Farmers' attitudes and behaviour towards the natural environment: a New Zealand case study

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Abstract

Scholars from the natural and social sciences have sounded the alarm regarding the future of our productivist society, calling for a change in worldview towards our relationship with the environment. Agriculture rests at the centre of such an issue. Relying on natural resources, it fulfils our basic need for food, yet has caused great damage to this same environment it depends on. Sustainability of farming lies increasingly today in farmers' ability to generate and export ecologically sound products, while remaining competitive on the international market. The New Zealand farming population represents a particularly good case study. New Zealand's short human history is associated with one of the highest rates of natural habitat destruction, enabling the country to develop a strong agricultural sector. Today, due to a lack of a comprehensive national legislation, management of native ecosystems on private land depends mainly on private owners' goodwill.

The first of the four objectives of the present research was to assess the general and specific environmental attitudes of farmers in New Zealand. Farmers' general attitudes towards the natural environment were measured using the New Ecological Paradigm (NEP) scale and the Environmental Motives scale (EMS). Farmers' specific attitudes towards New Zealand native forest were assessed using the tripartite model of attitude composed of affective, cognitive and conative dimensions. The second objective was to compare the attitudes and context affecting the pro-environmental attitudes of farmers with and without native forest on their farm. The third objective was to assess the pro-environmental attitude-behaviour relationship in farmers with native forest. Finally, the fourth objective was to investigate the context affecting the relationship between pro-environmental attitudes and behaviour in farmers with native forest.

It was found that farmers with and without native forest responded to different models of attitude towards native forest. The attitudes of farmers without forest were more cognitively based than those of farmers with forest. Farmers without forest tended to distinguish between native forest on and off the farm, while farmers with forest tended to hold more holistic environmental attitudes. Farmers' environmental attitudes predicted their behaviour towards their native forest fragments to a similar extent to that usually found in the literature. Direct experience with nature, interactions with one's family and objective and subjective knowledge were instrumental in predicting the environmental attitudes of all groups of farmers and the behaviour of farmers with native forest.

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Approval for this research has been obtained from Massey University Ethics Committee for the survey.

Finally, I would like to dedicate this thesis to my grand-father, Raymond Bastendorff, *mon étoile du Berger…*

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List of acronyms and definition of key terms

Affect: feelings towards an attitudinal object (e.g. forest)

Altruistic environmental concern: one evaluates the consequences of an environmental issue in reference to a human group

Biospheric environmental concern: one is concerned for the natural environment out of concern for the whole biosphere

CFA: Confirmatory Factor Analysis, a statistical method of analysis

CFI: Comparative Fit Index, an index to measure models' statistical fit to data

Cognition: beliefs towards an attitudinal object

Conation: behavioural intentions towards an attitudinal object

DIF: Differential Item Functioning

DSP: Dominant Social Paradigm

EFA: Exploratory Factor Analysis, a statistical method of analysis

Egoistic environmental concern: one is concerned for the natural environment out of concern for oneself or close kin

EMS: Environmental Motives Scale, also referred to as Schultz' Value-based environmental concern scales

Environmental attitude: people's feelings and/or beliefs and/or intentions towards the natural environment

Environmental behaviour: people's actions towards the natural environment

Environmental concern: the degree to which people are aware of problems regarding the environment and *agrees with* efforts to solve them and/or indicate a willingness to contribute personally to their solution

ESEM: Exploratory Sructural Equation Modeling, a statistical method of analysis.

Farmers with native forest: respondents with New Zealand native forest fragments of any size (unless specified otherwise) on their farm

Farmers with native forest by chance: respondents for whom the presence of New Zealand native forest on the farm did not influence their choice to take over the property

Farmers with native forest by choice: respondents who chose to have New Zealand native forest fragments (of any size, unless specified otherwise) on their farm

Farmers without native forest: respondents who did not have New Zealand native forest on their farm.

General environmental attitude: attitude towards the natural environment as a broad concept (see specific environmental attitude)

HEP: Human Exemptionalism Paradigm

MIMIC: Multiple Indicators Multiple Causes, a statistical method of analysis

Native forest: New Zealand indigenous forest.

NEP: New Ecological and/or Environmental Paradigm, a scale measuring people' core environmental beliefs

RMA: Resource Management Act, New Zealand's main piece of legislation on the management of the environment

RMSEA: Root Mean Square Error of Approximation, an index to measure models' statistical fit to data

SEM: Structural Equation Modeling, a statistical method of analysis

Situational variables: external factors that can influence psychological processes

Specific environmental attitude: attitude towards a specific environmental object, such as in the present thesis, New Zealand native forest.

SPSS: Statistical Package for Social Sciences

SRMR: Standardized Root Mean Square Residual, an index to measure models' statistical fit to data

TLI: Tucker-Lewis index, an index to measure models' statistical fit to data

TPB: Theory of Planned Behaviour, an attitude-behaviour model

TRA: Theory of Reasoned Action, an attitude-behaviour model

Tripartite attitude: an attitudinal model where attitude is defined by feelings (*affect*), beliefs (*cognition*) and behavioural intentions (*conation*) towards an object.

Value: high-order, general guiding principles reflecting one's life goals or standards

WLSMV : Weighted Least Squares Mean- and Variance-adjusted, an index to measure models' statistical fit to data

WRMR: Weighted Root Mean Square Residual, an index to measure models' statistical fit to data

Chapter 1: Introduction

I. Rationale of the thesis

1. The historical background of humans' relationship with nature

Human beings have been very successful at using their environment to thrive. Their skills at adapting to and managing their environment have allowed them to extend in successive stages the scope of the earth's resources within their reach, enabling them in turn to spread over most of the planet (Catton 1980; Ponting 1991). Authors concur in identifying two great transitions in the relationship human beings have had with their environment (Ponting 1991; Good and Reuveny 2009). The first great transition was the development of agriculture occurring almost concurrently in different parts of the world about 10,000 years ago (Catton 1980; Ponting 1991; Good and Reuveny 2009). It is hypothesized that agrarian society came about as the hunter-gatherer-herder had saturated (or were close to saturating) their environment (Ponting 1991, p. 42). The development of agriculture was accompanied by changes in humans' social organizations (from nomads to sedentary). It favoured a great rise in human population and led to a major domestication of nature (Catton 1980; Ponting 1991).[1]

A shortage of energy resources resulted in the second great transition in the relationship between human beings and the natural environment: the industrial revolution (in the 18^{th}-19^{th} centuries). Running out of wood, human societies came to rely on harder-to-extract fossil fuels (Catton 1980; Ponting 1991; Good and Reuveny 2009). Industrialization has resulted in an era of apparent superabundance with human population rising explosively[2] and living standards improving considerably (Catton 1980; Ponting 1991). Nevertheless, because the technology humans have relied on since the industrial revolution depends on energies that take millions of years to form, such abundance is only temporary; particularly so as humanity is fast exhausting these energy reserves (see Chapter 6 in Nielsen 2005). Furthermore, the ever increasing number of humans on the planet coupled with a high level of consumption, waste and pollution of

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[1] Domestication of nature had already appeared in hunter-gatherer groups (some plant cultivation and herding), but in a looser fashion than with agrarian society (Ponting 1991 p. 37-41).

[2] Although human population has often been described as rising exponentially, an explosive or hyperbolic curve, which follows a more dramatic increase, is closer to the trend human population has been following (Nielsen 2005, p. 12-3).

the natural resources they generate have brought long-lasting and global disruptions to the natural environment (Catton 1980; Ponting 1991; Schnaiberg and Gould 1994, p. 26). There are strong indications that human activities are mainly responsible for the increase in global temperatures, which is likely to lead to disturbance of the planet's climatic cycles (Intergovernmental Panel on Climate Change 2007, p. 36-41). Nevertheless, humanity continues on its course almost as if it was indifferent to what is happening.

2. Anthropocentric perception of nature

Focusing on the Western perception of nature, some authors attribute such inertia to the long tradition of a dichotomist perception of the human-nature relationship. Ponting (see chapter 8 in 1991) and Wall (1994, p. 32) note that the concept of human's domination over nature was already present in antiquity. "The Mesopotamians saw nature as a wild beast to be tamed. Aristotle (384-322 B.C.) and the early Stoics claimed that nature was a resource placed before humanity for its exclusive use" (Wall 1994, p. 32). The idea of humans being superior to the rest of living beings and having the world at their disposal is further found in the Christian belief system (Ponting 1991). Although religious thinking was progressively replaced by a scientific approach to the world, especially with the input of 16th- and 17th- century thinkers like Francis Bacon and René Descartes, the concept of human's domination of nature was still central to secular thinking (Ponting 1991). The optimistic utilitarian perception of nature was reinforced by the apparent era of abundance Industrialization created and the novel idea that man was on a path of betterment and progress (Ponting 1991). Arguably, the development of the discipline of economics around two hundred years ago[3], a discipline that dismisses the finitude of natural resources and underlies the present capitalist society (Ponting 1991, p. 155; Hayes and Lynne 2004), could mark the apogee of such an anthropocentric view of the world.

Nevertheless, Western society has also showed, to some extent, diversity in the perception of its relationship with nature. At the same time as Aristotle and the early Stoics expressed their utilitarian views of nature, some Greeks continued to hold a pantheist[4] understanding of the world (Wall 1994, p. 32). Soon after Bacon and

[3] Adam Smith's *Inquiry into the Nature and Causes of the Wealth of Nations* (1776) is commonly referred to as the founding text of economics (Ponting 1991, p. 155).
[4] Pantheism is "the belief that every existing entity is only one Being" (Owen 1971: 65 in Levine 2007).

Descartes, 18th-century Enlightenment thinkers such as Rousseau[5] and Darwin[6] emphasized the inclusion of humanity within nature, while Malthus[7] argued for a finite world that would exercise natural constraints on the human population (Ponting 1991). In the 20th century, many schools of thought relayed such ideas (e.g., Hardin's tragedy of the commons (1968), Deep Ecology (Næss 1973), Wilson's Biophilia Hypothesis (1984)). Thus, according to Eder (1996, p. 163), the European cultural history can be defined by a "domination of nature being the primary relationship with nature; and sensibility towards nature being its inferior counterpart". In the present *knowledge society*[8], Eder (1996, p. 163) argues that "contemporary environmentalism is a turning point in the cultural evolution of modernity insofar as it provides a new cultural orientation by substituting ecology for industrialism as the basic cultural model for modernization" (Eder 1996, p. 163).

3. Modern environmentalism

Eder (1996, p. 163) situates the beginning of modern environmentalism in the Western world in the 1960s, unfolding in three phases. The first phase consisted of the realisation that the economic system caused environmental damage. In the 1960s and 1970s, scientific proofs of industrialisation's damaging effects on the natural environment started to emerge, the oft-cited milestone in this realisation being Rachel Carson's critique of pesticides in Silent Spring (1962) (Schnaiberg and Gould 1994, p. 32). This recognition led institutions to take measures to mitigate such damages, which represents the second phase of modern environmentalism (Eder 1996, p. 163). In 1972, the first United Nations Conference on the environment was held in Stockholm with the goal of exploring ways to reduce man's impact on the planet (United Nations 1972). In 1987, the World Commission on Environment and Development, established by the United Nations General Assembly, published the report 'Our Common Future' (1987) defining the concept of a sustainable society.[9] This was followed by a series of world summits meant to set up global standards for achieving sustainable development: the

[5] With his essay *Discours sur l'Origine et les Fondements de l'Inégalité parmi les Hommes* (1755) and the concept of 'homme naturel' (noble savage).
[6] With his hypothesis of evolution in *On the Origin of Species* (1859).
[7] With his *Essay on the Principle of Population* (1798).
[8] "where information is the basis of the productive system" (Giddens 1997, p. 526)
[9] "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development 1987).

Earth Summit conference in Rio de Janeiro in 1992, the 2002 World Summit on Sustainable Development conference in Johannesburg, and recently, the Copenhagen Climate Change Conference in 2009 (United Nations 1992; United Nations 2009). The third phase of modern environmentalism equates with a wider acceptance of a pro-environmental philosophy by the public, a process that Eder refers to as the 'cultural normalisation' of environmental concern (Eder 1996, p. 163). Since the 1990s, surveys of people's attitudes have revealed increasing levels of concern for environmental issues. These high levels of environmental concern have been found in poor and rich social classes and developed and developing countries alike (Dietz et al. 2005, p. 360; Schultz et al. 2005, p. 457). Nevertheless, global environmental concerns have not yet resulted in widespread environmentally concerned behaviour (Nordlund and Garvill 2002, p. 741; Castro 2006, p. 249). However, researchers have argued that the relationship between attitudes and behaviour towards the natural environment can be better understand once the context – measured by situational variables (Barr 2007) – within which pro-environmental attitudes and behaviour occur is taken into account (e.g., Guagnano et al. 1995; Corraliza and Berenguer 2000).

4. Farmers and nature

As a product of Industrialisation, modern agriculture has been driven by the idea of progress and the idea that yields, with the help of technology and *scientization* of farming, can always improve (Bohlen and House 2009, p. 2-3). As a result, conventional[10] agriculture has been linked to pollution of waterways, depletion of biodiversity, emission of greenhouse gases, soil erosion, etc (Nielsen, 2005; Richardson, 2004); issues that are jeopardizing the future of our planet as we know it, and consequently the future of agriculture itself. Environmental issues, along with a growing number of resulting regulations (Rosin 2008, p. 46-7), now challenge the intensive productivist agricultural model (Gafsi and Brossier 1997, p. 72-3; Rosin 2008). Society has been increasingly aware and concerned about the negative consequences of agriculture on the natural environment and there is now demand for 'greener', more ecologically friendly farming produce (Beus and Dunlap 1990, p. 591, 611; Dodd et al. 2008, p. 127; Rosin 2008). Consequently, farmers – as if symbols of the rest of Western society – are torn between two antagonistic driving forces: on the one hand, international market fluctuations, which encourage intensification for short-term profits

[10] As opposed to organic or sustainable agriculture.

(Swanson and Maurer 1983, p. 647-8), and, on the other hand, the preservation of the environment from which they earn their living and ensure the world is fed. Despite the central role farmers play in the functioning of human society as well as the future of the planet, farmers' personal motives to engage or not in environmentally responsible behaviour remains poorly understood. Thus, some authors (e.g., Wilson 2001) strongly advocate looking at the farming community from within, and thence to look at their attitudes towards the natural environment.

II. Aim of the thesis

The overall goal of the thesis is to improve the understanding of farmers' relationships with the natural environment. Towards this goal, four research topics are addressed in this thesis, predicated on the following premises:

1. The role of farmers is pivotal in the future of our planet (humanity included),
2. Farmers' attitudes towards the natural environment are little understood,
3. A discrepancy exists between pro-environmental attitudes and behaviour,
4. New Zealand's agriculture sector is becoming increasingly intensive whereas its survival lies in a healthy environment and the country's 'Clean and Green' image,
5. The late human colonisation of New Zealand has been marked until recently by massive destruction and exploitation of its natural environment, and, finally,
6. New Zealand native forest, despite substantial loss to farmland, remains the most abundant of the country's native ecosystems and therefore represents an ideal opportunity for studying the relationship between farmers and non-farming nature.

The research topics investigated are:

1. Measuring the attitudes towards the natural environment in general and towards New Zealand native forest in particular of a sample of New Zealand farmers,
2. Comparing attitudes and the context affecting the attitudes of farmers with and without native forest fragments on their property,
3. Assessing the behaviour of farmers with native forest towards their native fragments predicted by their general-specific environmental attitudes, and
4. Investigating the situational factors affecting the correspondence between farmers' pro-environmental attitudes and behaviour

III. Thesis outline

Chapter 2 reviews the literature on the social-psychological framework used in this thesis to measure farmers' attitudes and behaviours towards the natural environment. The review follows a general to specific structure. Thus, first, Schultz' value-based environmental concerns (2000; 2001) and Dunlap and colleagues' New Environmental Paradigm (NEP) scale (Dunlap et al. 2000) are examined. These two scales formed the measure of farmers' general attitudes towards the environment. Second, the tripartite model of attitude, composed of a cognitive, affective and conative dimension, is addressed. This model is used to determine farmers' attitudes towards New Zealand native forest. Finally, the relationship between attitudes (general and specific) and behaviour is examined.

Chapters 3 and 4 address the relationship between farmers and the natural environment. Chapter 3 examines the literature on farmers' attitudes towards the environment, and the relevance of the cognitive, affective and conative dimensions to the study of such attitudes and the prediction of farmers' environmentally responsible behaviour. Chapter 4 reviews how situational factors (socio-demographic variables, direct contact with nature, environmental literacy, and social interactions) affect farmers' attitudes and behaviour towards the natural environment.

Chapter 5 describes the research conducted for this thesis. It presents the sample, the questionnaire designed to estimate the environmental attitudes and behaviour of farmers from Manawatu-Wanganui and Wellington regions, New Zealand, and the statistical methods used to analyze farmers' attitudes and behaviour.

Chapter 6 consists of the preliminary analysis of the sample subjects. It examines the situational differences between farmers who possess native forest fragments of any size on their property and farmers who do not.

Chapters 7 and 8 consist of the estimation of the general environmental attitudes of farmers with and without native forest fragments. Chapter 7 addresses farmers' value-based environmental concerns, while Chapter 8 deals with farmers' responses to the NEP scale. General attitudinal responses of farmers with and without native fragments of any size are compared, as well as the responses of farmers who had sought farms with native forest (farmers with forest by choice) and farmers with native forest whose presence on the farm did not influence their purchase decision (farmers with forest by chance).

Chapter 9 examines farmers' specific attitudinal responses to New Zealand native forest based on the tripartite attitude model. The specific attitudinal models of farmers with and without native fragments of any size, as well as farmers with forest by choice and those with forest by chance, are compared and discussed.

Chapter 10 tests the general-specific attitude model on the different groups of farmers (with and without forest of any size, and with forest by choice and by chance). Results are compared between the different groups.

Chapter 11 describes the effects the situational variables used in chapter three have on farmers' general-specific attitude towards nature. Again, farmers with and without native forest fragments of any size are compared, as well as farmers with forest by choice and farmers with forest by chance.

Chapter 12 focuses on farmers with forest fragments of one hectare or more, estimates their level of environmentally responsible behaviour towards their native forest fragments, and assesses the relationship between their general-specific environmental attitudes and behaviour towards the fragments. Additionally, the attitude-behaviour relationship is re-examined under the influence of each of the situational variables. Again, the cases of farmers with forest by choice and farmers with forest by chance are compared.

Finally, Chapter 13 draws the results of the preceding chapters together and discusses the implications of the findings. Suggestions for future research conclude the chapter and the thesis.

Chapter 2: The social-psychological framework

I. Introduction

This chapter is the first of the three literature review chapters and presents the social-psychological framework which will be used in the thesis to assess farmers' relationships with the natural environment. The first section of this chapter gives an overview of the concept of attitude, and more particularly, attitude towards nature, as well as its relationship with behaviour. The theoretical framework follows a general-to-specific attitudinal model, where the Environmental Motives Scale (EMS, Schultz 2001) and the New Ecological Paradigm (NEP) scale (Dunlap et al. 2000) serve as measures of the farmers' general attitudes towards the natural environment, and the tripartite attitude model (Maloney and Ward 1973; Maloney et al. 1975) evaluates farmers' specific attitudes towards New Zealand native forest. These scales are reviewed in the second section.

II. Context: Attitude theories

1. The topical context of the study

Today, most natural scientists agree on the deteriorating state of our planet and on the role humans play in such events (e.g. Rutt et al. 1993; Taylor et al. 1994; Oskamp 2000; Watson 2003, p. 1925; Intergovernmental Panel on Climate Change 2007, p. 36-41). Faced with the prospect of an uncertain future, many people – public, politicians, scientists alike – believe that there is a need to change our ways of thinking and behaviour (e.g., the United Nations Framework Convention on Climate Change, of which emerged the 1997 Kyoto protocol; the special issue American Psychologist of May 2000, especially, Oskamp 2000, and the comments the issue generated in May 2001; Dietz et al. 2003; reports of the Intergovernmental Panel on Climate Change, e.g. 2007). New ways of thinking and behaviour will have to "[meet] the needs of the present without compromising the ability of future generations to meet their own needs" WCED, 1987, p. 363 , or, in other words, to be *sustainable* (from the Brundtland Report of the World Commission on Environment and Development, 1987, p. 363 in Oskamp 2000, p. 496).

As a consequence, different research fields have focused on what influences human behaviour toward the environment (Hines et al. 1987; Smith et al. 1994, p. 359). As behaviour is assumed to result from mental processes (Jaccard and Blanton 2005, p. 156-164; Vaughan and Hogg 2005, p. 26), numerous studies have borrowed from psychological theories (e.g., Zajonc 1980; Hines et al. 1987; Dunlap and Jones 2002; Albarracin et al. 2005) and are concerned with the influence of attitudes on behaviour (Hines et al. 1987; Kim and Hunter 1993; Dunlap and Jones 2002; Jaccard and Blanton 2005, p. 156-164; Vaughan and Hogg 2005, p. 97).

2. Definition of attitude

Attitude is a controversial and topical concept in the social sciences (Ajzen 2001; Vaughan and Hogg 2005, p. 97; Eagly and Chaiken 2007). It is a particularly central notion in social-psychology[1], where it has taken various definitions (Vaughan and Hogg 2005, p. 97). Nevertheless, the notion of *evaluation* remains central to all of them (Zanna and Rempel 1988; Albarracin et al. 2005, for e.g., Jaccard and Blanton, 2005, p. 126; Castro 2006; Eagly and Chaiken 2007). Eagly and Chaiken's (1993) definition of attitude is, according to Albarracin and colleagues' (2005, p. 4) "what may be the most conventional contemporary definition", and it will be adopted in this thesis. Eagly and Chaiken define attitude as "*a psychological tendency that is expressed by evaluating a particular entity with some degree of favor or disfavor*" (Eagly and Chaiken, 1993 in Albarracin et al. 2005, p. 4, italic in original).

To date, attitude remains an abstract notion, therefore, not directly measurable (Chaiken 2001; Vaughan and Hogg 2005, p. 97). Researchers have relied on the measure of three mental responses, either one or several at a time, to assess attitude. These are *affect*, *cognition* and *conation* (Rosenberg 1956; Hilgard 1980; Zanna and Rempel 1988; Bohner 2001). *Affect* refers to "feelings or emotional response to the attitude object"; *cognition* represents the "beliefs or knowledge about the attitude object"; finally, *conation* corresponds to "predisposition to respond in some fashion toward the attitude object" (Albrecht et al. 1980, p. 194-5).[2] The tripartite classification of a person's mental events comes from a long tradition of about two hundred years

[1] The field of social psychology is defined as "interdiscipline lodged between the disciplines of psychology, which examines inner lives and selves, and sociology, which examines the relationships between collectivities and organizations. Social psychologists argue that it is essential to examine how self and system interpenetrate" (Cook et al. 1995: xii in Knottnerus 2007, p. 153).

[2] Some researchers have even included 'overt behaviour' (performed behaviour) in conation.

(Hilgard 1980), with *affect*, *cognition* and *conation* constituting at first a holistic definition of attitude, to be eventually regarded as three distinct attitudinal entities (Forgas 2002, p. 3).

3. Attitude: predictor of behaviour

From the Latin origin, *aptus*, meaning “fit and ready for action” (Vaughan and Hogg 2005, p. 97), the concept of attitude has long been associated with behaviour, which is assumed to result from mental processes. “In fact, the field of social psychology was originally defined as the scientific study of attitudes (Thomas & Znaniecki, 1918; Watson, 1925) because it was assumed that attitude was the key to understanding human behaviour” (Ajzen and Fishbein 2005, p. 174). However, the attitude-behaviour relationship was challenged by several researchers who did not find significant correlations between the two concepts (Ajzen and Fishbein 2005, p. 174). According to Ajzen and Fishbein (2005, p. 178), there are two types of attitude-behaviour inconsistency: literal inconsistency, when people do not follow through with what they said they would do, and evaluative inconsistency, when general attitudes do not relate with specific behaviour. Numerous attitude-behaviour inconsistencies have been due to evaluative inconsistency (Ajzen and Fishbein 2005, p. 178). It is easily conceivable that two individuals could hold the same positive attitude towards the natural environment in general, but behave in different ways towards a particular natural object like snakes, for instance. It has been shown that attitude would predict behaviour more accurately if both attitudinal and behavioural objects are of a similar level of specificity; the more specific the objects are, the stronger the attitude-behaviour relationship will be (Heberlein and Black 1976). However, general attitudes can also predict specific behaviour if aggregate measures of behaviour covering different aspects of the attitudinal object are used (Ajzen and Fishbein 2005, p. 178).

Additionally, for attitudes to predispose behaviour, the former needs to be activated. Attitudes are more likely to be activated the more accessible to memory they are. It has been found that when the object of attitude is of personal relevance to the attitude holder or when the individual directly interacts with the attitudinal object, stronger, therefore, more accessible attitudes tend to be formed (Fazio and Zanna 1981; Fazio et al. 1992; Millar and Millar 1996; Ajzen and Fishbein 2005, p. 184-6; Fabrigar et al. 2005, p. 108).[3] Attitude has been found to predict, on average, between 10% and 20% of the total variance of behaviour, and rarely more than 30% (Tarrant and Green 1999, p. 25).

4. Environmental attitude

Research on environmental attitudes and their relationships to behaviour has extensively borrowed from the theoretical framework developed in psychology on attitude (Heberlein 1981, p. 242; Hackett 1992; Dunlap and Jones 2002, p. 486, 490-1; Castro 2006). Overall, the field is characterized by two main distinct attitudinal focuses: (1) attitude toward pro-environmental behaviour, and (2) attitude toward the environment in general or environmental objects in particular (Hines et al. 1987; Kaiser et al. 1999). In a meta-analysis on environmentally responsible behaviour, Hines and colleagues (1987, p. 4) found that these two approaches explained environmentally-responsible behaviour with similar strength.[4]

a. Attitude towards pro-environmental behaviour

The most common model of attitude toward pro-environmental behaviour is based on Fishbein and Ajzen's theory of reasoned action (TRA; Fishbein and Ajzen 1975) and its more general form, the theory of planned behaviour (TPB; Ajzen 1991) (Ajzen 2001, p. 30). TRA and TPB use the three cognitive, affective and conative responses, yet Fishbein and Ajzen renamed the usual three components of attitude as, "respectively, belief, attitude, and intention" (Ajzen 1988, p. 32). In both TRA and TPB, *affect-attitude* toward a behaviour (e.g., "pleasant/unpleasant", "good/bad" (Hrubes and Ajzen 2001, p. 168)) is fashioned by the beliefs one holds regarding a particular behaviour, and, in turn, *affect-attitude* influences the intention to perform such a behaviour. In addition, Fishbein and Ajzen (1975; 1991) postulated that beliefs about what important others think of one's performing such behaviour (subjective norm), as well as how much one perceives the behaviour to be feasible to perform (perceived

[3] Stronger attitudes are believed to be more stable over time (Ajzen and Fishbein 205, p. 185).
[4] Correlation of behaviour with: attitude toward the environment $r = 0.338$, $SD = 0.243$; attitude toward pro-environmental behaviour $r = 0.377$, $SD = 0.145$. However, it is worth mentioning that, in Hines and colleagues' (1987) review, attitudes were affect and/or cognition based, and conation and knowledge were treated independently of attitude.

behavioural control; only in TPB) also influence behavioural intentions. Hence, the whole model revolves around the behaviour of interest and the assumption that such behaviour is driven by rational and self-centred thinking (Vaughan and Hogg 2005, p. 107; Bamberg and Möser 2007, p. 15).

b. Attitude towards the environment and environmental concern

Studies on attitudes toward the environment or its objects, on the other hand, encompass a variety of models and, therefore, still represent a ‘work in progress’. Such attitudes have been defined as either uni- or multi-dimensional and affective-, cognitive- and/or conative-based (Kaiser et al. 1999, p. 2; Vaughan and Hogg 2005, p. 97-8). Environmental social-psychology research has also often employed the terms ‘environmental concern’ (e.g., Ester and van der Meer 1982; Kaiser et al. 1999; Dunlap and Jones 2002; Milfont 2007, p. 10-1). However, environmental concern stems from environmental attitudes and seems to be preferentially used within the empirical realm of the environmental social-psychology literature (Dunlap and Jones 2002, particularly, p. 484). Furthermore, environmental concern tends to reflect only part of the concept of environmental attitude (see for instance Milfont 2007, p. 10-1). Heberlein (1981, p. 241), for instance, argues that “[e]nvironmental concern appears to be a specific belief which is largely embedded in cognitive structure and should be considered an opinion rather than an attitude”.[5] As the present thesis endeavours to give a comprehensive picture of farmers’ mental responses toward the natural environment and, in particular, New Zealand native forest, farmers’ attitudes towards the natural environment rather than their attitudes towards environmental behaviour are the focus of the present study. Research on environmental attitudes and environmental concern have thus been reviewed. The terms ‘environmental concern’ will be used when referring to Schulz’ Environmental Motives Scale (EMS), as the author employs these words himself to define his scale (e.g., Schultz 2001). However, for all other mentions of farmers mental

[5] Dunlap and Jones’ (2002, p. 485) defines environmental concern as “the degree to which people are aware of problems regarding the environment and support efforts to solve them and/or indicate a willingness to contribute personally to their solution”. However, the word *support* can convey a sense of active participation, that is, pro-environmental behaviour. Based on the many studies on environmental concern I came across and in line with Heberlein (1981, p. 241), I would slightly modify this definition to environmental concern being the degree to which people are aware of problems regarding the environment and *agrees with* efforts to solve them and/or indicate a willingness to contribute personally to their solution.

responses to the natural environment, the more general term *attitude* will be hereinafter adopted.

III. General-specific attitudinal model

The theoretical framework used in this thesis takes a general-specific attitudinal approach based on research on the relationship between values, value orientations, attitude, environmental concern and behaviour (Stern et al. 1995a; Stern et al. 1995b). The general measures of attitude towards the natural environment are assessed using Schultz' (2000; 2001) value-based environmental concerns and Dunlap and colleagues' (1978b; 2000) revised New Environmental Paradigm scale, while the measure of attitude towards a specific object of nature (here, New Zealand native forest) is estimated using the tripartite attitudinal model (Hilgard 1980). The three measures are reviewed next in this order. The review of Schultz' (2000; 2001) value-based environmental concerns begins with an introduction to the notion of 'value'. Finally, the general-specific attitudinal approach is explained in more detail.

1. General measures of attitude towards the environment

a. Value-based environmental concern

i. Definition of value

The notion of value is a core concept of social-sciences (Dietz et al. 2005). Its meaning has evolved over time (Hitlin and Piliavin 2004; Dietz et al. 2005; Vaughan and Hogg 2005, p. 115), but since Rokeach (1973, p. 5 in Vaske and Donnelly 1999, p. 524), values are viewed as high-order, general guiding principles reflecting one's life goals or standards, and, as such, are "closely related to [one's] identity" (Murphy and Zajonc 1993, p. 2; Oskamp 2000, p. 115; Dietz et al. 2005, p. 362). Specifically, Rokeach (1973, p. 5 in Vaske and Donnelly 1999, p. 524) defines a value as "an enduring belief that a specific mode of conduct is personally or socially preferable to an opposite or converse mode of conduct or end state of existence". Hence, values are the cognitive framework that helps us in taking decisions, making choices, which would ultimately affect our behaviour (Dietz et al. 2005).

It is argued that values are especially drawn on when one is confronted by new objects of decision and conflicting "desired" outcomes. Decisions and choices are then made on the basis of what is "desirable" (Dietz et al. 2005, p. 338-341), and, as Schwartz and Bilsky (1987, p. 551) wrote in their seminal work on universal values, what is "desirable" depends on: "three types of universal human requirements: biologically based needs of the organism, social interactional requirements for interpersonal coordination, and social institutional demands for group welfare and survival". Therefore, values are, partly, a reflection of a particular culture, community. Value orientations derive from values. They represent "patterns of basic beliefs relative to a particular topic (e.g., environmental preservation-use, wildlife rights)" (Vaske et al. 2001, p. 773).

ii. Value orientations behind pro-environmental attitudes and behaviour

An important part of the literature assessing the value basis of pro-environmental behaviour or pro-environmental concern, first attempted to explain such types of behaviour or concerns by people's level of altruistic value orientation, using Schwartz' norm-activation model of altruism (1977 in Stern et al. 1993, p. 323; Stern and Dietz 1994, p. 70; Dietz et al. 2005, p. 343-5, 355). Schwartz' model of altruism postulates that "individuals experience a sense of moral obligation (a personal moral norm) and act on it when they believe adverse consequences are likely to occur to others (awareness of consequences) and that they personally can, by appropriate action, prevent or ameliorate those consequences (ascription of responsibility to self)" (Stern and Dietz 1994, p. 70). Stern and colleagues (1993; 1994) expanded Schwartz' model of altruism by including the concepts of the intrinsic value of nature, drawn from the work of ecologists, environmentalists and social-scientists (e.g., Leopold, Naess, Dunlap & Van Liere), and free rider[6], from economic and sociobiological models (e.g., Hardin, Olson) (Stern et al. 1993; Stern and Dietz 1994; Dietz et al. 2005, p. 343-4). They, therefore, argued that three types of value orientations underlie pro-environmental attitudes and behaviour: altruistic, biospheric and egoistic value orientations. An egoistic value orientation supposes that one behaves to the benefit of the environment out of concern for oneself or close kin (e.g. following a vegetarian diet out of concern

[6] "The free rider proposition asserts that in a wide range of situations, individuals will fail to participate in collectively profitable activities in the absence of coercion or individually appropriable inducements" (Stigler 1974, p. 359).

for one's health). An altruistic value orientation implies that one evaluates the consequences of an environmental issue in reference to a human group (e.g., following a vegetarian diet out of concern that an animal-based diet cannot feed the world). Finally, a biospheric[7] value orientation extends this assessment beyond humanity to the whole biosphere (e.g., following a vegetarian diet out of concern for the impact on the environment of animal farming) (Stern and Dietz 1994, p. 70-2).

iii. The Environmental Motives Scale: measure of value-based environmental concerns

Based on Stern and colleagues' three value orientations (1993; 1994; 1995b), Schultz (2000; 2001) proposed a measure of people's egoistic, altruistic and biospheric environmental *concerns* measured by the type of 'objects' (self, other human beings or non-human living beings) people would be the most worried about in case of environmental problem.[8] Schultz' three scales do not *directly* assess people's value orientations. As the measures focus on specific objects of concern, they coincide with the concept of value-expressive attitude (Schultz 2000; Schultz 2001; Maio & Olsson, 1994 in Hitlin and Piliavin 2004, p. 361; Hansla et al. 2008, p. 2).[9] Thus, Schultz assumes that the closer people feel to the object, that is, the more people include the object within their cognitive representation of their self, the more they are going to be concerned about the object. Rooted in the notion that values reflect people's identity, the type of objects people feel concerned with, hence, would reflect their value orientation. Rather than people expressing clear-cut egoistic, altruistic or biospheric concerns, it is expected that people's objects of concerns would reveal combinations of the three value orientations. Yet, although people displaying egoistic value orientation can still act in an environmentally friendly way (Stern and colleagues (1993; 1994), Schultz 2000, 2001), "[i]t does seem likely [...] that biospheric concerns provide a broader motive for behaviour. For example, we would expect egoistic concerns to be positively predictive of attitudes about specific local issues that directly impact self. In contrast, we would predict that biospheric concerns would be positively related to

[7] Egoistic has also been referred in the literature on values as self-interest, altruistic as social altruism or humanistic altruism, and biospheric as biospheric altruism, and biocentrism (Dietz et al. 2005, p. 344).

[8] The items constituting the value-based environmental concern scales, also called the Environmental Motives Scale (EMS) (Schultz et al. 2004, p. 34), have slightly changed from one study to another (Schultz 2000; Schultz 2001; Schultz et al. 2004). The scales used in this thesis are based on Schultz 2000 and 2001 publications, and are the same as used by Hansla and colleagues (2008) and Mayer and McPherson Frantz (2004).

[9] Value-expressive attitude are attitudes towards an object that closely relate to one's definition of self.

attitudes about global, more abstract environmental issues, as well as to more specific issues" (Schultz 2000, p. 394).

Previous studies have usually failed to distinguish altruistic from biospheric value orientations (Stern and Dietz 1994; Stern et al. 1995b; Schultz 2001, p. 328), and thus referred to this dimension as a biospheric–social-altruistic value orientation (Hansla et al. 2008, p. 2). However, Schultz' measures have so far successfully separated into the hypothesized three value-based concerns: egoistic, altruistic and biospheric (Schultz 2000; Schultz 2001; Mayer and McPherson Frantz 2004; Snelgar 2006; Hansla et al. 2008).[10] Further confirming the validity of the measures, Schultz' environmental concerns significantly related with published measures of environmental concerns, as well as value orientations (Schultz 2000; Schultz 2001; Hansla et al. 2008).[11] Additionally, Schultz' value-based environmental concerns correlated significantly and positively with their expected respective Schwartz' (1992; 1994) values: egoistic environmental concern with self-enhancement, biospheric and altruistic with self-transcendence, while correlating negatively with the other Schwartz' value (Schultz 2001). Additionally, using a slightly different classification of Schwartz' (1992; 1994) universal values, Hansla and colleagues (2008) found that each of Schultz' environmental concerns related to the expected value type: biospheric environmental concern with Schwartz' universalism, altruistic concern with benevolence, and egoistic concern with power.

b. New Environmental Paradigm

In the late 1970s, Catton and Dunlap (1978a; 1978b) argued that a shift in western society's mindset was occurring, evolving from an anthropocentric view of the world where human beings are above the natural laws, the Human Exemptionalism

[10] Yet, although Snelgar's (2006) use of Schultz' value-based environmental concerns found that the tri-dimensional model gave acceptable results, the author found that the biospheric scale could be divided into two factors: animal and plants. However, Snelgar did not use exactly the same sets of items that Schultz used in his 2000 and 2001's studies, which are used in this thesis. Furthermore, neither Mayer and McPherson Frantz (2004) nor Hansla and colleagues (2008) submitted Schultz' scales to factor analysis, but they found a very strong coefficient of internal reliability for each of the three value-based environmental concern.

[11] However, Snelgar (2006) did not find strong correlation patterns between Schultz' value-based environmental concerns and Stern and colleagues (1993; 1995) corresponding beliefs of adverse consequence scales. Nevertheless, the authors also found that Stern and colleagues' (1993; 1995) scales did not neatly separated into the hypothesized egoistic, (social-) altruistic and biospheric.

Paradigm (HEP)[12], to a New Environmental Paradigm (NEP), which acknowledged our inclusion within and interdependence with the natural environment. Dunlap and Van Liere (1978b) created the 12-item NEP scale in order to assess such a shift. The scale focused on beliefs "about humanity's ability to upset the balance of nature, the existence of limits to growth for human societies, and humanity's right to rule over the rest of nature" (Dunlap and Van Liere 1978b; Dunlap et al. 2000). It was later updated in order to measure more completely and accurately an ecological worldview, and was, thus, referred to as the 'New Ecological Paradigm' scale (Dunlap et al. 2000).[13] This new scale reflected five sets of beliefs: the reality of limits to growth, antianthropocentrism, the fragility of nature's balance, rejection of exemptionalism and the possibility of an ecocrisis. Each set was described by three items and contained a more balanced amount of pro-NEP and anti-NEP items than the original NEP scale. Obsolete items were re-phrased. As the same paradigm underlies the two scales, it will be further referred to in the present thesis as the "New Environmental Paradigm". The first NEP scale (Dunlap and Van Liere 1978b) will be referred as the 'original NEP scale', while the second, the New Ecological Paradigm scale (Dunlap, Van Liere et al. 2000), will be called the 'revised NEP scale'.

To date, the NEP scale (in its original or revised form) has been the most widely used measure of environmental worldview (Stern et al. 1995a, p. 725; Dunlap et al. 2000, p. 427; Cordano et al. 2003, p. 22; Castro 2006, p. 251; Dunlap 2008). It has been assumed to represent different psychological concepts, such as attitude, beliefs, concern or values; but Dunlap and colleagues (2000, p. 427) as well as others (e.g., Stern et al. 1995a, p. 725) argue that the NEP scale measures people's core beliefs about the relationship between human beings and the biosphere. As such, the scale is cognitively-based and assumed to influence attitudes towards more specific environmental issues (e.g., Stern et al. 1995a). Thus, although people subscribing to the New Environmental Paradigm are more likely to perform environmentally responsible behaviour, a direct influence of the NEP scale on specific pro-environmental behaviour is more likely to be weak due to a lack of measurement correspondence (Dunlap et al. 2000, p. 428). Yet studies have found positive and significant relationships between NEP and pro-environmental behaviour (e.g., Tarrant and Cordell 1997; Dunlap et al. 2000).

[12] HEP is also referred to as the Dominant Social Paradigm, DSP (e.g., Dunlap and Van Liere 1978b; La Trobe and Acott 2000).

[13] As Cordano and colleagues (2003, p. 27) explain: "The revised NEP was first introduced in 1992 at the annual meeting of the Rural Sociological Society and the sixth meeting of the Society for Human Ecology. In 2000, the revised scale reached a wide audience when it was published in the Journal of Social Issues. Although the conference and journal papers report the same study, the two papers have different authors and slightly different text."As the two papers convey the same general concepts, both are cited throughout this thesis.

i. Validity of the NEP scale

The dozens of studies that have used the original NEP scale have demonstrated that the scale had known-group validity (distinguishing a group known to hold pro-environmental attitude from the rest of the sample) and predictive validity (correlating significantly and positively with pro-environmental behavioural intentions and behaviour). Hence, as known-group validity and predictive validity form criterion validity, the NEP scale shows criterion validity (Dunlap et al. 2000, p. 429). Dunlap and colleagues also argue that the original NEP scale displayed content validity since an ethnographic study by Kempton et al (1995, chap. 3 in Dunlap et al. 2000, p. 429) on Americans' environmental worldviews described the same three major perspectives as the ones underlying the NEP: limits to growth, balance of nature, and human domination over nature. Finally, the significant relationships NEP scale has shown so far with contextual variables (e.g., age, education, environmental knowledge) as well as with other psychological variables, such as values (Stern et al. 1995a), value-based environmental concerns (Schultz 2001), or connectedness with nature (Mayer and McPherson Frantz 2004), demonstrate construct validity (Dunlap et al. 2000, p. 429).[14]

ii. Dimensionality of the NEP scale

Dunlap and colleagues (Dunlap and Van Liere 1978b; Dunlap et al. 2000) designed the NEP scales to be uni-dimensional. However, many studies that used the scales found that their sample's response to the NEP scales described a complex factor structure. Yet the number of dimensions changed from one study to the other, or, when the same number of factors was found, the items forming these dimensions were likely to differ (Dunlap et al. 2000, p. 430; Dunlap 2008, p. 413). However, Dunlap and colleagues (2000, p. 431) have argued that the factorization of twelve or fifteen items is likely to result in several dimensions, which will often be sample-specific. Therefore, the authors suggest that "[i]f two or more distinct dimensions that have face validity emerge and are not highly correlated with one another, then it is sensible to employ them as separate variables. If substantively meaningful dimensions do not emerge,

[14] Zeller and Carmines (1980) define 'construct validity' as "the assessment of whether a particular measure relates to other measures consistent with theoretically derived hypotheses concerning the concepts (or constructs) that are being measured" (Zeller and Carmines 1980, p. 81).

however, and the entire set of items (or at least a majority of them) are found to produce an internally consistent measure, then we recommend treating the NEP Scale as a single variable" (Dunlap et al. 2000, p. 431).

2. Specific measure of attitude towards the environment: tripartite attitudinal model

Since Maloney and colleagues (1973; 1975), most studies on attitudes toward the environment when treated as multidimensional build on the tripartite attitude theory and assess attitude by measuring affective, cognitive and conative responses (Kaiser et al. 1999; Dunlap and Jones 2002; Du Nann Winter and Koger 2004). Next, the relevance of each attitudinal dimension to the measure of attitude towards the environment is reviewed.

a. *Cognition* and pro-environmental attitude and behaviour

Cognition in environmental socio-psychology is usually defined as *beliefs* and/or *knowledge* about the object of attitude (e.g., Evans and Gärling 1991, p. 3; Dunlap and Jones 2002, p. 490). Following the trend occurring in general social-psychology since the 1970s (Vaughan and Hogg 2005, p. 13), cognitive-based models of attitude in the environmental socio-psychological field are by far the most common way of measuring attitude (Hilgard 1980, p. 115; Ajzen 2001, p. 30). Thus, as mentioned above, the NEP scale (Dunlap and Van Liere 1978b) (Dunlap et al. 1992; Dunlap et al. 2000), which assesses people's general beliefs about the environment and its relationship with human beings, is one of the most popular environmental concern scales (Stern et al. 1995a; Fransson and Gärling 1999; Cordano et al. 2003; Castro 2006). Such cognitive scales have shown that general pro-environmental beliefs are widespread around the world (Dunlap et al. 1993; Schultz 2001, p. 327; Costarelli and Colloca 2004, p. 279; Castro 2006, p. 247, 254). Yet, as postulated by the ambivalence theory ("coexistence of positive and negative dispositions toward the attitude object", Malhotra 2005, p. 478), some studies have found that people could hold simultaneously seemingly antagonistic beliefs (e.g., preservation and utilization) (Castro 2006, p. 255). Furthermore, the prevalence of pro-environmental beliefs around the world does not necessarily translate into a prevalence of pro-environmental behaviour[15] (Nordlund and Garvill 2002, p. 741; Castro 2006, p. 249); or, when pro-environmental behaviour do occur, people sharing the same beliefs towards the environment do not necessarily engage in the same pro-environmental behaviour (e.g., Berenguer et al. 2005). These findings suggest that the relationship between *cognition* and behaviour may be indirect, or at least incomplete, emphasizing the need for other attitudinal components to be studied besides *cognition*.[16]

As mentioned at the beginning of this section, *cognition*, in environmental socio-psychology, also often includes *ecological knowledge*. Ecological knowledge reflects knowledge about the environment or environmental issues. It is also referred to as "factual knowledge" (e.g., Grob 1995) inasmuch as it measures something one 'knows' rather than 'believes'. However, it has been shown or argued that the two do not necessarily equate. Factual knowledge needs to be appropriated by the individual before it can impact on an individual's belief system. Therefore, in the present thesis, *cognition* is only defined as beliefs a person holds towards the natural environment, and factual ecological knowledge is treated as an external factor, a situational variable, which can impact on *cognition*, as well as other attitudinal dimensions.[17]

b. *Affect* and pro-environmental attitude and behaviour

"We cannot win this battle to save species and environments without forging an emotional bond between ourselves and nature as well - for we will not fight to save what we do not love" Gould (1991 in Orr 1992, p. 4).

Despite the ascendancy of cognitive-based attitude research, *affect* – or the emotions one sustains towards the object of study – has also been shown to be an

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[15] Also called "environmentally responsible behaviour" (e.g., Kaplan 2000) or "responsible environmental behaviour" (e.g., Hines et al. 1987).

[16] It should also be ensured that beliefs match the specificity level of the measured behaviour (the object of attitude corresponds to the object of behaviour) (for review, see Kim and Hunter 1993, p. 115).

[17] This stance is further supported by the risk, inherent to assessing ecological literacy using postal survey, of having respondents actively looking for the 'right' answers. Therefore, the researcher cannot be sure that respondents' ecological literacy measured by postal survey represents respondents' internalized knowledge. Furthermore, going back to the notion of *personal evaluation* that is common to the different definitions of attitude, and based on cognitive psychology (Vaughan and Hogg 2005, p. 13), I consider *cognition* as being a person's *interpretation* of his/her world. Knowledge has the potential to influence how people interpret their world, yet all pieces of information a person knows, or rightly guesses, does not necessarily affect how this person evaluates or interpret a situation, an object. The central process here is not whether one remembers facts but how such facts are interpreted. Therefore, ecological literacy was not treated in this research as an attitude component per se, but as an external variable potentially influencing attitude.

important part of environmental attitude (Pooley and O'Connor 2000). As Eder (1996, p. 160) argues: “[a] sentimental relationship to nature has [now] become possible precisely through the distance from nature made possible by modern knowledge of it”. Although scholars have postulated the relevance of *affect* on explaining pro-environmental behaviour, few studies have actually looked at such an influence (Smith et al. 1994; Vining and Ebreo 2002, p. 546; Carrus et al. 2008). Langeheine and Lehman (1986 in Carrus et al. 2008, p. 53) found that positive emotional experiences with the natural environment induced pro-environmental behaviour. Kals and colleagues (1999) found that self-reported ecological behaviour, as well as the willingness to act in a pro-environmental manner (*conation*), were significantly predicted by emotional affinity with nature. They further showed that emotional affinity with nature was influenced by past and present direct contact with natural areas (Kals et al. 1999). Similarly, Mayer and McPherson Frantz (2004) found that connectedness with nature was positively related with pro-environmental attitude and behaviour, as well as the amount of time spent in contact with natural settings. Hinds and Sparks (2008) found that the more the emotional connection people feel with the natural environment, the more they were prepared to engage with it. Supporting Kals and colleagues’ (1999) findings, they also found that people who spent their childhood in a rural environment had stronger positive affective connections and pro-environmental behaviour intentions than their urban counterparts (Hinds and Sparks 2008).

Such work on the affective connection with the natural environment also corroborates studies in the field of place attachment. Although several definitions of place attachment exist, they consistently include an affective dimension (Low and Altman, 1992 in Jorgensen and Stedman 2006, p. 317). Following Hidalgo and Hernandez (2002, p. 1177), place attachment is defined as “a positive affective bond between an individual and a specific place”. In a similar vein to the work of Zajonc and colleagues on mere exposure theory[18] (Zajonc 1968; Zajonc 1980; Murphy and Zajonc 1993; Murphy et al. 1995), Hidalgo and Fernandez found that “a brief contact with a certain place is sufficient for it to be favoured after a short time over another”; even if this did not involve social bonds, as it is usually assumed in place attachment theory (Hidalgo and Hernandez 2002, p. 1179). Place attachment has been positively linked to pro-environmental behavioural intentions (Walker and Chapman 2003; Halpenny 2006), as well as environmentally responsible behaviour (e.g., sorting recyclable trash, Vaske

[18] Mere exposure effect can be defined as “when frequency of exposure to a particular stimulus is increased, the stimulus is better liked” (Murphy, Monahan et al. 1995, p. 591).

and Kobrin 2001) and place-protective behaviour (e.g., preventing ecological damage to a lake, Stedman 2002).

Research has also recently demonstrated the role of *affect* in rapid evaluation of the environment (Korpela et al. 2002) and decision-making (affect heuristic model, Slovic et al. 2002; Sinaceur et al. 2005). From a psychoevolutionary perspective, people's rapid affective assessment of their environment (non-mediated by *cognition*) enhances one's survival as it allows fast behavioural reactions: people are quickly able to judge the potential beneficial or harmful characteristics of an environment or of a situation (for review, see Korpela et al. 2002; Joye 2007). As Costarelli and Colloca (2004, p. 281) note: "the affective component may serve an adaptive/behavioural function, whereas the cognitive component may serve an information processing/knowledge function (see Breckler & Wiggins, 1989)". Work by neuroscientist Damasio corroborates the importance of *affect* in the reading of one's environment. He has shown that damage of the frontal lobe of the brain results in loss of emotions and knowledge of social conventions. People suffering from such impairment "would no longer act in accordance with social and moral conventions, […] would not show emotions in situations of danger or when shown pictures of catastrophes. […] This led Damasio to conclude that emotion plays a far greater role in reasoning than has hitherto been acknowledged (Damasio, 1994)" (Gerber 1997, p. 8). Finally and importantly, as Zajonc (1980) and Edwards and von Hippel (1995) show, we tend to trust more our affective than cognitive reactions; perhaps because "[w]hen we [affectively] evaluate an object or an event, we are describing not so much what is in the object or in the event, but something that is in ourselves", and "we are never wrong about what we like or dislike" (Zajonc 1980, p. 157).

c. *Conation* and pro-environmental attitude and behaviour

Research has shown that behavioural intention[19] is a significant predictor of behaviour toward the environment (for reviews, see Hines, Hungerford et al. 1987; Bamberg and Möser 2007) in many different contexts (see Ajzen 1991, p. 185-6). Studying the relationship between attitude and behaviour in general, Ostrom (1969) and Kothandapani (1971) found that, out of the three attitudinal responses (*affect*, *cognition*, *conation*), behavioural intention was the strongest predictor of behaviour. In a review of

[19] Behavioural intentions can also be referred to as "verbal commitment" (e.g., Maloney and Ward 1973).

determinants of environmentally-minded behaviour, including knowledge, psycho-social and demographic variables, Hines and colleagues (1987) found that *affect*- or *cognition*-defined attitudes, indistinctively, were correlated with behaviour (r = 0.347, SD = 0.224). Yet *conation* displayed the strongest relationship with behaviour of all the considered precursors (r = 0.49, SD = 0.130). In a follow-up review, Bamberg and Möser (2007, p. 21) found very similar results to Hines and colleagues' (1987, p. 21) study[20], indicating "a high temporal stability of the association between psycho-social variables and pro-environmental behaviour". Kaiser and colleagues in their review of environmental attitude and ecological behaviour refer to the impact of intention on behaviour as "the most striking effect usually found" (Kaiser et al. 1999, p. 4).

d. Relationship between *cognition*, *affect* and *conation*

As mentioned in the review above, the affective, cognitive, and conative attitudinal dimensions are related to one another. Yet the hierarchy in which such interactions may occur is a particularly vibrant topic as studies so far have produced conflicting results (Seibold 1975; Morris et al. 2002; Joye 2007). Essentially, the three components used to be modelled as influencing, in parallel, behaviour (Rosenberg and Hovland 1960; Kothandapani 1971; Breckler 1984). Now, they are usually assumed to follow the hierarchy where *affect*, *cognition*, or both, influences behavioural intentions, which in turn influence behaviour (Bagozzi 1982; Kim and Hunter 1993; Vaske and Donnelly 1999; Ajzen 2001; Bamberg and Möser 2007). Experimental studies have supported the soundness of such relationships (e.g., Lutz 1977; Triandis 1977 in Bagozzi 1982; Ryan 1982; Bamberg and Möser 2007). Some authors have investigated the hierarchy further with *cognition* driving *affect* (for review, see Bagozzi 1982; Morris et al. 2002), or *affect* preceding *cognition* (for review, see Zajonc 1980; Bagozzi 1982). However, at this stage, no consensus has been reached regarding the potentially hierarchical relationship between *affect* and *cognition*.

e. Advantages of the tripartite attitude model

The tripartite attitude model has many advantages over the uni- or bi-dimensional models.

[20] However the authors focused on studies on attitudes toward behaviour.

By including the affective, cognitive and conative processes of the human's mind, the model encompasses the diverse assumptions about attitude formation and change (e.g., cognitive learning process, Zajonc's (1968) affectively based theory of mere exposure; Eagly and Chaiken 2007, p. 591) and its relationship with behaviour. Of particular interest for this thesis, Millar and Millar (1996) suggested that direct experiences produce more affective than cognitive attitudes, which is, on the other hand, predominantly induced by indirect experiences with the attitudinal object. They further found that emotionally driven attitudes preferentially lead to what they call 'consummatory behaviour' as opposed to 'instrumental behaviour', which is more cognitively based. Consummatory behaviour is "performed only for the activity involved in performing it", where the "focus [is] on the intrinsic enjoyment of the activity" (Millar and Millar 1996, p. 563). Instrumental behaviour, on the other hand, is "performed to accomplish a goal beyond the activity involved in performing it", and the "focus [is] on the attributes of the object as they relate to the goal of the behaviour" (Millar and Millar 1996, p. 563).

The tripartite model also captures the contradictions within the human mind. Although it has been found that consistency between attitudinal responses denotes more stable attitudes (Rosenberg 1960; Rosenberg 1968) and better predicts behaviour (Norman 1975; Lavine et al 1998 in Ajzen 2001, p. 34), studies have also shown that it is not uncommon for people to hold different attitudes towards the same object (Lavine et al 1998 in Ajzen 2001, p. 34). As mentioned earlier, such a phenomenon is called 'ambivalence'[21] and can happen within or between *affect*, *cognition* and *conation* (Breckler 1984; Ajzen 1988; Chaiken 2001). Results show that when feelings and beliefs toward an object result in an opposite evaluation, people tend to rely more on their feelings to form their attitude (Ajzen 2001, p. 34). In the same vein, the evaluation of an object or a situation does not necessarily trigger the same mental processes in people; "thinkers" would evaluate an object based more on their beliefs, while "feelers" would attach more importance to their feelings (Ajzen 2001, p. 34; Forgas 2002; Jorgensen and Stedman 2006, p. 317). Additionally, different attitudinal objects can trigger different attitudinal responses in the same people (Ajzen 2001, p. 34-5; Forgas 2002; Jorgensen and Stedman 2006, p. 317). Thus, one can be a 'thinker' or a 'feeler' depending on the object of attitude.

Furthermore, situational factors (e.g., socio-demographic characteristics, social interactions, physical interaction with attitudinal object) may impact differently on

[21] "[C]oexistence of positive and negative dispositions toward the attitude object" (Malhotra 2005, p. 478).

people's beliefs, feelings, and/or intentions to act. Therefore, the tripartite model enables the researcher to identify with more precision the effects of various variables of interest on attitude, which will potentially reflect on the attitude-behaviour relationship (Jorgensen and Stedman 2006, p. 317).

The three-component model could, therefore, expose potential divergences in the contribution, intensity, and/or interactions of affective, cognitive, and/or conative responses between different groups of people and/or different objects of attitude. Finally, as Seibold (1975, p. 15) argues: "a multidimensional measure of attitude allows for more precise prediction of behaviour". This argument was also made by Jorgensen and Stedman (2006, p. 317) and Castro (2006, p. 249).

3. General-specific attitudinal model

The general-specific attitudinal model stems from work done by Stern and colleagues (Stern et al. 1995a; Stern et al. 1995b), Vaske and Donelly (1999) and Homer and Kahle (1988), which ultimately originates from the concept of value as developed by Rokeach (1973, see Vaske and Donnelly 1999) and Schwartz' work on altruism (Schwartz 1970; Schwartz 1977). Thus, these authors postulate that a hierarchy from the most general mental process (values) to the most specific (attitude towards specific object) leads to the performance of behaviour. As values are general guiding principles reflecting one's life goals or standards (see section III.1.a.), they are "the most abstract of the social cognitions", and "reflect the most basic characteristics of adaptation. These abstractions serve as prototypes from which attitudes and behavior are manufactured" (Vaske and Donnelly 1999, p. 524). Like attitudes, values "convey people's evaluations of 'objects'" (Chaiken 2001, p. 900); however, "values focus on ideals" (Hitlin and Piliavin 2004, p. 361), hence, on more general, abstract objects than attitudes (Murphy et al. 1995, p. 346; Hitlin and Piliavin 2004, p. 360-1). Consequently, values are more durable than attitudes and precede them in our evaluative hierarchy (Hitlin and Piliavin 2004, p. 361). Value orientations are expressions of values towards specific topics and should therefore precede attitudes. Schultz' measures have been argued to be value-expressive attitudes reflecting people's value orientation towards the natural environment. Similarly, the new environmental paradigm scale (original or revised) assesses people's core beliefs towards the natural environment and the relationship between the latter and human beings. Therefore, Schultz and NEP scales represent high-order attitudes that influence more specific attitudes directed at a particular object of the natural environment. Thus the Schultz and NEP scales are expected to predict the tripartite attitude model towards New Zealand native forest, which, itself, should predict behaviour towards the forest.

Since the NEP scale assesses people's beliefs about human dependence and impact on the natural environment, and notably about the likelihood of ecological catastrophes, the NEP scale is expected to correlate positively with Schultz' scales, which asks respondents what would concern them the most in the eventuality of environmental problems. As the New Environmental Paradigm implies taking the perspective of the natural world, Schultz' biospheric environmental concern is expected to relate more strongly to the NEP scale than the other two value-based concerns. So far, studies have shown contradictory results, except for the biospheric value-based concern, which consistently correlated positively with the NEP scale (Schultz 2001; Mayer and McPherson Frantz 2004; Schultz et al. 2004). Since the NEP scale evaluates people's broad beliefs towards the natural environment, it is expected to relate more strongly with farmers' specific beliefs towards New Zealand native forest, than their affective or conative responses. However, as beliefs towards the native forest are expected to be related with feelings and intention to act towards the forest, the NEP scale is also hypothesized to be positively associated with *affect* and *conation*. As Schultz' measure contains both cognitive and affective dimensions in its formulation, it is expected to correlate more strongly with both farmers' cognitive and affective attitudes towards the forest than with their behavioural intentions. Yet, for the same reason as mentioned above, Schultz' scales are also assumed to positively correlate with *conation*. Nevertheless, as New Zealand native forest is hypothesized to represent this part of nature that is perceived as a priori not benefiting humans' economic activities (see next chapter), farmers who empathise with nature, as characterised by biospheric environmental concern, are expected to show stronger positive specific attitudes towards native forest.

Finally, it should be mentioned that a general measure of *affect* was not contemplated. To truly render people's feelings towards an attitudinal object, ideally, *affect* should be measured in the presence of the object. Although it is somewhat presumptuous to measure *affect* by postal survey, I was still confident that farmers' feelings towards New Zealand native forest could be assessed because, as seen in the next chapter, despite much reduction from its original state, New Zealand native forest is still sufficiently present to be a known-feature of the rural landscape to farmers. However, how can such an affective measure be possible when the abstract notion of 'natural environment' is the attitudinal object? The natural environment is made of a multitude of objects, to which the same individual could hold totally opposite affective responses. Therefore, there is no point in trying to capture people's feelings towards the natural environment as a whole.

IV. Conclusion

A need to change our behaviour towards the natural environment has been long identified. However, if we are to change such behaviour, we need to understand the mental processes that predispose it. Attitudes have been hypothesized and found to be precursors of behaviour. However, such a relationship is likely to be stronger if both psychological variables are directed at objects with the same level of specificity; the more specific the objects are, the stronger the relationship between attitudes and behaviour. The thesis adopts a general to specific attitude framework, where the specific attitudes are hypothesized to follow from the general attitudes. Schultz' value-based environmental concerns and Dunlap and colleagues' revised New Environmental Paradigm scale are used to estimate farmers' general attitudes towards the natural environment. The tripartite attitudinal model assesses farmers' specific attitudes towards New Zealand native forest. This general to specific attitudinal model is further expected to predict the behaviour towards the forest of farmers who own fragments of New Zealand native forest.

Chapter 3: Farmers' attitudes and behaviour towards the natural environment

I. Introduction

This chapter is the second of the three literature review chapters and its aim is to present more extensively the rationale of the thesis. The relevance of the subjects (New Zealand farmers and native forest) and of a social-psychological framework to understand the relationships between farmers and nature is demonstrated. The first section presents the nature-agriculture issues in a general context and in the specific case of New Zealand. The interdependence between agriculture and the natural environment is underlined, as well as the detrimental impacts of conventional farming on the environment. Additionally, the New Zealand legislation pertinent to the protection of New Zealand native forest on private land is briefly reviewed. The second section examines the pertinence of the social-psychological framework, and more specifically the tripartite attitude model, to the study of farmers' relationships with the natural environment.

II. Agriculture-natural environment issues

1. General context

Farmers fulfil one of our most basic needs: providing food. They are essential to the functioning of our society. However, the industrialization and intensification of agriculture inherent to the productivist model[1], which has underlain farming production since WWII, has had serious impacts on the natural environment. Deforestation, loss of biodiversity, erosion of topsoil, nutrient depletion, soil compaction, water pollution and

[1] Lowe et al (1993, 221 in Wilson 2001, p. 78) defined productivism as "a commitment to an intensive, industrially driven and expansionist agriculture with state support based primarily on output and increased productivity. The concern [of productivism] was for 'modernization' of the 'national farm', as seen through the lens of increased production. By the 'productivist regime' we mean the network of institutions oriented to boosting food production from domestic sources which became the paramount aim of rural policy following World War II. These included not only the Ministry of Agriculture and other state agencies but the assemblage of input suppliers, financial institutions, R&D centres, etc., which facilitated the continued expansion of agricultural production."

overuse, and salinisation are common issues associated with agriculture (El Bassam 1998; Richardson et al. 2004; ME Assessment 2005; Nielsen 2005). As farming ultimately relies on the smooth functioning of the natural ecosystems in which it is embedded, the degradation or disappearance of natural habitats impairs the future of farming itself. The impacts of conventional agriculture are all the more daunting given that farmland now covers large areas of land. At the turn of the 21st century, it was estimated that out of a total of 13.0 billion hectares (Gha) of land area on the planet, 4.9 Gha (38%) was dedicated to arable production and pastures (see Nielsen 2005, p. 33). Some fragments of natural ecosystems remain on these farmlands (e.g., Cocklin and Doorman 1994; Ernst and Wallace 2008). However, these fragments potentially face conversion to more farming areas. It is therefore important to understand what motivates farmers to retain natural areas.

2. In New Zealand

Since Europeans settled in New Zealand in the 1800s (primarily from the United Kingdom), agriculture has been the predominant source of subsistence for the country. New Zealand, although one of the last regions colonized by humans, has been rapidly and massively transformed into an agrarian landscape (King 2003). Farmland covers today about 58% of the country (Statistics New Zealand 2003a, table 2.03). With the European colonisation came strong, preferential economic ties with the United Kingdom, which favoured a *quantitative* rather than *qualitative* New Zealand agricultural production (Rosin 2008, p. 49). The grasslands revolution (1890s-1980s), during which high use of fertilisers and grasslands selection by agricultural scientists boosted pasture production (Brooking et al. 2004), helped the country in meeting the British market demand. However, in 1973, as the UK entered the European Economic Community, New Zealand lost its status of privileged supplier to the *motherland* (Rosin 2008, p. 49). The New Zealand economy, and hence its agricultural sector, had to adapt to the competitiveness of the international market. The neo-liberal reform that followed in the 1980s heightened the productivist orientation of the New Zealand farming sector (King 2003; Rosin 2008, p. 49). Today the New Zealand economy still depends greatly on agricultural exports: agriculture contributes the most to the country's GDP (gross domestic product; 9.2%) and is one of the main sectors of employment (Morris 2004; Statistics New Zealand 2005; Rosin 2008, p. 46).

Ultimately, the New Zealand economy depends on a healthy environment. New Zealand agriculture, as any other in the world, can only continue producing if the natural cycles it depends on are sustained (Phelan 2009). In addition, the greater awareness of the public about the adverse effects of farming on the natural environment has resulted in an increasing societal demand for sustainable farming produces (Gafsi and Brossier 1997, p. 72-3). Therefore, it is in the interest of New Zealand to be able to justify and sustain its 'clean and green' image (PCE 2002, p. 50). [2] Nevertheless, the development of agriculture in New Zealand has been synonymous with major natural habitat destruction and species eradication (e.g., Ewers et al. 2006). In the last two or so decades, despite the growing recognition of the benefits natural ecosystems bring to our society (Costanza et al. 1997; Pimentel et al. 1997; Chapin et al. 2000), New Zealand agriculture has been marked by an increasing intensification, especially in the dairy sector (Williams 2001; Richardson et al. 2004).

The New Zealand native forest, which covered about 80% of the country before humans settled here (Williams 2001, p. 4; Ewers et al. 2006, p. 316), was continuously destroyed to make room for agricultural land. New Zealand has lost 71% of its original forest to pastoral farming, crop production, and urban development (Ewers et al. 2006). Despite providing essential services on farms, such as shade, erosion control (Madden 1998; Environment Waikato 2002), native forest clearance was encouraged by the government until the late 1970s (King 2003; Smith et al. 2007). "In consequence, the productive pastoral landscape, free of scrub and other introduced impediments to efficient pastoral farming, has traditionally been highly prized in our culture" (Smith et al. 2007, p. 39). Ewers and colleagues (2006) estimated that in 55 political districts out of 73, native forest cover was below the 'extinction threshold'.[3] They predicted that another five districts could follow the same fate within the next 45 years. Nevertheless, "[e]xcept for the most heavily deforested regions, relatively modest annual rates of habitat restoration could bring forest cover back above the extinction threshold by the year 2050" (Ewers et al. 2006, p. 312).

[2] According to the Parliamentary Commissioner for the Environment (2002) "This image is worth at least hundreds of millions, possibly billions, of dollars - aggregating value elements from dairy, tourism and organic produce and extrapolating to other sectors such as meat."

[3] "Landscape thresholds are the result of "rapid changes in the size and isolation of patches at critical proportions of habitat in the landscape" (Andrén, 1994), and are predicted to occur at approximately 30% remaining habitat cover (Andrén, 1994). Below this value, there is often an abrupt increase in the gap structure of landscapes, a marked discontinuity in dispersal between isolated sub-populations and a sharp decline in the probability of metapopulation persistence (Hanski, 1998; Hanski and Ovaskainen, 2002), at which point an extinction threshold has been passed. The extinction threshold compounds the risks posed by forest destruction, as even a small loss of habitat near the threshold may result in a precipitous decline in the probability of species persistence (With and King, 1999)" (Ewers, Kliskey et al. 2006).

Most of the native vegetation protected today is in mountainous areas (Hawes and Memon 1998, p. 114; Janssen 2002, p. 5). In 1997, 15,000 km^2 of indigenous forest remained in private ownership (The Ministry for the Environment 1997, p. 8.5; Ewers et al. 2006). However, most of the native forest on private land is unprotected from conversion to other land uses (The Ministry for the Environment 1997, p. 8.5). Since 1993, commercial logging of native forest has been controlled by the Forests Amendment Act (FAA). The act allows landowners to harvest indigenous timber at a sustainable scale (Hawes and Memon 1998, p. 119).[4] However, the FAA does not prevent private landowners from logging indigenous trees for their personal use (e.g., firewood) or to create more farmland or planting exotic forest fragments (Hawes and Memon 1998, p. 119, 125). The Reserves Act 1977 and the Conservation Act 1987 enables the Department of Conservation[5] to acquire land for conservation purposes (Jones et al. 1995, p. 146). However, acquisitions of private lands still depend upon the willingness of the landowner to sell, and the available funds of the Department. Restricted budgets mean that governmental agencies can only target the most ecologically significant natural areas (Hawes and Memon 1998, p. 117; PCE 2002, p. 22). The most appropriate legislation for dealing with the conservation of native forest on private lands is the Resource Management Act 1991, which "promotes the sustainable management of natural and physical resources" (Part 2 in Government of New Zealand 1991).[6] However, as Hawes and Memon (1998, p. 127) state: "The focus [of the act] is not on regulating the actual land use, as in previous planning legislation, but on controlling the adverse environmental effects of that activity". The Ministry for the Environment, regional councils and territorial local authorities are to implement the purpose of the Act. The Ministry for the Environment has the potential power to establish national environmental standards (Jones et al. 1995, p. 147). However, such

[4] Under the Forests Amendment Act 1993, plans and/or permits, administered by the Ministry of Agriculture and Fisheries, regulate the amount of indigenous trees landowners can cut down on their property. "A plan allows for the harvesting of indigenous timbers, but at a rate which is not greater than the ability of the forest to replace the timber removed either annually or periodically. Under a permit, owners of small forest areas are allowed to harvest up to 250m^3 of coniferous podocarp or kauri (Agathis australis), or 500m^3 of beech, over a 10 year period, providing that the quantity removed does not exceed 10% of timber standing on the landholding" (Hawes and Memon 1998p. 119).

[5] "The Department of Conservation is the leading central government agency responsible for the conservation of New Zealand's natural and historic heritage. […] Like other government departments, the Department of Conservation has the responsibility to advise Ministers and the Government and to implement government policy" (Department of Conservation 2010).

[6] "*sustainable management* means managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural well-being and for their health and safety while—(a) sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and (b) safeguarding the life-supporting capacity of air, water, soil, and ecosystems; and (c) avoiding, remedying, or mitigating any adverse effects of activities on the environment" (Government of New Zealand 1991).

standards have not yet been agreed upon and "in practice the effectiveness of the Act is highly dependent on how it is interpreted by district and regional plans" (Burtt, 1994, p. 40 in Hawes and Memon 1998, p. 126). Within the RMA, the regional and local government agencies[7] can improve the sustainable management of natural habitats on private lands via land purchase, regulatory mechanisms to control specific activities or restrict land uses in some areas. The governmental agencies can also use voluntary mechanisms where landowners choose to protect natural features on their property (e.g., covenants). Local authorities can also use incentives (e.g. rebates on property rates, subdivision incentive) (Jones et al. 1995, p. 148). However, as funds are restricted and regulatory mechanisms are not often enforced (Ministry for the Environment 2005, p. 25), the sustainable management of natural habitat, hence native forest, on private land rests mainly with farmers. Therefore it is necessary to understand what induces farmers to look after the natural environment on their land.

III. Relevance of the social-psychological framework

1. Economic models

Because farmers' economic survival depends on the exploitation of nature, they have been depicted as being driven by profit maximization (e.g., see Olli et al. 2001, p. 185). It has also been argued that the financial insecurity of the farming profession and of small towns where farmers may live would entice farmers to value economic growth over protection of environmental quality (Van Liere and Dunlap 1980, p. 185). In the same vein, the future of the farm once the farmer retires has also been hypothesized to play a role on farmers' adoption of conservation management. As the product of the property sale usually serves as farmers' retirement fund, the latter may be reluctant to subscribe to a conservation plan that may decrease the economic value of their property (see Freudenburg 1991, p. 193). Moreover, several studies have suggested that farmers tend to adhere to the tacit rule of passing on to the next generation a farm at least as

[7] Regional councils can impact indirectly on the management of native forest on private land, via "a regional policy statement which sets out, inter alia, the significant resource management issues of the region, resource management objectives, policies in respect of significant issues and a statement of methods to be used to implement the policies. The regional councils may also prepare regional plans relating to any functions for which they are responsible, including the protection, restoration or enhancement of natural and physical resources" (Jones, Cocklin et al. 1995, p. 148). Regional councils can also impact directly on native forest management through consents granting. Local agencies (district and city councils) can affect directly the management of native habitat through land use control and subdivision (Jones et al. 1995, p. 148).

prosperous as when they first got it (Keating and Little 1991, p. 26; Eaton 1993; McCrostie Little and Taylor 1998; Siebert et al. 2006, p. 327). Thus, in attempting to understand what motivates farmers to engage in the sustainable management or conservation of natural features on their property, numerous studies have used economic models (Lynne and Rola 1988, p. 20; Edwards-Jones et al. 1998, p. 154; Flett et al. 2004, p. 200). However, such economic models have usually failed to predict farmers' environmental behaviour (Lynne et al. 1988, p. 12; Ward and Lowe 1994, p. 173; Burton 2004, p. 360; Ajayi 2007, p. 23). Research has shown that farmers' practices are not solely driven by profitability (e.g., Gravsholt Busck 2002). For instance, Allen and Bernhardt (1995 in Schneider and Francis 2006, p. 86-8) showed that while all farmers they surveyed believed that "agriculture should be run like a business, that agriculture is a minor cause of ecological problems, that the long-term productive capacity of the land should be protected", alternative and conventional farmers differed in their perception of their relationship with nature. Similar differences in perception of nature between conventional and alternative farmers have been found in several studies (Beus and Dunlap 1990; Beus and Dunlap 1991; Abaidoo and Dickinson 2002).

2. Social-psychological models

Harrison and colleagues (Harrison et al. 1998, p. 305) argue that farmers are not mere "'technicians', motivated solely by financial rewards, [but are] knowledgeable experts who also have emotional attachments and ethical values for nature". Due to the extractive nature of their profession, farmers have long been expected to have a utilitarian mindset. It has also been argued that by living in a potentially less modified environment than urban dwellers and perceiving themselves as improving natural productivity rather than impairing it, farmers may not recognize the threat their activities can pose to the natural environment (Freudenburg 1991, p. 171-173). In contrast, because they are in constant contact with the natural environment, they also potentially have ringside seats in understanding how nature works and in empathizing with it. Furthermore, studies have suggested that farmers feel a strong sense of identity from their occupation (Burton 2004, p. 364), and they can feel all at once: "steward or caretaker, frontier conqueror and early technological adopter" (Stock 2007, p. 85). Additionally, Catton and Dunlap (1978a) postulated that a change in worldview from humans being all powerful over nature to a more encompassing relationship with the natural environment has occurred. This position has been supported by numerous studies around the world (Schultz 2001, p. 327), showing a consensus for environmental concerns. As Smith, Montgomery and Rhodes (2007, p. 33) note: "the last few decades have seen a massive increase in popular awareness and understanding of environmental concerns and there is no reason to believe farm households have been isolated from this trend". Jones and Dunlap (1992, p. 33) also hypothesized that as environmental problems become more obvious and threatening to human health over time, residents of rural areas (including farmers), like the rest of the population, should be expected to become more concerned about the natural environment. Public environmental concern has already permeated the policy realm forcing farmers to become aware of the environmental issues of their activities and change their practices (Ward and Lowe 1994; Gafsi and Brossier 1997, p. 72-3, 93; McHenry 1997, p. 1039; Rosin 2008). Therefore, researchers have argued that to understand why some farmers come to engage in sustainable practices and others do not, psychological variables (such as attitudes) need to be taken into account (Albrecht and Carpenter, 1976:2 in Swanson and Maurer 1983, p. 648; Lynne et al. 1988; Wilson and Hart 2001, p. 255; Burton 2004; Flett et al. 2004, p. 200).

Studies that have investigated the influence of environmental attitudes on farmers' environmentally-friendly behaviour tend to show positive relationships (e.g., Lynne and Rola 1988; Gould et al. 1989; Carr and Tait 1991; Battershill and Gilg 1996; Wilson and Hart 2001; Bayard and Jolly 2007; Berentsen et al. 2007; Toma and Mathijs 2007). In particular, Battershill and Gilg (1996) found that attitude had more impact on farmers' decision making and behaviour than any structural variables such as financial constraints. Morris and Potter (1995) found that "[the] attitudes of farmers entering schemes decide the quality of the result", while Coleman et al. (1992 in Ahnström et al. 2008, p. 40) found that "a positive change in attitude will give greater conservation success and more conservation goods per unit of input money invested". However, most studies have looked at farmers' attitudes towards a series of farm management behaviour more or less profitable for the farmer. In comparison, few studies have looked at farmers' attitudes and behaviour toward the natural environment itself, moreover, a-priori not directly profitable to the farmer in the short-term. Winter and colleagues (2005, p. 384) "are unaware of any studies that have developed an objective, quantitative measure, such as an index, to measure landowner attitudes towards conservation on private farmland". They acknowledge that "[t]here is a burgeoning literature on what influences attitudes towards conservation, but there is very little on what constitutes the actual components of conservation attitudes among farmers"

(Winter et al. 2005, p. 384). In the same vein, Brook, Zint and De Young (2003, p. 1639) note that "empirical research on rare-species conservation by private landowners is sparse".

3. Cognitive, affective, conative dimensions and tripartite attitude model

Very few studies have used the tripartite model of attitude on farmers. Nevertheless, the literature shows that measures of farmers' attitudes based either on cognitive, affective, or conative attitudinal response (especially cognitive) have been used numerous times. The literature on farmers' cognitive, affective and conative responses towards the natural environment is reviewed below, followed by a review of studies that have used the three attitudinal dimensions at once.

a. Cognitive variables

Numerous studies have found that farmers held different beliefs towards the natural environment compared to urban or non-farmer individuals. Thus, studies have found at times that the rural population[8] exhibited lower environmental concern, while other studies found the opposite (e.g., see Schneider and Francis 2006, p. 86-8). For instance, Berenguer and colleagues (2005) found that rural respondents tended to be more concerned about conservation matters while urban dwellers tended to be more concerned about pollution issues.[9] They also found that rural residents perceived environmentally responsible behaviour (e.g., saving water) in a more positive light than urban residents. Additionally, Beus and Dunlap (1990), adapting the DSP-NEP scale to the farming context, suggested the existence of a conventional versus alternative agriculture paradigm. In a review of key agriculturists, the authors found that both alternative and conventional groups recognize that the success of agriculture relies on nature and both recognize that farming has had detrimental effects on the environment.

[8] The rural population includes, but doe not necessarily equates to, the farming population. A large amount of the literature concerned the environmental attitudes and/or behaviour of rural populations in general as opposed to farmers in particular. Despite its more general focus, this literature is included in the present review.
[9] Berenguer and colleagues (2005) found no statistical difference between farmers and the rest of the rural population.

However, the traditional agriculturalists are profit-oriented, aiming for maximum efficiency, hence modifying natural patterns to suit their aims (this group often referred to nature as a 'machine'). Exploitation and domination of nature, and engaging with nature as with an enemy (language of war) dominate their discourse. On the other hand, alternative agriculturalists have a holistic perception of agriculture based on ecological principles, feel interconnected with nature and ultimately at nature's mercy. The conventional versus alternative paradigm has been supported by several studies (Abaidoo and Dickinson 2002; Allen and Bernhardt 1995 in Schneider and Francis 2006, p. 86-8).

Perception of a problematic situation has been shown to be instrumental to farmers' decision making (Lynne et al. 1988, p. 17; Ward and Lowe 1994; Gafsi and Brossier 1997, p. 93; Rahman 2003; Paudel and Thapa 2004, p. 39; see Ajayi 2007, p. 23; see Wei et al. 2007, p. 131). In New Zealand, Smith, Montgomery and Rhodes (2007, p. 33, 35) found that farmers they interviewed were well aware of environmental issues, notably on their land, and that "conservation of native bush was backed by a conscious belief in its ecological value", as well as awareness of environmental issues on the farm (e.g. soil erosion). Yet such perception is not always the guarantee that actions are going to be taken. French farmers in Weiss and colleagues' study (2006) tended to perceive pollution problems as being the result of the actions of previous generations, or neighbours. Michel-Guillou and Moser (2006, p. 233) found that although both traditional farmers and farmers engaging in pro-environmental actions were aware of water pollution problems, environmentally responsible farmers felt "more involved towards this problem than farmers having maintained traditional practices. Moreover, they consider[ed] that intervention regarding the water problem [was] still possible; and they [felt] personally more capable of acting towards solving this current problem". Additionally, farmers' perception of a situation can also prevent them from addressing environmental issues in a sustainable fashion. Work by van den Berg and colleagues (1998 in Williams 2002, p. 2) and Williams and Cary (2001 in Williams 2002, p. 2) found that farmers and experts differed significantly in their appraisal of the ecological quality of various agrarian landscapes. In particular, when asked 'How valuable is this paddock for protecting native plants and wildlife?', farmers judged the native grassland scene, which contained the greatest extent of native vegetation of all the landscapes presented, as having significantly lower ecological value (Williams 2002, p. 2).

b. Affective variables

As people's decisions can be influenced by their emotions (*affect*) (Smith et al. 1994), there is no reason to believe farmers' decisions would be otherwise. Yet, in comparison to cognitive variables, the affective relationships farmers have with the land have been largely ignored in attitudinal and behavioural studies. As Erikson and colleagues (2002, p. 110) state: "[w]e have only begun to understand the implications of these [affective] connections in terms of planning and management".

The field where such connections have been investigated the most is the study of landscape preferences.[10] Research in this domain has found that land-conservation practices were positively related with the aesthetic values landowners attribute to natural features (see Brook et al. 2003, p. 1639). In a study on owners of non-commercial woodlots in Michigan, Erikson and colleagues (2002) found that landowners' motivations to keep woodlots on their property were firstly affectively driven. Indeed, for both farmers and non-farmers aesthetic reasons were the strongest motivation to retain forest fragments, followed by environmental protection. Economic benefits only came third[11], while natural area constraints (such as "difficult to clear") came last. In New Zealand, Dodd and colleagues (2008) found that positive beliefs towards the natural environment were also strongly associated with the aesthetic of the landscape. Cocklin and Doorman's (1994) study on rural landowners with native forest on their property showed that *all* owners, whether they had legally protected their fragments or not, valued the scenic aspect of the remnant as important or very important. Similarly, "[b]locks and scattered plantings of native trees" were among the landscape features of the farm that were aesthetically important to farmers (Smith et al. 2007, p. 40). Smith and colleagues (2007, p. 35) also found that the aesthetic of the farm was linked with retaining or planting native trees on the farm, with "[n]o farmer expect[ing] such initiatives to be reflected in the value of their property".

[10] Landscape preference is "the degree to which people like a landscape in response primarily to the visual stimuli the landscape provides" (Natori and Chenoweth 2008, p. 250).

[11] However, it is worth noting that some items under the label 'environmental protection' could be equally attributed to 'economic benefits' (e.g. "windbreak", "protect soil from erosion").

c. Conative variables

Farmers' intentions towards the natural environment have been found to relate with their beliefs and feelings towards it. Studies have shown that farmers' willingness to conserve or enhance biodiversity on their property was associated with their perception of the areas to conserve (Padt 2000 in Wossink and van Wenum 2003, p. 467; Benjamin et al. 2007). Thus, "[t]hose who have not protected their wetlands in any way stated reasons relating to the lack of significance of the wetland" (as well as to the physical impossibility of fencing it off) (Dodd et al. 2008, p. 157). In their study on farmers' perceptions of biodiversity on the farm, Herzon and Mikk (2007) found that pro-environmental behaviour intentions of preserving or enhancing wildlife habitat were positively related with interest in wildlife as well as a positive attitude toward birds. Furthermore, the farmers who understood basic links between vegetation and wildlife displayed stronger intentions of preserving or restoring habitat (Herzon and Mikk 2007).

d. Tripartite attitude model

As demonstrated by the literature reviewed above, the cognitive, affective and conative responses of farmers towards nature are valuable dimensions to take into account when trying to understand what motivates farmers to engage in conservation. Nevertheless, to the extent of my knowledge[12], very few studies have applied the tripartite attitude model (*affect*, *cognition* and *conation*) to the farming community in general and more specifically regarding its attitudes toward the natural environment. Many studies, on farmers' participation in agri-environmental schemes for instance, have used the theories of reasoned action (Fishbein and Ajzen 1975) or planned behaviour (Ajzen 1985) (Lynne and Rola 1988; Lynne et al. 1988; e.g., Luzar and Cosse 1998; Willock et al. 1999a; Beedell and Rehman 2000; for review, see Burton 2004). Researchers have also predominantly used cognitive-only based assessment of attitude (e.g., Swanson and Maurer 1983; Prokopy et al. 2008).[13] Regarding general farming issues, Heffernan and colleagues' (2008) study is one of the few, if not the only one, to use a form of the tripartite model.[14] Concerning the specific topic of farmers' response

[12] Searches done on ISI Web of knowledge, Ovid, Science Direct, and CSA Illumina with a combination of the following keywords: affect*/emot*/feel* and cognit*/belief/know* and farm*.

[13] despite Propoky and colleagues' claim that their measure of attitude was affective-based, p. 304.

[14] Nevertheless, some of the items Heffernan and colleagues referred to as "emotive factors" (*affect*) actually resemble more cognitive than affective items.

to environmental issues, Vogel (1994; 1996)[15] and Winter and colleagues (2005) are the only ones I am aware of who acknowledged the use of the tripartite model to assess farmers pro-environmental attitude and behaviour. However, their representations of the three attitudinal dimensions are questionable, especially their distinction between *affect* and *cognition*. Overall, Vogel's (1994; 1996) study supports the tripartite model. The author found that beliefs[16] about the environment in general and the farming-environment relationship were significantly associated with behavioural intentions, which significantly predicted behaviour. *Affect*[17] related with both general beliefs about the environment and beliefs about the relationship between farming and the natural environment. In parallel, beliefs about the farming-environment relationship and *affect* also directly predicted behaviour. Winter and colleagues' (2005, p. 389) index of landowners' attitudes toward a South-African endangered ecosystem had also claims upon the tripartite model. However, the item closest to a measure of landowners' affective response to the endangered ecosystem ('aesthetic appeal') was unfortunately too entangled with cognitive dimensions to truly measure *affect* (Winter et al. 2005, p. 385, 387). Maybe as a consequence of its ambiguous nature, this item was not retained in the final index and only "perceived benefits" and "willingness to conserve" remained, assessing farmers' attitudes via their cognitive and conative responses to the ecosystem (Winter et al. 2005, p. 388).[18] The authors found that farmers had overall a positive attitude toward the endangered ecosystem, and the more farmers perceived the endangered ecosystem to be beneficial to the farm, the more they were willing to conserve it (Winter et al. 2005, p. 389).

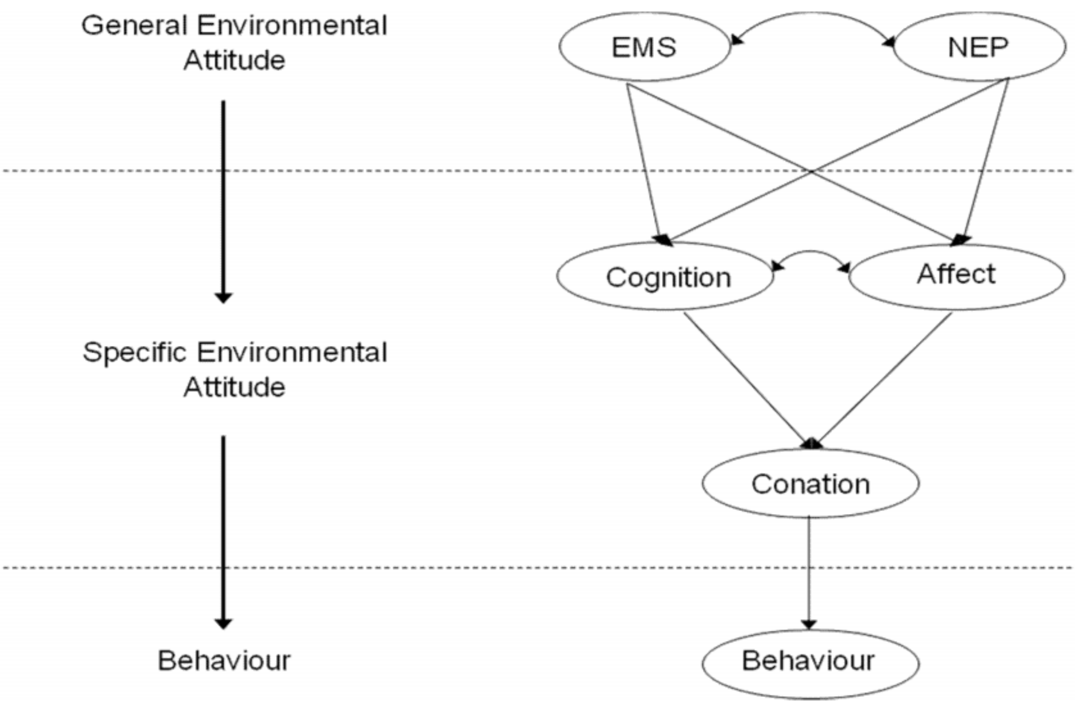
IV. Conclusion

The productivist model of agriculture is threatening the future of the planet the way we know it and, consequently, the future of farming itself. Fragments of natural habitats scattered about farmland bring essential support to our livelihood and to farming production. Nevertheless, it seems that the services such ecosystems provide are not yet obvious to the human eye as natural ecosystems continue to be damaged.

[15] Vogel 1996 article is peer reviewed and a shorter version of the discussion paper produced in 1994.
[16] Vogel refers to 'beliefs' as 'attitude'.
[17] In Vogel's study, 'affect' is represented by 'feeling of stress'.
[18] Despite the authors stating that the retained items respectively represented "affective" and "behavioural". (conative) attitudinal responses (Winter, Esler et al. 2005, p. 390).

Therefore it is important to understand how farmers relate to nature and what motivates them to set aside fragments of natural habitat on their land. Pure economic models have failed in explaining the sustainable practices of farmers. Researchers have advocated for investigating farmers' behaviour from a social-psychological angle. Thus, this thesis investigates the attitudes of farmers towards nature as a whole and native forest in particular, taking a general to specific attitudinal approach (Stern et al. 1995a). This general-specific attitudinal model is then used to assess respondents' behaviour towards the native forest fragments on their farm (figure 3.1).

