



The  
**CLIMPACTS**  
Programme

# Human Dimensions of Global Environmental Change: A Review of Frameworks and Research Gaps

An IGCI Report for FRST

by

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## Glossary of terms and acronyms

- FRST** – The Foundation for Research, Science and Technology. FRST invests in research, science and technology on behalf of the New Zealand Government.
- IHDP** – International Human Dimensions Programme
- ISSC** – International Social Science Council
- LGA** – Local Government Act (2002)
- NRC** – National Research Council
- NSF** – National Science Foundation (USA)
- RMA** – The Resource Management Act (1991)
- UCAR** – University Corporation for Atmospheric Research

**The CLIMFACTS research programme explores the human dimensions of global environmental change**

**A conceptual framework for application in New Zealand is derived from New Zealand and international literature**

## **1. Executive Summary**

This review of current knowledge in, and development of, priorities for research into the human dimensions of global environmental change has been conducted to assist the Foundation for Research Science and Technology to formulate their research needs agenda. An overview of the emergence of the human dimension of the global environmental change research field is used as a prelude to a review of the international literature on frameworks for conducting human dimensions research.

The terminology used in the human dimension field is diverse. An attempt is therefore made to consolidate the myriad of definitions for key concepts, in order to form a basis for human dimensions research in New Zealand and build a platform for the remainder of this report.

Three disciplinary areas of academic inquiry were explored in the context of human dimensions of global environmental change research: economics, law and biological sciences. These disciplinary perspectives are reviewed through the international literature and in a New Zealand context.

A conceptual framework for research into the human dimensions of global environmental change is provided based on the knowledge-base developed from the both international and New Zealand research. Core concepts, such as found in multidisciplinary and transdisciplinary research are reviewed in historical context to form the basis for a specific research framework for New Zealand. Some general needs for research are derived from the New Zealand framework.

The remainder of this report details the methods used for drawing out expert opinion on the priorities for research on the human dimensions of global environmental change in the context of information, knowledge and method. Thirty-eight interviews and two hui were conducted and 254 research needs defined by questions were obtained. A modified Delphi technique was applied to the questions and prioritised lists of responses are provided. The final list

Provides European/Pakeha and Māori perspectives. Divergence and convergence between the European/Pakeha and Māori responses is provided, as well as justification for the prioritisation stance that is taken. This research had four outputs:

- A conceptual framework for considering the human dimensions of global environmental changes and research contributions;
- A description of the gaps in knowledge that impede effective response to global change and provisional research needs: one for New Zealand generally, and one on Māori in particular;
- A network of end-users and research providers that are cognisant of, and contributors to, the human dimensions research assessment;
- A set of priority research needs pertaining to the human dimensions of global environmental change, in a form suitable for use by FRST.

**Over 250 research needs were identified and collated to form core research areas spanning European/Pakeha and Māori perspectives**

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**The concept of global environmental change emerged in the 1980s**

**Social scientists' first attempts at establishing a research agenda were focused on complimenting the natural and physical sciences**

**High quality examples of fully implemented frameworks for conducting human dimensions research are lacking**

## 2. Introduction

The purpose of this report is to provide a framework for carrying out research on the human dimensions of global environmental change in New Zealand. The concept of global environmental change research emerged in the mid 1980s with the adoption of a resolution by the International Social Science Council to establish an *ad hoc* committee to explore the possibility of establishing a social science research programme to parallel the International Geosphere-Biosphere Programme: A Study of Global Change (IGBP) of the International Council of Scientific Unions (ICSU), as it was clear that human activities had become an important, if not pre-eminent, driving force behind global change.

First attempts by members of the social sciences (plural because there are multiple methodological approaches to human phenomena) at formulating an agenda for research were established as separate from the physical sciences. Social scientists sought to establish an international and interdisciplinary research agenda that was to “complement natural science research on changes in the earth’s