Figure 3. 1 The general to specific attitudinal and behavioural model used in this thesis



New Zealand native forest was chosen as the attitudinal object because it represented a part of nature that was not of obvious usefulness to farmers, and as a result, had been widely transformed and/or decimated. Nevertheless, this locally endangered natural ecosystem is still sufficiently present over the country to be at least a known sight to farmers. The relatively common presence of native forest fragments on private land allowed for the use of a tripartite attitude model, combining the measure of cognitive, affective and conative dimensions. Direct contact on the farm with forest remnants of any size were assumed to be of influence on farmer' attitudes. Thus, the environmental attitudes of respondents with native forest fragments were assessed indiscriminately of the fragments' size. On the other hand, when measuring farmers' actions towards native forest, it was important to target respondents who would actively reflect on whether or not to put their forest fragments aside from farming. Therefore, only the behaviour of respondents with native forest fragments of one hectare or more was studied (chapter 12, II for more details).

Chapter 4: Effects of situational variables on farmers' attitudes and behaviour towards the natural environment

I. Introduction

The previous chapter argued for investigating the relationship between farmers and the natural environment from a social-psychological perspective. Yet, in order to improve the understanding of farmers' attitudes towards nature and ultimately the prediction of pro-environmental behaviour, situational variables need to be taken into account. Thus, this chapter is the last of the literature review chapters and examines the various situational variables relevant to farmers' relationships with nature.

II. Attitude-behaviour relationship: the need for situational variables

Surveys have shown that, since the end of the 20th century, pro-environmental attitudes have become more mainstream (Dunlap et al. 1993; Schultz 2001, p. 327; Costarelli and Colloca 2004, p. 279; Castro 2006, p. 247, 254). As attitudes are hypothesized to predispose behaviour (Fishbein and Ajzen 1975; Weigel 1983; Stern and Oskamp 1987), such commonly held pro-environmental attitudes would be expected to lead to numerous and enduring environmentally friendly behaviour. Nevertheless, such a consensus in attitudes towards the natural environment has not necessarily been reflected in people's behaviour (Nordlund and Garvill 2002, p. 741; Castro 2006, p. 249). Even when the measures of attitudes and behaviour target the same object of interest (same level of specificity, e.g., see Heberlein and Black 1976), some discrepancy still exists between people's attitudes and their behaviour (e.g., Herzon and Mikk 2007, p. 20). Attitude generally explains between 10% and 20% of the total variance of behaviour, and rarely more than 30% (Tarrant and Green 1999, p. 25). As a consequence, researchers have drawn attention to the necessity of exploring the relationship between attitudes and behaviour within the boundaries of situational variables, that is, external factors that can influence psychological processes (e.g., Guagnano et al. 1995; Corraliza and Berenguer 2000). Thus, studies have shown that farmers and farm characteristics, governmental institutions, social relationships as well as interactions with the natural environment play a role on farmers' dispositions and/or practices towards the natural environment (e.g, Brook et al. 2003; Paudel and Thapa 2004; Winter et al. 2005). However, if a substantial number of studies have already investigated the effects of situational variables[1] on environmental attitudes or behaviour, comparatively, only a few have assessed how situational factors affect the consistency between pro-environmental attitudes and behaviour (Tarrant and Cordell 1997, p. 622; Corraliza and Berenguer 2000, p. 836). As Tarrant and Cordell (1997, p. 622) note, this is a particularly important gap in the environmental social-psychology literature because external factors are hypothesized to only *indirectly* influence behaviour via attitude (Fishbein 1979 in Guagnano et al. 1995, p. 701; Ajzen & Fishbein 1980 in Tarrant and Cordell 1997, p. 622).

Thus, the present thesis looks at the extent situational factors explain farmers' environmental attitudes and influence the relationship between farmers' general-specific environmental attitudes and their behaviour toward New Zealand native forest. The situational variables examined in the present studies are respondents' (1) sociodemographic variables, (2) direct contact with nature, (3) ecological knowledge, (4) social interactions, and (5) perception of the regional governmental agencies. Different reasons drove the choice of these situational variables. On one hand, some were chosen because they have been commonly used in environmental social psychology research, thus represented useful means of comparisons, yet, have at times brought antagonist results, thus deserved more insight (e.g. sociodemographic variables). On the other hand, others were chosen because they have been sparsely found in environmental social psychology studies and/or seldomly tested on samples of farmers, yet, have shown promising results (e.g. direct contact with nature). In the rest of this chapter, the effects of these situational variables on farmers' attitudes and behaviour towards the natural environment are reviewed.

[1] Following the use of the terms "situational variables" from (Barr 2007).

III. Situational variables effects on farmers' pro-environmental attitudes and behaviour

1. Socio-demographic variables

Among the general public, the environmental social-psychological literature has usually found only a slight tendency for younger individuals and women to express more pro-environmental value orientations and attitudes, whereas men tend to display more pro-environmental behaviour. Although education and income have been regularly expected to positively affect people's attitudes and behaviour towards the natural environment, the effects of such variables are not conclusive (for review, see Van Liere and Dunlap 1980; Vaske and Donnelly 1999; Olli et al. 2001; Ignatow 2006). Such results are not necessarily transferable to the farming community. Nevertheless, similarly to the general population, research focusing on the socio-demographic correlates of farmers' pro-environmental attitudes and behaviour has also produced rather weak results.

a. Farmer's characteristics

i. Gender

The profession of farmer is dominated by males (e.g., Wilson 1996, p. 126; Best 2008, p. 98). Thus, few studies have looked at gender effects on environmental attitudes and behaviour. Nevertheless, Schneider and Francis (2006) found that women farmers tended to express a greater land ethic than males. However, the sample was too small to test the significance of this relationship. In a study on conversion to organic farming, Stofferahn (2009) found no significant relationship between gender and farming organically; nor did Wilson (1996) on the participation in conservation schemes and Vogel (1996), with regard to farmers' general environmental attitudes. On the other hand, Fairweather and Campbell (2003) found more women among New Zealand conventional farmers than among organic farmers.

ii. Age

Farmers' age has not clearly been correlated with farmers' attitudes towards the natural environment or farmers' attitudes towards sustainable farming practices. Most of the presently reviewed studies that looked at the effects of age on farmers' environmental attitudes did not show significant relationships (Lasley et al. 1990; Cocklin and Doorman 1994; Ryan et al. 2003; Winter et al. 2005; Schneider and Francis 2006). Nevertheless, some studies found that younger farmers were more willing to conserve (Winter 2003 in Winter et al. 2005, p. 391), more favourable to land use planning (Bultena et al. 1981) and exhibited stronger general pro-environmental attitudes than older farmers (Vogel 1996). The relationship between farmers' age and pro-environmental behaviour consistently shows, on the other hand, that younger rather than older farmers engage in sustainable practices (Gould et al. 1989; Lasley et al. 1990; Jacobsen et al. 1991; Featherstone and Goodwin 1993; Drost et al. 1996; Wilson 1996; Stofferahn 2009). One possible explanation is that older farmers are less likely to undertake sustainable practices as they perceive them "unfeasible or impractical" and, being closer to retirement, they may not reap the benefits of learning and implementing new practices (Drost et al. 1996).

iii. Part-time/full-time

Since part-time farmers are not as financially dependent on their farm as full-time farmers, they have been expected to be more likely to set aside portions of land for conservation and/or engage into low-input farming practices (Ryan et al. 2003, p. 34). However, the distinction between full-time and part-time farmers on environmental attitudes or behaviour is equivocal, principally because few studies mention this distinction. Ryan and colleagues (2003) found no significant differences between the two groups regarding their motivation for adopting conservation practices on their farm. In contrast, the authors found that they were willing to engage in different environmentally friendly behaviour (e.g., full-time: no-till; part-time: maintain woody cover along streams and drains) (Ryan et al. 2003). Jacobsen and colleagues (1991) found that part-time farmers were more likely to farm in a more sustainable fashion.

iv. Length of farming experience

The more experienced farmers are, the more they are expected to be able to recognize environmental problems on their farm (Gould et al. 1989, p. 172). Such awareness should further induce the appropriate mitigating behaviour. Length of farming experience has indeed been demonstrated on some occasions to positively influence farmers' environmental attitudes (Gould et al. 1989). However, other studies did not establish any significant relationship (Ryan et al. 2003; Winter et al. 2005). Furthermore, negative (Gould et al. 1989) or no significant association (Traore 1998; Fairweather and Campbell 2003; Stofferahn 2009) has been found between farming experience and farmers' sustainable behaviour.

v. Farm in family

It has been hypothesized that if the property has been in the farmer's family for more than one generation, he or she would feel more connected to the land, and would not perceive it simply as an economic asset. In such a case, the farmer is more likely to take care of the farm (Winter et al. 2005, p. 391). However, depending on the type of on-farm pro-environmental practices, farm transfer has produced antagonistic hypotheses. On one hand, farm owners are expected to care about the environmental viability of the farm (e.g., limiting erosion) in order for the next generation to take over a property that is at least in as good an environmental state as when the farmer got the farm and to reap the benefits of the conservation management (Gould et al. 1989, p. 176; Featherstone and Goodwin 1993, p. 72). On the other hand, farmers are tacitly expected by their community to pass on a financially prosperous farm to the next generation. Retiring some land for conservation may lower the economic value of the property and may be perceived by the farmer or his/her peers as a failure to fulfil the transfer duty (Siebert et al. 2006, p. 327). The international literature shows that having the farm remaining in the family for several generations was positively associated with pro-environmental attitudes (Winter et al. 2005) and behaviour (Gould et al. 1989; Wilson 1996). On a related topic, Fairweather and Campbell (2003) found, however, that whether or not respondents' parents were farmers themselves did not significantly impact on the likelihood of respondents engaging in sustainable farming practices.

b. Farm's characteristics

i. Farm income

Based on the postmaterialist hypothesis (Inglehart, 1977, 1997 in Olli et al. 2001, p. 185-6) and Maslow's hierarchy of needs theory (1970 in Van Liere and Dunlap 1980, p. 183)[2], wealthier farmers are expected to be more willing to engage in environmentally friendly behaviour since their material well-being is assured. Such an hypothesis has been confirmed at times (e.g., Wilson and Hart 2000). However, Ryan and colleagues (2003) and Bultena and colleagues (1981) found that farm income did not significantly relate to, respectively, farmers' motivations for adopting conservation practices and attitudes towards land use planning, while Schneider and Francis (2006) found that farm income did not relate to land ethics. The relationship between farm income and farmers' environmentally friendly behaviour yields similar ambiguous results. Berentsen and colleagues (2007) showed that farmers engaging in on-farm environmental conservation had a lower farm income than farmers not engaging in such practices. Similarly, Fairweather and Campbell (2003) found that organic farmers had lower farm income than conventional farmers. However, the findings of Westmacott and Worthington (1984 in Ahnström et al. 2008, p. 42) and Dick (1992 in Ahnström et al. 2008, p. 42) indicated that higher farm income was associated with more use of chemicals, but also with a greater likelihood of alternative farming practices on the farm. Lynne and colleagues (1988, p. 18) found that farmers' conservation efforts on their property augmented "at an increasing rate over the range of the income data".[3] In another study, Lynne and Rola (1988) found that income alone did not have a significant effect on farmers' soil conservation behaviour, but, when included with attitude, the two variables explained more variance in behaviour than attitude alone. In a study on New Zealand hill country farmers, Smith and colleagues (2007, p. 33) found no relationship "between levels of farm profitability and farmers' overall commitment to environmental management, nor between profitability and any individual strategy". Similarly, Stofferahn (2009) did not identify significant differences in total gross farm income between conventional and organic farmers of North Dakota. Regarding farmers' perception of forest fragments, Benjamin and colleagues (2007, p. 238) found that owners with property of lesser value, and with the least children, perceived woodlot as

[2] The extension of the post-materialist hypothesis and Maslow's hierarchy of needs theory state that only once one's basic material needs are met one will start worrying about such issues as environmental problems.

[3] Behaviour was positively related to square of income.

productive. Cocklin and Doorman (1994, p. 273) found that the financial value of forest fragments did not count for much in New Zealand farmers' attitudes towards the fragments compared to other factors, such as aesthetic value.

ii. Farm Size

The relationship between farm size and farmers' pro-environmental attitudes has been well documented. Farm size is usually related to farm income (Ryan et al. 2003). Hence, larger farms are supposed to be signs of farmers' wealth, and, based on the postmaterialist hypothesis, larger farms are hypothesized to be associated with environmentally friendly inclinations in farmers. However, results remain contradictory. Numerous studies have found no significant relationship between farm size and pro-environmental attitudes (Bultena et al. 1981; Cocklin and Doorman 1994; Ryan et al. 2003; Winter et al. 2005). In contrast, Gould and Saupe (1989) and Lasley and colleagues (1990) found that respondents with smaller farms were, respectively, more likely to recognize the existence of erosion problems and hold positive opinions about low-input farming methods. Similarly, Schneider and Francis (2006) found that farm size negatively related to land ethics, and Vogel (1996) found that participants with smaller farms showed stronger general and specific pro-environmental beliefs. Benjamin and colleagues (2007, p. 238) found that owners of large properties who expressed low ecocentric values[4] did not perceive the general decline of wooded areas in the region over the last 30 years, and, on the contrary, stated that such an ecosystem had increased over that time. These results are in line with Buttel and colleagues, who stated "that agricultural scale and wealth indicators generally have an inverse relationship to indexes for environmental concern" (1981 in Schneider and Francis 2006, p. 87). However, Ryan and colleagues (2003, p. 31) found that different farm size was associated with different intentions in terms of farm practices. Farmers with large farms were more likely to indicate intentions of no-till farming; while participants with small farms were more likely to wanting to maintain woody cover along their streams and/or drains. The relationship between farm size and pro-environmental behaviour is slightly less variable. Studies either found that larger farms were more likely to include sustainable farming practices (Rahm and Huffman 1984; Gould et al. 1989; Lasley et al. 1990; Featherstone and Goodwin 1993), or that farm size and on-farm pro-

[4] Ecocentric value means valuing nature for itself

environmental behaviour were not significantly related (Traore 1998; Fairweather and Campbell 2003; Stofferahn 2009).

iii. Farm ownership status

Owning part of or the entire farm is expected to make farmers feel more connected to the land, hence, more likely to look after it (Ahnström et al. 2008, p. 42). However, Cocklin and Doorman (1994) found that ownership status did not affect New Zealand farmers' attitudes towards the natural environment, whereas Schneider and Francis (2006) found that farmers who did not own land expressed higher land ethics than farmers who did own land. In contrast, owning land tends to be positively associated with pro-environmental behaviour (Lynne et al. 1988; Featherstone and Goodwin 1993), although Traore (1998) found no significant relationship with on-farm soil and water conservation practices in Canada.

iv. Farm type

As different types of farming (e.g., dairy, horticulture) involve different types of management, different farm types are expected to relate differently to environmental attitudes and behaviour. As for most of the socio-demographic variables, farm type produced ambiguous results. Gasson (1974 in Winter et al. 2005) and Coughenour and Swanson (1988 in Winter et al. 2005) found that farmers' environmental attitudes depended on the type of farming they were engaged in, whereas Cocklin and Doorman (1994) found no significant relationship with attitudes towards forest covenants. However it seems that farming involving livestock (Featherstone and Goodwin 1993), especially dairy farming (Gould et al. 1989; Fairweather and Campbell 2003), does not favour on-farm conservation behaviour. Furthermore, Fairweather and Campbell (2003) found that New Zealand organic farmers were more numerous in horticultural farming. Although some authors have demonstrated that organic farmers hold a wide range of motivations for farming more sustainably (e.g., Fairweather 1999), all of the studies presently reviewed that investigated the relationship between organic farming and environmental attitudes found that most of the organic farmers showed stronger pro-environmental attitudes than conventional farmers (Hendriks et al. 2000; Abaidoo and Dickinson 2002; Fairweather and Campbell 2003; Best 2008).

Overall, the literature on the relationships between socio-demographic characteristics and farmers' pro-environmental attitudes and behaviour show contradictory results. However, some trends can be brought out. Farmers' pro-environmental attitudes tend to be associated with farming organically, while pro-environmental behaviour are more likely to be found among younger farmers, on larger farms, when farmers own part of or the entire farm, on farms not engaged in livestock farming and on organic farms.

2. Direct experience with nature

Two theories underlie the relationship between direct experience with nature and farmers' dispositions towards the natural environment as treated in this thesis: the biophilia hypothesis (Kellert and Wilson 1995; Kellert 1997) and the mere exposure theory (Zajonc 1968). The biophilia hypothesis states that being part of nature, we, human beings, have an intrinsic, biological need for nature (Kellert and Wilson 1995; Kellert 1997), and that "[our] well-being depends, to a great extent, on the relationship with the surrounding natural world" (Kals et al. 1999, p.183). Zajonc, in the mere exposure theory (Zajonc 1968), argues that the more an individual is exposed to an object, the more favourable the attitude the individual will exhibit towards it. Based on these two theories, it is assumed that the more direct experience respondents have with the natural world, the more favourable the attitudes, and, to a certain extent, behaviour they will exhibit towards nature in general and New Zealand native forest in particular.

Social-psychological studies have indeed found that past experiences play a role in attitudinal evaluation (see Smith et al. 1994, p. 360) and, via attitude, these past experiences would influence behaviour (Fazio and Zanna 1981). Regarding the specific influence of experience with nature on environmental attitudes and behaviour, a positive relationship is generally assumed (Kals et al. 1999, p. 182-3). Non-causal studies based on correlations or regressions have supported this hypothesis. Mayer and McPherson Frantz (2004) found that spending time in natural settings was positively associated with connectedness with nature[5], which was in turn positively related to biospheric value orientation, pro-environmental attitudes and behaviour, and correlated negatively with egoistic value orientation. Similarly, Kals and colleagues (1999) found that direct

[5] Mayer and McPherson Frantz (2004) define their connectedness to nature scale as "a measure designed to tap an individual's affective, experiential connection to nature", p. 304.

experience with nature was positively related to *affect* (which they refer to as 'emotional affinity toward nature'), as well as *cognition*, and *conation*. Based on German-speaking literature, they further suggest that "[e]motional affinity toward nature should become stronger the more concrete and specific nature contacts are (Göpfert, 1987; Maaßen, 1993a, 1993b; Seel, Sichler, & Fischerlehner, 1993)" (Kals et al. 1999, p. 198). Nevertheless, relatively few empirical studies have tested the causation between experience with nature and pro-environmental attitudes, values or behaviour (Kals et al. 1999, p. 182-3, 198; Bögeholz 2006, p. 66). However, studies that have measured people's dispositions towards the natural environment pre- and post-interactions with nature have usually found a positive increase in such dispositions (Bögeholz 2006, p. 68). Many of these studies belong to the education literature on children and adolescents, and show that outdoor educational programmes are associated with an increase in ecological knowledge, and pro-environmental attitudes, values or behaviour (see Bögeholz 2006). Studies on adult populations are scarcer, but suggest, nevertheless, that similar relationships can be expected. Orams' (1997) and Powell and Ham's (2008) studies, respectively set in an Australian and a Galapagos ecotourist organization, showed that environmental educational programmes involving information and direct experience with nature increased ecological knowledge, pro-environmental awareness, attitudes, commitments and behaviour towards nature in adult populations. Schultz and Tabanico (2007), reporting the results of five studies conducted in different geographical settings and including different activities in built and natural environments, found that spending time in nature was associated with an increase in connectedness with nature. Most of the participants also reported higher connectedness with natural than with built environments (Schultz and Tabanico 2007). Additionally, studies asking environmentally-minded groups or the general public the source of their environmental concern demonstrated that participants regularly cite past or present experiences with the natural world (Finger 1994; Chawla 1998; Degenhardt 2002; Eigner and Schmuck 1998 in Bögeholz 2006, p. 66). Although little is known about the mechanisms that could induce such a positive influence (Kals et al. 1999, p. 183), Millar and Millar (1996) suggest that direct experiences with the attitudinal object produce more affective reactions, while indirect interactions induce more cognitive reactions. As a consequence, it is assumed that farmers with more direct interactions with New Zealand native forest will exhibit more positive attitudes and behaviour towards the natural environment in general, but more importantly towards native forest.

In the same vein, it is expected that outdoor activities, by providing direct experiences with nature, will affect environmental attitudes and behaviour as well as improving the consistency between the two (Tarrant and Green 1999; Thapa and Graefe 2003). Furthermore, the association between environmental concern and outdoor recreation is expected to be stronger for contemplative (e.g., hiking) than extractive (e.g., hunting) recreational activities, and when environmental concern is specifically directed to the environment necessary for pursuing the recreational activity rather than general environmental issues (e.g., air pollution) (Dunlap and Heffernan 1975 in Nord et al. 1998, p. 237; Dunlap and Heffernan 1975 in Thapa and Graefe 2003, p. 79). It is also assumed that people would be more likely to protect natural features that sustain their recreational activities (Bjerke et al. 2006, p. 119). Contemplative recreational activities are assumed to reflect a more preservationist ethic than extractive activities, which are, in contrast, expected to indicate utilitarian views (Dunlap and Heffernan 1975 in Teisl and O'Brien 2003, p. 507-8). Few studies have empirically assessed the influence of outdoor recreational activities on pro-environmental attitudes and, especially, behaviour. Hence, little is known about the effects of outdoor recreational activities on the consistency between pro-environmental attitudes and behaviour (Tarrant and Green 1999, p. 17-8; Thapa and Graefe 2003, p. 79-80). However, most studies found that environmental concern and pro-environmental behaviour were positively and more strongly associated with contemplative than extractive activities (Teisl and O'Brien 2003, p. 507-9; Thapa and Graefe 2003, p. 79-80). Thus, Teisl and O'Brien (2003) and Nord and colleagues (1998) found that bird watching was positively related to pro-environmental behaviour. Nord and colleagues (1998) also found a positive association between pro-environmental behaviour and visits to forest areas. Additionally, results indicate that the proximity with natural features is associated with more recreational activities in these areas as well as more concern when these features are at risk (e.g., Baptiste and Nordenstam 2009).

Regarding the relationship between landowners' outdoor activities and conservation management decisions, studies have usually found a positive association (Brook et al. 2003, p. 1639). Studies have also shown that personal recreational activities were among the land use priorities for the conserved land on the property (e.g., Williams et al. 2004; Serbruyns and Luyssaert 2006; Ernst and Wallace 2008). In New Zealand, Cocklin and Doorman (1994, p. 273) found that the majority of farmers owning native forest fragments stated that the recreational value of the remnant was important or very important. Furthermore, in another New Zealand study, Wilson

(1992) found that landowners who did not engage in recreational activities in their native forest fragments tended to have a more utilitarian view of native forest. Finally, a study by Vktersø and colleagues (1999) suggests that even negative interactions with the natural world may induce pro-environmental attitudes or a biospheric value orientation. In a study of Norwegian sheep farmers experiencing different degree of depredation by wild large carnivores (e.g., wolves), the authors found that, after statistically controlling for anticipated personal losses, farmers from the region with the highest depredation rate showed more positive value orientation toward the large carnivores than farmers from the low-loss region. The authors hypothesized that experience with the predators induced a more complex perception of the animals in farmers from the high-loss region, resulting in stronger perspective-taking and empathy (Vktersø et al. 1999).

3. Knowledge

a. Education

Individuals who have gone further in their schooling have been expected to be more knowledgeable about the natural environment and the impacts human beings exert on it, as well as being more able to tackle new information on such topics (Gould et al. 1989, p. 172; Smith et al. 2007, p. 36). Although greater levels of education have been associated with environmentally friendly attitudes (Bultena et al. 1981; Gould et al. 1989) and behaviour (Rahm and Huffman 1984; Lasley et al. 1990; Wilson 1996; Traore 1998), some studies have not found any significant relationships between these variables (Lasley et al. 1990; Cocklin and Doorman 1994; Fairweather and Campbell 2003; Winter et al. 2005; Schneider and Francis 2006; Stofferahn 2009).

b. Objective and subjective ecological knowledge

Ecological literacy or knowledge represents the sum of facts and understandings people have about environmental systems and environmental issues; ecological literacy is expected to positively correlate to a certain extent with level of education. Ecological knowledge should "[reduce] uncertainty which allows people to take actions" (Lantermann et al., 1992 in Kaiser and Fuhrer 2003, p 600-1). In support of this hypothesis, Hines and colleagues' (1987) meta-analysis of predictors of environmentally responsible behaviour indicated that ecological knowledge, as well as education were significant correlates of pro-environmental actions. However, in their own review of the social-psychological literature on the relationship between ecological literacy and environmentally friendly behaviour, Kaiser and Fuhrer (2003, p 600-1) argue that ecological knowledge is at best a moderate predictor of pro-environmental behaviour.

Research has demonstrated that farmers possess at least some ecological knowledge. For instance, Herzon and Mikk's (2007) study on Finnish and Estonian farmers' perceptions of biodiversity on the farm found that farmers had some understanding of ecological concepts. Moreover, most farmers in this study expressed the wish to learn more about wildlife (Herzon and Mikk 2007, p. 14-5). In New Zealand, Smith and colleagues (2007) found that farmers were well aware of environmental issues, notably on their land, and that conservation of native bush was associated with awareness of environmental issues on the farm (e.g. soil erosion). However, a recent report for the Parliamentary Commissioner for the Environment (PCE 2002) identified a lack of knowledge among the New Zealand public and specifically landowners about possible uses of native plants. It also showed that the public (including landowners) perceived a lack of the availability of information and guidance (PCE 2002, p. 28). Such a lack of information may be detrimental to conservation on private land as research suggests that farmers' sustainable actions are influenced by their knowledge (Rahman 2003; Schultz, 1964 in Paudel and Thapa 2004, p. 38; Salam and Koike 2005; see Ajayi 2007, p. 23; Wei et al. 2007). Similarly, exposure to information influences farmers' attitudes (Rhodes et al. 2002) and behaviour (McNally 2002). Specifically, McNally (2002) found that attending recent training courses in farming increased the chance that the farmer self-reports maintaining or enhancing biodiversity on the farm. Brook, Zint and De Young (2003) found that farmers were more likely to protect endangered species when information about the species has been relayed by 'important others' (family, friends, peers). In contrast, Herzon and Mikk (2007, p. 15-6) found that knowledge about wildlife was not associated with following a "special agri-environment agreement", but was positively related to interest and pro-environmental attitudes. This result is consistent with Lichtenberg and Zimmerman's (1999) findings, which showed that farmers preferred first-hand sources of information (field observations and pesticide labels) over information from institutions. Furthermore, the authors found that farmers who expressed the most environmental concern about the impacts of agriculture were those who relied the most on media as a source of information. However, in their study, media came overall as only third, out of four preferred sources of information (Lichtenberg and Zimmerman 1999).

As suggested by Kaiser and Fuhrer (2003, p 600-1) knowing about environmental processes or environmental issues is not necessarily a guarantee that farmers hold pro-environmental attitudes or engage in environmentally responsible behaviour. Weiss and colleagues (2006) found that, although farmers knew about pollution issues, they tended to perceive such issues to be outside their control (happening on other farms, or due to previous farmers' generations). Michel-Guillou and Moser (2006) found similar results in conventional farmers as opposed to farmers engaged in sustainable practices. It has been argued that people, including farmers, need to appropriate ecological knowledge in order to make it part of their belief system (Hungerford and Volk 1990 in Clayton and Myers 2009, p. 183). A study on predictors of environmental behaviour among five European countries showed that subjective (self-assessed knowledge level) and objective ecological knowledge (actual level of ecological literacy) significantly predicted pro-environmental behaviour in most countries (Levy-Leboyer et al. 1996). However, subjective and objective knowledge do not necessarily correspond (Levy-Leboyer et al. 1996; Clayton and Myers 2009, p. 184). Thus, confidence in one's knowledge (measured by the proxy: self-assessed knowledge level) may be as important as the level of objective knowledge in affecting attitudes and behaviour towards the natural environment.

4. Social influence of family and fellow farmers

Research has shown that an individual's attitudes and behaviour are influenced by his/her social surrounding (Burton 2004, p. 363-4; Albarracin et al. 2005, p. 15). 'Important others' like parents and peers (Fine 2005, p. 73) serve as referents to evaluate the soundness of one's decisions (Burton 2004, p. 363; Dietz et al. 2005, p. 363). The more those 'important others' act as referents for an individual, the more likely the individual's attitudes in line with the logic of these referents are to translate into behaviour (Vaughan and Hogg 2005, p. 111). The influence of 'important others', or social norms, can operate by observational learning (Vaughan and Hogg 2005, p. 113) as well as communication (Dietz et al. 2005, p. 363). Influence of such interactions is particularly highlighted in cultures where several generations cohabit under the same roof. In such instances, young and old are more likely to share similar environmental concerns (Sarigöllü 2009, p. 379). Similar intergenerational influence can be expected in the farming community where it is not uncommon for several generations to live together.

In a similar vein to the general public, research has shown that social norms are a particularly instrumental influence on farmers' management decisions (Michel-Guillou and Moser 2006; see Siebert et al. 2006, p. 327, 330; e.g., Stock 2007). Thus, on-farm conservation is more likely to occur when supported by 'important others' (Brook, Zint and De Young, 2003, p. 1640). In a study on sustainable lifestyle pioneers, Degenhardt (2002) found that participants referred to their close social environment (especially parents) as a cause for their pro-environmental attitudes. In particular, Brook, Zint and De Young (2003) found that the more information farmers received about endangered species from family, friends or neighbours the more likely they were to protect the species in question. Additionally, Michel-Guillou and Moser (2006, p. 234), in a study of French farmers' commitment to sustainable practices, suggested that participants engaged in sustainable practices more in search of social approval (in order to improve their public image) than out of environmental concern. On the other hand, the influence of family and peers can also be detrimental to on-farm conservation. Farm transfer is an important influence, if not the most important, in a farmer's general farm management orientations (Keating and Little 1991, p. 26; Eaton 1993; McCrostie Little and Taylor 1998; Siebert et al. 2006, p. 327). One of the great worries for the farmer faced with farm succession is to pass on to the next generation an economically viable property (Keating and Little 1991, p. 26; Eaton 1993; McCrostie Little and Taylor 1998; Siebert et al. 2006, p. 327). By putting land in covenant, the farmer may reduce the cultivable area that the next generation can inherit. Furthermore, this may be "interpreted by others as showing that the farmer has not fulfilled his or her obligations to the family and to widely held notions of tradition in the farming community" (Siebert et al. 2006, p. 327). The influence of peers is particularly strong in the farming community (Carr and Tait 1990 in Burton 2004, p. 364; Siebert et al. 2006, p. 330), where "[n]eighbours and colleagues are usually closely watched and their farming practices are continuously noticed and judged (Retter et al. 2002)" (Siebert et al. 2006, p. 330). Thus, farming neighbours have been found to influence farmers' behaviour towards biodiversity protection both positively (by showing a successful example) and negatively (encouraging disapproval to a conservation plan for individuals that were not a priori against it) (Siebert et al. 2006, p. 330).

5. Institutions

Information provided by government agencies on sustainable farming practices is usually valued by farmers (see Lichtenberg and Zimmerman 1999, p. 232; Smith et al. 2007) (but see e.g. the Salam and Koike 2005 study in Bangladesh for a counter example). Yet institutional information is usually not the favoured source of information regarding conservation management issues (see Lichtenberg and Zimmerman 1999, p. 232). New Zealand North Island hill country farmers in Smith and colleagues' study (2007) were an exception. There is also evidence that governmental agencies do not provide sufficient and/or useful information about conservation issues to farmers. Herzon and Mikk (2007) showed that farmers could not name biodiversity preserving or enhancing activities outside those already included in the agri-environmental schemes the farmers had entered. They also found no association between conservation programmes and farmers' knowledge about wildlife. Instead, participants' ecological knowledge was correlated with interest and pro-environmental attitudes (Herzon and Mikk 2007). A high proportion of New Zealand hill country farmers showed a lack in confidence in engaging in different sustainable practices, especially planting trees (Smith et al. 2007). These farmers also wished such agencies could provide the big picture into which their reserve would fit (Smith et al. 2007, p. 35). These results are in line with a New Zealand report from the Parliamentary Commissioner for the Environment (2002, p. 28) stating that a great number of submissions to an earlier draft of the report asked for "greater guidance, encouragement and support for landowners in relation to the establishment, regeneration, enhancement, use and overall management of native plant areas". Such demand was already suggested in Cocklin and Doorman's (1994) study of New Zealand farmers from the Rodney District (north of the North Island). Respondents indicated a lack of information on "mechanisms to encourage habitat protection" and the vast majority of farmers with forest covenants (far more than farmers without covenants) felt they were ill-informed about methods to protect native forest on private land (Cocklin and Doorman 1994, p. 276). Similarly, Jones and colleagues' (1995) study on farmers from the Franklin district (north of the North Island, New Zealand) highlighted participants' lack of knowledge regarding ways to protect wetlands on private lands. Respondents also predominantly reported unawareness regarding the District Council's ways of controlling and encouraging the protection of wetlands. Additionally, the majority of the landowners did not know that consents were required for transforming wetlands. Brook and colleagues (2003) also found that the majority of Colorado and Wyoming farmers they surveyed did not know whether their property was included in the protected areas for the Preble's meadow jumping mouse (an endemic species to the two U.S.A. states) or wrongly thought that their land was not within the protected areas.

Rural social-psychological research has shown that landholders cherish their independence (Ward and Lowe 1994, p.173; Wilcove et al. 1996 in Brook et al. 2003, p. 1639; Baptiste and Nordenstam 2009). Therefore, any institutional intervention that impedes farmers' freedom of actions is likely to dissuade them from entering a conservation programme (see Kabii and Horwitz 2006, p. 12). Thus, regulations are notable farmers' "bêtes noires" (Cocklin and Doorman 1994; Ward and Lowe 1994; Jones et al. 1995). Kabii and Horwitz argue that "landholders will only take up a conservation innovation when they understand it well, have confidence in it over other mechanisms, view it to be easy to implement and in accord with their goals and objectives for the land, and their reasoning is not unduly impeded by financial considerations" (Kabii and Horwitz 2006, p. 13) and "when they have a stake in the outcomes of conservation" (Klapproth and Johnson 2001 in Kabii and Horwitz 2006, p. 12). Additionally, experience has shown that rather than informational pamphlets, participatory projects where governmental consultants instructed and worked on site with farmers were successful ways of engaging farmers in new methods and practices (see Costanzo et al. 1986, p. 527). Management support services have also been demonstrated to improve the establishment of new practices (Gafsi and Brossier 1997). Finally, financial compensation for taking care of the natural environment is often sought by landowners (Cocklin and Doorman 1994; PCE 2002, p. 17; Herzon and Mikk 2007). However, studies have demonstrated that this is not necessarily the most efficient enticement. Erickson and colleagues (2002, p. 107) found that "receiving government compensation for retaining one's woodlots [...] was by far the least likely to motivate protection" in Michigan landowners. Other North American studies have found that although financial support attracted farmers to enter conservation programmes, positive attitudes towards conservation made farmers more likely to sustain their efforts (see Ahnström et al. 2008, p. 42). Clayton and Myers particularly warn about the size of the incentive:

> "overly large rewards for behavior can reduce the tendency to engage in the behavior when the reward is not present. People assume that the behavior must be unpleasant if such a large reward is needed. In addition, people's inferences about their own motivations are affected by the reward structure: if I have done something for which there is a large financial reward, I assume that I have

> engaged in the behavior in order to get the reward. If I have done something for which the reward is less substantial, I will be more mindful of the intrinsic reasons for the behavior, such as my own satisfaction in helping to protect the environment" (Clayton and Myers 2009, p. 149).

As an alternative to incentive, they argue for social approval:

> "Non-monetary incentives, such as social approval, may sometimes be more effective than monetary ones because they do not as clearly undermine the intrinsic reasons for the behavior; people do not tend to believe that they are recycling to get the approval of their neighbors, even if they are" (Clayton and Myers 2009, p. 149-50).

Overall, research suggests that information provided by governmental agencies regarding the conservation of the natural environment on private land is usually trusted by landowners, but there is compelling evidence that not enough and not the right kind of information is reaching farmers. Furthermore, institutions have to take into account the need for farmers to remain independent in their management decisions. The literature shows that governmental organizations may succeed in initiating change in farmers' behaviour towards conservation on-farm, but these organizations have been unable to deeply impact on farmers attitudes and, hence, in making durable changes.

IV. Conclusion

Pro-environmental attitudes are now widespread. Additionally, although attitudes influence behaviour, the relationship is moderate. Therefore, in order to understand better the pro-environmental attitudes of farmers and to improve the consistency between farmers' attitudes and behaviour towards nature, situational variables need to be taken into account. Rural environmental social-psychological research has in general found that situational variables have ambiguous effects on farmers' attitudes and behaviour. Results indicate that farmers' pro-environmental attitudes tend to be associated with organic farming, direct experience with nature (especially contemplative outdoor recreational activity), objective and self-assessed ecological literacy, and interactions with 'important others' (family, peers). On the other hand, farmers' pro-environmental behaviour tended to be related to age, objective and subjective knowledge, farm size, farm ownership status, non-livestock farming, organic farming, direct experience with nature and contemplative outdoor recreation, and finally, 'important others' and institutions.

The next chapter presents the sample and the stastical methods used for the present study. Then, from chapter 6 onward, the different theories and results reviewed in the three literature review chapters are put in practice.

Chapter 5: Research design

I. Introduction

This chapter presents the research design and the statistical methods used in the thesis. The first section of the chapter gives the timeline of the postal survey and introduces the farmers sample in more detail. The second section presents the variables at the core of this study. The final section reviews the statistical analysis tools that underlie this research.

II. Sample Design

1. What, when, where, who

a. The survey tool

Still today little is known about the actual components of conservation attitudes among farmers (Winter et al. 2005, p. 384). Moreover, situational variables commonly found in environmental social psychology literature have shown contradictory results (e.g. income) in sample of farmers, whereas other situational variables, while showing promising results (e.g., direct experience with nature), have seldomly been used in such samples (chapter 4). Such gaps in rural environmental social psychology called for an exploratory study on a large sample, and a postal survey emerged as the best research method to reach as many farmers as possible (Giddens 1997, p. 543-5). One of the great advantages of postal survey resides in allowing people to take part to the survey at their convenience (Bourque and Fielder 2003, p.12), which was particularly relevant for my target population. Furthermore, an anonymous postal survey may appear less frightening to respondents than face-to-face or phone interviews, thus, eliciting more honest answers from respondents, especially about sensitive topics (Bourque and Fielder 2003, p.14). Internet surveys were not considered because, although New Zealand farmers can have access to internet, I was not sure of the familiarity they had with the tool and the frequency at which they used it.

b. Timeline

The questionnaire on which this research is based was designed during the austral winter of 2004 and was tested on a sample of 12 experts (academics in ecology and agricultural sciences, and farmers) between the end of October and early November 2004. The pre-test survey led to some amendments of the questionnaire. By March 2005, a questionnaire of 18 pages and 82 questions was sent by post to 1799[1] farmers of two regions in the lower part of the North Island of New Zealand: the Manawatu-Wanganui and Wellington regions (Figures 5.1 and 5.2). This was followed by reminders sent in April (a letter only) and May (a letter with an additional copy of the questionnaire) 2005 to non-respondents.

[1] It was originally planned to send 1800 questionnaires but a mishap during the printing of the survey led to the removal of one survey.

Figure 5. 1 Map of the Manawatu-Wanganui region

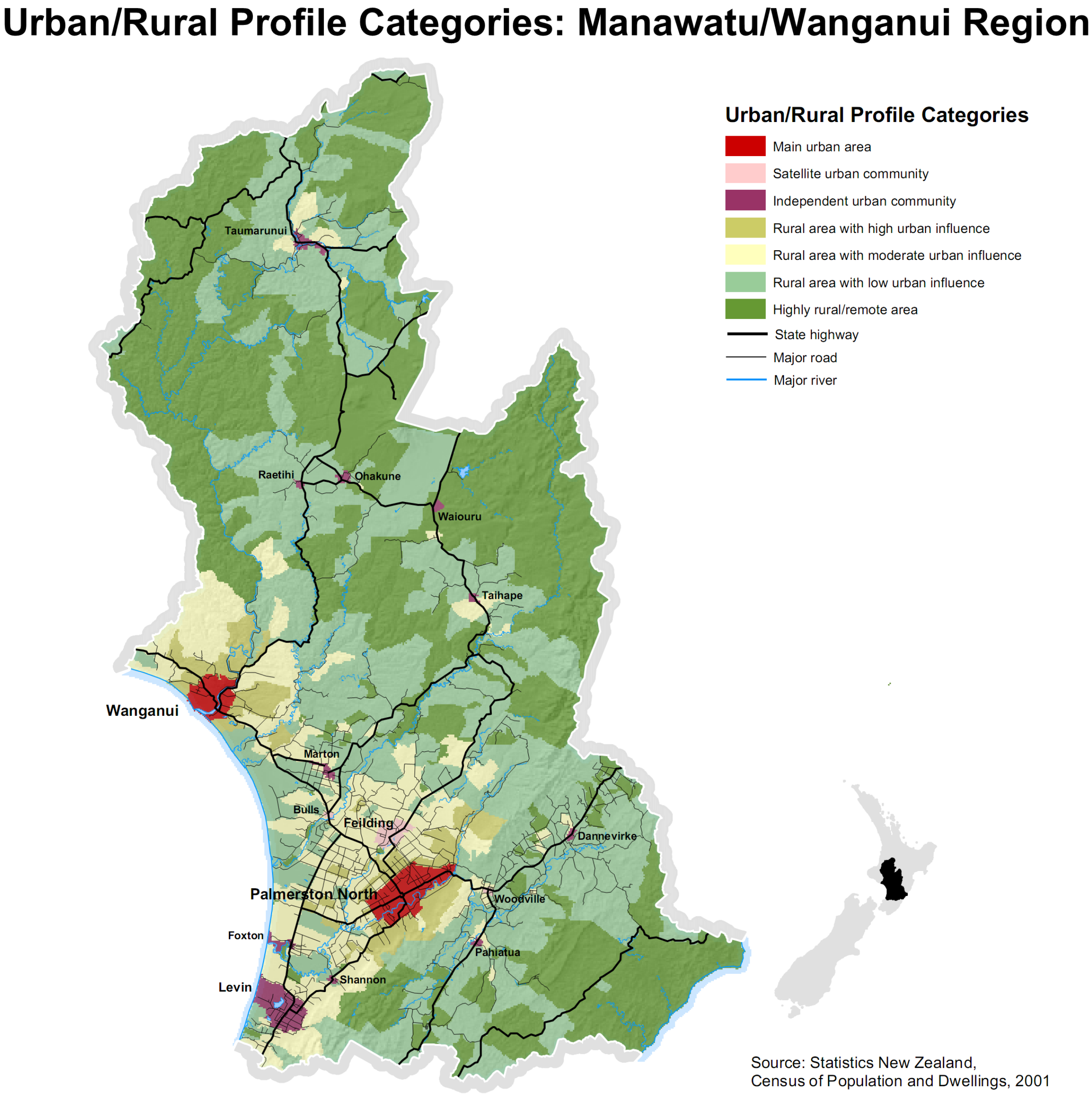
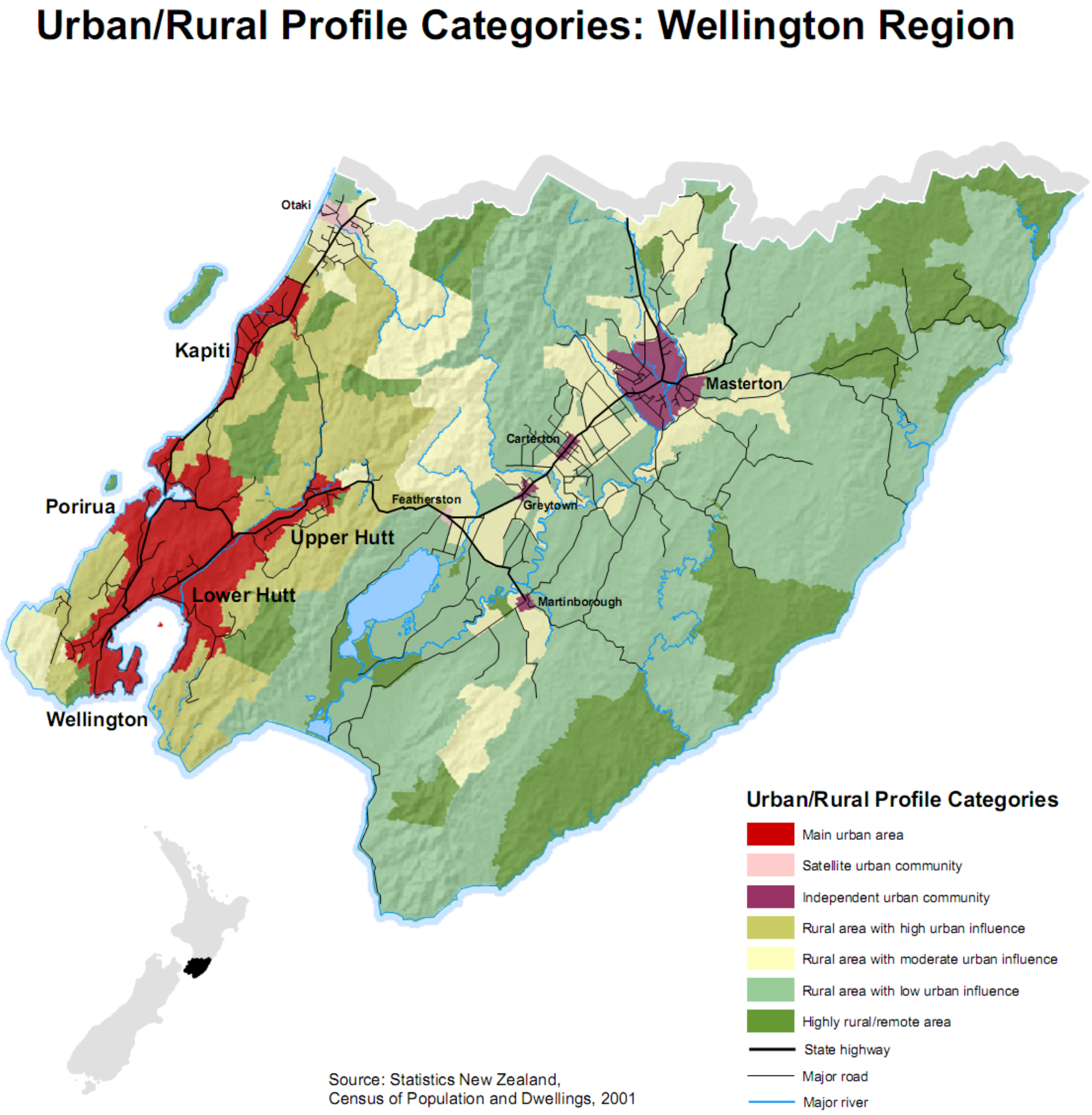


Figure 5. 2 Map of the Wellington region



c. Sampling

Farmers' contact details and information about their farms were obtained from a near-exhaustive survey conducted by AgriQuality six years prior to the present study. A random stratified sample was used: at least 25% of farmers in each of the main regional farm types, with and without native forest on their property and within the Manawatu-Wanganui and Wellington regions were randomly chosen from the AgriQuality database[2]. The three predominant farm types in the two regions and the country in terms

[2] The sampling categories correspond to farming type × presence/absence of native forest × region.

of land area and exports are meat (beef, sheep, beef and sheep, and to a lesser extent deer), dairy, and horticulture (Statistics New Zealand 2003a, Tables 2.03, 3.03; Richardson et al. 2004, p. 34). Because dairy and horticulture farming categories contained few candidates, they were oversampled to ensure they had sufficient statistical power compared to the more numerous category, meat farmers. Additionally, information about organic farmers was hard to obtain in the two regions: only 44 organic farmers were identified in total.[3] As their numbers were low, all organic farmers were included in the sample irrespective of their farming categories, whether or not they had native forest on their property, or the region their farm was based.

d. Response rate

After discarding the people wrongly targeted (wrong addresses, people who were no longer farming, and doubled-up questionnaires[4]), 859 valid completed questionnaires were received. This brought the total response rate to 53.7% of the active and contactable targeted farming community, which is a very satisfactory response rate for a farmer survey. Surveys of farmers can get as low as 12% response rate (Gamble et al. 2000 in Fairweather and Campbell 2003) and commonly get around 30%-40% response rate (Rhodes et al. 2002, p. 673; Fairweather and Campbell 2003; Winter 2005; Michel-Guillou and Moser 2006). Furthermore, Fairweather and Campbell (2003) have noted a decline in response rates to New Zealand farm surveys since the late 1970s – in line with an international trend (Rogelberg et al. 2001).

e. Sample used for the thesis

Out of the 859 valid questionnaires received, 806 were selected for the present research. In order to minimize inconsistency between respondents' attitudes and behaviour toward native forest on farms, the study was directed at the person in charge of the farm management decisions, which was specified in the cover letter as well as in the questionnaire instructions. Nevertheless, to further ensure that the person in charge of farm decisions was targeted, the power the respondent had over the farm

[3] Thanks to the Wellington and Manawatu-Wanganui Regional Councils.
[4] Farmers rather than farms were targeted, that is, although one farmer may own several farms, only one address per farmer's name was targeted and double-up questionnaires were eliminated from the sample.

management decisions was assessed via a five-point Likert-scale-like question. Respondents who had chosen the upper part of the scale[5] were selected, amounting to a total of 806 farmers.

Based on the farring population size in each region of study, 546 questionnaires were sent to farmers from the Wellington region and 1210 to farmers from the Manawatu-Wanganui region.[6] There was no difference in proportions of questionnaires sent back from each region ($\chi^2 = 0.364$, df = 1, p = 0.546). However, compared to the number of questionnaires sent to farmers with and without native forest, the proportions of respondents with and without native forest showed that the sample was biased towards farmers with native forest on their property in both regions and all farm types (Table 5.1). This bias may be due to the topic of the questionnaire. Although it was emphasized that the survey was aimed at farmers with and *without* native forest, farmers with native forest may have felt more comfortable or impelled to answer the survey than farmers without native forest.

Table 5. 1 Number of questionnaires per farm region, with and without native forest and per farm type that constitutes the analysis sample (N = 806).

Farm types	Wellington		Manawatu-Wanganui		Missing region	
	With Forest	No Forest	With Forest	No Forest	With Forest	No Forest
Meat	115	43	246	128	0	3
Dairy	20	13	48	46	0	0
Horticulture	7	7	2	12	1	1
Missing farm type	19	8	57	28	0	2

2. Characteristics and representativeness of the sample

a. Region

Overall, 71% of respondents came from the Manawatu-Wanganui Region. This proportion was similar to the actual proportion of agriculture and fishery workers in Manawatu-Wanganui region over the total of the two regions covered by our study:

[5] See question 69 in Appendix 0. The upper part of the scale corresponds to category 3 and above; with 5 meaning ‘total control’.
[6] 546 + 1210 = 1756. The remaining 44 respondents correspond to organic farmers, who were included in the sample irrespective of their farming categories, whether or not they had native forest on their property, or the region their farm was based.

Manawatu-Wanganui and Wellington (67.1%) (Statistics New Zealand 2001, Table 18).[7]

b. Sex

The majority of respondents were male (86.3%). The survey targeted the person in charge of decisions on the farm. There was no comparable data available in the reports of Statistics New Zealand on the country's farming population.

c. Ethnicity

The majority of respondents (93.2%) were Pakeha (New Zealanders of European descent), 2% defined themselves as Pakeha-Maori, and 1.1% as Maori. The proportion of Maori in the survey was in line with the proportion in the agriculture industry of Maori employers and self-employed without employees[8] (2.7%) (Statistics New Zealand 2001, Tables 15 and 15a).

d. Age

The average age of the thesis sample was between 40 and 49 years old, which was close to the average age in the Manawatu-Wanganui (40 years old) and the Wellington (39) regions, the North Island (40) and New Zealand in general (40) (Statistics New Zealand 2001, Table 43). However, again, there was no equivalent in the reports of Statistics New Zealand regarding the age of farm managers.

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[7] The Statistics New Zealand reports present compiled results from the most recent census of the agriculture sector at the time of our questionnaire. Such censuses typically target all the farming population of the country, as the 2002 report states: "The target population for the 2002 Agricultural Production Census was all units that were engaged in 'agricultural production activity' (…) with the intention of selling that production and/or which owned land that was intended for agricultural activity during the year ended 30 June 2002. The target population also includes businesses and persons commonly referred to as 'lifestylers' engaged in agricultural production activity" (Statistics New Zealand 2003a, p. 83). The 2002 New Zealand Statistics survey had a response rate of 81% (Statistics New Zealand 2003a, p. 84).

[8] These categories represent the closest categories to the population targeted for the thesis

e. Farming activity

The vast majority of respondents were farming full time (90.6%). There was no available data from the national census to compare with.

The proportions of each farm type in the sample were as follows: 77.3% of respondents were meat farmers, 18.4% dairy farmers, and 4.3% horticulture farmers. The percentage of the different farm types by region in the respondents' sample, and a comparison with data from the national census (Statistics New Zealand 2003b, Table Farms by Farm Type (ANZSIC) and Region) can be found in table 5.2.

Table 5. 2 Comparison of percentage of farm type per region of study found in the respondents sample and in the region census done by Statistics New Zealand (N = 806).

Region	Farm Types	Study sample	Regional population[a]
Manawatu-Wanganui	Meat	78.0%	61.6%
	Dairy	19.5%	17.2%
	Horticulture	3.0%	8.7%
Wellington	Meat	77.0%	46.6%
	Dairy	16.0%	11.2%
	Horticulture	7.0%	15.5%

[a]: The percentage for the regional population are from the 2003 national census (Statistics New Zealand 2003b, Table Farms by Farm Type (ANZSIC) and Region)

As stated earlier, all 44 registered organic farmers identified in the two regions were contacted. Overall, 37 respondents (4.6%) self-identified as organic farmers and 625 (78.4%) as conventional. However, 135 (16.9%) reported being both organic and conventional. This latter figure was unexpected, and suggests either that some people claimed to be organic without being associated with organic groups or without following recognised organic principles, or more people were registered organic than expected.[9] Unfortunately, the 2002 agriculture census provides only incomplete data on the number of farms, or hectares being fully organic or in transition towards being so (Statistics New Zealand 2003a), which prevented comparisons from being made with the study sample.

[9] These people may have become organic between the census and the present study, or not been captured by the previous surveys.

f. Farm size

In the sample, the median farm size from Wellington was 109.2 ha, and the median farm size from Manawatu-Wanganui was 125.6 ha. Both these numbers were larger than the regional medians, especially for the Wellington region (Wellington: between 20 and 39 ha; Manawatu-Wanganui: between 60 and 79 ha; Statistics New Zealand 2003c).

The median meat farm in the present study was 126.6 ha, the median dairy farm 125.4 ha, and the median horticulture farm 9.7 ha. The sample dairy and horticulture median farm size were comparable with the 2002 New Zealand Agriculture Production Census (dairy: between 100 and 199 ha; horticulture: between 5 and 9 ha). In contrast, the median meat producer respondent had a larger farm than the national median (between 60 and 79 ha) (Statistics New Zealand 2003d).[10]

Lifestyle blocks represented a relatively small proportion of the sample. Following the definition of the Ministry for the Environment (less than 10 ha; Ministry for the Environment 2000, p. 26), lifestyle blocks represented 10.9% of respondents; following the definition used by Cook and Fairweather (between 0.4 and 35 ha; Cook and Fairweather 2005, p. 6), lifestyle blocks corresponded to 22.8% of the sample.

g. Presence of native forest

About two thirds of the respondents had native forest on their farm (64%). Of the 515 respondents with native forest, 70% had fragments of more than 1 ha size. The average number of fragments of more than 1 ha was three. More respondents from the Wellington region had native forest than from the Manawatu-Wanganui region (69.4% and 62.1%, respectively; $\chi^2 = 3.843$, df = 1, p = 0.050). This was consistent with results from the 2002 New Zealand Agricultural Production Census (Statistics New Zealand 2003b, Table Hectares Used and Farms by Land Use by Region). In contrast, the present sample included more farmers with native forest than the regional proportion (38.4% of farms in Wellington had native forest, and 33.8% of Manawatu-Wanganui farms). As in the 2002 New Zealand Agricultural Production Census (Statistics New Zealand 2003b, Table Hectares and Farms by Land Use and Farm Type (ANZSIC)), dairy farms were found to have the least amount of native forest relative to the farm

[10] Census data was not available for farm size per farm type and region.

size. Meat and horticulture farms in the thesis sample showed a similar ratio of native forest area to the total farm area, whereas, nation-wide, horticulture farms tended to have more native forest per farm hectare.

h. Representativeness of the sample

To summarize, although the characteristics of the respondents in the present study were overall close to those of the Manawatu-Wanganui and Wellington regional and national farming population, the sample differed markedly from the New Zealand census in the proportion of farms with native forest, and the number and size of meat farms. The topic of the survey could explain such a bias. Although the cover letter as well as the questionnaire instructions stressed that both the answers of farmers with and without native forest on their farm were important for the survey, farmers with forest may have felt more concerned about the subject, while farmers without forest may have feared being judged for not having native forest. Therefore, the study represents a better picture of meat and dairy farms than horticulture farms, and farmers with rather than without native forest.

III. Description of the questionnaire

1. The psychological variables

Four groups of variables measured farmers' responses to the natural environment. Value-based environmental concerns (Schultz 2000; Schultz 2001) and a shortened version of the revised New Environmental Paradigm scale (Dunlap et al. 2000) assessed farmers' general attitudes towards the natural environment.[11] The tripartite attitude model (Rosenberg 1956; Maloney and Ward 1973; Maloney et al. 1975; Hilgard 1980), consisting of affective (feelings), cognitive (beliefs), and conative (behavioural intentions) dimensions, estimated farmers' attitudes towards New Zealand native forest. Finally, a group of questions adapted to the present study formed an ad hoc measure of farmers' behaviour towards the native forest. All attitudinal and behavioural variables were recoded for the analysis so that the higher the value, the more favourable the farmers' responses were toward the natural environment. The

[11] See Chapter 2 III 1 for a general review of Schultz' and the NEP scales and Chapter 7 and 8, respectively, for a description of the scales as used in this thesis.

different scales are described next. The code name and a brief description of each psychological variable can be found in Table 5.2. Variable code names appear in italics in the rest of the thesis. See Appendix 0 for a copy of the questionnaire.

Table 5. 3 List of the psychological variables with their code names and descriptions.

Variable Group	Variable sub-group	Variable name	Variable description
General attitude	**Value-based environmental concern**	*Egoistic*	concern for self in case of environmental problem
		Altruistic	concern for other human beings
		Biospheric	concern for all living beings
	Revised-NEP	*NEPEarthLimit*	"We are approaching the limit of the number of people the earth can support"
		NEPModify	"Humans have the right to modify the natural environment to suit their needs"
		NEPCope	"The balance of nature is strong enough to cope with the impacts of modern industrial nations"
		NEPNatLaw[a]	"Because of our special abilities, humans are **not** subject to the laws of nature as are other living" beings
		NEPCata:	"If things continue on their present course, we will soon experience a major ecological catastrophe"
Specific attitude	**Affect**	*EnjoyForest*	enjoy being in the native forest as an adult
		ChildEnjoyForest	enjoy being in the native forest as an child
		LikeDistrictForest	extent respondents like the district they live in (LikeDistrict) X percent of native forest in the respondent's district
	Cognition	*ForestNatural*	how much respondents perceived fragments of native forest on farms to be natural
		ForestUseful	evaluate native fragment on farm between "Useful for farming" and "Useless for farming"
		ForestBenefit	evaluate native fragment on farm between "Financial benefit" and "Financial cost"
		ForestDecline	extent loss of native forest is major environmental problem for New Zealand
		ForestHelpBird	extent native fragment on farm contribute to helping native bird populations' survival

[a]: The NEPNatLaw item was rephrased in a reversed form compared to the original version in order to have a balanced amount of pro- and anti-NEP worded items.

Table 5.3 (cont.) List of the psychological variables with their code names and descriptions.

Variable Group	Variable sub-group	Variable name	Variable description
Specific attitude	**Conation**	*Conservation*	what participation respondents would be willing to take regarding the protection of New Zealand's native forest
		Tree Planting	trees species (native, exotic, or both) respondents would plant if they were to plant trees for farming purposes
		More Forest	intention of having more forest on farm
		NoDecrease	intention of not decreasing the size of any of the farm native fragments
		Fence	intention of fencing off more native forest on farm
		Control	intention of controlling against pests/weeds on any of the fragment on farm
		Inventory	intention of having an ecological inventory of any of the fragment on farm
		Protection	intention of legally protecting any of the fragment on farm
Behaviour	**Behaviour**	*BSizeChange*	change in size over the 10 years prior to the time of the survey
		BFenced	percentage of each fragment's fenced-off area
		BControl	If fragments were controlled against pests or weeds
		BInventory	If fragments' fauna or flora had been inventoried since the respondent had been running the farm
		Bprotection	If fragments were legally protected

a. General environmental attitude: Value-based environmental concerns

The value-based environmental concerns question asked respondents to indicate how concerned they would be for themselves (egoistic environmental concern), other human beings (altruistic) and non-human living beings (biospheric) in the face of environmental problems. Each environmental concern was evaluated through four related objects of concern. The question (Appendix 0, question 4) followed the same wording as used by Schultz (Schultz 2000; Schultz 2001), with the exception of the range of the rating scales. Originally the question used seven-point rating scales.

However, in order to be consistent with the majority of the other questions in the survey, Schultz' scales were rated from 1 to 5 in this questionnaire.

b. General environmental attitude: revised New Environmental Paradigm scale

An abbreviated version of the revised New Environmental Paradigm (NEP) scale was used (Appendix 0, question 5). The five sets of beliefs (the reality of limits to growth, antianthropocentrism, the fragility of nature's balance, rejection of exemptionalism and the possibility of an ecocrisis) covered in the full revised-NEP scale remained, but instead of three statements per set of beliefs, only one was chosen. The statement chosen best represented the set of beliefs it belonged to and was the least prone to ambiguous interpretation.[12] Three of the five statements were worded in order to present an anti-NEP position, and two statements were pro-NEP. Respondents expressed their agreement on a Likert-scale (strongly agree, agree, unsure, disagree and strongly disagree). For the analysis, the rating for the anti-NEP statements were reversed and all the ratings were recoded from 1 (strongly disagree) to 5 (strongly agree).

c. Specific tripartite attitude: *Affect* variables

EnjoyForest and *ChildEnjoyForest* (Appendix 0, questions 8 and 33) were five-point Likert-like scales evaluating how much respondents 'enjoy being in the native forest' as an adult, and when they were a child. Additionally, the extent respondents liked their district, depending on the amount of native forest present in the district (*LikeDistrictForest*), was estimated retrospectively based on the question *LikeDistrict* and the amount of native forest on farms over the respondents' district. *LikeDistrict* (Appendix 0, question 82) was a five-point Likert-like scale measuring the extent respondents liked the district they lived in. This variable was regressed on the percentage of native vegetation present on farms over the respondents' whole district

[12] See Chapter 8 for a discussion on the use of an abbreviated form of the NEP scale.

(Statistics New Zealand 2003a, p. 11-12).[13] See Chapter 9 for the analysis of *LikeDistrictForest*.

d. Specific tripartite attitude: Cognition variables

The five cognitive variables were formulated as five-point Likert-like scales. *ForestNatural* (Appendix 0, question 7) asked how much respondents perceived fragments of native forest on farms to be natural. *ForestUseful* and *ForestBenefit* (Appendix 0, question 9) were two components of the same question and asked farmers how they would evaluate native fragments on the farm on a five-point scale between "Useful for farming" and "Useless for farming", and "Financial benefit" and "Financial cost", respectively. *ForestDecline* (Appendix 0, question 10) was part of a four-item question listing possible environmental issues for New Zealand and asking respondents to rate the importance of these issues for the New Zealand environment. *ForestDecline* specifically concerns the loss of New Zealand native forest. Finally, *ForestHelpBird* (Appendix 0, question 11) asked farmers to grade the contribution of native forest fragments on the farm in helping the survival of native bird populations.

e. Specific tripartite attitude: *Conation* variables

Three questions were put to all farmers to measure their behavioural intentions toward native forest in general. The first of these questions, referred to in this thesis as *Conservation* (Appendix 0, question 12), asked what kind of action respondents would be willing to take regarding the protection of New Zealand's native forest. It offered four possible actions (including no participation) coded from 1 to 4, with 4 representing the most demanding action (active participation and financial donation). While that question gave a general view of farmers' positions regarding the protection of New Zealand indigenous forest, the subsequent questions applied particularly to the farming environment. The second question, called *TreePlanting* (Appendix 0, question 44),

[13] The amount of native forest on farms per district was estimated by summing the amount of "mature native bush" and "native scrub and regenerating native bush" in each district (Statistics New Zealand 2003a, p. 11-12). The districts' total land areas were found on the New Zealand Department of Internal Affairs website (Department of Internal Affairs). According to the data gathered from the agriculture census (Statistics New Zealand 2003a) and the New Zealand Department of Internal Affairs website (The Department of Internal Affairs), on average, 60% of the area of the districts targeted by the present study was used for agricultural production.

enquired about the tree species respondents would plant if they were to plant trees for farming purposes (exotic, both exotic and native, or native, coded 1, 2, 3, respectively). Finally, the last question (Appendix 0, question 27) asked respondents if, in the next five years following the reception of the questionnaire, they intended to have (more) native forest on their farm (*MoreForest*; intention of having more native forest coded '1'). The time context of this question was assumed to help respondents projecting themselves in a more tangible situation, hence reducing the risk of socially desirable answers.[14] This last question was included in a group of six (Appendix 0, question 27). The five others in the group were only addressed to farmers with native forest fragments on their property as they referred to intentions in the management of such fragment(s) over the next five years. These binary (0, 1) questions asked if the respondents had the intention of: decreasing the size of any of the fragments (*NoDecrease*; with intention of *not* decreasing coded '1'), fencing off more native forest (*Fence*; intention of fencing coded '1'), controlling against pests/weeds on any of the fragments (*Control*; intention of controlling coded '1'), having an ecological inventory of any of the fragments (*Inventory*; intention of inventory coded '1'), and finally legally protecting any of the fragments (*Protection*; intention of protection coded '1').

f. Behaviour variables

Farmers with native forest fragments were asked six questions regarding the fragments' features and management. The behaviour questions focused on the (at most) three largest fragments farmers had on their farm. On average, respondents with native forest on their farm had around three native fragments of more than 1 ha; therefore, by concentrating on the three largest fragments, a high proportion of native forest on the farms was covered.

Respondents were asked about the possible change in size in the fragments over the 10 years prior to the time of our survey (*BSizeChange*) (Appendix 0, question 19). This question had three categories: 'decreased', 'no change', and 'increased', respectively coded as -1, 0, 1, with answers summed over up to three fragments. All negative sums were recoded '-1' (more decreases occurred than increases), the positive sums were recoded '+1' (more increases occurred than decreases), and the null sums were left as they were (no change in fragments' size occurred overall). Farmers were

[14] Social desirability "refers to the tendency of some people to respond to items more as a result of their social acceptability than their true feelings" (Podsakoff et al. 2003, p. 882).

asked the percentage of each fragment's fenced-off area (*BFenced*) (Appendix 0, question 20). *BFenced* was an average over the fragments, categorised as follows, with x being the ratio of fenced area to the total fragment's area:

$x \leq 1/3$	=> coded '0'
$1/3 < x < 2/3$	=> coded '1'
$x \geq 2/3$	=> coded '2'

Respondents were then asked if the fragments were controlled against pests or weeds (*BControl*) (Appendix 0, question 21), whether the fragments' fauna or flora had been inventoried since the respondent had been running the farm (*BInventory*) (Appendix 0, question 23), and whether the fragments were legally protected (*BProtection*) (Appendix 0, question 24). These last three variables were averaged over the fragments, and these averages were then coded into binary answers: an average value greater than or equal to 0.5 corresponded to 'yes', coded '1'; an average value less than 0.5 corresponded to 'no', coded '0'.

Questions were worded to minimize the likelihood of the respondents not answering or feeling that their answers presented them in a negative light, which may encourage a social desirability bias.[15] Such indirect wording was possible because, ultimately, the respondent had chosen the farm. The questions referred to behaviours whose results could be associated with the respondent, either because the respondent had been performing such behaviours or, being the main decision-maker of the farm management, the respondent agreed with the behaviours. The *BProtection* question is a good illustration: because of the management constraints legal protection of native forest fragments imposes on farmers and the irrevocability of such a process, the result for the farmer is the same whether or not he/she started the protection process him/herself. Regarding flora and/or fauna inventories of the fragments, such inventories are usually done by governmental agencies such as the Department of Conservation (DOC), not by the farmers. However, as such an inventory would have needed the authorization of the respondent, its occurrence could be taken as a positive behaviour by the farmer toward the native forest. Furthermore, it showed a certain interest from the respondent in knowing more about the fragments. The question *BSizeChange* was the only one not following exactly the same logic. For the sake of fragments' size comparison, a time frame had to be specified. Because the management of farms'

[15] Social desirability refers "to the tendency of some people to respond to items more as a result of their social acceptability than their true feelings" (Podsakoff, MacKenzie et al. 2003, p. 882).

natural features is not a fast process, a period of 10 years prior to the reception of the questionnaire was chosen as the threshold. Therefore, when this question was included in the analysis, only the answers of respondents who had been running the farm for at least 10 years were analyzed.

2. The situational variables

This section describes the situational questions. These variables are used as predictors of New Zealand native forest presence on farms (Chapter 6), moderators of farmers' pro-environmental attitudes (Chapter 11) and of the pro-environmental attitude-behaviour relationship (Chapter 12). For the exact wording of each question, please refer to Appendix 0.

a. Socio-demographic questions: respondents' and farm's characteristics

The socio-demographic variables covered the respondents' age, the number of years they had been farming in general and farming on the farm targeted by the survey, the average farm income before tax over the 10-year period before the survey, the size of the farm, the percentage of the farm product that was exported overseas, the respondents' predominant type of farming, whether farming was undertaken following organic principles, the region where the farm was located, whether respondents owned most of the farm, whether they inherited the farm, whether they intended to pass it on to one of their family members, and whether they intended to quit farming in the near future (other than for retirement).[16]

b. Direct experience with nature: recreational activities and direct encounters with New Zealand native forest

The outdoor recreational activities included measures of the frequency with which respondents went fishing and/or hunting, took a short walk and/or went tramping,

[16]The corresponding socio-demographic questions in the survey were: questions 60, 65, 67, 79, 73, 80, 74, 78, the region was known thanks to the questionnaire number, 70, 71, 70, 72.

and observed nature for recreational purposes. Farmers' direct encounters with New Zealand native forest were assessed by the frequency with which respondents went into the native forest, used resources from the native forest, and finally the frequency at which they went into the native forest as a child.[17]

c. Knowledge

Farmers' objective knowledge was assessed, directly, by a measure of their ecological knowledge, and indirectly by the educational level of the respondents. The measure of respondents ecological knowledge was based on Morrone and colleagues' scale (Morrone et al. 2001). Farmers' subjective knowledge, i.e., the confidence they have in their knowledge, was evaluated by enquiring how knowledgeable they felt about general environmental issues and about costs and benefits associated with native forest on farms, and whether they had learnt to identify New Zealand native animals or plants. For the prediction of presence of native forest on farms, in Chapter 6, respondents were also asked to identify their main source of knowledge regarding the costs and benefits of native forest on farms.[18]

d. Social influences (including institutions)

Social influences were measured through questions about respondents' parents, their regional council and fellow farmers. Respondents were asked whether their parents were farmers and had had native forest on their property, and they were also asked to rate the environmental concern of their parents. Farmers were then asked whether their children and partner, when they had some, were involved on a regular basis in the running of the farm, how often they talked about environmental issues with members of their household as well as with other farmers, and how often these discussions helped them in decision-making. Finally, respondents were asked to rate how much they thought their regional council encouraged farmers to look after native forest fragments. Again, for the analysis of the presence of native forest on farms (Chapter 6),

[17] The corresponding direct experience with nature questions were: 1, 2, 3, 32.
[18] The corresponding knowledge questions were: 43, 46, 48 to 58, 63, 41, 13, 45, 14.

respondents chose from a list the services they would like their regional council to provide them with.[19]

e. Native forest fragments features

This group of variables was only used in the analysis of the pro-environmental attitude-behaviour relationship in farmers with native forest fragments on their property (Chapter 12). Farmers were asked to indicate the number of native forest fragments on the farm, the areas of their largest fragments (a maximum of three, from which the proportion of farm area covered by native forest was estimated), and finally whether these fragments were on slopes of 30° or more.[20]

3. Issues with the variables

a. Variable distribution

Variables' distributions and crosstabulations were examined in SPSS 17.0.[21] The *affect* and *cognition* indicators had very similar variance, except for the variable *LikeDistrictForest*. To achieve the same range of variance, the weight variable (percentage of native forest in the district) was divided by 10. None of the variables had a skewness of 2.0 or greater or a kurtosis of 7.0 or greater (Curran et al. 1996, p. 20, 26). On the other hand, crosstabulations showed that all variables had combinations with one or more variables resulting in empty cells. To remedy these empty cells, some categories were collapsed (Table A5.1). None of the variables with collapsed categories exceeded the 2.0 skewness or 7.0 kurtosis thresholds.

b. Missing values

Almost all variables in the sample contained some missing values.

[19] The corresponding social influences questions were: 30, 28, 31, 34, 35, 37, 36, 38, 13, 16.
[20] The corresponding social influences questions were: 17, 18, 22.
[21] Most of the study variables are ordinal, and SPSS does not model such variables by underlying continuous, normally distributed variables, as Mplus does. Yet treating these variables as continuous in SPSS gave rough but valuable estimations of distribution statistics to gauge difficulties the continuous latent responses underlying the observed variables may encounter in the Mplus factor analyses.

The analysis tool (the weighted least squares mean- and variance-adjusted estimator) used in Mplus software (Muthén and Muthén 1998-2007) relied by default on pairwise deletion for the psychological variables and listwise deletion for the situational variables. In order to avoid losing large amounts of data by listwise deletion, the situational variables were imputed using the multiple imputation technique.[22]

The situational variables were separately imputed via multiple regression using variables found to be associated with the situational variables. Associations were identified by estimating correlations between the situational variables and between the situational and psychological variables with the software Mplus 5.21. Mplus 5.21 was used because of its capacity for computing polychoric correlations between non-continuous variables. Using SPSS 17.0, forty variables were imputed and seven imputed datasets were produced in total.

IV. Statistical methods

Farmers' attitudes and behaviour were assessed using factor analysis techniques. General attitudes were estimated using exploratory and confirmatory factor analysis. Specific attitudes towards New Zealand native forest were evaluated through exploratory structural equation modeling and confirmatory factor analysis. The relationship between farmers' general and specific attitudes and between farmers' attitudes and behaviour were estimated via structural equation modeling. Finally, the effects of the situational variables on the psychological variables were also examined through structural equation modeling. Comparisons between the attitudes of the different samples of New Zealand farmers were made using Multiple Indicators Multiple Causes (MIMIC) analysis. Finally, the internal consistency of the different scales were assessed using Cronbach's alpha and the average inter-item correlation. These various statistical tools are reviewed next.

[22] See Appendix A5, section III.3.b. for more details about the different techniques available to deal with missing data.

1. Factor analysis

a. The classical common factor model

Based on the correlation or covariance matrix, factor analysis enables the researcher to assess how the variables relate to each other in defining more general, underlying concepts. Such underlying concepts are referred to as latent (unobserved), common factors (e.g., Muthén and Muthén 1998-2007; Kline 2005; Brown 2006), or trait factors (Campbell and Fiske 1959; Kline 2005; Brown 2006).

Based on Spearman's (1904; 1927) seminal work on factor analysis (Harman 1976, p. 3-4; Fabrigar et al. 1999), the classical Thurstonian common factor analysis model defines the relationships between a set of p observed variables y and m latent continuous factors θ (with p>m) by multiple linear regression functions (Thurstone 1947 in Mislevy 1986, p.3; Fabrigar et al. 1999, p.275; Brown 2006, p. 13), such as:

$$
\begin{gathered}
y_1 = \lambda_{11}\theta_1 + \ldots + \lambda_{1m}\theta_m + \varepsilon_1 \\
y_2 = \lambda_{21}\theta_1 + \ldots + \lambda_{2m}\theta_m + \varepsilon_2 \\
\vdots \\
y_p = \lambda_{p1}\theta_1 + \ldots + \lambda_{pm}\theta_m + \varepsilon_p
\end{gathered}
$$

It is assumed that these continuous latent variables (common factors) account for the relationships between the p observed variables, which are also called indicators (Brown 2006, p. 13), manifest or outcome variables (Muthén and Muthén 1998-2007), and that the residuals, or error terms ε are uncorrelated (Mislevy 1986, p. 5).

Thus, the two main goals of factor analysis are to find (1) the number of factors underlying the relationship between the manifest (observed) variables and (2) the regression coefficients of the observed variables on the factors so that the discrepancy between the observed and the model correlation/covariance matrices is minimized (Mislevy 1986, p. 3, 7).[23]

[23] See Appendix A5, section IV.1.a and b for more details on factor analysis of continuous variables based on the maximum likelihood estimation and the issues when the data are categorical.

b. The factor analysis techniques used in the study

Farmers' environmental attitudes and behaviour were estimated using exploratory and confirmatory factor analysis, exploratory structural equation modeling and structural equation modeling, via the weighted least squares mean- and variance-adjusted (WLSMV) estimator[24] (Muthén and Muthén 1998-2007) in the Mplus 5.21 software (Muthén and Muthén 1998-2007).

i. EFA and CFA

Exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) are both based on the common factor model (Brown 2006, p. 14). As they measure the relationship between observed variables and latent factors, they are also referred to as 'measurement models' (Kline 2005, p. 71; Brown 2006, p. 1). However, the two techniques serve different purposes. Typically, EFA is used when one wants to explore the relationships between manifest variables without any preconceptions, whereas CFA is used when one wants to test already theoretically formulated models (e.g., Albright 2006, p. 2; Brown 2006, chapter 2). As Brown (2006, p. 42-3) explains: "all indicators in EFA freely load on all factors and the solution is rotated to maximize the magnitude of primary loadings and minimize the magnitude of cross-loadings. […] [R]otation is not necessary in CFA because the simple structure is obtained by specifying indicators to load [usually] on just one factor". Hence, CFA models are usually more parsimonious than EFA models. Both methods can be used to validate models, in CFA one has access to statistical tools to test the significance of differences between nested models as well as between groups of respondents (Brown 2006, p. 42).

ii. SEM and ESEM

Structural equation modeling (SEM) is an extension of the common factor model as it is composed of (1) a measurement component (CFA), that is, the relationship between observed variables and the latent variables underlying them, as well as (2) a structural component (path analysis), that is, the causation links between

[24] See Appendix A5, section IV.1. b for more details on the estimator WLSMV in Mplus 5.21.

latent variables (Kline 2005).[25] Following the notation in Jöreskog's paper (1994, p. 298), the linear structural relation is defined as follows:

$$\eta = B\eta + \Gamma\xi + \zeta$$

where $\eta = (\eta_1, \eta_2, ..., \eta_m)$ and $\xi = (\xi_1, \xi_2, ..., \xi_n)$ are random vectors of latent dependent and independent variables, respectively, $B(m \times m)$ and $\Gamma(m \times n)$ are coefficient matrices and $\zeta = (\zeta_1, \zeta_{2,} ..., \zeta_m)$ is a random vector of residuals (errors in equations, random disturbance terms).

Classically, SEM models, via their CFA component, are used to assess the validity of an a priori model (most often theoretically based), where outcome variables are often constrained to depend on only one latent factor (Kline 2005, p. 166-7).[26] However, such constrained models rarely render reality. The *affect* and *cognition* dimensions in the specific tripartite attitude model can be hard to distinguish, especially by postal surveys (Ajzen 1988, p.21; Morris et al. 2002). Therefore, a more appropriate method than SEM to assess if *affect* and *cognition* are indeed two distinct factors would be one that would allow the hypothesized *affect* and *cognition* indicators to load freely on two factors – hence, validating or invalidating the presence of an *affect* and a *cognition* factor – while still allowing these two factors to predict *conation*, as postulated by the tripartite model.

Exploratory Structural Equation Modeling (ESEM), recently developed by Asparouhov and Muthen (2008), allows such estimations. As the measurement component of ESEM is based on exploratory factor analysis (as opposed to confirmatory analysis in SEM), it allows observed variables to load freely on all latent factors, therefore resulting in estimations closer to reality. Additionally, SEM structure

[25] See Appendix A5, section IV.1.b.ii for a discussion on causation in SEM (regression versus correlation).

[26] When variables are constrained to depend on only one latent factor, it is called 'unidimensional measurement'. 'Multidimensional measurement' is when an indicator loads on different factors and/or its error term correlates with the error term of another indicator (Kline 2005, p. 166-7).

(causal paths) can still be modelled between factors.[27] By default, ESEM in Mplus uses oblique Geomin rotation (where the factors are assumed to be correlated).[28]

2. MIMIC analysis

To compare the environmental attitudes and behaviour of the samples of farmers with native forest by chance and farmers with native forest by choice, a Multiple Indicators Multiple Causes (MIMIC) analysis was used (Jöreskog and Goldberger 1975; Muthén 1989).[29]

MIMIC analysis assesses the effects of one or more covariates[30] on the latent factors and factors' indicators. A significant effect of the grouping variable on an indicator implies that, for equal value on the latent factor, groups differ in their average agreement with the item (measurement noninvariance, also referred to as differential item functioning, DIF). On the other hand, a significant effect of the grouping variable on the latent factor indicates that the different groups display different strength (level) on the latent dimension after all differences on the indicators has been taken into account (population heterogeneity). Contrary to Multiple-group analysis, MIMIC analyzes differences between groups using only one covariance matrix that includes the grouping variables (Multiple-group analysis requires a different dataset for each group). This implies that MIMIC analysis is more parsimonious (requires estimation of fewer parameters), deals more easily with several covariates, and can function on smaller sample sizes.[31]

Following stepwise forward protocol (Muthén 1989, p. 563-4; Hagtvet and Sipos 2004, p. 53; Brown 2006, p. 315-6), direct paths from the grouping variable to the latent factors were specified, while the direct effects of the grouping variable on the

[27] As in classical SEM, causal paths can also be modelled between factors, observed variables and/or between factors and observed variables, e.g. covariates (observed variables external to the latent model), model constraints can be specified, thus method bias (correlated residual errors) can be assessed, and multiple group comparisons, undertaken (Asparouhov and Muthén 2008, p. 4).
[28] 'Target' rotation is also available (Asparouhov and Muthén 2008, p.16). The target rotation enables the researcher to suggest the loadings of some variables, typically zero loadings, in order to help in the process of convergence. These loadings are not fixed however, and can end up very far from their suggested values if the model does not fit the data (Asparouhov and Muthén 2008, p. 20).
[29] To distinguish these two groups the grouping variable *ForestInfluence* was used as it indicates whether farmers had chosen to have native forest on their farm.
[30] These are also referred as grouping variables.
[31] However, MIMIC only identifies two sources of invariance (indicator intercepts, latent factor means) (Brown 2006, p. 304-6) as opposed to Multiple-group analysis.

attitudinal indicators were constrained at zero. Estimating all the direct effects of the grouping variable on the indicators at once would result in underidentification of the model. Instead, Mplus provides modification indices that indicate the change in model fit if these parameters were freely estimated (Muthén 1998-2004, p. 24; Gomez and Vance 2008, p. 960). If modification indices ≥ 4, corresponding direct effects of the covariate on indicators would then be specified (Brown 2006, p. 122), and the model parameters re-estimated.

3. Model fit indices

The acceptance or rejection of a model in factor analysis and SEM is based on the overall goodness-of-fit and on the significance and meaning of the parameter estimates (Brown 2006, p. 145-146). One is advised to report χ^2 (chi-square), the Steiger–Lind root mean square error of approximation (RMSEA; Steiger, 1990), the Bentler comparative fit index (CFI; Bentler, 1990), the Tucker–Lewis index (TLI; Tucker & Lewis, 1973) (Kline 2005, p. 134; Brown 2006, p.81-86), as well as the weighted root mean square residual (WRMR; Muthén and Muthén 1998-2007), and the standardized root mean square residual (SRMR) (Muthén 1998-2004, p. 23-24; Yu 2002). The different indices of overall goodness-of-fit are reviewed next.

The value of chi-square (χ^2) represents the amount of discrepancy between the model covariance/correlation matrices and the data, while the probability associated with the measure of chi-square indicates the significance of the amount of discrepancy. Therefore, a non-significant chi-square would indicate a good fit. However, chi-square is very sensitive to the complexity of the model (the more complex the model the more chance of accepting the model, or type-I error), the sample size (the bigger the sample, the more chance of rejecting the model because of inflated chi-square, type-II error), the size of the correlations (the bigger the correlations, the more chance of rejecting the model, type-II error) and the violation of the assumption of multivariate normality (departure from normality causes inflated chi-square, therefore type-II error). Therefore, one is advised to rely on other goodness-of-fit statistics as well (e.g., Breckler 1984; Byrne 2001; Schultz 2001; Kline 2005, p. 134-41; Brown 2006, p. 81-6; Chia 2007).

The fit indices commonly used in the SEM literature (Breckler 1984; Muthén and Muthén 1998-2007; Byrne 2001; Schultz 2001; Brown 2006, p. 81-6; Chia 2007) are RMSEA, CFI, TLI, SRMR and WRMR. RMSEA "takes into account the error of approximation in the population" (Byrne 2001, p. 84). The smaller the RMSEA value the greater fit of the model to the data. Thus, values greater than 0.1 indicate poor fit, while values between 0.08 and 0.05 indicate reasonable fit (Byrne 2001). Hu and Bentler (1999), whose cut-off values for ML-based fit indices are usually endorsed by the literature, advise an RMSEA of $\leq$ 0.06. CFI gives an indication of the improvement in the specified model compared to the independent model, where all the variables are independent from each other (the correlations equal zero) (Breckler 1984; Byrne 2001; Chia 2007). CFI takes into account the sample size (Byrne 2001). A value of 1 indicates a perfect fit and a value of 0.95 and above are assumed to indicate a well-fitting model (Breckler 1984; Hu and Bentler 1999; Byrne 2001; Schultz 2001; Arbuckle 2003). TLI is comparable to CFI but considers the parsimony of the model by taking into account the degrees of freedom (Brown 2006, p.85). The same thresholds as for CFI are advised for TLI (Breckler 1984; Hu and Bentler 1999; Byrne 2001; Schultz 2001; Arbuckle 2003). SRMR represents "the average discrepancy between the correlations observed in the input matrix and the correlations predicted by the model" (Brown 2006, p. 82). Hu and Bentler (1999) recommend a SRMR $\leq$ 0.08. WRMR is similar but is preferable to SRMR when ordinal or binary variables are used (Muthén 1998-2004, p. 23-24; Yu 2002). WRMR was not reviewed by Hu and Bentler (1999) since it has only been implemented recently in the Mplus software (Muthén and Muthén 1998-2007). To my knowledge, only Yu's (2002) dissertation has investigated the performance of such an index fit with the WLSMV-based and ML-based factor analysis.[32] With severely non-normal variables, and for N = 250, Yu found that the Santorra-Bentler-based CFI was reliable at a cut-off value of 0.95 and SRMR, at 0.07[33]. For binary outcome variables, SRMR was not reliable, whereas acceptable cut-off values for CFI, RMSEA and WRMR were, respectively, equal or greater than 0.96, equal or lesser than 0.05 and equal or lesser than 1.0 (Yu 2002, p. 157-8).

In view of Hu and Bentler's (1999) and Yu's (2002) results, and because most of our variables were ordinal rather than binary, models were ***rejected*** if CFI/TLI <0.95,

[32] However, it is worth noting that Yu only investigated the behaviour of such fit indexes on WLSMV analysis of binary variables.

[33] "Simulation studies in Yu and Muthén (2001) suggest that [Hu and Bentler's (1999) cut off values] are reasonable also with categorical outcomes, except that the SRMR cut off of 0.08 does not work well with small sample size ($\leq$ 250)" (Muthén 1998-2004, p. 24).

RMSEA>0.06, WRMR $\geq$ 1.0. Models within the acceptable range of these fit indexes and with a robust χ^2 p value $\geq$ 0.05 would be preferred to models with a significant χ^2 p value.[34] Parameter estimates were reported significant when the associated p value was $\leq$ 0.1.

4. Internal consistency

Following Clark and Watson (1995), the internal consistency of the different psychological scales was estimated using Cronbach's alpha and the average inter-item correlation. The purpose of the internal consistency index is to indicate the extent to which the scale's items are correlated to one another (Clark and Watson 1995, p. 315). The rule of thumb is that an alpha of 0.7 and above indicates a good scale reliability (Field 2005, p. 668). However, Clark and Watson (1995, p. 315) note that there are "no longer any clear standards regarding what level of reliability is considered acceptable". Mueller (1986 in Milfont 2007, p. 84) suggested that "for samples larger than 100, Cronbach's alpha coefficients greater than 0.40 are acceptable for research purposes". Regarding the average inter-item correlation, Clark and Watson (1995, p. 316) recommend a value ranging between 0.15 and 0.50, depending on the specificity of the concept the scale is meant to measure (the greater the specificity of the concept, the greater the value on the scale).

[34] Under WLSMV, the degrees of freedom are not computed as usual (Muthén 1998-2004, p. 24).

Chapter 6: Preliminary analysis: distinctions between farmers with and without native forest

I. Introduction

The topics and subjects of the thesis were presented in the previous chapters. This chapter represents the first of the analysis chapters, in which the preliminary analysis of the sample subjects is performed. Potential situational predictors of the presence of New Zealand native forest on farms were examined using discriminant analysis between farmers with and without native forest fragments. The potential situational predictors consisted of the socio-demographic characteristics of the farmers and farms, respondents' objective and subjective knowledge, respondents' direct experience with nature and the social interactions with important others with respect to environmental issues.

II. Analysis

1. Description of the method

Discriminant analysis is a classification technique used when groups are known a priori and the interest lies in which factors allow the prediction of these groups. Hence, a set of independent variables are linearly arranged in order to best separate the groups. This is achieved by maximising the ratio of between-group to within-group variance. The number of discriminant functions corresponds to the lesser of the number of groups minus 1 and the number of variables. In the present case, as there are only two groups (farmers with and without native fragments), the group prediction only requires one function (Quinn and Keough 2002p. 435-42).

2. Description of the predictor variables

The variables used to explain the presence of native forest on respondents' property include all the situational variables used as moderators of farmers' pro-environmental attitudes and behaviours in the chapters that follow. These variables were reviewed in Chapter 5, section III.2, and are listed in Table A6.1[1]. The reader is invited to refer to the aforementioned section and the questionnaire in Appendix 0 for a more detailed account. For the purpose only of the present discriminant analysis a few variables were added to these situational variables. Respondents were asked to identify their main source of knowledge regarding the cost and benefits of native forest on farms (question 14 in Appendix 0). They also indicated if they currently belonged to an environmental organization, used to belong, intended to or belonged to none (question 40 in Appendix 0).

3. Multiple imputation of the predictor variables

Discriminant analysis, as performed in SPSS 17.0, does not handle missing values and deletes from the analysis any respondents with at least one missing value (listwise deletion). Out of the 43 potential predictors of the presence of native forest on farms, 41 had missing values (Table 6.1). Although most of the predictors did not have many missing values, running the discriminant analysis on the original dataset would have resulted in analyzing only 150 cases out of a total of 806. Therefore, each potential discriminator was separately imputed via the multiple imputation method.[2] Table A6.1 displays information about the potential predictors before and after imputation.

III. Results: Who were the respondents with and without native forest?

1. Statistical issues

Due to some limitations, the following variables were removed from the discriminant analysis: *Make Mind Family*, *Make Mind Farmer*, *Dairy farming*, *Own Farm*, *Parent Farmer* and *Walking/Tramping* (see Appendix A5, section III.3. for a more detailed review of the statistical issues).

[1] Tables whose name starts by ‘A’ are to be found in the appendix of the corresponding thesis chapter.
[2] See Chapter 5, section III.3.b. and Appendix A5, section III.3.b for details about multiple imputation.

2. What predicts the presence of native forest on farms?

The discriminant analysis was first run on the 37 remaining potential discriminators described above, using the seven imputed datasets as well as the original. The original dataset was included in the analysis for reference. The discriminant function was built on a random selection of 70% of the data, and validated using the leave-one-out procedure as well as the 30% of the data initially left out. Out of 806 respondents, 515 had native forest fragments (of any size) on their property and 291 did not. Equal prior probability to belong to one of the two groups was specified in order to avoid wrongly assigning people without forest to the group with forest.[3]

Based on tests of equality of group means, standardized discriminant coefficients, Wilks' lambda and structure matrices[4], 16 variables were found to be significantly and consistently different at $p = 0.10$ between respondents with and without native forest in most of the datasets. Table 6.1 presents the 16 predictors in decreasing order of the standardized discriminant coefficients, averaged over the seven imputed datasets (N = 803). For comparison, the standardized discriminant coefficients were also averaged over the seven imputed datasets and the original dataset (N = 410).

[3] Such an error is called false positive, and would result here, from using prior probabilities based on the proportion of each group in the sample.

[4] The test of equality of group means is a one-way ANOVA indicating which variables significantly discriminate between the groups based on the Wilks' lambda, where smaller values indicate greater difference between the groups' means. The structure matrix shows the correlation of each predictor with the discriminant function: the greater the correlation, the greater the contribution of the covariate. The standardized discriminant coefficients correspond to the relative importance of each independent variable in discriminating between the two groups. The ordering of the predictors should be the same between the test of equality of group means, structure matrix and standardized discriminant coefficients.

Table 6. 1 Standardized discriminant coefficients of the 16 predictors of presence of native forest on farms averaged over the 7 imputed datasets, N = 803, and over the imputed and original datasets, N=410.

Variables group	Variables	Average stand. coeff. on imputed datasets	Average stand. coeff. on imputed + original datasets
Nature experience	Frequency Visit Forest	0.519	0.507
Farm sociodemographic	LogFarmSize	0.436	0.444
Social Influences	Parent Forest	0.389	0.389
Knowledge	Forest Knowledge Experience	0.210	0.215
Forest Influence	Forest Influence	0.194	0.200
Knowledge	Education	0.148	0.160
Knowledge	Forest Informed	0.127	0.128
Nature experience	Fishing/Hunting	-0.120	-0.120
Farm sociodemographic	Farm Income	0.116	0.134
Nature experience	Visit Forest Child	-0.112	-0.102
Social Influences	Environmental Talk Farmer	-0.078	-0.089
Nature experience	Frequency Use Forest	0.077	0.052
Knowledge	Forest Knowledge Regional Council	-0.067	-0.043
Social Influences	Environmental Talk Family	0.045	0.067
Nature experience	Observe Nature	0.044	0.046
Farm sociodemographic	Export	0.033	0.001

Therefore, compared with farmers without forest, farmers with forest (by decreasing order of importance) visited native forest more frequently, had bigger farms, were more likely to have had parents who had native forest on their property, were more likely to attribute their knowledge about costs and benefits of native forest on farm to personal experience, and gave more thought about having or not native forest on the farm before taking over the property they were running at the time of the survey. Additionally, farmers with native forest tended to have gone further in their education, to feel more informed about costs and benefits of native forest on farms, to go fishing and/or hunting less frequently, to have more financially successful farms, and to have visited native forest less during their childhood. To a much smaller extent, farmers with native forest also tended to engage less in conversations about environmental issues with fellow farmers, to use more frequently material from New Zealand native forest, to acknowledge less their regional council as their main source of knowledge about costs and benefits of native forest on farms, to talk more about environmental issues with their family, to observe nature for recreational purposes more often, and finally, to export more of their farm product than farmers without native forest.

The discriminant function explained between 24.6% and 31.1% of the total variance in discriminant scores (1-Wilks' Lambda in Table 6.2). The significant Chi-squares show that the discriminant function did better than chance at separating the groups.

Table 6. 2 Amount of total variance in discriminant scores explained by the discriminant function (1-Wilks' Lambda) and Chi-square tests of the discriminant function over the eight datasets

Imputation #	1-Wilks' Lambda	Chi-square	df	Sig.
Original	0.311	105.403	16	.000
1	0.253	155.592	16	.000
2	0.273	181.887	16	.000
3	0.263	164.251	16	.000
4	0.262	173.839	16	.000
5	0.262	166.054	16	.000
6	0.258	160.958	16	.000
7	0.246	149.858	16	.000

Overall, the discriminant function correctly predicted the presence/absence of native forest on farms in almost three cases out of four (Table 6.3).

Table 6. 3 Model validation by percentage of respondents correctly classified over the eight datasets.

Imputation #	% of the originally selected cases (70% of sample) correctly classified	% of the originally unselected cases (30% of sample) correctly classified	% of selected cross-validated grouped cases correctly classified
Original	76.8	78.6	73.4
1	72.4	71.7	69.7
2	73.8	65.8	72.5
3	73.5	71.8	71.0
4	73.2	74.1	71.2
5	72.5	66.4	70.7
6	73.1	71.5	70.2
7	72.5	71.0	69.1
Average (on imputed datasets)	73.0	70.3	70.6
Average (on all datasets)	73.5	71.4	71.0

IV. Discussion

The amount of direct contact respondents had with nature played an important role in predicting the presence of native forest on farms. Direct contact variables were among the strongest predictors and the most numerous variables of any situational group present in the final discriminant analysis. Farmers who had native forest had more regular direct experiences with New Zealand indigenous forest than farmers without native forest. They also visited and tended to use material from New Zealand native forest more often than farmers without indigenous forest fragments. While using material from the forest could reflect a utilitarian perception of the natural world, it could also result in a more intimate relationship with the native forest. This hypothesis is supported by the fact that farmers with forest were also more likely to engage in contemplative activities (observing nature) than farmers without forest, who were more likely to undertake extractive recreational activities (fishing-hunting). Outdoor contemplative recreational activities have been more strongly associated with pro-environmental attitudes than extractive activities (Teisl and O'Brien 2003, p. 507-9; Thapa and Graefe 2003, p. 79-80).

On the other hand, farmers without native fragments reported visiting New Zealand forest as a child more often than farmers with fragments. This result was unexpected, although *Visit Forest Child* had a relatively small discriminatory power. The bivariate chi-square comparison test between *Visit Forest Child* and *Forest Presence* showed that the two variables were significantly related (Chi-square = 26.906; df = 2; p = 0.000, on the original dataset, N=782). However, the test showed that more farmers without fragments had hardly ever visited New Zealand forest as a child, while more farmers with fragments had occasionally or regularly visited indigenous forest during their childhood. These results suggested that, after taking into account the other variables relevant to the prediction of the presence of native forest on farms,[5] visiting native forest as a child tended to discourage future farmers to have some on their property. Such a result does not seem to be related to the respondents' farming background as the variable *Farm in Family* (also collinear to *Parent Farmer*, which was therefore not retained in the final discriminant analysis) did not come out as a relevant predictor of the presence of native forest on farms.[6] On the other hand, it was found that respondents without fragments were less likely than respondents with fragments to have

[5] This is possible via discriminant analysis, as opposed to the bivariate chi-square test.
[6] Although it is only bivariate analysis, Chi-square comparison tests between *Parent farmer* and *Forest Presence* did not show any significant relationship either (Chi-square = 0.893; df = 1; p = 0.345, on the original dataset, N=801).

had parents with native forest fragments on their own property. Thus, respondents without fragments were more likely than respondents with fragments to have had interactions with the native forest during their childhood outside a farming context, and more probably as recreational. Furthermore, up until the late 1980s and early 1990s, New Zealand policies did not promote conservation of native forest on farms, rather the opposite (Wilson 1994, p. 181), and clearing native vegetation to make room for bare agricultural landscapes was predominately considered good farming (Smith et al. 2007, p. 39). Because of this, it is reasonable to hypothesize that farmers who still had native forest on their property at that time were likely to hold a particularly positive attitude toward the forest, an attitude that is likely to have influenced the next farming generation.[7] Therefore, respondents without native forest fragments, who were less likely to have had parents with indigenous forest fragments – hence less likely to have had direct contact with native forest and/or grown into a family positively inclined towards native forest –, may have more difficulty seeing the relevance of native forest on a farm than respondents with fragments, who were more likely to have had parents with forest themselves. Supporting this hypothesis, respondents without fragments felt less informed about the costs and benefits of native forest on farms and also tended to rely more on their regional council as the main source of information about such costs and benefits. In contrast, respondents with fragments felt more confident relying primarily on their personal experience; confidence they may have started building at a young age.

The importance of the respondents' family regarding the presence of native forest on farms was further illustrated by the fact that farmers with native fragments tended to talk more with their family about environmental issues than farmers without fragments. Additionally, having indigenous forest on farm tended to be a family story passing from one generation to the next as respondents with forest were more likely to have had parents who had native forest on their own property. Thus, these results suggested that the more the family interacted with respect to natural features on the farm, the more likely respondents were to preserve native forest. On the other hand, farmers without fragments tended to talk more about environmental issues with other farmers than respondents with fragments. This result could imply that farmers with

[7] Especially since the child to take over would have learnt how to farm under the supervision of his father and would have received his help for a while after the transfer (Keating and Little 1991, p. 25, 28-9; Eaton 1993; McCrostie Little and Taylor 1998). Therefore, the principles of the farm management would be less likely to change after the transfer.

fragments felt they had little in common with the rest of the farming community on these issues. In contrast to the sample in this study (where two thirds of the sample are constituted of farmers with fragments), farmers with native forest are in fact a minority in the two regions of study (33.8% of Manawatu-Wanganui farms and 38.4% of Wellington farms) and over the country as a whole (27.3% of farms) (NZStatistics(e) 2003, Hectares Used and Farms by Land Use by Region).

Regarding farmers' subjective and objective knowledge, it was found that more educated farmers were more likely to have native forest. However, no significant difference was found between farmers with and without native fragments regarding their level of ecological literacy, nor in how confident they were regarding their knowledge of environmental issues. On the other hand, as mentioned earlier, farmers with fragments tended to feel more knowledgeable about costs and benefits of native forest on farms. After filtering out farmers who had wanted native forest on their farm (who felt more knowledgeable than the rest of farmers with native forest), a crosstabulation between *Forest Informed* and *Forest Presence* showed that farmers with fragments by chance (who had not particularly sought farms with native forest) still felt significantly more confident in their knowledge about indigenous forests' costs and benefits than farmers without native forest (Chi-square = 21.541; df = 4; 2-sided p = 0.000). This result suggested that confidence in knowledge about native forest costs and benefits may be the result of having forest on one's property. This would further suggest that useful information about native forest costs and benefits was not readily available to farmers. Thus, farmers who had indigenous forest were more likely to attribute their knowledge to personal experience, while farmers without forest, who may lack such perosnal experience, tended to cite their regional council as their main source of information.

Wealthier farmers and farmers who exported greater proportions of their product tended to be more likely to have native forest. Such a result could be interpreted in two ways. As farms gave large financial returns, the owner could afford to retain and/or add some (non-productive) land with native forest. Conversely, the higher farm income and quantity of farm product exported may be the favourable outcomes of the presence of native forest on the farm. Forest fragments, native or not, perform useful functions on farms: e.g., help reducing wind and/or water erosion (Madden 1998; Environment Waikato 2002). Furthermore, natural features on farms participate to New Zealand's reputation as a clean and green country, which can be a serious advantage on international markets given the increasing demand from the public for environmentally-friendly products. However, when the covariate *Export* was regressed on a five-point Likert-like scale asking farmers how much they thought the clean and green image of New Zealand contributed to the ability of New Zealand farmers to sell their product overseas, the two variables were not significantly related (standardized regression coefficient = -0.051, p = 0.157). The 'Clean and Green' scale was not related with the presence of indigenous forest on farms either (Chi-square = 3.370; df = 4; p = 0.498, on the original dataset, N=790). These results suggested that native fragments were not used as a branding tool for promoting 'sustainable' farming. Furthermore, the fact that the farm size, which positively correlated with farm income, was also positively associated with the presence of native forest on the property suggested that farmers might have had native forest on their farm primarily because they could 'afford' it or because removing the fragments was not cost-effective. Nonetheless, higher income on farms with native forest can also be reasonably linked to ecological benefits from the presence of forest.

Finally, it was found that the more thought respondents gave to the issue of having native forest on the farm or not when choosing their property, the more likely they were to have native forest. This indicated that more respondents tended to look for farms with rather than without native forest, suggesting that positive attitudes towards New Zealand native forest were more frequent than negative attitudes among the sample. Such a result could be due to the sample being biased towards farmers with native forest. However, this group included farmers who did not seek property with native forest, hence without a priori positive attitudes towards the forest.

V. Conclusion

Farmers with and without native forest were subjected to a discriminant analysis in order to understand what may explain the presence of native forest on New Zealand farms. The situational variables described in Chapter 5, section III.2, and used later in the analysis of farmers' pro-environmental attitudes and behaviours, constituted the pool of predictors of indigenous forest presence on farms. Respondents' source of knowledge about native forest's costs and benefits for farming as well as respondents' membership of environmental organizations were added to the list of potential discriminators. The presence of native forest on New Zealand farms was dependent on respondents' direct interaction with nature, the influence of their family, their subjective more than their objective knowledge towards the natural environment, and their wealth. Overall, when respondents pondered the issue of native forest on a property before purchase, more farmers sought farms with indigenous forest rather than farms without. This result suggests that positive attitudes towards the forest could be more common among the sampled farming community than negative attitudes. Although the sample was biased towards farmers with native forest, the latter included farmers who did not actively seek farms with native forest (farmers with native forest by chance).

Chapter 7: Farmers' value-based environmental concern towards the environment

I. Introduction

In Chapter 6, the situational differences between farmers with native forest fragments on their property and farmers without such fragments were established. The principal findings were that farmers with indigenous forest visited native forest more, had bigger farms, were more likely to have parents who had native forest fragments on their property, were more likely to attribute their main source of knowledge about native forest's costs and benefits on farms as coming from their personal experience, and were more likely to have thought about the issue of the presence or absence of native forest on the farm before purchasing their property.

The present chapter initiates the analysis of farmers' attitudes towards the natural environment, which ultimately leads to the study of the behaviour of farmers with forest towards native forest. Specifically, this chapter examines farmers' value-based environmental concerns based on Schultz' (2000; 2001) egoistic, biospheric and altruistic scales.[1] While farmers' values have regularly been portrayed as mainly anthropocentric, farmers have also been found to hold ecocentric values alongside their utilitarian orientation (e.g., Freudenburg 1991). Additionally, some authors suggest that agriculture may be going through a 'greening' of the mentalities (e.g., Smith et al. 2007, p. 33; see chapter three for a discussion). Furthermore, despite having been tested in different contexts, Schultz' (2001) Environmental Motives Scale (EMS) has not been, to my knowledge, used on a farming population. Thus, the aim of this chapter is twofold. First, it tests Schultz' tripartite value-based environmental concern model on a new kind of sample: New Zealand farmers. Second, and most importantly, it gives an insight into New Zealand farmers' value orientations towards the natural environment and how they shape their environmental concern. In particular, it tests the assumption that farmers with native forest hold more biospheric-driven environmental concern than farmers without native forest. The analysis starts by investigating the dimensionality of Schultz'

[1] Schultz' (Schultz 2001) egoistic, biospheric and altruistic value-based environmental concern scales are also referred to as Environmental Motives Scale (EMS) (Schultz et al. 2004, p. 34).

scales and its internal consistency[2] on the whole sample of farmers. Respondents' levels of egoistic, biospheric and altruistic environmental concerns are evaluated. In addition, the environmental concerns of farmers with forest are compared with the environmental concerns of farmers without forest. The analysis also distinguished between farmers with forest by choice and farmers with forest by chance.

II. Analysis

1. Model hypotheses

Following Schultz' rationale (2000; 2001), respondents' environmental concern was hypothesized to be divided into the three distinct but correlated value orientations (egoistic, altruistic and biospheric) hypothesized by Stern and Dietz (1994) to underlie environmental attitudes. Schultz' three-correlated-factor model has been supported in a range of samples but, to my knowledge not on farmers (Schultz 2000; Schultz 2001; Schultz et al. 2004; Schultz et al. 2005; Milfont et al. 2006; Snelgar 2006). Farmers, or rural dwellers, have been found to be environmentally concerned, although to a lesser extent than non-farmers, non-rural inhabitants (Van Liere and Dunlap 1980; Jones and Dunlap 1992; Schneider and Francis 2006, p. 86), and to hold anthropocentric as well as ecocentric attitudes in a non-antagonistic fashion (Bjerke and Kaltenborn 1999; Winter 2005; Winter and Lockwood 2005; Baptiste and Nordenstam 2009).

Following the literature on Schultz' environmental motives scale (EMS) and on farmers' value orientations towards the natural environment, farmers in the study sample were expected to express concern about the consequences of environmental problems towards three distinct types of objects: egoistic, altruistic and biospheric.[3] Egoistic-, altruistic- and biospheric-based concerns were expected to correlate with one another. However, because farmers have regularly expressed more anthropocentric than ecocentric values (Bjerke and Kaltenborn 1999; Winter 2005), respondents were expected to display stronger egoistic and altruistic than biospheric environmental concerns. Additionally, because direct experience with nature has been associated with feelings of connectedness and affinity with nature (Kals et al. 1999; Mayer and McPherson Frantz 2004), farmers who had some native forest fragments on their property were expected to hold stronger biospheric environmental concern, while farmers who did not have such fragments were expected to display stronger

[2] Internal consistency is also referred to as internal reliability (Clark and Watson 1995, p. 315).
[3] See Appendix 0, question 4 for the EMS wording.

anthropocentric environmental concern (i.e., egoistic and altruistic). Additionally, respondents who had actively chosen a farm including native forest fragments (farmers with forest by choice) were expected to express stronger biospheric environmental concern than farmers who had farms with native forest *by chance*.[4]

2. Analysis framework

Schultz hypothesized his value-based environmental concerns to form three distinct factors representing biospheric, egoistic and altruistic environmental concerns. The dimensionality of the EMS was investigated, using confirmatory factor analysis[5] (CFA), by comparing the three-factor model to the one- and two-factor alternatives (Schultz 2000; Schultz 2001).

The one-factor model, with Schultz' biospheric, egoistic and altruistic items combined together, represented the unidimensional definition of environmental concern common in the literature, with the low end of the scale corresponding to low concern and the high end of the scale to high concern (Schultz 2000, p. 397; Schultz 2001, p. 329). The two-factor model was based on Thompson and Barton's (1994) ecocentric and anthropocentric[6] environmental attitudes. Schultz' equivalents to Thompson and Barton's ecocentric attitudes were the biospheric items, while Thompson and Barton's anthropocentric attitudes were represented by the combination of Schultz' egoistic and altruistic items.

Dimensionality and internal consistency of EMS were assessed on the whole sample of respondents as well as on farmers with and without native forest using, respectively, confirmatory factor analysis (CFA), and Cronbach's alpha and the average inter-item correlation.[7] To test if EMS dimensionality held on different randomly selected cases, the whole sample (806 cases) was split into two groups comprising 60% and 40%.

Finally, the average responses of farmers to each of the three environmental concerns were compared as well as the average environmental concerns between

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[4] I refer to farmers who have but did not actively choose to have native forest fragments on their property as 'farmers with forest by chance'.
[5] See Chapter 4 for a description of the technique.
[6] Ecocentric individuals "value nature for its own sake and, therefore, judge that it deserves protection because of its intrinsic value", while anthropocentric individuals "feel that the environment should be protected because of its value in maintaining or enhancing the quality of life for humans" (Gagnon Thompson and Barton 1994, p. 149).
[7] See Chapter 5, section IV.

farmers with and without forest and between farmers with forest by choice and by chance.[8]

Importantly, while Schultz' original EMS is measured on seven-point rating scales, the scales in the present study ranged from 1 to 5 in order to homogenize with most of the other questions present in the questionnaire. The low end of the scale signifies that respondents are not concerned about the item, and the high end of the scale represents their highest concern.

III. Results

1. Variable frequency

Averaging over the four items constituting each value-based concern, 46.3% of farmers were highly concerned about biospheric objects, 50.5% about altruistic objects, and 39.9% about egoistic objects.

Among the different biospheric items, respondents were the most concerned about birds (48.4% of respondents being highly concerned). Among the altruistic items, *Future generations* gathered the most numbers of high concerns (68.4% of respondents highly concerned). It is worth noting that people clearly did not respond in the same way to the four altruistic objects. *People in my country* and *All people* received the least amount of high concern within the group, with a mean of 37.6% of people highly concerned; whereas *Children* and *Future generations* gathered high proportions of people highly concerned, with a mean of 63.4% of people highly concerned. Their health was the item people were the most concerned about within the egoistic scale (44.6% of respondents highly concerned).

Of all the 12 items, respondents showed the most concern about future generations (altruistic scale). Respondents were the least concerned about their lifestyle (33.7% of respondents highly concerned about this egoistic item).[9]

[8] Following Schultz and colleagues (2004), the mean value of each value-based environmental concern was corrected for response tendency. The EMS contains 12 items in total, four for each of the three value-based environmental concerns (Appendix 0, question 4). The mean response over the three environmental concerns (average response to the 12 items) was computed for each respondent and was subtracted from respondents' mean response to each environmental concern (average response to the concern's four items) (Schultz et al. 2004, p. 36).

[9] For all Schultz' items, a very small proportion of respondents showed low levels of concern (scale categories '1' and '2'). Therefore, categories '1' and '2' of each of twelve items were collapsed with category '3' for the rest of the analyses.

2. Dimensionality and reliability analysis

a. Over the whole sample

The hypotheses that Schultz' EMS formed three distinct dimensions constituted of items measuring the same underlying concept were then tested over the whole sample divided in randomized subsamples of 60% and 40%.[10]

In both the 60% and 40% portions of the whole sample, the hypothesized three-factor model displayed the best fit to the data (Tables A7.1 and A7.2).

The more complex the model became, the stronger the factor loadings got (Tables A7.3 and A7.4) and the greater amount of variance was explained in Schultz items overall (Tables A7.5 and A7.6). In the three-factor model run on the 60% portion (40%), the factor loadings ranged between 0.835 and 0.978 (0.829 and 0.975), and the amount of variance explained in items, between 0.697 and 0.956 (0.688 and 0.951). Additionally, the correlation between altruistic and egoistic concerns was 0.726 (0.732), between altruistic and biospheric, 0.650 (0.707), and between biospheric and egoistic, 0.573 (0.529).

Cronbach's alpha for the biospheric, egoistic and altruistic environmental concerns was 0.94, 0.96, and 0.94 respectively. The average inter-item correlations for biospheric, egoistic, altruistic concerns were 0.813, 0.853, and 0.789 respectively. Such values indicate that each scale was composed of items of similar meaning, therefore exhibiting good internal consistency.

b. Comparison between farmers with and without native forest

Next, the dimensionality and the internal consistency of Schultz' scales were separately assessed on the sample of 291 respondents who did not have native forest fragments on their property and on the sample of 515 respondents with native forest. The responses of the two groups were compared.

[10] In the 60% portion of the sample, 25 farmers did not answer the EMS question, hence the analysis was performed on 459 cases; while in the 40% portion of the sample, 20 individuals did not answer, resulting in 302 cases.

i. Farmers without native forest

As for the whole sample, the three-factor model described the data best (Table A7.7). In the three-factor model, the factor loadings (Table A7.8) of the EMS items varied between 0.854 and 0.983, and the amount of variance explained (Table A7.9), between 0.729 and 0.965. As on the whole sample, the three environmental concerns of farmers without forest were highly correlated to each other (Egoistic – Altruistic: 0.740; Egoistic – Biospheric: 0.652; Biospheric – Altruistic: 0.695).

Cronbach's alpha of the biospheric, egoistic and altruistic environmental concerns scales was 0.93, 0.95, and 0.94 respectively, and the corresponding average inter-item correlations were 0.776, 0.830 and 0.800. As for the whole sample, the scales showed good internal reliability.

ii. Farmers with native forest

The results of the factor analysis of Schultz egoistic, altruistic and biospheric environmental concerns on farmers with fragments also mimicked the results on the whole sample. The three-factor solution described the respondents' environmental motive concerns best (Table A7.10). Again, the three-factor model exhibited the strongest factor loadings (between 0.803 and 0.974, Table A7.11) and explained the greatest amount of variance in the items (between 0.644 and 0.807, Table A7.12). The three environmental concerns were strongly correlated to one another (Egoistic – Altruistic: 0.726; Egoistic – Biospheric: 0.501; Biospheric – Altruistic: 0.656).

Cronbach's alpha of the biospheric, egoistic and altruistic environmental concern scales was 0.95, 0.96, and 0.93 respectively. The average inter-item correlation for the three scales were 0.836 (biospheric), 0.866 (egoistic) and 0.784 (altruistic). Again, the three value-based environmental concerns displayed acceptable internal consistency.

iii. Comparison between farmers with and without native forest

Since both farmers with and without fragments responded best and in a similar fashion to the three-factor model, a Multiple Indicators Multiple Causes (MIMIC) analysis was performed on the whole sample (Jöreskog and Goldberger 1975; Muthén 1989) in order to compare the strength of concerns between the two groups of farmers and possible differences in response to particular items. The variable *Forest Presence* indicated whether respondents had native forest on their property, and was used as the grouping variable. Farmers with forest were expected to hold a stronger biospheric environmental concern, while farmers without forest were hypothesized to hold stronger egoistic and altruistic environmental concerns.

As expected, the three-factor MIMIC model produced an acceptable fit for most of the indices (Table A7.13). The direct effects of *Forest Presence* on the egoistic, altruistic and biospheric latent factors were not significant, indicating that the two groups of farmers did not differ in their strength of concern towards the three types of objects. Similarly, the modification indices indicated that, holding the latent scores equal between groups, the two groups also did not differ in their response to the individual items. As a consequence, the grouping variable explained none of the variance in the latent egoistic, biospheric and altruistic concerns (Table A7.15). Therefore, farmers with and without fragments exhibited on average the same response to Environmental Motives Scale. The EMS items still loaded strongly on their respective factors (Table A7.14).

c. Comparison between farmers with native forest by choice and farmers with native forest by chance

A MIMIC analysis was then run between farmers who had native forest on their property by choice (74 respondents) and farmers who had native forest by chance (433 respondents).[11] Farmers who had native forest by choice were hypothesized to hold a stronger biospheric concern towards the natural environment.

[11] Eight farmers with forest did not specify whether they had wanted native fragments on their property.

Again, the three-factor model resulted in a satisfactory overall goodness-of-fit (Table A7.16). Farmers with forest by choice and farmers with forest by chance did not significantly differ either in their general level of different environmental concerns, or on their response to particular items. Therefore, the grouping variable again contributed little to explaining the variance of the three latent factors (egoistic, biospheric, and altruistic) (Table A7.18). As before, the various EMS items loaded highly on their corresponding latent factor (Table A7.17).

3. Mean responses

Since the tri-dimensionality of the EMS has been verified, the average mean response of farmers is computed for each value-based environmental concern and compared between the different groups of respondents.

a. Over the whole sample

Farmers, as a whole, were significantly less concerned about egoistic objects than biospheric and altruistic (Tables 7.1 and 7.2). On the other hand, the difference between altruistic and biospheric concerns was not as marked: respondents tended to show more altruistic concern than biospheric but the difference was only significant at p = 0.067 (Table 7.2).

Table 7. 1 Means, Standard Deviations of farmers' three value-based environmental concerns, and number of cases on which the means are based. The three scales ranged from 1 (not concerned) to 5 (most highly concerned).

Variables	All Farmers		
	Mean	S.D.	N
EMS	3.94	0.85	761
Egoistic	3.73	1.16	734
Altruistic	4.10	0.94	757
Biospheric	4.03	0.99	746
Egoistic corrected	-0.23	0.66	734
Altruistic corrected	0.15	0.54	757
Biospheric corrected	0.09	0.58	746

Table 7. 2 Paired differences and paired-t tests of the mean responses of farmers to the three value-based environmental concerns.

Variables	t	df	Sig. (2-tailed)
Biospheric[a] - Egoistic[b]	7.669	723	0.000
Biospheric - Altruistic[c]	-1.835	742	0.067
Egoistic - Altruistic	-10.222	730	0.000

[a]: 'Biospheric', for biospheric environmental concern mean. [b]: 'Egoistic', for egoistic environmental concern mean. [c]: 'Altruistic', for altruistic environmental concern mean. The corrected means were not compared because the results are equivalent to those with raw means as the same value was subtracted from the three environmental concerns means.

b. Comparison between farmers with and without native forest

Farmers with forest and farmers without forest did not exhibit significant differences in their mean responses, corrected or not, on any of the three environmental concerns (Tables 7.3 and 7.4).

Table 7. 3 Means, Standard Deviations of the three value-based environmental concerns of farmers with and without forest, and number of cases on which the means are based. The three scales ranged from 1 (not concerned) to 5 (most highly concerned).

Variables	Farmers with Forest			Farmers without Forest		
	Mean	S.D.	N	Mean	S.D.	N
EMS	3.93	0.86	490	3.96	0.85	271
Egoistic	3.72	1.15	475	3.75	1.18	259
Altruistic	4.09	0.94	488	4.11	0.94	269
Biospheric	4.04	1.00	483	4.01	0.96	263
Egoistic corrected	-0.23	0.68	475	-0.22	0.63	259
Altruistic corrected	0.15	0.53	488	0.15	0.56	269
Biospheric corrected	0.11	0.60	483	0.05	0.54	263

Table 7. 4 Independent-t tests of the mean responses of environmental concerns between farmers with and without forest with equal variances between the two groups assumed and not assumed.

Variables	t	df	Sig. (2-tailed)
Egoistic[a1]	0.252	732	0.801
Altruistic[b1]	0.255	755	0.799
Biospheric[c1]	-0.478	744	0.633
EgoisticCorr[d1]	0.252	732	0.801
AltruisticCorr[e1]	0.063	755	0.95
BiosphericCorr[f2]	-1.38	595.215	0.168

[a]: 'Egoistic', for egoistic environmental concern mean. [b]: 'Altruistic', for altruistic environmental concern mean. [c]: 'Biospheric', for biospheric environmental concern mean. [d]: 'EgoisticCorr', for egoistic environmental concern corrected mean. [e]: 'AltruisticCorr', for altruistic environmental concern corrected mean. [f]: BiosphericCorr', for biospheric environmental concern corrected mean. [1]: Equal variances assumed between the two groups (based on the Levene's test for equality of variances). [2]: Equal variances not assumed between the two groups (based on the Levene's test for equality of variances)

c. Comparison between farmers with native forest by choice and with native forest by chance

Farmers with forest by choice and farmers with forest by chance did not hold significantly different average biospheric and altruistic environmental concerns (Tables 7.5 and 7.6). On the other hand, farmers with forest by chance tended to express stronger egoistic environmental concern, although the difference between the two groups was only significant at $p = 0.074$ (Table 7.6).

Table 7. 5 Mean and Standard Deviations (S.D.) of the three value-based environmental concerns of farmers with native forest by chance (Forest Influence = 0) and farmers with native forest by choice (Forest Influence = 1), and number of cases on which the means are based. The three scales ranged from 1 (not concerned) to 5 (most highly concerned).

Variables	Forest Influence	Mean	S.D.	N
Egoistic	0	3.689	1.164	398
	1	3.864	1.106	70
Altruistic	0	4.057	0.946	411
	1	4.253	0.901	70
Biospheric	0	4.007	1.023	406
	1	4.250	0.910	70
Egoistic corrected	0	-0.234	0.675	398
	1	-0.250	0.713	70
Altruistic corrected	0	0.152	0.547	411
	1	0.139	0.465	70
Biospheric corrected	0	0.101	0.615	406
	1	0.164	0.565	70

Table 7. 6 Independent-t tests of the mean responses of environmental concerns between farmers with native forest by choice and with native forest by chance with equal variances between the two groups assumed and not assumed.

Variables	t	df	Sig. (2-tailed)
Egostic[a1]	-1.794	466	0.074
Altruistic[b1]	-0.951	479	0.342
Biospheric[c1]	-1.338	474	0.182
EgoisticCorr[d1]	-1.347	466	0.179
AltruisticCorr[e1]	0.86	479	0.39
BiosphericCorr[f1]	0.059	474	0.953

[a]**:** 'Egoistic', for egoistic environmental concern mean. [b]: 'Altruistic', for altruistic environmental concern mean. [c]: 'Biospheric', for biospheric environmental concern mean. [d]: 'EgoisticCorr', for egoistic environmental concern corrected mean. [e]: 'AltruisticCorr', for altruistic environmental concern corrected mean. [f]: BiosphericCorr', for biospheric environmental concern corrected mean. [1]: Equal variances assumed between the two groups (based on the Levene's test for equality of variances).

IV. Discussion

In this chapter, Schultz' Environmental Motives Scale (EMS) was tested on different samples of New Zealand farmers. Biospheric, egoistic and altruistic environmental concerns of farmers with and without native forest as well as with native forest by chance and with native forest by choice were compared.

Schultz tri-dimensional value-based environmental concern scale was validated on the sample of New Zealand farmers. This result was in line with the studies that have examined the measure so far (Schultz 2000; Schultz 2001; Schultz et al. 2004; Schultz et al. 2005; Milfont et al. 2006; Snelgar 2006).

As expected, overall, farmers expressed substantial environmental concern: their mean responses over the three value-based environmental concerns were greater than the medium value of the scale (3). Furthermore, the three concerns were highly correlated with each other. On average, farmers were more concerned about others (altruistic environmental concern) and any living beings (biospheric environmental concern) – with a slight tendency towards altruistic over biospheric environmental concern – than about the consequences environmental problems may have on themselves (egoistic environmental concern). This result partially contradicted findings that farmers or rural dwellers hold stronger anthropocentric values than ecocentric (e.g., Van Liere and Dunlap 1980; Bjerke and Kaltenborn 1999). The present results supported Schultz and colleagues' (2005) results, which showed that New Zealand university students exhibited on average weaker egoistic environmental concern than altruistic and biospheric concerns. Therefore, New Zealand farmers may be closer in their value orientations to the New Zealand general population than to the European or North American farming community on which the bulk of the literature is based.

Contrary to expectations, farmers with and without forest did not show different levels of biospheric and anthropocentric (altruistic and egoistic) environmental concerns. Thus, the presence of native forest fragments on the farm did not seem to be associated with a different value system in respondents. On the other hand, comparisons of the mean answers of farmers with forest by choice and farmers with forest by chance (via t-tests of equality of means) suggested that farmers with forest by chance tended to show stronger egoistic environmental concern. However, the MIMIC analysis, which is a more comprehensive technique than the t-test of equality of means, did not reveal any significant differences in value-based environmental concern between the two groups. The facts that (1) farmers with native forest did not display different strengths in environmental concerns compared to farmers without native forest, and (2) neither did farmers with native forest by choice compared to farmers with native forest by chance, suggested that interaction with nature may not impact on the value system of farmers. As values are conceived as high-order, general guiding principles that are assumed not to be highly susceptible to change (Murphy and Zajonc 1993, p. 2; Oskamp 2000, p. 115; Hitlin and Piliavin 2004, p. 361; Dietz et al. 2005, p. 362), it is understandable that somewhat fortuitous encounters with native forest may not influence value to a large extent. However, these encounters with nature may affect more farmers' attitudes, which are hypothesized to be more flexible than values (Hitlin and Piliavin 2004, p. 361). It would be interesting to see if interactions with nature at an early age and/or the length of interaction as an adult are more likely to affect farmers' value-based environmental concerns. These issues are explored in later chapters. Finally, the sample of respondents with forest by choice was rather small compared to the sample of respondents with forest by chance, and the analysis of the value-based environmental concerns between the two groups of farmers would gain from a more numerous – hence more representative – sample of farmers who chose to have native forest on their farm.

V. Conclusion

This chapter examined farmers' responses to the first of the two measures of general attitude towards the natural environment: Schultz' Environmental Motive Scale. As expected, Schultz' tri-dimensional model of value-based environmental concerns, distinguishing egoistic from altruistic from biospheric environmental concerns, was supported in the present sample of New Zealand farmers, whether or not they had native forest on their property. Respondents consistently showed stronger biospheric and altruistic environmental concerns than egoistic. The results suggested that the presence of native forest does not affect the present sample of New Zealand farmers' value-based environmental concerns, whether or not respondents had chosen to have native forest on their farm. In the next chapter farmers' response to the second measure of general attitude towards the environment is investigated.

Chapter 8: Farmers' core beliefs towards the environment

I. Introduction

In Chapter 7, Schultz' (2000; 2001) tri-dimensional environmental motives scale (EMS) was validated on the samples of New Zealand farmers with and without native forest fragments on their property, as well as between farmers with native forest by choice and farmers with native forest by chance. Contrary to expectations, farmers with and without forest did not differ in their level of egoistic, altruistic or biospheric environmental concerns, and nor was there a difference between farmers with forest by choice and farmers with forest by chance. On average, respondents showed less egoistic environmental concern than biospheric and altruistic concerns.

In this chapter, another approach is taken to measure farmers' general attitudes towards the natural environment. A shortened version of the revised new environmental paradigm (NEP) scale (Dunlap et al. 2000) is used to assess farmers' core environmental beliefs towards the relationship between nature and human beings. The dimensionality and internal consistency of the NEP scale are investigated on the whole sample of farmers. The level of agreement to the new environmental paradigm is compared between farmers with and without native forest on their property, as well as between farmers with native forest by choice and farmers with native forest by chance.

II. Analysis

1. Model hypotheses

Dunlap and colleagues developed the New Environmental Paradigm (NEP) scale (Dunlap and Van Liere 1978b) – later updated and renamed the New *Ecological*

Paradigm scale (Dunlap et al. 2000)[1] – in order to measure people's core beliefs on the relationship between human beings and nature[2] (Dunlap and Van Liere 1978b; Dunlap et al. 2000). Both scales are hypothesized to be unidimensional, with high scores representing an endorsement of the ecological worldview described by the New Environmental Paradigm where human beings are perceived as part of and dependent on nature. Low scores conform with the Human Exemptionalism Paradigm[3] (HEP; Catton and Dunlap 1980; Buttel and Humphrey 2002), describing a utilitarian, growth-oriented worldview where human beings dominate nature (Dunlap 2008). Although HEP was the dominant belief system in Western society (Catton and Dunlap 1980), studies suggest that, especially since the 1970s, environmental problems have become one of the strongest concerns common to both Western society and the rest of the world (Dunlap and Van Liere 1978b; Schultz 2001, p. 327; Costarelli and Colloca 2004, p. 279; Castro 2006, p. 247).

Farmers, or rural dwellers, have regularly expressed more utilitarian beliefs towards nature than the general public (Van Liere and Dunlap 1980; Edgell and Nowell 1989). However, to the best of my knowledge, very few studies have found farmers exhibiting predominantly HEP beliefs (e.g., Edgell and Nowell 1989). The majority of studies assessing farmers' responses to the NEP scale have suggested that farmers expressed above-average agreement with the new environmental paradigm (Albrecht et al. 1982; Kaltenborn et al. 1998; Berenguer et al. 2005), or held neutral (or HEP/NEP mixed) orientation (Abaidoo and Dickinson 2002; Zhong 2003; Mitchell et al. 2006; Landry 2007).

Therefore, following the literature, the present sample of New Zealand farmers were expected to display at least a neutral position on the HEP/NEP scale, or NEP-oriented beliefs. Additionally, because interacting directly with nature has been shown to be associated with feeling connected to nature (Kals et al. 1999; Mayer and

[1] The New *Ecological* Paradigm (also called the revised-NEP) scale (Dunlap, Van Liere et al. 2000) comprises 15 statements, instead of 12 in the early version (Dunlap and Van Liere 1978b), with which respondents are asked to rate their dis/agreement on Likert scales from 1 to 5 (strongly disagree, mildly disagree, unsure, mildly agree, and strongly agree). The original version consisted of only four categories (no 'unsure' category), and some statements of the early version have been re-worded. Because the paradigm underlying the two scales is the same, I only refer to this paradigm as the New Environmental Paradigm. When referring to the different scales, I use the qualifiers 'original' for the New Environmental Paradigm scale (Dunlap and Van Liere 1978b) and 'revised' for the New Ecological Paradigm scale (Dunlap, Van Liere et al. 2000).

[2] The latest version, the New *Ecological* Paradigm scale, or revised-NEP scale, covers five facets, or themes, of the human-nature relationship: the reality of limits to growth, antianthropocentrism, the fragility of nature's balance, rejection of exemptionalism and the possibility of an ecocrisis (Dunlap, Van Liere et al. 2000).

[3] HEP is also referred to as the Dominant Social Paradigm, DSP (Dunlap and Van Liere 1978b; La Trobe and Acott 2000).

McPherson Frantz 2004), farmers with native forest on their property were expected to agree more strongly with the new environmental paradigm than farmers without native forest. Furthermore, farmers who had actively chosen to have native forest were expected to display stronger NEP-oriented beliefs than farmers with native forest by chance.

2. Analysis framework

The present study relies on a subset of the revised NEP scale (Dunlap et al. 2000). Other researchers have used abbreviated versions of the NEP scale (for a review, see Dunlap 2008; Hawcroft and Milfont 2010). In their meta-analysis of studies using the NEP scale, Hawcroft and Milfont (2010) found that abbreviated versions tended to generate lower NEP scores than the full scale. However, as they noted, such lower scores may be due to the specific items these shortened scales have used rather than the length of the scale *per se*. Furthermore, a number of the studies that used an abbreviated version of the NEP scale suggested that such modified scales can achieve good reliability, discriminate well between samples and explain amounts of variance in the NEP items and/or dependent variables (e.g., environmentally-friendly behaviour) comparable to the amount explained by the full NEP scale (Edgell and Nowell 1989; Luzar et al. 1995; La Trobe and Acott 2000; Cordano et al. 2003). Additionally, although the original and revised NEP scales respectively cover three[4] and five facets of the relationship between humans and nature and both scales’ dimensionality have occasioned conflicting results, Dunlap and colleagues envisioned both NEP scales as forming one coherent set of beliefs, hence a unidimensional scale (Dunlap and Van Liere 1978b; Dunlap et al. 2000; Dunlap 2008).[5]

Based on these considerations, and due to limited space in the questionnaire designed for the present study, the revised-NEP scale was abbreviated to five items. One out of the three items constituting each of the five sets of beliefs in the revised-scale (the reality of limits to growth, antianthropocentrism, the fragility of nature’s

[4] The three main themes of the original-NEP scale are “existence of ecological limits to growth”, “importance of maintaining the balance of nature”, and “rejection of the anthropocentric notion that nature exists primarily for human use” (Dunlap 2008, p. 6).

[5] Dunlap and colleagues (1978b; 2000) argue that a 12- or 15-item scale would very likely generate multi-factor solutions. Moreover, these solutions would often be different depending on the sample. “If substantively meaningful dimensions do not emerge, […] and the entire set of items (or at least a majority of them) are found to produce an internally consistent measure, then [we] recommend treating the NEP Scale as a single variable” (Dunlap, Van Liere et al. 2000, p. 431).

balance, rejection of exemptionalism and the possibility of an ecocrisis; Dunlap et al. 2000) was chosen. The choice was based on the criteria that the statements should best render the general idea of each of the five facets but have the least ambiguous interpretation.[6] The dimensionality of the abbreviated scale was investigated on the sample of New Zealand farmers using exploratory and confirmatory factor analysis.

Acceptable factor analysis models should produce good overall fit to the data (achieved for the fit indexes' values CFI/TLI $\geq$ 0.95, RMSEA$\leq$ 0.06, WRMR<1.0, and ideally, a non-significant Chi-square (Muthén 1998-2004; Hu and Bentler 1999; Yu 2002)), significant estimates, and meaningful factors with salient item loading coefficients (Brown 2006, p. 38, 113; Stevens 2009, p. 331-3, 360-7).[7]

The scale's reliability[8] was estimated via Cronbach's alpha and the average inter-item correlation. Cronbach's alpha of at least 0.7 are usually preferred for stating that a scale is reliable (Field 2005, p. 668). However, this value has been challenged (e.g., Clark and Watson 1995, p. 315). The average inter-item correlation should range between 0.15 and 0.50, with higher values the more specific the scale is (Clark and Watson 1995, p. 316).[9]

III. Results

1. Variable frequency

Overall, the majority of respondents conformed to the new environmental paradigm rather than the human exemptionalism paradigm (Table 8.1).

In three statements out of five, more than half of respondents gave pro-NEP answers.[10] Respondents were the most unanimous in their disagreement that the balance of nature was strong enough to cope with the impact of modern industrial nations (*NEPCope*). The proportion of respondents who disagreed[11] with this statement was 76.5%, with 25.6% of respondents strongly disagreeing. Such a high level of disagreement indicated that respondents either had a rather critical perception of their

[6] For instance, the statement "The earth has plenty of natural resources if we just learn how to develop them" in the revised-NEP scale could reflect a utilitarian mindset, as well as a more ecologically oriented belief if 'development' is perceived as a sustainable one.
[7] See Chapter 5, section IV.3.
[8] Scale's reliability is also referred to as internal consistency
[9] See Chapter 5, section IV.4.
[10] Pro-NEP answers correspond, for items 1 and 5, to the 'Strongly Agree' and 'Agree' categories and, for items 2, 3 ,4, to 'Strongly Disagree' and 'Disagree'
[11] That is, 'Strongly Disagree' and 'Disagree' combined.

activity, or actually misinterpreted the word 'industrial'. They may have understood this statement as being critical of the impacts on the natural environment of the manufacturing sector and parts of the primary sector whose resources are used in industries such as mining and quarrying. Respondents also predominantly rejected the beliefs that 'because of our special abilities, humans are not subject to the laws of nature as are other living beings' (*NEPNatLaw*), with 73.1% of respondents disagreeing[12] with this statement and 27.4% strongly disagreeing. The last statement to induce more pro-NEP answers than pro-HEP was the belief that 'if things continue on their present course, we will soon experience a major ecological catastrophe' (*NEPCata*): 57.0% of respondents agreed with this statement, including 18.7% of all farmers who strongly agreed with it.

Table 8. 1 Frequency distributions for the abbreviated revised-NEP scale items.

NEP items	SA (%)[a]	A (%)	U (%)	D (%)	SD (%)	N
1. NEPEarthLimit: We are approaching the limit of the number of people the earth can support	17.9	28.5	25.3	24.0	4.2	803
2. NEPModify: Humans have the right to modify the natural environment to suit their needs	4.9	34.6	13.8	35.6	11.2	804
3. NEPCope: The balance of nature is strong enough to cope with the impacts of modern industrial nations	1.7	7.6	14.2	50.9	25.6	802
4. NEPNatLaw[b]: Because of our special abilities, humans are **not** subject to the laws of nature as are other living beings	2.8	15.1	9.0	45.7	27.4	799
5. NEPCata: If things continue on their present course, we will soon experience a major ecological catastrophe	18.7	38.3	25.1	15.2	2.8	797

[a]: SA = Strongly Agree; A = Agree; U = Unsure; D = Disagree; SD = Strongly Disagree
[b]: The NEPNatLaw item was rephrased in a reversed form compared to the original version.

Less than half of respondents (although still the majority), displayed pro-NEP answers towards the two statements: 'We are approaching the limit of the number of people the earth can support' (*NEPEarthLimit*) and 'Humans have the right to modify the natural environment to suit their needs' (*NEPModify*). More farmers showed pro-HEP beliefs for these two statements than for the other three (28.2% of respondents

[12] That is, 'Strongly Disagree' and 'Disagree' combined.

disagreed with the first statement and 39.5% agreed with the second). Additionally, it is interesting to note that the *NEPModify* statement produced almost symmetrical mild answers. This result suggests that this statement, particularly relevant to the farming activity, may generate complex beliefs within respondents.

Less than 15% of farmers gave neutral answers to most of the statements. However, in two instances a quarter of respondents could not decide between a pro-NEP and a pro-HEP stance. The statements about the earth's carrying capacity and about a future ecological catastrophe gathered the greatest number of neutral responses (*NEPEarthLimit*: 25.3% and *NEPCata*: 25.1%). Both statements imply a prediction about the future. The factual orientation of these two NEP items could explain the greater number of neutral positions they generated in the sample of New Zealand farmers.

Because the human exemptionalism end of the scale[13] gathered too small a proportion of respondents to be properly analyzed in factor analysis, categories '1' (strongly disagree with pro-NEP statement) and '2' (disagree with pro-NEP statement) of each of the five NEP items were collapsed with category '3' (unsure).

2. Dimensionality and reliability analysis

a. Over the whole sample

Because an abbreviated version of the New Ecological Paradigm (NEP) scale (Dunlap et al. 2000) was used, and because the dimensionality of the NEP scale has been found to vary from one study to another (Dunlap et al. 2000, p. 430-1), the five items were first submitted to an exploratory factor analysis[14] testing one- and two-factor solutions. The analysis was first performed on a randomized 60% of the sample (484 respondents), and checked on the remaining 40% (322 cases). Because the NEP scale has been designed as and demonstrated to be, at times, unidimensional (Dunlap and Van Liere 1978b; Dunlap et al. 2000; Dunlap 2008), the five NEP items were expected to form one dimension.

[13] That is, categories '1' and '2' of a 1 (anti-NEP) to 5 (pro-NEP) scale.
[14] See Chapter 5, section IV.1.c.

In both the 60% and 40% subsamples, the one-factor model did not produce acceptable overall goodness-of-fit (Tables A8.1 and 8.2). A two-factor solution showed better fit than the one-factor model (Tables A8.1 and 8.2). In the two-factor model of the 60% subsample, the NEP statement about approaching the numeric limit of people the earth can sustain (*NEPEarthLimit*) loaded highly on the first factor along with the NEP statement about a major ecological catastrophe looming (*NEPCata*), while all the NEP variables except *NEPEarthLimit* loaded on the second factor (Table A8.3). However, the loading of *NEPEarthLimit* on the first factor generated an inadmissible solution: its loading was greater than 1.0 and associated with a negative residual variance. The loading of *NEPCata* on this same factor was trivial (0.144), whereas all the NEP items loading on the second factor (all NEP variables except *NEPEarthLimit*) were between 0.527 and 0.784. The two factors were correlated to a small extent (0.318).

In the one-factor model on the 40% subsample, *NEPEarthLimit* had the smallest loading of all the NEP items, 0.446, while the four others ranged between 0.633 and 0.743 (Table A8.4). The two-factor model displayed similar results to the 60% sub-sample. *NEPEarthLimit* and *NEPCata* loaded on a separate factor, while four out of five NEP items loaded on a second factor. However, *NEPCata*, as opposed to *NEPEarthLimit* in the 60% subsample, loaded on only one factor with a coefficient greater than 1.0 associated with a negative residual variance. *NEPEarthLimit* loaded poorly on both factors (coefficients smaller than 0.30). Again, the two factors were moderately correlated (0.279).

As mentioned earlier, both *NEPEarthLimit* and *NEPCata* included a stronger factual component than the other NEP statements, which could explain that these two NEP items loaded on a separate factor. On the other hand, the unconditional wording of *NEPEarthLimit*, as opposed to the use of 'if' in *NEPCata*, could explain why *NEPEarthLimit* only loaded on one factor separately from the other NEP items in the larger subsample, while *NEPCata* loaded on the two factors. In his list of procedural steps for exploratory factor analysis, Brown (2006, p. 38) recommends discarding factors with only two or three salient loadings and items with small loadings on all factors. For these reasons, a one-factor model was run without the *NEPEarthLimit* item. This model produced excellent fit and the p-value associated with the Chi-square test increased in both the 40% and the 60% subsamples (Tables A8.1 and A8.2). The p-values associated with the Chi-squares of the one-factor model excluding *NEPEarthLimit* and the two-factor model including the five items could not be directly compared because the two models were not nested (they used different set of variables). The one-factor four-item model also exhibited strong loadings in both samples (Tables A8.3 and A8.4).

b. Comparison between farmers with and without native forest

Since the exploratory factor analysis on the randomized samples suggested that a one-factor model of four NEP items was the best of the models assessed, confirmatory factor analysis was used to test the four-item one-factor model against the originally expected five-item one-factor model in the samples of farmers with and without native forest. The internal consistency of the best NEP model was estimated for both samples. Differences in agreement to the individual NEP statements as well as the difference in general level of agreement to the new environmental paradigm were examined across the two samples using a Multiple Indicators Multiple Causes (MIMIC) framework.[15]

i. Farmers without native forest

Out of 291 farmers without forest fragments, one respondent did not answer any of the NEP questions. Thus, the analysis was run on 290 respondents. The one-factor CFA model including the five NEP items did not result in satisfactory overall goodness-of-fit values (Table A8.5). *NEPEarthLimit* displayed the most disparate correlations with the other NEP items. They ranged between 0.090 and 0.469, while the correlations between the four other NEP items ranged between 0.353 and 0.524. As a consequence, *NEPEarthLimit* also exhibited a weaker factor loading than the other NEP items (Table A8.6) and less variance was accounted for in this item (Table A8.7). On the other hand, the one-factor CFA model based on the four items excluding *NEPEarthLimit* produced excellent fit statistics (Table A8.5). The four standardized loadings were of similar strength, ranging between 0.601 and 0.782 (Table A8.6). The model explained a large amount of variance in the NEP items (Table A8.7).

The four-item scale showed good reliability, with a Cronbach's alpha of 0.760 and an average inter-item correlation of 0.447.

[15] See Chapter 5, section IV.2.

ii. Farmers with native forest

All respondents with forest answered at least part of the NEP question; thus, the analysis was run on 515 respondents. Similarly to farmers without forest, the one-factor model including the five NEP items did not fit the data well (Table A8.8). Again, NEPEarthLimit did not correlate consistently with the other NEP items (correlations ranging between 0.160 and 0.512), while the other items showed more uniformity (correlations ranging between 0.303 and 0.507). Once NEPEarthLimit was removed from the dataset, the overall goodness-of-fit improved markedly. As was the case for farmers without native forest, the four NEP items loaded strongly and with similar magnitude on one factor. The loadings ranged between 0.545 and 0.779 (Table A8.9). The model based explained a substantial amount of total variance in the NEP items (Table A8.10).

As was the case for farmers without forest, the four-item NEP scale showed good reliability. Cronbach's alpha was 0.730 and the average inter-item correlation, to 0.410. However, these reliability values were slightly weaker than for farmers without forest.

iii. Comparison between farmers with native forest and farmers without native forest

Since both samples of farmers with and without native forest responded to the same four-item one-factor model, a MIMIC confirmatory factor analysis was run on the whole sample (806 cases). This analysis tested whether the two groups of farmers held different levels of agreement to the new environmental paradigm (comparison of the latent factor mean), and/or, for latent factor values being the same, whether the two groups responded differently to particular NEP items (differential item functioning).[16] The variable *ForestPresence* indicated the presence of native forest fragments on respondents' farms and acted as the grouping variable in the MIMIC analysis. Farmers with forest were expected to conform more strongly to the new environmental paradigm than farmers without forest.

[16] See Chapter 5, section IV.2.

Contrary to expectation, farmers with native forest did not agree more strongly with the NEP scale than farmers without native forest. No significant difference was found between the two samples regarding their answers to the latent NEP factor or to the individual NEP statements. As a consequence the grouping variable *ForestPresence* did not explain any variance in the latent factor (Table A8.13). The model fitted the data well (Table A8.11). Each NEP item loaded strongly on the NEP latent factor (Table A8.12).

c. Comparison between farmers with native forest by chance and farmers with native forest by choice

Given that the four-item one-factor model fitted the sample of farmers with native forest well, a second MIMIC analysis was performed to assess whether farmers with native forest by chance and farmers with native forest by choice differed in their responses to the NEP variables. Farmers with forest by choice were expected to agree more strongly to the new environmental paradigm than farmers with forest by chance.

As expected, farmers with forest by choice tended to agree more strongly with the new environmental paradigm in general than farmers with forest by chance. The significant standardized effect of the grouping variable (*ForestInfluence*) on the latent factor NEP amounted to 0.187. Latent factor values being the same, the two groups of farmers did not differ in their response to particular NEP items. As a consequence, the MIMIC model explained, to a small extent, some variance in the NEP latent factor but not more in the NEP items than the initial CFA model explained already (Table A8.16 and for comparison, Table A8.10). The model fitted the data well (Table A8.14). Again, the NEP items showed strong factor loadings (Table A8.15).

3. Mean responses

The mean responses of farmers with and without native forest and farmers with native forest by choice and by chance were estimated over the four NEP statements (*NEPModif*, *NEPCope*, *NEPNatLaw* and *NEPCata*) that formed the best model to emerge from the factor analyses. The means were estimated on the non-collapsed categories in order to check that the results concur with the MIMIC analysis, performed on collapsed data.

a. Comparison between farmers with and without native forest

On a scale coded from 1 (anti-NEP) to 5 (pro-NEP), farmers on average showed agreement with the new environmental paradigm (mean response = 3.60). Concurring with the MIMIC analysis, farmers with and without native forest displayed similar mean NEP response (Table 8.2, independent-t test = -0.298, df = 803, p = 0.766).

Table 8. 2 Means and Standard Deviations of the core environmental beliefs of all respondents, and farmers with and without native forest (four NEP items), and number of cases on which the means are based.

Variables	All Farmers			Farmers with Forest			Farmers without Forest		
	Mean	S.D.	N	Mean	S.D.	N	Mean	S.D.	N
NEP	3.60	0.74	805	3.60	0.73	515	3.58	0.75	290

b. Comparison between farmers with native forest by choice and with native forest by chance

Both farmers with forest by choice and farmers with forest by chance showed above-average agreement with the NEP scale (Table 8.3). Similarly to the MIMIC results, independent t-tests between the mean NEP response of farmers with forest by choice and farmers with forest by chance indicated that the former group of farmers endorsed the new environmental paradigm significantly more strongly than the latter (t = -2.887, df = 505, p = 0.004).

Table 8. 3 Mean and Standard Deviations of the core environmental beliefs of farmers with native forest by chance (Forest Influence = 0) and farmers with native forest by choice (Forest Influence = 1), and number of cases on which the means are based.

Variables	Forest Influence	Mean	S.D.	N
NEP	0	3.56	0.72	433
	1	3.82	0.76	74

IV. Discussion

This chapter examined how a sample of New Zealand farmers responded to the revised new environmental paradigm scale (revised-NEP scale) and whether the presence of native forest was associated with different NEP responses.

An abbreviated version of the revised new environmental paradigm scale (or new ecological paradigm scale) (Dunlap et al. 2000) was used to assess the core environmental beliefs of farmers with and without native forest on their property. Out of the five items used in the subset, the statement about the limited number of people the earth can sustain (*NEPEarthLimit*) consistently failed to measure the factor common to the other NEP items. The *NEPEarthLimit* statement makes a strong prediction about the future, which seems to have polarised respondents. This statement also generated one of the lowest levels of agreement and one of the highest proportion of neutral answer. Additionally, the strong factual orientation of the statement also seems to have confused respondents or led them think they did not have the required knowledge to take a position on this statement. *NEPEarthLimit* was therefore dropped from further analysis.

The resulting one-factor four-item model revealed a good fit to the two randomized samples of respondents, showed good internal consistency and explained substantial amount of variance in the NEP indicators. These results concurred with other researchers who have used subsets of the full original and revised NEP scales (Luzar et al. 1995; La Trobe and Acott 2000; Cordano et al. 2003). On average, respondents tended to endorse more the new environmental paradigm than the human exemptionalism paradigm (HEP). This is in line with the mean response of New Zealand students assessed by Schultz and colleagues (mean response: 3.74 ± 0.44; Schultz et al. 2005). The frequencies associated with the statement *NEPModify* are particularly interesting: about the same number of respondents mildly agreed and disagreed with this statement (about a third of the respondents in each of these two categories). The issue of having the right to modify the environment to suit humans' needs is at the core of the farmer's relationship with nature. Due to the extractive nature of their activity, farmers were especially expected to agree with this statement. The balanced frequencies could suggest that some respondents may have answered this item dissociating farming activity from the rest of human activities. However, these results could also suggest that respondents may be in the process of questioning their relationship with nature, shifting to a less intrusive way of farming. As in the general public, a number of studies have found farmers to hold more pro-NEP than HEP beliefs (Albrecht et al. 1982; Kaltenborn et al. 1998; Berenguer et al. 2005). Two studies separated by only a few years in two different but nearby and similar parts of the prairie provinces in Canada suggested an increase to NEP endorsement in farmers (Abaidoo and Dickinson 2002; Mitchell et al. 2006). Fairweather and Campbell (2003, p. 296-7), in their study of conventional, organic and GE-oriented[17] New Zealand farmers, found that utilitarian beliefs such as the need for "harnessing nature for the benefit of humans" were "no longer so dominant". They also found that conventional farmers held similar values to organic farmers. In any case, the results NEPModify generated indicate that the issue of modifying the environment is complex for respondents. Although the general NEP scale was used in this study in order to be able to assess farmers core environmental beliefs and draw comparisons[18] from the varied pool of results from the general and farming population, Beus and Dunlap (1991) have also developed a NEP version specially adapted to farming. It would certainly be worthwhile to investigate further the position of New Zealand respondents on the relationship between their activity and the natural environment via Beus and Dunlap's scale.

The four items (*NEPModif*, *NEPCope*, *NEPNatLaw* and *NEPCata*) formed also a reliable unidimensional scale in both the group of farmers with native forest and the group without. Contrary to expectations, farmers with forest did not display stronger agreement with the ecological worldview assessed by the NEP scale than farmers without forest. Both groups answered in a similar fashion the four NEP items and showed the same level of agreement with the NEP latent factor. On average, both groups held pro-environmental beliefs towards nature and its relationship with human beings (mean values above the middle value of the scale).

Both farmers with native forest by choice and farmers with native forest by chance showed above-average agreement with the ecological worldview. Nevertheless, farmers who had decided to have native forest on their property showed, as expected,

[17] GE: genetic engineering technologies.

[18] However, the comparisons would still be limited as different versions and subsets of the NEP scales have been used over the years.

stronger agreement with the new environmental paradigm than farmers with forest by chance, indicated by both the MIMIC analysis and the independent-t tests. However, farmers with forest by choice and farmers with forest by chance did not exhibit any salient difference in their items' answers.

V. Conclusion

This chapter investigated farmers' answers to the second of the two general measures of attitudes towards the natural environment: the abbreviated revised New Environmental Paradigm scale. Consistent with the trend observed within the general public, farmers from New Zealand overall displayed above-average endorsement of the new environmental paradigm. The mere presence of native forest on farms was not associated with stronger core pro-environmental beliefs. However, and as expected, respondents who had chosen to have native forest displayed stronger pro-environmental core environmental beliefs. The present results could suggest that core beliefs are rather stable, or at least resistant to change from interaction with nature. However, such a hypothesis would need to be properly tested via a longitudinal study. In the next chapter, respondents' specific attitudes towards New Zealand native forest are investigated.

Chapter 9: Farmers' specific attitude towards native forest: tripartite model

I. Introduction

The previous chapters examined the two general measures of attitudes towards the natural environment on the sample of New Zealand farmers: the Environmental Motives Scale[1] (Schultz 2000; Schultz 2001) and the revised New Environmental Paradigm Scale (Dunlap et al. 2000). The expected dimensionality of the two general measures was validated on the various samples of New Zealand farmers. Respondents exhibited above average environmental concern and pro-environmental core beliefs. Moreover, farmers displayed more biospheric- and altruistic-based environmental concern than egoistic. Neither the presence of native forest, nor the decision to have native forest on the farm impacted on the amount or the nature of farmers' value-based environmental concerns. On the other hand, farmers who had native forest by choice displayed stronger core pro-environmental beliefs towards nature in general.

In this chapter, the specific attitude of farmers towards New Zealand native forest is examined. The specific attitude model follows the tripartite definition of attitude as being constituted of affective (feelings), cognitive (beliefs) and conative (behavioural intentions) dimensions (e.g., Maloney and Ward 1973; Hilgard 1980; Zanna and Rempel 1988; Bohner 2001). This chapter includes three major sections based on the various samples of farmers on which the tripartite model is tested. The first section tests the tripartite attitude model on the whole sample of farmers; the second section focuses on farmers without native fragments on their property; and finally, the last section concentrates on farmers with fragments. Additionally, in this last part, the specific attitudes of farmers who actively sought a farm with native forest (farmers with forest by choice) are compared to the attitudes of farmers who had native forest but had not actively sought to have some on their property (farmers with forest by chance). Where the various samples follow the same attitudinal model, the influence of the presence of native forest on farms, as well as the conscious decision to take over a farm with native forest, are assessed by comparing the levels of pro-environmental attitude between the different groups of farmers. The chapter discussion summarises the results

[1] Also referred to in this thesis as 'value-based environmental concerns'.

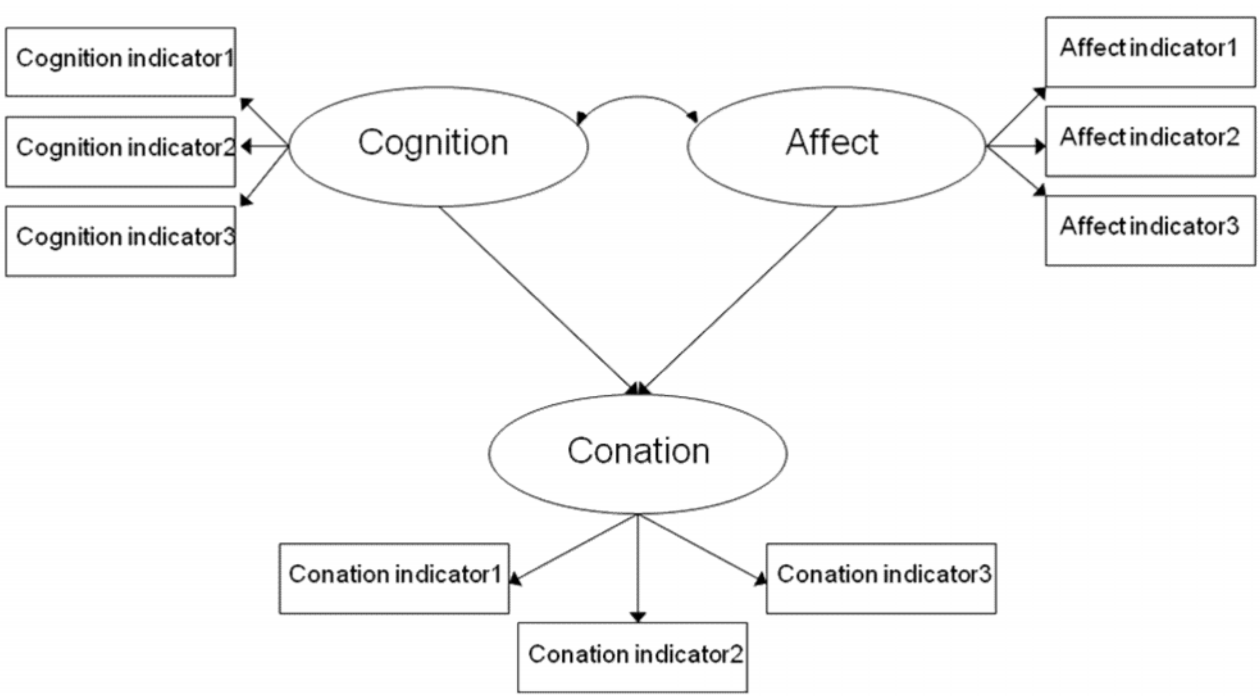
and specifically concentrates on the comparison between farmers with and without fragments.

II. Methods

1. Assessing the validity of the tripartite attitude model on the samples of New Zealand farmers

The same protocol was followed to assess the validity of the tripartite model on each sample of farmers (Figure 9.1). First, because authors have pointed at the potential difficulty in assessing people's *affect* (feelings) independently from *cognition* (beliefs) (Ajzen 1988, p.21; Morris et al. 2002), the distinction between the *affect* and *cognition* dimensions was assessed by comparing one- and two-factor models fit to the data. In the one-factor model, both the hypothesized *affect* and *cognition* indicators loaded on the same factor; while in the two-factor model, the hypothesized *affect* and *cognition* indicators had the possibility to load on separate factors. Next the *conation* indicators were added to the model and the validity of the hypothesized tripartite model was evaluated by testing three alternative models: one-, two- and three-factor models. The one-factor model implied that the hypothesized three dimensions were actually indiscernible from one another, hence, all the attitudinal indicators formed a unique attitudinal factor (see Kaiser et al. 1999, p. 2). The two-factor model supposed that only *affect* and *cognition* were indiscernible, while the *conation* indicators produced a factor on their own; the *affect-cognition* factor predicted farmers' behavioural intentions. Finally, the three-factor model corresponded to the tripartite model, where the indicators were hypothesized to load on their respective hypothesized factor, and where correlated *affect* and *cognition* dimensions predicted the *conation* dimension.

Figure 9. 1 The tripartite attitudinal model. The oval shapes represent the latent factors and the rectangular shapes correspond to the factor indicators. The one-headed arrows symbolize regression relationships; the two-headed arrows symbolize correlation relationships.



The distinction between *affect* and *cognition* was assessed using the Exploratory Structural Equation Modeling technique (ESEM; Asparouhov and Muthén 2008).[2] As ESEM is based on exploratory factor analysis, outcome variables are not forced to load on some factors and not others. Therefore, ESEM is somewhat less lenient towards the hypothesized model structure than the usual structural equation modeling analyses using confirmatory factor analysis (CFA), and is therefore a particularly appropriate technique to address the disputed distinction between *affect* and *cognition*. Thus, the tripartite model is assessed on the various samples of farmers using the ESEM technique, with the weighted least squares mean- and variance-adjusted (WLSMV) estimator[3] and theta

[2] See Chapter 5, section IV.1.c.ii.
[3] When using the WLSMV estimator, the missing values on the outcome variables are handled by pairwise deletion (Muthén and Muthén 1998-2007, p. 7).

parameterization based on polychoric correlations. The scale of the latent dimension was set by fixing the factor's variance to one (Asparouhov and Muthén 2008).

To confirm the validity of the hypothesized *affect-cognition* division, the hypothesized *affect* variables should load higher on one factor than the *cognition* questions, and vice versa. However, because the exploratory latent variables are estimated simultaneously, they cannot be regressed on one another at the same time (Asparouhov and Muthén 2008, p. 12-3). Hence, because behavioural intentions are assumed to be influenced by *affect* and *cognition* (e.g., Bagozzi 1982; Ajzen 2001), the conative indicators cannot be part of the exploratory analysis with the *affect* and *cognition* indicators and at the same time be predisposed by the *affect* and *cognition* factors. Therefore, in the three-factor model, the *conation* indicators were specified as loading on a separate factor[4] while the *affect* and *cognition* indicators could freely load on the two exploratory factors; the *conation* factor regressed on the *affect-cognition* exploratory factors.

2. MIMIC analysis

Finally, the strength in the attitudinal responses of farmers with native forest by choice and farmers with native forest by chance were compared using a Multiple Indicators Multiple Causes (MIMIC) analysis (Jöreskog and Goldberger 1975; Muthén 1989). MIMIC analysis estimates the effects of one or more grouping variables on the latent factors and factor's indicators. *ForestInfluence*[5] was used as the grouping variable distinguishing between farmers with forest by choice and farmers with forest by chance (see Chapter 5, section IV.2. for details on the MIMIC analysis).

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[4] The loadings of the conation indicators on the affect-cognition exploratory factors were specified as null.

[5] *ForestInfluence* indicates whether farmers had chosen to have native forest on their farm. *ForestInfluence* was originally a 5-point Likert-like scale asking farmers to which extent the presence or absence of native forest on the farm influenced their decision to become the manager or owner of the place. The occurrence of native forest on the farm mattered for 15% of respondents (categories '4' and '5' on the scale). This variable was transformed into a binary variable with categories '4' and '5' of the original scale becoming the category '1', i.e., the respondent wanted a farm with native forest, and categories '1' to '3' corresponding to the category '-1', i.e., the respondent did not care about having native forest or not on the farm.

III. Analysis

1. The tripartite attitude model on the whole sample of farmers

a. Affective and cognitive response toward native forest tested over the whole sample: initial results

i. Analysis

One- and two-factor models were run on the eight indicators of farmers' feelings and beliefs[6] toward native forest. Two subsamples (60% and 40% of the whole sample; n = 806 cases[7]) were used to test the generalisation of the model.

These analyses included the variable *LikeDistrict* weighted by the percent of native forest in the respondent's district (*PercentForest*). The resulting variable, *LikeDistrictForest*, was divided by 10 in order to match the variance range of the other seven attitudinal variables.

ii. Results

The correlation coefficients over the whole sample of farmers were all positive (Table A9.1). This was, to some extent, expected because all the attitudinal variables had been re-coded where the high end of the scale corresponded to the more positive attitude towards native forest. However, this result also indicated a certain consistency in farmers' attitudinal responses toward native forest. The two hypothesized *affect* variables *EnjoyForest* and *ChildEnjoyForest* were strongly correlated to each other, and the hypothesized *cognition* variables described a coherent pattern. On the other hand, *LikeDistrictForest* was as poorly linked to the other *affect* variables as to the cognitive variables. Among the *cognition* variables, *ForestUseful* and *ForestBenefit* were more strongly associated than the rest of the cognitive variables. Finally, the *affect* variables seemed more related to some *cognition* variables (*ForestNatural*, *ForestHelpBird*) than others (*ForestUseful*, *ForestBenefit*).

[6] The reader is invited to refer to the Chapter 5 for a detailed account on the *affect* and *cognition* variables.
[7] This includes missing values.

As expected, the distinction between an *affect* and *cognition* dimension described the attitudinal response of farmers towards native forest best in both the 40% and the 60% subsamples.

The one-factor model did not fit the data (Tables A9.2 and A9.3). The fit improved dramatically when the two-factor model was specified. In the two-factor model, the *cognition* variables loaded highly on one factor as expected in both the 40% and the 60% subsamples (Tables A9.4 and A9.5). However, although the majority of the hypothesized *affect* variables (*EnjoyForest* and *ChildEnjoyForest*) loaded highly on the other factor, two of the expected cognitive variables (*ForestUseful*, *ForestBenefit*) displayed equally strong loadings on this factor. *ForestUseful* and *ForestBenefit* also exhibited the two strongest loadings on the *cognition* factor. Interestingly, the particularly high loadings of both *ForestUseful* and *ForestBenefit* ahead of the rest of the variables were also a feature of the one-factor model. *LikeDistrictForest*'s loadings on both factors were weak and highly non-significant on the *affect* factor, which was also the case in the one-factor model. The two factors were strongly correlated. Excluding the variable *ForestLikeDistrict*, the relationship between the observed variables mimicked the one in the correlation table: the *affect* and *cognition* variables were positively linked.[8] The two-factor model explained a moderate to large amount of variance in the attitudinal indicators, with the exception of *ForestLikeDistrict* (Tables A9.6 and A9.7).

b. Affective and cognitive response toward native forest tested over the whole sample: Amendments

i. LikeDistrictForest

The consistently low correlations between *LikeDistrictForest* and the seven other variables, and the poor loadings of this variable on the latent factors suggested that it was different from the other variables (Brown 2006, p. 180). Furthermore, the regression of the hypothesized *affect* variable *LikeDistrict* on its weighing variable, the percent of native forest in the respondent's district (*PercentForest*) was not significantly

[8] In the 60% subsample, the strongest loadings of the hypothesized affect variables *EnjoyForest* and *ChildEnjoyForest* were negative. The loadings of the hypothesized cognition outcomes were positive on their factor. The correlation between the two factors was negative.

different from zero (unstandardized coefficient = 0.025, p = 0.094).[9] The expectation that the amount of native vegetation in the respondents' district would influence respondents' appreciative feelings toward their district was therefore wrong. The question *LikeDistrict* suffered from too general a perspective – respondents could like the district they live in for multiple reasons other than the amount of native vegetation – and did not relate enough to the object of attitude: New Zealand native forest. For these reasons, the variable *LikeDistrictForest* was discarded from further analyses.

ii. ForestUseful, ForestBenefit and potential method bias

ForestUseful and *ForestBenefit* strongly correlated, as did *EnjoyForest* and *ChildEnjoyForest* (Table A9.1). However, *ForestUseful* and *ForestBenefit* also displayed a consistent ascendance over the latent factors (in both the one- and two-factor models) suggesting that these two variables may be affected by method bias. Method bias occurs when the indicators' common variance, besides measuring the underlying concepts of interest (latent factors[10], e.g. *cognition*), is biased by the intrinsic characteristics of the questions, survey, and/or the respondents themselves, e.g., social desirability or context-induced mood[11] (for a review of the main sources of method biases and ways of dealing with them, see Podsakoff et al. 2003). The patterns described by *ForestUseful* and *ForestBenefit* in the attitude model could either be the strongest manifestation of a general method bias affecting all the indicators, or indicates a bias specific only to these two variables. As *ForestUseful* and *ForestBenefit* belonged to the same two-item question, bearing very similar wording[12], it is strongly suspected that the two variables suffered from what could be related to an item context effect (Wainer & Kiely, 1987 in Podsakoff et al. 2003, p. 882).[13]

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[9] The regression was run in Mplus 5.21 using the weighted least squares mean- and variance-adjusted (WLSMV) estimator, which performs probit regression on categorical outcomes (Muthén and Muthén 1998-2007).

[10] Also called trait factors.

[11] Social desirability refers "to the tendency of some people to respond to items more as a result of their social acceptability than their true feelings". Context-induced mood refers "to when the first question (or set of questions) encountered on the questionnaire induces a mood for responding to the remainder of the questionnaire." (Podsakoff et al. 2003, p. 882)

[12] That is, "to what extent are native forest fragments on farm useful to farming?" and "to what extent are native forest fragments on farm a financial benefit?"

[13] An item context effect refers to "any influence or interpretation that a respondent might ascribe to an item solely because of its relation to the other items making up an instrument" (Wainer & Kiely, 1987 in Podsakoff, MacKenzie et al. 2003, p. 882).

If a general method bias affected all the attitudinal indicators, one could take into account in the model the parts of variance variables shared outside the hypothesized construct. A range of techniques take into account such bias in variance (see Podsakoff et al. 2003), among which two apply to the present framework. The first technique controls "for the effects of a directly measured latent method factor" (Podsakoff et al. 2003, p. 893-4). In this technique, the potential method bias is modelled by a latent method factor measured by specific observed variables.[14] The second technique controls "for the effect of an unmeasured latent method factor" (Podsakoff et al. 2003, p. 894). This technique resembles the first one as the observed variable's variance is decomposed into trait, method and random error. However, unlike the first technique, the method factor is not directly measured by method outcomes (Podsakoff et al. 2003, p. 891). Therefore, the researcher does not have to identify a priori the main source of method bias.

On the other hand, if a method bias only affected *ForestUseful* and *ForestBenefit*, one could discard one of the problematic variables. However, it could be argued that if two variables are not perfectly collinear, they both could contain valuable information. Thus, another way to deal with such problematic variables would be to aggregate them into a parcel. Parceling amounts to summing or averaging two or more unidimensional items from the same scale. The relationship of such a sum or average with other variables and its potential for improving the modeling of a multivariate dataset is central, rather than its interpretation (Little et al. 2002; Bandalos 2008).[15] Finally, the residual variances (also called uniqueness) of the variables suspected to suffer from method bias could be correlated. In correlated uniqueness (CU) models, observed variables' variance are assumed to represent trait factors (e.g., *cognition*) and measurement error (residual variance), which includes potential method biases[16] (Lance et al. 2002, p. 231).[17]

[14] All the outcome variables representing the theoretical constructs (e.g. *cognition*) also load on this method factor, yet they can load with different strength. Hence, the measurement error due to this method can be estimated distinctively from trait variance and error term, and for each outcome variable. The researcher assumes that the modelled method factor is the most important source of method bias, and, as in most techniques dealing with method bias, the method and traits factors are orthogonal (not correlated) (Podsakoff, MacKenzie et al. 2003, p. 891, 894).

[15] For a review of the main pros and cons of parcelling see Little, Cunningham et al. (2002).

[16] CU models assume that method biases are not correlated with trait factors. The CU technique allows for different biases, assuming they are also uncorrelated (Lance, Noble et al. 2002, p. 231). The CU technique is typically used when only a subset of observed variables shows strong associations beyond the latent constructs. However, Brown (2006, p. 186) warns against trying to simply increase model fit in an ad-hoc fashion. Hence, one should be able to justify such a correlation of residuals, and consistently apply the same treatment to other variables fitting the same pattern of bias.

[17] See Appendix A9, section III.1.b.i. for a review of other techniques dealing with method bias.

Therefore, based on the above discussion, the following strategies were explored in the next analyses to deal with the *ForestUseful*/*ForestBenefit* issue:

(1) *ForestUseful* or *ForestBenefit* be discarded;

(2) Parcelling (sum) of *ForestUseful* and *ForestBenefit* into *ForestValue*;

(3) The inclusion of a method factor measured by method indicators (CT-CM);

(4) Trait-method factors model where the type of method bias is not known a priori;

(5) Correlated residuals.

The method indicators involved in strategy (3) corresponded to the response wave numbers corresponding to the mailing event (a total of three). People who answered the survey later were expected to be less positively inclined towards native forest, hence, toward the survey. Research suggests that early and late respondents could sometimes display different characteristics and/or answers to the survey topic (e.g., Green 1991; Lankford et al. 1995).

c. *Affect-Cognition* attitudinal model amended

The *affect-cognition* distinction was assessed again without the variable *LikeDistrictForest* and following the strategies mentioned above on the 60% and 40% subsamples.

None of the models converged to a proper solution in the 40% subsample, while only the two-factor models with only *ForestUseful* (strategy 1) converged on the 60% subsample. The same analyses performed on the whole sample of farmers (N = 806) showed that the two-factor model with *ForestUseful* and *ForestBenefit*'s residual variances correlated (strategy 5) and the two-factor models with only *ForestUseful* (strategy 1) converged to proper solution.

This result suggested that the *affect-cognition* structure could not be generalized for any random group of New Zealand farmers.

d. Conclusions

The factor analysis of the attitudinal indicators on random 60% and 40% subsamples of the whole sample of farmers showed that the hypothesized *affect* indicator *LikeDistrictForest* did not fit any of the underlying hypothesized factors. Additionally, two hypothesized *cognition* indicators, *ForestUseful* and *ForestBenefit*, showed signs of method bias. Five strategies were examined to account for the special relationship between these two variables. Results indicated that no general method bias seemed to affect all the attitudinal indicators, but only the *cognition* variables *ForestUseful* and *ForestBenefit* suffered from method bias. Nevertheless, convergence issues affected the results on the 40%-60% subsamples. This suggested that the *affect-cognition* structure could not be generalized for any random group of New Zealand farmers.

Initially, the next step would have been to add the *conation* indicators to the *affect-cognition* model and assess the validity of the tripartite model on the randomly chosen 40%-60% subsamples. However, since the *affect-cognition* model could not be generalised for any group of New Zealand farmers, it was then tested on the two specific groups of interest: farmers with and without native forest fragments on their property.

2. The tripartite attitude model on farmers without native forest fragments

The tripartite attitude model was tested on the sample of farmers without native forest fragments on their property. The same protocol as described in the Methods section of this chapter is followed. Briefly, the distinction between the *affect* and *cognition* dimensions is first investigated. The *conation* dimension is then added to the model and the fit of the tripartite model is assessed. The analyses included 291 respondents.

a. Affective and cognitive response toward native forest of farmers without native forest fragments

i. Analysis of the attitudinal variables

All variables were positively correlated with one another, except *ChildEnjoyForest* and *ForestBenefit*, whose association was almost nonexistent (Table A9.8). The strong correlations between *ForestValue* and *ForestUseful* and *ForestBenefit* reflected the parceling of the two latter variables into *ForestValue*. The relationships between the attitudinal observed variables were very similar to the whole sample correlations, with the exception of *ForestUseful* and *ForestBenefit* (or the parcel *ForestValue*) with the *affect* variables. Here, the associations were much weaker, especially regarding *ForestBenefit*. The hypothesized *affect* and *cognition* variables were strongly correlated within each attitudinal group.

The five analysis strategies (section III.A.2.b) were performed on a one-, and two-factor model. The *affect-cognition* distinction is validated if the indicators of each of the hypothesized attitudinal dimensions load more strongly together on one factor each.

As for the whole sample, there was no support for the effect of a specific method factor represented by the mailing sequences, nor for a general, unspecified method factor affecting all the attitudinal indicators. None of the five strategies gave satisfactory results with the one-factor model. Three strategies fitted the answers of farmers without native forest well when a two-factor model was specified (Table A9.9): only *ForestBenefit* retained (strategy 1), *ForestValue* replacing *ForestUseful* and *ForestBenefit* (strategy 2), and *ForestUseful* and *ForestBenefit*'s residual correlated (strategy 5).

The three models produced similar estimates and attitudinal structure. The indicator variables expected to represent the *affect* or *cognition* factor significantly loaded with similar strength on their respective hypothesized factor. However, *ForestBenefit* (or the related *ForestValue*) also significantly and negatively loaded on the *affect* factor. Nevertheless, compared to its loading on its own *cognition* factor as well as the loadings of the hypothesized *affect* indicators on the *affect* factor, *ForestBenefit*'s loading on the *affect* factor was of a lesser magnitude. The two latent factors were significantly correlated, as well as the residuals of *ForestUseful* and *ForestBenefit* in model-strategy 5. The standardized estimate of *EnjoyForest* on the *affect* factor was very high and highly significant. Its unstandardized estimate was significant at least at $p = 0.075$, except in model-strategy 2. Collapsing *Enjoyforest* categories did not improve the results.

ii. Attitudinal model choice

According to indices of fit, all three attitudinal models fitted the data well. But, were they describing the data equally well?

The models were not nested in one another as they used different sets of variables.[18] Brown (2006, p. 175) suggests comparing non-nested models "with regard to the three major aspects of model acceptability: overall goodness of fit, focal areas of ill fit, and interpretability/strength of parameter estimates".

Comparing the models' overall fit values, the strategy (1) model (*ForestBenefit*) fitted the dataset the best. Although estimates were similar in each model, the models using strategies (1) and (5) (*ForestUseful* and *ForestBenefit*'s residuals correlated) gave the most reliable estimates overall. Finally, although it has been argued that parceling (strategy 2, *ForestValue*) could be used to absorb method bias, Little and colleagues (2002, p. 169) warn: "The largest threats to the validity of parceling are model misspecification in general and a specific form of misspecification, multidimensionality". The strategy (1) model showed that *ForestBenefit* played a role in both the underlying *cognition* and *affect* dimensions. The loading of the parcel *ForestValue* on only the *cognition* factor therefore hid the multidimensionality of *ForestBenefit*. Because the interest ultimately lies in the relationship among items, and between items and latent factors, models including the most information should be preferred – as long as they fit the data.

Based on the overall goodness-of-fit, the reliability of the estimates and the amount of information contained in the model, the model from strategy (1) (only *ForestBenefit*) was retained for the rest of the analyses.

iii. Conclusions

Three attitudinal models presented acceptable and similar solutions. The attitude towards New Zealand indigenous forest of farmers without native forest fragments on their property revealed overall distinct, yet related, emotional and cognitive dimensions,

[18] As these models are non-nested, the model choice cannot rely on the Chi-square test difference. Non-nested models can be compared via the Aikaike information criterion (AIC) or the Bayesian information criterion (BIC) (Brown 2006, p. 175). However, these criteria are maximum-likelihood-based, and are not provided with WLSMV estimation (Muthén 1998-2004, p. 22; Muthén 2006). Mplus provides a robust maximum likelihood (MLR) estimator, which can be used for EFA or CFA with ordinal variables and produces AIC and BIC measures of model fit; yet such an option is not available for ESEM. One could get around this issue for model strategies 1 and 2, as they are actually equivalent to simple EFA models, but model strategy 5 is not, due to the correlated residuals.

with these three models displaying the hypothesized correlated *affect* and *cognition* factors. Nevertheless, the positive affective response of farmers without native forest was also directly influenced by how non-beneficial for the farm farmers without fragments perceive native forest to be. Such attitudes would suggest that these respondents see two types of native fragments: those whose features were fit for farming purposes, and those that respondents enjoyed but were not appropriate for farming. Such a dichotomy in perceptions towards native forest could indicate an inherent difficulty for such farmers to have indigenous forest on their farm.

Based on the overall goodness of fit, focal areas of ill fit, interpretability and strength of the parameter estimates, and amount of information in the model, the model keeping *ForestBenefit* and discarding *ForestUseful* (strategy 1) gave the most satisfactory results. Next, the *conation* dimension was added to the *affect-cognition* model.

b. Affective, cognitive and conative responses toward native forest of farmers without native forest fragments

The *conation* latent dimension was defined by the three variables measuring intentions of behaviour common to the whole sample of farmers: *MoreForest*, *Conservation* and *TreePlanting*.[19] As the *conation* structure was just-identified[20], it was directly added to the *affect-cognition* strategy-1-model. *Affect* and *cognition* latent factors were assumed to directly influence the latent *conation*.

As a large number of missing values affected the variable *MoreForest* (50.3%), models were computed both with and without this variable.

The intention variables fitted well with the other attitudinal variables as the moderate and consistent correlations show (Table A9.14). On the other hand, the correlations between the intention variables themselves displayed less coherence.

[19] See Chapter 5 for a description of the variables.
[20] The number of observations, that is, variances and covariances, was equal to the number of parameters to be estimated (Kline 2005, p. 107, 212; Brown 2006, p. 64).

i. Analysis of the affective, cognitive and conative response of farmers without native forest: three *conation* outcomes

The tripartite attitude model (*affect*, *cognition* and *conation* latent factors), based on the *affect-cognition* structure found previously (strategy 1 model), was compared to two alternatives: one- and two-factor models (see Methods section). Because of the number of missing values on *MoreForest*, results from these three models are tentative. Incidentally, the presence of a general method bias affecting all the attitudinal variables was tested.[21]

The responses of farmers without fragments supported the three-factor model (Table A9.15). The one- and two-factor models did not generate sufficiently good fit to the data. No effect of general method bias was found to affect the sample of farmers without fragments. As in the *affect-cognition* model previously found, the loading estimates supported the hypothesized *affect-cognition* distinction, with *ForestBenefit* loading moderately and negatively on the *affect* dimension (Table A9.16). *EnjoyForest* standardized loading was large and highly significant, while its unstandardized loading was greater than 1 and non-significant.[22] The *conation* outcomes significantly and positively loaded on their hypothesized latent variable. Both *affect* and *cognition* positively influenced *conation*, although the influence of *affect* on *conation* was half as much as that of *cognition*, and the unstandardized effect had a p value of 0.107. This model explained a large amount of *conation* total variance (63.7%) (Table A9.17).

Additionally, the *affect* and *cognition* dimensions showed good reliability, with the respective Cronbach alpha equal to 0.77 and 0.75 and the average inter-item correlations 0.63 and 0.42 (Clark and Watson 1995, p. 315-6; Field 2005, p. 668;

[21] Strategies 3 and 4, see section III.A.2.b. of this chapter.

[22] Collapsing more categories in *EnjoyForest* was considered, as it had some degree of skew, but this did not improve the results. The fact that the *affect* factor is only composed of two outcomes, instead of three as it is often recommended, may play a role in the discrepancy between the p values of unstandardized and standardized estimates. Unfortunately, the issue of non-significant unstandardized estimates but highly significant standardized values in a well fitting model has not yet received much attention in the literature (McIntosh 2009). As a consequence these results should be taken with a certain caution. However, the fact that both the unstandardized and standardized estimates of *EnjoyForest* described the same loading patterns with respect to the other indicators' loadings gives one more confidence in the estimates.

Mueller 1986 in Milfont 2007, p. 84).[23] However, *affect* average inter-item correlations were beyond the threshold advised by Clark and Watson (0.50, Clark and Watson 1995). The *conation* dimension showed less internal consistency than the other two scales: Cronbach alpha was equal to 0.49 and the average inter-item correlation was 0.25.

ii. Analysis of the affective, cognitive and conative response of farmers without native forest: two *conation* outcomes

As mentioned at the beginning of this section, the behavioural intention variable *MoreForest* suffered from a large number of missing values, which weakened the model reliability**.** Although the model generated good results, a model without the variable *MoreForest* may yield different results. Nevertheless, a latent factor only defined by two indicators has a high chance of generating estimation problems (i.e., empirical underidentification, negative residual variance; Rindskopf 1984). Two alternatives were therefore considered: (1) a *conation* latent factor represented by the two remaining outcome variables; (2) no *conation* latent factor, where *affect* and *cognition* directly predicted the two remaining intention variables. When *MoreForest* was removed the covariance coverage[24] ranged between 76.7% and 99.3%.

Alternative 1: Conation factor defined by two indicators

When the relationships between the *conation* latent factor and its indicators (Conservation and TreePlanting) were specified in ESEM the model was empirically underidentified. The scale of the *conation* latent factor was then set by fixing one of its indicators unstandardized loading to one, as in CFA. Nevertheless, the model generated a negative residual variance for the *conation* latent factor. None of these solutions was acceptable.

[23] Usually, an alpha of 0.7 and above indicates good scale reliability (Field 2005, p. 668). However, Mueller (1986 in Milfont 2007, p. 84) suggested that "for samples larger than 100, Cronbach's alpha coefficients greater than 0.40 are acceptable for research purposes". The average inter-item correlation should be between 0.15 and 0.50, depending on the specificity of the concept the scale is meant to measure (the greater the specificity, the greater the value) (Clark and Watson 1995, p. 316).

[24] The covariance coverage over the whole sample represents the percentage of data available per pair of variables (Muthén 1998-2004, p. 26)

Alternative 2: no Conation factor, two independent intention observed variables

For this second alternative, no *conation* latent factor was specified as underlying the two intention outcomes, *Conservation* and *TreePlanting*. Instead, *affect* and *cognition* directly predicted the two intention variables. The model converged to an acceptable solution. However, as suggested by the correlation table (Table A9.14), the two *conation* variables did not significantly correlate with one another. This lack of correlation is most probably responsible for the non-proper solutions generated by the previous model including a *conation* latent variable defined by these two outcomes.

The present model produced very similar results to the initial model including *MoreForest* and a latent *conation* factor (section III.B.2.a) in terms of overall-goodness-of-fit (Table A9.18) and parameter estimates (Table A9.19). The factor structure was unchanged and the *affect* and *cognition* indicators' loadings had similar strength. Only farmers' beliefs (*cognition*) significantly influenced both kinds of intentions towards native forest. Farmers' feelings (a*ffect*) did not influence *TreePlanting*, and their influence on *Conservation* was weak. A larger sample may reveal a more significant effect.[25] The ESEM *affect*-*cognition*-2-*conation*-variables (only *ForestBenefit*) model accounted for less variance in the intention variable *Conservation* (Table A9.20) than in the initial model (section III.B.2.a).

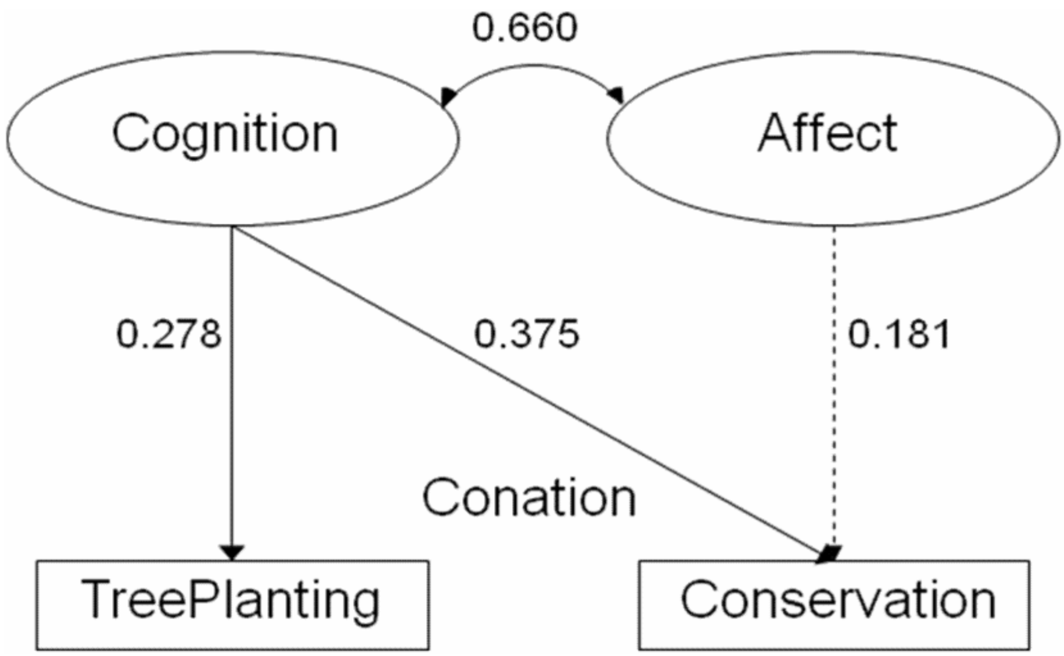
iii. Conclusion

Because of a large number of missing values on the *conation* indicator *MoreForest*, the hypothesized tripartite construct was investigated with and without the *conation* indicator. Two models converged to acceptable solutions supporting the hypothesized tripartite model, with farmers' feelings (*affect*) and beliefs (*cognition*) towards native forest predicting their intentions to act in an environmentally responsible way towards the forest (*conation*). The first model was a three-factor model including *MoreForest*. In the second model, *MoreForest* was removed, and no *conation* latent factor was specified, with *affect* and *cognition* latent dimensions directly predicting the two remaining intention variables. The two models displayed very similar goodness-of-fit and parameter estimates. However, the second model (excluding *MoreForest*), based

[25] The somewhat different relationships between *affect* and the two intention variables may partly explain the significant standardized, yet non-significant *unstandardized,* effect of *affect* on the latent *conation* factor in the initial model (0.289, p = 0.70; see section III.B.2.a).

on a more consistent number of cases between all correlations, was more reliable. Furthermore, the non-significant correlation between the two intention variables found in the last model indicated that for farmers without fragments, enhancing native forest outside the farm and on the farm were different issues, opposing the use of a *conation* latent factor. Finally, as the next goal is to assess the effects of situational variables on the attitudes of the sampled New Zealand farmers, it was necessary to include as many respondents as possible in the analysis. Therefore, the next analyses concerning farmers without native forest would be done on the *affect*-*cognition*-2-*conation*-variables (only *ForestBenefit*) model (Figure 9.2). In this model, a*ffect* and *cognition* explained more of the intention variable *Conservation*'s variance than *TreePlanting*, suggesting that the attitudinal model was measuring more an abstract attitude towards a native forest outside the farm area. Next, the attitudinal responses of farmers with native fragments are examined.

Figure 9. 2 ESEM *affect-cognition*-2-*conation-variables* (only *ForestBenefit*) model on farmers without native forest, N = 291, with standardized regression and correlation coefficients. In solid line, relationships significant at p ≤ 0.10; in dashed line, relationships significant at 0.10 < p ≤ 0.15.



3. The tripartite attitude model on farmers with native forest fragments

The same analysis protocol as for farmers without native forest (see section II) was followed for testing the validity of the tripartite model on farmers with native forest. Again, the partition between *affect* and *cognition* factors was first examined, and was followed by the assessment of the hypothesized tripartite model.

a. Affective and cognitive responses toward native forest of farmers with native forest fragments

i. Analysis of the attitudinal variables

The analysis of the affective and cognitive dimensions was performed on 515 respondents with native forest fragments on their property.

The correlations between the *affect* and *cognition* indicators (Table A9.21) exhibited more consistency than for respondents without native forest. The variables were strongly correlated to each other, especially the two *affect* variables and *ForestUseful* with *ForestBenefit*. Contrary to farmers without forest, *ForestUseful*, *ForestBenefit* and *ForestValue* all correlated well with the other altitudinal variables.

One- and two-factor models were run under the five analysis strategies (section III.A.2.b.). Only the two-factor model retaining *ForestUseful* and discarding *ForestBenefit* (strategy 1) fitted respondents' attitudes toward New Zealand forest well (Table A9.22). In contrast, the attitudes of farmers without forest was best described when *ForestBenefit* was retained and *ForestUseful* discarded.

The hypothesized *affect* and *cognition* factors emerged more clearly than on the sample of farmers without native forest (Table A9.23 compared to Table A9.10). *EnjoyForest* and *ChildEnjoyForest* loaded significantly on one factor, while *ForestNatural*, *ForestUseful*, *ForestDecline*, and *ForestHelpBird* loaded on the other factor. The two factors were significantly and positively correlated. However, it is worth noting that, while the standardized loading of *EnjoyForest* on the *affect* factor was very high and significant, the unstandardized loading was again of large magnitude compared to the other loadings, and not significant.[26] A substantial amount of variance in the attitudinal indicators was accounted for in the model (Table A9.24).

ii. Conclusions

Results supported the hypothesized *affect-cognition* distinction in the attitudes toward native forest of farmers with native fragments. While both affective and cognitive responses were still related, farmers with native forest distinguished between the feelings and the beliefs they held towards native forest more clearly than farmers without native forest. Unlike the latter, farmers with indigenous forest appreciated native forest irrespective of its role (or its absence of role) on the farm.

However, such results implied that farmers with and without fragment(s) responded to a different construct of attitude, thus preventing further quantitative comparison between the two groups' attitudinal responses towards New Zealand native forest.

b. Affective, cognitive and conative responses toward native forest of farmers with native forest fragments

Since a satisfactory affective and cognitive structure of the attitudes towards native forest of farmers with fragment(s) was found, the attitudinal picture was completed by adding the *conation* (behavioural intention) dimension.

Since farmers with and without native forest followed different *affect* and *cognition* models, it was not necessary to concentrate only on the *conation* indicators common to both groups of farmers. Therefore, the behavioural intentions of farmers with forest were assessed in greater detail by adding to the three common *conation* indicators (*Conservation*, *MoreForest*, *TreePlanting*) of farmers' intentions towards their own native fragments (*NoDecrease*, *Fence*, *Control*, *Inventory*, *Protection*).[27]

[26] See note 22 in section III.B.2.a. Again, the model was run with *EnjoyForest* collapsed into two categories, but this did not improve the results. The variable was therefore left as it was.
[27] See Chapter 5 for a description of the variables.

i. *Conation* variables and issues

Screening of the *conation* variables revealed that two of the five *conation* variables specifically addressed to farmers with native forest fragments – *NoDecrease* and *Inventory* – had to be discarded because of high skewness and kurtosis. Only 6.1% of respondents stated they would decrease the size of some of their native fragment(s), and 6.6% would get an ecological inventory.

ii. Analysis of the *conation* variables

The most relevant of the six remaining intention variables in representing the *conation* latent factor were first identified before assessing the tripartite model. Polychoric correlations between the remaining six *conation* indicators were rather disparate (Table A9.25).

The six *conation* variables were submitted to an exploratory factor analysis. This analysis showed that three more variables had to be excluded because they produced factor loadings that were too low (>0.3) and/or inadmissible solutions. Interestingly, the final three variables left were the three *conation* indicators common to both farmers with and without native forest: *Conservation*, *MoreForest*, and *TreePlanting*. They loaded on a unique factor.[28] Because the one-factor model was just-identified (zero degree of freedom), it perfectly fitted the data.

iii. Analysis of the affective, cognitive and conative response of the whole sample of farmers with fragments

The *conation* latent variable defined by the indicators *Conservation*, *MoreForest*, and *TreePlanting* was added to the *affect-cognition* model found earlier. Based on the tripartite model, the *affect* and *cognition* latent factors were assumed to cause *conation* while still correlating with one another. Affective and cognitive observed variables were still free to load on either of the two factors. Following the

[28] They loaded on a unique factor with the following significant standardized loadings: *Conservation* = 0.348, *MoreForest* = 0.778, *TreePlanting* = 0.467.

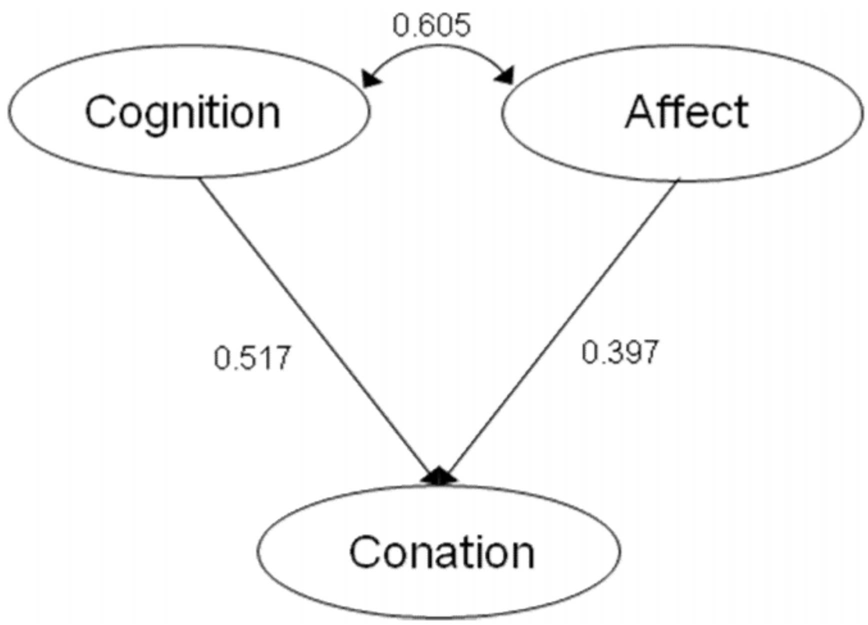
same rationale as for farmers without fragments, the tripartite attitude model was assessed against one- and two-factor models. The polychoric correlations between the three groups of attitudinal indicators showed that the behavioural intention variables correlated consistently well with the affective and cognitive variables (Table A9.26).

The three-factor model described the attitudinal answer of farmers with fragments towards New Zealand indigenous forest best (Table A9.27 and Figure 9.3). Neither the one-factor nor the two-factor models fitted the data well enough. The attitudinal indicators significantly and strongly loaded on their respective hypothesized factors (Table A9.28). Both farmers' feelings (*affect*) and beliefs (*cognition*) towards the forest significantly and positively predicted their intentions (*conation*) towards the forest, but, as for farmers without fragments, *cognition* was a stronger predictor of *conation* than *affect*. The model significantly explained 67.3% of *conation* variance, about the same as for farmers without native forest (63.7%) (Table A9.29).

While the *affect* and *cognition* dimensions displayed good internal consistency (respective Cronbach alpha were both equal to 0.73 and average inter-item correlations were 0.57 and 0.40), *affect* average inter-item correlation was just above the top threshold (Clark and Watson 1995, p. 315-6; Field 2005, p. 668; Mueller 1986 in Milfont 2007, p. 84). Again, the *conation* dimension exhibited less reliability than *affect* and *cognition* (Cronbach alpha = 0.52; average inter-item correlation = 0.26).[29]

[29] Usually, an alpha of 0.7 and above indicates good scale reliability (Field 2005, p. 668). However, Mueller (1986 in Milfont 2007, p. 84) suggested that "for samples larger than 100, Cronbach's alpha coefficients greater than 0.40 are acceptable for research purposes". The average inter-item correlation should be comprised between 0.15 and 0.50, depending on the specificity of the concept the scale is meant to measure (the greater the specificity, the greater the value) (Clark and Watson 1995, p. 316).

Figure 9. 3 The three-factor ESEM model (only *ForestUseful*) on farmers with native forest, N = 515, with standardized regression and correlation coefficients. In solid line, relationships significant at p ≤ 0.10.



c. Comparison of attitude of farmers with native forest by choice and with native forest by chance

The attitude of farmers with native forest towards New Zealand indigenous forest was then examined in greater detail by comparing the strength in attitudinal responses of farmers who had chosen their farm according to the presence of native forest on the property (farmers with forest by choice) and farmers who had not actively sought to have native forest on their farm (farmers with forest by chance). Because they actively chose farms with native forest, farmers with forest by choice were assumed to have an a priori positive attitude towards native forest, and were therefore expected to hold stronger positive attitudes towards native forest than farmers with forest by chance.

The attitudinal responses of farmers with forest by choice and forest by chance were compared analyzing the ESEM tripartite model found previously (see section III.C.2) using the Multiple Indicators Multiple Causes (MIMIC) framework (Muthén 1989; Hrubes and Ajzen 2001). The two groups were distinguished via the grouping variable *ForestInfluence*. The MIMIC analysis is briefly described in section II of this chapter. See Chapter 5, section IV.2. for a more detailed account.

i. Results

As expected, farmers with forest by choice did exhibit stronger positive feelings and beliefs towards native forest than farmers with forest by chance, as shown by the significant direct effects of *ForestInfluence* found on the *affect* and *cognition* latent factors (Table A9.31). However, following Cohen's *d* guidelines (Cohen, 1992 in Brown 2006, p. 314)[30], the effect of *ForestInfluence* on the latent factors *affect* and *cognition* were small. The two groups of farmers also tended to differ in their level of pro-environmental intentions towards the forest. While *ForestInfluence* did not have a direct significant effect on the *conation* dimension, its direct effects on *affect* and *cognition* propagated to *conation* (Table A9.31, row indirect effect). Interestingly, once the influence of the presence of native forest on the farm was taken into account, the effect of farmers' beliefs on their intentions towards native forest decreased while the effect of farmers' feelings increased to display similar levels of influence on intentions towards native forest. Finally, no significant effect of the covariate on particular factors' indicators was found. The two groups responded similarly to the individual items. The MIMIC three-factor ESEM model fitted the dataset well (Table A9.30). The distinction between the two groups of farmers with native forest explained some variance in the *affect* and *cognition* latent factor (Table A9.32), but not in the *conation* latent factor (67.3% of variance explained in the model without *ForestInfluence*, Table A9.29)

ii. Conclusion

The analysis of the attitudinal responses of farmers with native forest fragments supported the tripartite construct as the best attitudinal model. Although farmers' feelings (*affect*) and beliefs (*cognition*) towards New Zealand native forest were correlated, the distinction between the two was clear. Furthermore, both farmers' feelings and beliefs explained a large amount of their behavioural intentions (*conation*) towards the forest. Nevertheless, as for farmers without native forest, the intentions towards indigenous forest of farmers with native forest were more strongly influenced by their beliefs than their feelings towards native forest. However, this relationship changed once the farmers with forest by choice were distinguished from farmers with forest by chance: the influence of *affect* and *cognition* on farmers' intentions became similar. This result suggests that farmers with forest by choice had a balanced attitude

[30] d = 0.20, small; 0.50, medium; 0.80, large effects (Cohen, 1992 in Brown 2006, p. 314).

towards the forest, where their feelings and beliefs played an equal role in their decision to take action. Farmers with forest by chance, on the other hand, tended to base their decisions more strongly on their beliefs rather than feelings towards indigenous forest. Overall, and as expected, farmers with forest by choice showed higher levels of positive feelings, beliefs and intentions towards native forest than farmers with forest by chance.

IV. Discussion

As hypothesized, farmers' specific attitudes towards New Zealand native forest involved three distinct components: feelings (*affect*), beliefs (*cognition*) and intentions (*conation*), supporting the hypothesized tripartite model. The more farmers appreciated indigenous forest and held pro-environmental beliefs towards it, the more they were ready to act in an environmentally responsible way towards the forest. Positive feelings and beliefs towards the forest were also positively correlated.

However, detailed analysis of the attitude constructs distinguishing between farmers with native fragments on their property and farmers without fragments revealed that both groups did not respond in exactly the same fashion. While the feelings and beliefs towards native forest of farmers with fragments were distinct yet correlated, farmers without fragments tended to enjoy New Zealand native forest when it was perceived as not having monetary value for the farm. Such a monetary notion was absent from the attitudes of farmers with fragments, whose pro-environmental beliefs only revolved around the positive *functions* of native forest within the natural environment and the farm, and the realization that New Zealand indigenous forest was a finite resource. Beliefs of farmers without native forest also included the notions of services the forest rendered to the environment and of its possible disappearance. However, farmers without forest responded more strongly to the idea of native forest on farms being 'financially beneficial' rather than 'useful' in general. These differences in *affect* and *cognition* constructs suggest that farmers without fragments tended to dissociate the profit-oriented farm environment from the natural environment, whereas farmers with fragments tended to have a more integrative perception of native forest.

Differences between farmers with and without native forest fragments were further apparent in the way farmers' feelings and beliefs towards native forest affected their intentions towards it. The intentions of farmers with native forest formed a rather coherent dimension, which was influenced by both their feelings and beliefs towards indigenous forest. For farmers without native forest, on the other hand, feelings – associated with the belief that native fragments were costly for farming – only influenced general intentions towards New Zealand indigenous forest, but not intentions towards fragments on farms. Willingness to take part in the protection of native forest in a general abstract context involved rational thinking as well as emotional appreciation of indigenous forest – with the condition that forest was perceived as being costly for farming. On the other hand, planning to improve native forest on the farm was only dependent on rational thinking. Moreover, for farmers without fragments, these two intentions were not related: planning in getting involved in the conservation of New Zealand indigenous forest outside the farm did not imply planning of enhancing the condition of native forest on the farm (and vice versa). Again, these results suggested that, while farmers with native forest tended to perceive native forest as a whole, farmers without native forest fragments tended to perceive two distinct native forests: one outside the farm that one can enjoy and one on the farm aimed at profit-making. Such differences can be viewed in terms of instrumental versus intrinsic values of nature (Dietz et al. 2005), suggesting that farmers with native forest tended to grant an intrinsic value to native forest, while farmers without fragments tended to perceive more strongly its instrumental value.

The differences within the *affect*, *cognition* and *conation* constructs between farmers with and without native forest prevented further comparisons of the strength of the positive attitudes towards New Zealand indigenous forest between these two groups. In particular, the hypothesis that the presence of native forest on the farm was associated with stronger positive attitudes towards native forest in general could not be directly assessed. However, the levels of pro-environmental attitudes were compared between farmers with forest by choice and farmers with forest by chance. Farmers with forest by choice were hypothesized to have a priori highly positive attitudes towards native forest. However, because direct interactions with nature have been shown to induce an increase in pro-environmental attitudes (e.g., Orams 1997; Powell and Ham 2008), farmers with forest by chance were expected to show smaller differences, if any at all, in pro-environmental attitudes compared to farmers with forest by choice. Results showed that farmers who had chosen to have native forest indeed tended to display a higher level of pro-environmental feelings, beliefs and behavioural intentions towards native forest than farmers with forest by chance. Yet the differences were of small magnitude. Additionally, the intentions of farmers with forest by choice were equally predisposed by their feelings and beliefs towards native forest, whereas the intentions of farmers with forest by chance were more strongly predicted by their beliefs. As farmers with forest by choice held stronger pro-environmental attitudes, specifically stronger intentions, towards indigenous forest, this result emphasizes the importance of the affective dimension in pro-environmental attitudes.

V. Conclusion

This chapter examined the validity of the tripartite attitude model on the various samples of New Zealand farmers. The tripartite attitude model is defined by affective (feelings), cognitive (beliefs) and conative (behavioural intentions) dimensions, where correlated *affect* and *cognition* predispose *conation*. This model was used to measure farmers' specific attitudes towards New Zealand native forest.

The tripartite model was first assessed on two randomly chosen subsamples of the whole sample of farmers. However, lack of model convergence in one of the subsamples showed that the tripartite model could not be generalised to any group of New Zealand farmers. Secondly, the validity of the tripartite attitude model was examined on the samples of farmers with and without native forest fragments, as well as farmers with forest by choice and with forest by chance. The analyses of the attitudes of farmers with and without forest fragments supported the tripartite model. However, the two groups still showed some differences in their respective attitudinal construct, preventing quantitative comparisons between them. Farmers with fragments had a more comprehensive attitude towards native forest, while the attitude of farmers without fragments seemed to be split between New Zealand indigenous forest inside and outside the work environment. This could indicate an inherent difficulty for such farmers to accept having native forest on their farm. Finally, the strength of the pro-environmental attitudes of farmers with forest by choice and farmers with forest by chance were compared. As expected farmers with forest by choice displayed stronger pro-environmental attitudes towards indigenous forest. Furthermore, the intentions towards forest of farmers with forest by choice were equally influenced by their beliefs and feelings towards native forest. The intentions of farmers with forest by chance, on the other hand, were more strongly influenced by their beliefs than their feelings.

The next chapter combines the two measures of general attitudes towards the natural environment investigated in the two previous chapters and the specific attitude model examined here in order to form a more complete picture of farmers' attitudes towards nature.

Chapter 10: Farmers' general and specific attitudes towards native forest: Schultz' scale, NEP scale, and tripartite attitude model

I. Introduction

In Chapters 7 and 8, the general environmental attitudes of farmers with and without native forest on their property were assessed using an abbreviated version of the revised New Environmental Paradigm (NEP) scale (Dunlap et al. 2000) and Schultz' (2001) value-based environmental concern scales.[1] As expected, the NEP scale was found to be unidimensional and the EMS scale to be tri-dimensional in both samples. Farmers with and without native forest did not significantly differ in their level of adherence to the two scales, but farmers with forest by choice displayed stronger core general pro-environmental beliefs (NEP) than farmers with forest by chance. The specific attitude of farmers towards native forest was then assessed using the tripartite framework (see Chapter 9). While the tripartite construct was supported in both the samples of farmers with and without native forest, the two groups responded to different attitudinal structures, preventing further qualitative comparisons of the attitudinal responses between these two groups.

In this chapter, the two general attitudinal measures are combined with the specific measure of attitude towards New Zealand native forest based on a general-specific attitudinal approach (Stern et al. 1995a; Stern et al. 1995b). A general-specific approach allows better understanding of New Zealand farmers' attitudes towards the natural environment. Additionally, as EMS and especially NEP scales have been validated in different studies as measuring people's environmental attitudes, they are also used as references for the tripartite specific attitude measure. Significant relationships between these general measures of attitude and the specific measure of attitude towards New Zealand indigenous forest would support the validity of the specific attitudinal measure. In order to test this proposition, this chapter is organized as follows: first, the structure and fit of the combined models, NEP-tripartite and Schultz-tripartite, were separately assessed. Secondly, as these two preliminary models gave

[1] Schultz' (2001) value-based environmental concern scales are also referred to as the Environmental Motives Scale (EMS) (Schultz et al. 2004, p. 34).

acceptable results, the three scales were then combined together and the structure and fit of the full general-specific attitude model was assessed. This investigation was conducted using a structural equation modeling (SEM) framework, first on the sample of farmers without native forest, then on farmers with native forest. A qualitative comparison of the model structures was carried out between the two samples. Finally, the general-specific attitudes of farmers with forest by choice were quantitatively compared the general-specific attitudes of farmers with forest by chance using a Multiple Indicators Multiple Causes (MIMIC) analysis.

II. Analysis framework

The structure of the three attitudinal measures (NEP, EMS and the tripartite model) were individually tested in the three previous chapters. As the attitudinal models become more complex and the effects of situational variables are later added to farmers' attitude and attitude-behaviour models, the number of parameters to estimate increases. For these reasons, the relationships between the variables are hereafter examined using the conventional structural equation modeling (SEM) framework, as opposed to the exploratory structural equation modeling (ESEM) analysis used to assess the tripartite attitude model in Chapter 9. In contrast to ESEM, the variables in SEM are not free to load on different factors; the relationships between the observed variables and the latent factors are predetermined.[2]

As in the previous chapters, the comparison of pro-environmental attitudes between farmers with forest by choice and farmers with forest by chance is assessed through Multiple Indicators Multiple Causes (MIMIC) analysis (Jöreskog and Goldberger 1975; Muthén 1989).[3] Again, *ForestInfluence* served as the grouping variable.[4]

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[2] See Chapter 5, section IV.1.c.ii.
[3] See Chapter 5, section IV.2.
[4] *ForestInfluence* indicates whether farmers chose to have native forest on their farm when they took over the property.

III. NEP and tripartite attitudinal responses of farmers

1. Model hypotheses

Since the NEP scale assesses people's core beliefs about the relationship between human beings and the natural environment, a significant positive relationship between NEP and the specific cognitive measure of beliefs towards New Zealand indigenous forest was expected. As pro-environmental beliefs are likely to be associated with an affective bond with, and a willingness to behave in an environmentally responsible way towards, the natural environment (Chapter 2), the NEP scale was also expected to relate positively, but to a lesser extent, to the specific affective and conative attitudes towards native forest. Furthermore, the difference in the objects' scale[5] was likely to generate relationships of 'small' magnitudes[6] between the NEP scale and the tripartite attitudinal measures. Within the sample of farmers with native forest, farmers who had actively sought farms with native forest (farmers with forest by choice) were expected to exhibit stronger pro-environmental general attitudes and specific attitudes towards native forest than the rest of farmers with native forest (farmers with forest by chance).

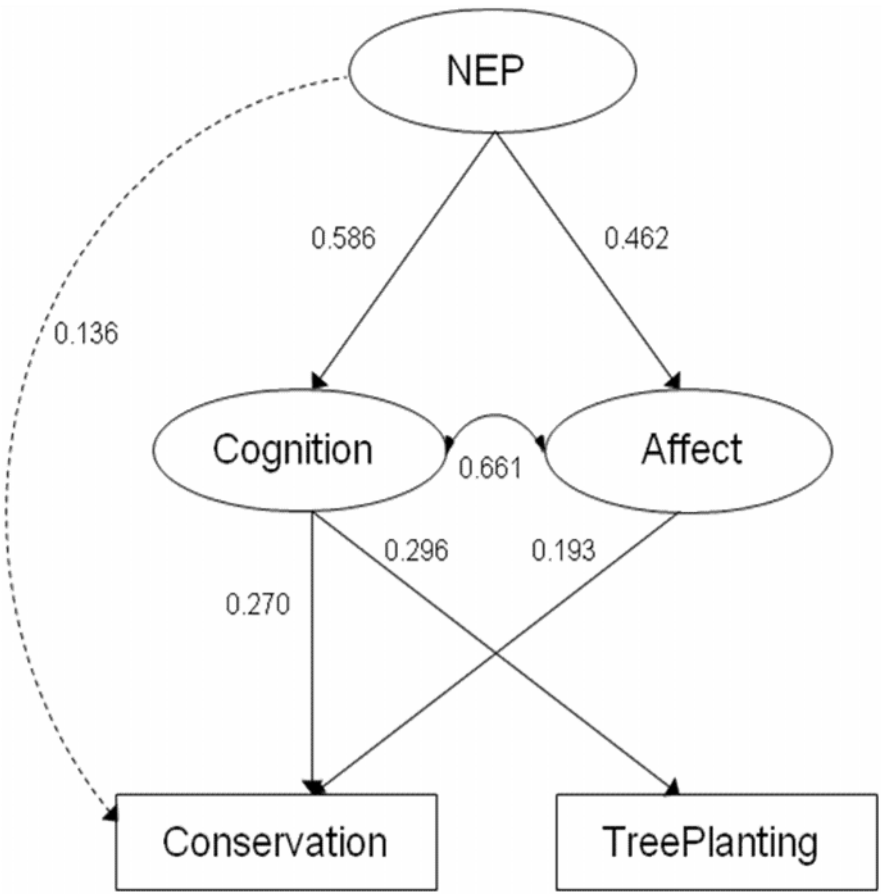
2. Results: NEP and tripartite attitude responses of farmers without native forest

The model fitted the data well (Table A10.1). As hypothesized, farmers' core beliefs towards the natural environment (NEP) predicted their specific attitudes towards New Zealand indigenous forest (Figure 10.1). NEP had significant and positive direct effects on farmers' feelings (*affect*) and beliefs (*cognition*) towards native forest (Figure 10.1). These effects were of medium magnitude (Cohen 1992) and, as expected, NEP predicted *cognition* more strongly than *affect*. The effects on farmers' behavioural intentions towards native forest (*conation* variables: *TreePlanting* and *Conservation*) were more ambiguous. NEP did not directly influence *TreePlanting*[7] (standardized regression coefficient less than 0.10 and associated p value greater than 0.15), while the

[5] NEP measures general beliefs, whereas the specific cognitive, affective and conative scales focus on native forest.
[6] Following Cohen's (1992) guidelines: standardized regression coefficient below |0.20|: 'trivial'; between |0.20| and |0.50|: 'small'; between |0.20| and |0.80|: medium; greater than |0.80|: 'large'.
[7] The reader is invited to consult Chapter 5 or Appendix 0 for a description or the exact wording of any attitudinal variables.

trivial standardized direct effect on *Conservation* (0.136) had a p value of 0.104. However, the indirect effects of NEP on the *conation* variables via *affect* and *cognition* were significant (Table A10.2). Overall, farmers' core beliefs had a marginal influence on farmers' intentions towards indigenous forest (Table A10.3): due to either a lack of, or trivial direct effects of NEP on the intention variables, the NEP-Tripartite model accounted for about the same amount of variance in *Conservation* and *TreePlanting* as *affect* and *cognition* alone.[8] On the other hand, farmers' core beliefs towards the environment explained substantial amounts of the variance in farmers' affective and cognitive responses towards native forest.

Figure 10. 1 Schema of the NEP-Tripartite model with standardized regression (direct effects) and correlation coefficients of farmers without native forest (N = 291). Solid lines represent relationships significant at p ≤ 0.10; dashed lines represent relationships significant at 0.10 < p ≤ 0.15.



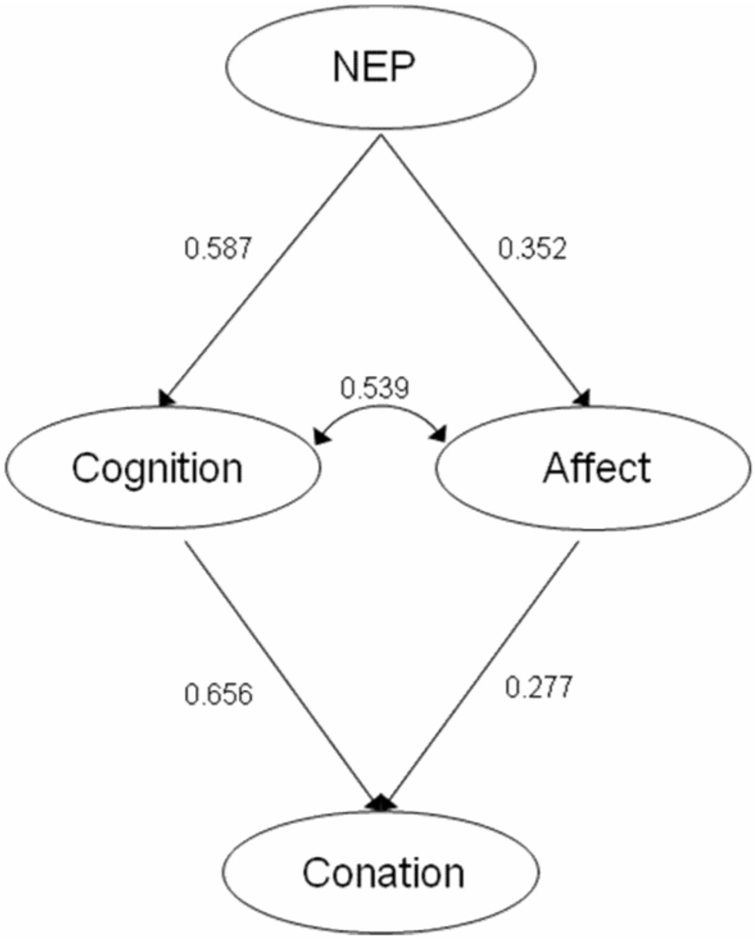
[8] In the tripartite model alone (see Chapter 9), *affect* and *cognition* accounted for 26.1% of *Conservation*'s total variance and 9.2% of *TreePlanting*'s variance. The slight decrease in amount of *TreePlanting*'s variance explained compared to the tripartite model alone was most probably due to discarding the *affect*-*TreePlanting* relationship, which was non-significant in the present model, but was kept in the initial tripartite model.

3. Results: NEP and tripartite attitude responses of farmers with native forest

Overall, the NEP-tripartite model fitted the data well, although CFI was below its 0.95 threshold (Table A10.4). As expected, respondents' core beliefs towards the natural environment predicted their beliefs and feelings towards native forest. NEP also influenced *cognition* more than *affect* (Figure 10.2). Consequently, NEP explained more of *cognition*'s total variance than *affect*'s (Table A10.6). On the other hand, respondents' core beliefs towards nature did not directly influence their behavioural intentions towards New Zealand native forest (Figure 10.2). However, via *affect* and, especially, *cognition*, the indirect effects of NEP translated into stronger pro-environmental intentions towards the forest (Table A10.5).[9] Core environmental beliefs explained 6.3 percentage units more of *conation*'s variance than the tripartite model alone (Table A10.6).[10] The addition of the NEP scale did not alter the structure of the tripartite model, with *conation* still being more influenced by *cognition* than by *affect*.

[9] The addition of the NEP scale increased the influence of *cognition* on *conation* and decreased the impact of *affect*. The standardized regression coefficient of *cognition* and *affect* on conation in the tripartite model alone were respectively 0.517 and 0.397.
[10] 66.8% of *conation*'s variance was accunted for in the initial tripartite model (see Chapter 9).

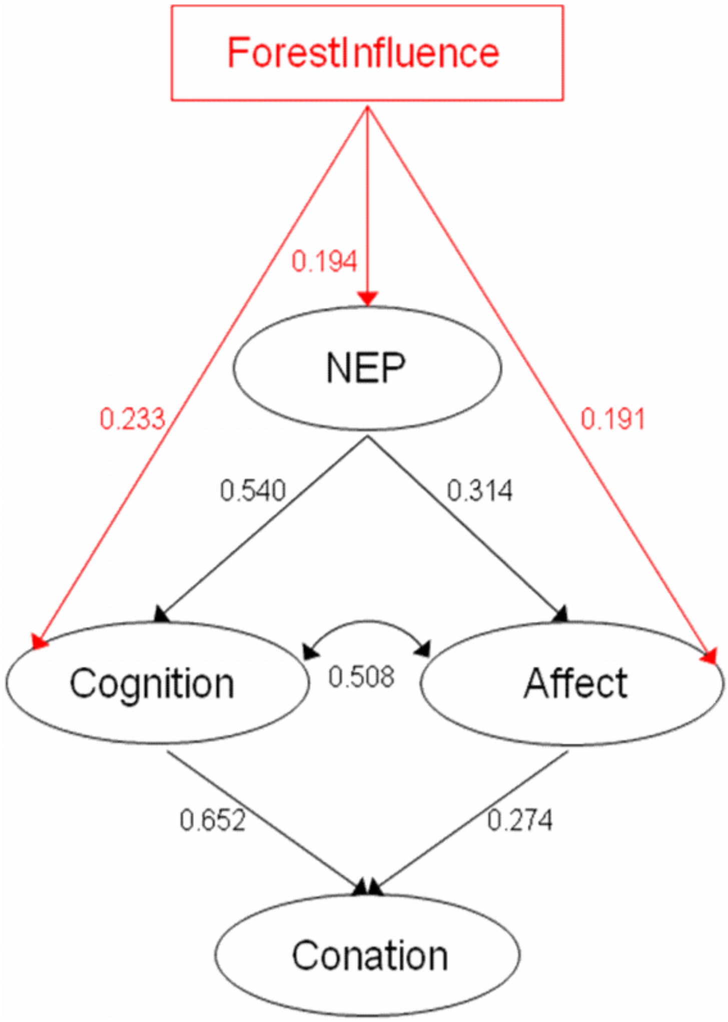
Figure 10. 2 Schema of the NEP-Tripartite model with standardized regression (direct effects) and correlation coefficients of farmers with native forest (N = 515). Solid lines represent relationships significant at p ≤ 0.10.



4. Results: NEP and tripartite attitude responses of farmers with native forest by choice and farmers with native forest by chance

The MIMIC model fitted the data well (Table A10.7). Farmers with forest by choice and farmers with forest by chance responded to the same attitudinal model, as none of the effect coefficients of the grouping variable (*ForestInfluence*) on the attitudinal indicators were significant (Figure 10.3). As expected, farmers with a priori positive attitudes towards indigenous forest (farmers with forest by choice) displayed slightly more pro-environmental feelings (*affect*) and beliefs towards native forest (*cognition*), as well as more core beliefs towards nature in general (NEP), than farmers with forest by chance (Figure 10.3). Distinguishing between the two groups of farmers with native forest accounted for a small amount of variance in respondents' core beliefs towards the environment: the addition of the grouping variable *ForestInfluence* explained 3.8% of variance in NEP (Table A10.9). *ForestInfluence* also explained a small additional amount of variance in *affect* and *cognition* than NEP alone (3.5 and 4.9 percentage units more, respectively). Distinguishing between the two groups of farmers with native forest resulted in only a small change in the magnitude of the indirect effect of NEP on *conation* (Table A10.8 compared to Table A10.5). Therefore, in both groups of farmers with native forest, stronger pro-environmental affective and cognitive responses, due to stronger pro-environmental core beliefs (NEP), translated into stronger pro-environmental intentions towards native forest. However, distinguishing between the two groups did not change the relative influence of beliefs and feelings on farmers' intentions towards the forest. As a consequence, the MIMIC model did not account for more variance in intentions (Table A10.9).

Figure 10.3 Schema of the MIMIC NEP-Tripartite model with standardized regression (direct effects) and correlation coefficients of farmers with native forest by choice and farmers with native forest by chance (N = 507). Solid lines represent unstandardized[a] estimates significant at p ≤ 0.10.



[a] Mplus outputs of SEM analysis with exogenous effects on latent variables do not provide p values for standardized estimates

IV. Environmental Motives Scale and tripartite attitudinal responses of farmers

1. Model hypotheses

Although Schultz' (2001) Environmental Motives Scale (EMS) has been tested on different populations, to my knowledge, it has not been applied to a farming population. Therefore, all three value-based environmental concern scales (egoistic, altruistic and biospheric) were directly linked to all three dimensions of the tripartite attitudinal model (*affect*, *cognition* and *conation*). Because people are likely to show a continuum of concern between these three motives – rather than being only concerned for oneself, only for others, or the biosphere – it was expected that the three environmental concerns would positively correlate to each other. However, since farmers engage in extractive activities towards nature in order to make a living, their attitude towards native forest, especially when it is on the farm, was expected to be influenced by egoistic environmental concern. However, due to a constant proximity with native forest and the familiarity and attachment that may result from it, the attitudes of farmers with native forest was expected to be also influenced by biospheric concern. Furthermore, as the tripartite attitudes of farmers with native forest suggested they perceived native forest as having an intrinsic value, whereas farmers without native forest tended to perceive more of its instrumental value (see Chapter 9), farmers with native forest were expected to correlate higher on biospheric concern while farmers without native forest would correlate higher on egoistic concern. Finally, farmers with forest by choice were expected to display stronger biospheric environmental concern than the rest of farmers with native forest.

Because Schultz' measure invokes a mix of affective and cognitive responses, it was expected to relate more strongly to the affective and cognitive dimensions of the tripartite attitude model than the conative dimension. Additionally, as people are more likely to feel concerned for the environment when they positively relate to it on an emotional level (Chapter 2), the affective dimension of the tripartite model was expected to correlate more strongly with biospheric concern than any of the other two environmental concerns. Nevertheless, as the value-based environmental concerns operate on a more general level than the tripartite measure of attitude, the relationships between the environmental concerns and the tripartite model were likely to be of small strength.

2. Results: Environmental Motives Scale and tripartite attitude responses of farmers without native forest

The EMS-tripartite model did not fit the data as well as the NEP-tripartite model, but remained within the reasonable thresholds (Table A10.10). As hypothesized, farmers' value-based environmental concerns (EMS) predisposed their specific attitudes towards New Zealand indigenous forest (Figure 10.11). Pro-environmental beliefs towards New Zealand native forest of farmers without native forest were affected by biospheric and altruistic environmental concerns. Pro-environmental feelings towards indigenous forest were not directly related to farmers' value-based environmental concerns.[11] Both intention variables were directly influenced by egoistic environmental concern. However, pro-environmental intentions towards native forest in general (*Conservation*) were associated with non-egoistic environmental concern, while pro-environmental intentions towards the forest on the farm (*TreePlanting*) were related to egoistic environmental concern. *Conservation* was also predicted by biospheric environmental concern. The three environmental concerns were significantly and positively correlated to one another.

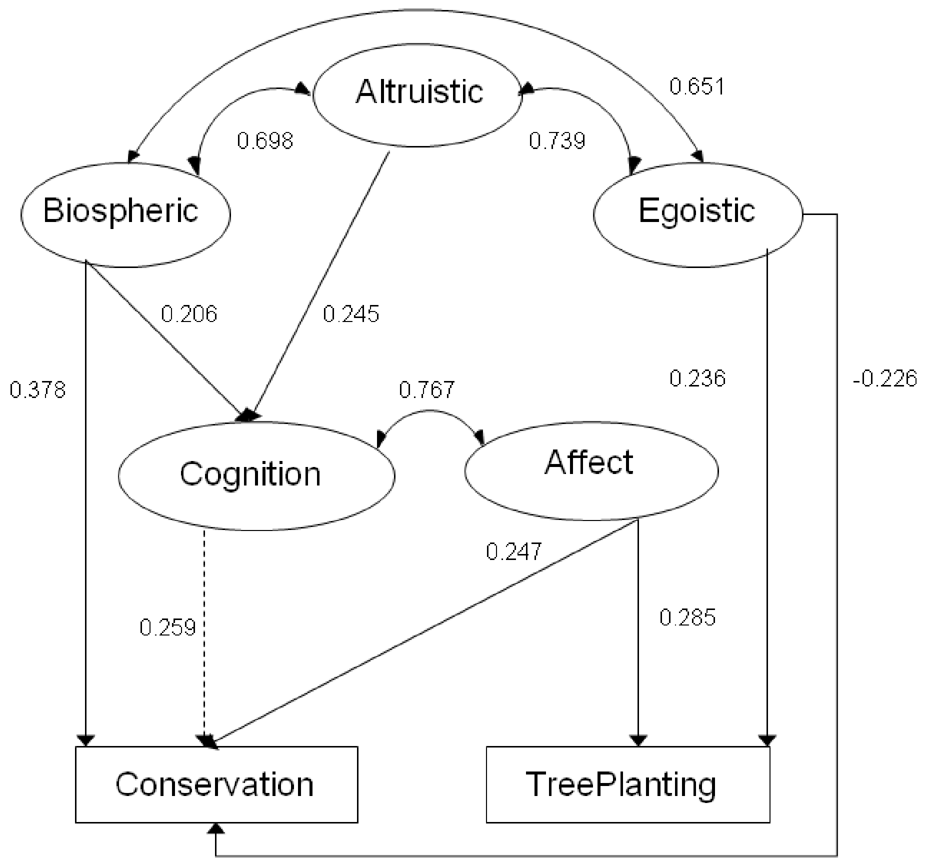
The addition of the egoistic, altruistic and biospheric scales changed some aspects of the tripartite attitude model. EMS made the loading of *ForestBenefit* on the *affect* factor non-significant. Furthermore, *ForestBenefit*'s loading on the *cognition* factor decreased. Finally, the *conation* indicator *TreePlanting* was now driven by *affect*, instead of *cognition* (compare Figure 10.11 with Figure 10.4).

The value-based environmental concerns accounted for a substantial amount of variance in respondents' beliefs towards New Zealand indigenous forest (Table A10.11). The EMS-tripartite model explained 7.6 percentage points more variance of *Conservation* and 4.5 percentage points more variance of *TreePlanting* than *affect* and *cognition* alone[12]. In comparison to the amount of variance accounted for in the NEP-tripartite model, the intentions towards New Zealand native forest of farmers without native forest depended more on their value-based environmental concerns, while their beliefs towards the forest were more strongly predicted by their core beliefs towards the natural environment (NEP).

[11] Initially, the regression of the *affect* dimension on the biospheric environmental concern was significant, but as this relationship induced an inadmissible solution, it was removed. The fact that the *affect* scale included only two indicators could be at the origin of such a problem. It would be worthwhile to examine again the effects of Schultz' environmental concerns on a measure of *affect* composed of more indicators.

[12] See Chapter 9.

Figure 10. 4 Schema of the EMS-Tripartite model with standardized regression (direct effects) and correlation coefficients of farmers without native forest (N = 291). Solid lines represent relationships significant at p ≤ 0.10; dashed lines represent relationships significant at 0.10 < p ≤ 0.15.

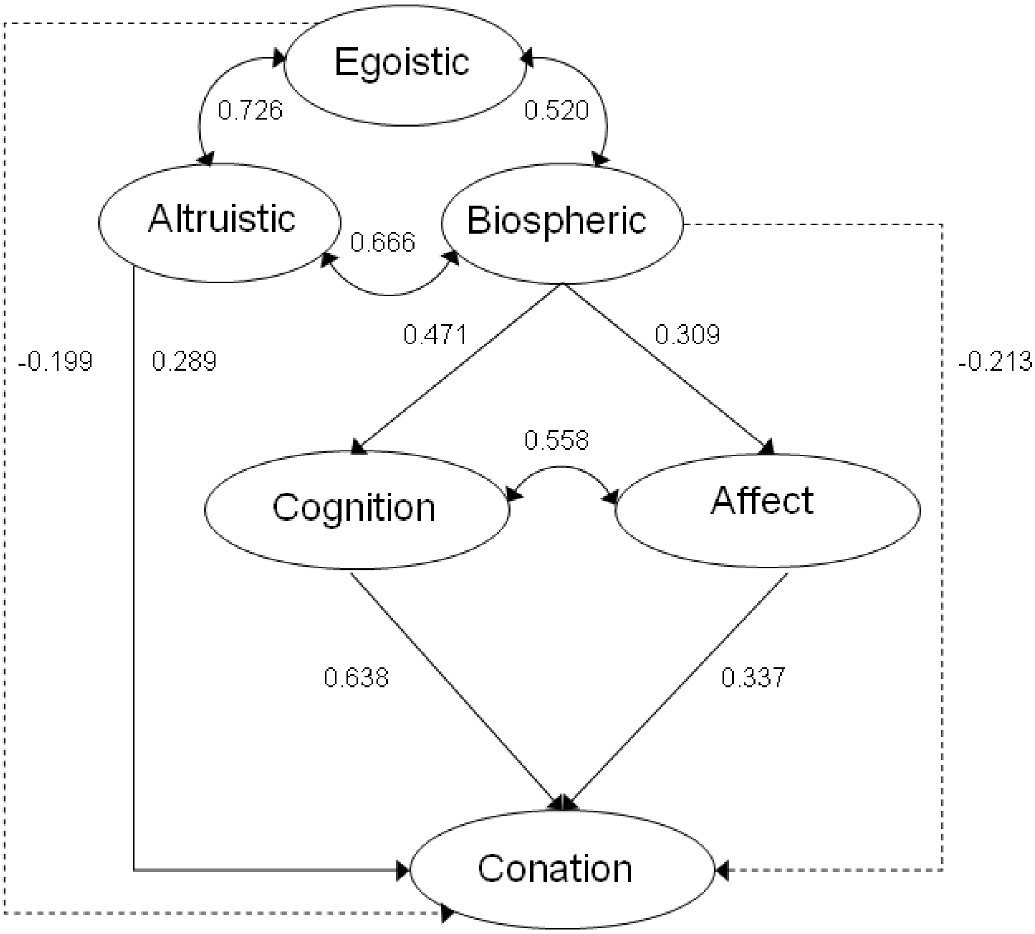


3. Results: Environmental Motives Scale and tripartite attitude responses of farmers with native forest

The EMS-tripartite model fitted the data well (Table A10.12). As hypothesized, respondents' value-based environmental concerns predicted their attitude towards New Zealand indigenous forest. Pro-environmental beliefs and feelings towards the forest of farmers with native forest were influenced by respondents' biospheric environmental concern (Figure 10.5). The effect of biospheric environmental concern was greater on *cognition* than *affect*. Respondents' pro-environmental intentions were mostly predicted by altruistic environmental concern, although non-biospheric and non-egoistic concerns also tended to play a role. The three value-based environmental concerns directly affected *conation*.[13] The three environmental concerns were significantly and positively correlated to one another. The value-based environmental concerns accounted for more variance in respondents' beliefs towards New Zealand native forest than feelings (Table A10.13), but farmers' core environmental beliefs explained more of the variance of beliefs towards native forest (34.5%). The environmental concerns explained the same amount of variance in respondents' intentions as NEP. Adding the egoistic, biospheric and altruistic factors did not impact on the structure of the tripartite attitude model.

[13] Only the effect of altruistic concern was significant at $p \leq 0.10$; the influence of the biospheric factor on conation was significant at $p = 0.107$, and egoistic, at $p = 0.141$. However, removing the effects of biospheric and egoistic on *conation* decrease substantially the amount of variance explained in *conation*.

Figure 10. 5 Schema of the EMS-Tripartite model with standardized regression (direct effects) and correlation coefficients of farmers with native forest (N = 515). Solid lines represent relationships significant at p ≤ 0.10; dashed lines represent relationships significant at 0.10 < p ≤ 0.15.



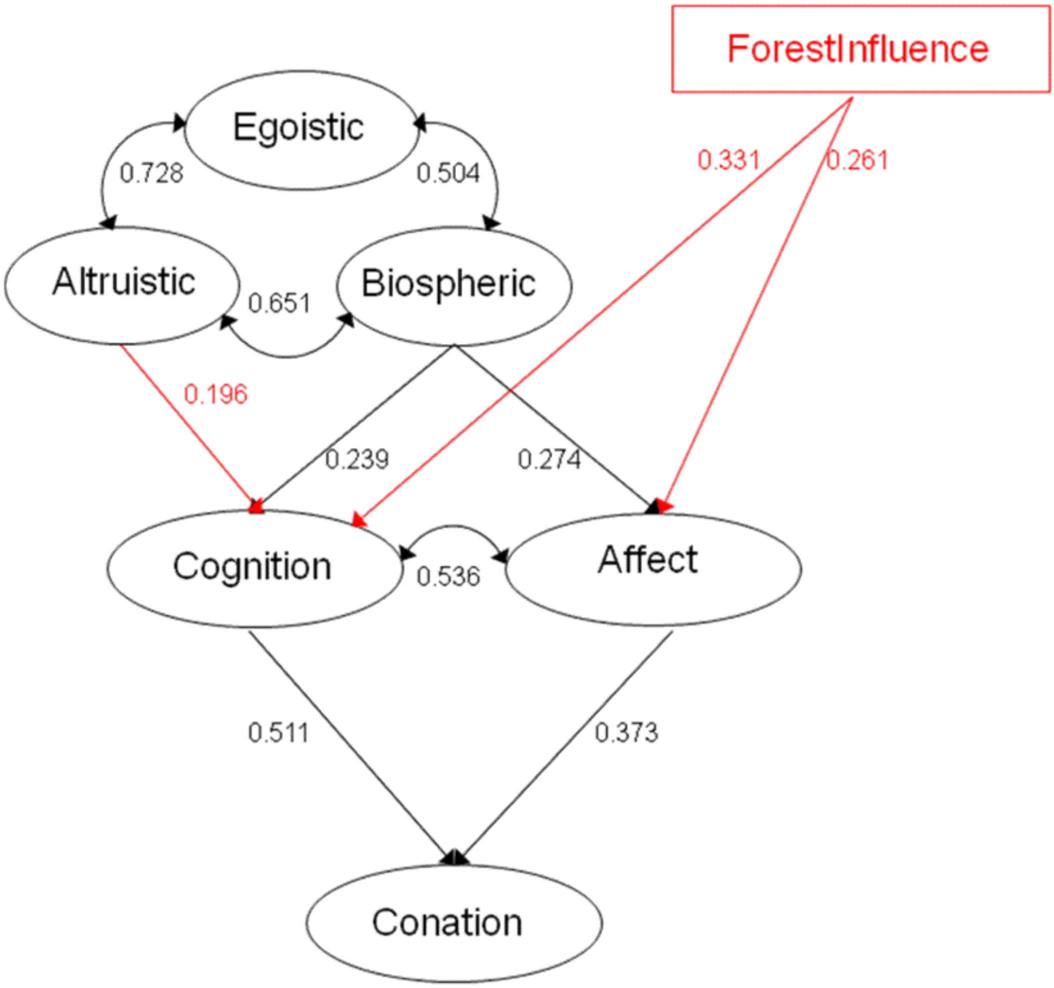
4. Results: Environmental Motives Scale and tripartite attitude responses of farmers with native forest by choice and farmers with native forest by chance

As expected, farmers with forest by choice exhibited stronger pro-environmental beliefs and feelings towards native forest than farmers with forest by chance (Figure 10.6). The stronger pro-environmental beliefs and feelings of farmers with forest by chance translated into more environmentally friendly intentions towards native forest (Table A10.15). On the other hand, the two groups did not differ in their level of value-based environmental concerns or intentions towards indigenous forest (Figure 10.6). Neither of the two groups of farmers with native forest was biased towards specific indicators, as none of *ForestInfluence*'s direct effects on the indicators were significant. The model fitted the data well (Table A10.14).

However, distinguishing between the two groups of farmers with native forest changed the relationships between the value-based environmental concerns and *conation* (compare Figure 10.6 with Figure 10.5). Respondent's intentions were no longer directly influenced by any of the three environmental concerns as they had been in the EMS-Tripartite model (Figure 10.5). Additionally, respondents' beliefs were predicted by biospheric as well as altruistic environmental concerns. Finally, the effects of biospheric concern on *cognition* and *affect* decreased and became more similar.

Distinguishing between the two groups of farmers with native forest accounted for some variance in respondents' feelings (4.8 percentage units more than in the EMS-tripartite model on farmers with native forest as a whole, Table A10.16 compared with Table A10.13), and beliefs towards indigenous forest (4.4 percentage units more of cognition's variance). However, *ForestInfluence* did not explain more of *conation*.

Figure 10. 6 Schema of the MIMIC EMS-Tripartite model with standardized regression (direct effects) and correlation coefficients of farmers with native forest by choice and farmers with native forest by chance (N = 507). Solid lines represent relationships significant at p ≤ 0.10.



V. Environmental Motive Scale, NEP and tripartite attitudinal responses of farmers

1. Model hypotheses

The previous results showed that the NEP and EMS scales separately predicted farmers' tripartite attitudes towards New Zealand native forest. The effects of NEP and EMS on the tripartite model were combined together and the full general-specific attitude model was assessed next.

As NEP measures the extent to which human beings see themselves as part of the natural world, and as both the EMS and NEP scales are cognitively based[14], NEP is expected to be positively correlated with feeling concerned about environmental problems, as measured by EMS. However, as the New Ecological Paradigm supposes a broadening of perspective including all living beings (Barr and Gilg 2007, p. 364; Kaiser et al. 2007, p. 243), NEP is expected to have stronger relationships with altruistic and biospheric concerns rather than with egoistic concern. Moreover, as ultimately NEP measures people's ecological worldview (Dunlap 2008, p. 9), it is expected to have a stronger relationship with biospheric concern than altruistic concern.

As previously noted, these two general measures were assumed to predict the more specific attitude towards New Zealand native forest. Nevertheless, both the NEP and the tripartite cognitive scales measure people's beliefs about the natural environment.[15] Therefore, a stronger relationship between the tripartite cognitive and NEP scales was expected than between the tripartite cognitive scale and EMS, which does not evaluate environmental beliefs but identifies the nature of what motivates peoples' concern when environmental problems occur.

2. Results: Environmental Motives Scale, NEP and tripartite attitude responses of farmers without native forest

The EMS-NEP-Tripartite model fitted the data well (Table A10.17). The specific attitudes towards New Zealand indigenous forest of farmers without native forest were predicted by both their core environmental beliefs and value-based environmental concerns (Figure 10.7). As expected, respondents' beliefs towards native forest were more strongly predisposed by their core environmental beliefs than value-based environmental concerns. The three environmental concerns positively related to one another and with NEP. Also as expected, NEP positively correlated with biospheric and altruistic concerns more strongly than with egoistic concerns. The strongest relationship between NEP and the environmental concerns was first with biospheric, then altruistic and finally, egoistic concern.

[14] EMS is also affectively based.

[15] NEP addresses the whole natural environment while *cognition* focuses on one particular ecosystem (the New Zealand forest).

Combining the two general attitudinal measures with the tripartite construct changed the relationships between the attitudinal variables compared to the structures found in the tripartite model alone, the NEP-Tripartite and EMS-Tripartite models. In contrast to the NEP-tripartite model, the direct relationship between NEP and *Conservation* was no longer significant.[16] Unlike the EMS-tripartite model, biospheric concern no longer had a salient effect on farmers' beliefs towards native forest (*cognition*). Again, the *affect* latent factor was only composed of its two hypothesized *affect* indicators.[17] Finally, the intention variable *Conservation* was only directly driven by *cognition*, while *TreePlanting* was directly driven by *affect.*[18]

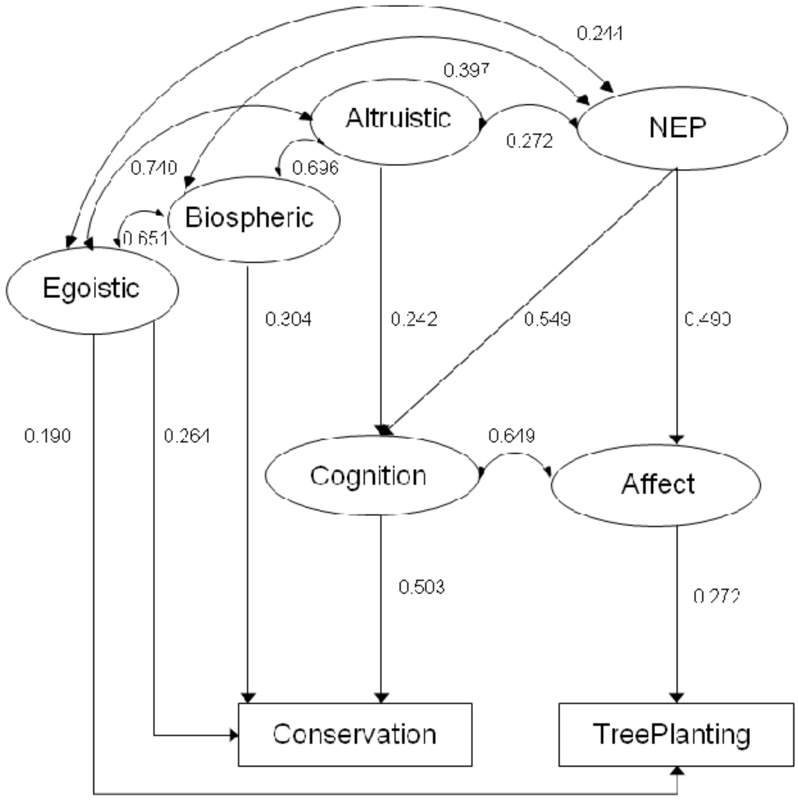
The general-specific model explained more variance in *affect* and *cognition* than the value-based environmental concerns or the NEP scale alone (Table A10.18 compared with Tables A10.3 and A10.11). About the same amounts of *Conservation* and *TreePlanting*'s variances were accounted for in the general-specific model as in the EMS-Tripartite model, which explained the most of the intentions' variances (34% and 14%, respectively; Table A10.11).

[16] Standardized coefficient estimate below 0.10 and associated p value greater than 0.15.

[17] The *affect* latent factor no longer included the *cognition* indicator *ForestBenefit* as it had in the tripartite model alone and in the NEP-Tripartite model.

[18] In the tripartite model alone, *TreePlanting* was only directly driven by *cognition*, while *Conservation* was predicted by *cognition* and *affect*.

Figure 10. 7 Schema of the EMS-NEP-Tripartite (general-specific attitude) model with standardized regression (direct effects) and correlation coefficients of farmers without native forest (N = 291). Solid lines represent relationships significant at p ≤ 0.10.



3. Results: Environmental Motives Scale, NEP and tripartite attitude responses of farmers with native forest

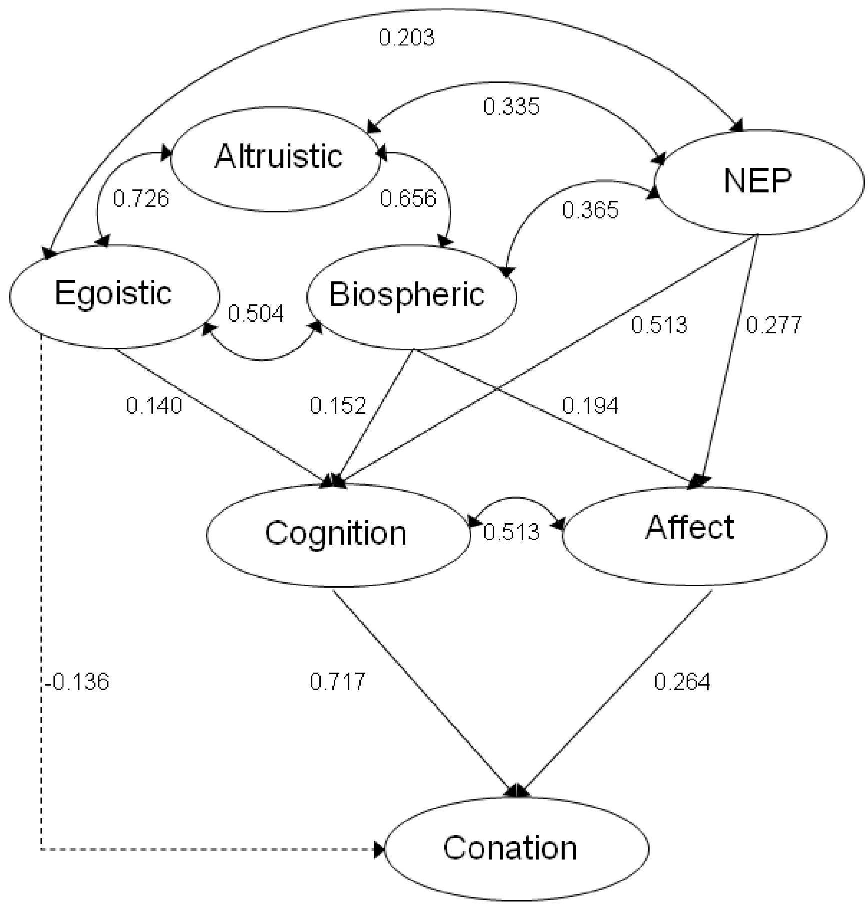
The EMS-NEP-Tripartite model fitted the data well (Table A10.20). As for farmers without native forest, the specific attitude towards New Zealand indigenous forest of farmers with native forest was predisposed by value-based environmental concerns and core beliefs towards nature.

Combining EMS and NEP scales together as predictors of the specific attitude did not change the structure of the tripartite attitude model. Nevertheless, respondents' intentions towards native forest were even more strongly predicted by their beliefs than their feelings towards the forest than in any of the previous EMS-tripartite, NEP-tripartite, or tripartite models (Figure 10.8). The effects of NEP on *affect*, *cognition* or *conation* remained similar to those previously found (Figure 10.8 and Table A10.22). On the other hand, the relationships between the three value-based environmental concerns and the specific attitudinal dimensions slightly differed from the EMS-tripartite model. In addition to the effect of the biospheric factor on *affect* and *cognition* previously present, the egoistic factor significantly impacted on *cognition*. The environmental concerns had less impact on *affect* and *cognition* than NEP. Furthermore, the biospheric and altruistic factors no longer directly related to respondents' intentions, although the indirect effect of biospheric concern on intentions was significant (Table A10.22). NEP predicted more strongly respondents' beliefs towards indigenous forest than any of the environmental concerns.

The three value-based environmental concerns were highly and positively correlated to one another. NEP was positively correlated with the three environmental concerns, but, as expected, the relationship was stronger with biospheric and altruistic than with egoistic, and stronger with biospheric than altruistic.

The general-specific attitude model explained more variance of *affect*, *cognition* and *conation* than the tripartite, NEP-tripartite, or EMS-tripartite models (Table 10.21).

Figure 10. 8 Schema of the EMS-NEP-Tripartite (general-specific attitude) model with standardized regression (direct effects) and correlation coefficients of farmers with native forest (N = 515). Solid lines represent relationships significant at p ≤ 0.10; dashed lines represent relationships significant at 0.10 < p ≤ 0.15.



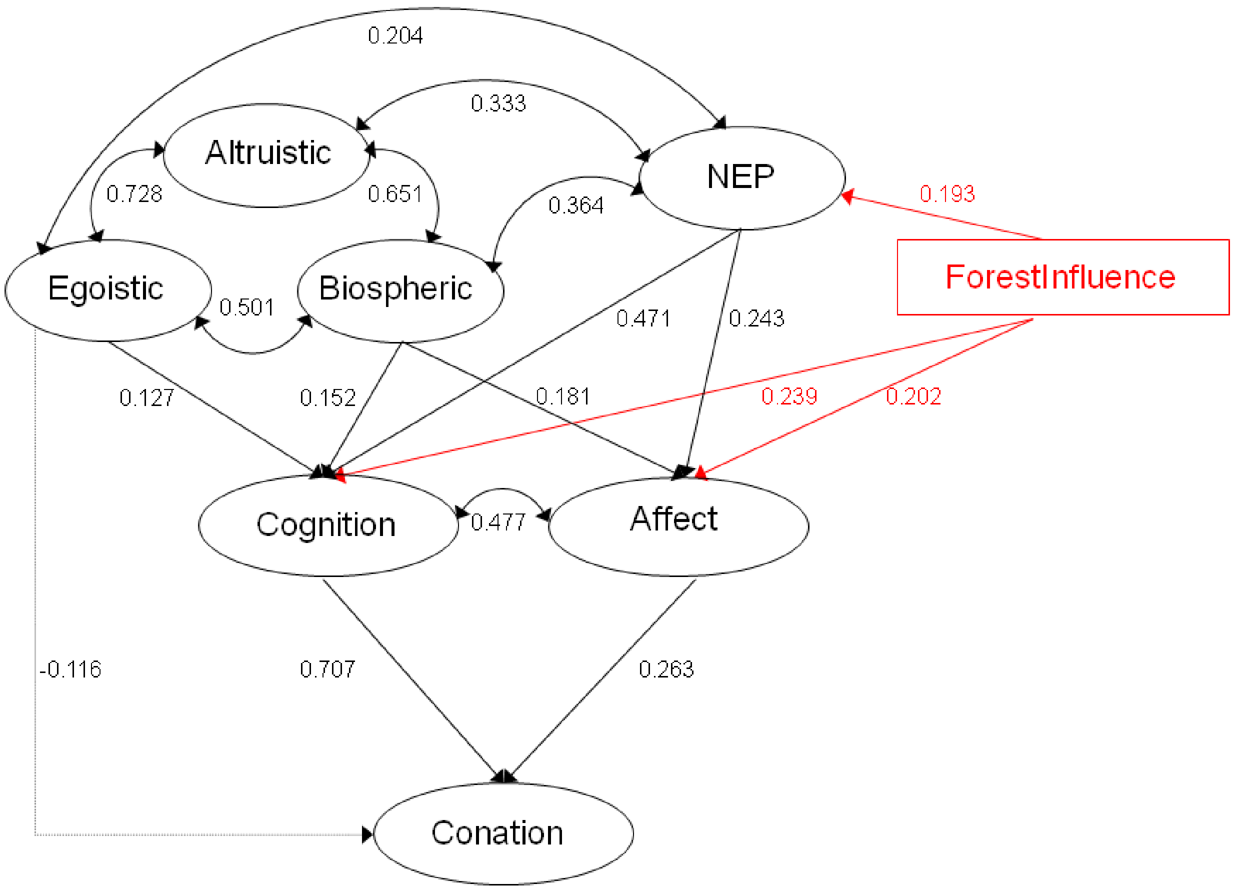
4. Results: Environmental Motives Scale, NEP and tripartite attitude responses of farmers with native forest by choice and farmers with native forest by chance

As found previously, farmers with native forest by choice expressed more environmentally friendly core beliefs towards nature, and feelings, beliefs and intentions towards New Zealand indigenous forest than farmers with forest by chance while not differing in their level of value-based environmental concerns (Figure 10.9 and Table A10.24). The EMS-NEP-tripartite model with the grouping variable *ForestInfluence* fitted the data well (Table 10.23). The two groups of farmers responded in a consistent fashion to the attitudinal indicators because none of the direct effects of the grouping variable on the indicators were significant. The regression and correlation relationships between the attitudinal variables were very similar to the ones found in the model performed on farmers with native forest as a whole. Thus, the influence of core beliefs (NEP) on farmers' feelings (*affect*) and beliefs (*cognition*) towards New Zealand native forest still translated into more environmentally responsible intentions towards the forest (Table A10.24 compared to Table A10.21). However, the unstandardized direct effect of egoistic environmental concern on respondent's intentions was only significant at p = 0.159[19], but removing the relationship dropped the amount of variance explained in *conation* from 74.8% to 67%. The regression link was therefore kept in the model.

Compared to the study of farmers with native forest as a whole, distinguishing between the two groups of farmers with native forest slightly increased the amount of variance explained in respondents' feelings and beliefs towards the forest (3 percentage points more of variance explained in *affect* and 4.3, in *cognition*), but not in respondents' intentions (Table A10.25). The MIMIC model also explained some variance in respondents' core environmental beliefs (3.7%).

[19] Mplus outputs of SEM analysis with exogenous effects on latent variables do not provide p values for standardized estimates.

Figure 10. 9 Schema of the MIMIC EMS-NEP-Tripartite model with standardized regression (direct effects) and correlation coefficients of farmers with native forest by choice and farmers with native forest by chance (N = 507). Solid lines represent relationships significant at p ≤ 0.10; dotted lines represent relationships not significant (p > 0.15) but meaningful for amount of variance explained.



VI. Discussion

The focus of this chapter was twofold. First, the validity of the specific environmental attitude model (the tripartite model) was examined via regressions on two established general environmental attitude scales, the value-based environmental concerns (EMS) and an abbreviated version of the New Ecological Paradigm (NEP) scale. Each of the two general scales predicted the specific attitude model well, and the hypotheses regarding the relationships between the general scales and particular dimensions of the tripartite model were supported. Second, the general-specific attitudinal responses towards the natural environment were compared between four groups of farmers: farmers who did not have native forest on their property, farmers who had native forest, and, among the latter, farmers with forest by choice and farmers with forest by chance. The attitudinal construct of farmers without forest differed from that of farmers with forest. The quantitative comparison of farmers with forest by choice and farmers with forest by chance showed that the former tended to exhibit stronger pro-environmental attitudes. Patterns are identified next for each of the three models: NEP-tripartite, EMS-tripartite and EMS-NEP-tripartite.

1. NEP-tripartite attitude model

a. The role of direct contact with nature on *affect*

As expected, in all four groups of farmers, respondents' core environmental beliefs (NEP) predicted their beliefs (*cognition*) and feelings (*affect*) towards New Zealand indigenous forest, and predicted more strongly their cognitive than their affective response. Yet NEP explained almost twice as much of *affect*'s variance in the sample of farmers without native forest than in the sample of farmers with native forest. The fact that the cognitively-based scale predicted the affective responses of farmers without forest better than that of farmers with forest suggested that the 'feelings' of the former towards New Zealand indigenous forest were more the result of a thoughtful process than for farmers with forest. In line with the literature (Millar and Millar 1996), this result suggested that sustained direct experience with nature had a direct impact on *affect* rather than filtered through *cognition*. The proximity with New Zealand indigenous forest allowed farmers with native forest to form feelings towards this ecosystem that were less subject to *cognition* influence. As *affect* is a precursor to behavioural intentions (*conation*), this result also highlighted the role regular direct and personal contact with nature could play in forming farmers' intentions towards the environment.

b. Direct contact with nature and holistic relationship with the natural environment

The strong association between core environmental beliefs (NEP) and beliefs towards New Zealand native forest translated into better prediction of intentions towards the forest of farmers with native forest. On the other hand, despite a direct – albeit weak – effect on *conation*, NEP did not predict the intentions of farmers without native forest more than *affect* and *cognition* alone. These results showed (1) that intentions of farmers with native forest were strongly influenced by their beliefs towards the forest, and (2) that farmers with native forest tended to show more consistency between their general and specific attitudes than farmers without native forest. This result suggested that either regular direct contact with native forest induced a more holistic relationship with nature or that farmers with native forest had forest because they already had a more holistic view of nature than other farmers.

As expected, farmers with native forest by choice[20] tended to hold more positive feelings, beliefs and intentions towards New Zealand native forest than farmers with native forest by chance, as shown by the direct and indirect effects of the grouping variable, *ForestInfluence*, found in the MIMIC analysis. However, both farmers with forest by choice and by chance responded to the same attitudinal structure, with the influence of core environmental beliefs on *affect* and *cognition* towards indigenous forest still translating into more pro-environmental intentions towards the forest. This result suggested that NEP indeed explained more intentions than *affect* and *cognition* alone in the sample of farmers with native forest but this increase was not a bias introduced by farmers with a priori positive attitudes towards the forest (farmers with forest by choice). This result implies that both farmers with forest by choice and by chance showed consistency between their general and specific environmental attitudes. This result therefore suggested that, although some farmers with native forest may hold already a rather holistic attitude towards nature, direct and regular contact with nature may also play a role.

2. Value-based environmental concerns – tripartite attitude model

a. Change in the tripartite attitude structure in farmers without native forest

The value-based environmental concerns (EMS) changed the composition of the *affect* dimension in the sample of farmers without native forest. The affective responses of farmers with native forest were devoid of cognitive bias as the *cognition* indicator, *ForestBenefit*, no longer loaded on the *affect* latent factor. As a consequence, the predictors of intentions of farmers without forest changed. In the initial tripartite attitude

[20] Farmers with forest by choice were assumed to hold a priori positive attitude towards New Zealand native forets since they chose to have a farm with native forest.

model, intention towards planting native trees on one's farm[21] was predicted by respondents' beliefs towards native forest. After including EMS to the model, *TreePlanting* was now driven by respondents' feelings towards the forest only. On the other hand, general intentions towards the conservation of New Zealand native forest[22] were still driven by *affect* and *cognition*. This result further demonstrated the importance of *affect* on how farmers related to native forest and what they were ready to do for it on their own farm, and agrees with the study of Kals and colleagues (1998 in Bögeholz 2006). As summarized by Bögeholz (2006, p. 73), the authors found that "decisions in the private context tend to be influenced more by emotional affinity, whereas decisions in the public context tend to be based more on the interest variable". Such a result also demonstrated the importance of EMS in relation to specific environmental attitudes, hence, in assessing the big picture.

b. Predictive power of the three environmental concerns

In line with results from the literature (Schultz 2001; Schultz et al. 2004; Milfont et al. 2006; Snelgar 2006), the value-based environmental concerns were correlated strongly and positively to one another; in decreasing order: egoistic/altruistic, altruistic/biospheric, biospheric/egoistic. Unexpectedly, despite the extractive nature of the farming activity, egoistic concern had only some direct and significant influences on attitudes of farmers without native forest. On the other hand, biospheric and altruistic concerns were common predictors of attitudes towards New Zealand indigenous forest in both farmers with and without native forest. In particular, biospheric environmental concern commonly determined farmers' cognitive responses. The general and the MIMIC analysis of farmers with forest concurred in showing that *affect* and *cognition* were mainly driven by biospheric environmental concern (as the influence of the other two concerns were negative), while *conation* tended to be more driven by altruistic concern. The model of farmers without forest was more complex. Respondents' beliefs towards indigenous forest were mostly driven by biospheric and altruistic concerns, but counter to expectations, respondents' feelings were not directly predicted by biospheric environmental concern. None of the three environmental concerns had a direct effect on

[21] *TreePlanting* intention represents a tangible and personal, hence, committed intention as it refers to intentions on one's farm.

[22] *Conservation* intention represents a more abstract intention as the question referred to New Zealand native forest in general, without space or time indications.

it. Finally, the nature of the regression of *conation* on the environmental concerns depended on the object of intention. The 'abstract' intention towards conservation of New Zealand native forest was mostly driven by biospheric concern, whereas the 'tangible' intention towards planting native trees on one's farm was driven by egoistic concern. Hence, farmers without native forest tended to differentiate between native forest in the large sense of the term and native forest on the farm. Such a distinction was not apparent in the attitude of farmers with native forest. Again, these results suggested that farmers with forest tended to have a bigger picture in mind regarding native forest than farmers without forest. The two groups of farmers with native forest, on the other hand, did not show differences in any of the three environmental concerns.

As farmers work with nature and as such have a ringside seat to understand and relate to the natural environment, it was reasonable that they would display empathy towards the natural environment, as measured by biospheric concern. The role of altruistic concern on the attitudes towards New Zealand indigenous forest can be viewed in light of the importance the natural environment plays in New Zealand culture. New Zealand, as a young country, is still largely defined by its natural history rather than its human history, and native forest animals (e.g. kiwi) and plants (e.g. silver fern) are regularly presented as symbols of the New Zealand national identity (e.g. by government and environmental non-governmental organizations, the media, and sport). Thus, when the natural environment suffers, potentially the entire nation suffers with it.

3. Value-based environmental concerns – NEP-tripartite attitude model

a. Relationships between the value-based environmental concerns and NEP

As hypothesized, the NEP scale was positively correlated with the three value-based environmental concerns in both samples of farmers with and without native forest. In both cases, NEP correlated more strongly with biospheric, then altruistic and finally egoistic concern. However, these results are somewhat in contradiction with results from Schultz and colleagues (Schultz 2001; Schultz et al. 2004) and Mayer and McPherson (2004), who found that only biospheric concern positively correlated with NEP. Mayer and McPherson (2004) and Schultz (2001) found that altruistic concern did not correlate with NEP, while Schultz and colleagues (2004) found that altruistic concern correlated negatively with NEP. Finally, Mayer and McPherson (2004) and

Schultz and colleagues (2004) found that egoistic concern correlated negatively with NEP, while Schultz (2001) found that egoistic concern did not correlate with NEP. Despite these results, it is argued that, as the EMS question is set within the context of *environmental problems* and asking respondents how *concerned* they are about different objects, it is reasonable to expect that such concerns, whether they focus on oneself, other human beings or all living beings, would be positively associated with beliefs that environmental problems are likely to occur and that human beings are not exempt from them, as measured by NEP.

b. Predictive power of the three environmental concerns and NEP

Overall, the general structure of the different scales in the EMS-NEP-tripartite model changed little from those found in the EMS-tripartite and NEP-tripartite models. Even after adding the value-based environmental concerns, *affect* and *cognition* remained positively influenced by NEP in both groups of farmers. As expected, NEP was a stronger predictor of *cognition* than the value-based environmental concerns. A few changes occurred between the EMS scales and the tripartite variables. Thus, due to the presence of NEP, which correlated strongly with biospheric concern, the direct influence of the latter on *cognition* – as well *affect*, in the sample of farmers with forest – decreased in both samples, to the point of disappearing in the sample of farmers without forest. Conversely, the combination of NEP with EMS led to egoistic concern directly influencing *cognition* in farmers with forest, but the effect was trivial. As farmers without forest did not display such a relationship, this effect could be interpreted as a consequence of the direct experience with the forest. Positive beliefs of farmers with native forest towards native forest are likely to develop through the realisation of egoistic benefits. On the other hand, it is harder for farmers without native forest to realise the benefit indigenous forest could bring to them as they do not have any on their farm.

Combining the two general scales, NEP and EMS, together accounted for more variance explained in *cognition* and *affect* than either of the two scales alone. About the same amount of variance in *cognition* was explained in both samples of farmers with and without native forest, but more variance in *affect* was explained in the group without forest than in the group with forest. The variance explained in farmers' feelings towards native forest was mostly due to the cognitively-based NEP scale, as EMS (both cognitively and affectively based) had little relationship with *affect*. As mentioned earlier, this result indicated the role direct experience with nature may play on the affective responses of farmers. In both groups of farmers, the general-specific attitude model explained more of *conation*'s variance than the tripartite attitude model alone. It also explained slightly more than the NEP-tripartite or EMS-tripartite models alone.

c. Direct contact with and attitude towards native forest

It was hypothesized that direct and regular contact with indigenous forest, as favoured by having native forest fragments on the farm, would be associated with stronger pro-environmental attitudes towards it. Farmers without native forest were thus hypothesized to be on the lower end of pro-environmental attitudes, followed by farmers with forest by chance, and finally farmers with forest by choice. A difference in attitudinal structure prevented quantitative comparison between farmers without and with native forest. However, as expected, farmers with forest by choice consistently exhibited stronger pro-environmental feelings and beliefs towards New Zealand indigenous forest than farmers with forest by chance, which translated into more environmentally responsible intentions towards native forest. Nevertheless, both groups of farmers with forest responded to the same attitudinal model, hence showing the same propensity for a holistic relationship with nature in contrast to farmers without forest. This result suggested that farmers without native forest, in certain circumstances (e.g., protecting native forest on one's farm), could indeed display weaker pro-environmental attitudes than farmers with native forest by chance, and, therefore, farmers with native forest by choice. However, to properly confirm or refute the hypothesis that having native forest on the farm induces pro-environmental attitudes in farmers, longitudinal studies would be needed where attitudes towards the forest would be measured in farmers with native forest and compared to farmers initially without native forest who acquire property with indigenous forest at some point in time.

VII. Conclusion

The relationships found between the two well published scales, EMS and NEP, and the tripartite model supported the validity of the tripartite attitude model in the samples of New Zealand farmers. Furthermore, the amount of variance explained in the three specific attitudinal factors by EMS and NEP supported the use of a general-specific attitude model in order to gain better understanding of farmers' attitudes towards the environment in general and New Zealand indigenous forest in particular. Moreover, the differences in the nature and strength of certain relationships between EMS and NEP on the one hand, and with the tripartite dimensions on the other, between the groups of farmers with and without native forest demonstrated the complexity of farmers' attitudes, and therefore the relevance of taking into account farmers' affective, cognitive and conative responses. Finally, these results pointed towards direct and regular contact with native forest as a possible factor of positive attitudes towards the natural object.

Chapter 11: Effects of situational variables on farmers' general and specific attitudes towards native forest

I. Introduction

Results of the previous analyses showed that farmers without native forest responded to a different attitudinal construct than farmers with forest. For this reason, quantitative comparisons of the mean response of the two groups on the attitudinal dimensions were not feasible. Nevertheless, results suggested that the attitudes towards New Zealand native forest of farmers without forest were more cognitively driven than the attitudes of farmers with forest. The absence of native forest on the farmer's property, which decreased opportunities for regular contact with the forest, was invoked as an explanation for this difference between the two groups of farmers.[1] Farmers with native forest by chance and by choice responded to the same attitudinal model and both groups tended to show more holistic environmental attitudes than farmers without. Quantitative comparisons of farmers with forest by chance and farmers with forest by choice, which were assumed to have stronger positive attitudes towards the forest, showed differences in core environmental beliefs, and beliefs, feelings and intentions towards native forest.

In this chapter, the aim is to identify whether different situational factors relate to pro-environmental attitudes in farmers with and without native forest. Secondly, the effects of the situational variables are compared between farmers with forest by choice and by chance. The situational variables covered eight themes: direct contact with the New Zealand indigenous forest and outdoor recreational activities (which represent farmers' direct experience with nature), farmers' socio-demographic and farm's characteristics, knowledge, family influence, farmer influence, and perception of regional council's strategy for native forest protection on private land.

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[1] See chapter 10 VI.1.a. and b.

II. Hypotheses

A review of the literature on the relationships between attitudes towards the environment and the situational variables studied here can be found in Chapter 4. The hypotheses are briefly noted hereafter.[2] Due to a lack of research on the effects of situational variables on the environmental attitudes of farmers with and without native natural features on their farm, no hypotheses were formulated for farmers with and without forest separately, except for the situational variables describing direct experience with nature. A description of the situational variables can be found in Chapter 5, section III.2.

1. Direct experience with nature (Recreational activities & Direct contact with New Zealand forest)

In both groups of farmers with and without native forest, respondents with more frequent direct experience with nature were expected to show greater pro-environmental general attitudes towards the environment and greater specific attitudes towards New Zealand indigenous forest. Moreover, it was expected that direct experience with nature would be among the strongest predictors of pro-environmental *affect*.

Pro-environmental attitudes were also hypothesized to relate to contemplative more than extractive activities. Furthermore, extractive activities were expected to relate more to egoistic environmental concern than biospheric or altruistic concerns. Conversely, contemplative activities were expected to relate more to biospheric and altruistic concerns than egoistic environmental concern, as engaging in these activities implies an ability to be interested by something other than the self.

Finally, it was hypothesized that for the same amount of direct experience with nature, farmers with native forest by chance would show similar positive affective response to farmers with native forest by choice (a priori positive attitudes towards the forest). As direct experience with nature was expected to be the strongest predictor of *affect*, it was further hypothesized that farmers with forest by choice and farmers with forest by chance would show less difference in affective response after controlling for direct experience with nature than after controlling for other situational variables.

[2] Note that Recreatonal activities and direct contact with New Zealand forest are gathered under Direct experience with nature, and Farmers' characteristics and Farm characteristics are gathered under Socio-demographic variables.

2. Socio-demographic variables (Farmers' Characteristics & Farm Characteristics)

Studies on sociodemographic predictors of environmental attitudes in the farming population have shown contradictory results. Among those variables, only organic farming tends to be more consistently associated with pro-environmental attitudes. Furthermore, because of their farm management choice, organic farmers would be expected to express more biospheric concern than non-organic farmers.

3. Knowledge

It was expected that higher level of education, ecological literacy as well as confidence in one's level of knowledge about environmental issues would be linked with stronger pro-environmental attitudes, especially stronger pro-environmental beliefs. It was also hypothesized that greater ecological knowledge would be associated with greater biospheric concern.

4. Social influence: Family Influence

The influence of respondents' immediate families was hypothesized to be an important predictor of respondents' attitudes towards the environment, which were expected to reproduce to a certain extent their parents' view on the environment. The stronger the relationship between the two, the more it would suggest the instrumental role parents played in shaping respondents' environmental attitudes.

5. Social influence: Farmer Influence

As with their family, respondents were expected to agree to some extent with their farming community's position toward the natural environment. However, the influence of fellow farmers on respondents' attitudes was assumed to be weaker than the influence of the respondents' families.

6. Social influence: RC conservation efforts

Finally, farmers were expected to hold stronger pro-environmental attitudes towards native forest when they favourably viewed their regional councils' attempts in encouraging protection of native forest on private lands. This hypothesis was based on studies that found that environmental concern was linked with support for environmental protection policies (e.g., Blake 2001, p. 709), and on the expectation that these farmers should care enough about New Zealand indigenous forest to appreciate potential intrusions in the management of their farm. However, as the regional council was unlikely to belong to the realm of 'important others', particularly because of its role of law enforcer, its influence on farmers' environmental attitudes was likely to be weak. This factor was expected to play a more important role in the prediction of farmers' behaviour toward native forest (see Chapter 12).

III. Analysis methods

The effects of the situational variables on farmers' environmental attitudes were examined for farmers with and without native forest using the MIMIC (Multiple Indicators Multiple Causes) analytical framework (Jöreskog and Goldberger 1975; Muthén 1989).[3] Because farmers with and without forest differed in their model of general and specific attitudes (see Chapter 10), the covariates effects were *qualitatively* compared between the two groups.[4] Within the sample of farmers with native forest, on the other hand, farmers who had forest by choice were quantitatively and qualitatively compared with the rest of farmers with forest as both groups described the same general-specific attitude model (see Chapter 10).

1. Model selection

Because of the relatively small number of cases in each group of farmers, the situational variables could not be studied all at once. The variables were separated

[3] See Chapter 5, section IV.2.

[4] The qualitative comparison consisted of comparing which situational variables had an effect on which attitudinal variables as well as the nature of these relationships.

according to eight themes (as reviewed in the previous section).[5] Firstly, the effects of each situational variable on the attitudinal responses of farmers with and without native forest were assessed individually. Situational variables were considered salient when their relationships with attitudes were significant at $p \leq 0.10$ or when their removal caused a substantial drop in the amount of variance explained in the latent attitudinal factors compared to the original general-specific attitudinal model. Secondly, significant situational variables of the same theme group were combined together and their effects on farmers' attitudes were re-examined. In such models, the effects of each situational variable are estimated controlling for the other situational variables present in the model. Overall goodness-of-fit, focal areas of ill-fit (notably those compromising the integrity of the attitudinal model), strength of parameter estimates and interpretability (Brown 2006, p. 175) and amounts of variance explained dictated the final choice of the model for each situational group.

2. Data issues

Some situational variables suffered from an important number of missing values. In such instances, multiple imputation of the missing cases was used to allow analysis without major loss of data.[6] For this reason, the following analyses are tentative with results only indicating trends.

Two sets of models were separately assessed for the *Farm Characteristics* covariates depending on the farm type. The sample originally included three farming types: meat, dairy and horticulture farming. However, the number of horticulture farmers overall was too low to form a farm type category on its own. Therefore, the farm type variable was decomposed into two binary variables: dairy vs. non-dairy farmers (this latter category including meat and horticulture farmers) and meat vs. non-meat farmers (with the latter category including dairy and horticulture farmers). Due to the imputation process in SPSS applied on the farm types dairy and horticulture, a few imputed cases happen to be both dairy and horticulture. These cases were removed from the analysis when the farm type dairy vs. non-dairy was entered in the model. This was not an issue when the farm type meat was present in the model, as the imputation of this

[5] However, this separation was also somewhat arbitrary in order to keep a reasonable number of variables in each group with a certain number of valid cases (e.g., *Farmers Socio-demographic* and *Farm Characteristics*).
[6] See Chapter 5, section III.3.b.

variable was done retrospectively as the opposite of the imputation combination of dairy and horticulture.

IV. Results: Effects of situational variables on the general-specific attitudes of farmers without native forest

The effects of the situational variables on the attitudinal variables in the general-specific attitudes model of farmers without native forest were investigated.[7]

The fit indexes of all models were within the acceptable ranges, except for the chi-square test (see Table A11.1). Not all situational variables in each of the eight groups were significant predictors of the general-specific attitudes of farmers without forest (Table A11.2). Next, the significant effects of the various groups of situational variables are reviewed by decreasing order of percentage of variance explained in the attitudinal variables (Table A11.3). Following the attitudes model, the general attitudes variables are reviewed first, followed by the specific attitudinal variables. Although significant, some standardized regression coefficients presented in the summary table were 'trivial' according to Cohen's guidelines[8], and none exceeded 'small' effects.

1. Effects of covariates on EMS

Overall, *Knowledge* and *Family Influence* were among the best predictors of the three value-based environmental concerns. *Farmer Influence* was another strong predictor of altruistic and egoistic concerns, while biospheric concern was about equally predicted by *Farm Characteristics* and *Direct Contact with New Zealand Forest*.

[7] See Figure A11.1 in Appendix A11, section IV, for an overview of the general-specific attitudes model of farmers without forest.
[8] Standardized regression coefficient below |0.20|: 'trivial'; between |0.20| and |0.50|: 'small'; between |0.50| and |0.80|: medium; greater than |0.80|: 'large' (Cohen, 1992).

2. Effects of covariates on NEP

By decreasing order of variance explained, the situational groups of variables explaining the most of the New Environmental Paradigm (NEP) were *Knowledge*, *Farm Characteristics*, *Family Influence* and *Recreational Activities*.

3. Effects of covariates on *affect*

Direct Experience with nature was the best predictor of farmers' affective response towards New Zealand indigenous forest, followed by *Family Influence* and *Knowledge*.

4. Effects of covariates on *cognition*

Family Influence variables explained the greatest amount of variance in farmers' beliefs about New Zealand native forest, followed by *Knowledge* and *Recreational Activities* variables.

5. Effects of covariates on *conation* indicators

The two *conation* variables, *Conservation* and *TreePlanting*, are examined separately, starting with *Conservation*. The situational variables only explained marginal amounts of *Conservation*'s variance, with *Farmer Influence*, *Knowledge* and *Recreational Activities* explaining the most. On the other hand, a substantial amount of *TreePlanting*'s variance was explained by direct experience with nature (*Direct contact with Forest* and *Recreational Activties*), and to a lesser extent, *Knowledge*. The direct effects the situational variables had on the attitudinal precursors of intentions usually translated to intentions (Table A11.2, columns *Cons (IndEff)* and *TreePl (IndEff)*).

V. Results: Effects of situational variables on the general-specific attitudes of farmers with native forest

As for farmers without native forest, the situational variables were added to the general-specific attitudes model of farmers with native forest and their effects on the attitudinal variables assessed.[9]

The fit indexes of all models were within the acceptable ranges for most of the indexes. WRMR was just above its acceptable threshold of 1.0 for some models and the chi-square test was significant (Table A11.4). The relevant relationships between situational and attitudinal variables (Table A11.6) are reviewed hereafter by decreasing order of percentage of variance explained (Table A11.8), starting from the general to the more specific attitudinal variables. As for farmers without forest, most regressions of the attitudinal latent variables on the covariates were of small magnitude, with a few relationships being trivial while still being significant at $p \leq 0.10$.

1. Effects of covariates on EMS

Farmer Influence covariates were consistently among the best predictors of the three concerns. Altruistic-oriented environmental concern was related to no other covariate. In addition to *Farmer Influence*, egoistic environmental concern was also partly explained by *Farm Characteristics*, while biospheric concern was predicted by *Family Influence*, *Knowledge*, and, to a lesser extent, *Socio-demographic* variables. *Regional Council Conservation Effort* related very little to the value-based environmental concerns. *Direct Experience with nature* did not predict any of the three environmental concerns, which concurs with the absence of differences in EMS responses between farmers with and without native forest found in chapter 7. Overall, the situational variables did not explain much of the value-based environmental concerns, with none explaining more than 5% of variance.

[9] See Figure A11.2 in Appendix A11, section V, for an overview of the general-specific attitudes model of farmers with forest.

2. Effects of covariates on NEP

Farmers' core environmental beliefs, as measured by the New Environmental Paradigm (NEP) scale, were, as expected, first and foremost predicted by *Knowledge*, as well as *Family Influence*. *Farm Characteristics* and *Farmer Influence* also explained a reasonable amount of environmental core beliefs. Finally, *Socio-demographic* and *Recreational Activities* explained a relatively small amount of NEP's variance, while *Direct Contact with New Zealand Forest* and *Regional Council Conservation Effort* did not predict core beliefs. As for EMS, the absence of effect of *Direct Contact with New Zealand Forest* on NEP concurs with earlier results showing that farmers displayed similar core beliefs whether they had native forest or not (Chapter 8).

3. Effects of covariates on *affect*

As expected *Direct Experience with nature* was the best predictor of farmers' feelings towards New Zealand native forest. *Family Influence* and *Knowledge* explained a substantial amount of farmers' feelings, while *Farmer Influence*, a more moderate amount. *Socio-demographic variables*, *Farm Characteristics* and *Regional Council Conservation Effort* did not improve the understanding of farmers' *affect*.

4. Effects of covariates on *cognition*

Contrary to the assumption, *Knowledge* was not a particularly strong predictor of farmers' beliefs toward New Zealand indigenous forest. Such beliefs were best explained by *Family Influence*, followed by *Farm Characteristics* and *Socio-demographic variables*. *Knowledge*, like *Recreational Activities* and *Regional Council Conservation Effort*, explained little more than 2% of variance in *cognition*. Similarly, *Direct Contact with New Zealand Forest* and *Farmer Influence* relate very little to farmers' beliefs toward native forest.

5. Effects of covariates on *conation*

Out of the eight groups of situational variables, only *Recreation Activities* predicted farmers' intentions towards New Zealand native forest. The more respondents spent time walking or tramping, the stronger environmentally friendly intentions they had towards native forest. The effect of walking/tramping on farmers' intentions was only indirect via *conation*s' precursors.[10]

VI. Comparison of farmers with and without native forest

Next, a picture is drawn of farmers with pro-environmental attitudes, based on the commonalities between farmers with and without native forest. However, this picture is tentative as the explanatory variables were not studied all at once but divided into groups. Furthermore, due to the large number of variables, interactions effects were not examined.

1. Common characteristics

a. Direct experience with nature

Consistent with the literature (e.g., Kals et al. 1999; see also Bögeholz 2006), direct experience with nature was a strong predictor of farmers' environmental attitudes, positively relating with their beliefs, feelings and intentions towards the natural environment (Tables A11.2 and A11.6, rows *Direct Contact Forest* and *Recreational Activities*). However, in agreement with the results of Millar and Millar (1996), direct experience with nature, whether as a child or as an adult, had a stronger effect on farmers' affective responses towards native forest than on the cognitive attitudinal dimensions. As hypothesized, among the situational factors, direct experience with nature was the strongest predictor of farmers' feelings towards New Zealand indigenous

[10] Some of the remaining groups of situational variables had a direct relationship with *conation* but did not explain more of its variance than the attitudinal variables alone. Certain effects even resulted in less of *conation*'s variance being explained (e.g., *Farm Characteristics*). The rest of the covariates groups only had indirect effects on *conation*, which also did not increase the amount of *conation*'s variance explained (e.g., *Farmer Influence*).

forest whether farmers had native forest on their farm or not, and whether they had actively sought a farm with native forest or not.

Specifically, outdoor recreational activity was one of the strongest predictors of intentions towards New Zealand native forest. However, the relationships between recreational activity and farmers' intentions were different between farmers' subsamples (see section VI.2 below). As hypothesized, in all groups of farmers contemplative outdoor recreational activities were more strongly associated with pro-environmental attitudes than extractive activities. Farmers who regularly visited native forest and went regularly for walks or tramps had strong positive feelings towards the forest. In addition, the more respondents went for walks or tramps, the more positive intentions they tended to express towards the forest.

b. Sociodemographic variables: Farmer's and farm's characteristics

The principal findings were that poorer farmers, organic farmers and meat producers displayed more pro-environmental attitudes than their counterparts (Tables A11.2 and A11.6, rows *Farmers' characteristics* and *Farm's characteristics*).

Similarly to Swanson and Maurer (1983) and Lynne and Rola (1988), the smaller and the less profitable the farm[11] was (as well as the less produce respondents with native forest exported), the more pro-environmental beliefs[12] farmers held. These results contradicted the postmaterialist hypothesis (Inglehart, 1977, 1997 in Olli et al. 2001, p. 185-6) and Maslow's hierarchy of needs theory (1970 in Van Liere and Dunlap 1980, p. 183)[13] and suggested that wealthier farmers were more profit-oriented than their poorer counterparts. In contrast, poorer farmers may worry more about environmental issues and value more the natural environment because the survival of

[11] Although farm size and farm income are closely related (Smith, Montgomery et al. 2007), they were not part of the same model due to an important number of missing values when analyzed together. It would be interesting in later analyses to re-examine these two variables together to see whether the two effects remained.

[12] In order to make this summary more readable, and as the core environmental beliefs (NEP) were positively predicting specific environmental beliefs toward New Zealand forest (*cognition*), the two types of beliefs were combined when the same explanatory variable had some positive effect on one type of beliefs in one sample of farmers, and on the other type of beliefs in the other sample of farmers. Readers are invited to refer to the summary tables for each sample.

[13] The extension of the post-materialist hypothesis and Maslow's hierarchy of needs theory state that only once one's basic material needs are met will one start worrying about such issues as environmental problems.

their business would depend much more on what the natural environment can directly provide them with, as opposed to improving the profitability of the farm by external input.

A similar argument is used to explain why the more respondents stated following organic farming principles, the stronger pro-environmental core beliefs they showed. Organic farmers, by their very approach to farming, are expected to understand and rely on the intricate ecosystems processes, and would logically worry about issues undermining such processes.

Meat producers also tended to hold more pro-environmental beliefs towards New Zealand native forest than dairy farmers. Furthermore, meat producers without forest showed less egoistic environmental concern than dairy and horticulture farmers, while meat producers with forest tended to express more positive feelings of being in indigenous forest than dairy and horticulture farmers. This result is in line with the greater intensive methods applied in dairy farming than in meat farming especially since the mid 1990s (Richardson et al. 2004, p. 3-4; Brooking 2006, p. 3; comparing CO2 emissions of Dairy, p. 61, and lamb production, p. 92, in Saunders et al. 2006), suggesting a somewhat more mercantile spirit from dairy farmers than meat producers.

However, relevant to both the effect of farm income and farm type on environmental attitudes, some studies have suggested that off-farm income can play an important role in the survival of the farm (Ahnström et al. 2008), and it has been found that off-farm income represented a greater proportion of disposable farm income of meat producers than dairy farmers (Ministry for the Environment 2000, p. 27). Based on these studies, the relationhips between pro-environmental attitudes and meat producers as well as lower farm income found in the present study could be related to the existence of off-farm income. Meat producers and farmers whose farm generated lower income could hold greater environmental attitudes because off-farm income allowed them to worry less about financial issues. Off-farm income could also indirectly influence environmental attitudes by bringing new ideas from outside the farming community, a potentially more urban influence. Off-farm income was not investigated in the present study but it would be worth investigating in further research.

Finally, contrary to Schultz (2001) and Snelgar (2006), no significant relationship was found between value-based environmental concerns and respondents' age.

c. Knowledge

Objective and subjective knowledge[14] were among the best predictors of environmental attitudes, whether respondents had native forest on their farm or not (Tables A11.2 and A11.6, row *Knowledge*). In line with the literature (e.g., Arcury 1990), the more literate respondents were about ecological facts and principles, the stronger pro-environmental core beliefs they reported. Also, as expected, the more ecologically literate respondents were, the greater the biospheric and altruistic environmental concerns they expressed. On the other hand, although subjective knowledge was an important predictor of pro-environmental attitudes in both samples, it was associated with different attitudinal dimensions in the samples of farmers with and without forest (section VI.2.).

d. Social influence: Family influence

As expected, the influence of respondents' families (Tables A11.2 and A11.6, row *Family Influence*) was also one of the strongest explanatory factors of farmers' environmental attitudes, supporting results from the literature (e.g., Degenhardt 2002; Brook et al. 2003). Discussions with one's family about environmental issues and taking into account one's family's opinions on these issues, as well as the farming background of one's parents were instrumental in explaining farmers' attitudes in all samples. Respondents expressed greater concern for all life forms (biospheric concern) and pro-environmental beliefs, the more they engaged in discussions about environmental issues with their immediate family. They also showed more pro-environmental beliefs, the more they stated being *influenced* by discussions with their family about environmental issues, and when their parents had not been farmers themselves.

e. Social influence: Farmer influence

The influence of fellow farmers was associated with more egoistic concern in both farmers with and without native forest (Tables A11.2 and A11.6, row *Farmer*

[14] Objective and subjective knowledge are also referred to as, respectively, ecological literacy and confidence in one's knowledge.

Influence). Additionally, the more respondents talked with other farmers about environmental issues, the more pro-environmental attitudes they had.

f. Social influence: Regional Council Conservation Effort

As expected, the perception respondents had of their regional council encouraging farmers to look after native forest had little relation with respondents' environmental attitudes (Tables A11.2 and A11.6, row *RC conservation efforts*). Yet the more council's encouragements were seen in a favourable light, the more concerned for altruistic and biospheric reasons farmers with forest tended to be, while the less concerned for egoistic reasons farmers without forest tended to be.

After reviewing the common points between farmers with and without native forest, the main differences between the two samples of farmers in the relationships between the situational variables and respondents' environmental attitudes are considered next.

2. Differences between farmers with and without native forest

a. Direct experience with nature

The main differences between farmers with and without native forest concerned their intentions towards native forest and the effects of direct experience with nature on farmers' environmental beliefs (Tables A11.2 and A11.6, rows *Direct Contact Forest* and *Recreational Activities*).

Intentions of farmers without native forest, which did not show strong correlations with one another[15], displayed antagonistic associations with the situational variables. The less farmers without native forest went in native forest as a child or an adult, the more they were ready to plant native tree species on their farm (Table A11.2, row *Direct Contact Forest*, column *TreePlanting*), but the less effort they were willing to devote to the conservation of New Zealand native forest in general (Table A11.2, row

[15] Contrary to farmers with forest, behavioural intentions of farmers without forest did not share enough common variance to form a latent factor. In the general-specific attitude model, they stand on their own, uncorrelated, individually predicted by the other attitudinal factors.

Direct Contact Forest, column *Conservation*). Frequency of visits to New Zealand indigenous forest as an adult did not directly impact on the intentions of farmers with native forest. Additionally, the more farmers without native forest used resources from native forest, and the less they observed nature for a pastime, the more they intended to plant more native than exotic species (Table A11.2, rows *Direct Contact Forest* and *Recreational activitie*s, column *TreePlanting*). These variables did not have direct effects on the intentions of farmers with native forest. These results suggest a demand for native natural features in the everyday environment from farmers without native forest with poor regular contact with nature. Thus, planting native trees on their farm could compensate for their lack of access to the forest and could give them more opportunities to observe wild animals and plants. These results corroborate the biophilia hypothesis, which "claims that humans possess a biologically based attraction to nature and that their well-being depends, to a great extent, on the relationship with the surrounding natural world" (Kellert 1997 in Kals et al. 1999, p. 183). The results suggest that, once this need is met, farmers without native forest would be ready to participate in a more abstract and global conservation of New Zealand indigeous forest, as the situational variables cited above were also positively associated with more efforts intended for the conservation of New Zealand native forest in the general context.

Finally, the frequency of visits to native forest as a child was positively associated with more pro-environmental beliefs, as well as feelings towards the forest in farmers without native forest (Table A11.2, rows *Direct Contact Forest*, columns NEP and *affect*). The situational variable was only associated with *affect* in the sample of farmers with forest. As mentioned earlier in the thesis, this result suggests again that farmers without native forest had a more strongly cognitively driven attitude towards the natural environment than farmers with native forest.

b. Sociodemographic variables: Farmer's and farm's characteristics

Interestingly, commitment to organic farming was positively associated with biospheric environmental concern in farmers without native forest, but with egoistic concern in farmers with (Tables A11.2 and A11.6, rows *Farmers' characteristics* and *Farm's characteristics*). As organic farming tends to work in symbiosis with natural cycles, it is logical that the prospect of environmental problems triggered biospheric concern in organic respondents. Thus, farmers without forest also tended to show stronger biospheric and altruistic concerns the less profitable was their farm. Nevertheless, as organic farmers are aware, probably more than other farmers, of how farming relies on intricate ecological processes, they are also probably more aware of how disturbances in these processes could have detrimental effects on their business and lifestyle, leading them to express egoistic environmental concerns.[16] The difference in concern between the two groups of farmers may be due to the fact that farmers with native forest, when reading 'environmental problems', may have focused on native forest. These respondents may perceive the destruction of native forest, which would take decades to 'rebuild', as a great threat to their lifestyle[17] and/or the functioning of their business. In support of this hypothesis, egoistic concern of farmers with forest also tended to increase the smaller their farms were. Indeed, the smaller the farm is, the more likely the respondent's business is to be impacted by environmental problems, especially as, for the same total farm area, the exploitable area would likely be smaller for farmers with forest than for farmers without.

Although dairy farmers exhibited weaker pro-environmental attitudes than meat producers, dairy farmers with native forest showed more environmentally responsible intentions towards the forest than meat producers with native forest. Such a disparity within the environmental attitudes of dairy farmers may be a consequence of the 2003 Clean Streams Accord signed between Fonterra (dairy industry), the Ministers for the Environment, Agriculture & Forestry, and Local Government New Zealand (Deans and Hackwell 2008, p.4), which encouraged dairy farmers to plant and fence around streams to mitigate pollution. These findings suggested that dairy farmers' intentions may be more *ad hoc* than the results of positive attitudes towards the natural environment.

Finally, respondents' age, years spent farming and region of farming had an impact on the attitudes of one group of farmers but not the other. The older farmers with native forest were, the greater pro-environmental beliefs they held towards New Zealand indigenous forest. In line with the effects of direct experience with nature mentioned above, this result suggests that durable proximity with forest may induce positive attitudes towards it. However, such positive beliefs towards the forest were not

[16] Supporting this hypothesis, it was also found that the more farmers followed organic principles, the more they perceived human beings and the natural environment to be interrelated (Tables 11.2 and 11.6, row Farmer's characteristics, column NEP).

[17] As Ahnström and colleagues (2008, p. 41-2) write "Being a farmer is not simply a profession but a way of life".

necessarily a sign of more empathy towards the natural environment as a whole, because the more years farmers with native forest had spent farming, the less they were concerned about the impact environmental issues would have on all life forms (biospheric environment concern). On the other hand, farmers without native forest differed in their beliefs towards New Zealand indigenous forest according to their region of farming, with farmers without forest from the Wellington region tending to hold more pro-environmental beliefs. This result could suggest that the Wellington Regional Council has a better approach with farmers without forest than the Manawatu-Wanganui Regional Council. Additionally, the effect of the region on the attitudes of farmers without forest could be due to the proximity to one of the major urban centres of New Zealand, the capital city. Urban residents have been found at times to hold greater environmental attitudes than rural residents (see Van Liere and Dunlap 1980), and more urban attitudes could influence the neighbouring farmers.

c. Knowledge

The main differences between farmers with and without native forest lay in subjective knowledge (confidence in one's knowledge) and in education (Tables A11.2 and A11.6, row *Knowledge*).

First, the confidence farmers with forest had in their ecological knowledge was dependent on how knowledgeable respondents actually were.[18] Conversely, the confidence farmers without forest had in their knowledge was positively related to environmental attitudes whatever their actual level of knowledge was. Second, confidence in different types of knowledge was important in explaining the attitudes of farmers without forest, whereas only confidence in knowledge about environmental issues was relevant for farmers with forest.[19]

Counter to expectations, the more educated farmers without native forest were, the less environmentally concerned they were in general. Furthermore, this variable was not instrumental in explaining the environmental attitudes of farmers with forest. Although the bulk of studies on education and environmental concern have found

[18] The confidence farmers with forest had in their ecological knowledge only influenced their environmental attitude when confidence was regressed on knowledge.

[19] Interestingly, it was also associated with more intentions to plant exotic rather than native trees on the farm.

positive relationships (Vaske et al. 2001, p. 765), some have found negative associations (Grendstad & Wollebaek, 1998 in Vaske, Donnelly et al. 2001, p. 765, Vaske et al. 2001), while Schultz (2001) found no significant relationship between his value-based environmental concerns and education. The negative relationship found here could suggest that the more educated farmers without native forest were, the more 'rationally' rather than emotionally they tended to respond to Schultz' variable, and hence the more they played their answers down. However, farmers without forest also tended to have a lower level of general education than farmers with forest. This could also suggest that passing a certain educational level may be important to develop people's environmental awareness.

d. Social influence: Family influence

The *family influence* variables affected differently farmers with and without native forest in two ways (Tables A11.2 and A11.6, row *Family Influence*). The variables common to both samples affected different attitudinal dimensions in each sample, and the environmental attitudes of farmers with and without forest were also affected by different family variables.

Farmers without native forest who, when they were children, had parents with indigenous forest on their property showed stronger positive emotions and pro-environmental beliefs towards native forest. This finding supported further the hypothesis that direct and regular interactions with native forest induced positive attitudes towards it. However, in light of the negative association found between the frequency of visits to the forest as a child and pro-environmental attitudes in farmers without forest (section VI.2.a), this result suggests that for such a bond with the forest to occur the presence of important others, such as parents, may be needed. Interactions between these variables would need to be assessed, however this hypothesis has been supported by research (see Vaughan and Hogg 2005, p. 111).

The attitudes of farmers with forest were affected by their parents' environmental concern and the involvement of their children on the farm. The greater environmental concern farmers with native forest reported for their parents, the more positive feelings and pro-environmental beliefs respondents expressed towards native forest. On the other hand, farmers with forest whose children helped in running the farm tended to show less pro-environmental core beliefs. In a similar vein, the more farmers without forest reported being influenced by discussions with their family on environmental issues, the stronger egoistic concerns they expressed.

These results suggest that, although the influence of respondents' family on their environmental attitude was generally positive, interactions with the family could also incite farmers to hold attitudes focused on the immediate family to the detriment of the natural environment.

e. Social influence: Farmer influence

The *farmer influence* variable common to both farmers with and without native forest affected their attitudes at different attitudinal levels (Tables A11.2 and A11.6, row *Farmer Influence*). Farmers with and without forest were also affected by different *farmer influence* variables. The environmental attitudes of farmers without forest were predicted by how much respondents felt influenced by conversations with fellow farmers about environmental issues. The more respondents reported these exchanges helped them understand these issues, the greater altruistic and egoistic environmental concerns they displayed. On the other hand, the environmental attitudes of farmers with native forest were related to the amount of discussions about environmental issues those farmers had with colleagues. The amount of such discussions was positively related to value-based environmental concerns in general as well as pro-environmental core beliefs and feelings towards the natural environment.

f. Social influence: Regional council conservation effort

This variable had little impact on farmers' attitudes. Nevertheless, the beliefs towards native forest of farmers with forest tended to be positively associated with the belief that their regional council was encouraging farmers to look after native forest on farms.

VII. Comparison of farmers with native forest by choice and with native forest by chance

1. Analysis

The effects of the situational variables on environmental attitudes were compared between farmers with native forest by choice and farmers with native forest by chance[20] using MIMIC analysis (Jöreskog and Goldberger 1975; Muthén 1989).[21] The models found in the previous analysis on farmers with native forest as a whole (section V) were re-assessed in the presence of the grouping variable *ForestInfluence*.

The grouping variable had previously been found to have an effect only on NEP, *affect* and *cognition* latent variables (Chapter 10, Figure 10.9). However, in order to assess whether the two groups of farmers with forest differed on their average answers to value-based environmental concerns and *conation* once controlling for the situational variables, paths between the grouping variable *ForestInfluence* and all the latent attitudinal variables were estimated.[22] Results of these analyses were compared with results obtained from the whole group of farmers with native forest.

It was previously found that pro-environmental attitudes of farmers with native forest were associated with direct experience with nature. It was also found, however, that farmers with forest by choice engaged more with New Zealand indigenous forest or the natural environment in general than farmers with forest by chance (Chapter 6). Therefore, it may be that the first of these two results was largely because of the second result. The positive relationship between the attitudes of farmers with native forest and direct experience with nature may be due to the a priori positive attitude of farmers with forest by choice and their higher interaction with nature, compared to farmers with forest by chance. This hypothesis was tested with the MIMIC analysis.

Additionally, in order to test further whether direct experience with nature could induce stronger positive feelings towards New Zealand native forest, the difference in

[20] 'Farmers with forest by choice' are farmers who had wanted native forest on their farm. They are hypothesized to hold a priori positive attitudes towards New Zealand forest. The rest of farmers with forest are referred to as 'farmers with forest by chance'.

[21] See Chapter 5, sectionIV.2.

[22] As the goal was to assess how situational variables would affect the degree of positive environmental attitudes between farmers with forest by choice and farmers with forest by chance, only relationships from the situational variables (including the grouping variable *ForestInfluence*) to the attitudinal latent variables were specified. Relationships between the situational variables and each of the attitudinal indicators were not estimated. This decision is further supported by earlier results on the difference in attitudes between farmers with forest by choice and farmers with forest by chance, which showed that the two groups of respondents were not biased towards particular attitudinal items (see Chapter 10).

affective responses of farmers with forest by choice and farmers with forest by chance was evaluated controlling for the amount of direct experience with nature. It was hypothesized that if both groups of farmers had similar regular contact with nature they would show less difference in affective responses.

2. Results

The overall goodness-of-fit of the various models changed little with the addition of the grouping variable *ForestInfluence* (see Table A11.5). Again, although chi-square tests were significant and WRMR was just above its threshold of 1.0 in a few models, CFI, TLI and RMSEA indicated that the models fitted the data well. The effects of the situational variables on the attitudinal factors of farmers with forest by chance and by choice are compared before (Table A11.6) and after the inclusion of *ForestInfluence* (Table A11.7). Additionally, the effects of *ForestInfluence* on the attitudinal factors of farmers with forest by chance and by choice are compared before and after the inclusion of the situational variables (Table A11.7).

First, the relationships between the eight groups of situational variables and the attitudinal variables were modestly affected by the distinction between farmers with forest by choice and farmers with forest by chance. This result suggests that the pro-environmental attitudes of farmers with forest by chance and by choice were associated with similar contexts (see Table A11.7 compared to Table A11.6). All but a few situational effects decreased, although these decreases never exceeded 0.07 standardized point changes.

Second, as found previously (Chapter 10, Figure 10.9), respondents with forest by choice showed the same levels of biospheric, altruistic, or egoistic concerns and intentions towards native forest as farmers with forest by chance, whatever the situational variables added to the model (Table A11.7). On the other hand, in most instances, farmers with forest by choice tended to display stronger core (NEP) and specific pro-environmental beliefs (*cognition*) and greater liking of (*affect*) and pro-environmental intentions (*conation*) towards New Zealand native forest than farmers with forest by chance. However, the two groups of farmers with native forest showed more similar pro-environmental core beliefs once organic farming, the influence of family discussions, respondents' parents' farming background, and, to a lesser extent, respondents' children involvement on the farm and the percentage of farm products export were controlled for. Furthermore, distinguishing between the two groups of farmers with forest did not change the amount of variance explained in NEP by farm's characteristics and family influence. This result suggested that the difference in core environmental beliefs between the two groups may be accounted for by farm's characteristics and family influence. Therefore, farmers with forest by choice and by chance were likely to share some of the characteristics assessed in the *Family Influence* and the *Farm Characteristics* groups of variables. Yet *Family Influence* or *Farm Characteristics* variables did not explain all differences in environmental attitudes between farmers with forest by choice and by chance because farmers with forest by choice still expressed more positive feelings, beliefs and intentions towards the forest even when farm characteristics and family interactions were taken into account.

In the same vein, after controlling for the amount of direct contact respondents had with New Zealand native forest, the two groups of farmers no longer showed any significant difference on their liking of native forest (*affect*). Similarly, after controlling for frequency of contemplative recreational activity, farmers with forest by choice and farmers with forest by chance showed less difference in their respective feelings towards native forest than with any other situational group. In line with Millar and Millar (1996), these results further supported the hypothesis that direct experience with nature could incite a positive emotional response towards the natural environment.

VIII. Discussion

The previous chapter on the general and specific environmental attitudes of farmers with and without native forest suggested an instrumental relationship between direct contact with nature and a positive affective response towards the natural object. This present chapter has examined this relationship further. Thus, the predictive power of farmers' direct experience with nature on their environmental attitudes was compared between samples of farmers with and without native forest as well as between farmers with native forest by choice and by chance. Additionally, the predictive power of farmers' direct experience with nature was compared to the predictive power of other situational factors on farmers' environmental attitudes, some of which have already been found to be associated with pro-environmental attitudes. Analyzing the effects of these situational variables on farmers' attitudes also served the purpose of better understanding what may trigger pro-environmental attitudes in the different groups of farmers and/or what may need to be done to enhance such attitudes.

The discussion first examines the validity of the arbitrary distinction between the different samples of farmers made at the beginning of the thesis. Secondly, the effects of the situational variables on the value-based environmental concerns – a topic that has been little covered in the literature – are reviewed. Thirdly, the validity of the hypotheses made at the beginning of this chapter regarding the effects of the situational variables on farmers' pro-environmental attitudes is assessed. Fourthly, the main results of the three most important predictors of farmers' environmental attitudes are put in theoretical perspective. Finally, the limitations of the analysis are considered.

1. Distinction between samples

The analyses showed that the pro-environmental attitudes of farmers with native forest and farmers without native forest were best predicted by the same situational factors: direct experience with nature, family influence and knowledge. Nevertheless, despite these commonalities, the pro-environmental attitudes of farmers with and without forest were often predicted by different variables within the groups of situational covariates. Additionally, situational variables tended to impact on different attitudinal dimensions in each of the two samples. Furthermore, despite controlling for the situational variables, farmers with forest by choice displayed in most instances stronger pro-environmental core and specific beliefs, as well as stronger pro-environmental emotions and intentions towards New Zealand native forest.

These results supported the initial choice made in the present research of examining the environmental attitudes of farmers with native forest on their property and farmers without forest. The hypothesis that farmers who had consciously chosen to have remnants of New Zealand indigenous forest on their farm (farmers with forest by choice) had stronger pro-environmental attitudes than the rest of farmers with native forest (farmers with forest by chance) was also corroborated. Additionally, the fact that the situational variables affected different attitudinal dimensions according to the group of farmers justified the general–specific attitudinal approach.

2. The relationships between EMS and situational variables

A very limited number of studies have investigated the effects of situational variables[23] in relation to Schultz' (2001) value-based environmental concerns[24] (Schultz 2001; Snelgar 2006).

The present results did not fully concur with those found by Schultz (2001) or Snelgar (2006). Contrary to Schultz (2001) and Snelgar (2006), age did not significantly relate to any of the environmental concerns in both samples. Furthermore, although Schultz (2001) found that income was not correlated with any value-based environmental concern, in the present study it was negatively associated with biospheric and altruistic environmental concerns of farmers without native forest. Finally, while Schultz (2001) did not find any relationship between education and EMS, in this study the higher educational level farmers without forest achieved, the less environmentally concerned they were overall.

Regarding external factors not investigated before, the study revealed that the following all predicted respondents' value-based environmental concerns: contemplative recreational activity, objective ecological knowledge, self-reported level of knowledge, conversations about environmental issues with one's immediate family or other farmers, the number of years spent farming, organic farming, farm type, farm size and to a lesser extent, respondents' perception of their regional governmental agency's conservation strategy.

These results suggest that more research must be done on the situational context of EMS.

3. Assessment of the hypotheses

a. Is direct experience with nature a good predictor of environmental attitudes?

Results support the hypothesis that direct experience with nature plays a predominant role in explaining farmers' environmental attitudes. Direct experience with nature related first and foremost to farmers' affective responses towards native forest.

[23] Moreover, only the effects of a few situational variables have been investigated on EMS.
[24] This is also called Environmental Motives Scale, EMS.

While direct experience with nature impacted on all dimensions of environmental attitudes in farmers without forest, farmers with forest by choice and farmers with forest by chance who had the same amount of direct experience with nature showed more similar, or even equal, affective response, but still different beliefs. Furthermore, in line with the biophilia hypothesis (Wilson 1984), results suggested that farmers without forest who had little contact with the natural environment desired more nature on the farm.

b. Do organic farmers hold more pro-environmental attitudes than conventional farmers?

As expected, organic farmers expressed stronger pro-environmental attitudes than conventional farmers. However, the differences were first and foremost cognitive rather than affective or conative.

c. Are objective and subjective knowledge good predictors of pro-environmental attitudes, especially of beliefs?

Ecological literacy and confidence in one's knowledge were among the strongest predictors of farmers' environmental attitudes, and particularly of farmers' core environmental beliefs.

d. Are interactions with family good predictors of environmental attitudes?

Similarly, the family environment played a crucial role in explaining farmers' environmental attitudes. Interactions with the family related to the natural environment and outside the farming context encouraged pro-environmental attitudes. In contrast, interactions with the immediate family within the farming context (e.g., when respondents' children are involved in running the farm) could induce more egoistic attitudes.

e. Are interactions with other farmers good predictors of environmental attitudes, but less than interactions with family?

Interactions with other farmers were relatively good predictors of respondents' environmental attitudes, but, as expected, it had overall less explanatory power than the family environment. Nevertheless, unlike the family factor, it explained respondents' value-based environmental concerns more consistently over the different samples.

f. Do farmers favourable to their regional council have pro-environmental attitudes? Is this variable a weak predictor?

As expected, this factor was weakly related to farmers' environmental attitudes. Predictably, it had slightly more impact on farmers who already had native forest on their property.

4. Results of the three main predictors of environmental attitudes in theoretical perspective

a. Direct experience with nature

While the present research has demonstrated the importance of direct experience with nature in predicting environmental attitudes, the study did not explicitly test the causal relationship from direct experience with nature to greater positive *affect* and/or environmental attitudes. Thus, the positive relationship between direct experience with nature and farmers' pro-environmental attitudes observed here could mean that a positive contact with nature induced positive attitudes/*affect* towards it, as much as positive attitudes towards the natural environment led people to seek more contact with wilderness. However, the facts that (1) the age of farmers with native forest was positively associated with pro-environmental attitudes towards the forest, and (2) farmers with native forest by choice and by chance showed little difference in their feelings towards the forest when both groups had similar direct contact with nature, suggests a causal effect of direct interactions with nature on farmers' pro-environmental attitudes. Furthermore, farmers who had direct contact with the forest as a child showed overall stronger pro-environmental attitudes. Concurring with Kals and colleagues (1999, p. 196), experiences with nature as a child are likely to be a good indication of how nature affects people's attitudes since childhood is the time when the first experiences with nature would occur and when decisions to go out in the wild would mostly depend on someone other than the respondent (e.g., the respondent's parents). Furthermore, experiences in childhood are formative and are most likely to set patterns for adult life. In support of this argument, only a few farmers with native forest never went into the forest as a child compared to farmers without forest. Furthermore, farmers without forest who went regularly into the forest as children showed stronger positive attitudes towards native forest.

More importantly, however, the hypothesis that direct experience with nature would encourage pro-environmental attitudes, common in environmental education (Kals et al. 1999, p. 183), has been supported empirically (see Orams 1997; Kals et al. 1999, p. 198; Degenhardt 2002; Kals and Maes 2002; Bögeholz 2006, p. 81; Powell and Ham 2008). In further support of the thesis results, there is also evidence that experience with nature is an especially good predictor of environmental attitudes when it involves 'important others' such as family or friends (Kals et al. 1999).

b. Interactions with family

Results showed that the respondents' family milieu was particularly important in explaining their pro-environmental attitudes. As mentioned above, it has been found that sharing with 'important others' may enhance a positive experience with nature (Kals et al. 1999). Furthermore, Eigner and Schmuck (1998) "showed that environmental identity is evoked and stabilized by the interaction with other members, the so-called in-group" (Kals and Maes 2002, p. 108), while Brook, Zint and De Young (2003) found that the more information farmers received about endangered species from family, friends or neighbours the more they were likely to protect the species in question. Therefore, changes in attitudes towards the environment are likely to be mediated by the farmers' families.

c. Objective and subjective knowledge

Ecological knowledge and confidence in one's knowledge were also instrumental in explaining farmers' environmental attitudes. Confidence in one's knowledge is of particular importance here as the present study found, in line with the international literature (Levy-Leboyer et al. 1996; Clayton and Myers 2009, p. 184), that subjective and objective knowledge do not necessarily correspond. Therefore, improving both objective and subjective knowledge of farmers is likely to favour positive environmental attitudes.

5. Limitations of the study

It is worth mentioning that these pictures are tentative as the explanatory variables were not studied all at once but divided in groups. Furthermore, due to the large number of variables, interaction effects were not examined. Additionally, negative experience with nature was not investigated. Regarding the measure of respondents' numbers of visits to native forest as a child, there is the possibility that "the amount of time spent in nature might have been overestimated due to romantic distortions (see Fischerlehner, 1993)" (Kals et al. 1999, p. 196). Ideally, the causal relationship between experience with nature and environmental attitudes should be tested by longitudinal studies. All these limitations should be taken account of in further research.

IX. Conclusion

Overall, direct experience with nature, interactions with one's family and objective and subjective knowledge played major roles in predicting the environmental attitudes of all groups of farmers. Nevertheless, depending on whether farmers had native forest or they had sought a farm with native forest, situational contexts affected farmers' attitudinal responses differently. This result therefore supported (1) the distinction between farmers with and without native forest, as well as between farmers with forest by choice and by chance, and (2) a general-specific approach in studying farmers' attitudes towards the natural environment.

Chapter 12: Relationship between general and specific environmental attitudes and behaviour towards New Zealand native forest of farmers with native forest

I. Introduction

The previous chapter assessed which situational exogenous variables were associated with pro-environmental attitudes of farmers without native forest on their property, farmers with native forest, and, among the latter, farmers who had forest by choice and farmers who had forest by chance.

This chapter focuses on farmers with native forest fragments of at least one hectare on their property and goes a step further by determining how the attitudinal and situational variables predict farmers' pro-environmental behaviour towards the forest fragments on their farm. First, the environmental attitudes and the situational context of farmers with native forest fragments of at least one hectare (≥ 1 ha) are compared to those of farmers with native forest fragments of less than one hectare (< 1 ha). Secondly, the extent the general-specific model of environmental attitudes predicts the behaviour of farmers with ≥ 1 ha fragments is assessed. Thirdly, the situational variables that improve the consistency between pro-environmental attitudes and behaviour are identified. While situational variables are expected to affect behaviour indirectly through attitudes (Ajzen and Fishbein 1980 in Tarrant and Cordell 1997, p. 622), few studies have looked at the effects of situational variables on the correspondence between attitudes and behaviour towards the natural environment (Tarrant and Cordell 1997, p. 623). The effects of direct experience with nature on farmers' attitude-behaviour relationship are investigated, along with the effects of farmer's characteristics, farm characteristics, knowledge, family influence, farmer influence, perception of regional council's strategy for native forest protection on private land, and a new group of variables: fragment features.

II. Do farmers with native fragments of 1 ha or more differ from farmers with fragments less than 1 ha?

Not all farmers with native forest had their pro-environmental behaviours studied. It was necessary to distinguish the clump of native trees that the landholder may consider as a fragment from a more substantial group of trees that would form a distinct landscape unit within the farming environment. The rationale was that such a distinct landscape unit would force the landowner to actively reflect on whether or not to put it aside from farming. However, the minimum fragment size should not be too large or the risk was run of having too narrow a sample of farmers and attitudes. Based on the fact that most of the native forest left on private lands is highly fragmented (Ausseil et al. 2005, p. 44; Ewers et al. 2006, p. 316), and that the New Zealand Forest Accord, which "has been cited as an example of a working comprehensive approach", "seeks to protect any area of indigenous vegetation […] between one and five hectares where the average vegetation height is more than six metres" (Ministry for the Environment 2000, p. 30), the threshold was set at a minimum of one hectare. The attitudes of farmers with ≥ 1 ha forest fragments were expected to show more coherence than those of farmers with < 1 ha fragments. Farmers with < 1 ha fragments were hypothesized to display weaker pro-environmental attitudes on average than farmers with bigger fragments.

Before analysing the attitude-behaviour relationship in farmers with ≥ 1 ha native forest fragments on their property, the hypothesis that above and below the threshold of one-hectare fragments two distinct groups of farmers could be found was examined. The environmental attitudes of the two groups of farmers as well as their answers to the situational questions were tested for differences.

1. Do the two groups of farmers differ in environmental attitude?

a. Method

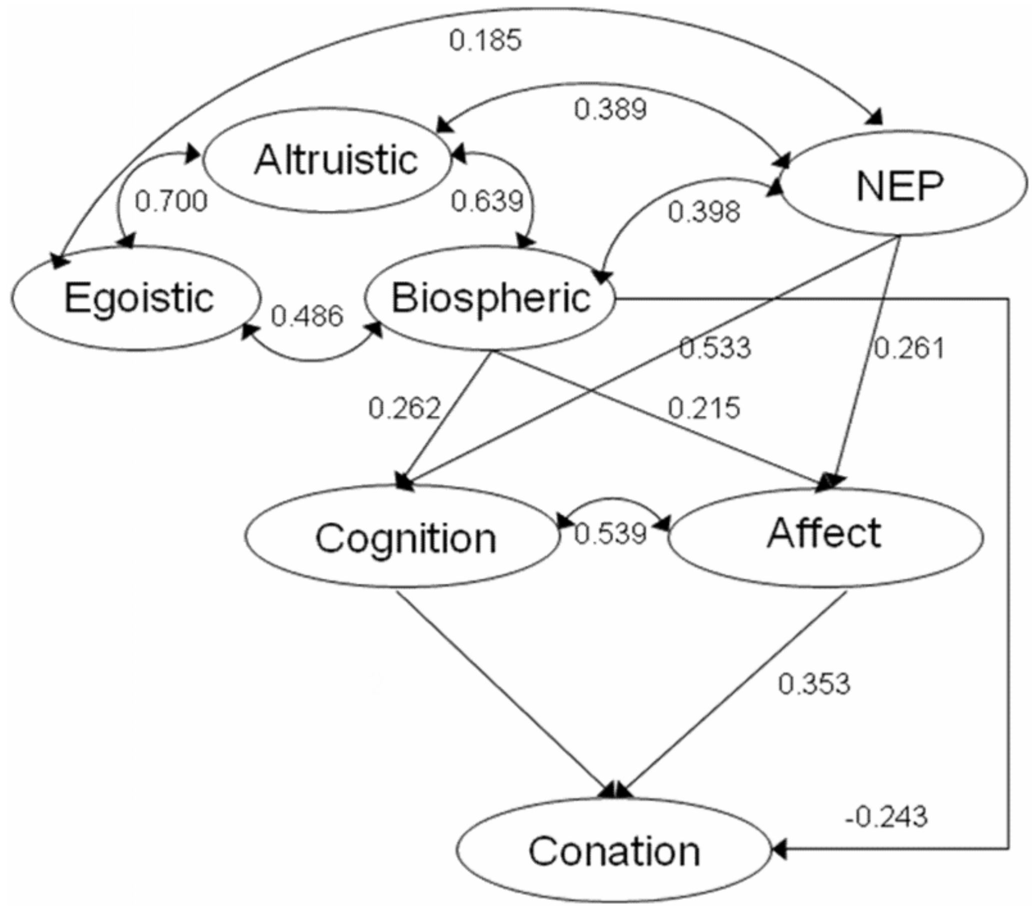
Out of the 515 respondents with native forest fragments, 154 had fragments less than one hectare, and 361 had fragments of one hectare or bigger. To test if farmers with < 1 ha fragments held different environmental attitudes to farmers with ≥ 1 ha fragments, the model describing the environmental attitudes of farmers with fragments[1] was used on the two groups of farmers. The test consisted of two phases. The first check was that the attitude model fitted the two groups of farmers separately. If different attitude models were found for the two samples, the two groups of farmers were indeed distinct in their attitudes towards the natural environment, and the comparison stopped there. If the same attitude model fitted the two samples, a MIMIC analysis would follow using the fragment size binary variable as the grouping variable (see Chapter 10 for a description of MIMIC analyses). The MIMIC analysis would determine if the two groups of farmers showed structural differences in their attitude[2] and/or if one group held a stronger pro-environmental attitude[3].

b. Results

Compared to farmers with forest fragments studied as a whole in the previous chapters, farmers with ≥ 1 ha fragments held a slightly different attitude towards the natural environment. The attitudinal model found in Chapter 10 produced acceptable overall goodness-of-fit indices (Table A12.1, Original general-specific attitude model) but showed some points of ill-fit[4]. Farmers with ≥ 1 ha fragments responded better to the model where specific beliefs and intentions towards the native forest were predicted by biospheric rather than egoistic concern (Table A12.1, Alternative model, for model fit, and Figure 12.1 for paths significance).

[1] Corresponding to the EMS-NEP-Tripartite model in Chapters 9 and 10.
[2] That is, if the two groups of farmers showed different levels of answers on particular latent indicators.
[3] That is, if the two groups of farmers showed different levels of answers on the latent factors.
[4] The path between cognition and egoistic environmental concern was not significant (standardized p value = 0.183, Figure 12.1).

Figure 12. 1 Schema of the alternative attitude model of farmers with ≥ 1 ha native forest fragments (N = 361) with standardized regression and correlation coefficients between the attitudinal latent factors. Solid lines represent relationships significant at p ≤ 0.10.



The attitude of farmers with <1 ha fragments could not be assessed because the sample size was too small[5]. All the models tested on the sample of farmers with ≥ 1 ha fragments produced inadmissible solutions on the sample of farmers with fragments less than 1 ha.

[5] It is well known that, due to the complexity of structural equation models, small sample sizes have a higher chance of resulting in improper solutions (e.g., Gerbing and Anderson 1987). With the WLSMV estimator, used here, it has been suggested that sample sizes of 150-200 may be sufficient for estimating models with 10 to 15 indicators (Brown 2006, p. 389). With 154 cases and 25 indicators, the sample of farmers with forest fragments of less than one hectare is stretching the limit of what is possible, preventing further assessments of potential differences in attitude between the two groups.

2. Do the two groups of farmers differ in their situational answers?

a. Method

Due to a small sample size, it was not possible to assess if farmers with < 1 ha forest fragments held a different average environmental attitude from farmers with bigger fragments. However, a comparison of the two groups' answers to the situational variables may still reveal differences. As in Chapter 6, a discriminant analysis was run on eight groups of situational variables[6]. They consisted of respondents' sociodemographic and farms' characteristics, knowledge-related variables, direct contact with nature questions (2 groups), and social influences (3 groups), totalling 40 potential discriminators (Table A12.3). Multiple imputation was used on missing values (see section II.2.a in Appendix A12 for more details). The discriminant function was estimated on a random 70% of the data, and validated using the leave-one-out procedure as well as the 30% of the data initially left-out. Equal prior probability of group membership was assumed.

b. Results

Based on tests of equality of group means, the standardized discriminant coefficients and the structure matrix[7], it was found that farmers with ≥ 1 ha fragments differed from farmers with fragment less than 1 ha in:

- the size of the farm: farmers with ≥ 1 ha fragments had bigger farms
- the quantity of exported farm products: farmers with ≥ 1 ha fragments tended to export more
- the number of times respondents visited native forest: farmers with ≥ 1 ha fragments more often visited native forest
- desire to pass on the farm: farmers with ≥ 1 ha fragments were more likely to be planning to pass on the farm to a member of their family
- in the source of knowledge coming from the general media (e.g., newspapers, T.V.): the general media was less a source of knowledge about

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[6] Farmers with fragments of less than one hectare were not asked the *Fragment features* questions.

[7] See Chapter 6, section III.2 for a brief description of test of equality of group means, Wilks' lambda and structure matrix.

native fragments' costs and benefits on the farm for farmers with ≥ 1 ha fragments.

The discriminant function did better than chance at separating the groups (Chi-square column in Table A12.4) and explained between 16.6% and 26.9% of the total variance in discriminant scores (1-Wilks' Lambda).

Overall, the discriminant function correctly predicted the presence of native forest of one hectare or more on respondents' farms in more than two cases out of three (Table A12.5).

3. Conclusions

The hypothesis that farmers with ≥ 1 ha forest fragments and farmers with < 1 ha fragments formed two distinct groups was tested. Because the sample size of farmers with < 1 ha forest fragments was too small, their attitudes towards the natural environment could not be compared to those of farmers with bigger fragments. However, as the attitude model of farmers with ≥ 1 ha fragments was slightly different from the model of farmers with native forest of any size, it is likely that farmers with ≥ 1 ha fragments and farmers with < 1 ha fragments would also show some differences in their attitudinal models.

The two groups of farmers differed on their farm's characteristics, direct contact with New Zealand native forest, and source of environmental knowledge. Farmers with ≥ 1 ha fragments had bigger farms, a higher proportion of their farm products aimed at international markets, were more likely to be planning to pass on the farm to a member of their family, visited the native forest more often, and tended to rely less on the general media for information about the costs and benefits of native fragments on farms. Differences in some of these situational variables have been associated with differences in the level of pro-environmental attitudes in earlier analyses (Chapter 11). However, while greater numbers of visits to the native forest was significantly associated with stronger pro-environmental attitudes, bigger farms and higher proportions of farming products for export tended to be associated with weaker pro-environmental attitudes.[8]

In conclusion, the two groups of farmers are likely to hold different attitudes towards the natural environment, but their level of pro-environmental attitude cannot be foreseen based only on their different answers to the situational variables.

III. Reasons of farmers with ≥ 1 ha fragments to keep native forest fragments on their property

Out of a list of nine possible answers[9], farmers with ≥ 1 ha fragments were asked to give their two main reasons for having kept native forest fragments on their property. Results were compared between farmers with native forest by choice and with native forest by chance.

1. Results

The two most often cited answers were, first, to protect native fauna and flora and, second, for aesthetic reasons. Far behind in terms of frequency were, by decreasing order, for farming purposes, the practical or legal trouble cutting the fragments down would cause, and finally, for leisure purposes (Table A12.6).

The answers from farmers with forest by choice and farmers with forest by chance were compared. Out of the five reasons given, the two groups of farmers only differed on *Farming purposes* and *Leisure*. Farmers with forest by choice tended to choose the *Farming purposes* reason more often (Tables A12.7 and A12.8), whereas farmers with forest by chance tended to choose the *Leisure* reason more often (Tables A12.9 and A12.10).

[8] It is worth noting that the farm type, ownership status of the farm and self-reported influence respondents' family and fellow farmers had on the respondents' perception of environmental issues could not be included in the analysis. It would be interesting in future analyses to investigate if the two groups of farmers differed also on these variables.
[9] Including 'Other' and 'don't know'.

2. Conclusions

Farmers with native forest fragments ≥ 1 ha by choice and farmers with fragments ≥ 1 ha by chance differed very little in their self-reported motivations for keeping native forest on their property. Whether or not respondents had wanted a farm with native forest, they predominantly justified their keeping of the forest for ecosystem protection and aesthetical reasons, suggesting non-utilitarian motives.

Next, the relationship between farmers' attitudes and behaviour towards the natural environment is examined, followed by the assessment of the effects of the situational variables on the attitude-behaviour relationship.

IV. The attitude-behaviour relationship in farmers with native forest fragments of 1 ha or more

1. Behaviour variables description

The behaviour variables only concerned native forest fragments ≥ 1 ha, focusing on the three biggest fragments respondents had on their farm. These variables are already described in Chapter 5, but they are briefly noted here.

1. *SizeChange* referred to the change in fragments' size over the 10 years prior to the reception of the questionnaire
2. *Fenced* represented the average proportion of the (up to the three biggest) fragment's area that was fenced off (three categories: a third or less of the fragment fenced off, between a third and two-thirds, and more than two-thirds)
3. *Control* assessed if at least half of the fragments (up to the three biggest) were controlled against pests or weeds,
4. *Inventory* asked if at least half of the fragments' (up to the three biggest) fauna or flora had been inventoried since the respondent had been running the farm
5. *Protection* asked if at least half of the fragments (up to the three biggest) were legally protected.

Out of the 361 respondents with native fragments ≥ 1 ha, 319 had been running the farm for at least 10 years.

2. Analysis of the Behaviour variables

The variable *SizeChange* had to be discarded because too few respondents reported changes in the size of their native forest fragments over the 10 years prior to the study. This result is in line with Ewers and colleagues' (2006, p. 318) study, who also found that at the regional and national scales for the period 1997-2002 the amount of native forest cover in New Zealand had changed little. The correlations among the four remaining behaviour variables were disparate, with *Inventory* showing the weakest associations with the other behaviour indicators, and both *Fenced* and *Control* correlating strongly with *Protection* but poorly with one another (Table A12.11).

The hypothesis that a uni-dimensional latent factor representing farmers' behaviour towards their native forest underlay *Inventory*, *Fenced*, *Control*, *Protection* was tested via confirmatory factor analysis. As suggested by the variables' correlations (Table A12.11), *Inventory* did not fit well with the other three variables, and was therefore discarded. Consequently, the behaviour model comprised a latent factor described by three indicators. Because this model corresponded to a just-identified model (the number of degrees of freedom is null), its goodness-of-fit could not be tested. Therefore, the relationship between the behaviour latent factor defined by this model and the general-specific environmental attitudes of farmers with native remnants of at least one hectare was directly assessed next.

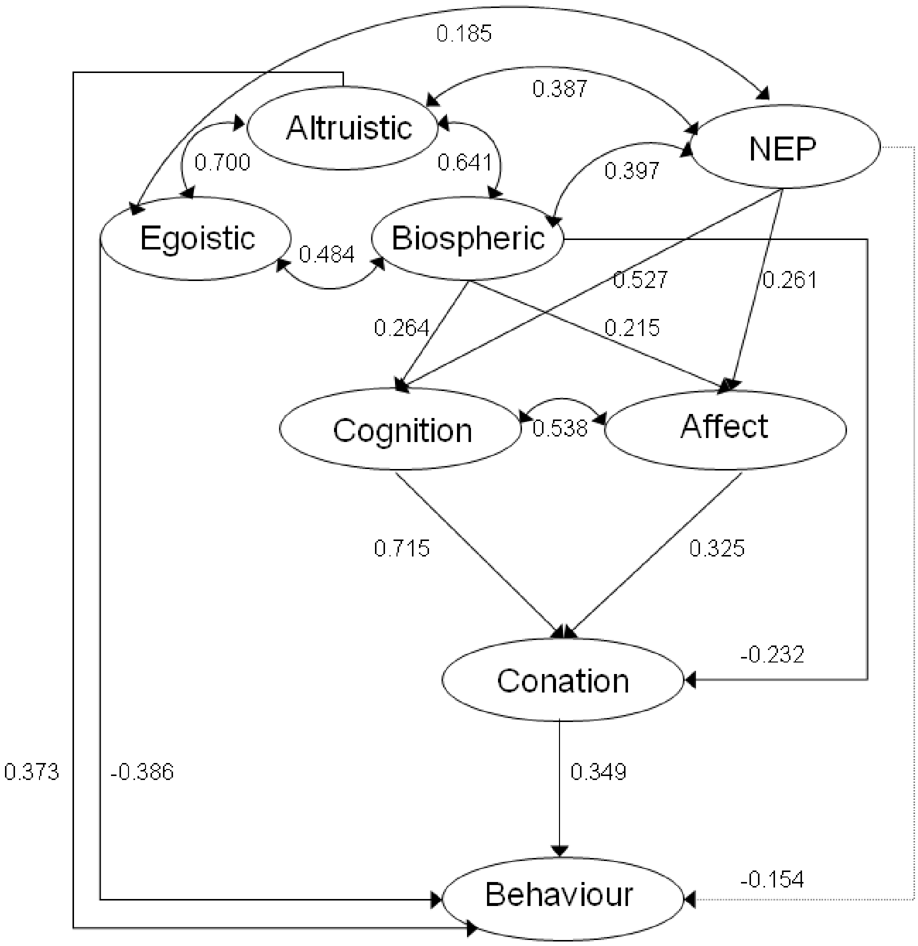
3. General-Specific Attitude & Behaviour

The relationship between farmers' attitudes towards the natural environment, including New Zealand native forest, and their behaviour towards the native forest was examined on the 361 respondents who had native forest fragments of at least one hectare. The first analysis in this chapter (section II.1) showed that farmers with fragments ≥ 1 ha had a slightly different attitudinal structure than the whole group of farmers with native fragments.[10] This attitude model was used to predict their behaviour towards native forest on their farm (Figure 12.2). The attitude-behaviour model fitted the data well (model 1 in Table A12.12). Farmers' environmental attitudes explained

[10] The beliefs and intentions towards New Zealand native forest of farmers with fragments ≥ 1 ha were influenced by biospheric instead of egoistic environmental concern.

18.3% of their behaviour towards their native forest fragments (Table A12.13), but the model explained the behaviour indicators *Protection* and *Fenced* better than *Control*[11]. Due to the small number of data points compared to the number of parameters to estimate, results are only tentative.

Figure 12. 2 Schema of attitude-behaviour model 1 of farmers with native forest fragments ≥ 1 ha (N = 361) with standardized regression and correlation coefficients between the attitudinal latent factors. Solid lines represent relationships significant at p ≤ 0.10; dotted lines represent relationships not significant (p > 0.15) but meaningful for the amount of variance.



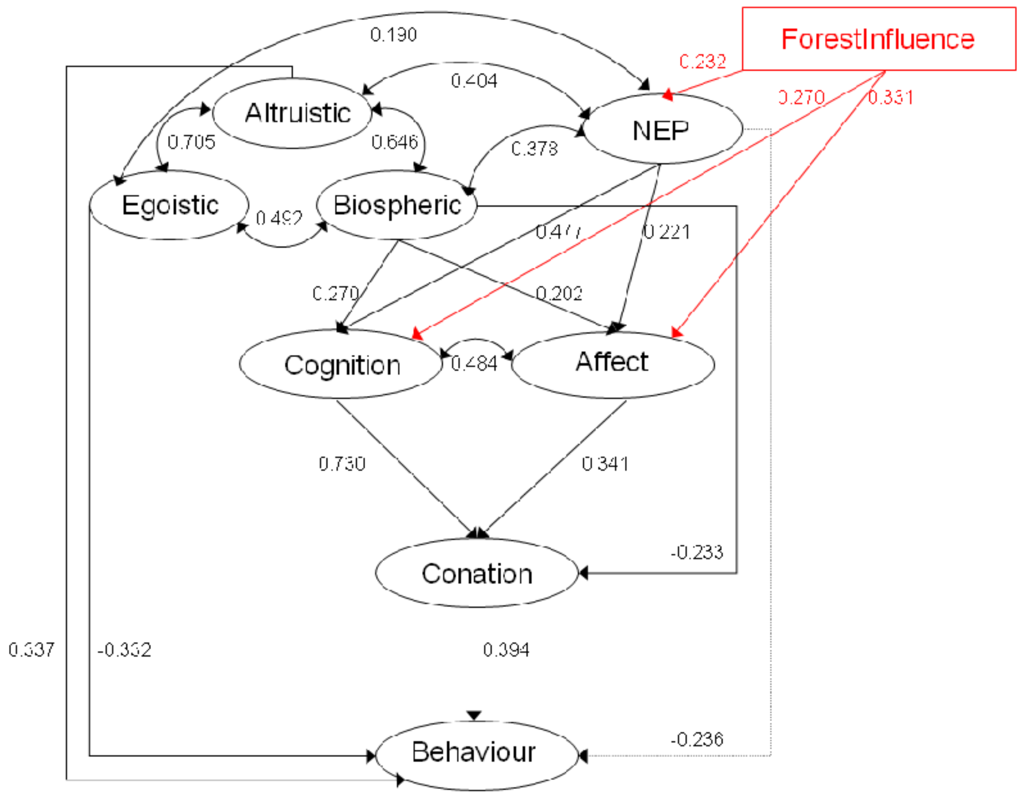
[11] See Appendix A12, section IV.3., for more details on the selection of the general-specific attitude-behaviour model.

4. General-Specific Attitude & Behaviour – MIMIC

The assumption that farmers with native forest fragments ≥ 1 ha who chose to have native forest on their farm (farmers with forest by choice) had stronger pro-environmental attitudes and behaviour towards the natural environment than farmers who did not particularly seek farms with native forest (farmers with forest by chance) was examined next.

The results were consistent with those found in Chapter 10. Farmers with forest by choice and farmers with forest by chance exhibited the same mean values of value-based environmental concerns. Yet farmers with forest by choice still showed a higher level of pro-environmental core beliefs towards the natural environment (measured by NEP), as well as more sympathetic beliefs (*cognition*) and feelings (*affect*) towards the native forest (Figure 12.3). Furthermore, their pro-environmental beliefs and feelings towards the forest translated into stronger favourable intentions (*conation*) towards the forest, which, in turn, tended to translate into more positive behaviour towards the forest (Table A12.15). The model fitted the data well (Table A12.14) and explained more of *cognition*'s, *affect*'s and *conation*'s variances than the model without distinction between farmers with forest by choice and chance (model 1 in Table A12.13, and Table A12.16).

Figure 12. 3 Schema of the MIMIC attitude-behaviour model 1 with standardized regression (direct effects) and correlation coefficients between the attitudinal and behavioural latent factors of farmers with native forest fragments ≥ 1 ha (N = 356), distinguishing between farmers with native forest by choice and farmers with native forest by chance (grouping variable *ForestInfluence*). Solid lines represent relationships significant at p ≤ 0.10; dotted lines represent relationships not significant (p > 0.15) but meaningful for the amount of variance.



5. Attitude – Behaviour relationship: conclusions

The attitudes of farmers with ≥ 1 ha fragments ≥ 1 ha were slightly different from the attitudes of the group of farmers with native forest fragments of any size. The specific attitude towards native forest was not directly influenced by egoistic environmental concern anymore, but rather only by biospheric concern. Farmers' attitudes towards the natural environment (general and specific) predicted farmers' behaviour towards the native forest fragments on their farm. However, the behaviour construct tended to suffer from inconsistent correlations among its indicators. Again, farmers with forest by choice and farmers with forest by chance expressed the same value-based environmental concerns. However, farmers with forest by choice did display more pro-environmental core beliefs and specific attitudes towards native forest. They also tended to behave in a more favourable way towards native fragments on their farm.

V. Effects of situational variables on the attitude-behaviour relationship in farmers with native forest fragments ≥ 1 ha

Next to be examined were the effects of the situational variables on the environmental attitudes and behaviour of the 361 farmers with native fragments ≥ 1 ha. The primary goal was to identify which situational variables favour the consistency between pro-environmental attitudes and behaviour. In case the first goal was not met, the secondary goal was to better predict farmers' behaviour towards native forest fragments on their property. The procedure of model selection is explained in the next section.

In addition to the eight groups of situational variables already used in Chapter 11, the present chapter included a new group of situational variables: *Fragment features*. This group of covariates consisted of the number of native forest fragments on the farm, the proportion of farm area covered by native forest compared to the total farm area, and finally, the distinction between fragments that were situated on slopes of 30° or steeper (at least half of the fragment area) and fragments covering flatter ground. The effects of these variables were not analysed previously because they were not relevant for the comparison of farmers with and without fragments.

1. Model Selection

The reader is invited to consult Chapter 11, section III.1, for a general description of the model selection.

Because the primary purpose of these analyses was to identify which situational variables improved the attitude-behaviour consistency, direct relationships between the situational and attitudinal variables were first assessed. The resulting changes in path coefficients between attitude and behaviour were estimated as well as the indirect effects the situational variables had on behaviour. If the situational variable did not have significant relationships with the attitudinal variables or substantially decreased the amount of variance explained in the psychological latent variables, direct effects between the situational variables and behaviour were then assessed.

Final models were selected based on overall goodness-of-fit, focal areas of ill-fit (notably those compromising the integrity of the attitudinal model), strength of parameter estimates and interpretability (Brown 2006, p. 175), and amounts of variance explained. Only the best model for each theme group of covariates is reported below. Finally, these nine best models[12] from the whole sample of farmers with fragments ≥ 1 ha were then run using the MIMIC procedure distinguishing between farmers with native forest by choice and farmers with native forest by chance. This allowed testing whether the effects of the situational variables on the psychological variables were confounded with the desire to have native forest on the property.

2. Hypotheses

The hypotheses tested here followed from those in Chapter 11, updated according to the results found in that chapter. Hypotheses 1 to 5 reflected the primary goal stated earlier, that is, identifying which situational variables favour the consistency between pro-environmental attitude and behaviour. Hypotheses 6 and 7 directly referred to the second goal of better predicting farmers' behaviour towards native forest fragments on their property. The hypotheses are:

1. *Direct contact with nature*: the more contact with the natural world respondents had, the more their pro-environmental attitude was expected to translate into pro-environmental behaviour
2. *Farmers' characteristics variables and Farm's characteristics*: the pro-environmental attitudes of older farmers, organic farmers, farmers with less profitable farms and farmers with smaller farms were expected to lead to pro-environmental behaviour.
3. *Knowledge-related questions*: the more respondents were and felt knowledgeable about the natural environment, the more their pro-environmental attitude was expected to predict pro-environmental behaviour.

[12] Corresponding to the nine theme groups of situational variables.

4. *Family Influence*: the positive effects respondents' families had on respondents' environmental attitude were expected to be also associated with pro-environmental behaviour. In particular, the more respondents talked about environmental issues with their immediate family and reported being influenced by these discussions and the higher the level of environmental concern respondents reported for their parents, the more their pro-environmental attitude was expected to translate into pro-environmental behaviour. The same result was expected for respondents whose parents were not farmers.
5. *Farmer Influence*: the more respondents talked about environmental issues with fellow farmers, the more their pro-environmental attitude was expected to transpose into pro-environmental behaviour.
6. *RC Conservation Effort*: the way respondents perceive their regional council's strategy regarding conservation of native forest on private land was expected to be more strongly directly related to respondents' behaviour towards their native fragments than with their environmental attitude.
7. *Fragment Features:* Assuming that farmers' primary goal is to ensure the viability of their business, fragments on steep slopes were expected to receive more conservation treatments because these steep areas were less suited for farming, and vegetation cover on such slopes can prevent erosion of the topsoil. However, this hypothesis was expected to be more strongly supported in the sample of farmers with native forest by chance because farmers with forest by choice were expected to give similar treatments to all fragments. Abundance of native forest on the farm (measured by number of fragments as well as forest cover compared to farm total area) was hypothesized to be associated with stronger pro-environmental behaviour. This hypothesis followed from the assumption that the proximity with the native forest would encourage pro-environmental behaviours in farmers with forest by chance. Finally, farmers with forest by choice were expected to show a stronger relationship between native forest abundance and pro-environmental behaviour since they wanted native forest on their farm.

3. Results

Four groups of situational variables were imputed because the total number of missing values in each group, when analysed with the psychological variables, reduced the sample size by at least 10%. These four groups of situational variables were *Farm's Characteristics* (27.3% of missing values in the attitude-behaviour model), *Farmers' characteristics* (11.2%), *Family Influence* variables (13.2%) and *Fragment features* (24.6%). However, the results with and without imputed values differed on some aspects. Therefore, these initial results are to be taken with caution and would need further replications.

The nine final models fitted the data well whether or not respondents were distinguished between those with forest by choice and those with forest by chance (Table A12.17 and A11.18).

a. How the situational variables affect the consistency between the attitudinal variables and between the attitudinal and behavioural variables

i. On the whole sample of farmers with fragments ≥ 1 ha

The standardized regression coefficients between attitudinal variables and between attitudinal and behavioural variables from the simple attitude-behaviour model (model 1, section III.3) were compared to those from the attitude-behaviour models with situational variables (Table A12.19). Changes were considered when an arbitrary difference of 0.06 standardized regression coefficient units or more occurred. *Direct contact with the natural environment* and *Knowledge* variables were particularly important in reinforcing the relationships between the psychological variables. Detailed results are presented below.

Direct Experience with nature (Recreational activities & Direct Contact with New Zealand Forest)

Direct experience with nature was associated with one of the strongest consistencies between farmers' feelings and beliefs towards native forest (Table A12.19, 3rd and 2nd rows and 5th column). On the other hand, the feelings of farmers with fragments ≥ 1 ha were among the least influenced by core environmental beliefs once direct experience with nature was accounted for (2nd row and 4th column). In addition, their intentions towards native forest were the most influenced by non-biospheric environmental concern (3rd row and 6th column).

Knowledge

The intentions of respondents who were and felt the most knowledgeable about environmental issues were the most driven by feelings towards native forest (Table A12.19, 8th row and 8th column). The strong influence of respondents' feelings on intentions was matched by the weakest influence beliefs towards the forest had on intentions (8th row and 7th column). Consequently, respondents' intentions towards New Zealand native forest were equally driven by their feelings and beliefs towards it.[13] Additionally, intentions best predicted behaviour towards native forest fragments when respondents were and felt the most environmentally knowledgeable (9th column). On the other hand, respondents' behaviour was more influenced by human-exceptionalism-inclined core environmental beliefs than in the attitude-behaviour model. [14]

Family Influence

When the family covariates were taken into account, respondents tended to show less coherence between their different attitudinal components (Table A12.19, 6th row, especially 4th and 7th columns). However, this did not affect the predictive power of respondents' attitude over their behaviour. On the contrary, respondents' behaviour was more influenced by human-exceptionalism-inclined core environmental beliefs than in the attitude-behaviour model (6th row, 9th to 12th columns, especially the10th column).

Farm Characteristics

When farm size, organic farming and proportion of product exported were considered, respondents' pro-environmental behaviour was less driven by their intentions towards native forest and most influenced by human-exceptionalism-inclined core environmental beliefs (Table A12.19, compare the 9th and 10th columns of the 6th and 1st rows). Respondents' behaviour was the most influenced by non-egoistic and altruistic environmental concerns.

[13] In most models (the attitude model without situational variables included), intentions towards native forest were influenced by beliefs towards the forest about twice as much as by their feelings towards it (Table A12.19, 7th and 8th columns).
[14] "human exceptionalism" is defined as the "belief in an evolutionary discontinuity between man the symbolizer and other biological creatures" (Klausner, 1971 in Catton and Dunlap, 1980, p. 18). "Human exceptionalism" is also referred as "anthropocentrism" in this thesis.

Fragment features

When native forest fragment features were accounted for, respondents had the least emotionally-driven intentions towards native forest and showed the weakest association between their intentions and their actual behaviour (Table A12.19, compare the 8th and 9th columns of the 10th row with the rest of the rows). Additionally, respondents' behaviour was the least influenced by non-egoistic environmental concern (10th row, 11th column).

Farmer Influence

When the influence of fellow farmers was acknowledged, respondents' general attitudes towards the natural environment tended to predict less their specific attitudes towards New Zealand indigenous forest (Table A12.19, 7th row, columns 1st to 4th). However, the most noticeable change from the original attitude-behaviour model was in respondents' intentions being less related to their beliefs towards the forest.

Farmers' Characteristics and Regional Council Conservation Effort

These two sets of situational variables did not induce any changes of at least 0.06 standardized coefficient units in respondents' attitudes and/or behaviour.

ii. Distinguishing between farmers with native forest fragments ≥ 1 ha by choice and farmers with native forest by chance

Overall, distinguishing between the two groups of farmers with fragments ≥ 1 ha tended to increase the consistency between feelings and beliefs towards native forest, compared to the general-specific attitude-behaviour model. In contrast, taking account of the two groups tended to reduce the relationship of self-reported behaviour towards the forest on the one hand, and human-exceptionalism-inclined core environmental beliefs and intentions towards the forest on the other. Results per group of situational variables are given below. Main differences (changes in standardized values ≤ |0.06|) with the influences of the situational variables on the attitude-behaviour model of farmers with native forest fragments ≥ 1 ha are discussed (Tables A12.19 and 12.20).

Direct Experience with nature (Recreational activities & Direct Contact with New Zealand Forest)

After distinguishing between farmers with forest by choice and farmers with forest by chance, intentions towards native forest were more influenced by beliefs towards the forest (Tables A12.19 and A12.20, 1st and 3rd rows, 7th and 8th columns). Additionally, respondents' behaviour towards native forest was now less predicted by respondents' environmental attitudes (9th to 12th columns, 1st and 3rd rows in Table A12.20).

Knowledge

Although respondents' intentions remained least influenced by beliefs towards native forest but most influenced by feelings towards the forest, a greater difference than previously was found between beliefs and feelings towards the forest in predicting farmers' intentions (8th rows, 7th and 8th columns in Tables A12.19 and A12.20). In addition, unlike the previous finding, the influences of respondents' intentions and their core environmental beliefs on behaviour towards the forest were no longer different from the relationships found in the simple attitude-behaviour model (1st and 8th rows, 7th and 8th columns in Table A12.20).

Family Influence

The influence of respondents' core environmental beliefs on their behaviour was no longer different from the relationship found in the attitude-behaviour model (Table A12.20, 1st and 6th rows, 10th column). On the other hand, respondents' behaviour was now more driven by non-egoistic environmental concern (11th column).

Farm Characteristics

Core environmental beliefs no longer influenced respondents' behaviour more than in the simple attitude-behaviour model (Table A12.20, 1st and 5th rows, 10th column).

Fragment features

The correlation between respondents' feelings and beliefs towards native forest was now stronger than the one found in the attitude-behaviour model (10th rows, 5th columns in Table A12.19 and A12.20). Additionally, respondents' behaviour was now the least influenced by human-exceptionalism-inclined core environmental beliefs (10th rows, 10th columns in Tables A12.19 and A12.20). In contrast, the influence of non-egoistic environmental concern over behaviour was now not different from the one found in the attitude-behaviour model (10th rows, 11th columns in Tables A12.19 and A12.20).

Farmer Influence

Compared to the analysis on the whole sample of farmers with fragments ≥ 1 ha, the influence of respondents' beliefs towards native forest on their intentions was no longer weaker than the one found in the attitude-behaviour model (7th rows, 7th columns in Tables A12.19 and A12.20). However, the influence of respondents' feelings towards the forest was now smaller compared to the attitude-behaviour model (7th rows, 8th columns in Tables A12.19 and A12.20).

Regional Council Conservation Effort

The changes in standardized values were now important enough to be reported. When farmers' perception of their regional council's efforts in encouraging native forest conservation on private land was taken into account, respondents' behaviour was less influenced by their intentions towards native forest than in the attitude-behaviour model (Table A12.20, 1st and 9th rows, 9th column). Respondents' behaviour was also less influenced by human-exceptionalism-inclined core environmental beliefs (1st and 9th rows, 10th column).

Farmers' Characteristics

The previous results remained unchanged.

b. Effects of the situational variables on farmers' attitudes and behaviour towards the natural environment

In this section, the effects of the situational variables on attitude of farmers with fragments ≥ 1 ha are compared to those on the attitudes of farmers with native forest fragments of any size (which were examined in Chapter 11). As earlier, the effects of the situational variables on the attitudes and behaviour are compared between the whole sample of farmers with fragments ≥ 1 ha and the same sample distinguishing between farmers with forest by choice and by chance.

With some exceptions, the relationships between the situational and the attitudinal variables were consistent overall with those found in the previous analyses on attitude alone of farmers with native fragments of any size (Table A11.6 in Chapter 11). The situational variables tended to explain more variance in the intentions towards New Zealand indigenous forest of farmers with fragments ≥ 1 ha than in the analyses of the whole group of farmers with native forest fragment of any size. Although the situational variables generally related only indirectly and weakly to behaviour, the direct effects the situational variables had on the attitudinal variables usually induced increases in explained variance of behaviour. Additionally, combining the situational variables and the distinction between farmers with forest by choice and chance resulted in less difference in pro-environmental attitudes and behaviour between the two groups of farmers than when the situational variables were not included. This suggested that some differences between the attitudes and behaviour of the two groups of farmers were due to differences in the situational context of the two groups.

Distinguishing between farmers with forest by choice and chance usually resulted in a decrease in magnitude of the situational effects on the psychological variables. However, most of the effects remained significant suggesting that these situational variables were relevant for both farmers with forest by choice and farmers with forest by chance. The results are presented in Table A12.21 for the whole sample of farmers with native fragments ≥ 1 ha and in Table A12.22 for farmers with forest by choice and farmers with forest by chance.

i. Hypotheses evaluation

Hypothesis 1. Direct contact with nature: the more contact with the natural world respondents had, the more their pro-environmental attitude was expected to translate into more pro-environmental behaviour.

As in Chapter 11 (Table A11.6), more regular direct contact with nature, as a child or an adult, was found to be associated with stronger positive feelings and beliefs towards native forest, which translated into stronger intentions towards the forest, which in turn tended to predict more pro-environmental behaviour towards the forest fragments on the farm (Table A12.21, rows *Direct Contact Forest* and *Recreational Activities* and columns *Affect*, *Cognition*, *Cona (Ind)* and *Behav (Ind)*). [15] Unlike for the sample of farmers with native forest of any size, *FrequencyUse* played a role in explaining the environmental attitudes and behaviour of farmers with fragments ≥ 1 ha. The less frequent the use of resources from native forest respondents reported, the more they intended to behave or had behaved in an environmentally friendly manner towards the forest.

As in the sample of farmers with native forest of any size, farmers with large fragments by choice and farmers with large fragments by chance showed the smallest dissimilarity in positive feelings towards New Zealand indigenous forest once the amount of direct contact with nature was controlled for (Table A12.22, compare rows *Direct Contact Forest* and *Recreational activities* columns *Affect* with other rows). Farmers with forest by choice and farmers with forest by chance also showed one of the most similar levels of pro-environmental intentions towards the forest, once direct contact with nature was accounted for (compare rows *Direct Contact Forest* and *Recreational activities* columns *Con(Ind)* with other rows).

After controlling for forest influence, out of four indicators of direct experience with nature, only the effect of *Visit as a child* on environmental attitude and behaviour barely changed (Tables A12.21 and A12.22, row *Direct Contact Forest*). Therefore, whether or not farmers wanted native forest, farmers who regularly visited New Zealand native forest as a child displayed stronger positive feelings, intentions and behaviour towards the forest.

[15] It is worth recalling from section II.1.b, however, that the attitudinal models of farmers with forest of any size and farmers with fragments ≥ 1 ha were slightly different.

These results suggest that direct contact with nature is first and foremost associated with feelings rather than *cognition*, and corroborated the hypothesis that contact with nature encourages pro-environmental attitudes and behaviour.

Hypothesis 2. Farmer's characteristics variables and Farm's characteristics: the pro-environmental attitudes of older farmers, organic farmers, farmers with less profitable farms and farmers with smaller farms was expected to lead to pro-environmental behaviour.

As in Chapter 11, older farmers, organic farmers, farmers with less profitable farms and farmers with smaller farms held more pro-environmental attitudes and also tended to behave in a more pro-environmentally friendly way towards their native fragments[16] (Tables A12.21 and A12.22, rows *Farmer's characteristics* and *Farm Characteristics*). Unlike in the sample of farmers with native forest fragment of any size, farm type was not relevant in predicting the attitudes, or behaviour, of farmers with fragments ≥ 1 ha (84.5% of the respondents were meat producers). Additionally, farm income and farm size had direct effects on behaviour. Moreover, organic had a direct positive effect but a negative – although weaker – indirect effect on behaviour.

Hypothesis 3. Knowledge-related questions: the more respondents were and felt knowledgeable about the natural environment, the more their pro-environmental attitudes were expected to predict pro-environmental behaviour.

As expected, ecological knowledge and confidence in one's ecological knowledge were associated with pro-environmental attitudes and behaviour (Table A12.21, row *Knowledge*). Farmers with fragments ≥ 1 ha who were and felt more knowledgeable about environmental issues showed stronger pro-environmental attitudes[17] than the sample of farmers with native forest fragments of any size (Chapter 11 Table A11.6).

Most noticeably, the effect of environmentally informed on *affect* decreased once native forest influence was controlled for.

[16] The path between farm income and behaviour was not significant at p=0.150, but, if removed, the variance explained in behaviour diminished quite substantially. The relationship was therefore kept.
[17] That is, except for intentions, which had similar values in both samples.

Hypothesis 4. Family Influence: the positive effects respondents' family had on their environmental attitudes were expected to also be associated with pro-environmental behaviour. Especially, the more respondents talked about environmental issues with their immediate family and reported being influenced by them, the higher level of environmental concern respondents reported for their parents, and, for respondents whose parents were not farmers, the more their pro-environmental attitudes were expected to translate into more pro-environmental behaviour.

As with the sample of farmers with native forest of any size (Table A11.6 in Chapter 11), respondents with large fragments displayed more pro-environmental attitudes when their parents were not farmers, when respondents were not farming with their children, when they talked more about environmental issues with their family and found these discussions most helpful for making up their mind about such issues, and when they had a higher level of environmental concern they attributed to their parents. However, overall, the family influence covariates tended to have stronger effects on the attitudes of respondents with fragments ≥ 1 ha than on the sample of respondents with native forest of any size (Tables A11.6 and A12.21, the *Family Influence* rows, especially *MakeMind*, *ChildInvtFarm* and *Parent EC* on *Affect*). Respondents who reported a higher rating of environmental concern for their parents, who talked regularly with their family about environmental issues, and, more importantly, whose parents were not in the farming business reported more pro-environmental behaviour towards their native fragments (the *ParEC*, *EnvtalTalk* and *ParentFarmer* rows, *Behaviour* and *Behav (Ind)* columns in Table A12.21). It is worth noting that *ParentFarmer* had a significant direct effect on behaviour, which may be due to respondents still farming with their parents. The self-reported influence of discussion with family member on respondents' view of environmental issues (*MakeMind*) was more weakly associated with attitudes and behaviour once the distinction between farmers with forest by choice and by chance was accounted for.

Hypothesis 5. Farmer Influence: the more respondents talked about environmental issues, the more their pro-environmental attitudes were expected to transpose into pro-environmental behaviour.

Similarly to the sample of farmers with fragments of any size (*Farmer Influence* row in Table A11.6 in Chapter 11), farmers with large fragments who talked often about environmental issues with fellow farmers showed stronger pro-environmental attitudes (Table A12.21 *Farmer Influence* row). However, this did not translate into greater pro-environmental behaviour. The number of discussions with other farmers per se did not predict respondents' behaviour towards their native fragments. Only being influenced by other farmers as a result of these discussions explained some of farmers' pro-environmental behaviour. However, the effects of *Farmers' influence* were ambiguous. Its indirect effect on behaviour through attitude was positive, yet its direct effect was negative. The total effect on behaviour was not significant.

The effects of the *Farmer influence* situational variables before and after controlling for forest influence remained similar (Table A12.22).

Hypothesis 6. RC Conservation Effort: the way respondents perceive their regional council's strategy regarding the conservation of New Zealand native forest on private land was expected to be more strongly related directly to respondents' behaviour towards their native fragments, rather than respondents' environmental attitudes.

Respondents' perception of their regional council's actions towards the conservation of native forest on private land had a stronger direct and positive effect on behaviour than indirect through attitudes (Table A12.21, row *RC conservation efforts*, columns *Behaviour* and *Behav (Ind)*).

The effect of RC on attitude reduced slightly once the two groups of farmers with fragments ≥ 1 ha were controlled for (Table A12.22).

Hypothesis 7. Fragment Features: Fragments on steep slope would receive more conservation treatment because these steep areas are less suited for farming. It was further expected that, due to the proximity with native forest, respondents would tend to show more pro-environmental behaviour the more fragments and the more area in native forest compared to the farm size the respondents have.

Contrary to expectations, fragments on steep slopes received less conservation treatments than fragments on flatter areas, whether or not farmers wanted indigenous forest on their farm (Tables A12.21 and A12.22 row *Fragment Features*). On the other hand, the greater the ratio of fragment size to farm size was, the more pro-environmental behaviour respondents showed (Table A12.21). However, this relationship diminished once the two groups of farmers with fragments ≥ 1 ha were controlled for (Table A12.22). The number of fragments was not related to farmers' attitudes or behaviour.

ii. Best predictors of attitudinal and behavioural variables

The greatest amount of variance explained in each psychological variable by the effects of situational variables (Tables A12.24 and A12.25) is reviewed next. However, it is important to note that explained variance in the dependent variable is mainly influenced by direct effects of independent variables. While indirect effects[18] can modify the predictors' values, they are less likely to affect the dependent variable.

In the present analysis, most of the situational effects affected farmers' behaviour indirectly via attitude, with a few situational variables directly affecting behaviour. The results below focused on several of the most important predictors of farmers' attitudes and behaviour, rather than on only the best predictor.

Best predictor(s) of environmental concerns

The three groups of situational variables having an effect on farmers' biospheric environmental concern (*Farmer's characteristics*, *Family Influence* and *Knowledge*) explained about the same, small, amount of variance in biospheric concern. Of these, *Knowledge* variables explained the most. Out of the three situational groups predicting altruistic concern (*Farmer Influence*, *Knowledge*, and *RC Conservation efforts*) and the two groups predicting egoistic concern, *Farmer Influence* explained the most variance in the two environmental concerns (Tables A12.24 and A12.25).

Best predictor(s) of core environmental beliefs

Farmers' core environmental beliefs were best explained by the *Knowledge* situational variables (Tables A12.24 and A12.25, column NEP). However, *Family*

[18] Indirect effects are effects affecting the predictors of the dependent variable.

Influence was also a very strong group of predictors of farmers' general environmental beliefs.

Best predictor(s) of feelings towards New Zealand native forest

Direct Contact with New Zealand Forest predicted the most variance in farmers' feelings towards native forest (Tables A12.24 and A12.25, column *Affect*). *Knowledge*, *Family Influence* and *Recreational Activities* were the next best predictors of farmers' feelings.

Best predictor(s) of beliefs towards New Zealand native forest

Overall, every group of situational variables but *Fragment Features* explained about the same amount of variance in farmers' beliefs towards New Zealand native forest, around 7% more than the higher-level attitudinal variables (Tables A12.24 and A12.25, column *Cognition*). However, *Family Influence*, followed by *RC Conservation efforts*, explained the largest amount of variance in farmers' beliefs towards the forest.

Best predictor(s) of intentions towards New Zealand native forest

Recreational Activities explained the most variance in farmers' intentions towards native forest (Tables A12.24 and A12.25, column *Conation*). The rest of the situational groups explained little or no more of the variance in farmers' intentions.

Best predictor(s) of behaviours towards New Zealand native forest

Overall, the situational variables predicted little more of farmers' behaviour than attitudes did. *Farm Characteristics*, followed by *Family Influence*, explained the most of behaviour's variance (Tables A12.24 and A12.25).

iii. Situational effects on psychological variables that remained stable for farmers with native forest by choice and farmers with native forest by chance

Controlling for farmers with forest by choice and farmers with forest by chance barely altered the results found in the previous section (Tables A12.21 and A12.22). Most of the path coefficients between the situational and the psychological variables decreased as a result of the introduction of the grouping variable *Forest Influence*, but remained significant. However, a few coefficients were almost unaffected by the control. These stable coefficients indicated that the positive effects the situational variables had on environmental attitudes and/or behaviour were not biased by the priori positive attitudes of farmers who wanted native forest on their property. Therefore, these variables are particularly important in predicting pro-environmental attitudes and/or behaviour of farmers with fragments ≥ 1 ha. The stable paths are listed below in Table 12.1.

Table 12. 1 List of paths between situational and psychological variables that remained stable after controlling for farmers with native forest by choice and farmers with native forest by chance.

Situational group	Situational variable	Psychological variable
Direct Contact Forest	VisitAsChild	Affect
		Cona(Ind)
		Behav(Ind)
Farm Characteristics MI	Farm Size	Behaviour
	Organic	Egoistic
		Behav(Ind)
Family Influence MI	Parent EC	Affect
		Cognition
		Cona(Ind)
		Behav(Ind)
	Child Invt Farm	NEP
		Cona(Ind)
	Environmental Talk	Conation
Farmer Influence	Environmental Talk	Egoistic
		Conation
	Make Mind	Altruistic
		Cognition
		Cona(Ind)
		Behav(Ind)
Knowledge	EcoLit	Biospheric
		Altruistic
Fragment Features	Steep	Behaviour

VI. Discussion

The purpose of this chapter was twofold. Firstly, it aimed to assess the extent to which farmers' attitudes towards the natural environment (including New Zealand native forest) predicted their behaviour towards their native forest fragments. Secondly, and in continuity with the previous chapter[19], the present chapter looked at how direct contact with nature and other situational variables impacted on the correspondence between farmers' attitudes and behaviours towards the natural environment. This chapter only concerned farmers having native forest fragments ≥ 1 ha on their property. In addition, the effects of the different situational variables were also controlled for the fact that some of the farmers had wanted farms with native forest (farmers with forest by choice). This group of farmers was expected to have a priori positive attitude and behaviour towards the native forest.

1. Sample choice

The purpose of this study was to explain farmers' pro-environmental behaviour towards their native forest fragments. A somewhat arbitrary minimum fragment size of one hectare fragments was chosen to distinguish farmers with native forest fragments from those with only groups of a few trees. Examining the situational context of farmers with fragments ≥ 1 ha and farmers with fragments < 1 ha, it was found that the two groups did diverge. They differed on the number of visits to the native forest, their intention to pass on the farm to a family member, the source of information about costs and benefits of native fragments on farms, and the proportion of exported farm products. A comparison of their attitudes towards the natural environment was, however, not possible because there were too few cases in the group of farmers with fragments < 1 ha. Yet slight differences between the attitudinal models of farmers with native forest of any size and farmers with fragments ≥ 1 ha suggested that the latter group of farmers could have a different attitudinal model from farmers with fragments < 1 ha. The arbitrary distinction between farmers with fragments ≥ 1 ha and < 1 ha was therefore partly supported by the data.

[19] Chapter 11 reviewed the effect of situational variables on farmers' attitude towards the natural environment.

2. Reasons for keeping native forest fragments on the farm

The most common reasons given by farmers with fragments ≥ 1 ha for keeping these fragments on their property were ecosystem protection and aesthetic reasons. These results indicated that farmers had predominantly kept native forest fragments on their property for the intrinsic value of the forest, whether or not they wanted native forest on their land in the first place. While it can be expected that protection and aesthetic reasons motivated the search of farmers with forest by choice for a property with native forest, finding a similar result for farmers with forest by chance[20] suggested that the proximity with the forest could have triggered such thoughts a posteriori. The fact that more farmers with forest by chance than farmers with forest by choice chose *Leisure* as a reason for keeping the fragments further suggested that the presence of the forest could instigate a non-utilitarian bonding between the forest and the farmer. The fact that more farmers with forest by choice than farmers with forest by chance chose *Farming purposes* as a reason for keeping the fragments indicated that keeping native fragments was not incompatible with farming in respondents' minds.

3. Psychological Models

a. Attitude Measure

Farmers with native forest fragments ≥ 1 ha on their property described an attitudinal structure slightly different from the sample of farmers with native forest fragments of any size. The direct ascendance of egoistic environmental concern on the lower-level attitudinal variables was replaced by one of biospheric concern.

b. Behaviour Measure

Out of five initial behaviour indicators, three remained to describe the behaviour latent factor. Fenced, pest or weed controlled and legally protected native forest fragments showed the strongest associations. Such relationships were expected as pest/weed controls were highly encouraged by protection agencies and keeping cattle

[20] Farmers with forest by chance are assumed not to have an a priori positive attitude towards the native forest, hence they are assumed not to have a priori thoughts about why having native forest on their property might be positive.

off the fragments to be protected (usually by fencing) was compulsory and assisted by the protection agencies (Cocklin and Doorman 1994, p. 267; Ministry for the Environment 2000, p. 59; Davis and Meurk 2001, p. 25; Greater Wellington 2004, p. 4; Janssen 2006, p. 106-7). However, these associations still showed some inconsistency, reflected in the different amount of variance explained in each of the behaviour indicators by the model. This suggested that respondents engaged disparately in pro-environmental behaviour towards native forest.

Psychological theories postulate that, although human beings need internal consistency and coherence to function, and hence would tend to behave in a consistent manner across similar objects of behaviours, they do not always do so[21] (see chapter 2, especially 'behavioural consistency' p. 31 in Ajzen 2005). A range of reasons have been invoked to explain behavioural inconsistency towards the natural environment. Thøgersen and Ölander have argued that observing consistency in a person's behaviours would depend on how related these behaviours are in that person's mind (Ölander & Thøgersen, 2000; Thøgersen & Ölander, 1999 in Thøgersen and Ölander 2003, p. 226). They have also argued that if people perceived environmental issues as collective matters rather than individual, and therefore perceived their environmentally friendly action as just a very small part of a collective effort, they did not feel compelled to behave in an environmentally friendly manner in every aspect of their life (Thøgersen and Ölander 2003, p. 226). Following from these two arguments, it is also conceivable that people could reach a sort of threshold where performing such behaviours could impair the inclination to engage in another. It has also been argued that people may perform more willingly low-cost than demanding pro-environmental behaviours (e.g., Vogel 1996).

In the present study, controlling the forest fragments for pests and weeds was the least related to the other behavioural indicators (legally protecting and fencing). Farmers in the present study may have considered that legally protecting and fencing their native fragments were already strong commitments to native forest conservation, hence controlling for pests or weeds was not necessary. Furthermore, controlling for pests and weeds was probably more time and energy consuming as one would need to walk a great part of the fragment and this would need to be more regularly repeated than fencing or legal protection (one-off). Another interpretation could be that weed and pest control would most likely succeed the other two, and as legal protection would go hand-

[21] In such case, human beings will post-rationalize to justify to themselves their inconsistency (Chapter 2, especially 'behavioural consistency' p. 31in Ajzen 2005).

in-hand with keeping farm animals out, one can expect a stronger correlation between legal protection and fencing.

4. Predictors of farmers' behaviour towards native fragments on farms.

a. Attitude – behaviour relationship

The environmental attitudes of farmers with fragments ≥ 1 ha explained between 17.3% and 18.3% of their behaviour, whether or not farmers were distinguished between those with forest by choice and those with forest by chance. This amount of explained variance is at the high end of the range of the usually expected amount of variance explained in behaviour by attitude. Attitude is usually found to explain 10%-20% of behaviour, and not more than 30% (Tarrant and Green 1999). Wicker (1969 in Vogel 1996, p. 592) stated that, in general, attitude would at most explain 10% of behaviour variance. This relationship could be improved up to 20% by the addition of direct effects of external variables on behaviour (Vogel 1996, p. 592). Furthermore, in environmental attitude and behaviour studies, an even lower portion of variance explained is not uncommon (Vogel 1996, p. 592).

Nevertheless, the measure of farmers' behaviour towards New Zealand native forest fragments relied on self-reports as opposed to actual behaviour. Studies have shown that self-reporting could lower the attitude-behaviour correspondence (Hines et al. 1987). Furthermore, the behavioural indicators were inconsistently correlated. Therefore, actual measures of behaviour and better correlated behaviour indicators should improve further the relationship between attitude and behaviour.

Finally, the relationship between farmers' core environmental beliefs (NEP) and their behaviour was important in explaining behaviour's variance, yet was not significant at $p \leq 0.10$. The small number of cases relative to the number of parameters to estimate could partly explain the low significance.

b. Effects of situational variables on farmers' attitude-behaviour relationship

Some situational variables were imputed. Additionally, due to already complex analyses, interactions between the situational variables were not examined. Therefore, the following results are tentative and would benefit from replications.

The relationships found between the pro-environmental attitudes of farmers with native forest fragments and situational variables (Chapter 11) were re-assessed with farmers' behaviour towards their native fragments. Most of the situational variables were hypothesized to affect farmers' behaviour towards native forest *indirectly* through farmers' environmental attitudes. As a result, the addition of situational variables improved the amount of variance explained in behaviour to only a small extent. The majority of the significant relationships found earlier between attitudinal and situational variables remained and translated into significant indirect effects on farmers' behaviour. Occasionally, situational variables impacted directly and significantly on behaviour. Overall, the hypotheses regarding the effects of situational variables on farmers' attitude-behaviour relationship were confirmed. The effects of the situational variables on the psychological response of farmers with fragments ≥ 1 ha were stronger than for the whole group of farmers with native forest fragments suggesting that the group of farmers with fragments ≥ 1 ha included more like-minded people than the whole sample of farmers with native fragments. The hypotheses are reviewed next.

i. Direct contact with nature:

The results were consistent with the hypothesis that direct experience with nature would positively influence pro-environmental attitudes and behaviour (see Tarrant and Green 1999). The more contact with the natural world respondents had, the more they held pro-environmental attitudes, which translated into more pro-environmental behaviour towards their native forest fragments. This result corroborated findings that direct experience improves attitude-behaviour consistency (Kraus 1995). Furthermore, the less often respondents extracted native forest resources, and the more they engaged in walking/tramping as a recreational activity, the more pro-environmental attitudes and behaviour they showed. Previous studies have found positive associations between landholders' engagement in outdoor activities and conservation management decisions (Brook et al. 2003, p. 1639). Studies in New Zealand and overseas have emphasized the importance of the recreational quality of protected natural features for landowners (e.g., Cocklin and Doorman 1994, p. 273; Williams et al. 2004; Serbruyns and Luyssaert 2006; Ernst and Wallace 2008). Furthermore, the fact that farmers with fragments engaged in contemplative rather than extractive activities suggested a more preservationist ethic as opposed to utilitarian orientations (Teisl and O'Brien, 2003: 507-508 in Wilson 1992; Young 2008, p. 36).

Farmers with numerous direct experiences with nature showed the most correspondence between their (positive) beliefs and feelings towards native forest whether they had wanted farms with native forest or not, suggesting that these respondents held more coherent attitudes towards native forest than their counterparts. Additionally, these respondents' feelings were the least driven by core environmental beliefs. Moreover, direct experience with nature also explained more variance in farmers' feelings than any other attitudinal components, and the greatest amount compared to any other situational group. Of all situational groups, controlling for respondents' amount of direct experience with nature had the most effect on increasing the similarity of positive feelings towards native forest between farmers with forest by choice and farmers with forest by chance. These results supported findings that direct experience with nature impacted first and foremost on people's feelings rather than beliefs (Millar and Millar 1996). Finally, again whether or not farmers had wanted a farm with native forest, those who regularly visited New Zealand indigenous forest as a child showed stronger positive feelings, intentions and behaviour towards the forest. This result is in line with the theoretical and the few experimental studies on the effect of nature on people's environmental orientations. Such a literature has suggested that experience with nature was instrumental in the formation of environmental values, attitudes and behaviour (Bögeholz 2006, p. 68). Experience with nature during childhood has been found to positively influence pro-environmental behaviour in the household (Langeheine & Lehmann, 1986 in Bögeholz 2006, p. 66). Furthermore, studies have found that past or present experiences with nature were perceived by respondents as significant for their environmental sensitivity (Finger 1994; Chawla 1998; Degenhardt 2002; Eigner and Schmuck, 1998 in Bögeholz 2006, p. 66).

The study of farmers with native forest by chance suggested that direct experience with nature has a positive effect on farmers' attitudes and behaviour towards the forest. These farmers were not expected to have an priori positive attitudes towards the forest. However, they predominantly gave the same reasons as farmers with native forest by choice in why they had kept the fragments: ecosystem protection and aesthetics. Furthermore, they also tended to act in a more environmentally friendly manner the more forest they had on their farm. These results suggested that the proximity with native forest could transform an a priori neutral attitude into an a posteriori pro-environmental one, leading to pro-environmental behaviour. This hypothesis would need to be tested within a longitudinal framework.

ii. Farmer's and Farm's characteristics:

The pro-environmental attitudes of older farmers, organic farmers, farmers with less profitable farms and farmers with smaller farms led to pro-environmental behaviour.

The negative relationship between age and pro-environmental attitudes and behaviour, in both groups of farmers with native forest by choice and by chance, tended to contradict results found in the literature. Drost and colleagues (1996) found that older farmers were less likely to retire part of their land for conservation purposes as they perceived "[conservation] covenants to be unfeasible or impractical, and were more sceptical about the benefits of uptake [of covenants], since those benefits would not occur during their lifetime" (Kabii and Horwitz 2006, p. 12). On the other hand, younger farmers tended to be more likely to take on sustainable practices because they were more profit-oriented and therefore more inclined to try new methods (Ahnström et al. 2008, p. 41-2). In addition, younger people in general have been expected to hold stronger pro-environmental attitudes and behaviour because they were "less integrated […] into the dominant social order (Malkis and Grasmick, 1977; Hornback, 1974)" and therefore less susceptible to favour the economy argument over the environment (Van Liere and Dunlap 1980, p. 183). However, there is evidence that environmental concern has now permeated all parts of society (Berenguer et al. 2005; Castro 2006, p. 254). Furthermore, supporting Mannheim's (1952) theory of generations[22], the older generations of New Zealand farmers were more likely to have experienced first hand the *grasslands revolution*[23] followed by its adverse consequences on the country's natural environment (Brooking et al. 2004), and therefore be more receptive to environmental issues. Although New Zealand farmers were for a long time encouraged to clear indigenous forest to make room for farmland, studies have shown that landscape

[22] Mannheim's (1952) theory of generations "suggests that important historical events occurring at the crucial adolescent and young adulthood phase of the life cycle can permanently affect a cohort throughout its existence." (Van Liere and Dunlap, 1980, p. 183).

[23] The grasslands revolution refers to the massive concentration of efforts initiated by agricultural scientists in improving pasture production via selection of grasslands and high use of fertilisers that occurred in New Zealand from 1890s to around 1980s (see Brooking et al. 2004).

preferences can change with age (Kaltenborn and Bjerke 2002, p. 2). Moreover, the younger generation would more likely be in the process of financially establishing itself, thus, more likely to be profit-oriented; whereas the older generation would have less to prove. Finally, this could also be the result of the direct proximity of native forest on the farm.

When *Farm Characteristics* variables were taken into account, farmers' behaviour towards their native forest fragments was less determined by their specific attitudes towards the forest. Instead, farmers' behaviour depended more on the situational variables and general environmental attitudes. These variables represented the practicality, the materiality that tempered the strength of farmers' environmental attitudes. As a consequence, most of these variables did not impact differently on farmers' psychological variables whether farmers had native forest on their property by choice or by chance.

Farm size impacted directly on farmer's behaviour as well as attitudes, and farm income only significantly affected their behaviour through direct effect.[24] Wealthier farmers may behave in a less pro-environmental way towards their fragments, but not necessarily because they do not care about the forest or the environment. These results suggested that wealthier farmers were more profit-oriented, which overrode favourable attitudes they may have towards the natural environment. Conversely, on farms that are less successful economically, respondents may focus on developing the aesthetic aspect of the farm, either to sell as lifestyle blocks or for personal benefit.

Farmers from different farm types no longer showed any differences in their attitudes. The sample of farmers with fragments ≥ 1 ha was indeed mostly constituted of meat producers. Although organic farmers still displayed stronger pro-environmental attitudes than conventional farmers, overall the two groups did not significantly differ in their behaviour towards native fragments. Nevertheless, a direct effect of organic farming on farmers' behaviour was positive, suggesting considerations other than internal (i.e., attitude) encouraged organic farmers to look after their forest fragments. The sustainable image they may want to project may be part of the reason for such a direct relationship.

[24] Farm size and Farm income were not studied simultaneously (Chapter 11), therefore the effect of one was not controlled for the other.

iii. Knowledge-related questions:

Ecological knowledge and confidence in one's knowledge played instrumental roles in predicting the environmental attitudes and behaviour of farmers with fragments ≥ 1 ha. Farmers with greater ecological knowledge showed more pro-environmental core beliefs towards the natural environment, while farmers with greater confidence in such knowledge showed stronger positive feelings towards native forest. Both relationships translated into stronger pro-environmental intentions and behaviours towards the forest. Furthermore, farmers with greater ecological knowledge and confidence in their knowledge showed the most consistency between their intentions and their behaviour towards the forest. These results are in line with those of Hines and colleagues (1987), who found that knowledge was a reliable predictor of environmental behaviour; and with those of Cottrell (2003) and Levy-Leboyer and colleagues (1996), who found that self-professed knowledge on environmental issues was a good predictor of pro-environmental attitudes and self-reported behaviour.

iv. Family Influence:

"[I]ndividuals' attitudes, affect, beliefs, and behavior have social correlates, both because they often derive from socially shared information, and because they collectively influence social representations, rules, and actions" (Albarracin et al. 2005, p. 15). In line with this statement by Albarracin and colleagues, respondents' interactions with their family were one of the best predictors of farmers' attitudes and behaviour. The more respondents talked about environmental issues with their immediate family and reported being influenced by these discussions, as well as the stronger environmental concern respondents reported of their parents, the stronger pro-environmental attitudes these respondents exhibited, attitudes which translated into pro-environmental behaviour. The same result was found for respondents whose parents were not farmers. In addition, the farming status of respondents' parents directly affected respondents' behaviour towards the forest independently of their attitude. This could be partly explained by some respondents' parents being involved in the running of respondents' farms.

Interacting and agreeing with the family and agreement with it were important for predicting respondents' pro-environmental attitude and behaviour. However, interactions with the family in the farming activity tended to be associated with more anthropocentric considerations. As for direct experience with nature and knowledge, family influence mostly played a similar role on both farmers with forest by choice and farmers with forest by chance.

v. Farmer Influence:

There is evidence that farmers are influenced by their peers (McNally 2002; Burton 2004, p. 363-4). However, while talking with fellow farmers about environmental issues was associated with pro-environmental attitudes in farmers with fragments ≥ 1 ha, such discussions were not related to pro-environmental behaviour. In contrast, farmers' self-report of being influenced by discussions with fellow farmers had a positive impact on their environmental attitudes that translated into pro-environmental behaviour. Yet being influenced by such discussions also directly and negatively impacted on respondents' behaviour. This result suggested that conflicting effects were at play among farmers regarding environmental issues. Farmers like-minded on environmental issues can positively influence each other. Nevertheless, respondents may voice agreement with what other farmers say about environmental issues even if such agreement does not align with their attitudes towards the natural environment.

vi. RC Conservation Effort:

The way respondents perceived their regional council's strategy regarding conservation of New Zealand indigenous forest on private land was more strongly related to respondents' behaviour towards their native fragments directly than indirectly through their attitudes. This indicated that farmers may perceive their regional councils as an ad hoc provider of practical help (e.g., funding for fencing) rather than as provider of the big picture about environmental issues. However, perceiving one's regional council's conservation strategy in a favourable light also tended to be associated with pro-environmental attitudes. This could indicate that regional councils succeeded to some extent in conveying a pro-environmental message to farmers – although there was still room for improvement. This could also be a manifestation of farmers' pro-environmental orientation, as literature has found that environmental concern was linked with support for environmental protection policies (Blake 2001, p. 709). This matter would require further investigation. Finally, although *RC Conservation Effort* impacted on farmers' attitudes, it decreased the predictive power of farmers' environmental attitudes on behaviour. Like *Farm Characteristics* variables, such a phenomenon indicated that factors other than environmental attitudes were at stake and could override such attitudes, favourable though they may be.

vii. Fragment Features:

Contrary to expectation, farmers tended to engage in pro-environmental behaviour towards fragments on flat areas more than on steep areas. Furthermore, this was not dependent on farmers' desire to have native fragments in the first place: both groups of farmers with forest by choice and with forest by chance showed the same tendency. This can be explained, however, by the practicality of taking care of fragments on flat areas (e.g. fencing). Also, it may reflect the ecological quality of the fragments. Fragments on steep areas may be smaller and with less coherent shape than those on flat areas. As a consequence, the farmer may be more inclined to protect healthy-looking fragments, and governmental agencies and/or environmental groups may also be more willing to financially help the conservation of such fragments. It may also be due to the possibility that the sampled farms may come from rather flat areas.

In addition, the more native forest farmers had on their property (ratio of native forest cover to farm size), the more respondents behaved in a pro-environmentally fashion towards the forest. The relationship remained after controlling for farmers who had wanted native forest on their farm. This result further suggested that the proximity of the native fragments encouraged pro-environmental behaviour (*Direct experience with nature*). Additionally, as *Fragments features* variables directly related to behaviour, the correspondence between farmers' environmental attitudes and behaviour decreased.

VII. Conclusion

Farmers' general and specific environmental attitudes explained their behaviour towards native fragments on their farms to a similar extent to what is usually found in the literature. As expected, farmers with native forest by choice tended to show stronger pro-environmental attitudes and behaviour than farmers with native forest by chance. However, the two groups reported the same non-utilitarian motivations for having kept the fragments on their property. Overall, direct experience, farmer's characteristics variables, farm characteristics, knowledge, family influence, farmer influence, perception of regional council's strategy for native forest protection on private land, and fragment features helped predict farmers' behaviour, either indirectly via attitude or directly. Specifically, direct experience with nature, knowledge and family influence affected both farmers with native forest by choice and farmers with native forest by chance in a similar way, making these variables particularly relevant while working towards the conservation of the natural environment. Farm characteristics, perception of regional council's strategy and fragment features tended to decrease the consistency between environmental attitudes and behaviour. Results suggested that the proximity of native forest could encourage pro-environmental attitudes and behaviour in farmers with fragments $\geq$ 1 ha.

Chapter 13: Discussion & Conclusions

I. Introduction

The present research was aimed at better understanding farmers' attitudes and behaviour towards the natural environment in general and to New Zealand native forest in particular. This was achieved by (1) assessing the general-specific model of farmers' attitudes with general attitudes measured by the revised New Environmental Paradigm (NEP) and Environmental Motives Scale (EMS) and with specific attitudes based on a tripartite attitudinal model; (2) comparing attitudes and the context affecting the attitudes of farmers with and without native forest fragments on their property; (3) predicting behaviour of farmers with native forest towards their native fragments by their environmental attitudes; and (4) assessing the situational factors impacting on the correspondence between farmers' pro-environmental attitudes and behaviour. In this chapter, results are drawn together and put in theoretical perspectives.

II. Outlines of the study

Research data were obtained from a postal survey conducted on the farming community of two regions of the lower North Island of New Zealand: Manawatu-Wanganui and Wellington regions. A random stratified sample was used where equal proportions of farmers from the two regions, with and without native forest on their property, and within each of the three regional major farm types (meat, dairy and horticulture farming) were targeted. The survey response rate was very satisfactory (53%) and the sample represented around 13% of the farming population of the two regions. However, the response sample was biased towards farmers with native forest and meat producers. Attitudes towards the natural environment in general and New Zealand native forest in particular were compared between farmers with and without native forest. Additionally, the study distinguished between farmers with native forest by choice and farmers with native forest by chance. Finally, the behaviour of farmers with native forest towards indigenhous forest fragments on farms was also evaluated.

III. Discussion and implications of findings

Compared to an economic justification of farmers' behaviour towards the natural environment, little research has been done looking at their attitudes towards the natural environment and how it relates to pro-environmental behaviour on farms. The affective dimension of their relationship with nature has been especially neglected. Only a handful of studies have looked at New Zealand farmers' position towards native forest (Wilson 1992; Cocklin and Doorman 1994; Smith et al. 2007). Although New Zealand native forest has been severely reduced from its original cover (Ewers et al. 2006), it still represents the most important inland native ecosystem remaining today in the country and on private land especially. Thus, native forest offers the best opportunity to assess the attitudes and behaviour of farmers towards nature that does not enter the conventional farming equation.

1. The situational context of the different samples of New Zealand farmers

Before assessing the environmental attitudes of the different groups of farmers, these groups were compared on their situational context.

Farmers with and without native forest differed on a number of situational variables. Farmers with forest reported having more experience with native forest; notably, their parents were more likely to have had native forest on their property. The presence of native forest on farms also tended to be attached to the respondents' wealth, higher education, self-confidence in their knowledge regarding native forest, and less practice of utilitarian outdoor recreational activities. Respondents who had native forest on their property tended to have sought farms with forest. Desire for a property *with* native forest was positively linked to the number of visits respondents with forest had in native forest when they were children. However, it was found that not having forest on one's farm also tended to be positively related to the frequency of visits to native forest during childhood.[1] Farmers without forest were also more likely to have grown up on a farm without native forest, and it was suggested that this might be explained by a perception that native forest was only a recreational place (Chapter 6). This hypothesis was supported by the differences in attitudinal responses found between farmers with

[1] However, this result is to be viewed with caution due to category-bias.

and without forest (the differences are reviewed in the next sections). Results also showed that having sought native forest on one's farm was positively associated with feeling knowledgeable about the natural environment. Nevertheless, farmers with forest by chance[2] also felt more confident about their knowledge regarding native forest than farmers without forest.

Farmers with ≥ 1 ha fragments and farmers with <1 ha fragments also diverged on a number of situational variables. They differed on the number of visits to native forest, their intention to pass on the farm to a family member, the source of information about costs and benefits of native fragments on farms, and the proportion of exported farm products.

2. Findings about attitudes structure

a. General attitudes

The general attitudes of farmers towards the natural environment were assessed using two published scales: a subscale of the revised New Environmental Paradigm (NEP, Dunlap et al. 2000) and the Environmental Motives Scale (EMS, Schultz 2000; Schultz 2001).[3] The two groups of farmers with and without native forest described the same models of value-based environmental concerns and NEP, i.e., a one-factor NEP scale and a three-factor EMS scale. These results agreed with the findings of the scales' authors (Dunlap et al. 2000; Schultz 2000; Schultz 2001). Additionally, the two groups of farmers did not show any difference in level of environmental concerns and general pro-environmental beliefs. These results indicate that the presence of native forest on the farm did not relate to farmers' general pro-environmental attitudes. These results are not surprising as literature shows that holding pro-environmental attitudes towards the general natural environment is now common over all parts of society (Castro 2006). Consequently, such a general positive inclination towards the environment is so commonly spread that some authors have argued that it does not allow the researcher to accurately predict people's behaviour towards nature (Berenguer et al. 2005). The literature suggests that correspondence between attitudes and behaviour is greater when both focus towards the same specific object (e.g., Sarigöllü 2009, p. 373).

[2] Farmers with forest who did not particularly look for farms with native forest are referred to as 'farmers with forest by chance', as opposed to 'farmers with forest by choice'.

[3] The Environmental Motives Scale, as named by Schultz and colleagues (2004, p. 34), is also referred to in this thesis as the value-based environmental concern scales.

b. Specific attitudes

The specific attitudes of farmers towards New Zealand native forest were estimated following a tripartite definition of attitudes (e.g., Hilgard 1980). The three dimensions of attitudes consisted of c*ognition* (beliefs about the attitudinal object), *affect* (feelings or emotional response to the attitudinal object) and *conation* (behavioural intentions toward the attitudinal object) (Albrecht et al. 1980, p. 194-5). Both farmers with and without native forest supported the *cognition*-*affect*-*conation* division suggested by the tripartite attitudinal model. However, the two groups did not respond to exactly the same specific attitudinal model. Farmers without forest displayed (1) a more profit-oriented *cognition*, (2) cognitively-driven *affect* and (3) seemed to differentiate between native forest in general and native forest on farms. Furthermore, their intentions to act in an environmentally friendly manner towards native forest were driven by both their *affect* and *cognition* as long as native forest was not on farms. In the prospect of behaving in an environmentally friendly way towards native forest on farms, farmers without forest only relied on the cognitive attitudinal dimension. In contrast, for farmers with forest, (1) the beliefs towards native forest did not include any monetary connotation, (2) the distinction between *cognition* and *affect* was clear, and (3) the two correlated attitudinal dimensions influenced their behavioural intentions towards native forest[4], which was perceived in the same way whether or not it was on farms. Thus, farmers with native forest displayed more holistic specific attitudes towards native forest than farmers without.

The pure *affect* of farmers with native forest, as opposed to the cognitively-influenced *affect* of farmers without native forest, is consistent with Millar and Millar's (1996) experiments showing that direct experience activated affective attitudes, while indirect experience activated cognitive attitudes. In addition, Pooley and O'Connor's (2000) study showed that between *affect* and *cognition*, respondents reported that *affect* was most important to their attitudes towards logging of native forests. Hinds and Sparks (2008, p. 109), found that "affective connection was a significant independent predictor of intentions to engage with the natural environment". These results suggest that *affect*, either in its role in defining people's attitudes or in relaying external experience to the self, is an important attitudinal dimension to take into account.

[4] *Cognition* influenced behavioural intentions more strongly than a*ffect*.

c. General-Specific attitudes

Based on the literature (Stern et al. 1995a), it was assumed that farmers' specific attitudes towards native forest would follow from their general environmental attitudes. The general-specific attitude model consisted of NEP and EMS scales correlated to one another and predicting the tripartite attitude.

Farmers' core environmental beliefs (NEP) and value-based environmental concerns (EMS) were positively correlated with one another. This result differed from the few studies that have investigated the relationships between NEP and EMS, which found that, of biospheric, altruistic and egoistic environmental concerns, only biospheric concern was positively correlated with NEP (Schultz 2001; Mayer and McPherson Frantz 2004; Schultz et al. 2004).[5] However, it is argued that due to the context of the EMS scale – amount of concern about the effects of environmental issues on different objects of value – positive correlations between all the EMS dimensions and NEP are likely to occur.

General environmental attitudes predicted the specific attitudes of both farmers with and without native forest. In particular, egoistic/non-egoistic and biospheric environmental concerns directly influenced the specific attitudes of both farmers with and without forest. Despite the avalanche of diverse technologies that mediate the contact farmers have with the natural environment during their work, farmers' lives still revolve around interacting with the natural environment. Therefore, it is understandable that their attitudes towards native forest would be influenced by empathy towards nature. The egoistic influence on farmers' attitudes towards native forest indicated that they recognised a personal benefit in protecting nature. This is in line with the literature, which indicates that farmers need to appropriate conservation projects in order to participate (e.g., see Kabii and Horwitz 2006).

However, the two groups of farmers with and without native forest also differed in their general-specific attitudinal responses. Only the attitudes of farmers without forest were directly influenced by altruistic environmental concern. This could be interpreted on the basis that conservation of native forest is potentially more abstract for farmers without forest than for farmers with forest. Hence, farmers without forest would be more likely to form pro-environmental attitudes toward forest based on a grand, anthropocentric motive, than farmers with forest, who would be more likely to have a more practical and ecologically aware experience of native forest. Such altruistic

[5] However, in Schultz (2005, 2004, 2001), EMS scores were controlled for the average response of each respondent over all the environmental concerns indicators (mean correction).

concern fits, furthermore, with the fact that New Zealand national identity is strongly defined via its natural environment. The two groups of farmers also diverged regarding the factors influencing their intentions towards native forest. The behavioural intentions of farmers with forest were better explained by taking into account farmers' core environmental beliefs (NEP) and the three value-based environmental concerns (EMS). In contrast, the intentions of farmers without forest were more driven by value-based environmental concerns than by core environmental beliefs. This result suggested that farmers with forest had more coherent attitudes towards the natural environment than farmers without forest. Additionally, the cognitively based measure of core environmental beliefs was more strongly related to the feelings towards native forest of farmers without forest than to the feelings of farmers with forest.[6]

This result concurred with the findings mentioned earlier regarding the specific tripartite model and Millar and Millar's conclusions (1996) in suggesting that direct, and regular, contact with native forest is associated with emotional responses, while indirect contact involved primarily cognitive responses. Nonetheless, affective response still played an important role in defining the environmental attitudes of farmers without native forest. Therefore, *affect* is a relevant factor to take into account for understanding the attitudes towards the natural environment of farmers, whether or not their farm includes natural ecosystems.

3. Findings about the structure of farmers' behaviour towards New Zealand native forest

Farmers' behaviour towards native forest on a farm was assessed, focusing on the three biggest fragments of at least one hectare. Farmers' behaviour towards their fragments was defined by three indicators: the average area of fenced-off fragments, whether at least half of the fragments were controlled against pests or weeds, and whether at least half of the fragments were legally protected. The behavioural indicators were correlated, but disparately. The dissimilar correlations indicated some inconsistency in respondents' behaviours towards their native forest.

Behavioural inconsistency is not an uncommon phenomenon (Ajzen 2005, p. 31) and various arguments have been suggested to explain such a discrepancy towards conservation. First, what could appear inconsistent to the observer may be consistent in

[6] As a result, the feelings of farmers without forest were no longer biased by specific beliefs towards the forest: the *cognition* indicator *ForestBenefit* no longer loaded on the *affect* factor.

the mind of the actor. Second, if subscribing to the belief that environmental issues are collective matters, individuals may choose to perform some behaviours and not others (Ölander & Thøgersen, 2000; Thøgersen & Ölander, 1999 in Thøgersen and Ölander 2003, p. 226). Third, it has been argued that people tend to prefer to perform low-cost behaviours (e.g., Vogel 1996). The inconsistencies in the present study can be explained in light of these arguments. While fencing and legally protecting native fragments were highly correlated, the relationships these two behavioural indicators had with controlling native forest fragments against pests and weeds were weaker. Keeping away farm animals from fragments is required for legal protection. Moreover, protection agencies would usually help the owner with fencing costs (Cocklin and Doorman 1994, p. 267; Ministry for the Environment 2000, p. 59; Davis and Meurk 2001, p. 25; Greater Wellington 2004, p. 4; Janssen 2006, p. 106-7). Therefore, a strong association between the two behaviours makes practical sense. On the other hand, the emphasis on fencing when legally protecting fragments may give the impression to landowners that controlling against pests and weeds is only of secondary importance.[7] Finally, such control would also be more time- and energy-consuming than the other two behaviours.

4. Findings about the attitudes-behaviour relationship

Farmers' behaviour towards their native fragments was significantly predicted by their general and specific attitudes towards the natural environment. Attitudes explained almost 20% of behaviour, which corresponds to the upper end of the range of what is usually reported in the psychology literature (Wicker, 1969 in Vogel 1996, p. 592; Tarrant and Green 1999). The significant correspondence between attitudes and behaviour can be attributed to the fact that the lower order of the attitudes model focused on the same specificity level (New Zealand native forest) as the behaviour it was supposed to predict. The respondents' proximity with the attitudinal object (native forest) is also likely to have contributed to the congruence between attitudes and behaviour. Research has shown that attitudes formed through direct interaction with the attitudinal object were more accessible to memory and predicted better behaviour than attitudes formed through indirect interactions (Fazio and Zanna 1981; Millar and Millar

[7] Although such control is encouraged by regional councils (Greater Wellington 2004).

1996; see Fabrigar et al. 2005, p. 108).[8] As mentioned earlier, Millar and Millar (1996) go further by arguing that attitudes formed through direct experience induce more affective reactions, while attitudes formed through indirect experience produce more cognitive reactions. They then propose that these different attitudes relate more strongly to different behaviours. Millar and Millar (1996, p. 563) distinguish between instrumental behaviour – where the behaviour performed helps achieving a greater goal – and consummatory behaviour – where the behaviour's goal is itself. They add that "[i]n a consummatory situation there is more focus on the intrinsic enjoyment of the activity". Consequently, they suggest that affectively driven attitudes predict consummatory behaviours better, while cognitively-driven attitudes predict instrumental behaviour better (Millar and Millar 1996).[9] Behaviour of farmers towards their native fragments was found to be significantly influenced by both a*ffect* and *cognition* (via their intentions).[10] Following Millar and Millar's argument, this suggested that farmers' behaviour towards their native forest fragments involved both a greater goal (instrumental behaviour) and an instant enjoyment from performing the behaviour (consummatory behaviour). Based on the literature, an immediate reward in performing such behaviour (i.e., enjoyment) is likely to strengthen the positive attitudes that induced the behaviour in the first place, which would in turn lead to performing the behaviour again (Clore and Schanlla 2005; Olson and Stone 2005; Schimmack and Crites 2005). Therefore, based on how direct experience impacts on *affect* and how affectively driven attitudes may impact on behaviour, there is strong reason to expect that direct contact with native forest would induce pro-environmental attitudes likely to lead to pro-environmental behaviours towards native forest.

Finally, as well as exhibiting an overall positive relationship with attitudes, farmers' pro-environmental behaviour was also directly but weakly influenced by anthropocentric-inclined core environmental beliefs (NEP). The influence of such anthropocentric beliefs, along with biospheric, non-egoistic environmental concerns and pro-environmental specific attitudes on behaviour seems counterintuitive. However, the environmental psychology literature shows that people can simultaneously hold apparently antagonistic beliefs (see Castro 2006, p. 255). Therefore, "it seems more

[8] Being more accessible, attitudes are more likely to be invoked when measured by the researcher, and more likely to have determined the behavioural response. An attitude more often evoked also tends to further strengthen the consistency between attitudinal and behavioural responses (Fabrigar, MacDonald et al. 2005, p. 108).
[9] However, Fabrigar and colleagues (2005, p. 109) call for more evidence on the relationship between attitudes types (a*ffect*-c*ognition*) and behaviour types.
[10] Behaviour was more influenced by c*ognition* than a*ffect*. Indirect standardized regression coefficient of a*ffect* on behaviour = 0.113, p = 0.066; Indirect standardized regression coefficient of c*ognition* on behaviour = 0.249, p = 0.010.

relevant to assume that old and new ideas [towards the natural environment] tend to co-exist and interact, and this interaction is linked to different identities" (Castro & Lima, 2001 in Castro 2006, p. 255).

5. Findings about situational variables

In order to better understand the relationship between farmers' pro-environmental attitudes and behaviour, situational variables (non-psychological variables) were introduced (Tarrant and Cordell 1997; Berenguer et al. 2005).

a. Do different contexts influence pro-environmental attitudes, and behaviour in the different groups of farmers?

Farmers with and without native forest were only compared on the effects the situational variables had on their attitudes towards the natural environment.[11] The pro-environmental attitudes of both farmers with and without forest were first and foremost explained by direct experience with nature, family influence and knowledge. However, the two groups were not influenced by exactly the same variables within each situational group. In contrast, almost the same situational variables predicted the attitude-behaviour relationship in farmers with native forest fragments $\geq$ 1 ha and farmers with native forest of any size. However, farmers with $\geq$ 1 ha fragments showed stronger associations between situational and attitudinal variables than the sample of farmers with native forest of any size. These results suggested that the sample of farmers with $\geq$ 1 ha fragments formed a coherent group distinct from farmers with smaller fragments. Additionally, farmers with native forest by choice consistently showed stronger pro-environmental attitudes throughout the study, as well as stronger pro-environmental behaviour in Chapter 12.

[11] Logically, farmers without forest could not be tested on the effects of situational variables on their behaviours towards their own native fragments.

b. Direct Contact with Nature

i. General findings

Direct experience with nature was consistently instrumental in explaining farmers' pro-environmental attitudes throughout the study. Direct contact with nature increased the coherence of specific attitudes of farmers with native forest, and was associated with stronger positive feelings towards the forest in all groups of farmers. Moreover, more than any other situational group, direct contact with nature was found to reduce differences in feelings towards native forest of farmers with forest by choice and farmers with forest by chance. Furthermore, the more contact with native forest respondents had had as a child, the stronger pro-environmental attitudes they held, whether or not they now had native forest, and the stronger pro-environmental behaviour farmers with fragments ≥ 1 ha reported. Additionally, the effects of such visits on respondents' attitudes and behaviour were little affected by whether or not farmers wanted native forest on their farm. These results further supported the hypothesis mentioned earlier that direct contact with nature could induce positive attitudes and behaviours towards the natural environment. These results also further supported Millar and Millar's (1996) argument that direct experience activated affective attitudes. However, the strong impact direct experience with nature had on farmers' *affect* did not translate into a more affectively driven behaviour.[12]

Although experimental work on the effect of direct contact with nature on people's inclination towards the natural environment is still scarce (especially among adults, and even more so among farmers), the available literature suggests that direct experience with nature favours positive dispositions towards the natural environment (e.g., Bögeholz 2006). Research has shown that by bonding with the environment, human beings develop a sense of stewardship towards the natural place and dominating attitudes tend to be replaced by a desire to live with nature (Dresner and Gill 1994). The relationship between direct experience with nature and farmers' affective response found in the present analysis would tend to indicate that such bonding has occurred. Moreover, the fact that only contemplative outdoor activities predicted the environmental attitudes of farmers with native forest – as opposed to both contemplative

[12] Controlling for direct contact with native forest, indirect standardized regression coefficient of a*ffect* on behaviour was 0.138, p (unstand.) = 0.046, compared to 0.113 without the situational variables; indirect standardized regression coefficient of c*ognition* on behaviour was 0.251, p (unstand.) = 0.015, compared to 0.249. Controlling for outdoor recreational activities, indirect standardized regression coefficient of a*ffect* on behaviour was 0.112, p (unstand.) = 0.129; indirect standardized regression coefficient of c*ognition* on behaviour was 0.226, p (unstand.) = 0.060.

and extractive recreational activities[13] for farmers without native forest – would also suggest that having native forest on one's farm could lead to a less utilitarian-motivated bonding with nature. This was further supported by the fact that both farmers with native forest by chance and farmers with native forest by choice predominantly indicated non-utilitarian reasons for having kept their native fragments.[14] However, farmers without forest should not be dismissed as being only utilitarian. Farmers without forest who less regularly visited native forest and those who reported observing less often nature as a hobby showed strong intentions to plant native species on their farm. Such a result could be interpreted as a reflection of the biophilia hypothesis, which states that "humans possess a biologically based attraction to nature and that their well-being depends, to a great extent, on the relationships with the surrounding natural world" (Kals et al. 1999, p. 183).[15]

ii. Towards inclusion with nature

Expanding from the biophilia hypothesis, recent studies have examined the notion of inclusion with nature (e.g., Kals et al. 1999; Schultz 2000; Schultz 2002; Mayer and McPherson Frantz 2004; Schultz et al. 2004; Jorgensen and Stedman 2006). Inclusion with nature is defined by connectedness with, caring for, and commitment to protect nature (Schultz 2002). Connectedness with nature represents the degree to which individuals believe themselves part of nature, that is, how much the perception of nature overlaps with the perception of self (Schultz 2002, p. 67). It is assumed that when people feel connected with nature, they would be less inclined to harm nature, as it

[13] Contemplative outdoor recreational activities have been associated with preservationist orientations and extractive activities, with utilitarian orientations (Teisl and O'Brien, 2003, p. 507-8).

[14] The most common reasons given by farmers with $\geq$ 1 ha fragments for keeping native fragments on their property drew on intrinsic values of the forest: their two preferred reasons, far ahead of other motives, were *Protection* and *Aesthetic*. This remained true whether or not they wanted native forest on their property in the first place. This result is in line with research in another region of New Zealand, Waikato, where farmers used "their native bush for aesthetic, symbolic, heritage, and spiritual reasons and for the pleasure derived from the presence of wildlife" (PCE 2002, p. 17). As farmers with forest by chance were not expected to have a priori positive attitudes towards the forest, this result suggested that the proximity with the forest could have induced such thoughts a posteriori. Furthermore, results also indicated that more farmers with forest by choice also recognized a farming value to native forest than farmers with forest by chance. This indicated that this belief may have existed a priori, or that farmers with forest by choice knew better how to take advantage of the natural feature. In any case, it suggested a change in attitudes in farmers with forest by chance.

[15] The biophilia hypothesis was introduced by Wilson (1984) and later developed by Kellert and Wilson (1993), then Kellert (1997). However, Kals and colleagues' (1999) definition of the hypothesis was chosen for its conciseness.

would equate to harming oneself (Mayer and McPherson Frantz 2004, p. 512).[16] Based on the literature on the representation of self, connectedness with nature is thought to be cognitive at core, whereas caring for nature corresponds to the affective dimension of inclusion with nature. Commitment to protect nature is conative in substance (Schultz 2002, p. 67-8; Jorgensen and Stedman 2006, p. 317). In the recent literature, inclusion with nature has taken many forms.[17]

In the literature, inclusion with nature[18] had been found to correlate positively with biospheric environment concern (Schultz 2000; Schultz et al. 2004), NEP (Mayer and McPherson Frantz 2004; Schultz et al. 2004), pro-environmental behaviour (Kals et al. 1999; Mayer and McPherson Frantz 2004; Schultz et al. 2004), past and/or present direct experience with nature (Kals et al. 1999; Mayer and McPherson Frantz 2004), and preference for retaining native vegetation on one's property (Jorgensen and Stedman 2006).

Although the present study did not specifically study farmers' inclusion with nature in general and with native forest in particular, the diverse points emphasized above suggest that such inclusion with nature could possibly underlie farmers' positive responses towards New Zealand native forest. Both farmers' specific attitudes towards native forest and the measure of inclusion with nature are defined by interconnected cognitive, affective and conative dimensions. Additionally, both farmers' specific attitudes and inclusion with nature correlate with biospheric environmental concern, core environmental beliefs (NEP), pro-environmental behaviour, and past and present direct contact with nature. Finally, as mentioned above, landowners who had favoured native vegetation on their property showed stronger inclusion with nature.

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[16] Of course, one has to be aware that one's behaviour is harmful (Mayer and McPherson Frantz 2004, p. 512).

[17] Jorgensen and Stedman's notion of place identity (2006) recalls Schultz' (2002) connectedness with nature, while their notion of place attachment is similar to the notion of caring for nature. On the other hand, the notion of empathy towards nature used in Schultz' (2000) study relates to both the affective and cognitive dimensions of inclusion with nature (Schultz 2000, p. 394-5), while Mayer and McPherson Frantz (2004, p. 504-5), and Kals and colleagues (1999, p. 182) argue that their respective measures of connectedness with nature, and affinity towards nature, are affectively-based. Nevertheless, as Zajonc argues, every affective evaluation may be a reflection of the connectedness to the self: "When we evaluate an object or an event, we are describing not so much what is in the object or in the event, but something that is in ourselves. […] Thus, affective judgments are always about the self. They identify the state of the judge in relation to the object of judgment" (Zajonc 1980, p. 157).

[18] Represented by either connectedness with, caring for, or commitment to protect nature, or combinations of them.

iii. Recreational activities

It is generally assumed that recreational activities in nature, especially those more contemplative than extractive, would positively influence pro-environmental attitudes and behaviour, partly because people would tend to protect places they use for recreational activities, and direct experience with nature would be likely to induce people to take a more biospheric-oriented perspective towards nature (Dunlap and Heffernan 1975 in Schultz 2000, p. 403; Bjerke et al. 2006, p. 119). However, few studies have actually tried to assess the extent to which recreational activities influence the relationship of pro-environmental attitudes to behaviour, and the little information that exists is rather inconsistent (Tarrant and Green 1999; Thapa and Graefe 2003). The results found for the sampled New Zealand farmers supported studies showing that contemplative rather than extractive outdoor recreational activities are associated with stronger pro-environmental attitudes and behaviour (Tarrant and Green 1999; Teisl and O'Brien 2003; Thapa and Graefe 2003). Nevertheless, outdoor recreational activities did not improve the consistency between the pro-environmental attitudes and behaviour of farmers with native forest.

Cocklin and Dorman (1994) found in their study of New Zealand farmers that respondents predominantly cherished the recreational value of their native forest remnants. Cocklin and Dorman's (1994) finding concurred with international research (e.g., Williams et al. 2004; Serbruyns and Luyssaert 2006; Ernst and Wallace 2008). Wilson (1992) further found that New Zealand landowners who did not use their native remnants for recreational purposes tended to have a more utilitarian view of the forest than those who used their remnants for such purposes. While in the present study a minority of respondents chose recreation as an important motive for keeping native forest on their property, the majority of farmers with native forest still gave non-utilitarian reasons for having kept their native fragments. In addition, a large number of farmers with or without native forest engaged in recreational activities[19] and results suggested a demand for native forest from farmers without forest who had low frequency of direct contact with nature.

[19] Of farmers with forest, 75.4% went fishing-hunting at least once a month, 89.6% walking-tramping, and 91.7% observing nature. Of farmers without forest, 65% went fishing-hunting at least once a month, 83.5% walking-tramping, and 81.6% observing nature.

c. Knowledge

Because more educated people are more likely to have encountered and understood information about environmental issues, education has usually been found to be a relatively good predictor of the cognitive dimension of environmental attitudes, environmental concern and biospheric value orientations (e.g., Van Liere and Dunlap 1980; Olli et al. 2001, p. 183; Vaske et al. 2001, p. 765). However, the relationship between education and pro-environmental behaviour is less well established (Olli et al. 2001). Education in the present study was not highly relevant: it only explained environmental concerns of farmers without native forest. However, the sign of the relationships was unexpected and suggested some bias.

In contrast, actual and self-reported environmental knowledge[20] were important determinants of farmers' pro-environmental attitudes and behaviour. Also, farmers with ≥ 1 ha fragments showed the strongest consistency between their intentions and behaviour towards native forest when both ecological knowledge and confidence in knowledge were taken into account. Environmental knowledge has been a central topic of interest for researchers on pro-environmental attitudes and behaviour and also for policy makers (e.g., Fransson and Gärling 1999, p. 369; Barr and Gilg 2007, p 363). Studies on farmers' ecological knowledge have regularly identified a lack of ecological knowledge in general or on how to look after the natural environment (Cocklin and Doorman 1994, p. 276; Jones et al. 1995, p. 155; PCE 2002; Brook et al. 2003, p. 1642; Herzon and Mikk 2007, p. 21-2; Smith et al. 2007, p. 34). However, the relationships of ecological knowledge with attitudes and behaviour towards the natural environment have been mixed. Hungerford and Volk (1990 in Clayton and Myers 2009, p. 183) demonstrated that, more than knowledge per se, the appropriation of the information was important in determining pro-environmental attitudes and behaviour. Furthermore, subjective knowledge is not necessarily linearly predicted by objective knowledge (Levy-Leboyer et al. 1996; Clayton and Myers 2009, p. 184).

In the present study, farmers with and without native forest did not significantly differ in their level of ecological literacy, with both groups showing a relatively high level of knowledge. However, supporting the argument of Hungerford and Volk (1990), the two groups did differ in their level of confidence in their knowledge regarding native forest: farmers with forest felt significantly more confident. They also differed in

[20] Actual environmental knowledge is also referred to as 'objective knowledge', 'ecological knowledge' or 'ecological literacy', and self-reported environmental knowledge, as 'subjective knowledge' or 'confidence in one's knowledge'.

the source of their knowledge towards the forest, with more farmers with forest attributing such knowledge to personal experience. As farmers with forest did visit native forest significantly more often than farmers without forest, it seems logical that farmers with forest would invoke personal experience as an important source of knowledge. However, such a result could also reflect a stronger perception in farmers with forest of being in control regarding native forest fragments on farm. Furthermore, confidence in knowledge was directly related to the amount of ecological knowledge of farmers with forest, but not of farmers without forest. Finally, and rather unexpectedly, confidence in knowledge was directly related to feelings towards native forest. These results emphasized the importance of feeling confident in one's knowledge, as well as the affective attitudinal dimension for understanding farmers' attitudes and behaviour towards the natural environment.

d. Social Influence: Family and Farmer Influences

Social interactions, notably with family, were strongly expected to influence respondents' environmental attitudes and behaviour (Burton 2004, p. 363-4; Dietz et al. 2005, p. 363; Fine 2005, p. 73). Studies have found that environmental attitudes can be induced and reinforced by 'important others' (e.g., the family) (see Kals and Maes 2002, p. 108; Clayton and Myers 2009, p. 58). Influence of 'important others' can occur through observational learning (Vaughan and Hogg 2005, p. 113), but also through conversations (Dietz et al. 2005, p. 363). Childhood is a particularly important period for determining environmental orientations (see Chapter 4: Environment and Identity in Clayton and Myers 2009). However, it has also been claimed that interactions with 'important others', notably through conversations, remain influential throughout a person's life (Dietz et al. 2005, p. 363). Ultimately, 'important others' can influence behaviour: studies have found that pro-environmental actions are more likely to be performed when supported by 'important others' or when information was provided by 'important others' (Brook et al. 2003; Bögeholz 2006).

Supporting the international literature, the influence of respondents' families was a key factor for explaining farmers' attitudes and behaviour towards the natural environment. In all groups of farmers, agreeing with one's family on environmental issues was instrumental in determining respondents' pro-environmental attitudes. Nevertheless, interactions with the family within the farming working environment were negatively associated with environmental attitudes, as well as with behaviours (of farmers with ≥ 1 ha fragments). Respondents farming with their parents may be under the influence of the older generation's attitudes towards the environment, which may have been less permeated by the ambient general environmental concern. Although studies suggest that environmental concern has now reached every sphere of society, the farming community, due to its special (extractive) interactions with the natural environment, may have been less affected than other communities. In addition, farmers may feel at times ostracized by the more environmentally minded rest of society (Ward and Lowe 1994, p. 181; Siebert et al. 2006, p. 331-2). Thus, they may respond to such perceived pressure by re-centring on the values that define them as a group against the "out-group" (Kals and Maes 2002, p. 108; Vaughan and Hogg 2005, p. 111). The question of succession may also explain the negative influence of the farming family on respondents' attitudes. While the question of passing the farm to a family member did not influence respondents' environmental attitudes and behaviour per se, farming with one's children resulted in more anthropocentric core environmental beliefs in farmers with native forest. Such anthropocentric beliefs could be caused by worrying about ability to provide a sufficiently successful farm to potential successors (Keating and Little 1991, p. 26; Eaton 1993; McCrostie Little and Taylor 1998). Ultimately, this would imply that respondents with such a worry do not perceive conservation behaviour as financially viable. On the other hand, the negative influence of farming with one's children on farmers' environmental attitudes could also be interpreted as the influence of a profit-oriented younger generation (Marsden and Munton 1991 in Ward and Lowe 1994, p. 117). Respondents' children may be worried that they would not inherit a financially viable farm, especially if respondents have several children between whom the farm needs to be divided. The 'younger generation' interpretation would concur with the result that younger respondents with native forest were less environmentally minded than the older generation.

Unlike family relations, interactions with fellow farmers had a limited influence on respondents' environmental attitudes and behaviour. However, as Burton suggests, the farming community is known to be close-knit, and farmers are certainly influenced by each other. However, farmers are probably less prone than others to admit being influenced by peers (Burton 2004, p. 363-4). The results found here may be biased by the questions regarding peer influence being too direct in nature. The question of influence of peers on farmers' attitudes and behaviour towards the natural environment must be addressed further.

e. Farmers' and Farms' Characteristics

Farmers' socio-demographic characteristics and farms' characteristics had limited influence on farmers' environmental attitudes, affecting mostly respondents' (general and specific) environmental beliefs. However, their effects on behaviour of farmers with $\geq$ 1 ha fragments were more salient. Farm characteristics tended to weaken the influence of specific attitudes on such behaviour. The literature offers contradictory results on the socio-demographic characteristics of pro-environmental farmers.

i. Farm in the family, passing on the farm, owning the farm, number of years spent on the farm

Just as these variables did not influence the presence or absence of native forest on farms, they did not influence attitudes, or behaviours, of respondents towards the natural environment either. More relevant to the effect of farm succession on farmers' psychological responses towards nature were whether the respondents' parents' were farmers themselves and whether respondents were farming with their children (for respondents with native forest), as discussed in the section on social influence.

ii. Number of years farming and age

Although older farmers are generally expected to be less willing to change their farm management and adopt conservation practices (see Ahnström et al. 2008, p. 42), older respondents with native forest in the present study showed stronger pro-environmental attitudes and behaviour. Several arguments could be invoked here. Older farmers may have less to prove financially compared to still-establishing younger farmers. Based on Mannheim's (1952) theory of generations, New Zealand's older farmers may be more sensitive to environmental issues because they may have witnessed the negative effects of the modernisation of farming (i.e., 'the grasslands revolution'; Brooking et al. 2004).

The number of years respondents spent farming had a mild negative effect on the biospheric concern of farmers with native forest only. Biospheric concern has been found to be positively related to general environmental concern and perception of inclusion with nature (Schultz et al. 2004). Therefore, such a result would suggest that the longer respondents with forest have socialized with other farmers, the less able they were to take a biospheric perspective. The farming community may influence environmental attitudes of farmers with native forest rather than farmers without native forest because the farming orientation of the former may be more at odds with the rest of the farming community than that of the latter. However, no relationship with the other psychological variables was found, so, if this argument is correct, the influence of the farming community on the environmental attitudes of farmers with forest seems weak.

iii. Farm income and farm size

Following the postmaterialism hypothesis (Inglehart, 1977, 1997 in Olli et al. 2001, p. 185-6) and Maslow's hierarchy of needs theory (1970 in Van Liere and Dunlap 1980, p. 183)[21], wealth has been expected to correlate positively with pro-environmental attitudes and behaviour (Olli et al. 2001, p. 185-6). However, such a relationship has not been well supported in the literature (Ignatow 2006), and the present study did not support such theories either. In all groups of farmers, respondents with smaller farms and with less financially successful farms showed stronger pro-environmental attitudes and behaviour. Less wealthy farmers may value the natural environment more than wealthy farmers because their survival more directly depends on it. Conversely, farmers may be less wealthy because they may be less ready to use damaging or polluting farming methods (see Fairweather 1999, p. 61). Farmers with low farm income may also rely more on off-farm income which could favour less intensive farming practices. Additionally, although farmers may profess a desire for incentives to look after the environment (e.g., Cocklin and Doorman 1994), studies have shown that receiving financial compensation for such behaviour is not necessarily the primary reason for farmers' conservation behaviour (Ward and Lowe 1994; Erickson et al. 2002). Erikson and colleagues (2002) found that aesthetic and ecosystem protection were the first motives for Michigan farmers to retain their woodlots, and similar results were found in the present study.

[21] Once basic needs like shelter and food are met, individuals (the next generation in Inglehart's original thesis) can concentrate on postmaterialist values such as a healthy natural environment.

iv. Region of farming and Farm type

Region of farming affected the beliefs towards native forest of only farmers without native forest. Respondents from the Wellington region showed stronger pro-environmental beliefs than respondents from the Manawatu-Wanganui region. This result could be explained by the proximity to the country's capital: urban dwellers have been found to be more environmentally minded than their rural counterparts. By extension, proximity to a large urban centre could influence farmers' environmental attitudes. This result could also suggest possible differences between regional councils' strategies towards native forest on private lands, and/or differences in how respondents perceived their regional councils. As farmers without native forest may be less environmentally minded than farmers with forest, this result could be particularly relevant if one's goal is to encourage an environmentally friendly orientation in New Zealand farmers. The difference in regional councils' influence over New Zealand farmers' attitudes and behaviour towards native forest would merit further exploration.

Dairy farmers, whether or not they had native forest, tended to show less pro-environmental attitudes than meat producers, but they also tended to show stronger intentions towards native forest. Although New Zealand agriculture in general has intensified over the last few decades, dairy farming has followed this trend more strongly than other farming sectors (MacLeod and Moller 2006; Deans and Hackwell 2008). The stronger pro-environmental intentions towards native forest, on the other hand, can be understood in light of the 2003 Clean Streams Accord signed between Fonterra (representing most of the dairy industry), the Ministers for the Environment and Agriculture & Forestry, and Local Government New Zealand (Deans and Hackwell 2008, p.4). This accord may have translated into more *intentions* from dairy farmers to act in a more environmentally friendly way, but it does not seem to have yet permeated deeper levels of attitudes. In support of this hypothesis, the accord has not yet proved very effective on the ground (Deans and Hackwell 2008).

Farm type was not relevant in estimating pro-environmental behaviour of farmers with native forest $\geq$ 1 ha fragments. This result further supported the conclusion that dairy farmers were no more committed to the health of the environment than meat farmers.

v. Organic farming

Organic farmers, by virtue of their approach to farming, have been expected to hold stronger pro-environmental attitudes and especially to engage more in pro-environmental behaviour than conventional farmers. Literature has supported this hypothesis (e.g., Entec 1995 in Hendriks et al. 2000, p. 171; Wossink and van Wenum 2003; Darnhofer et al. 2005). In the present study, organic farmers both with and without native forest tended to show stronger pro-environmental attitudes than conventional farmers. However, organic farmers with native forest tended to hold more egoistic environmental concern than their conventional counterparts. Additionally, conventional and organic farmers with forest did not show significant differences in behaviour towards their fragments. Organic farmers may feel more vulnerable to environmental problems, and hence manifest more egoistic concern towards the environment than conventional farmers. The absence of an effect (direct and indirect combined) of organic farming on pro-environmental behaviour was unexpected. While this absence could be due to conflicting effects within the attitudinal-behaviour model, the sample of organic farmers identified from governmental sources was also small.[22] Furthermore, the survey relied on farmers self-reporting about the extent to which they were farming according to organic principles.[23] The sample size and the organic variable could have biased the relationship between organic farming and both egoistic concern and pro-environmental behaviour. Finally, research has also shown that organic farmers can include rather disparate farming orientations (Fairweather 1999; Darnhofer et al. 2005; Herberg 2007).

f. Fragments Features

This group of situational variables was only relevant for farmers with fragments. Whether or not farmers with $\geq$ 1 ha fragments had wanted a farm with native forest, respondents showed more pro-environmental behaviour towards flatter fragments and the more native cover the property had. Although the relationship between flatter fragments and pro-environmental behaviour was stronger before controlling for farmers with forest by choice/by chance, this result still suggested that the proximity to native forest could induce positive dispositions in farmers towards the forest.

[22] Personal contact details of organic farmers were hard to obtain from governmental agencies.
[23] Respondents could choose between “Conventional Farming”, “Organic Farming” or “Both”.

g. Regional Council Conservation Effort

Respondents' thoughts about their regional council's efforts towards native forest conservation were not strongly related to their level of pro-environmental attitudes, especially for farmers without forest. The perception of their regional council was more strongly related to environmental attitudes in the group of farmers with ≥ 1 ha fragments. As predicted, holding a positive view towards one's regional council was associated with more pro-environmental behaviour towards New Zealand native forest.

Table 13. 1 Summary table of key results and main contribution of the thesis to science

Key results

- Farmers with and without native forest had different situational backgrounds
- The general-specific attitudinal model defines the attitude of both farmers with and without native forest towards the natural environment
- Farmers with and without native forest had similar general environmental attitudes (EMS and NEP)
- But showed different specific attitudes (tripartite model) and different relationships between general and specific attitudes towards the natural environment:
    - Farmers with forest had a more holistic view of the environment, where both *cognition* and *affect* took part
    - While farmers without forest had a more cognitively-based attitude, and tended to perceive forest outside and inside the farm differently
    - Biospheric and egoistic environmental concerns related to the specific attitudes towards native forest fragments of all respondents, although differently according to the group. Altruistic environmental concern only directly related to the specific attitude of farmers without native forest
- The general-specific attitudinal model explained about 20% of farmers with forest's behaviour towards native forest fragments on their property
- Direct experience with nature, family influence and knowledge were particularly important in explaining respondents' attitudes towards the natural environment, whether they had native forest fragments on their property or not
- These situational factors were also detrimental in explaining the behaviour of farmers with ≥ 1 ha native forest fragments towards those fragments

Table 13. 2 (cont.) Summary table of key results and main contribution of the thesis to science

Main contributions of the thesis to science
➢ The general-specific attitudinal model is relevant to assess farmers' attitudes towards the natural environment ➢ Farmers with and without native forest showed different attitudes towards the natural environment ➢ First assessment of Schultz' (2000, 2001) value-based environmental concern scales on a sample of farmers and of a tripartite attitudinal model on a sample of NZ farmers ➢ First assessment of a tripartite attitudinal model on a sample of NZ farmers ➢ Affect is an important component of farmers' environmental attitudes, especially in relationship with direct contact with nature ➢ Among a set of 8 situational factors (9 for behaviour), direct experience with nature, family influence and knowledge, among which, 'self-confidence' in ecological knowledge, were particularly important in understanding environmental attitudes and behaviour of farmers [a]

[a]: for a detailed account of the situational variables on farmers' environmental attitudes and behaviour, see Chapters 11 and 12 and the corresponding Tables A11.2 and A11.6 in appendix A11 and Tables A12.19 and A12.20 in appendix A12

6. Recommendations

The results suggested that direct contact with native forest had the potential to induce positive attitudes towards the forest. Such a relationship was likely to depend on the relationship respondents' close family had with native forest. Additionally, direct contact with native forest may induce more confidence in one's knowledge. Conversely, confidence in one's knowledge could also entice farmers to purchase a property having native forest (see farmers with forest by choice). These initial results therefore emphasized the importance of direct contact with nature, knowledge and family in the relationship between farmers and native forest. Results also showed that regional councils did not have much impact on farmers' attitudes.

It is particularly important for governmental agencies to target farmers' attitudes rather than only focusing on behaviour, because as Ahnström and colleagues (2008, p.42) found, "[i]f the farmers' attitudes toward conservation had been negative, then funding had minimal and short-term impacts on their actions". Although behaviour may influence attitudes[24], this phenomenon is more likely to occur and last if value-expressive attitudes (where the function is to express one's central values and self-concept) rather than utilitarian attitudes (where the function is to maximize rewards and minimize punishments) are formed (Maio and Olson 1994 in Vaughan and Hogg 2005, p. 110). Therefore, government strategies should not be only focused on regulations. The bulk of the literature shows that farmers highly value their independence in managing their farm (Ward and Lowe 1994; Willock et al. 1999b, p. 9; Kabii and Horwitz 2006). It has even been suggested that landholders may eradicate endangered species on their property in order to avoid governmental interventions (Wilcove et al. 1996 in Brook et al. 2003, p. 1639). Stimulation of farmers' pro-environmental attitudes should be an ongoing effort because, as mentioned earlier, the more often attitudes are stimulated, the more likely it is to be evoked again later and influence behaviour (Fazio et al. 1992). Focus should also be on encouraging global environmental attitudes. Based on the results discussed above, direct contact with nature (native forest) together with better knowledge of the global ecological processes and how native forest fits in the big picture should help broaden farmers' environmental attitudes. Confidence in one's knowledge should also improve via direct experience with nature. Ideally, support from the immediate family should be sought. However, ultimately, farm characteristics are likely to affect the realisation of pro-environmental behaviours. Extra focus should be put on farms that present characteristics associated with lower pro-environmental attitudes (e.g. wealthier farmers). For these farmers, it may be worthwhile to emphasize new values for New Zealand native forest. For profit-oriented farmers, regional councils may want to focus first on encouraging positive values towards the natural environment that include an economic perspective. Later, after better acquaintance with native forest, more biospheric-oriented values may be emphasized. As Ahnström and colleagues (2008, p. 41-2) note, "[b]eing a farmer is not simply a profession but a way of life and thus money is not all that matters; quality of life and independence are important".

IV. Limitations of the study

1. Measures

The sample was biased towards farmers with native forest and meat producers. Furthermore, although the response sample was large it still represented a small

[24] Inconsistency between attitudes and behaviour "is one of the most potent mechanisms to produce attitudes change" (Forgas 2002, p. 19).

proportion of farmers from the two regions, and even smaller of the farming population of New Zealand. However, besides these two biases towards farmers with native forest and meat producers, overall the present sample resembled the farming population of the two regions.

Another bias may come from the mode of retrieving information; a few issues have been raised with using postal surveys. For instance, although the person to whom the questionnaire was destined was emphasized at several stages of the survey, it could not be guaranteed that only the targeted respondents answered the questionnaire. Additionally, postal surveys can leave the opportunity to respondents to answer in several stages. However, discontinuous answering should not overly affect the study as the interest of the study concerned more stable attitudes and behaviour. Another issue lies in assessing farmers' affective response. By using a questionnaire, chances are that affective response may be tainted by cognitive response (Breckler 1984): respondents may have to *think* about their feelings. Yet, in the presence of the attitudinal object, such cognitive mediation would tend to diminish (Breckler 1984). The impact of direct experience with native forest (on respondents' properties) on farmers' affective response was an inherent part of the comparison of farmers with and without native forest. Despite the potential bias the postal survey may have created, farmers with and without native forest in the present study still exhibited different affective and cognitive attitudinal dimensions concurring with the literature. Therefore, the use of a postal survey did not seem to have been detrimental to the research questions of the present study. Using a postal survey meant that behaviours were self-reported and evaluated at the same time as attitudes. Previous studies have found inconsistent patterns between attitudes and verbally reported behaviour (Seibold 1975, p. 16; Hines et al. 1987, p. 3). However, the relationship between attitudes and behaviour in the present study was at the stronger end of what is usually reported in the literature. Furthermore, the behavioural indicators involved little compromise for respondents, so farmers have probably been less inclined to embellish reality. Therefore, a certain confidence can be held towards respondents' self-reported behaviours. Because of the single-snapshot nature of the survey[25], the measured behaviour actually preceded the measure of attitudes. Therefore, the relationship found between farmers' attitudes and behaviour towards the natural environment could be actually due to *the influence of behaviour on attitudes* (Olson and Stone 2005), instead of attitudes predicting behaviour as hypothesized in the thesis model. However, it is believed that, because these behaviours

[25] A postal questionnaire measuring at a time *t* both respondents' attitudes and behaviour; not successive information retrieval.

are constraining with respect to time, energy, and money while still being non-compulsory, they are very likely to follow from positive attitudes towards the natural environment, rather than occurring 'by accident' or from non-voluntary processes. Furthermore, because of the behaviour already performed, their attitudes towards the natural environment are likely to be strengthened and more stable. Hence, the questionnaire is likely to record the same attitudes (or similar ones) that have induced the behaviour already performed and attitudes that would induce the behaviour to be performed.

Finally, the effect of each situational variable on farmers' attitudes and behaviour could not be controlled for the effects of *all* the other situational variables: because the number of respondents was too small, the situational variables could not be studied all at once. For the same reason, the effects of interactions between situational variables on farmers' psychological responses were not examined.

2. Missing data

The multiple imputation technique was used on missing data with parsimony as, although it represents the current state of the art, it is still subject to bias (Schafer and Graham 2002, p. 173; Wiggins and Sacker 2002; Allison 2003; Enders et al. 2006, p. 125). Therefore, the real data were used as much as possible. Multiple imputation was used only on some situational models (Socio-demographic, Farm Characteristics, Fragment features and family influence) when the addition of the corresponding situational variables decreased the sample available by at least 10%. Because of the bias still inherent to multiple imputation, the imputed models are to be taken with caution, and would merit replications.

3. Area of ill-fit

Areas of ill-fit were found in overall well-fitting specific attitudes models using Structural Equation Modeling. The unstandardized loading of one *affect* indicator on the *affect* factor was not significant while the corresponding standardized estimate was highly significant. This is not an isolated issue but has not yet received much attention in the literature (McIntosh 2009), preventing a fuller explanation. Therefore, until this phenomenon can be explained, these results must be taken with a certain caution.

Nevertheless, because both unstandardized and standardized estimates of the *affect* indicator were of similar magnitude and described similar patterns relative to the other attitudinal indicators, a certain degree of confidence in the results seems reasonable.

V. Future Directions

Firstly, future research should investigate further the relationship of farmers' affective response with the other psychological variables as well as with the situational variables used in this study. Indeed, the present *affect* factor comprised only two indicators, which can occasion computation problems (e.g., Rindskopf 1984); a minimum of three indicators is usually advised (Brown 2006, p. 70).

Secondly, the behavioural indicators showed inconsistency. The measure of behaviour and the congruence between farmers' attitudes and behaviour towards the natural environment should be improved by the addition of better correlated behavioural indicators. Additionally, using extra behavioural indicators could also allow distinguishing between different types of behaviours (e.g., low- vs. high-cost pro-environmental behaviour), and refine the understanding of farmers' actions towards the natural environment.

Thirdly, due to the large number of variables examined in this research compared to the relatively small number of participants, many possible associations between variables have not been investigated. Future studies should look at the interactions of situational variables in more detail. Some additional situational variables should also be looked at; for instance, how off-farm income can influence farmers' attitudes and behaviour towards natural ecosystems on farms (McNally 2002; Ahnström et al. 2008).

Fourthly, the present study suggested an important association between direct experience with nature (either by having native forest on the farm or by voluntarily engaging more with nature) and pro-environmental attitudes and. Although the comparison of farmers with native forest by choice and farmers with native forest by chance further suggested that direct experience with nature could induce positive attitudes towards the natural environment, this relationship was not experimentally tested in this study. Such a relationship has generally been little tested, but particularly on adults and even less so on farmers. The field of environmental social-psychology would gain tremendously from conducting experimental surveys on this question. For instance, longitudinal studies on the effect of adding land with native features to a farm previously devoid of such natural ecosystems on the attitudes and behaviour of farmers would be particularly interesting. Additionally, the effects of ecological quality of such natural features on farmers' affective, cognitive and behavioural responses should be particularly relevant to the question of conservation on private lands. Being in direct contact with ecologically sustainable natural ecosystems could also improve the acquisition by farmers of relevant ecological knowledge. Educational research has demonstrated the efficiency of such a combination on encouraging pro-environmental attitudes and behaviour of children and adolescents (see Bögeholz 2006), while a few studies on adults have supported such results (e.g., Orams 1997; Powell and Ham 2008).

Finally, the notion of inclusion with nature (section III.6.b.ii.) would also be worth studying in the farming population. Within the New Zealand farming population, two predominant phenomena could influence inclusion with nature. On one hand, because New Zealand's natural environment occupies an important place in defining the identity of the country and its inhabitants, one could expect New Zealanders to show relatively high inclusion with nature. On the other hand, because New Zealand's settlement history, accompanied by a radical process of taming nature of which farmers are the legatees, is still relatively recent, one could also expect New Zealand farmers to hold rather limited inclusion with nature. However, low inclusion with nature could be tempered by direct contact with native environment.

VI. Conclusions

The present research showed that, although differences in attitudes existed between the samples of New Zealand farmers with and without native forest, and between farmers with native forest by choice and by chance, a general-specific attitudinal model could be employed for all of them. It also demonstrated that the tripartite attitudinal model was relevant in explaining farmers' attitudes towards the natural environment. In view of the impact of direct experience with nature on farmers' attitudes and behaviour, the affective dimension in the relationship between farmers and the natural environment should not be ignored. The study also confirmed the importance of respondents' family and ecological knowledge in explaining farmers' pro-environmental attitudes and/or behaviour. On the other hand, it also emphasized the need to improve farmers' confidence in their ecological knowledge. However, this study calls for more research, notably on the relationship between direct experience with nature and farmers' attitudes and behaviour towards the natural environment.

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APPENDICES

The appendices number (e.g., A8) correspond to the thesis chapter (e.g., chapter 8) they referred to.

APPENDIX 0

RECREATION ACTIVITIES

1. How often do you undertake the following recreational activities? **For each activity**, tick (✓) the **one** answer that most suits you.

Activity	More than once a month	Once a month or Less	Never
Fishing or Hunting	☐ 1	☐ 2	☐ 3
Taking a short walk or tramping	☐ 1	☐ 2	☐ 3
Observing Nature (e.g. bird, plant)	☐ 1	☐ 2	☐ 3

2. How often do you go into the native bush (large forest or smaller fragments) for any purpose? Tick (✓) the **one** answer that most suits you.

   ☐ 1 Frequently
   ☐ 2 Occasionally
   ☐ 3 Never or hardly ever

3. How often do you use resources from the native bush apart from farming purposes (e.g. hunting, firewood, crafts material)? Tick (✓) the **one** answer that most suits you.

   ☐ 1 Frequently
   ☐ 2 Occasionally
   ☐ 3 Never or hardly ever

THE ENVIRONMENT IN GENERAL AND IN NEW ZEALAND

Your views on environmental issues

4. People around the world are generally concerned about environmental problems because of the possible consequences that result from harming the environment. However, people differ in what concerns them the most. Please rate **each of the following items** from **1** (not important) to **5** (greatest importance) in response to the question:

   I am concerned about environmental problems because of the consequences they could have on:

____Plants	____Me	____People in my country
____Marine life	____My lifestyle	____All people
____Birds	____My health	____Children
____Animals	____My future	____Future generation

5. Listed below are statements about the relationship between humans and the environment. For each one, please indicate whether you STRONGLY AGREE, AGREE, are UNSURE, DISAGREE or STRONGLY DISAGREE with it.

	Strongly Agree	**Agree**	**Unsure**	**Disagree**	**Strongly Disagree**
We are approaching the limit of the number of people the earth can support	☐ 1	☐ 2	☐ 9	☐ 3	☐ 4
Humans have the right to modify the natural environment to suit their needs	☐ 1	☐ 2	☐ 9	☐ 3	☐ 4
The balance of nature is strong enough to cope with the impacts of modern industrial nations	☐ 1	☐ 2	☐ 9	☐ 3	☐ 4
Because of our special abilities, humans are **not** subject to the laws of nature as are other living beings	☐ 1	☐ 2	☐ 9	☐ 3	☐ 4
If things continue on their present course, we will soon experience a major ecological catastrophe	☐ 1	☐ 2	☐ 9	☐ 3	☐ 4

6. In your view, what group in society should have primary responsibility for looking after the environment in a sustainable fashion? Tick (✓) the **one** answer that most suits you.

- ☐ 1 National or local government
- ☐ 2 Business and industry
- ☐ 3 Private landowners
- ☐ 4 Environmental groups
- ☐ 5 Everyone (the government, industry, private landowners, etc…)
- ☐ 6 No one

7. In your view, to what extent are **bush fragments on a farm** part of the natural world? Circle **the number** on the scale that best fits your opinion.

A great deal 5 4 3 2 1 Not at all

You and the New Zealand environment

8. Generally speaking, how much do you enjoy being in New Zealand's native bush? Circle **the number** on the scale that best fits your opinion.

A great deal	5 4 3 2 1	Not at all

9. Below are two items about the value of bush fragments on a farm. **For each line**, circle **the number** on the scale that best fits your opinion.

Useful to farming	5 4 3 2 1	Useless to farming
A financial benefit	5 4 3 2 1	A financial cost

10. To what extent do you consider climate change, flooding, the decline of the native bush and the decline of the wetlands to be now, or in the near future, **major environmental problems for New Zealand**? **For each issue**, circle **the number** on the scale that best fits your opinion.

Climate change:	A major problem	5 4 3 2 1	Not a problem at all
Flooding:	A major problem	5 4 3 2 1	Not a problem at all
Native bush decline:	A major problem	5 4 3 2 1	Not a problem at all
Wetlands decline:	A major problem	5 4 3 2 1	Not a problem at all

11. How much do you think native having bush fragments on a farm would help preserve the native bird populations? Circle **the number** on the scale that best fits your opinion.

A great deal	5 4 3 2 1	Not at all

12. How willing are you to participate in the protection of New Zealand's native bush (flora and fauna)? Tick (✓) the **one** answer that most applies.

☐ 1 Active participation and financial donation
☐ 2 Active participation only
☐ 3 Financial donation only
☐ 4 No participation of any sort

13. To what extent are you informed about costs and benefits of native bush remnants for farming? Circle **the number** on the scale that most applies.

A great deal 5 4 3 2 1 Not at all

14. Where does **most** of your knowledge on native bush's costs and benefits come from? Tick (✓) the **one** answer that best applies.

- [ ] 1 My regional council
- [ ] 2 The media: radio, TV, internet, newspapers and magazines (**other than from your**
- [ ] 3 **regional council**)
- [ ] 4 Talking with family or friends
- [ ] 8 Observation of natural processes during farming or recreational activities

Other. Please specify: ________________________

YOUR REGIONAL COUNCIL

15. Overall, to what extent do you feel your regional council encourages farmers to look after bush fragments? Circle **the number** from the scale that best fits your opinion.

A great deal 5 4 3 2 1 Not at all

16. Which of the following council services would be most likely to help a farmer to look after bush fragments on his/her farm? **Rank** the **two** answers that best fit your opinion, **1** (your first choice) and **2** (your second choice).

- [ ] 1 A certificate of Recognition of sustainable management (e.g. an environmental award)
- [ ] 2 Financial help
- [ ] 3 Occasional labour without additional costs for the farmer
- [ ] 4 Information on native bush management (e.g. booklets, workshops)
- [ ] 5 Assessment of the ecological value of the farmer's bush fragments
- [ ] 6 Farm products endorsement/branding (e.g. like ISO or BioGro)

BUSH CHARACTERISTICS

If you have no bush fragments of 1ha or more on your farm, please go on to question 26

17. How many native bush fragments of **1 ha or more** do you have on your farm?

    ______ native bush fragment(s)

We have a few questions about the bush fragments on your farm. **Please use the table below** to group your answers. If you have more than 3 fragments, **list only your 3 largest fragments in the table below.**

18. What is the actual **size** of your three largest native bush fragment(s)? Please answer in the table below.

19. Has the **size** of your three largest fragment(s) changed **in the last 10 years?** If the size **has increased**: write in the table below **'+'**, if the size **hasn't changed**: write '**O**', if it **has decreased**: write '–'.

20. What percentage of your three largest bush fragment(s) is **fenced off from stock**? Please indicate the percentage of the fragment's area that is fenced off in the box corresponding to the relevant fragment(s).

21. Are any of your three largest fragment(s) currently **controlled against pests or weeds**? Tick (✓), or write zero (**O**) if not, in the box corresponding to the relevant fragment(s).

22. Do any of your three largest bush fragment(s) have **most of their area** (at least 50%) **on steep slopes** (at least **30º** steep)? Tick (✓), or write zero (**O**) if not, in the box corresponding to the relevant fragment(s).

23. Have any of your three largest bush fragment(s) had a **plant or animal inventory** since you have been running the farm? Tick (✓), or write zero (O) if not, in the box corresponding to the relevant fragment(s).

24. Are any of your three largest bush fragment(s) **legally protected**? Tick (✓), or write zero (**O**) if not, in the box corresponding to the relevant fragment(s).

Questions #	Subject	*Example*	Fragment 1	Fragment 2	Fragment 3
18	Actual size	***1 ha***			
19	Size change	***O***			
20	Fenced off	***0%***			
21	Pest/weed control	***O***			
22	On steep area	✓			
23	Inventory	✓			
24	Legal protection	***O***			

25. Why have you kept your bush fragment(s)? Choose the **2 answers** that most suit you and **rank** them from **1** (your first choice) to **2** (your second choice).

☐ 1	For farm purposes	☐ 4	To protect native plants and animals
☐ 2	For leisure activities	☐ 8	Other: ___________________
☐ 3	To beautify the farm	☐ 9	Don't know

26. Do you have native bush fragments of **less than 1 hectare** on your farm that you still consider as a fragment?

☐ 1 Yes

☐ 2 No

27. **In the next five years**, which of the following actions do you intend to do? Tick (✓) **as many answers** as apply.

☐ 1 Decrease the size of any of the native bush fragment(s) on the farm

☐ 2 Fence off more bush fragment(s) on the farm

☐ 3 Control against pests/weeds on any of the fragment(s) on the farm

☐ 4 Have more native bush on the farm

☐ 5 Have an ecological inventory of any of the fragment(s) on the farm

☐ 6 Legally protect any of the fragment(s) on the farm

YOURSELF, YOUR FAMILY AND THE FARMING COMMUNITY

Your childhood

28. Were there bush fragment(s) on your parents' property when you were a child? Tick (✓) the **one** answer that best applies. **If 'No' is your answer, please go on to question 30**

☐ 1 Yes

☐ 2 No (**go to Q30**)

☐ 9 Don't know

29. In your view, what did or do **your parents** mainly use the bush fragment(s) for? Tick (✓) **as many answers** as apply.

☐ 1	For leisure activities	☐ 4	To protect native plants and animals
☐ 2	To beautify their property	☐ 8	Other. Please specify: _________________
☐ 3	For farm purposes	☐ 9	Don't know

30. Are (or were) your parents farmers? **If 'Yes', please indicate what type of farm.** Tick **as many answers** as apply. **If 'No'**, please tick the last box: '*They were never farmers*'

- ☐ 1 Dairy
- ☐ 2 Stock (e.g. beef, sheep, deer)
- ☐ 3 Horticulture
- ☐ 8 Other. Please specify:________________
- ☐ 9 Don't know
- ☐ 4 They were never farmers

31. To what extent do you think your parents are (or were) concerned by environmental issues? Circle **the number** on the scale that best fits your opinion.

A great deal 5 4 3 2 1 Not at all

32. When you were a child, how often did you go into the native bush (forests or smaller fragments)? Tick (✓) the **one** answer that best applies. **If 'Never' is your answer, please go on to question 34.**

- ☐ 1 Regularly
- ☐ 2 Occasionally
- ☐ 3 Never or hardly ever (**go to Q34**)
- ☐ 9 Don't remember

33. To what extent did you enjoy being in the native bush as a child? Circle **the number** on the scale that best fits your opinion.

A great deal 5 4 3 2 1 Not at all

You, your family and the farming community

34. Do your children, your parents or your partner help you on a regular basis in the **running of your farm**? Tick (✓) as many answers as apply.

- ☐ 1 My child/children
- ☐ 2 My parents
- ☐ 3 My partner

35. How often do you discuss environmental issues with people in your household? Tick (✓) the **one** answer that best applies. **If 'Never' is your answer, please go on to question 37**

- ☐ 1 Regularly
- ☐ 2 Occasionally
- ☐ 3 Never or hardly ever (**go to Q37**)

36. Do you think talking about environmental issues with people in your household helps you to make up your mind on such issues? Tick (✓) the **one** answer that best applies.

- ☐ 1 Yes, often
- ☐ 2 Yes, occasionally
- ☐ 3 Never or hardly ever

37. How much do you ever talk about environmental issues with other farmers? Tick (✓) the **one** answer that best applies. **If 'Never' is your answer, please go on to question 39**

- ☐ 1 Regularly
- ☐ 2 Occasionally
- ☐ 3 Never or hardly ever (**go to Q39**)

38. Do you think talking about environmental issues with other farmers helps you to make up your mind on such issues? Tick (✓) the **one** answer that best applies.

- ☐ 1 Yes, often
- ☐ 2 Yes, occasionally
- ☐ 3 Never or hardly ever

39. Which farming association(s) do you belong to, if any?

____

40. Have you, your partner, your children or your parents ever belonged to any environmental organizations? **For each person** indicate (✓) the **one** answer that most applies.

	Yes, currently	**Used to**	**Intend to**	**No**	**Don't know**
Me	☐ 1	☐ 2	☐ 3	☐ 4	☐ 9
My partner	☐ 1	☐ 2	☐ 3	☐ 4	☐ 9
My children	☐ 1	☐ 2	☐ 3	☐ 4	☐ 9
My parents	☐ 1	☐ 2	☐ 3	☐ 4	☐ 9

Your main source of information

41. Overall, how much do you think you are informed about **environmental issues** in general? Tick (✓) the **one** answer that most applies.

☐ 1 A lot
☐ 2 A moderate amount
☐ 3 Not much at all

42. Where does most of your knowledge on environmental issues come from? Tick (✓) the **one** answer that best applies.

☐ 1 My regional council (RC)
☐ 2 The media: radio, TV, internet, newspapers and magazines (**other than from your RC**)
☐ 3 Talking with family or friends
☐ 4 Observation of natural processes during farming or recreational activities
☐ 8 Other. Please specify: _________________________

THE NATURAL WORLD

The natural environment

43. In a few words, what does the word **biodiversity** mean to you? Please write in UPPERCASE.

Biodiversity: ____

____

44. If you wanted to plant trees for farming purposes, would you rather plant exotic, or native trees, or both? Why? Please tick (✓) the **one** answer that most suits you and explain in a few words, your choice.

- ☐ 1 Exotic species because: ______________________________________
- ☐ 2 Native species because: ______________________________________
- ☐ 3 Both because: ______________________________________

45. Have you ever learnt to identify New Zealand **native animals or native plants**? Tick (✓) the **one** answer that most suits you.

- ☐ 1 Yes, mostly in my childhood or adolescent years (up to age **20**)
- ☐ 2 Yes, mostly after age **20**
- ☐ 3 No

46. How much of New Zealand's land do you think is legally protected (e.g. reserves, national parks)?

________% of New Zealand's land

47. Do you think this percentage of legally protected areas in New Zealand is too much, enough or not enough? Tick (✓) the **one** answer that best fits your opinion.

- ☐ 1 Too much
- ☐ 2 Enough
- ☐ 3 Not enough
- ☐ 9 Don't know

Ecological knowledge

The following questions (Nos. 48 through 58) are about general ecological and environmental knowledge. Please respond with what **you think** is the best answer.

48. To protect an area from flooding, stopbanks are constructed along riverbanks. As a result, will downstream flooding **increase**, **stay the same** or **decrease**? Tick (✓) the **one** answer you think is best.

- ☐ 1 Increase
- ☐ 2 Stay the same
- ☐ 3 Decrease
- ☐ 9 Don't know

49. The shining cuckoo that lives in New Zealand migrates to the Solomon Islands for part of the year. Which of the following is the greatest threat to these birds: **loss of habitat in New Zealand**, or **in the Solomon Islands,** or **both**? Tick (✓) the **one** answer you think is best.

- ☐ 1 New Zealand
- ☐ 2 Solomon Islands
- ☐ 3 Both places
- ☐ 9 Don't know

50. Where can pesticides used in the Tropics spread to through evaporation? Tick (✓) the **one** answer you think is best.

- ☐ 1 Only above **the Tropics**
- ☐ 2 Only over **the Tropics and Northern Hemisphere**
- ☐ 3 Over **the Tropics, the Northern Hemisphere, and the Southern Hemisphere**
- ☐ 9 Don't know

51. When will humanity's use of the natural resources **first** exceed the regenerative capabilities of the planet, or has it already? Tick (✓) the **one** answer you think is best.

- [ ] 1 At our present state of resource consumption, we should start to exceed the regenerative capabilities of the planet **by 2030**
- [ ] 2 We are **currently** starting to exceed the regenerative capabilities of the planet
- [ ] 3 The regenerative capabilities of the planet have been exceeded since the **late 1970's**
- [ ] 9 Don't know

52. Landowners sometimes build dams on streams to create ponds. What is the impact of a dam on a stream? Tick (✓) the **one** answer you think is best.

- [ ] 1 The dam causes no major impact
- [ ] 2 The dam changes the stream in the pond area
- [ ] 3 The dam changes the entire stream
- [ ] 9 Don't know

53. An increasing number of plant and animal species is currently disappearing worldwide. Do you think this is **mainly** a natural process, as the world has faced before, or a consequence of human activity? Tick (✓) the **one** answer you think is best.

- [ ] 1 A natural process, as the world faced before
- [ ] 2 A consequence of human activity
- [ ] 9 Don't know

54. Falcons prey on bellbirds, a bird species that lives in the New Zealand bush. Bellbirds are in competition with tui for food and space in the bush. If all the falcons disappear, what would *logically* happen to the **tui**? Tick (✓) the **one** answer you think is best.

- [ ] 1 The population of tui will eventually decrease
- [ ] 2 The population of tui will remain the same as before
- [ ] 3 The population of tui will eventually increase
- [ ] 9 Don't know

55. Why do most organizations that promote the planting of native trees encourage people to get plants from a **local** seedbank? Tick (✓) the **one** answer you think is best.

- ☐ 1 To make sure the plants are the best adapted to the region's characteristics
- ☐ 2 To assure the economy of local nurseries
- ☐ 3 To maintain the aesthetic consistency of the country's vegetation
- ☐ 9 Don't know

56. Phosphorous fertilizer is applied to lawns, gardens, pastures and crop fields to encourage plant growth. What happens when phosphorous washes into a lake? Tick (✓) the **one** answer you think is best.

- ☐ 1 It increases algae production, whose decomposition eventually asphyxiates fish
- ☐ 2 Nothing, the phosphorous is diluted into the lake
- ☐ 3 It prevents the development of the lake's algae, which doesn't have the same needs as terrestrial plants
- ☐ 9 Don't know

57. Which ones of these trees are **exotic** trees, that is to say trees that were not in New Zealand before humans settled? Tick (✓) **as many** answers as you think are best.

- ☐ 1 Totara
- ☐ 2 Pinus Radiata
- ☐ 3 Pohutukawa
- ☐ 4 Willow
- ☐ 9 Don't know

58. Before humans arrived, how much of New Zealand was covered by native bush? Tick (✓) the **one** answer you think is best.

- ☐ 1 80%
- ☐ 2 60%
- ☐ 3 40%
- ☐ 9 Don't know

SOME DETAILS ABOUT YOU

You and your family

59. Are you …?

- ☐ 1 Male
- ☐ 2 Female

60. Which of these age groups do you fall into? Tick (✓) the **one** answer that best applies.

- ☐ 1 20 – 29 years old
- ☐ 2 30 – 39 years old
- ☐ 3 40 – 49 years old
- ☐ 4 50 – 59 years old
- ☐ 5 60 years old or more

61. What is your current marital status? Tick (✓) **as many answer**s as you need to.

- ☐ 1 Married
- ☐ 2 Living with a partner
- ☐ 3 Divorced
- ☐ 4 Separated
- ☐ 5 Widowed
- ☐ 6 Single

62. Do you still have children living at home with you? Tick (✓) the **one** answer that best applies.

- ☐ 1 Yes
- ☐ 2 No
- ☐ 3 I don't have any children.

63. Which **one** of these categories best describes your highest level of formal education you have had?

- ☐ 1 No formal schooling
- ☐ 2 Primary school (incl. intermediate)
- ☐ 3 Secondary school for up to 3 yrs
- ☐ 4 Secondary school for 4 years or more
- ☐ 5 Some university, polytechnic or other tertiary
- ☐ 6 Completed university or polytechnic degree

64. Which of the following categories describe your ethnic origin? Tick (✓) **as many answer**s as you need to.

- ☐ 1 New Zealand European
- ☐ 2 Maori
- ☐ 3 Pacific Islander
- ☐ 4 Asian
- ☐ 8 Other. Please specify: ____________

You and your farm

65. In which year did you start working on a farm full time in New Zealand?

__________________(year)

66. If you have farmed in more than one region of the country, where have you farmed the longest? Tick (✓) the **one** answer that best applies.

☐ 1 The only region I have ever farmed in is my current region
☐ 2 I have farmed the longest in the region where I am currently farming
☐ 3 I have farmed the longest in another region of the country

67. In what year did you start working on the farm you are currently running?

__________________(year)

68. Have you ever had a full-time work experience of at least a year outside agriculture?

☐ 1 Yes. Please specify: ___________________
☐ 2 No

69. To what extent do the **management decisions** (including on possible sustainability matters) for the farm you work on depend on **you**? Circle **the number** from the scale that most applies.

Totally dependent on me 5 4 3 2 1 Not at all dependent on me

70. Do you intend to pass on the farm to any member of your family once you stop farming? Tick (✓) the **one** answer that best applies.

☐ 1 Yes
☐ 2 No
☐ 3 No, because I don't own the farm
☐ 9 Don't know

71. Concerning the farm you currently work on, did it belong to your family before you started running it?

- ☐ 1 Yes
- ☐ 2 No

72. Apart from possible retirement, have you considered quitting agriculture in the **near future**?

- ☐ 1 Yes
- ☐ 2 No

73. What is the size of your farm? Tick (✓) the **one** answer that best applies.

- ☐ 1 0 – 9 ha
- ☐ 2 10 – 19 ha
- ☐ 3 20 – 79 ha
- ☐ 4 80 – 149 ha
- ☐ 5 150 – 499 ha
- ☐ 6 500 – 9,999 ha
- ☐ 7 10,000 ha or more

74. What type of farming do you do? Tick (✓) **as many answers** as suit you.

- ☐ 1 Dairy
- ☐ 2 Stock (e.g. beef, sheep, deer)
- ☐ 3 Horticulture
- ☐ 4 Other. Please specify: ______________________

75. To what extent did the presence – or absence – of native bush fragment(s) on the farm you are currently running influence your decision to become the manager or owner of this area?

A great deal 5 4 3 2 1 Not at all

76. Is there anti-erosion management on your farm?

- ☐ 1 Yes
- ☐ 2 No

77. How often is the amount of phosphorous in your soil checked? Tick (✓) the **one** answer that best applies.

- ☐ 1 Before every fertiliser input
- ☐ 2 Every year
- ☐ 3 Every 2 years
- ☐ 4 Every 3 – 5 years
- ☐ 5 Never or hardly ever
- ☐ 6 I don't use phosphorous
- ☐ 7 I don't use chemical fertilisers

78. Are you farming according to conventional, or organic principles, or both? Tick (✓) the **one** answer that best applies.

- ☐ 1 Conventional farming
- ☐ 2 Organic farming
- ☐ 3 Both

79. What is your **average** farm income before tax over the last 10 year?

- ☐ 1 $10,000 – 49,999
- ☐ 2 $50,000 – 99,999
- ☐ 3 $100,000 – 499,999
- ☐ 4 $500,000 – 999,999
- ☐ 5 $1,000,000 or more

80. Roughly speaking, what percentage of your farm product do you export overseas?

_______% of my farm product is exported.

81. In your view, how much does the clean and green image of New Zealand contribute to the ability of New Zealand farmers to sell their products overseas? Circle **the number** on the scale that best fits your opinion.

A great deal 5 4 3 2 1 Not at all

82. On average, how much do you like the district you live in? Circle **the number** on the scale that best fits your opinion.

A great deal 5 4 3 2 1 Not at all

You and this questionnaire

Comments. Please feel free to make any comments about the questionnaire and the information you have given.

Do you wish to receive a summary of the survey results? If yes, please tick (✓) the box below.

☐ I'd like to receive a summary of the survey results

Please place the fully completed questionnaire in the preaddressed stamped envelope and return it to me as soon you possibly can, to:

Miss Dorothee Durpoix
~Bush Fragment on Private Land Survey~
Ecology Group - PN 624
Massey University
Private Bag 11222
PALMERSTON NORTH

Your participation is greatly appreciated. I thank you very much for your time and honesty.

APPENDIX A5

III. Description of the questionnaire

3. Issues with the variables

a. Variable distribution

Too great a difference in variances between variables can prevent a model from converging[1]. Also, skewness and bivariate associations with zero count affect factor analysis based on polychoric correlations (Olsson 1979). Although there are no agreed values of skewness and kurtosis that are acceptable (Kline 2005, p. 50), Curran and colleagues Curran and colleagues (1996, p. 20, 26) found distributions with univariate skewness of 2.0 and kurtosis of 7.0 as multivariate "moderately nonnormal", and distribution with a univariate skewness of 3.0 and a kurtosis of 21.0 as multivariate "severely nonnormal", corroborating previous research.

Table A5. 1 Categories collapsed in the psychological variables.

Variable Group	Variable sub-group	Variable name	old categories	collapsed with category
General attitude	Value-based environmental concern	Egoistic	1 and 2	3
		Altruistic	1 and 2	3
		Biospheric	1 and 2	3
	Revised-NEP	NEPEarthLimit:	1 and 2	3
		NEPModify:	1 and 2	3
		NEPCope:	1 and 2	3
		NEPNatLawa:	1 and 2	3
		NEPCata:	1 and 2	3
Specific attitude	affect	EnjoyForest	1 and 2	3
		ChildEnjoyForest	1 and 2	3
	cognition	ForestNatural	1 and 2	3
		ForestUseful	1	2
		ForestBenefit	5	4
		ForestDecline	1	2
		ForestHelpBird	1 and 2	3
	Conation	Tree Planting	1	2

[1] Muthén and Muthén note, p. 382, that "[c]onvergence problems may occur when the range of sample variance values greatly exceeds 1 to 10" Muthén, L. K. and B. O. Muthén (1998-2007). Mplus User's Guide. Los Angeles, CA, USA, Muthen & Muthen.

b. Missing values

Almost all variables in the sample contained some missing values. The way one deals with missing data affects the results of one's analyses (Allison 2003, p. 545).

Removing every entire case containing missing data (listwise or casewise deletion (Allison 2002, p.1)) is the simplest solution and "the default in virtually all statistical packages" (Allison 2003, p. 547). If the missing variables are missing completely at random (MCAR)[2], listwise deletion does not introduce any bias to parameters estimations (Allison 2003, p. 547; Brown 2006, p. 365-6). Also, the standard errors estimates "should be approximately unbiased estimates of the true standard errors" (Allison 2003, p. 547; Brown 2006, p. 365-6). Yet the major drawback of listwise deletion is the potentially important amount of information that is discarded in the process. Consequently, "confidence intervals will be wider and hypothesis tests will have lower power than those produced by more efficient methods" (Allison 2003, p. 547). Furthermore, when data are not MCAR, but only missing at random (MAR)[3] , which is more common than MCAR, listwise deletion can produce biased estimates (Allison 2003, p. 547).

Pairwise deletion[4] allows more data to be kept compared to listwise deletion (Allison 2003, p. 547; Brown 2006, p. 366). If the data is MCAR, "parameter estimates […] are consistent [[5]] and, hence, approximately unbiased (Glasser, 1964)" (Allison 2003, p. 548). Nevertheless, because pairwise deletion produced analyses based on different sample sizes, this method can result in a correlation matrix that is not positive definite[6]. Finally, standard error estimates are not consistent estimates of the true standard errors, which "impact on the validity of confidence intervals and hypothesis tests" (Glasser, 1964 in Allison 2003, p. 548).

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[2] The probability of missing data on Y is unrelated to the value of Y, as well as any other variables of the dataset (Allison 2003, p. 3).

[3] The probability of missing data on Y is unrelated to the value of Y, but depends on other observed variables (Allison 2003, p. 4).

[4] All valid records remain available for analysis. Cases are excluded only if in the pair of variables being analyzed at least one record is missing. The overall analysis will thus depend on different sample sizes. Pairwise deletion is also called available case analysis (Allison 2003, p. 547)

[5] "Consistency means that the estimates converge in probability to the true parameter values as the sample size gets larger. This implies that the estimator is approximately unbiased in large samples, with the magnitude of the bias going to zero with increasing sample size" (Allison 2003, p. 547).

[6] "[A]n input matrix will be nonpositive definite when one or more of its elements have out-of-bounds values. The range of possible values that a correlation (or covariance) may possess is dependent on all other relationships in the input matrix" (Brown 2006, p. 367). A positive definite matrix is necessary for latent variables analysis (Brown 2006).

To date, the multiple imputation (MI) method and full-information maximum likelihood (FIML) methods represent the state of the art and are strongly recommended above all the other usual available methods (e.g. deletion, single imputation[7]) (Schafer and Graham 2002, p. 173; Wiggins and Sacker 2002; Enders, Dietz et al. 2006, p. 125). However, when data are categorical, MI may be more appropriate than FIML (Allison 2003, p. 550, 554; Brown 2006, p. 371). As Allison (2003, p. 550) explains, "the imputation method is based on iterated linear regressions in which each variable with missing data is regressed on other observed variables". In addition, MI introduces random noise in the imputation in order to compensate for underestimation of variances and overestimation of correlation among the variables with imputed data (Allison 2003, p. 550; Brown 2006, p. 371). The imputation process is repeated several times – usually five imputed datasets are enough, but if one can afford it, more is always better "in terms of getting more stable parameter estimates and better estimates of standard errors and test statistics" (Allison 2003, p. 553). The different imputed values are averaged and their standard errors computed (Allison 2002).

IV. Statistical methods

1. Factor Analysis

a. The classical common factor model

In factor analysis, the relationships between continuous observed variables are usually measured by Pearson's product-moment correlation (Kline 2005, p. 22-26) and parameters and model fit by maximum likelihood (ML) estimation (Breckler 1990, p. 261, 263; MacCallum and Austin 2000, p. 210; Flora and Curran 2004, p. 466). ML is a full-information estimator (Brown 2006, p. 22), i.e. it estimates all model parameters at once (Kline 2005, p. 112), and provides standard errors and confidence intervals, which represent statistical evaluations on how well the model is able to reproduce the relationship between the variables and how precise the estimates are (Brown 2006, p. 21-22).

However, ML is based on the assumption that the variables are continuous and normally distributed (Muthén 1984, p. 123; Breckler 1990, p. 263; Flora and Curran 2004, p. 466; Brown 2006, p. 21), and socio-psychological studies commonly involve

[7] There exist other methods to deal with missing values. We only mentioned here the most common and/or the ones employed in Mplus. For an overview of the methods available see (Allison 2002; 2003).

ordinal variables (Flora and Curran 2004, p. 466), which violate such assumptions. Besides the fact that ordinal variables are discrete rather than continuous, the scale points may not be equidistant, the variable' distributions may be skewed (Muthén 1984, p. 123) (i.e., asymmetric distribution (Kline 2005, p. 49)), and/or suffer from kurtosis (i.e., "peakedness" of the distribution (Kline 2005, p. 49)), to which ML is "particularly sensitive" (Brown 2006, p. 379)[8].

b. The factor analysis techniques used in the study

An alternative to Pearson product-moment correlation is polychoric correlation. Polychoric correlation assumes that the scale steps of the ordinal variable are realizations of an underlying continuous, normally distributed variable (Olsson 1979 building on the body of work regarding Pearson's (1901) tetrachoric correlations for dichotomous variables)[9]. It has been shown that polychoric correlations reproduced most accurately the relationships of discretized continuous data (Olsson 1979; Babakus, Ferguson et al. 1987). However, although ML factor analysis based on polychoric correlations computes accurate parameter estimates, standard errors and fit indexes are incorrect (Babakus, Ferguson et al. 1987; Rigdon and Ferguson 1991). Skewness can also lead to nonconvergent or improper solutions in factor analysis using polychoric correlations under different estimators (ML, and various least squares: generalized (GLS), unweighted (ULS), weighted (WLS) and diagonally weighted (DWLS)) (Rigdon and Ferguson 1991, p. 493), as well as less precise estimates and biased fit indexes (Rigdon and Ferguson 1991, p. 494-5).

To remedy problems encountered when performing classical, maximum-likelihood-based factor analysis on categorical data, Muthén and colleagues (1997) developed the weighted least squares mean- and variance-adjusted (WLSMV) approach, also called robust weighted least squares (robust WLS), which provides robust standard errors and a mean- and variance-adjusted chi-square test statistic (Muthén & Muthén

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[8] Moreover, it has been shown that Pearson's product-moment correlation coefficients underestimated relationships of discretized continuous data (Bollen and Barb 1981; Babakus, Ferguson et al. 1987, p. 224) and that an ML estimator based on Pearson's correlation tended to produce biased results with ordinal data of five or fewer categories (Flora and Curran 2004, p. 467). In such cases, the following problems were to be expected: inflated chi-square, underestimated standard errors (Flora and Curran 2004, p. 467), underestimated fit indices (Brown 2006, p. 379), incorrect number of factors, and biased estimates of the factor loadings (Olsson 1979). Moreover, skewed ordinal data would "distort ordinary Pearson product moment correlations (or covariances)" (Muthén 1984, p. 123), and lead to biased parameters estimates especially when the distributions of the observed variables are skewed in opposite directions (Olsson 1979).

[9] For a brief overview of the estimation steps of polychoric correlation see Flora and Curran (2004).

1998-2007).[10] Muthén's WLSMV estimator (1997) treats the variables as ordinal, assuming they are realizations of underlying continuous and normally distributed variables (Muthén et al. 1997, p. 6). The bivariate relationships are estimated via polychoric (or tetrachoric) correlation.[11] However, instead of estimating the whole asymptotic covariance matrix, as earlier techniques did, the robust WLS approach uses a diagonal weight matrix equal to the diagonal of the asymptotic covariance matrix (Muthén et al. 1997, p. 16, 18). There are indications in the literature that WLSMV performs better than the classical ML estimator when dealing with categorical data (Beauducel & Herzberg 2006). Moreover, unlike WLS[12], 'small' samples can be used with WLSMV analysis. It has been suggested that sample sizes of 150-200 are sufficient for estimating models with 10 to 15 indicators (Brown 2006, p. 389). Furthermore, "preliminary simulation research has shown that WLSMV performs well with samples as small as 200 for variables with floor or ceiling effects (although, as with continuous indicators, very skewed categorical indicators call for larger Ns)" (Muthén et al. 1997; Brown 2006, p. 389). Although the use of WLSMV is still rare in the factor analysis literature (especially concerning exploratory factor analysis), WLSMV "appears to provide the best options for CFA [confirmatory factor analysis] modeling with categorical data" (Brown 2006, p. 388). This approach is only available in Mplus to date (Brown 2006, p. 388).

ii. SEM and ESEM

Regressions vs. correlation

Raykov and Penev (1999) demonstrated that, for two latent factors A and B, the model A causing B was equivalent to B causing A, and to the residual variance of A and B covarying. Based on Stelzl (1986), they defined equivalent models as those that "reproduce the same set of covariance matrices when their parameters vary across their spaces" (Raykov and Penev 1999, p. 199). Such models, they wrote,

"typically give rise to equal overall goodness-of-fit indices, such as chi-square values and related descriptive fit indices, degrees of freedom, and p-values, as well as covariance residuals (e.g., Jöreskog & Sörbom, 1993). Hence these models can possibly

[10] See Appendix 4, section IV.1.b for more details on the development of factor analysis with categorical data.
[11] See Appendix 4, section IV.1.b. for more details on polychoric correlations.
[12] See Appendix 4, section IV.1.b. for more details on WLS estimation.

be differentiated between by employing additional criteria. These criteria are interpretability of parameters, meaningfulness of models, design features — for example, implied by experimental manipulation of key variables and/or longitudinal data collection — or characteristics of variables (MacCallum et al., 1993), as well as time precedence and mediating mechanism (Lee & Hershberger, 1990)" (Raykov and Penev 1999, p. 199-200).

When variables are concurrently measured, the causality relationships between variables are not justified by the experimental design (time precedence); rather, 'a clear rationale' must substantiate such a choice by the researcher (Kline 2005, p. 99).

The present study used cross-sectional[13] variables. Therefore, statistically speaking, the tripartite hypothesized model, with correlated affect and cognition causing conation, which predicts behaviour, is equivalent to a model with the four latent factors simply correlating to one another. However, the social-psychological literature supports the causal sequence within the tripartite attitude model and between attitude and behaviour (see chapters 2 and 3). Studies relying on concurrent measures have already found significant regression coefficients from cognitive and/or affective attitude significantly predicting conative attitude (e.g., Godin 1987; Ajzen 1991; Hinds and Sparks 2008). More importantly, research has also experimentally demonstrated that cognition through or in parallel with affect induced behavioural intentions (e.g., Lutz 1977 Triandis 1977 in Bagozzi 1982; Bagozzi 1982; Ryan 1982). Further, the mediation role of intention between affect and cognition on one hand, and behaviour, on the other, has been supported by many research papers (e.g., Bagozzi 1982; Bamberg and Möser 2007). However, findings are less unanimous regarding the relationship between affect and cognition. Some studies have supported the influence of cognition on affect (for review see Bagozzi 1982; Morris, Woo et al. 2002), others, the influence of affect on cognition (for a review, see Zajonc 1980; Bagozzi 1982). Faced with this inconsistency, all possibilities were covered in the present study by correlating the two latent factors' residual variance (Kline 2005, p. 155).

Furthermore, although the present thesis examines the prediction of behaviour by attitude and the behaviour measures are technically prior to the measure of attitude, it is likely that farmers held similar attitudes when they performed the behaviour. As legally protecting native forest fragments, for instance, is supposed to constrain the farm development *ad vitam aeternam*, it is likely that the attitude that predisposed such behaviour has been stable over time. Furthermore, attitudes are fairly stable in adults,

[13] Concurrently measured

the more so the more readily accessible the beliefs about the object of attitude are (Ajzen 2001, p. 35). This would hold particularly true for farmers with fragments who are in permanent and direct contact with the object of attitude. Finally, because the behaviour measured by the questionnaire are an on-going process (e.g., renewing fences), and it is likely that not all forest fragments on the farm have received such treatments (therefore more behaviour could be potentially performed on the farm), the measure of farmers' intentions towards native fragments on the farm is meaningful.

APPENDIX A6

II. Analysis

Based on Rubin (1987), SPSS computes parameters enabling the researcher to evaluate if more imputations are needed: the fraction of missing information, relative increase in variance and the relative efficiency. “The fraction of missing information is an estimate of the ratio of missing information to "complete" information, based on the relative increase in variance due to non-response, which in turn is a (modified) ratio of the between-imputation and average within-imputation variance of the regression coefficient. The relative efficiency is a comparison of this estimate to a (theoretical) estimate computed using an infinite number of imputations. The relative efficiency is determined by the fraction of missing information and the number of imputations used to obtain the pooled result; when the faction of missing information is large, a greater number of imputations are necessary to bring the relative efficiency closer to 1 and the pooled estimate closer to the idealized estimate” (SPSS 2008).

Table A6. 1 Number of missing values in the potential predictors of presence of New Zealand native forest on farms and efficiency of the imputations.

Var. Group	Variables[a]	Original data					Pooled results from 7 imputed datasets						
		N		Mean		S.D.	N		Mean		Fract. Miss. Info.[b]	Rel. Incr. Var.[c]	Rel. Eff.[d]
		Valid	Miss.	Stat.	S.E.		Valid	Miss.	Stat.	S.E.			
Farm sociodemographic characteristics	Dairy farming	692	114	0.180	0.015	0.387	806	0	0.220	0.041	0.900	7.118	0.886
	Export	708	98	0.622	0.014	0.372	806	0	0.611	0.013	0.026	0.026	0.996
	Farm in Family	797	9	0.420	0.017	0.493	806	0	0.420	0.017	0.008	0.008	0.999
	(Log)Farm Size	656	150	1.956	0.027	0.685	805	1	2.117	0.026	0.008	0.008	0.999
	FarmSize	*656*	*150*	*265.960*	*40.703*	*1042.513*	*805*	*1*	*396.683*	*36.806*	*0.031*	*0.032*	*0.996*
	Horticulture farming	692	114	0.040	0.008	0.204	806	0	0.110	0.016	0.595	1.250	0.922
	Organic farming	797	9	1.520	0.038	1.071	806	0	1.550	0.039	0.015	0.015	0.998
	Wellington	799	7	0.290	0.016	0.454	806	0	0.290	0.016	0.006	0.006	0.999
	Meat farming	692	114	0.770	0.016	0.419	806	0	0.710	0.027	0.690	1.854	0.910
	Pass Farm	544	262	0.660	0.020	0.474	806	0	0.650	0.022	0.451	0.723	0.939
Farmer sociodemographic characteristics	Age	803	3	3.720	0.035	0.989	806	0	3.740	0.034	0.003	0.003	1.000
	Farm Income	733	73	3.090	0.041	1.106	806	0	3.140	0.061	0.523	0.948	0.930
	Own Farm	584	222	0.930	0.010	0.253	806	0	0.890	0.026	0.854	4.696	0.891
	Quit Farming	792	14	0.210	0.014	0.407	806	0	0.210	0.014	0.011	0.011	0.998
	Year Farming	*739*	*67*	*33.300*	*0.529*	*14.391*	*806*	*0*	*32.920*	*0.601*	*0.266*	*0.335*	*0.963*
	(Log)Year Farming	739	67	1.465	0.009	0.254	806	0	1.455	0.010	0.206	0.244	0.971
	Year on Farm	*795*	*11*	*24.260*	*0.514*	*14.487*	*806*	*0*	*24.240*	*0.510*	*0.002*	*0.002*	*1.000*
	(Log)Year on Farm	795	11	1.287	0.011	0.323	806	0	1.287	0.011	0.002	0.002	1.000
	Environmental Organisation	758	48	1.870	0.056	1.547	806	0	1.910	0.056	0.061	0.064	0.991
Knowledge	Forest Informed	800	6	2.330	0.044	1.240	806	0	2.330	0.044	0.011	0.011	0.998
	Education	804	2	4.280	0.042	1.196	804	2	4.280	0.042	.	.	.
	Forest Knowledge	780	26	0.530	0.018	0.499	806	0	0.530	0.018	0.033	0.034	0.995
	Forest Knowledge Media	780	26	0.300	0.016	0.460	806	0	0.310	0.017	0.125	0.137	0.983
	Forest Knowledge SI	780	26	0.090	0.010	0.291	806	0	0.110	0.011	0.064	0.067	0.991
	Forest Knowledge RC	780	26	0.110	0.011	0.313	806	0	0.120	0.013	0.187	0.217	0.974
	Ecological Literacy	806	0	3.866	0.019	0.527	806	0	3.866	0.019	.	.	.
	Environmentally Informed	806	0	3.140	0.042	1.194	806	0	3.140	0.042	.	.	.
	NZ Environment knowledge	804	2	4.660	0.040	1.121	804	2	4.660	0.040	.	.	.

Table A6. 1 (cont.)

Var. Group	Variables[a]	Original data					Pooled results from 7 imputed datasets						
		N		Mean		S.D.	N		Mean		Fract. Miss. Info.[b]	Rel. Incr. Var.[c]	Rel. Eff.[d]
		Valid	Miss.	Stat.	S.E.		Valid	Miss.	Stat.	S.E.			
Nature experience	Fishing Hunting	726	80	2.720	0.048	1.280	806	0	2.690	0.047	0.097	0.104	0.986
	Frequency Use Forest	800	6	2.080	0.048	1.344	806	0	2.080	0.048	0.005	0.005	0.999
	Frequency Visit Forest	804	2	3.160	0.047	1.335	806	0	3.160	0.047	0.005	0.005	0.999
	Observe Nature	732	74	3.940	0.052	1.396	806	0	3.890	0.053	0.132	0.146	0.981
	Visit Forest As Child	782	24	3.510	0.051	1.416	806	0	3.500	0.051	0.016	0.016	0.998
	Walking Tramping	746	60	3.570	0.049	1.351	806	0	3.560	0.048	0.024	0.024	0.997
Social Influences	Environmental Talk Family	799	7	3.160	0.045	1.286	806	0	3.160	0.046	0.004	0.004	0.999
	Environmental Talk Farmer	804	2	2.880	0.041	1.174	806	0	2.870	0.041	0.004	0.004	0.999
	Make Mind Family	708	98	3.210	0.044	1.182	806	0	3.170	0.190	0.958	17.736	0.880
	Make Mind Farmer	699	107	2.930	0.044	1.170	806	0	2.950	0.246	0.975	30.263	0.878
	Parent Envtal Concern	798	8	2.930	0.043	1.202	806	0	2.930	0.043	0.008	0.008	0.999
	Parent Farmer	801	5	0.760	0.015	0.427	801	5	0.760	0.015	.	.	.
	Parent Forest	766	40	0.510	0.018	0.500	806	0	0.510	0.018	0.053	0.055	0.993
	Child Involvement Farm	719	87	0.570	0.018	0.495	806	0	0.570	0.018	0.027	0.028	0.996
	Partner Involvement Farm	718	88	0.820	0.014	0.388	806	0	0.810	0.016	0.309	0.409	0.958
	RC Encouragement	795	11	2.460	0.041	1.155	806	0	2.460	0.041	0.021	0.022	0.997
	Forest Influence	792	14	0.110	0.011	0.313	806	0	0.117	0.013	0.221	0.266	0.969
Valid N (listwise)		150	656				797	9					

[a]: Farm in Family stands for farm previously in respondents' family; Pass Farm, for respondents' intentions of passing the farm to a family member; Own farm, for if respondents own at least half of the farm; Forest Informed, for respondents' self-reported level of knowledge regarding cost and benefits of native forest on farms; Forest Knowledge SI, for respondents' main source of knowledge about cost and benefits of native forest on farms coming from social interactions; Forest Knowledge RC, for regional council as main source of knowledge; Make Mind Family, for if discussion with family about environmental issues helps respondents' to make up their mind about such issues; Parent Envtal Concern, for respondents' report of their parents' level of environmental concern; RC Encouragement, for respondents' evaluation of their regional council' encouragement of farmers to look after native forest; Forest Influence, for if the presence/absence of native forest on the farm influenced respondents' decision to take over the property.

[b]: Fract. Miss. Info. Stands for fraction of missing information. [c]: Rel. Incr. Var. stands for relative increase in variance. [d]: Rel. Eff. Stands for relative efficiency

III. Results: Who were the respondents with and without forest?

1. Statistical issues

A few variables were not imputed because they contained only a few missing values and showed little variance (‘Education’, ‘Ecological Literacy’, ‘Environmentally Informed’, ‘NZ Environment Knowledge’ and ‘Parent Farmer’) .

The variables ‘Make Mind Family’, ‘Make Mind Farmer’, ‘Dairy farming’, and ‘Own Farm’ had substantial missing information fractions (Table A6.1). As the number of imputations was already more than the five usually recommended and the generation of the imputed datasets was time-consuming, it was decided to exclude these four variables from the discriminant analysis. As ‘Dairy farming’ was no longer part of the analysis, the other two farm types (‘Horticulture’ and ‘Meat’) were also excluded.

The variables ‘Farm Size’, ‘Year Farming’ and ‘Year Farm’ displayed much greater standard deviation than the rest of the covariates. Muthén and Muthén (1998-2007, p. 382) warn against sample variances whose range varies by a factor of 10 or more. Therefore, log-transformed versions of these variables were used instead in the discriminant analysis. The original variables are still shown, in italics, in Table A6.1 to give the reader a sense of the sample values.

Some situational variables showed signs of collinearity (Table 6.2). It did not pose further problem for the farming type and the ‘Make Mind’ variables as they were already meant to be excluded from the analysis due to large missing information fraction. However, one variable out of each of the remaining pairs of collinear discriminators had to be removed from the discriminant analysis. Because ‘Parent Farmer’ was highly correlated to both ‘Parent Forest’ and ‘Family Farm’, while these two variables were not collinear, ‘Parent Farmer’ was eliminated. Finally, ‘Observe Nature’ was chosen over ‘Walking/Tramping’ because it represented the ultimate *contemplative* outdoor recreational activity.

Table A6. 2 Highest (polychoric) correlations between the situational variables selected for the prediction of presence of native forest on farms.

Variable1	Variable2	Polychoric Correlation
Meat farming	Dairy farming	-0.992
Meat farming	Horticulture farming	-0.906
Parent Farmer	Parent Forest	0.788
Parent Farmer	Farm in Family	0.794
Environmental Talk Family	Make Mind Family	0.670
Environmental Talk Farmer	Make Mind Farmer	0.762
Walking/Tramping	Observe Nature	0.660

APPENDIX A7

III. Results

2. Dimensionality and reliability analysis

a. Over the whole sample

In both the 60% and 40% portions of the whole sample, the hypothesized three-factor model displayed the best fit to the data (Tables A7.1 and A7.2).
Yet chi-square was significant, probably due to the high correlations between the items. WRMR was greater than 1.00 in the 60% portion of the sample, but below 1.00 in the 40% portion. Although RMSEA was greater than the 0.06 threshold advised by Yu (2002) in both samples, it was still below the threshold of 0.10 commonly referred to in the literature (Byrne 2001). CFI and TLI were greater than their minimum threshold of 0.95.

Table A7. 1 Overall goodness-of-fit of three alternative confirmatory factor analysis models of Schultz' value-based environmental concerns on 60% of the whole sample.

Model Statistics [a]	1-factor model	2-factor model	3-factor model
N	459	459	459
Chi-square	496.076	340.271	116.961
df [b]	14	17	27
p	0.000	0.000	0.000
# free parameters	36	37	39
CFI	0.891	0.927	0.980
TLI	0.930	0.961	0.993
RMSEA	0.274	0.204	0.085
WRMR	3.707	2.624	1.059

[a]: a model is not rejected if CFI/TLI >0.95, RMSEA<0.06, WRMR<1.0. Models with a robust χ^2 p value $\geq$ 0.05 would be preferred to models with a significant χ^2 p value.

[b]: Under WLSMV, the degrees of freedom are not computed as usual; see Mplus Technical Appendices (Muthén 1998-2004, p. 19-20) for the formula.

Table A7.2 Overall goodness-of-fit of three alternative confirmatory factor analysis models of Schultz' value-based environmental concerns on 40% of the whole sample.

Model Statistics [a]	1-factor model	2-factor model	3-factor model
N	302	302	302
Chi-square	275.622	188.617	72.560
df [b]	11	16	23
p	0.000	0.000	0.000
# free parameters	36	37	39
CFI	0.923	0.950	0.986
TLI	0.944	0.975	0.995
RMSEA	0.282	0.189	0.084
WRMR	3.117	1.937	0.880

[a]: a model is not rejected if CFI/TLI >0.95, RMSEA<0.06, WRMR<1.0. Models with a robust χ^2 p value $\geq$ 0.05 would be preferred to models with a significant χ^2 p value.

[b]: Under WLSMV, the degrees of freedom are not computed as usual; see Mplus Technical Appendices (Muthén 1998-2004, p. 19-20) for the formula.

Table A7.3 Standardized factor loadings of Schultz' value-based environmental concern items in the three alternative models run on 60% of the whole sample (N = 459). In the two- and three-factor models, items' loadings on factors other than their hypothesized one are specified as null (therefore not mentioned in the table)

Variable Groups	Variables	Factor Loadings		
		1-factor model	2-factor model	3-factor model
Egoistic Concern Indicators	Me	0.896	0.940	0.940
	Lifestyle	0.851	0.908	0.908
	Health	0.843	0.903	0.904
	Future	0.823	0.906	0.905
Altruistic Concern Indicators	People in my country	0.920	0.951	0.978
	All people	0.893	0.904	0.918
	Children	0.822	0.861	0.909
	Future generations	0.754	0.782	0.835
Biospheric Concern Indicators	Plant	0.840	0.859	0.901
	Marine	0.831	0.851	0.896
	Bird	0.840	0.859	0.892
	Animal	0.851	0.874	0.927

Table A7.4 Standardized factor loadings of Schultz' value-based environmental concern items in the three alternative models run on 40% of the whole sample (N = 302). In the two- and three-factor models, items' loadings on factors other than their hypothesized one are specified as null (therefore not mentioned in the table)

Variable Groups	Variables	Factor Loadings		
		1-factor model	2-factor model	3-factor model
Egoistic Concern Indicators	Me	0.951	0.969	0.969
	Lifestyle	0.913	0.944	0.944
	Health	0.904	0.938	0.939
	Future	0.906	0.943	0.943
Altruistic Concern Indicators	People in my country	0.902	0.956	0.975
	All people	0.872	0.889	0.899
	Children	0.837	0.884	0.920
	Future generations	0.765	0.796	0.829
Biospheric Concern Indicators	Plant	0.838	0.866	0.910
	Marine	0.785	0.817	0.869
	Bird	0.835	0.861	0.903
	Animal	0.842	0.872	0.920

Table A7.5 Amount of variance (R-square) accounted for in Schultz' value-based environmental concern items in the three alternative models run on 60% of the whole sample (N = 459).

Variable Groups	Variables	R-square		
		1-factor model	2-factor model	3-factor model
Egoistic Concern Indicators	Me	0.802	0.883	0.884
	Lifestyle	0.724	0.824	0.824
	Health	0.711	0.816	0.817
	Future	0.677	0.821	0.819
Altruistic Concern Indicators	People in my country	0.847	0.904	0.956
	All people	0.798	0.816	0.843
	Children	0.676	0.741	0.826
	Future generations	0.568	0.611	0.697
Biospheric Concern Indicators	Plant	0.705	0.737	0.811
	Marine	0.691	0.724	0.802
	Bird	0.705	0.738	0.796
	Animal	0.724	0.763	0.859

Table A7.6 Amount of variance (R-square) accounted for in Schultz' value-based environmental concern items in the three alternative models run on 40% of the whole sample (N = 302).

Variable Groups	Variables	R-square		
		1-factor model	2-factor model	3-factor model
Egoistic Concern Indicators	Me	0.904	0.939	0.939
	Lifestyle	0.833	0.891	0.891
	Health	0.817	0.881	0.881
	Future	0.821	0.889	0.888
Altruistic Concern Indicators	People in my country	0.814	0.914	0.951
	All people	0.761	0.790	0.808
	Children	0.701	0.782	0.846
	Future generations	0.585	0.633	0.688
Biospheric Concern Indicators	Plant	0.702	0.749	0.827
	Marine	0.616	0.668	0.754
	Bird	0.697	0.741	0.816
	Animal	0.709	0.760	0.847

b. Comparison between farmers with and without native forest

i. Farmers without forest

As for the whole sample, the three-factor model described the data best (Table A7.7). Although chi-square was still significant, RMSEA was just below 0.10, WRMR was smaller than 1.00 and CFI and TLI were greater than 0.95.

Table A7.7 Overall goodness-of-fit of three alternative confirmatory factor analysis models of Schultz' value-based environmental concerns on farmers without forest.

Model Statistics [a]	1-factor model	2-factor model	3-factor model
N	271	271	271
Chi-square	286.313	183.162	86.448
df [b]	16	19	24
p	0.000	0.000	0.000
# free parameters	36	37	39
CFI	0.901	0.940	0.977
TLI	0.944	0.971	0.991
RMSEA	0.250	0.179	0.098
WRMR	2.601	1.798	0.987

[a]: a model is not rejected if CFI/TLI >0.95, RMSEA<0.06, WRMR<1.0. Models with a robust χ^2 p value $\geq$ 0.05 would be preferred to models with a significant χ^2 p value.

[b]: Under WLSMV, the degrees of freedom are not computed as usual; see Mplus Technical Appendices (Muthén 1998-2004, p. 19-20) for the formula.

Table A7.8 Standardized factor loadings of Schultz' value-based environmental concern items in the three alternative models run on the sample of farmers without forest (N = 271). In the two- and three-factor models, items' loadings on factors other than their hypothesized one are specified as null (therefore not mentioned in the table)

Variable Groups	Variables	Factor Loadings		
		1-factor model	2-factor model	3-factor model
Egoistic Concern Indicators	Me	0.881	0.895	0.916
	Lifestyle	0.893	0.905	0.941
	Health	0.853	0.872	0.904
	Future	0.872	0.888	0.929
Altruistic Concern Indicators	People in my country	0.924	0.938	0.983
	All people	0.883	0.895	0.903
	Children	0.872	0.897	0.944
	Future generations	0.831	0.857	0.879
Biospheric Concern Indicators	Plant	0.805	0.878	0.878
	Marine	0.765	0.854	0.854
	Bird	0.790	0.855	0.855
	Animal	0.859	0.941	0.941

Table A7.9 Amount of variance (R-square) accounted for in Schultz' value-based environmental concern items in the three alternative models run on farmers without forest (N = 271).

Variable Groups	Variables	R-square		
		1-factor model	2-factor model	3-factor model
Egoistic Concern Indicators	Me	0.777	0.800	0.839
	Lifestyle	0.797	0.820	0.885
	Health	0.727	0.760	0.817
	Future	0.760	0.788	0.864
Altruistic Concern Indicators	People in my country	0.853	0.880	0.965
	All people	0.780	0.801	0.815
	Children	0.761	0.805	0.892
	Future generations	0.691	0.734	0.773
Biospheric Concern Indicators	Plant	0.647	0.771	0.772
	Marine	0.585	0.729	0.729
	Bird	0.624	0.731	0.732
	Animal	0.738	0.886	0.885

ii. Farmers with forest

The three-factor solution described the respondents' environmental motive concerns best (Table A7.10). Chi-square was significant and RMSEA was below 0.10 but above 0.06. WRMR was also below its threshold of 1.00, while CFI and TLI were greater than their minimal threshold of 0.95.

Table A7.10 Overall goodness-of-fit of three alternative confirmatory factor analysis models of Schultz' value-based environmental concerns on farmers with forest.

Model Statistics [a]	1-factor model	2-factor model	3-factor model
N	490	490	490
Chi-square	486.807	264.427	96.293
df [b]	11	15	25
p	0.000	0.000	0.000
# free parameters	36	37	39
CFI	0.916	0.956	0.987
TLI	0.931	0.974	0.995
RMSEA	0.297	0.184	0.076
WRMR	4.190	2.406	0.966

[a]: a model is not rejected if CFI/TLI >0.95, RMSEA<0.06, WRMR<1.0. Models with a robust χ^2 p value $\geq$ 0.05 would be preferred to models with a significant χ^2 p value.

[b]: Under WLSMV, the degrees of freedom are not computed as usual; see Mplus Technical Appendices (Muthén 1998-2004, p. 19-20) for the formula.

Table A7.11 Standardized factor loadings of Schultz' value-based environmental concern items in the three alternative models run on the sample of farmers with forest (N = 490). In the two- and three-factor models, items' loadings on factors other than their hypothesized one are specified as null (therefore not mentioned in the table)

Variable Groups	Variables	Factor Loadings		
		1-factor model	2-factor model	3-factor model
Egoistic Concern Indicators	Me	0.946	0.956	0.974
	Lifestyle	0.868	0.888	0.915
	Health	0.890	0.908	0.932
	Future	0.849	0.873	0.913
Altruistic Concern Indicators	People in my country	0.907	0.930	0.971
	All people	0.889	0.911	0.920
	Children	0.807	0.848	0.898
	Future generations	0.718	0.767	0.803
Biospheric Concern Indicators	Plant	0.863	0.919	0.919
	Marine	0.850	0.908	0.909
	Bird	0.869	0.920	0.920
	Animal	0.837	0.914	0.914

Table A7.12 Amount of variance (R-square) accounted for in Schultz' value-based environmental concern items in the three alternative models run on farmers with forest (N = 490).

Variable Groups	Variables	R-square		
		1-factor model	2-factor model	3-factor model
Egoistic Concern Indicators	Me	0.895	0.914	0.948
	Lifestyle	0.753	0.788	0.837
	Health	0.792	0.824	0.869
	Future	0.72	0.762	0.834
Altruistic Concern Indicators	People in my country	0.822	0.865	0.943
	All people	0.79	0.829	0.847
	Children	0.651	0.719	0.807
	Future generations	0.516	0.588	0.644
Biospheric Concern Indicators	Plant	0.745	0.845	0.844
	Marine	0.722	0.825	0.826
	Bird	0.755	0.847	0.847
	Animal	0.701	0.836	0.836

iii. Comparison between farmers with forest and farmers without forest

As expected, the three-factor MIMIC model produced an acceptable fit for most of the indices (Table A7.13). Despite a significant chi-square, only WRMR exceeded the limit value (1.0).

Table A7.13 Overall goodness-of-fit of the MIMIC analysis of the three-factor model of Schultz' value-based environmental concerns comparing farmers with and without forest.

Model Statistics [a]	3-factor model
N	761
Chi-square	181.476
df [b]	32
p	0.000
# free parameters	42
CFI	0.982
TLI	0.994
RMSEA	0.078
WRMR	1.192

[a]: a model is not rejected if CFI/TLI >0.95, RMSEA<0.06, WRMR<1.0. Models with a robust χ^2 p value $\geq$ 0.05 would be preferred to models with a significant χ^2 p value.

[b]: Under WLSMV, the degrees of freedom are not computed as usual; see Mplus Technical Appendices (Muthén 1998-2004, p. 19-20) for the formula.

Table A7.14 Standardized factor loadings of Schultz' value-based environmental concern items in the MIMIC three-factor model comparing farmers with and without forest on the whole sample (N = 761).

Variable Groups	Variables	Factor Loadings
Egoistic Concern Indicators	Me	0.952
	Lifestyle	0.925
	Health	0.921
	Future	0.919
Altruistic Concern Indicators	People in my country	0.976
	All people	0.912
	Children	0.913
	Future generations	0.831
Biospheric Concern Indicators	Plant	0.903
	Marine	0.885
	Bird	0.900
	Animal	0.925

Table A7.15 Amount of variance (R-square) accounted for in Schultz' value-based environmental concern items in the three-factor MIMIC model comparing farmers with and without forest on the whole sample (N = 761).

Variable Groups	Variables	R-square
Egoistic Concern Indicators	Me	0.906
	Lifestyle	0.855
	Health	0.847
	Future	0.845
Altruistic Concern Indicators	People in my country	0.953
	All people	0.831
	Children	0.834
	Future generations	0.691
Biospheric Concern Indicators	Plant	0.815
	Marine	0.783
	Bird	0.811
	Animal	0.856
Latent Factors	Egoistic	0.001
	Altruistic	0.000
	Biospheric	0.001

c. Comparison between farmers with forest by choice and farmers with forest by chance.

Table A7.16 Overall goodness-of-fit of the MIMIC analysis of the three-factor model of Schultz' value-based environmental concerns comparing farmers with forest by chance and farmers with forest by choice.

Model Statistics [a]	3-factor model
N	483
Chi-square	103.234
df [b]	29
p	0.000
# free parameters	42
CFI	0.987
TLI	0.995
RMSEA	0.073
WRMR	0.925

[a]: a model is not rejected if CFI/TLI >0.95, RMSEA<0.06, WRMR<1.0. Models with a robust χ^2 p value $\geq$ 0.05 would be preferred to models with a significant χ^2 p value.
[b]: Under WLSMV, the degrees of freedom are not computed as usual; see Mplus Technical Appendices (Muthén 1998-2004, p. 19-20) for the formula.

Table A7.17 Standardized factor loadings of Schultz' value-based environmental concern items in the MIMIC three-factor model comparing farmers with forest by chance and farmers with forest by choice (N = 483).

Variable Groups	Variables	Factor Loadings
Egoistic Concern Indicators	Me	0.971
	Lifestyle	0.913
	Health	0.937
	Future	0.912
Altruistic Concern Indicators	People in my country	0.974
	All people	0.917
	Children	0.901
	Future generations	0.803
Biospheric Concern Indicators	Plant	0.920
	Marine	0.909
	Bird	0.925
	Animal	0.920

Table A7.18 Amount of variance (R-square) accounted for in Schultz' value-based environmental concern items in the three-factor MIMIC model comparing farmers with forest by chance and farmers with forest by choice (N = 483).

Variable Groups	Variables	R-square
Egoistic Concern Indicators	Me	0.942
	Lifestyle	0.834
	Health	0.879
	Future	0.831
Altruistic Concern Indicators	People in my country	0.948
	All people	0.841
	Children	0.812
	Future generations	0.646
Biospheric Concern Indicators	Plant	0.847
	Marine	0.827
	Bird	0.855
	Animal	0.847
Latent Factors	Egoistic	0.001
	Altruistic	0.007
	Biospheric	0.006

APPENDIX A8

III. Results

2. Dimensionality and reliability analysis

a. Over the whole sample

Table A8. 1 Overall goodness-of-fit of the exploratory factor analysis of the three alternative NEP models on 60% of the whole sample.

Model Statistics [a]	1-factor model NEPEarth incl.	2-factor model NEPEarth incl.	1-factor model NEPEarth excl.
N	484	484	484
Chi-square	30.170	0.698	0.708
df [b]	5	1	2
p	0.000	0.4036	0.7017
# free parameters	5	9	4
CFI	0.941	1.000	1.000
TLI	0.917	1.000	1.000
RMSEA	0.102	0.000	0.000
SRMR	0.055	0.008	0.010

[a]: a model is not rejected if CFI/TLI >0.95, RMSEA<0.06, WRMR<1.0. Models with a robust χ^2 p value $\geq$ 0.05 would be preferred to models with a significant χ^2 p value.

[b]: Under WLSMV, the degrees of freedom are not computed as usual; see Mplus Technical Appendices (Muthén 1998-2004, p. 19-20) for the formula.

Table A8. 2 Overall goodness-of-fit of the exploratory factor analysis of the three alternative NEP models on 40% of the whole sample.

Model Statistics [a]	1-factor model NEPEarth incl.	2-factor model NEPEarth incl.	1-factor model NEPEarth excl.
N	321	321	321
Chi-square	34.386	0.061	7.817
df [b]	4	1	2
p	0.0000	0.8043	0.0201
# free parameters	5	9	4
CFI	0.915	1.000	0.982
TLI	0.872	1.000	0.964
RMSEA	0.154	0.000	0.095
SRMR	0.075	0.003	0.036

[a]: a model is not rejected if CFI/TLI >0.95, RMSEA<0.06, WRMR<1.0. Models with a robust χ^2 p value $\geq$ 0.05 would be preferred to models with a significant χ^2 p value.

[b]: Under WLSMV, the degrees of freedom are not computed as usual; see Mplus Technical Appendices (Muthén 1998-2004, p. 19-20) for the formula.

Table A8. 3 Standardized factor loadings of NEP items in the three alternative models run on 60% of the whole sample (N = 484).

Variable Groups	Variables	Factor Loadings			
		1-factor model NEPEarth incl.	2-factor model NEPEarth incl.		1-factor model NEPEarth excl.
NEP Indicators	NEPEarthLimit	0.529	1.621	0.000	-
	NEPModif	0.568	-0.015	0.592	0.588
	NEPCope	0.748	0.005	0.784	0.789
	NEPNatureLaw	0.459	-0.078	0.527	0.501
	NEPCata	0.709	0.144	0.580	0.615

Table A8. 4 Standardized factor loadings of NEP items in the three alternative models run on 40% of the whole sample (N = 321).

Variable Groups	Variables	Factor Loadings			
		1-factor model NEPEarth incl.	2-factor model NEPEarth incl.		1-factor model NEPEarth excl.
NEP Indicators	NEPEarthLimit	0.446	0.214	0.216	-
	NEPModif	0.680	0.102	0.593	0.706
	NEPCope	0.743	-0.019	0.855	0.775
	NEPNatureLaw	0.633	0.010	0.650	0.657
	NEPCata	0.718	1.783	0.000	0.635

b. Comparison between farmers with and without native forest

i. Farmers without forest

Table A8. 5 Overall goodness-of-fit of the confirmatory factor analysis models with five and four NEP items (excluding NEPEarthLimit) on the sample of farmers without forest fragment.

Model Statistics [a]	1-factor model NEPEarth incl.	1-factor model NEPEarth excl.
N	290	290
Chi-square	27.518	2.720
df [b]	5	2
p	0.000	0.2566
# free parameters	5	4
CFI	0.933	0.997
TLI	0.907	0.994
RMSEA	0.125	0.035
WRMR	0.881	0.319

[a]: a model is not rejected if CFI/TLI >0.95, RMSEA<0.06, WRMR<1.0. Models with a robust χ^2 p value $\geq$ 0.05 would be preferred to models with a significant χ^2 p value.

[b]: Under WLSMV, the degrees of freedom are not computed as usual; see Mplus Technical Appendices (Muthén 1998-2004, p. 19-20) for the formula.

Table A8. 6 Standardized factor loadings of NEP items in the one-factor, five- and four-item models on the sample of farmers without forest fragment (N = 290).

Variable Groups	Variables	Factor Loadings	
		1-factor model NEPEarth incl.	1-factor model NEPEarth excl.
NEP Indicators	NEPEarthLimit	0.476	-
	NEPModif	0.602	0.635
	NEPCope	0.791	0.782
	NEPNatureLaw	0.558	0.601
	NEPCata	0.720	0.665

Table A8. 7 Amount of variance (R-square) accounted for in the NEP items in the one-factor, five- and four-item models on the sample of farmers without forest fragment (N = 290).

Variable Groups	Variables	R-square	
		1-factor model NEPEarth incl.	1-factor model NEPEarth excl.
NEP Indicators	NEPEarthLimit	0.226	-
	NEPModif	0.363	0.404
	NEPCope	0.625	0.611
	NEPNatureLaw	0.312	0.361
	NEPCata	0.519	0.442

ii. Farmers with forest

Table A8. 8 Overall goodness-of-fit of confirmatory factor analysis models with five and four NEP items (excluding NEPEarthLimit) on the sample of farmers with forest fragment.

Model Statistics [a]	1-factor model NEPEarth incl.	1-factor model NEPEarth excl.
N	515	515
Chi-square	48.971	4.537
df [b]	5	2
p	0.000	0.1034
# free parameters	5	4
CFI	0.910	0.993
TLI	0.874	0.985
RMSEA	0.131	0.050
WRMR	1.234	0.445

[a]: a model is not rejected if CFI/TLI >0.95, RMSEA<0.06, WRMR<1.0. Models with a robust χ^2 p value $\geq$ 0.05 would be preferred to models with a significant χ^2 p value.

[b]: Under WLSMV, the degrees of freedom are not computed as usual; see Mplus Technical Appendices (Muthén 1998-2004, p. 19-20) for the formula.

Table A8. 9 Standardized factor loadings of NEP items in the one-factor, five- and four-item models on the sample of farmers with forest fragment (N = 515).

Variable Groups	Variables	Factor Loadings	
		1-factor model NEPEarth incl.	1-factor model NEPEarth excl.
NEP Indicators	NEPEarthLimit	0.504	-
	NEPModif	0.634	0.651
	NEPCope	0.716	0.779
	NEPNatureLaw	0.513	0.545
	NEPCata	0.706	0.593

Table A8. 10 Amount of variance (R-square) accounted for in the NEP items in the one-factor, five- and four-item models on the sample of farmers with forest fragment (N = 515).

Variable Groups	Variables	R-square	
		1-factor model NEPEarth incl.	1-factor model NEPEarth excl.
NEP Indicators	NEPEarthLimit	0.254	-
	NEPModif	0.402	0.423
	NEPCope	0.513	0.607
	NEPNatureLaw	0.264	0.297
	NEPCata	0.499	0.352

iii. Comparison between farmers with forest and farmers without forest

Table A8. 11 Overall goodness-of-fit of the MIMIC confirmatory factor analysis of the one-factor, four-item NEP model comparing farmers with and without forest (with null direct effects of the grouping variable *ForestPresence* on the NEP latent factor and NEP indicators).

Model Statistics [a]	1-factor model NEPEarth excl.
N	805
Chi-square	7.305
df [b]	4
p	0.1206
# free parameters	12
CFI	0.995
TLI	0.991
RMSEA	0.032
WRMR	0.723

[a]: a model is not rejected if CFI/TLI >0.95, RMSEA<0.06, WRMR<1.0. Models with a robust χ^2 p value $\geq$ 0.05 would be preferred to models with a significant χ^2 p value.

[b]: Under WLSMV, the degrees of freedom are not computed as usual; see Mplus Technical Appendices (Muthén 1998-2004, p. 19-20) for the formula.

Table A8. 12 Standardized factor loadings of NEP items in the one-factor, four-item MIMIC NEP model comparing farmers with and without forest (N total = 805).

Variable Groups	Variables	Factor loadings
NEP Indicators	NEPModif	0.644
	NEPCope	0.778
	NEPNatLaw	0.567
	NEPCata	0.619

Table A8. 13 Amount of variance (R-square) accounted for in the NEP items in the one-factor, four-item MIMIC NEP model comparing farmers with and without forest (N total = 805).

Variable Groups	Variables	R-square
NEP Indicators	NEPModif	0.415
	NEPCope	0.605
	NEPNatLaw	0.322
	NEPCata	0.384
Latent factor	NEP	0.000

c. Comparison between farmers with forest by chance and farmers with forest by choice

Table A8. 14 Overall goodness-of-fit of the MIMIC confirmatory factor analysis of the one-factor, four-item NEP model comparing farmers with forest by chance and farmers with forest by choice.

Model Statistics [a]	1-factor model NEPEarth excl.
N	507
Chi-square	11.323
df [b]	5
p	0.0453
# free parameters	13
CFI	0.982
TLI	0.975
RMSEA	0.050
WRMR	0.628

[a]: a model is not rejected if CFI/TLI >0.95, RMSEA<0.06, WRMR<1.0. Models with a robust χ^2 p value $\geq$ 0.05 would be preferred to models with a significant χ^2 p value.
[b]: Under WLSMV, the degrees of freedom are not computed as usual; see Mplus Technical Appendices (Muthén 1998-2004, p. 19-20) for the formula.

Table A8. 15 Standardized factor loadings of NEP items in the one-factor, four-item MIMIC NEP model comparing farmers with forest by chance and farmers with forest by choice (N total = 507).

Variable Groups	Variables	Factor loadings
NEP Indicators	NEPModif	0.650
	NEPCope	0.778
	NEPNatLaw	0.544
	NEPCata	0.604

Table A8. 16 Amount of variance (R-square) accounted for in the NEP items in the one-factor, four-item MIMIC NEP model comparing farmers with forest by chance and farmers with forest by choice (N total = 507)

Variable Groups	Variables	R-square
NEP Indicators	NEPModif	0.423
	NEPCope	0.605
	NEPNatLaw	0.296
	NEPCata	0.364
Latent factor	NEP	0.035

APPENDIX A9

III. Analysis

1. The tripartite attitude model on the whole sample of New Zealand farmers

a. Affective and cognitive response toward native forest tested over the whole sample: initial results

ii. Results

Table A9. 1 Polychoric correlation coefficients for WLSMV-ESEM analysis in Mplus, n = 806 with missing value, pairwise deletion.

Latent	Indicators	1	2	3	4	5	6	7	8
Hypothesized Affect	1. EnjoyForest	1.00							
	2. ChildEnjForest	0.60	1.00						
	3. LikeDistrictForest	0.12	0.09	1.00					
Hypothesized Cognition	4. ForestNatural	0.50	0.30	0.08	1.00				
	5. ForestUseful	0.34	0.20	0.12	0.39	1.00			
	6. ForestBenefit	0.22	0.16	0.10	0.31	0.62	1.00		
	7. ForestDecline	0.38	0.28	0.04	0.42	0.38	0.35	1.00	
	8. ForestHelpBird	0.44	0.28	0.07	0.55	0.45	0.32	0.43	1.00

The ESEM model was over-identified (positive degree of freedom); hence its overall goodness-of-fit could be estimated[14]. The covariance coverage over the whole sample was between 85.0% and 99.5%.[15]

[14] With 36 observations (number of observations = v (v + 1)/2, where v is the total number of observed variables in the model) for 27 free parameters to estimate, the number of degrees of freedom was positive.
[15] The covariance coverage over the whole sample represents the percentage of data available per pair of variables (Muthén 1998-2004, p. 26)

Table A9. 2 Overall goodness-of-fit of the ESEM one- and two-factor models on 60% of the whole sample.

Model Statistics[a]	1-factor model	2-factor model
N	484	484
Chi-square	134.800	28.094
df[b]	16	11
p	0.000	0.0031
# free parameters	27	34
CFI	0.859	0.980
TLI	0.876	0.974
RMSEA	0.124	0.057
WRMR	1.493	0.598

[a]: a model is not rejected if CFI/TLI >0.95, RMSEA<0.06, WRMR<1.0. Models with a robust χ^2 p value $\geq$ 0.05 would be preferred to models with a significant χ^2 p value.

[b]: Under WLSMV, the degrees of freedom are not computed as usual; see Mplus Technical Appendices (Muthén 1998-2004, p. 19-20) for the formula.

Table A9. 3 Overall goodness-of-fit of the ESEM one- and two-factor models on 40% of the whole sample.

Model Statistics[a]	1-factor model	2-factor model
N	322	322
Chi-square	127.962	35.119
df[b]	15	11
p	0.000	0.0002
# free parameters	27	34
CFI	0.798	0.957
TLI	0.798	0.941
RMSEA	0.153	0.083
WRMR	1.543	0.675

[a]: a model is not rejected if CFI/TLI >0.95, RMSEA<0.06, WRMR<1.0. Models with a robust χ^2 p value $\geq$ 0.05 would be preferred to models with a significant χ^2 p value.

[b]: Under WLSMV, the degrees of freedom are not computed as usual; see Mplus Technical Appendices (Muthén 1998-2004, p. 19-20) for the formula.

Table A9. 4 Standardized, unstandardized factor loadings and correlation coefficients of the hypothesized *affect* and *cognition* indicators in the ESEM two-factor model on 60% of the sample of farmers, N = 484. Loadings greater than |0.3| are in bold.

Variable Groups	Variables	Factor Loadings							
		Stand. Estimate[a]		P value		Unstand. Estimate		P value	
		1st factor	2nd factor	1st factor	2nd factor	1st factor	2nd factor	1st factor	2nd factor
Hypothesized Affect indicators	Enjoy Forest	**-0.809**	0.027	0.000	0.632	**-1.463**	0.049	0.000	0.621
	Child Enjoy Forest	**-0.664**	-0.045	0.000	0.684	**-0.851**	-0.058	0.000	0.687
	ForestLikeDistrict	0.112	0.252	0.360	0.027	0.146	0.329	0.361	0.029
Hypothesized Cognition indicators	Forest Natural	-0.313	**0.424**	0.008	0.000	-0.446	**0.604**	0.012	0.000
	Forest Useful	**0.834**	**1.450**	0.001	0.000	**1.575**	**2.737**	0.010	0.000
	Forest Benefit	**0.922**	**1.353**	0.000	0.000	**1.354**	**1.985**	0.003	0.000
	Forest Decline	0.086	**0.665**	0.188	0.000	0.07	**0.826**	0.186	0.000
	Forest Help Bird	-0.091	**0.579**	0.262	0.000	-0.121	**0.769**	0.264	0.000
Correlation 1st-2nd Factors		-0.860		0.000		-0.860		0.000	

[a]: Completely standardized estimates (standXY), that is, standardized on both the independent and dependent variables (Muthén and Muthén 1998-2007).

Table A9. 5 Standardized, unstandardized factor loadings and correlation coefficients of the hypothesized *affect* and *cognition* indicators in the ESEM two-factor model on 40% of the sample of farmers, N = 322. Loadings greater than |0.3| are in bold.

Variable Groups	Variables	Factor Loadings							
		Stand. Estimate[a]		P value		Unstand. Estimate		P value	
		1st factor	2nd factor	1st factor	2nd factor	1st factor	2nd factor	1st factor	2nd factor
Hypothesized Affect indicators	Enjoy Forest	**0.881**	0.022	0.000	0.606	**2.004**	0.050	0.015	0.562
	Child Enjoy Forest	**0.696**	-0.085	0.000	0.424	**0.896**	-0.110	0.000	0.437
	ForestLikeDistrict	0.111	0.015	0.358	0.899	0.145	0.019	0.359	0.899
Hypothesized Cognition indicators	Forest Natural	0.017	**0.649**	0.881	0.000	0.023	**0.867**	0.881	0.000
	Forest Useful	**-0.759**	**1.239**	0.000	0.000	**-1.239**	**2.022**	0.002	0.000
	Forest Benefit	**-0.747**	**1.186**	0.001	0.000	**-1.132**	**1.797**	0.010	0.000
	Forest Decline	0.042	**0.544**	0.640	0.000	0.051	**0.667**	0.640	0.000
	Forest Help Bird	-0.016	**0.714**	0.750	0.000	-0.022	**1.002**	0.750	0.000
Correlation 1st-2nd Factors		0.790		0.000		0.790		0.000	

[a]: Completely standardized estimates (standXY), that is, standardized on both the independent and dependent variables (Muthén and Muthén 1998-2007).

Table A9. 6 Amount of variance (R-square) accounted for in the hypothesized *affect* and *cognition* indicators in the two-factor ESEM model on 60% of the whole sample of farmers (N = 484).

Variable Groups	Variables	R-square	
		Stand. Estimate	P value
Hypothesized Affect indicators	EnjoyForest	0.694	0.000
	ChildEnjForest	0.391	0.000
	ForestLikeDistrict	0.028	0.103
Hypothesized Cognition indicators	ForestNatural	0.507	0.000
	ForestUsef	0.719	0.000
	ForestBenef	0.536	0.000
	ForestDecline	0.351	0.000
	ForestHelpBird	0.434	0.000

Table A9. 7 Amount of variance (R-square) accounted for in the hypothesized *affect* and *cognition* indicators in the two-factor ESEM model on 40% of the whole sample of farmers (N = 322).

Variable Groups	Variables	R-square	
		Stand. Estimate	P value
Hypothesized Affect indicators	EnjoyForest	0.807	0.000
	ChildEnjForest	0.398	0.000
	ForestLikeDistrict	0.015	0.363
Hypothesized Cognition indicators	ForestNatural	0.439	0.000
	ForestUsef	0.625	0.000
	ForestBenef	0.564	0.000
	ForestDecline	0.334	0.000
	ForestHelpBird	0.492	0.000

b. Affective and cognitive response toward native forest tested over the whole sample: Amendments

i. ForestUseful, ForestBenefit and potential method bias

Other techniques, which were not used in the present thesis, exist to take into account method bias, the most common of which probably being the MultiTrait-MultiMethod (MTMM) model (Campbell & Fiske (1959) in Podsakoff, MacKenzie et al. 2003, p. 894). However, such a technique requires that each trait is measured by different methods (Brown 2006, p. 214), which also necessitates that the method biases are identified beforehand (Podsakoff, MacKenzie et al. 2003, p. 894). Moreover, problems of solutions convergence and admissibility commonly affect the CT-CM models (Lance, Noble et al. 2002, p. 236; Podsakoff, MacKenzie et al. 2003, p. 894).

Finally, it is worth mentioning that models where trait and method factors are allowed to be related have also been suggested (e.g. direct product model). However, as Podsakoff and colleagues (2003, p. 892) note, to date, this model is not yet practical: "The conceptual nature of Trait X Method interactions has not been well articulated, thus making it difficult to predict when they are likely to occur. The effects of the trait and method components cannot be separated in the analysis. [The direct product model cannot] test for relationships between trait constructs while simultaneously controlling for method and Trait X Method effects. [It does] not test for interactions after first controlling for main effects".

2. The tripartite attitude model on New Zealand farmers without native forest fragments

a. Affective and cognitive response toward native forest of farmers without forest fragment

i. Analysis of the attitudinal variables

Table A9. 8 Polychoric correlation coefficients of affective, cognitive variables for WLSMV-ESEM analysis in Mplus of farmers without native forest, n = 291 with missing value, pairwise deletion.

Latent	Indicators	1	2	3	4	5	6	7	8
Hypothesized Affect	1. EnjoyForest	1.00							
	2. ChildEnjForest	0.63	1.00						
Hypothesized Cognition	3. ForestNatural	0.55	0.31	1.00					
	4. ForestUseful	0.31	0.16	0.38	1.00				
	5. ForestBenefit	0.10	-0.01	0.26	0.68	1.00			
	6. ForestValue	0.16	0.06	0.25	0.88	0.92	1.00		
	7. ForestDecline	0.49	0.38	0.52	0.47	0.32	0.34	1.00	
	8. ForestHelpBird	0.53	0.36	0.62	0.41	0.30	0.33	0.53	1.00

The attitudinal variables contained missing values: *ChildEnjoyForest* had the most missing values (16.8%), while the remaining variables had only between 5.1% and 0.3% missing values.

Table A9. 9 Overall goodness-of-fit of the ESEM of two-factor models strategy 1, 2 and 5 on farmers without forest

Model Statistics[a]	Only ForestBenefit (Strategy 1)	ForestValue (Strategy 2)	ForestUseful&Benefit corr. (Strategy 5)
N	291	291	291
Chi-square	6.092	8.100	10.402
df[b]	4	4	6
p	0.1924	0.0880	0.1087
# free parameters	25	27	31
CFI	0.995	0.991	0.993
TLI	0.991	0.982	0.988
RMSEA	0.042	0.059	0.050
WRMR	0.300	0.335	0.351

[a]: a model is not rejected if CFI/TLI >0.95, RMSEA<0.06, WRMR<1.0. Models with a robust χ^2 p value $\geq$ 0.05 would be preferred to models with a significant χ^2 p value.

[b]: Under WLSMV, the degrees of freedom are not computed as usual; see Mplus Technical Appendices (Muthén 1998-2004, p. 19-20) for the formula.

Table A9. 10 Standardized, unstandardized factor loadings and correlation coefficients of the hypothesized *affect* and *cognition* indicators in the ESEM two-factor strategy 1 model on the sample of farmers without forest, N = 291. Loadings greater than |0.3| are in bold.

Variable Groups	Variables	Only ForestBenefit (Strategy 1) - Factor Loadings							
		Stand. Estimate[a]		P value		Unstand. Estimate		P value	
		1st factor	2nd factor	1st factor	2nd factor	1st factor	2nd factor	1st factor	2nd factor
Hypothesized Affect indicators	Enjoy Forest	**0.683**	0.270	0.000	0.156	**1.413**	0.559	0.062	0.071
	Child Enjoy Forest	**0.747**	0.000	0.000	0.948	**1.125**	0.001	0.001	0.948
Hypothesized Cognition indicators	Forest Natural	0.023	**0.748**	0.849	0.000	0.035	**1.156**	0.849	0.000
	Forest Benefit	**-0.421**	**0.661**	0.012	0.000	**-0.493**	**0.774**	0.027	0.001
	Forest Decline	0.031	**0.679**	0.780	0.000	0.043	**0.949**	0.779	0.000
	Forest Help Bird	-0.005	**0.785**	0.659	0.000	-0.008	**1.260**	0.662	0.000
Correlation 1st-2nd Factors		0.616		0.000		0.616		0.000	

[a]: completely standardized estimates (standXY), that is, standardized on both the independent and dependent variables (Muthén and Muthén 1998-2007).

Table A9. 11Standardized, unstandardized factor loadings and correlation coefficients of the hypothesized *affect* and *cognition* indicators in the ESEM two-factor strategy 2 model on the sample of farmers without forest, N = 291. Loadings greater than |0.3| are in bold.

Variable Groups	Variables	Only ForestValue (Strategy 2) - Factor Loadings							
		Stand. Estimate[a]		P value		Unstand. Estimate		P value	
		1st factor	2nd factor	1st factor	2nd factor	1st factor	2nd factor	1st factor	2nd factor
Hypothesized Affect indicators	Enjoy Forest	**0.757**	0.200	0.006	0.459	**1.721**	0.456	0.206	0.326
	Child Enjoy Forest	**0.720**	-0.004	0.000	0.734	**1.033**	-0.006	0.001	0.723
Hypothesized Cognition indicators	Forest Natural	0.065	**0.706**	0.607	0.000	0.098	**1.065**	0.603	0.000
	Forest Value	**-0.310**	**0.624**	0.039	0.000	**-0.356**	**0.716**	0.054	0.000
	Forest Decline	0.040	**0.678**	0.729	0.000	0.056	**0.953**	0.728	0.000
	Forest Help Bird	-0.006	**0.795**	0.488	0.000	-0.009	**1.301**	0.484	0.000
Correlation 1st-2nd Factors		0.635		0.000		0.635		0.000	

[a]: completely standardized estimates (standXY), that is, standardized on both the independent and dependent variables (Muthén and Muthén 1998-2007).

Table A9. 12 Standardized, unstandardized factor loadings and correlation coefficients of the hypothesized *affect* and *cognition* indicators in the ESEM two-factor strategy 5 model on the sample of farmers without forest, N = 291. Loadings greater than |0.3| are in bold.

Variable Groups	Variables	ForestUseful & ForestBenefit's residuals correlated (Strategy 5) - Factor Loadings							
		Stand. Estimate[a]		P value		Unstand. Estimate		P value	
		1st factor	2nd factor	1st factor	2nd factor	1st factor	2nd factor	1st factor	2nd factor
Hypothesized Affect indicators	Enjoy Forest	**0.717**	0.241	0.000	0.226	**1.529**	0.514	0.075	0.124
	Child Enjoy Forest	**0.730**	0.002	0.000	0.801	**1.071**	0.003	0.000	0.804
Hypothesized Cognition indicators	Forest Natural	0.092	**0.686**	0.460	0.000	0.138	**1.029**	0.459	0.000
	Forest Useful	-0.209	**0.707**	0.143	0.000	-0.263	**0.887**	0.168	0.000
	Forest Benefit	**-0.413**	**0.665**	0.009	0.000	**-0.487**	**0.784**	0.023	0.001
	Forest Decline	0.008	**0.728**	0.748	0.000	0.011	**1.070**	0.747	0.000
	Forest Help Bird	0.063	**0.726**	0.616	0.000	0.097	**1.129**	0.613	0.000
Correlation 1st-2nd Factors		0.602		0.000		0.602		0.000	
Corr. ForestUseful & ForestBenefit's res.[b]		0.571		0.000		0.571		0.000	

[a]: completely standardized estimates (standXY), that is, standardized on both the independent and dependent variables (Muthén and Muthén 1998-2007).
[b]: 'Corr. ForestUseful & ForestBenefit's res.' stands for correlation of the *ForestUseful* & *ForestBenefit*'s residual variances.

Table A9. 13 Amount of variance (R-square) accounted for in the hypothesized *affect* and *cognition* indicators in the two-factor ESEM models, strategy 1, 2, and 5 on farmers without forest (N = 291).

Variable Groups	Variables	Only ForestBenefit (Strategy 1)		Only ForestValue (Strategy 2)		ForestUseful & Benefit's resid. corr. (Strategy 5)	
		Stand. Estimate	P value	Stand. Estimate	P value	Stand. Estimate	P value
Hypothesized Affect indicators	EnjoyForest	0.767	0.000	0.806	0.000	0.780	0.000
	ChildEnjForest	0.559	0.000	0.514	0.001	0.535	0.000
Hypothesized Cognition indicators	ForestNatural	0.581	0.000	0.561	0.000	0.555	0.000
	ForestUsef	Na	Na	Na	Na	0.365	0.000
	ForestBenef	0.271	0.006	Na	Na	0.282	0.006
	ForestValue	Na	Na	0.240	0.002	Na	Na
	ForestDecline	0.488	0.000	0.495	0.000	0.537	0.000
	ForestHelpBird	0.612	0.000	0.627	0.000	0.586	0.000

b. Affective, cognitive and conative responses toward native forest of farmers without forest fragment

Conservation had 1.7% missing values and *TreePlanting* had 8.6%. The covariance coverage of the model ranged between 99.3% and 42.1%. Table 9.14 presents the polychoric correlations between the *affect*, *cognition* and *conation* indicators.

Table A9. 14 Polychoric correlation coefficients of affective, cognitive and conative variables for WLSMV-ESEM analysis in Mplus of respondents without forest, n = 291 with missing value, pairwise deletion.

Latent	Indicators	1	2	3	4	5	6	7	8	9
Hypothesized Affect	1. EnjoyForest	1.00								
	2. ChildEnjForest	0.63	1.00							
Hypothesized Cognition	3. ForestNatural	0.55	0.31	1.00						
	4. ForestBenefit	0.10	-0.01	0.26	1.00					
	5. ForestDecline	0.49	0.38	0.52	0.32	1.00				
	6. ForestHelpBird	0.53	0.36	0.62	0.30	0.53	1.00			
Hypothesized Conation	7. Conservation	0.45	0.27	0.36	0.15	0.39	0.37	1.00		
	8. More Forest	0.34	0.23	0.41	-0.03	0.30	0.25	0.49	1.00	
	9. Tree Planting	0.27	0.24	0.14	0.24	0.24	0.17	0.12	0.13	1.00

i. Analysis of the affective, cognitive and conative response of farmers without forest: three conation outcomes

Table A9. 15 Overall goodness-of-fit of the ESEM of one-, two- and three-factor models (only *ForestBenefit*) on farmers without forest, N = 291

Model Statistics[a]	One-factor model	Two-factor model	Three-factor model (Strategy 1)
N	291	291	291
Chi-square	59.565	59.565	23.428
df[b]	21	21	16
p	0.0000	0.0000	0.1028
# free parameters	29	29	36
CFI	0.933	0.933	0.987
TLI	0.942	0.942	0.985
RMSEA	0.079	0.079	0.040
WRMR	0.944	0.944	0.567

[a]: a model is not rejected if CFI/TLI >0.95, RMSEA<0.06, WRMR<1.0. Models with a robust χ^2 p value $\geq$ 0.05 would be preferred to models with a significant χ^2 p value.

[b]: Under WLSMV, the degrees of freedom are not computed as usual; see Mplus Technical Appendices (Muthén 1998-2004, p. 19-20) for the formula.

Table A9. 16 Standardized, unstandardized factor loadings, correlation and regression coefficients of the ESEM three-factor model with only *ForestBenefit* (Strategy 1) on farmers without forest, N = 291. The *affect* and *cognition* factors represent the exploratory factors on which the *affect* and *cognition* hypothesized indicators are free to load. On the other hand, because the *conation* factor is regressed on *affect* and *cognition*, its indicators were constrained to load on a separate factor. Loadings greater than |0.3| are in bold.

Variable Groups	Variables	Three-factor model (Strategy 1) - Factor Loadings											
		Stand. Estimate[a]			P value			Unstand. Estimate			P value		
		Affect	Cognition	Conation	Affect	Cognition	Conation	Affect	Cognition	Conation	Affect	Cognition	Conation
Hypothesized Affect indicators	Enjoy Forest	**0.769**	0.203	0.000	0.000	0.338	Na	**1.882**	0.498	0.000	0.120	0.223	Na
	Child Enjoy Forest	**0.709**	-0.002	0.000	0.000	0.842	Na	**1.002**	-0.003	0.000	0.000	0.840	Na
Hypothesized Cognition indicators	Forest Natural	0.027	**0.741**	0.000	0.830	0.000	Na	0.041	**1.139**	0.000	0.829	0.000	Na
	Forest Benefit	**-0.429**	**0.682**	0.000	0.012	0.000	Na	**-0.503**	**0.801**	0.000	0.026	0.000	Na
	Forest Decline	0.026	**0.696**	0.000	0.819	0.000	Na	0.037	**0.994**	0.000	0.819	0.000	Na
	Forest Help Bird	-0.004	**0.770**	0.000	0.666	0.000	Na	-0.006	**1.199**	0.000	0.669	0.000	Na
Hypothesized Conation indicators	Conservation	0.000	0.000	**0.650**	Na	Na	0.000	0.000	0.000	**0.515**	Na	Na	0.013
	More Forest	0.000	0.000	**0.572**	Na	Na	0.000	0.000	0.000	**0.420**	Na	Na	0.004
	Tree Planting	0.000	0.000	**0.337**	Na	Na	0.000	0.000	0.000	**0.216**	Na	Na	0.009
Correlation Affect-Cognition		0.642			0.000			0.642			0.000		
Reg. Conation on Affect		0.289			0.007			0.479			0.107		
Reg. Conation on Cognition		0.582			0.000			0.966			0.017		

[a]: completely standardized estimates (standXY), that is, standardized on both the independent and dependent variables (Muthén and Muthén 1998-2007).

Table A9. 17 Amount of variance (R-square) accounted for in the hypothesized *affect*, *cognition* and *conation* indicators in the three-factor ESEM model with only *ForestBenefit* (strategy 1) on farmers without forest (N = 291).

Variable Groups	Variables	R-square	
		Stand. Estimate	P value
Hypothesized Affect indicators	EnjoyForest	0.833	0.000
	ChildEnjForest	0.500	0.000
Hypothesized Cognition indicators	ForestNatural	0.576	0.000
	ForestBenef	0.274	0.004
	ForestDecline	0.509	0.000
	ForestHelpBird	0.588	0.000
Hypothesized Conation indicators	Conservation	0.422	0.000
	More Forest	0.327	0.000
	Tree Planting	0.114	0.046
Latent factor	Conation	0.637	0.000

ii. Analysis of the affective, cognitive and conative response of farmers without forest: two conation outcomes

Alternative 2: no Conation factor, two independent intention observed variables

Table A9. 18 Overall goodness-of-fit of the ESEM of the affect-cognition-2-conation-variables model (only *ForestBenefit*) on farmers without forest, N = 291

Model Statistics[a]	Affect-Cognition-2 intention variables (strategy 1)
N	291
Chi-square	16.291
df[b]	11
p	0.1307
# free parameters	34
CFI	0.990
TLI	0.988
RMSEA	0.041
WRMR	0.470

[a]: a model is not rejected if CFI/TLI >0.95, RMSEA<0.06, WRMR<1.0. Models with a robust χ^2 p value $\geq$ 0.05 would be preferred to models with a significant χ^2 p value.

[b]: Under WLSMV, the degrees of freedom are not computed as usual; see Mplus Technical Appendices (Muthén 1998-2004, p. 19-20) for the formula.

Table A9. 19 Standardized, unstandardized factor loadings, correlation and regression coefficients of the ESEM affect-cognition-2-conation-variables model (only *ForestBenefit*) on farmers without forest, N = 291. Note that because there was no conation latent factor in the model, there were no loadings of intention variables. Loadings greater than |0.3| are in bold.

Variable Groups	Variables	Factor Loadings							
		Stand. Estimate[a]		P value		Unstand. Estimate		P value	
		Affect	Cognition	Affect	Cognition	Affect	Cognition	Affect	Cognition
Hypothesized Affect indicators	Enjoy Forest	**0.780**	0.190	0.000	0.378	**1.953**	0.476	0.123	0.270
	Child Enjoy Forest	**0.702**	-0.001	0.000	0.959	**0.984**	-0.001	0.000	0.959
Hypothesized Cognition indicators	Forest Natural	0.035	**0.724**	0.773	0.000	0.053	**1.089**	0.772	0.000
	Forest Benefit	**-0.477**	**0.736**	0.008	0.000	**-0.573**	**0.883**	0.021	0.000
	Forest Decline	0.016	**0.703**	0.883	0.000	0.023	**1.003**	0.883	0.000
	Forest Help Bird	-0.001	**0.769**	0.949	0.000	-0.001	**1.201**	0.949	0.000
Correlation Affect-Cognition		0.660		0.000		0.660		0.000	
Reg. Conservation on Affect		0.181		0.109		0.211		0.111	
Reg. Conservation on Cognition		0.375		0.001		0.437		0.001	
Reg. TreePlanting on Affect		0.036		0.791		0.038		0.792	
Reg. TreePlanting on Cognition		0.278		0.017		0.292		0.021	

[a]: completely standardized estimates (standXY), that is, standardized on both the independent and dependent variables (Muthén and Muthén 1998-2007).

Table A9. 20 Amount of variance (R-square) accounted for in the ESEM affect-cognition-2-conation-variables model (only *ForestBenefit*) on farmers without forest, N = 291.

Variable Groups	Variables	R-square	
		Stand. Estimate	P value
Hypothesized Affect indicators	EnjoyForest	0.840	0.000
	ChildEnjForest	0.492	0.000
Hypothesized Cognition indicators	ForestNatural	0.558	0.000
	ForestBenef	0.306	0.003
	ForestDecline	0.509	0.000
	ForestHelpBird	0.590	0.000
Hypothesized Conation indicators	Conservation	0.264	0.000
	Tree Planting	0.092	0.031

3. The tripartite attitude model on New Zealand farmers with native forest fragments

a. Affective and cognitive responses toward native forest of farmers with forest fragments

i. Analysis of the attitudinal variables

The covariance coverage of the hypothesized *affect* and *cognition* indicators was between 88.9% and 100%.

Table A9. 21 Polychoric correlation coefficients of affective, cognitive variables for WLSMV-ESEM analysis in Mplus of farmers with native forest, n = 515 with missing value, pairwise deletion.

Latent	Indicators	1	2	3	4	5	6	7	8
Hypothesized Affect	1. EnjoyForest	1.00							
	2. ChildEnjForest	0.57	1.00						
Hypothesized Cognition	3. ForestNatural	0.46	0.29	1.00					
	4. ForestUseful	0.35	0.21	0.38	1.00				
	5. ForestBenefit	0.29	0.24	0.34	0.59	1.00			
	6. ForestValue	0.31	0.24	0.39	0.91	0.89	1.00		
	7. ForestDecline	0.31	0.24	0.36	0.34	0.36	0.37	1.00	
	8. ForestHelpBird	0.36	0.23	0.49	0.46	0.32	0.42	0.38	1.00

Table A9. 22 Overall goodness-of-fit of the ESEM two-factor model (only ForestUseful) on farmers with forest, n = 515.

Model Statistics[a]	Only ForestUseful (Strategy 1)
N	515
Chi-square	1.148
df[b]	4
p	0.8865
# free parameters	25
CFI	1.000
TLI	1.012
RMSEA	0.000
WRMR	0.149

[a]: a model is not rejected if CFI/TLI >0.95, RMSEA<0.06, WRMR<1.0. Models with a robust χ^2 p value $\geq$ 0.05 would be preferred to models with a significant χ^2 p value.

[b]: Under WLSMV, the degrees of freedom are not computed as usual; see Mplus Technical Appendices (Muthén 1998-2004, p. 19-20) for the formula.

Table A9. 23 Standardized, unstandardized factor loadings and correlation coefficients of the hypothesized *affect* and *cognition* indicators in the ESEM two-factor model (only ForestUseful) on farmers with forest, n = 515 Loadings greater than |0.3| are in bold.

Variable Groups	Variables	Only ForestUseful (Strategy 1) - Factor Loadings							
		Stand. Estimate[a]		P value		Unstand. Estimate		P value	
		1st factor	2nd factor	1st factor	2nd factor	1st factor	2nd factor	1st factor	2nd factor
Hypothesized Affect indicators	Enjoy Forest	**0.932**	0.002	0.000	0.982	**2.585**	0.005	0.522	0.981
	Child Enjoy Forest	**0.613**	-0.002	0.007	0.992	**0.774**	-0.002	0.041	0.992
Hypothesized Cognition indicators	Forest Natural	0.158	**0.560**	0.155	0.000	0.211	**0.749**	0.153	0.000
	Forest Useful	0.005	**0.607**	0.657	0.000	0.007	**0.767**	0.655	0.000
	Forest Decline	0.057	**0.500**	0.573	0.000	0.068	**0.593**	0.571	0.000
	Forest Help Bird	-0.084	**0.791**	0.494	0.000	-0.125	**1.187**	0.504	0.000
Correlation 1st-2nd Factors		0.587		0.000		0587		0.000	

[a]: completely standardized estimates (standXY), that is, standardized on both the independent and dependent variables (Muthén and Muthén 1998-2007).

Table A9. 24 Amount of variance (R-square) accounted for in the hypothesized *affect* and *cognition* indicators in the two-factor ESEM model with only *ForestUseful* (strategy 1) on farmers with forest (N = 515).

Variable Groups	Variables	R-square	
		Stand. Estimate	P value
Hypothesized Affect indicators	EnjoyForest	0.870	0.011
	ChildEnjForest	0.374	0.014
Hypothesized Cognition indicators	ForestNatural	0.442	0.000
	ForestUsef	0.373	0.000
	ForestDecline	0.287	0.000
	ForestHelpBird	0.556	0.000

b. Affective, cognitive and conative responses toward native forest of farmers with forest fragments

ii. Analysis of the conation variables

Table A9. 25 Polychoric correlation coefficients of conative variables for WLSMV-ESEM analysis in Mplus of respondents with forest, n = 515 with missing value, pairwise deletion.

Latent	Indicators	1	2	3	4	5	6
Hypothesized Conation	1. Conservation	1.00					
	2. Fence	0.14	1.00				
	3. Control	0.06	-0.16	1.00			
	4. More Forest	0.27	0.26	-0.24	1.00		
	5. Protection	0.14	0.14	0.03	-0.04	1.00	
	6. Tree Planting	0.16	0.03	0.01	0.36	0.08	1.00

Conservation had less than 1% missing values, and TreePlanting had 2.3%. The items regarding respondents' intentions towards their native fragments had between 13.8 and 14.6% missing values.

The covariance coverage of *Conservation*, *MoreForest*, and *TreePlanting* ranged between 84.2% and 97.1%.

iii. Analysis of the affective, cognitive and conative response of the whole sample of farmers with fragments

The covariance coverage varied between 99.6% and 84.2% in the hypothesized tripartite model.

Table A9. 26 Polychoric correlation coefficients of affective, cognitive and conative variables for WLSMV-ESEM analysis in Mplus, respondents with forest, n = 515 with missing value, pairwise deletion

Latent	Indicators	1	2	3	4	5	6	7	8	9
Hypothesized Affect	1. EnjoyForest	1.00								
	2. ChildEnjoyForest	0.57	1.00							
Hypothesized Cognition	3. ForestNatural	0.46	0.29	1.00						
	4. ForestUseful	0.35	0.21	0.38	1.00					
	5. ForestDecline	0.31	0.24	0.36	0.34	1.00				
	6. ForestHelpBird	0.36	0.23	0.49	0.46	0.38	1.00			
Hypothesized Conation	7. Conservation	0.42	0.27	0.30	0.28	0.28	0.31	1.00		
	8. More Forest	0.22	0.25	0.21	0.24	0.28	0.24	0.27	1.00	
	9. Tree Planting	0.23	0.13	0.21	0.14	0.23	0.21	0.16	0.36	1.00

Table A9. 27 Overall goodness-of-fit of the three-factor ESEM model (only *ForestUseful*) on farmers with forest, N = 515

Model Statistics[a]	Only ForestUseful (Strategy 1)
N	515
Chi-square	23.165
df[b]	18
p	0.1843
# free parameters	36
CFI	0.993
TLI	0.992
RMSEA	0.024
WRMR	0.548

[a]: a model is not rejected if CFI/TLI >0.95, RMSEA<0.06, WRMR<1.0. Models with a robust χ^2 p value $\geq$ 0.05 would be preferred to models with a significant χ^2 p value.

[b]: Under WLSMV, the degrees of freedom are not computed as usual; see Mplus Technical Appendices (Muthén 1998-2004, p. 19-20) for the formula.

Table A9. 28 Standardized, unstandardized factor loadings, correlation and regression coefficients of the three-factor ESEM model (only *ForestUseful*) on farmers with forest, N = 515. Loadings greater than |0.3| are in bold.

Variable Groups	Variables	Only ForestUseful (Strategy 1) Factor Loadings											
		Stand. Estimate[a]			P value			Unstand. Estimate			P value		
		Affect	Cognition	Conation	Affect	Cognition	Conation	Affect	Cognition	Conation	Affect	Cognition	Conation
Hypothesized Affect indicators	Enjoy Forest	**0.884**	0.010	0.000	0.000	0.607	Na	**1.946**	0.023	0.000	0. 088	0.515	Na
	Child Enjoy Forest	**0.672**	-0.053	0.000	0.000	0.755	Na	**0.877**	-0.069	0.000	0.005	0.761	Na
Hypothesized Cognition indicators	Forest Natural	0.165	**0.542**	0.000	0.132	0.000	Na	0.218	**0.718**	0.000	0.130	0.000	Na
	Forest Useful	0.006	**0.604**	0.000	0.669	0.000	Na	0.008	**0.760**	0.000	0.668	0.000	Na
	Forest Decline	0.071	**0.516**	0.000	0.511	0.000	Na	0.085	**0.624**	0.000	0.509	0.000	Na
	Forest Help Bird	-0.078	**0.778**	0.000	0.534	0.000	Na	-0.114	**1.145**	0.000	0.541	0.000	Na
Hypothesized Conation indicators	Conservation	0.000	0.000	**0.596**	Na	Na	0.000	0.000	0.000	**0.424**	Na	Na	0.001
	More Forest	0.000	0.000	**0.505**	Na	Na	0.000	0.000	0.000	**0.335**	Na	Na	0.000
	Tree Planting	0.000	0.000	**0.382**	Na	Na	0.000	0.000	0.000	**0.236**	Na	Na	0.000
Correlation Affect-Cognition		0.605			0			0.605			0		
Reg. Conation on Affect		0.397			0.005			0.694			0.023		
Reg. Conation on Cognition		0.517			0			0.904			0.004		

[a]: completely standardized estimates (standXY), that is, standardized on both the independent and dependent variables (Muthén and Muthén 1998-2007).

Table A9. 29 Amount of variance (R-square) accounted for in the three-factor ESEM model (only *ForestUseful*) on farmers with forest, N = 515.

Variable Groups	Variables	R-square	
		Stand. Estimate	P value
Hypothesized Affect indicators	EnjoyForest	0.793	0.000
	ChildEnjForest	0.412	0.000
Hypothesized Cognition indicators	ForestNatural	0.429	0.000
	ForestUsef	0.369	0.000
	ForestDecline	0.315	0.000
	ForestHelpBird	0.538	0.000
Hypothesized Conation indicators	Conservation	0.355	0.000
	MoreForest	0.255	0.000
	Tree Planting	0.146	0.001
Latent factor	Conation	0.673	0.000

c. Comparison of attitude of farmers with forest by choice and with forest by chance.

i. Results

Table A9. 30 Overall goodness-of-fit of the MIMIC three-factor ESEM model (only *ForestUseful*) between farmers with forest by choice and farmers with forest by chance.

Model Statistics[a]	Only ForestUseful (Strategy 1)
N	507
Chi-square	26.193
df[b]	23
p	0.2918
# free parameters	38
CFI	0.996
TLI	0.995
RMSEA	0.017
WRMR	0.589

[a]: a model is not rejected if CFI/TLI >0.95, RMSEA<0.06, WRMR<1.0. Models with a robust χ^2 p value $\geq$ 0.05 would be preferred to models with a significant χ^2 p value.

[b]: Under WLSMV, the degrees of freedom are not computed as usual; see Mplus Technical Appendices (Muthén 1998-2004, p. 19-20) for the formula.

Table A9. 31 Standardized, unstandardized factor loadings, correlation and regression coefficients of the MIMIC three-factor ESEM model (only *ForestUseful*) between farmers with forest by choice and farmers with forest by chance, N = 507. Loadings greater than |0.3| are in bold.

Variable Groups	Variables	Only ForestUseful (Strategy 1) Factor Loadings								
		Stand. Estimate[a]			Unstand. Estimate			P value[b]		
		Affect	Cognition	Conation	Affect	Cognition	Conation	Affect	Cognition	Conation
Hypothesized Affect indicators	Enjoy Forest	**0.872**	0.002	0.000	**1.714**	0.004	0.000	0. 022	0.556	Na
	Child Enjoy Forest	**0.721**	-0.104	0.000	**0.928**	-0.133	0.000	0.002	0.557	Na
Hypothesized Cognition indicators	Forest Natural	0.215	**0.510**	0.000	0.274	**0.642**	0.000	0.025	0.000	Na
	Forest Useful	0.066	**0.570**	0.000	0.080	**0.682**	0.000	0.517	0.000	Na
	Forest Decline	0.116	**0.480**	0.000	0.133	**0.547**	0.000	0.249	0.000	Na
	Forest Help Bird	-0.009	**0.751**	0.000	-0.014	**1.069**	0.000	0.572	0.000	Na
Hypothesized Conation indicators	Conservation	0.000	0.000	**0.601**	0.000	0.000	**0.437**	Na	Na	0.001
	More Forest	0.000	0.000	**0.496**	0.000	0.000	**0.331**	Na	Na	0.000
	Tree Planting	0.000	0.000	**0.392**	0.000	0.000	**0.247**	Na	Na	0.000
Correlation Affect-Cognition		0.521			0.521			0.000		
Reg. Conation on Affect		0.461			0.761			0.009		
Reg. Conation on Cognition		0.460			0.751			0.005		
Reg. Affect on ForestInfluence		0.287			0.848			0.000		
Reg. Cognition on ForestInfluence		0.315			0.938			0.000		
Indirect effect of ForestInfluence on Conation		0.277			1.349			0.000		

[a]: completely standardized estimates (standXY), that is, standardized on both the independent and dependent variables (Muthén and Muthén 1998-2007).
[b]: Mplus does not provide p value for the standardized value when the model includes covariates predicting the latent factors.

Table A9. 32 Amount of variance (R-square) accounted for in the MIMIC three-factor ESEM model (only *ForestUseful*) between farmers with forest by choice and farmers with forest by chance, N = 507.

Variable Groups	Variables	R-square Stand. Estimate[a]
Hypothesized Affect indicators	EnjoyForest	0.762
	ChildEnjForest	0.446
Hypothesized Cognition indicators	ForestNatural	0.431
	ForestUsef	0.372
	ForestDecline	0.306
	ForestHelpBird	0.556
Hypothesized Conation indicators	Conservation	0.361
	MoreForest	0.246
	Tree Planting	0.153
Latent factor	Affect	0.082
	Cognition	0.099
	Conation	0.663

[a]: Mplus does not provide p value for the standardized value when the model includes covariates predicting the latent factors.

APPENDIX A10

III. NEP and tripartite attitudinal responses of farmers

2. Results: NEP and tripartite attitude responses of farmers without forest

Table A10. 1 Overall goodness-of-fit of the NEP-Tripartite model on farmers without forest.

Model Statistics[a]	NEP-Tripartite model
N	291
Chi-square	62.103
df[b]	33
p	0.0016
# free parameters	45
CFI	0.960
TLI	0.969
RMSEA	0.055
WRMR	0.773

[a]: a model is not rejected if CFI/TLI >0.95, RMSEA<0.06, WRMR<1.0. Models with a robust χ^2 p value $\geq$ 0.05 would be preferred to models with a significant χ^2 p value.

[b]: Under WLSMV, the degrees of freedom are not computed as usual; see Mplus Technical Appendices (Muthén 1998-2004, p. 19-20) for the formula.

Table A10. 2 Indirect effects of NEP on the *conation* variables in the NEP-Tripartite model on farmers without forest (N = 291).

Indirect Effects	Indirect Effects			
	Stand. estimate	p value	Unstand. estimate	p value
NEP -> Affect -> Conservation	0.089	0.120	0.144	0.125
NEP -> Cognition -> Conservation	0.158	0.037	0.255	0.038
Total: NEP -> Conservation	**0.247**	**0.000**	**0.399**	**0.000**
NEP -> Cognition -> TreePlanting	0.174	0.000	0.280	0.000
Total: NEP -> TreePlanting	**0.174**	**0.000**	**0.280**	**0.000**

Table A10. 3 Amount of variance (R-square) accounted for in the *affect*, *cognition*, *conation* and NEP indicators and in *affect* and *cognition* latent factors in the NEP-Tripartite model on farmers without forest (N = 291).

Variable Groups	Variables	R-square	
		Stand. Estimate	P value
Affect indicators	EnjoyForest	0.87	0.000
	ChildEnjForest	0.46	0.000
Cognition indicators	ForestNatural	0.52	0.000
	ForestBenef	0.27	0.000
	ForestDecline	0.60	0.000
	ForestHelpBird	0.55	0.000
Conation indicators	Conservation	0.27	0.000
	TreePlanting	0.09	0.037
NEP indicators	NEPModification	0.38	0.000
	NEPCope	0.51	0.000
	NEPNaturalLaw	0.35	0.000
	NEPCatastrophe	0.57	0.000
Latent factors	Affect	0.21	0.003
	Cognition	0.35	0.000

3. Results: NEP and tripartite attitude responses of farmers with forest

Table A10. 4 Overall goodness-of-fit of the NEP-Tripartite model on farmers with forest.

Model Statistics[a]	NEP-Tripartite model
N	515
Chi-square	112.260
df[b]	46
p	0.0000
# free parameters	46
CFI	0.938
TLI	0.951
RMSEA	0.053
WRMR	0.978

[a]: a model is not rejected if CFI/TLI >0.95, RMSEA<0.06, WRMR<1.0. Models with a robust χ^2 p value $\geq$ 0.05 would be preferred to models with a significant χ^2 p value.

[b]: Under WLSMV, the degrees of freedom are not computed as usual; see Mplus Technical Appendices (Muthén 1998-2004, p. 19-20) for the formula.

Table A10. 5 Indirect effects of NEP on the *conation* variables in the NEP-Tripartite model on farmers with forest (N = 515).

Indirect Effects	Indirect Effects			
	Stand. estimate	p value	Unstand. estimate	p value
NEP -> Affect -> Conation	0.098	0.022	0.088	0.025
NEP -> Cognition -> Conation	0.385	0.000	0.346	0.000
Total: NEP -> Conation	**0.483**	**0.000**	**0.434**	**0.000**

Table A10. 6 Amount of variance explained in indicators and latent variables by the NEP-Tripartite model. Amount of variance (R-square) accounted for in the *affect*, *cognition*, *conation* and NEP indicators and in *affect*, *cognition* and *conation* latent factors in the NEP-Tripartite model on farmers with forest (N = 515).

Variable Groups	Variables	R-square	
		Stand. Estimate	P value
Affect indicators	EnjoyForest	0.93	0.000
	ChildEnjForest	0.35	0.000
Cognition indicators	ForestNatural	0.40	0.000
	ForestUseful	0.32	0.000
	ForestDecline	0.41	0.000
	ForestHelpBird	0.44	0.000
Conation indicators	Conservation	0.33	0.000
	MoreForest	0.24	0.000
	TreePlanting	0.17	0.000
NEP indicators	NEPModification	0.41	0.000
	NEPCope	0.46	0.000
	NEPNaturalLaw	0.35	0.000
	NEPCatastrophe	0.45	0.000
Latent factors	Affect	0.12	0.005
	Cognition	0.34	0.000
	Conation	0.73	0.000

4. Results: NEP and tripartite attitude responses of farmers who wanted native forest and the rest of farmers with forest

Table A10. 7 Overall goodness-of-fit of the MIMIC NEP-Tripartite model on farmers with forest by choice and farmers with forest by chance.

Model Statistics[a]	NEP-Tripartite model
N	507
Chi-square	116.050
df[b]	52
p	0.0000
# free parameters	46
CFI	0.940
TLI	0.947
RMSEA	0.049
WRMR	0.980

[a]: a model is not rejected if CFI/TLI >0.95, RMSEA<0.06, WRMR<1.0. Models with a robust χ^2 p value $\geq$ 0.05 would be preferred to models with a significant χ^2 p value.

[b]: Under WLSMV, the degrees of freedom are not computed as usual; see Mplus Technical Appendices (Muthén 1998-2004, p. 19-20) for the formula.

Table A10. 8 Indirect effects of NEP and *ForestInfluence* on the *conation* variables in the MIMIC NEP-Tripartite model on farmers with forest by choice and farmers with forest by chance (N = 507).

Relationships	Indirect Effects		
	Stand. estimate	Unstand. estimate	p value[b]
NEP -> Affect -> Conation	0.086	0.077	0.026
NEP -> Cognition -> Conation	0.352	0.316	0.000
Total: NEP -> Conation	**0.438**	**0.393**	**0.000**
FI[a] -> Affect -> Conation	0.052	0.087	0.053
FI -> Cognition -> Conation	0.152	0.252	0.000
FI -> NEP -> Affect -> Conation	0.017	0.028	0.055
FI -> NEP -> Cognition -> Conation	0.068	0.113	0.004
Total: FI -> Conation	**0.289**	**0.479**	**0.000**

[a]: FI stands for *ForestInfluence*.

[b]: Mplus outputs of SEM analysis with exogenous effects on latent variables do not provide p values for standardized estimates.

Table A10. 9 Amount of variance (R-square) accounted for in the *affect*, *cognition*, *conation* and NEP indicators and in *affect*, *cognition*, *conation* and NEP latent factors in the MIMIC NEP-Tripartite model on farmers with forest by choice and farmers with forest by chance (N = 507).

Variable Groups	Variables	R-square
		Stand. Estimate[a]
Affect indicators	EnjoyForest	0.95
	ChildEnjForest	0.35
Cognition indicators	ForestNatural	0.40
	ForestUseful	0.32
	ForestDecline	0.41
	ForestHelpBird	0.45
Conation indicators	Conservation	0.33
	MoreForest	0.24
	TreePlanting	0.18
NEP indicators	NEPModification	0.42
	NEPCope	0.48
	NEPNaturalLaw	0.34
	NEPCatastrophe	0.45
Latent factors	NEP	0.04
	Affect	0.16
	Cognition	0.39
	Conation	0.72

[a]: Mplus outputs of SEM analysis with exogenous effects on latent variables do not provide p values for standardized estimates

IV. Environmental Motives Scale and tripartite attitudinal responses of farmers

2. Results: Environmental Motives Scale and tripartite attitude response of farmers without forest

Table A10. 10 Overall goodness-of-fit of the EMS-Tripartite model on farmers without forest.

Model Statistics[a]	EMS-Tripartite model
N	291
Chi-square	95.279
df[b]	40
p	0.0000
# free parameters	73
CFI	0.981
TLI	0.988
RMSEA	0.069
WRMR	0.997

[a]: a model is not rejected if CFI/TLI >0.95, RMSEA<0.06, WRMR<1.0. Models with a robust χ^2 p value $\geq$ 0.05 would be preferred to models with a significant χ^2 p value.

[b]: Under WLSMV, the degrees of freedom are not computed as usual; see Mplus Technical Appendices (Muthén 1998-2004, p. 19-20) for the formula.

Table A10. 11 Amount of variance (R-square) accounted for in the *affect*, *cognition*, *conation* and EMS indicators and in *cognition* latent factors in the NEP-Tripartite model on farmers without forest (N = 291).

Variable Groups	Variables	R-square	
		Stand. Estimate	P value
Affect indicators	EnjoyForest	0.98	0.000
	ChildEnjForest	0.42	0.000
Cognition indicators	ForestNatural	0.55	0.000
	ForestBenef	0.09	0.044
	ForestDecline	0.50	0.000
	ForestHelpBird	0.67	0.000
Conation indicators	Conservation	0.34	0.000
	TreePlanting	0.14	0.016
Biospheric indicators	SchPlant	0.77	0.000
	SchMarine	0.73	0.000
	SchBird	0.74	0.000
	SchAnimal	0.87	0.000
Egoistic indicators	SchMe	0.84	0.000
	SchLifestyle	0.88	0.000
	SchHealth	0.82	0.000
	SchFuture	0.86	0.000
Altruistic indicators	SchMyCountryPeople	0.96	0.000
	SchAllPeople	0.82	0.000
	SchChildren	0.89	0.000
	SchGeneration	0.78	0.000
Latent factor	Cognition	0.17	0.004

3. Results: Environmental Motives Scale and tripartite attitude response of farmers with forest

Table A10. 12 Overall goodness-of-fit of the EMS-Tripartite model on farmers with forest.

Model Statistics[a]	EMS-Tripartite model
N	515
Chi-square	139.769
df[b]	61
p	0.0000
# free parameters	76
CFI	0.989
TLI	0.994
RMSEA	0.050
WRMR	0.988

[a]: a model is not rejected if CFI/TLI >0.95, RMSEA<0.06, WRMR<1.0. Models with a robust χ^2 p value $\geq$ 0.05 would be preferred to models with a significant χ^2 p value.

[b]: Under WLSMV, the degrees of freedom are not computed as usual; see Mplus Technical Appendices (Muthén 1998-2004, p. 19-20) for the formula.

Table A10. 13 Amount of variance (R-square) accounted for in the *affect*, *cognition*, *conation* and EMS indicators and in *affect*, *cognition*, *conation* latent factors in the NEP-Tripartite model on farmers with forest (N = 515).

Variable Groups	Variables	R-square	
		Stand. Estimate	P value
Affect indicators	EnjoyForest	0.91	0.000
	ChildEnjForest	0.36	0.000
Cognition indicators	ForestNatural	0.34	0.000
	ForestUsef	0.30	0.000
	ForestDecline	0.48	0.000
	ForestHelpBird	0.47	0.000
Conation indicators	Conservation	0.33	0.000
	MoreForest	0.12	0.004
	TreePlanting	0.19	0.000
Biospheric indicators	SchPlant	0.84	0.000
	SchMarine	0.82	0.000
	SchBird	0.85	0.000
	SchAnimal	0.82	0.000
Egoistic indicators	SchMe	0.94	0.000
	SchLifestyle	0.84	0.000
	SchHealth	0.87	0.000
	SchFuture	0.84	0.000
Altruistic indicators	SchMyCountryPeople	0.94	0.000
	SchAllPeople	0.85	0.000
	SchChildren	0.80	0.000
	SchGeneration	0.65	0.000
Latent factor	Affect	0.09	0.012
	Cognition	0.22	0.000
	Conation	0.73	0.000

4. Results: Environmental Motives Scale and tripartite attitude response of farmers with forest by choice and farmers with forest by chance

Table A10. 14 Overall goodness-of-fit of the MIMIC EMS-Tripartite model on farmers with forest by choice and farmers with forest by chance.

Model Statistics[a]	MIMIC EMS-Tripartite model
N	507
Chi-square	137.237
df[b]	66
p	0.0000
# free parameters	76
CFI	0.991
TLI	0.994
RMSEA	0.046
WRMR	0.992

[a]: a model is not rejected if CFI/TLI >0.95, RMSEA<0.06, WRMR<1.0. Models with a robust χ^2 p value $\geq$ 0.05 would be preferred to models with a significant χ^2 p value.

[b]: Under WLSMV, the degrees of freedom are not computed as usual; see Mplus Technical Appendices (Muthén 1998-2004, p. 19-20) for the formula.

Table A10. 15 Indirect effects of *ForestInfluence* on the *conation* variables in the MIMIC EMS-Tripartite model on farmers with forest by choice and farmers with forest by chance (N = 507).

Indirect Effects	Indirect Effects		
	Stand. estimate	Unstand. estimate	p value[b]
FI[a] -> Affect -> Conation	0.097	0.1256	0.016
FI -> Cognition -> Conation	0.169	0.271	0.001
Total: FI -> Conation	**0.267**	**0.427**	**0.000**

[a]: FI stands for *ForestInfluence*.

[b]: Mplus outputs of SEM analysis with exogenous effects on latent variables do not provide p values for standardized estimates.

Table A10. 16 Amount of variance (R-square) accounted for in the *affect*, *cognition*, *conation* and EMS indicators and in *affect*, *cognition*, *conation* latent factors in the NEP-Tripartite model on farmers with forest by choice and farmers with forest by chance (N = 507).

Variable Groups	Variables	R-square
		Stand. Estimate[a]
Affect indicators	EnjoyForest	0.91
	ChildEnjForest	0.37
Cognition indicators	ForestNatural	0.33
	ForestUsef	0.31
	ForestDecline	0.49
	ForestHelpBird	0.50
Conation indicators	Conservation	0.31
	MoreForest	0.17
	TreePlanting	0.22
Biospheric indicators	SchPlant	0.84
	SchMarine	0.82
	SchBird	0.86
	SchAnimal	0.84
Egoistic indicators	SchMe	0.94
	SchLifestyle	0.83
	SchHealth	0.88
	SchFuture	0.83
Altruistic indicators	SchMyCountryPeople	0.94
	SchAllPeople	0.84
	SchChildren	0.81
	SchGeneration	0.64
Latent factor	Affect	0.14
	Cognition	0.27
	Conation	0.63

[a]: Mplus outputs of SEM analysis with exogenous effects on latent variables do not provide p values for standardized estimates

V. Environmental Motive Scale, NEP and tripartite attitudinal responses of farmers

2. Results: Environmental Motives Scale, NEP and tripartite attitude responses of farmers without forest

Table A10. 17 Overall goodness-of-fit of the EMS-NEP-Tripartite model on farmers without forest.

Model Statistics[a]	EMS-NEP-Tripartite model
N	291
Chi-square	129.328
df[b]	73
p	0.0001
# free parameters	88
CFI	0.980
TLI	0.991
RMSEA	0.051
WRMR	0.872

[a]: a model is not rejected if CFI/TLI >0.95, RMSEA<0.06, WRMR<1.0. Models with a robust χ^2 p value $\geq$ 0.05 would be preferred to models with a significant χ^2 p value.
[b]: Under WLSMV, the degrees of freedom are not computed as usual; see Mplus Technical Appendices (Muthén 1998-2004, p. 19-20) for the formula.

Table A10. 18 Indirect effects of NEP on the *conation* variables in the NEP-Tripartite model on farmers without forest (N = 291).

Relationships	Indirect Effects		
	Stand. estimate	Unstand. estimate	p value[b]
NEP -> Cognition -> Conservation	0.276	0.444	0.000
Total: NEP -> Coservation	**0.276**	**0.444**	**0.000**
NEP -> Affect -> TreePlanting	0.133	0.214	0.003
Total: NEP -> TreePlanting	**0.133**	**0.214**	**0.003**
Egoistic -> Conservation	-0.264	-0.287	0.008
Total: Egoistic -> Conservation	-0.264	-0.287	0.008
Egoistic -> TreePlanting	0.190	0.207	0.006
Total: Egoistic -> TreePlanting	0.190	0.207	0.006
Biospheric -> Conservation	0.304	0.344	0.003
Total: Biospheric -> Conservation	**0.304**	**0.344**	**0.003**
Altruistic -> Cognition -> Conservation	0.122	0.125	0.003
Total: Altruistic -> Coservation	**0.122**	**0.125**	**0.003**

Table A10. 19 Amount of variance (R-square) accounted for in the *affect*, *cognition*, *conation*, NEP and EMS indicators and in *affect* and *cognition* latent factors in the EMS-NEP-Tripartite model on farmers without forest (N = 291).

Variable Groups	Variables	R-square	
		Stand. Estimate	P value
Affect indicators	EnjoyForest	0.96	0.000
	ChildEnjForest	0.42	0.000
Cognition indicators	ForestNatural	0.51	0.000
	ForestBenef	0.09	0.038
	ForestDecline	0.56	0.000
	ForestHelpBird	0.61	0.000
Conation indicators	Conservation	0.34	0.000
	TreePlanting	0.12	0.016
Biospheric indicators	SchPlant	0.78	0.000
	SchMarine	0.74	0.000
	SchBird	0.74	0.000
	SchAnimal	0.86	0.000
Egoistic indicators	SchMe	0.84	0.000
	SchLifestyle	0.88	0.000
	SchHealth	0.82	0.000
	SchFuture	0.86	0.000
Altruistic indicators	SchMyCountryPeople	0.95	0.000
	SchAllPeople	0.82	0.000
	SchChildren	0.88	0.000
	SchGeneration	0.78	0.000
NEP indicators	NEPModification	0.39	0.000
	NEPCope	0.51	0.000
	NEPNaturalLaw	0.31	0.000
	NEPCatastrophe	0.56	0.000
Latent factors	Affect	0.24	0.007
	Cognition	0.43	0.000

3. Results: Environmental Motives Scale, NEP and tripartite attitude response of farmers with forest

Table A10. 20 Overall goodness-of-fit of the EMS-NEP-Tripartite model on farmers with forest.

Model Statistics[a]	EMS-NEP-Tripartite model
N	515
Chi-square	195.981
df[b]	93
p	0.0000
# free parameters	88
CFI	0.986
TLI	0.993
RMSEA	0.046
WRMR	0.977

[a]: a model is not rejected if CFI/TLI >0.95, RMSEA<0.06, WRMR<1.0. Models with a robust χ^2 p value $\geq$ 0.05 would be preferred to models with a significant χ^2 p value.

[b]: Under WLSMV, the degrees of freedom are not computed as usual; see Mplus Technical Appendices (Muthén 1998-2004, p. 19-20) for the formula.

Table A10. 21 Indirect effects of NEP and EMS on the *conation* variables in the EMS-NEP-Tripartite model on farmers with forest (N = 515).

Indirect effects	Indirect Effects			
	Stand. estimate	p value	Unstand. estimate	p value
NEP -> Affect -> Conation	0.073	0.041	0.065	0.043
NEP -> Cognition -> Conation	0.368	0.000	0.326	0.000
Total: NEP -> Conation	**0.441**	**0.000**	**0.391**	**0.000**
Egoistic -> Cognition -> Conation	0.100	0.055	0.058	0.057
Total: Egoistic -> Conation	0.100	0.055	0.058	0.057
Biospheric -> Affect -> Conation	0.051	0.077	0.031	0.078
Biospheric -> Cognition -> Conation	0.109	0.035	0.067	0.037
Total: Biospheric -> Conation	**0.160**	**0.006**	**0.098**	**0.007**

Table A10. 22 Amount of variance (R-square) accounted for in the *affect*, *cognition*, *conation*, EMS and NEP indicators and latent factors in the NEP-Tripartite model on farmers with forest (N = 515).

Variable Groups	Variables	R-square	
		Stand. Estimate	P value
Affect indicators	EnjoyForest	0.96	0.000
	ChildEnjForest	0.34	0.000
Cognition indicators	ForestNatural	0.31	0.000
	ForestUsef	0.28	0.000
	ForestDecline	0.51	0.000
	ForestHelpBird	0.45	0.000
Conation indicators	Conservation	0.31	0.000
	MoreForest	0.19	0.003
	TreePlanting	0.20	0.000
Biospheric indicators	SchPlant	0.84	0.000
	SchMarine	0.82	0.000
	SchBird	0.86	0.000
	SchAnimal	0.83	0.000
Egoistic indicators	SchMe	0.94	0.000
	SchLifestyle	0.84	0.000
	SchHealth	0.87	0.000
	SchFuture	0.84	0.000
Altruistic indicators	SchMyCountryPeople	0.94	0.000
	SchAllPeople	0.85	0.000
	SchChildren	0.80	0.000
	SchGeneration	0.66	0.000
NEP indicators	NEPModification	0.40	0.000
	NEPCope	0.48	0.000
	NEPNaturalLaw	0.29	0.000
	NEPCatastrophe	0.50	0.000
Latent factor	Affect	0.15	0.001
	Cognition	0.41	0.000
	Conation	0.76	0.000

4. Results: Environmental Motives Scale, NEP and tripartite attitude response of farmers who had chosen native forest and the rest of farmers with forest

Table A10. 23 Overall goodness-of-fit of the MIMIC EMS-NEP-Tripartite model on farmers with forest by choice and farmers with forest by chance.

Model Statistics[a]	MIMIC EMS-NEP-Tripartite model
N	507
Chi-square	195.245
df[b]	94
p	0.0000
# free parameters	95
CFI	0.987
TLI	0.992
RMSEA	0.046
WRMR	1.001

[a]: a model is not rejected if CFI/TLI >0.95, RMSEA<0.06, WRMR<1.0. Models with a robust χ^2 p value $\geq$ 0.05 would be preferred to models with a significant χ^2 p value.

[b]: Under WLSMV, the degrees of freedom are not computed as usual; see Mplus Technical Appendices (Muthén 1998-2004, p. 19-20) for the formula.

Table A10. 24 Indirect effects of NEP, EMS and *ForestInfluence* on the *conation* variables in the MIMIC EMS-NEP-Tripartite model on farmers with forest by choice and farmers with forest by chance (N = 507).

Relationships	Indirect Effects		
	Stand. estimate	Unstand. estimate	p value[b]
NEP -> Affect -> Conation	0.064	0.056	0.047
NEP -> Cognition -> Conation	0.337	0.291	0.000
Total: NEP -> Conation	**0.397**	**0.347**	**0.000**
Egoistic -> Cognition -> Conation	0.090	0.052	0.074
Total: Egoistic -> Conation	0.090	0.052	0.074
Biospheric -> Affect -> Conation	0.048	0.029	0.084
Biospheric -> Cognition -> Conation	0.108	0.066	0.033
Total: Biospheric -> Conation	**0.155**	**0.095**	**0.007**
FI[a] -> Affect -> Conation	0.053	0.085	0.057
FI -> Cognition -> Conation	0.169	0.270	0.000
FI -> NEP -> Affect -> Conation	0.012	0.020	0.071
FI -> NEP -> Cognition -> Conation	0.064	0.103	0.006
Total: FI -> Conation	**0.299**	**0.477**	**0.000**

[a]: FI stands for *ForestInfluence*.

[b]: Mplus outputs of SEM analysis with exogenous effects on latent variables do not provide p values for standardized estimates.

Table A10. 25 Amount of variance (R-square) accounted for in the *affect*, *cognition*, *conation*, NEP and EMS indicators and in *affect*, *cognition*, *conation*, NEP latent factors in the EMS-NEP-Tripartite model on farmers with forest (N = 515).

Variable Groups	Variables	R-square Stand. Estimate[a]
Affect indicators	EnjoyForest	0.97
	ChildEnjForest	0.34
Cognition indicators	ForestNatural	0.29
	ForestUsef	0.28
	ForestDecline	0.52
	ForestHelpBird	0.46
Conation indicators	Conservation	0.31
	MoreForest	0.18
	TreePlanting	0.23
Biospheric indicators	SchPlant	0.84
	SchMarine	0.82
	SchBird	0.86
	SchAnimal	0.84
Egoistic indicators	SchMe	0.94
	SchLifestyle	0.83
	SchHealth	0.88
	SchFuture	0.83
Altruistic indicators	SchMyCountryPeople	0.94
	SchAllPeople	0.85
	SchChildren	0.81
	SchGeneration	0.66
NEP indicators	NEPModification	0.41
	NEPCope	0.49
	NEPNaturalLaw	0.28
	NEPCatastrophe	0.51
Latent factor	NEP	0.04
	Affect	0.18
	Cognition	0.46
	Conation	0.75

[a]: Mplus outputs of SEM analysis with exogenous effects on latent variables do not provide p values for standardized estimates

APPENDIX A11

IV. Results: Effects of situational variables on the general-specific attitudes of farmers without forest

Figure A11. 1Schema of the general-specific attitude model with standardized regression (direct effects) and correlation coefficients of farmers without forest (N = 291), on which the effects of the situational variables are examined. Solid lines represent relationships significant at p ≤ 0.10; dashed lines represent relationships significant at 0.10 < p ≤ 0.15.

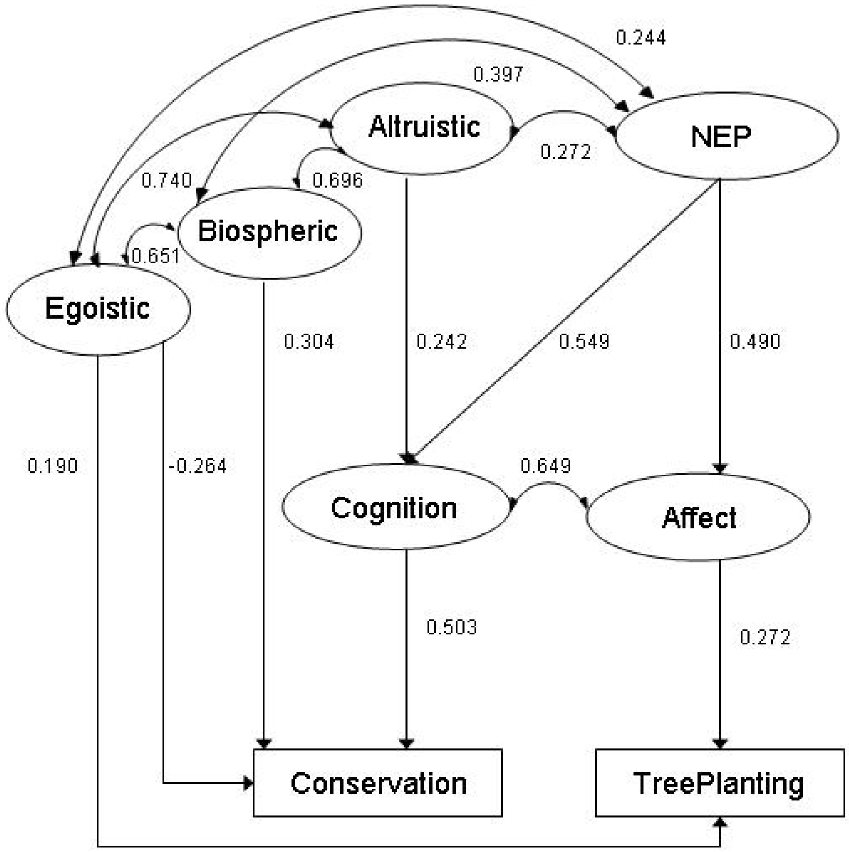

Table A.11 1 Overall goodness-of-fit of the best models assessing the effects of the situational variables on the general-specific environmental attitudes of farmers without forest.

Models [a]	N	Chi-square	df [b]	p	# free param. [c]	CFI	TLI	RMSEA	WRMR	# succ. comp. [c]
Direct Contact Forest	280	125.884	80	0.0008	197	0.985	0.991	0.045	0.894	
Recreational Activities	240	101.46	78	0.0384	99	0.991	0.994	0.035	0.811	
Socio-Demographic	258	126.128	77	0.0004	91	0.979	0.989	0.05	0.859	
Farm Characteristics Dairy MI [c]	283	na [c]	na	na	94	0.984 +/- 0.001	0.990 +/- 0.000	0.046 +/- 0.001	0.924 +/- 0.008	7 out of 7
Farm Characteristics Stock MI	291	na	na	na	93	0.983 +/- 0.000	0.989 +/- 0.000	0.047 +/- 0.000	0.930 +/- 0.002	6 out of 7
Family Influence	271	135.43	86	0.005	100	0.984	0.988	0.046	0.918	
Farmer Influence	291	141.53	80	0	94	0.98	0.988	0.051	0.929	
Knowledge	284	153.819	95	0.0001	105	0.983	0.988	0.047	0.917	
RC conservation efforts	284	130.957	77	0.0001	89	0.981	0.99	0.05	0.89	

[a]: A model is not rejected if CFI/TLI >0.95, RMSEA<0.06, WRMR<1.0. Models with a robust χ^2 p value $\geq$ 0.05 would be preferred to models with a significant χ^2 p value.

[b]: Because the Chi-square degrees of freedom are adjusted for the WLSMV estimator to obtain a correct p-value, they differ across the imputations replications; hence Mplus does not provide an average Chi-square value (Muthén 2007).

[c]: MI stands for multiple imputation, na for non-applicable, # free param. for numbers of free parameters, and # succ. comp. for numbers of successful computations.

Table A.11 2 Significant standardized effects of the situational variables on the general-specific environmental attitudinal variables of farmers without forest. Covariates effects are significant at p ≤ 0.10.

Variable group	Variable	Significant Standardized Regression Coefficient									
		Biospheric	Altruistic	Egoistic	NEP	Affect	Cognition	Cons [a]	Cons (IndEff)	TreePl [a]	TreePl (IndEff)
Direct Contact Forest	FrequencyVisit	0.203	ns	ns	ns	0.271	0.176	0.146	0.138	-0.309	0.103
	FrequencyUse	ns[a]	ns	ns	ns	ns	ns	ns	na	0.221	na
	VisitAsChild	ns	ns	ns	0.22	0.294	ns	ns	0.051	-0.16	0.140
Recreational Activities	Fish-Hunt	ns	ns	ns	ns	ns	ns	0.118	na	ns	na
	Walk-Tramp	ns	ns	0.138	ns	0.243	0.152	ns	ns	ns	0.129
	Obs Nature	0.174	0.124	ns	0.295	0.231	0.16	0.211	0.171	-0.192	0.133
Farmer Characteristics	Farm Income	-0.15	-0.123	ns	-0.221	ns	ns	ns	-0.127	ns	-0.026
Farm Characteristics MI[a]	Farm Size	ns	ns	ns	-0.180 (-0.182)	ns	ns	ns	-0.049 (-0.050)	ns	-0.023 (-0.023)
	Wellington	ns	ns	ns	ns	ns	0.139 (0.135)	ns	0.070 (0.070)	ns	na (na)
	Dairy (stock)	ns	ns	0.123 (-0.143)	ns	ns	-0.144 (0.131)	ns	-0.102 (0.096)	ns	ns (ns)
	Organic	0.219 (0.204)	ns	ns	0.295 (0.295)	ns	ns	ns	0.139 (0.138)	ns	0.038 (0.038)
Family Influence	EnvtalTalk	0.249	0.227	ns	0.333	ns	ns	ns	0.203	ns	0.069
	Make Mind	ns	ns	0.215	ns	ns	0.235	ns	ns	ns	0.046
	ParentFarmer	ns	ns	ns	ns	-0.313	-0.271	ns	-0.131	ns	-0.093
	ParentForest	ns	ns	ns	ns	0.224	0.276	ns	0.134	ns	0.066
Farmer Influence	EnvtalTalk	ns	ns	ns	ns	ns	ns	0.279	ns	ns	0.034
	Make Mind	ns	0.320	0.247	ns	ns	ns	ns	ns	ns	0.048
Knowledge	Education	-0.151	-0.146	-0.233	ns	ns	ns	ns	0.145	ns	0.094
	ForestInfo	ns	ns	-0.169	ns	ns	0.122	ns	ns	ns	0.057
	EnvtInfo	ns	0.121	0.132	0.191	ns	ns	ns	0.129	-0.207	0.076
	EcoLit	0.212	0.213	0.156	0.409	ns	ns	0.134	0.096	ns	-0.037
	NZEnvtInfo	0.115	ns	ns	ns	0.251	0.210	ns	ns	ns	-0.051
RC conservation efforts	RCEncour	ns	ns	-0.165	ns	ns	ns	ns	0.044	ns	-0.035

[a]: MI stands for multiple imputation, na for non-applicable, and ns for non-significant, Cons for conservation; TreePl for TreePlanting.

Table A.11 3 Variance explained in the general-specific environmental attitudinal variables of farmers without forest by the situational variables, and number of cases present in each analysis.

VARIABLE GROUP	VARIABLE	% Variance Explained								N
		Biospheric	Altruistic	Egoistic	NEP	Affect[a]	Cognition[a]	Conservation[a]	TreePlanting[a]	
Direct Contact Forest	FrequencyVisit FrequencyUse VisitAsChild	4.1	0.0	0.0	4.8	14.5	-0.3	1.2	8.3	280
Recreational Activities	Fish-Hunt Walk-Tramp Obs Nature	3.0	1.5	1.9	8.7	9.6	6.1	2.2	7.4	240
Farmer Characteristics	Farm Income	2.3	1.5	0.0	4.9	4.4	5.1	-0.2	-2.0	258
Farm Characteristics MI[b]	Farm Size Dairy (stock) Organic Wellington	4.8 (4.2)	0.0 (0.0)	1.6 (2.1)	12.9 (13.0)	-0.4 (-0.2)	5.0 (3.0)	0.3 (1.2)	-0.6 (-0.6)	291
Family Influence	EnvtalTalk Make Mind ParentFarmer ParentForest	6.2	5.2	4.6	11.1	8.2	12.9	-2.9	2.5	271
Farmer Influence	EnvtalTalk Make Mind	0.0	10.2	6.1	0.0	-1.7	-1.0	2.4	0.5	291
Knowledge	EcoLiteracy EnvtInformed NZEnvtInformed ForestInformed Education	7.0	8.3	6.8	23.2	8.0	7.4	2.3	4.9	284
RC conservation efforts	RC Effort	0.0	0.0	2.7	0.0	1.5	1.2	-0.9	-0.3	284

[a] : The amounts of variance explained in the tripartite attitudinal variables shown in the table only take into account the effects of the situational variables, that is, the variance of the tripartite variables (*Affect, Cognition, Conservation and TreePlanting*) already explained by the general attitudinal variables (NEP, the value-based environmental concerns) has been subtracted from the total percentage of variance explained.
[b]: MI stands for multiple imputation.

V. Results: Effects of situational variables on the general-specific attitudes of farmers with forest

Figure A11. 2 Schema of the general-specific attitude model with standardized regression (direct effects) and correlation coefficients of farmers with forest (N = 515), on which the effects of the situational variables are examined. Solid lines represent relationships significant at p ≤ 0.10; dashed lines represent relationships significant at 0.10 < p ≤ 0.15.

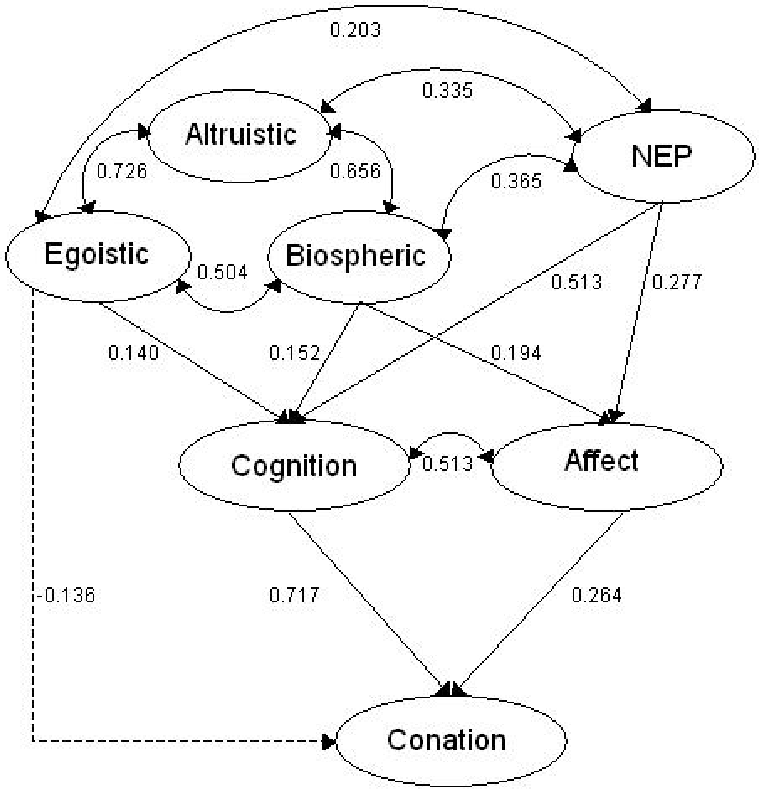

Table A.11 4 Overall goodness-of-fit of the best models assessing the effects of the situational variables on the general-specific environmental attitudes of farmers with forest.

Models [a]	N	Chi-square	df [b]	p	# free param. [c]	CFI	TLI	RMSEA	WRMR	# succ. comp. [c]
Direct Contact Forest	498	20.152	98	0	95	0.987	0.991	0.046	1.026	
Recreational Activities	479	183.914	95	0	94	0.988	0.993	0.044	0.962	
Socio-Demographic MI [c]	515	na [c]	na	na	95	0.986 +/- 0.001	0.991 +/- 0.001	0.047 +/- 0.002	1.068 +/- 0.019	7 out of 7
Farm Chara Dairy -MI	498	na	na	na	100	0.989 +/- 0.001	0.992 +/- 0.001	0.042 +/- 0.001	1.013 +/- 0.015	7 out of 7
Farm Chara Stock -MI	513	na	na	na	100	0.989 +/- 0.001	0.992 +/- 0.001	0.042 +/- 0.002	1.016 +/- 0.020	7 out of 7
Family Influence MI	511	na	na	na	104	0.987 +/- 0.001	0.991 +/- 0.000	0.043 +/- 0.001	1.055 +/- 0.011	7 out of 7
Farmer Influence	513	223.873	99	0	97	0.983	0.99	0.05	1.028	
Knowledge	515	225.843	102	0	100	0.985	0.99	0.049	1.055	
RC conservation efforts	511	205.576	101	0	95	0.987	0.993	0.045	0.977	

[a]: A model is not rejected if CFI/TLI >0.95, RMSEA<0.06, WRMR<1.0. Models with a robust χ^2 p value $\geq$ 0.05 would be preferred to models with a significant χ^2 p value.

[b]: Because the Chi-square degrees of freedom are adjusted for the WLSMV estimator to obtain a correct p-value, they differ across the imputations replications; hence Mplus does not provide an average Chi-square value (Muthén 2007).

[c]: MI stands for multiple imputation, na for non-applicable, # free param. for numbers of free parameters, and # succ. comp. for numbers of successful computations.

Table A.11 5 Overall goodness-of-fit of the best MIMIC models assessing the effects of the situational variables on the general-specific environmental attitudes of farmers with forest by choice and farmers with forest by chance.

Models [a]	N	Chi-square	df [b]	p	# free param. [c]	CFI	TLI	RMSEA	WRMR	# succ. comp. [c]
Direct Contact Forest	490	199.684	101	0	98	0.987	0.991	0.045	1.029	
Recreational Activities	472	182.242	97	0	97	0.989	0.993	0..043	0.972	
Socio-Demographic MI	515	na	na	na	98	0.988 +/- 0.001	0.992 +/- 0.001	0.043 +/- 0.001	1.041 +/- 0.016	7 out of 7
Farm Chara Dairy -MI	498	na	na	na	103	0.991 +/- 0.001	0.993 +/- 0.001	0.038 +/- 0.001	0.987 +/- 0.014	7 out of 7
Farm Chara Stock -MI	513	na	na	na	103	0.991 +/- 0.001	0.993 +/- 0.001	0.038 +/- 0.002	0.991 +/- 0.019	7 out of 7
Family Influence MI	511	na	na	na	107	0.989 +/- 0.000	0.991 +/- 0.000	0.040 +/- 0.001	1.035 +/- 0.010	7 out of 7
Farmer Influence	505	219.453	102	0	100	0.985	0.99	0.048	1.031	
Knowledge	507	231.088	105	0	103	0.985	0.99	0.049	1.076	
RC conservation efforts	503	205.397	102	0	98	0.987	0.992	0.045	0.999	

[a]: A model is not rejected if CFI/TLI >0.95, RMSEA<0.06, WRMR<1.0. Models with a robust χ^2 p value $\geq$ 0.05 would be preferred to models with a significant χ^2 p value.

[b]: Because the Chi-square degrees of freedom are adjusted for the WLSMV estimator to obtain a correct p-value, they differ across the imputations replications; hence Mplus does not provide an average Chi-square value (Muthén 2007).

[c]: MI stands for multiple imputation, na for non-applicable, # free param. for numbers of free parameters, and # succ. comp. for numbers of successful computations.

Table A.11 6 Significant standardized effects of the situational variables on the general-specific environmental attitudinal variables of farmers with forest. Covariates effects are significant at $p \leq 0.10$.

Variable group	Variable	Significant Standardized Regression Coefficient							
		Biospheric	Altruistic	Egoistic	NEP	Affect	Cognition	Conation	Cona. (Ind)
Direct Contact Forest	FrequencyVisit	ns[a]	ns	ns	ns	0.342	0.183	ns	0.218
	VisitAsChild	ns	ns	ns	ns	0.321	ns	ns	0.087
Recreational Activities	Walk-Tramp	ns	ns	ns	0.206	0.361	ns	ns	0.267
Farmer Characteristics MI[a]	Age	ns	ns	ns	ns	ns	0.245	ns	0.167
	Farm Income	ns	ns	ns	-0.167	ns	ns	ns	-0.072
	Yrs Farming	-0.131	ns	ns	ns	ns	ns	ns	ns
Farm Characteristics MI	Farm Size	ns	ns	-0.106 (-0.107)	ns	ns	-0.223 (-0.222)	ns	-0.117 (-0.095)
	Dairy (stock)	ns	ns	ns	ns	-0.126 (0.135)	-0.125 (0.122)	0.149 (-0.156)	-0.127 (0.097)
	Organic	ns	ns	0.113 (0.115)	0.286 (0.288)	ns	ns	ns	0.116 (0.116)
	Export	ns	ns	ns	-0.120 (-0.126)	ns	ns	ns	-0.048 (-0.053)
Family Influence MI	ParEnvtCon	ns	ns	ns	ns	0.266	0.203	ns	0.201
	ChildInvtFarm	ns	ns	ns	-0.141	ns	ns	ns	-0.053
	Make Mind	ns	ns	ns	0.309	0.211	ns	ns	0.171
	EnvtalTalk	0.178	ns	ns	ns	ns	0.195	0.147	0.245
	ParentFarmer	ns	ns	ns	-0.218	ns	ns	ns	-0.081
Farmer Influence	EnvtalTalk	0.154	0.172	0.207	0.296	0.192	ns	ns	0.195
Knowledge	EnvtInfo	ns	ns	ns	ns	0.250	ns	0.225	ns
	EcoLit	0.150	0.102	ns	0.433	ns	ns	ns	0.276
RC conservation efforts	RCEncour	0.110	0.107	ns	ns	ns	0.172	ns	0.138

[a]: MI stands for multiple imputation, ns for non-significant.

Table A.11 7 Significant standardized effects of the situational variables on the general-specific environmental attitudinal variables of farmers with forest, with grouping effect (*ForestInfluence*) distinguishing between farmers with forest by choice (a priori positive attitudes towards the forest) and the rest of farmers with forest. Covariates effects are significant at p ≤ 0.10.

Variable group	Variable	Significant Standardized Regression Coefficient							
		Biospheric	Altruistic	Egoistic	NEP	Affect	Cognition	Conation	Cona. (Ind)
Direct Contact Forest	FrequencyVisit	ns[a]	ns	ns	ns	0.313	0.119	ns	0.166
	VisitAsChild	ns	ns	ns	ns	0.326	ns	ns	0.091
	ForestInfluence	ns	ns	ns	0.192	0.093	0.200	ns	0.231
Recreational Activities	Walk-Tramp	ns	ns	ns	0.159	0.336	ns	ns	0.167
	ForestInfluence	ns	ns	ns	0.177	0.134	0.224	ns	0.066
Farmer Characteristics MI[a]	Age	ns	ns	ns	ns	ns	0.214	ns	0.146
	Farm Income	ns	ns	ns	-0.134	ns	ns	ns	-0.052
	Yrs Farming	-0.118	ns	ns	ns	ns	ns	ns	ns
	ForestInfluence	ns	ns	ns	0.172	0.201	0.212	ns	0.270
Farm Characteristics MI	Farm Size	ns	ns	-0.100 (-0.107)	ns	ns	-0.208 (-0.209)	ns	-0.144 (-0.141)
	Dairy (stock)	ns	ns	ns	ns	-0.120 (0.132)	-0.116 (0.119)	0.155 (-0.151)	-0.115 (0.121)
	Organic	ns	ns	0.107 (0.112)	0.240 (0.238)	ns	ns	ns	0.085 (0.085)
	Export	ns	ns	ns	-0.102 (-0.111)	ns	ns	ns	ns (-0.042)
	ForestInfluence	ns	ns	ns	0.105 (0.109)	0.208 (0.205)	0.199 (0.204)	ns	0.238 (0.241)
Family Influence MI	ParEnvtCon	ns	ns	ns	ns	0.251	0.184	ns	0.182
	ChildInvtFarm	ns	ns	ns	-0.145	ns	ns	ns	-0.050
	Make Mind	ns	ns	ns	0.273	0.184	ns	ns	0.140
	EnvtalTalk	0.173	ns	ns	ns	ns	0.166	0.150	0.207
	ParentFarmer	ns	ns	ns	-0.181	ns	ns	ns	-0.062
	ForestInfluence	ns	ns	ns	0.125	0.153	0.187	ns	0.203
Farmer Influence	EnvtalTalk	0.147	0.166	0.204	0.263	0.176	ns	ns	0.165
	ForestInfluence	ns	ns	ns	0.155	0.171	0.226	ns	0.259
Knowledge	EnvtInfo	ns	ns	ns	ns	0.224	ns	0.174	0.219
	EcoLit	0.149	0.098	ns	0.413	ns	ns	ns	0.235
	ForestInfluence	ns	ns	ns	0.144	0.183	0.225	ns	0.255
RC conservation efforts	RCEncour	0.110	0.107	ns	ns	ns	0.154	ns	0.123
	ForestInfluence	ns	ns	ns	0.196	0.198	0.223	ns	0.288

[a]: MI stands for multiple imputation, ns for non-significant.

Table A.11 8 Variance explained in the general-specific environmental attitudinal variables of farmers with forest by the situational variables, and number of cases present in each analysis.

Variable group	Variable	% Variance Explained							N
		Biospheric	Altruistic	Egoistic	NEP	Affect[a]	Cognition[a]	Conation[a]	
Direct Contact Forest	FrequencyVisit VisitAsChild	0	0	0	0	26.7	1.9	-4.6	498
Recreational Activities	Walk-Tramp	0	0	0	4.3	18.3	2.7	6.3	479
Farmer Characteristics MI[b]	Age Farm Income Yrs Farming	1.8	0	0	2.9	0.9	3.6	-1.1	515 (75 missing)
Farm Characteristics MI	Farm Size Dairy (stock) Organic Export	0(0)	0(0)	2.7(2.9)	11.4(11.8)	0.2(0.8)	4.6(4.5)	-1.5(-1.3)	513 (189 missing)
Family Influence MI	ParEnvtCon ChildInvtFarm Make Mind EnvtalTalk ParentFarmer	3.2	0	0	16.8	10.4	7.9	0.3	511
Farmer Influence	EnvtalTalk	2.4	3	4.3	8.7	3.8	1.8	-4.8	513
Knowledge	EnvtInfo EcoLit	2.3	1	0	18.7	6.7	2.2	0.4	515
RC conservation efforts	RCEncour	1.2	1.1	0	0	0.1	2.7	-0.7	511

[a] : The amounts of variance explained in the tripartite attitudinal variables shown in the table only take into account the effects of the situational variables, that is, the variance of the tripartite variables (*Affect, Cognition, Conservation and TreePlanting*) already explained by the general attitudinal variables (NEP, the value-based environmental concerns) has been subtracted from the total percentage of variance explained.
[b]: MI stands for multiple imputation.

Table A.11 9 **Variance explained in the general-specific environmental attitudinal variables of farmers with forest by the situational variables, and number of cases present in each analysis, with grouping effect (ForestInfluence) distinguishing between farmers with forest by choice (a priori positive attitudes towards the forest) and the rest of farmers with forest.**

Variable group	Variable	% Variance Explained							N
		Biospheric	Altruistic	Egoistic	NEP	Affect[a]	Cognition[a]	Conation[a]	
Direct Contact Forest	FrequencyVisit VisitAsChild ForestInfluence	0	0	0	3.7	24.6	0.3	-4.3	490
Recreational Activities	Walk-Tramp ForestInfluence	0	0	0	6.8	17.8	5.8	4.2	472
Farmer Characteristics MI	Age Farm Income Yrs Farming ForestInfluence	1.4	0	0	5.5	4.2	6.8	-2.6	515
Farm Characteristics MI	Farm Size Dairy (stock) Organic Export ForestInfluence	0 (0)	0 (0)	2.6 (2.9)	10.9 (11.3)	3.9 (4.3)	7.6 (7.7)	-2.6 (-2.7)	498 (513)
Family Influence MI	ParEnvtCon ChildInvtFarm Make Mind EnvtalTalk ParentFarmer ForestInfluence	3	0	0	16.2	11.5	10.1	-0.2	511
Farmer Influence	EnvtalTalk ForestInfluence	2.2	2.8	4.2	10.6	5.9	5.9	-5.8	505
Knowledge	EnvtInfo EcoLit ForestInfluence	2.2	1	0	20.7	8	6.2	-2.6	507
RC conservation efforts	RCEncour ForestInfluence	1.2	1.1	0	3.8	3.1	6.8	-1.8	503

[a] : The amounts of variance explained in the tripartite attitudinal variables shown in the table only take into account the effects of the situational variables, that is, the variance of the tripartite variables (*Affect, Cognition, Conservation and TreePlanting*) already explained by the general attitudinal variables (NEP, the value-based environmental concerns) has been subtracted from the total percentage of variance explained. [b]: MI stands for multiple imputation

APPENDIX A12

II. Do farmers with native fragments of 1 hectare or more differ from farmers with fragments less than 1 hectare?

1. Do the two groups of farmers indeed differ in environmental attitude?

b. Results

Table A12. 1 Overall goodness-of-fit of the two attitude models of farmers with forest fragments ≥ 1 ha. The first model represents the attitudinal model used in chapters 9 and 10 on farmers with forest of any size; in the alternative model, paths between biospheric concern and *cognition*, and biospheric concern and *conation* have replaced the paths between egoistic concern and *cognition*, and egoistic concern and *conation* in the first model.

Model Statistics[a]	Original general-specific attitude model	Alternative model
N	361	361
Chi-square	145.354	138.772
df[b]	84	82
p	0.0000	0.0001
# free parameters	92	91
CFI	0.988	0.989
TLI	0.993	0.993
RMSEA	0.045	0.044
WRMR	0.890	0.891

[a]: a model is not rejected if CFI/TLI >0.95, RMSEA<0.06, WRMR<1.0. Models with a robust χ^2 p value $\geq$ 0.05 would be preferred to models with a significant χ^2 p value.

[b]: Under WLSMV, the degrees of freedom are not computed as usual; see Mplus Technical Appendices (Muthén 1998-2004, p. 19-20) for the formula.

Table A12. 2 Amount of variance accounted for (R-square) in the attitudinal indicators and latent factors by the alternative attitudinal model of farmers with ≥ 1 ha fragments (N = 361).

Variable Groups	Variables	Alternative model	
		R-square	P value
Affect indicators	EnjoyForest	0.939	0
	ChildEnjForest	0.391	0
Cognition indicators	ForestNatural	0.312	0
	ForestUseful	0.266	0
	ForestDecline	0.535	0
	ForestHelpBird	0.432	0
Conation indicators	Conservation	0.361	0
	MoreForest	0.223	0.006
	Tree Planting	0.136	0.012
Biospheric Concern indicators	SchPlant	0.833	0
	SchMarine	0.811	0
	SchBird	0.858	0
	SchAnimal	0.816	0
Egoistic Concern indicators	SchMe	0.932	0
	SchLifestyle	0.862	0
	SchHealth	0.865	0
	SchFuture	0.812	0
Altruistic Concern indicators	SchMyCountryPeople	0.953	0
	SchAllPeople	0.864	0
	SchChildren	0.789	0
	SchGeneration	0.68	0
NEP indicators	NEPModification	0.423	0
	NEPCope	0.471	0
	NEPNaturalLaw	0.291	0
	NEPCatastrophe	0.486	0
Latent factors	Affect	0.159	0.003
	Cognition	0.463	0
	Conation	0.789	0

2. Do the two groups of farmers differ in their situational answers?

a. Method

Multiple imputation was used on missing values. A few variables did not need to be imputed (*Ecological Literacy*, *Education*, *Farm Family*). Table A12.3 gives basic descriptive parameters of the 40 potential predictors before and after imputation. The fraction of missing information, relative increase in variance and the relative efficiency indicate if more imputations are needed (Rubin 1987). In brief, the closer to zero the fraction of missing information is and the closer to one the relative efficiency is, the more reliable are the imputations[16]. Seven imputed variables, as well as the original dataset, were used. Because of the number of missing values in the original dataset, it was included for information only.

As in chapter 5, *Make Mind Family*, *Make Mind Farmer*, *Own Farm*, and the different farm types (*Dairy*, *Horticulture*, and *Meat*) had important missing information fractions, and would need more imputations to be useable. However, because the multiple imputation process is time-consuming and the number of imputations already exceeded the recommended five, no extra imputations were run. These variables were discarded from the discriminant analysis.

[16] See chapter 4, section III.3.b., for the different steps leading to the imputation of the missing values and appendix A5, section II for more details about the fraction of missing information, relative increase variance and the relative efficiency.

Table A12. 3 Descriptive statistics of the 40 potential predictors of the presence of forest fragments of 1 ha or more on respondents' farms before and after imputations of the missing values.

Variables	Original data					Pooled results from 7 imputed datasets				
	N		Mean	S.E. of Mean	Standard Deviation	Mean	S.E. of Mean	Fraction Miss. Info.	Relative Increase Var.	Relative Efficiency
	Valid	Missing								
Age	513	2	3.68	0.043	0.983	3.69	0.042	0.003	0.003	1
Child Invt Farm [a]	460	55	0.59	0.023	0.492	0.59	0.022	0.050	0.052	0.993
Dairy	439	76	0.15	0.017	0.362	0.19	0.044	0.874	5.534	0.889
CS Brand/Certification [a]	505	10	0.15	0.016	0.36	0.15	0.016	0.032	0.033	0.995
CS Money [a]	505	10	0.6	0.022	0.49	0.6	0.022	0.022	0.023	0.997
Ecological Literacy	515	0	3.88	0.022	0.511	3.881	0.022	na [a]	na	na
Education	515	0	4.38	0.053	1.211	4.38	0.053	na	na	na
Envt. Organisation [a]	484	31	1.98	0.073	1.612	2.01	0.073	0.057	0.059	0.992
Environmental Talk Family	509	6	3.29	0.056	1.253	3.29	0.056	0.004	0.004	0.999
Environmental Talk Farmer	513	2	2.98	0.051	1.166	2.98	0.052	0.006	0.006	0.999
Export	458	57	0.65	0.017	0.355	0.642	0.015	0.023	0.024	0.997
Farm Family	515	0	10.14	4.319	98.008	0.45	0.022	na	na	na
Farm Income	475	40	3.23	0.052	1.127	3.27	0.073	0.472	0.783	0.937
Farm Size	416	99	2.13	0.032	0.650	2.264	0.030	0.049	0.051	0.993
Fishing Hunting	463	52	2.83	0.059	1.268	2.79	0.062	0.190	0.221	0.974
Forest Influence	507	8	0.146	0.0157	0.353	0.153	0.017	0.133	0.148	0.981
Forest Informed	513	2	2.51	0.057	1.287	2.52	0.057	0.006	0.006	0.999
Forest Know. Experience [a]	503	12	0.61	0.022	0.487	0.61	0.022	0.021	0.022	0.997
Forest Know. Media [a]	503	12	0.25	0.019	0.433	0.25	0.02	0.041	0.042	0.994
Forest Know. Reg. Council [a]	503	12	0.09	0.013	0.291	0.1	0.014	0.079	0.084	0.989
Frequency Use Forest	513	2	2.29	0.062	1.406	2.3	0.062	0.004	0.004	0.999
Frequency Visit Forest	514	1	3.51	0.056	1.26	3.51	0.056	0.002	0.002	1
Horticulture	439	76	0.02	0.007	0.149	0.1	0.019	0.589	1.22	0.922

[a]: 'Child Invt Farm' stands for respondents' children's involvement on the farm; 'CS', for 'Regional Council service'; 'Envt. Organisation', for environmental organisation; 'Forest Know.', for origin of respondents' knowledge about native forest; 'Parent EC', for respondents' parents' environmental concern; 'Partner Invt Farm', for respondents' partners' involvement on the farm; 'RC Encouragement', for Regional Council encouragement; 'na', for non-applicable.

Table A12. 3 continued.

Variables	Original data					Pooled results from 7 imputed datasets				
	N		Mean	S.E. of Mean	Standard Deviation	Mean	S.E. of Mean	Fraction Miss. Info.	Relative Increase Var.	Relative Efficiency
	Valid	Missing								
Make Mind Family	464	51	3.28	0.054	1.158	3.24	0.159	0.908	7.781	0.885
Make Mind Farmer	465	50	2.91	0.057	1.221	2.93	0.181	0.922	9.356	0.884
Meat	439	76	0.82	0.018	0.383	0.74	0.029	0.598	1.263	0.921
Observe Nature	472	43	4.12	0.059	1.284	4.08	0.063	0.172	0.197	0.976
Organic	509	6	1.54	0.048	1.073	1.56	0.049	0.033	0.034	0.995
Own Farm	369	146	0.93	0.014	0.261	0.89	0.023	0.695	1.891	0.91
Parent EC [a]	510	5	3	0.053	1.186	3	0.052	0.005	0.005	0.999
Parent Forest	494	21	0.62	0.022	0.487	0.61	0.022	0.020	0.02	0.997
Partner Invt Farm [a]	458	57	0.82	0.018	0.387	0.81	0.02	0.233	0.283	0.968
Pass Farm	342	173	0.7	0.025	0.457	0.68	0.024	0.270	0.34	0.963
Quit Farming	507	8	0.19	0.017	0.394	0.19	0.018	0.013	0.014	0.998
RC Encouragement [a]	511	4	2.47	0.053	1.199	2.47	0.053	0.004	0.004	0.999
Visit Forest As Child	498	17	3.68	0.059	1.317	3.67	0.06	0.039	0.04	0.994
Walk-Tramp	479	36	3.68	0.06	1.318	3.67	0.059	0.018	0.018	0.997
Wellington (region 1)	514	1	0.31	0.02	0.464	0.31	0.02	0.003	0.003	1
Year Farming	509	6	24.1	0.617	13.91	24.09	0.613	0.002	0.002	1
Year on Farm	478	37	32.81	0.616	13.46	32.55	0.633	0.081	0.085	0.989

[a]: 'Child Invt Farm' stands for respondents' children's involvement on the farm; 'CS', for 'Regional Council service'; 'Envt. Organisation', for environmental organisation; 'Forest Know.', for origin of respondents' knowledge about native forest; 'Parent EC', for respondents' parents' environmental concern; 'Partner Invt Farm', for respondents' partners' involvement on the farm; 'RC Encouragement', for Regional Council encouragement; 'na', for non-applicable.

b. Results

Table A12. 4 Wilks' Lambda: amount of total variance in discriminant scores explained by the discriminant function and Chi-square tests of the discriminant function over the 8 datasets.

Imputation #	1-Wilks' Lambda	Chi-square	df	Sig.
Original	0.269	50.205	5	0
1	0.167	63.676	5	0
2	0.166	65.723	5	0
3	0.207	77.044	5	0
4	0.191	77.71	5	0
5	0.171	66.102	5	0
6	0.184	70.807	5	0
7	0.187	71.701	5	0

Table A12. 5 Model validation by percentage of respondents correctly classified over the eight datasets

Imputation #	% of selected original grouped cases correctly classified	% of unselected original grouped cases correctly classified	% of selected cross-validated grouped cases correctly classified
Original	73.9	72.2	70.3
1	68.1	67.9	67.5
2	71.4	66.7	70.6
3	70.3	71.2	68.8
4	71.0	66.2	70.4
5	72.5	65.2	71.9
6	71.4	70.8	70.8
7	71.5	66.9	70.9
Mean (on imputed datasets)	**70.9**	**67.8**	**70.1**
Mean (on all datasets)	**71.3**	**68.4**	**70.2**

III. Reasons of farmers with ≥ 1 ha fragments to keep native forest fragments on their property

1. Results

Table A12. 6 Frequency and percentage of reasons chosen by farmers with forest fragments ≥ 1 ha for keeping the fragments on their property. Respondents were allowed to choose 2 answers. 353 out 361 farmers answered this question.

Reasons to Keep Forest Fragments	Frequency	Valid Percent
Protect	247	70.0
Aesthetic	211	59.8
Farming Purposes	67	19.0
Not worth Chop/Illegal	49	13.9
Leisure	39	11.0

Table A12. 7 Reason for keeping native fragments on property: farming purposes. Crosstabulation between farmers with forest fragments ≥ 1 ha by choice and farmers with forest fragments ≥ 1 ha by chance.

		Forest by Chance	Forest by Choice	Total
No	Count	229	52	281
	Expected count	235.8	45.2	281
Yes	Count	63	4	67
	Expected count	56.2	10.8	67
Total	Count	292	56	348

Table A12. 8 Chi-square tests associated of the crosstabulation between farmers with forest fragments ≥ 1 ha by choice and farmers with forest fragments ≥ 1 ha by chance on the reason for keeping native fragments on property: farming purposes.

	Value	df	Asymp. Sig (2-sided)	Exact Sig. (2-sided)
Pearson Chi-square	6.296	1	0.012	na
Fisher's exact test	na	na	na	0.1

Table A12. 9 Reason for keeping native fragments on property: leisure. Crosstabulation between farmers with forest fragments ≥ 1 ha by choice and farmers with forest fragments ≥ 1 ha by chance.

		Forest by Chance	Forest by Choice	Total
No	Count	265	44	309
	Expected count	259.3	49.7	309
Yes	Count	27	12	39
	Expected count	32.7	6.3	39
Total	Count	292	56	348

Table A12. 10 Chi-square tests associated with the crosstabulation between farmers with forest by forest fragments ≥ 1 ha and farmers with forest by forest fragments ≥ 1 ha on the reason for keeping native fragments on property: farming purposes.

	Value	df	Asymp. Sig (2-sided)	Exact Sig. (2-sided)
Pearson Chi-square	7.008	1	0.008	na
Fisher's exact test	na	na	na	0.018

IV. The attitude-behaviour relationship in farmers with forest fragments of 1 ha or more

2. Analysis of the Behaviour variables

Table A12. 11 Polychoric correlation coefficients of behaviour variables of respondents with forest, n = 361 with missing value, pairwise deletion.

Variables	1.	2.	3.	4.
1. Inventory	1.00			
2. Fenced	-0.02	1.00		
3. Control	0.18	0.07	1.00	
4. Protection	0.16	0.51	0.38	1.00

3. General-Specific Attitude & Behaviour

Although the relationship between NEP and behaviour in model 1 was not significant at $p = 0.15$ (figure A11.2), removing it (model 2) caused the total amount of variance explained in behaviour to drop substantially (Table A12.13, compare the amounts of variance explained in the behaviour latent factors by models 1 and 2). Therefore, model 1 was preferred over model 2. Incidentally, modification indices (Muthén 1998-2004, p. 24; Gomez and Vance 2008, p. 960) suggested that some NEP indicators may be more strongly related to behaviour than others. This could explain the importance of NEP for explaining some variance of behaviour without having a relationship significant at $p \leq 0.10$ between the two variables. In any case, due to the small number of data points compared to the number of parameters to estimate, results are only tentative.

Table A12. 12 Overall goodness-of-fit of two alternative attitude-behaviour models of farmers with forest fragments≥ 1 ha. Model 1 corresponds to the alternative attitudinal model (section II.1) predicting farmers' behaviour towards their native forest fragments; model 2 corresponds to model 1 without the link between NEP and behaviour.

Model Statistics[a]	Model 1	Model 2
N	361	361
Chi-square	160.141	161.503
df[b]	97	98
p	0.0001	0.0001
# free parameters	102	101
CFI	0.988	0.988
TLI	0.992	0.992
RMSEA	0.042	0.042
WRMR	0.918	0.921

[a]: a model is not rejected if CFI/TLI >0.95, RMSEA<0.06, WRMR<1.0. Models with a robust χ^2 p value $\geq$ 0.05 would be preferred to models with a significant χ^2 p value.

[b]: Under WLSMV, the degrees of freedom are not computed as usual; see Mplus Technical Appendices (Muthén 1998-2004, p. 19-20) for the formula.

Table A12. 13 Amount of variance (R-square) accounted for in the attitudinal and behavioural indicators and latent factors by attitude-behaviour model 1 of farmers with forest fragments ≥ 1 ha (N = 361).

Variable Groups	Variables	Model 1	
		R-square	P value
Affect indicators	EnjoyForest	0.941	0
	ChildEnjForest	0.389	0
Cognition indicators	ForestNatural	0.318	0
	ForestUseful	0.265	0
	ForestDecline	0.534	0
	ForestHelpBird	0.436	0
Conation indicators	Conservation	0.378	0
	MoreForest	0.217	0.008
	Tree Planting	0.137	0.012
Behaviour indicators	Fencing	0.434	0.04
	PestControl	0.08	0.19
	ForestProtection	0.596	0.038
Biospheric Concern indicators	SchPlant	0.833	0
	SchMarine	0.811	0
	SchBird	0.859	0
	SchAnimal	0.816	0
Egoistic Concern indicators	SchMe	0.932	0
	SchLifestyle	0.862	0
	SchHealth	0.865	0
	SchFuture	0.812	0
Altruistic Concern indicators	SchMyCountryPeople	0.952	0
	SchAllPeople	0.864	0
	SchChildren	0.787	0
	SchGeneration	0.681	0
NEP indicators	NEPModification	0.423	0
	NEPCope	0.471	0
	NEPNaturalLaw	0.295	0
	NEPCatastrophe	0.485	0
Latent factors	Affect	0.159	0.004
	Cognition	0.458	0
	Conation	0.76	0
	Behaviour	0.183	0.05

4. General-Specific Attitude & Behaviour – MIMIC

Table A12. 14 Overall goodness-of-fit of the MIMIC attitude-behaviour model 1 of farmers with forest fragments ≥ 1 ha, distinguishing between farmers with forest by choice and farmers with forest by chance (grouping variable *ForestInfluence*).

	MIMIC model 1
N	356
Chi-square	166.530
df	101
p	0.0000
# free parameters	105
CFI	0.988
TLI	0.9921
RMSEA	0.043
WRMR	0.942

[a]: a model is not rejected if CFI/TLI >0.95, RMSEA<0.06, WRMR<1.0. Models with a robust χ^2 p value $\geq$ 0.05 would be preferred to models with a significant χ^2 p value.

[b]: Under WLSMV, the degrees of freedom are not computed as usual; see Mplus Technical Appendices (Muthén 1998-2004, p. 19-20) for the formula.

Table A12. 15 Indirect effects of *ForestInfluence* on *conation* and *behaviour* via NEP, *affect* and *cognition* in MIMIC model 1. Sample of farmers with forest fragments ≥ 1 ha, distinguishing between farmers with forest by choice and farmers with forest by chance (N = 356).

Indirect Effect	Unstandardized estimate	P value	Standardized estimate
ForestInfluence => Conation	0.186	0.000	0.408
ForestInfluence => Behaviour	0.050	0.022	0.106

Table A12. 16 Amount of variance (R-square) accounted for in the attitudinal and behavioural indicators and latent factors by the MIMIC model 1 of farmers with forest fragments ≥ 1 ha (N = 356).

Variable Groups	Variables	R-square
Affect indicators	EnjoyForest	0.927
	ChildEnjForest	0.412
Cognition indicators	ForestNatural	0.306
	ForestUseful	0.254
	ForestDecline	0.545
	ForestHelpBird	0.460
Conation indicators	Conservation	0.352
	MoreForest	0.193
	Tree Planting	0.133
Behaviour indicators	Fencing	0.407
	PestControl	0.075
	ForestProtection	0.606
Biospheric Concern indicators	SchPlant	0.835
	SchMarine	0.812
	SchBird	0.864
	SchAnimal	0.830
Egoistic Concern indicators	SchMe	0.932
	SchLifestyle	0.862
	SchHealth	0.872
	SchFuture	0.808
Altruistic Concern indicators	SchMyCountryPeople	0.952
	SchAllPeople	0.863
	SchChildren	0.796
	SchGeneration	0.681
NEP indicators	Modification	0.406
	Cope	0.496
	NaturalLaw	0.278
	Catastrophe	0.488
Latent factors	NEP	0.054
	Affect	0.266
	Cognition	0.527
	Conation	0.825
	Behaviour	0.174

V. Effects of situational variables on the attitude-behaviour relationship in farmers with forest fragments ≥ 1 ha

3. Results

Table A12. 16 Sample of farmers with forest. Overall goodness-of-fit of the best models assessing the effects of the situational variables on the attitude – behaviour model of farmers with forest fragments ≥ 1 ha.

Variable group [a]	N	Chi-square	df [b]	p	# free param. [c]	CFI	TLI	RMSEA	WRMR	# succ. comp. [c]
Direct Contact Forest	349	173.957	110	0.0001	106	0.988	0.991	0.041	0.966	NA
Recreational Activities	335	148.480	100	0.0012	104	0.990	0.993	0.038	0.889	NA
Farmer's characteristics MI [c]	361	NA [c]	NA	NA	106	0.989 ±0.001	0.991 ±0.000	0.041 ±0.001	0.963 ±0.009	7 out of 7
Farm Characteristics MI [c]	359	NA	NA	NA	109	0.989 ±0.000	0.992 ±0.000	0.039 ±0.001	0.948 ±0.005	7 out of 7
Family Influence MI [c]	357	NA	NA	NA	115	0.989 ±0.001	0.991 ±0.001	0.038 ±0.001	0.963 ±0.012	7 out of 7
Farmer Influence	360	175.292	107	0.0000	112	0.987	0.990	0.042	0.946	NA
Knowledge	361	190.162	108	0.0000	109	0.985	0.989	0.046	0.992	NA
RC conservation efforts [c]	359	164.866	103	0.0001	105	0.988	0.992	0.041	0.921	NA
Fragment Features MI [c]	340	NA	NA	NA	104	0.989 ±0.000	0.992 ±0.000	0.039 ±0.001	0.931 ±0.006	7 out of 7

[a]: a model is not rejected if CFI/TLI >0.95, RMSEA<0.06, WRMR<1.0. Models with a robust χ^2 p value $\geq$ 0.05 would be preferred to models with a significant χ^2 p value.

[b]: Because the Chi-square degrees of freedom are adjusted for the WLSMV estimator to obtain a correct p-value, they differ across the imputations replications; hence Mplus does not provide an average Chi-square value (Muthén 2007).

[c]: MI stands for multiple imputation, 'RC conservation efforts', for respondents' perceptions of Regional Council conservation efforts; NA, for non-applicable, # free param., for numbers of free parameters and # succ. comp., for numbers of successful computations.

Table A12. 17 Sample of farmers with forest. Overall goodness-of-fit of the best models assessing the effects of the situational variables on the attitude – behaviour model of farmers with forest fragments ≥ 1 ha by choice and with forest by chance.

Variable group [a]	N	Chi-square	df [b]	p	# free param. [c]	CFI	TLI	RMSEA	WRMR	# succ.l comp. [c]
Direct Contact Forest	344	177.168	113	0.0001	109	0.988	0.99	0.041	0.975	NA
Recreational Activities	331	151.958	102	0.0010	107	0.990	0.993	0.038	0.910	NA
Farmer's characteristics MI [c]	361	NA [c]	NA	NA	109	0.990 ±0.001	0.992 ±0.001	0.038 ±0.001	0.954 ±0.012	7 out of 7
Farm Characteristics MI [c]	359	NA	NA	NA	111	0.991 ±0.000	0.992 ±0.000	0.036 ±0.001	0.932 ±0.005	7 out of 7
Family Influence MI [c]	357	NA	NA	NA	118	0.990 ±0.000	0.992 ±0.000	0.036 ±0.001	0.958 ±0.008	7 out of 7
Farmer Influence	355	173.427	110	0.0001	115	0.988	0.991	0.040	0.946	NA
Knowledge	356	198.922	112	0.0000	112	0.985	0.988	0.047	1.015	NA
RC conservation efforts [c]	354	167.054	105	0.0001	107	0.989	0.992	0.041	0.943	NA
Fragment Features MI [c]	340	NA	NA	NA	107	0.990 ±0.001	0.993 ±0.000	0.037 ±0.001	0.928 ±0.009	7 out of 7

[a]: a model is not rejected if CFI/TLI >0.95, RMSEA<0.06, WRMR<1.0. Models with a robust χ^2 p value $\geq$ 0.05 would be preferred to models with a significant χ^2 p value.

[b]: Because the Chi-square degrees of freedom are adjusted for the WLSMV estimator to obtain a correct p-value, they differ across the imputations replications; hence Mplus does not provide an average Chi-square value (Muthén 2007).

[c]: MI stands for multiple imputation, 'RC conservation efforts', for respondents' perceptions of Regional Council conservation efforts; NA, for non-applicable, # free param., for numbers of free parameters and # succ. comp., for numbers of successful computations.

a. **How the situational variables affect the consistency between the attitudinal variables and between the attitudinal and behavioural variables**

i. **On the whole sample of farmers with fragments ≥ 1 ha**

Table A12. 189 Standardized regression coefficients (direct effects) between attitudinal variables and between attitudinal and behavioural variables of farmers with forest fragments ≥ 1 ha when each of the group of situational variables is taken into account. The corresponding unstandardized regression coefficients are significant at $p \leq 0.10$, except for ^{1}: $0.10 < p \leq 0.15$, ^{2}: $0.15 < p \leq 0.20$ and ^{3}: $p > 0.20$.

Variable group	Significant Standardized Regression Coefficient											
	Bio[a] ->Cog[a]	Bio->Aff[a]	NEP[a] ->Cog	NEP->Aff	Cog <-> Aff	Bio->Cona[a]	Cog->Cona	Aff->Cona	Cona->Behav[a]	NEP->Behav	Ego->Behav	Alt->Behav
No covariates	*0.264*	*0.215*	*0.527*	*0.261*	*0.538*	*-0.232*	*0.715*	*0.325*	*0.349*	*-0.154*	*-0.386*	*0.373*
Direct Contact Forest	0.251	0.260	0.495	**0.152**	**0.618**	-0.207	0.676	0.372	0.371	-0.202	-0.358	0.345
Recreational Activities	0.290	0.238	0.499	0.244	**0.606**	**-0.306**	0.763	0.377	0.296	-0.118^3	-0.349	0.330
Farmer's characteristics MI[a]	0.267	0.210	0.506	0.293	0.521	-0.222	0.667	0.369	0.354	-0.180	-0.380	0.367
Farm Characteristics MI[a]	0.266	0.197	0.508	0.263	0.542	-0.241	0.727	0.296	**0.287**	**-0.235^1**	**-0.475**	**0.463**
Family Influence MI[a]	0.228	0.217	0.514	**0.131^1**	0.489	-0.225	**0.624**	0.292	0.370	**-0.231^1**	-0.394	0.375
Farmer Influence	0.243	0.186	0.498	0.205	0.531	-0.223	**0.642**	0.282	0.406	-0.139^3	-0.359	0.349
Knowledge	0.244	0.209	0.564	0.270	0.537	-0.241	**0.546**	**0.539**	**0.409**	**-0.218^2**	-0.390	0.397
RC conservation efforts[a]	0.238	0.210	0.539	0.267	0.534	-0.227	0.699	0.344	0.290	-0.098^3	-0.369	0.333
Fragment Features MI[a]	0.257	0.222	0.529	0.296	0.580	-0.233	0.748	**0.234^1**	**0.269**	-0.107^3	**-0.320**	0.325

[a] : From left to right, top to bottom, 'MI' stands for multiple imputation; 'RC conservation efforts', for respondents' perceptions of Regional Council conservation efforts; 'Bio', for Biospheric Environmental Concern; 'Cog', for *Cognition*; 'Aff', for *Affect*; 'NEP' for New Ecological Paradigm; 'Cona', for *Conation*; 'Behav', for Behaviour; 'Ego', for Egoistic Environmental Concern; 'Alt', for Altruistic Environmental Concern. In bold are the differences between the standardized regression coefficients from the simple attitude-behaviour model (1st row) and those from the attitude-behaviour models with situational variables (all other rows) amounting to at least |0.06| units.

ii. Distinguishing between farmers with forest fragments ≥ 1 ha by choice and farmers with forest by chance

Table A12. 20 Standardized regression coefficients (direct effects) between attitudinal variables and between attitudinal and behavioural variables of farmers with forest fragments ≥ 1 ha by choice and with forest by chance when each of the group of situational variables is taken into account. The corresponding unstandardized regression coefficients are significant at $p \le 0.10$, except for [1]: $0.10 < p \le 0.15$, [2]: $0.15 < p \le 0.20$ and [3]: $p > 0.20$.

Variable group	Significant Standardized Regression Coefficient											
	Bio [a] ->Cog [a]	Bio->Aff [a]	NEP [a] ->Cog	NEP->Aff	Cog <-> Aff	Bio->Cona [a]	Cog->Cona	Aff->Cona	Cona->Behav [a]	NEP->Behav	Ego->Behav	Alt->Behav
No covariates	*0.270*	*0.202*	*0.477*	*0.221*	*0.484*	*-0.233*	*0.730*	*0.341*	*0.394*	*-0.236*	*-0.332*	*0.337*
Direct Contact Forest	0.249	0.241	0.455	**0.130**	**0.599**	-0.193	0.688	0.368	0.383	-0.242	-0.321	0.308
Recreational Activities	0.288	0.224	0.455	0.211	**0.568**	-0.291	**0.790**	0.349	**0.319**	**-0.154[3]**	**-0.276**	**0.261[2]**
Farmer's characteristics MI [a]	0.264	0.202	0.468	0.247	0.495	-0.221	0.672	0.367	0.348	-0.201[2]	-0.378	0.373
Farm Characteristics MI [a]	0.269	0.196	0.459	0.216	0.518	-0.235	0.731	0.292	**0.271**	-0.231[1]	**-0.460**	**0.449**
Family Influence MI [a]	0.232	0.203	0.480	**0.127[1]**	0.468	-0.222	**0.631**	0.284	0.346	-0.228[1]	**-0.397**	0.377
Farmer Influence	0255	0.178	0.443	0.179	0.500	-0.224	0.672	**0.273**	0.446	-0.208[2]	-0.322	0.332
Knowledge	0.249	0.191	0.517	0.230	0.472	-0.230	**0.608**	**0.471**	0.436	-0.276[1]	-0.344	0.359
RC conservation efforts [a]	0.241	0.193	0.498	0.233	0.497	-0.215	0.702	0.346	**0.321**	**-0.151[3]**	-0.323	0.295[1]
Fragment Features MI [a]	0.250	0.207	0.485	0.262	**0.554**	-0.228	0.751	**0.226[2]**	**0.263**	**-0.117[3]**	-0.316	0.321

[a] : From left to right, top to bottom, 'MI' stands for multiple imputation; 'RC conservation efforts', for respondents' perceptions of Regional Council conservation efforts; 'Bio', for Biospheric Environmental Concern; 'Cog', for *Cognition*; 'Aff', for *Affect*; 'NEP' for New Ecological Paradigm; 'Cona', for *Conation*; 'Behav', for Behaviour; 'Ego', for Egoistic Environmental Concern; 'Alt', for Altruistic Environmental Concern. In bold are the differences between the standardized regression coefficients from the simple attitude-behaviour model (1st row) and those from the attitude-behaviour models with situational variables (all other rows) amounting to at least |0.06| units.

b. **Effects of the situational variables on farmers' attitude and behaviour towards the natural environment.**

i. **Hypotheses evaluation**

Table A12. 19 Standardized regression coefficients (direct and indirect effects) of the situational variables on the attitude-behaviour model of farmers with forest fragments $\geq$ 1 ha when each of the group of situational variables is taken into account. Covariates effects are significant at $p \leq 0.10$, except for [1]: $0.10 < p \leq 0.15$, [2]: $0.15 < p \leq 0.20$ and [3]: $p > 0.20$.

Variable group	Variable	Significant Standardized Regression Coefficient									
		Biospheric	Altruistic	Egoistic	NEP	Affect	Cognition	Conation	Cona (Ind) [a]	Behaviour	Behav (Ind) [a]
Direct Contact Forest	VisitAsChild	ns [a]	ns	ns	ns	0.356	ns	ns	0.132	ns	0.049
	FrequencyVisit	ns	ns	ns	ns	0.389	0.268	ns	0.326	ns	0.121
	FrequencyUse	ns	ns	ns	ns	ns	ns	-0.231	na [a]	ns	-0.079
Recreational Activities	Walk-Tramp	ns	ns	ns	ns	0.381	0.171	ns	0.274	ns	0.081
Farmer's characteristics MI [a]	Age	ns	ns	ns	ns	ns	0.224	ns	0.150	ns	0.053
	Farm Income	ns	ns	ns	-0.184	ns	ns	ns	-0.082	-0.134[2]	ns
	Yrs Farming	-0.168	ns	ns	ns	ns	ns	ns	ns	ns	ns
Farm Characteristics MI [a]	Farm Size	ns	ns	ns	ns	ns	-0.196	ns	-0.143	-0.169	-0.041
	Organic	ns	ns	0.145	0.257	ns	ns	ns	0.115	0.166[1]	-0.097
	Export	ns	ns	ns	-0.139	ns	ns	ns	-0.062	ns	ns
Family Influence MI [a]	Parent EC [a]	ns	ns	ns	ns	0.313	0.165	ns	0.194	ns	0.072
	Child Invt Farm [a]	ns	ns	ns	-0.215	ns	ns	ns	-0.077	ns	ns
	Make Mind	ns	ns	ns	0.320	0.306	ns	ns	0.205	ns	ns
	Environmental Talk	0.154	ns	ns	ns	ns	0.190	0.265	0.227	ns	0.143
	ParentFarmer	ns	ns	ns	-0.224	ns	ns	ns	-0.080	-0.200	ns
Farmer Influence	Environmental Talk	ns	ns	0.206	0.238	0276	ns	0.186	0.248	ns	ns
	Make Mind	ns	0.232	ns	ns	ns	0.198	ns	0.127	-0.178	0.133
Knowledge	Envtly Informed [a]	ns	ns	ns	ns	0.391	ns	ns	0.211	ns	0.086
	EcoLit [a]	0.176	0.137	ns	0.473	ns	ns	ns	0.266	ns	ns
RC conservation efforts [a]	RC Encouragement [a]	ns	0.101	ns	ns	ns	0.241	ns	0.169	0.179	0.083
Fragment Features MI [a]	Steep	ns	ns	ns	ns	ns	ns	ns	na	-0.259	na
	RatioFrag/FarmSize	ns	ns	ns	ns	ns	ns	ns	na	0.207	na

[a] : From left to right, top to bottom, 'MI' stands for multiple imputation; 'RC conservation efforts', for respondents' perceptions of Regional Council conservation efforts; 'Parent EC', for respondents' parents environmental concern; 'Child Invt Farm', for respondents' children's involvement on the farm; 'Envtly Informed', for environmentally informed; 'EcoLit', for ecological literacy; 'RC Encouragement', for Regional Council encouragement; 'ns', for non-significant; 'NEP, for New Ecological Paradigm; 'ns', for non-significant; 'na', for non-applicable; 'Cona (Ind)', for sum of indirect effects on Conation; 'Behav (Ind)', for sum of indirect effects on Behaviour.

Table A12. 20 Standardized regression coefficients (direct and indirect effects) of the situational variables on the attitude-behaviour model of farmers with forest fragments ≥ 1 ha by choice and with forest by chance when each of the group of situational variables is taken into account. Covariates effects are significant at $p \leq 0.10$, except for [1]: $0.10 < p \leq 0.15$, [2]: $0.15 < p \leq 0.20$ and [3]: $p > 0.20$.

Variable group	Variable	Significant Standardized Regression Coefficient									
		Biospheric	Altruistic	Egoistic	NEP	Affect	Cognition	Conation	Cona(Ind) [a]	Behaviour	Behav(Ind) [a]
No covariates	*ForestInfluence*	*ns* [a]	*ns*	*ns*	*0.232*	*0.331*	*0.27*	*ns*	*0.408*	*ns*	*0.106*
Direct Contact Forest	VisitAsChild	ns	ns	ns	ns	0.362	ns	ns	0.133	ns	0.051
	FrequencyVisit	ns	ns	ns	ns	0.346	0.203	ns	0.267	ns	0.102
	FrequencyUse	ns	ns	ns	ns	ns	ns	-0.263	na [a]	ns	-0.101
	ForestInfluence	ns	ns	ns	0.199	0.156	0.225	ns	0.284	ns	0.06
Recreational Activities	Walk-Tramp	ns	ns	ns	ns	0.334	0.105[1]	ns	0.2	ns	0.064
	ForestInfluence	ns	ns	ns	0.219	0.205	0.236	ns	0.353	ns	0.079
Farmer's characteristics MI	Age	ns	ns	ns	ns	ns	0.181	ns	0.122	ns	0.043
	Farm Income	ns	ns	ns	-0.14	ns	ns	ns	-0.057	-0.116[3]	ns
	Yrs Farming	-0.15	ns	ns	ns	ns	ns	ns	ns	ns	ns
	ForestInfluence	ns	ns	ns	0.18	0.284	0.225	ns	0.329	ns	0.079
Farm Characteristics MI [a]	Farm Size	ns	ns	ns	ns	ns	-0.175	ns	-0.128	-0.167	ns
	Organic	ns	ns	0.151	0.204	ns	ns	ns	0.081	0.136[2]	-0.095
	Export	ns	ns	ns	-0.112[1]	ns	ns	ns	ns	ns	ns
	ForestInfluence	ns	ns	ns	0.129	0.271	0.233	ns	0.301	ns	0.052
Family Influence MI [a]	Parent EC [a]	ns	ns	ns	ns	0.3	0.152	ns	0.181	ns	0.063
	Child Invt Farm [a]	ns	ns	ns	-0.223	ns	ns	ns	-0.075	ns	ns
	Make Mind	ns	ns	ns	0.273	0.258	ns	ns	0.167	ns	ns
	Environmental Talk	0.134	ns	ns	ns	ns	0.143	0.254	0.173	ns	0.117
	ParentFarmer	ns	ns	ns	-0.187	ns	ns	ns	ns	-0.17	ns
	ForestInfluence	ns	ns	ns	0.138	0.204	0.181	ns	0.218	ns	ns
Farmer Influence	Environmental Talk	ns	ns	0.203	0.184	0.233	ns	0.18	0.208	ns	ns
	Make Mind	ns	0.228	ns	ns	ns	0.192	ns	0.129	-0.206	0.133
	ForestInfluence	ns	ns	ns	0.173	0.238	0.238	ns	0.285	ns	0.091
Knowledge	Envtly Informed [a]	ns	ns	ns	ns	0.314	ns	ns	0.148	ns	0.065
	EcoLit	0.163	0.133	ns	0.453	ns	ns	ns	0.225	ns	ns
	ForestInfluence	ns	ns	ns	0.153	0.278	0.227	ns	0.334	ns	0.103
RC conservation efforts [a]	RC Encouragement [a]	ns	ns	ns	ns	ns	0.2	ns	0.14	0.193	0.045
	ForestInfluence	ns	ns	ns	0.223	0.271	0.222	ns	0.345	ns	0.077
Fragment Features MI [a]	Steep	ns	ns	ns	ns	ns	ns	ns	na	-0.253	ns
	RatioFrag/FarmSize	ns	ns	ns	ns	ns	ns	ns	na	0.17	na
	ForestInfluence	ns	ns	ns	0.209	0.248	0.25	ns	0.332	ns	0.063

[a] : From left to right, top to bottom, 'MI' stands for multiple imputation; 'RC conservation efforts', for respondents' perceptions of Regional Council conservation efforts; 'Parent EC', for respondents' parents environmental concern; 'Child Invt Farm', for respondents' children's involvement on the farm; 'Envtly Informed', for environmentally informed; 'EcoLit', for ecological literacy; 'RC Encouragement', for Regional Council encouragement; 'ns', for non-significant; 'NEP, for New Ecological Paradigm; 'ns', for non-significant; 'na', for non-applicable; 'Cona (Ind)', for sum of indirect effects on Conation; 'Behav (Ind)', for sum of indirect effects on Behaviour.

ii. Best predictors of attitudinal and behavioural variables

Table A12. 21 Variance explained in the attitudinal and behavioural variables of farmers with forest fragments ≥ 1 ha by each group of situational variables. The amounts of variance explained in *affect*, *cognition*, *conation* and behaviour are compared with those found in the attitude-behaviour model.

Variable group	Variable	% Variance Explained							
		Biospheric	Altruistic	Egoistic	NEP	Affect	Cognition	Conation	Behaviour
Direct Contact Forest	VisitAsChild FrequencyVisit FrequencyUse	0	0	0	0	+33.1	+1.9	+1.1	0.0
Recreational Activities	Walk-Tramp	0	0	0	0	+15.3	+3.1	+14.2	-4.2
Farmer's characteristics MI [a]	Age Farm Income Yrs Farming	2.9	0	0	3.4	+1.6	+1.7	-0.9	+1.9
Farm Chara[c]teristics MI [a]	Farm Size Organic Export	0	0	2.1	10.5	-1.3	+2.6	-2.2	+5.4
Family Influence MI [a]	Parent EC [a] Child Invt Farm [a] Make Mind Environmental Talk ParentFarmer	2.4	0	0	20.1	+18.5	+6.5	+3.1	+4.2
Farmer Influence	Environmental Talk Make Mind	0	5.4	4.3	5.7	+4.9	+1.2	-2.4	+0.4
Knowledge	Envtly Informed [a] EcoLit [a]	3.1	1.9	0	22.4	+18.8	+3.2	+3.7	+3.8
RC conservation efforts [a]	RC Encouragement [a]	0	1	0	0	+0.1	+5.0	-0.3	+2.8
Fragment Features MI [a]	Steep RatioFrag/FarmSize	0	0	0	0	+3.0	-0.5	-5.3	+3.0

[a] : From left to right, top to bottom, 'MI' stands for multiple imputation; 'RC conservation efforts', for respondents' perceptions of Regional Council conservation efforts; 'Parent EC', for respondents' parents' environmental concern; 'Child Invt Farm', for respondents' children's involvement on the farm; 'Envtly Informed', for environmentally informed; 'EcoLit', for ecological literacy; 'RC Encouragement', for Regional Council encouragement; 'NEP, for New Ecological Paradigm.

Table A12. 22 Variance explained in the attitudinal and behavioural variables of farmers with forest fragments ≥ 1 ha by each group of situational variables. The amounts of variance explained in *affect*, *cognition*, *conation* and behaviour are compared with those found in the attitude-behaviour model.

Variable group	Variable	% Variance Explained							
		Biospheric	Altruistic	Egoistic	NEP	Affect	Cognition	Conation	Behaviour
Direct Contact Forest	VisitAsChild FrequencyVisit FrequencyUse ForestInfluence	0	0	0	4.0	+35.4	+6.2	+3.1	-1.1
Recreational Activities	Walk-Tramp ForestInfluence	0	0	0	4.8	+18.1	+6.8	+16.8	-6.5
Farmer's characteristics MI [a]	Age Farm Income Yrs Farming ForestInfluence	2.3	0	0	6.1	+9.0	+5.6	+1.5	+0.9
Farm Characteristics MI [a]	Farm Size Organic Export ForestInfluence	0	0	2.3	10.3	+5.3	+6.8	0.0	+3.3
Family Influence MI [a]	Parent EC [a] Child Invt Farm [a] Make Mind Environmental Talk ParentFarmer ForestInfluence	1.8	0	0	19.7	+20.9	+8.4	+3.8	+2.1
Farmer Influence	Environmental Talk Make Mind ForestInfluence	0	5.2	4.1	7.7	+9.9	+6.1	+2.1	+0.5
Knowledge	Envtly Informed [a] EcoLit [a] ForestInfluence	2.7	1.8	0	24.9	+19.5	+7.7	+4.5	+2.6
RC conservation efforts [a]	RC Encouragement [a] ForestInfluence	0.0	0.0	0	5.0	+6.8	+9.0	+2.9	+0.7
Fragment Features MI [a]	Steep RatioFrag/FarmSize ForestInfluence	0	0	0	+4.5	+8.2	+4.3	-3.9	+1.4

[a] : From left to right, top to bottom, 'MI' stands for multiple imputation; 'RC conservation efforts', for respondents' perceptions of Regional Council conservation efforts; 'Parent EC', for respondents' parents' environmental concern; 'Child Invt Farm', for respondents' children's involvement on the farm; 'Envtly Informed', for environmentally informed; 'EcoLit', for ecological literacy; 'RC Encouragement', for Regional Council encouragement; 'NEP, for New Ecological Paradigm.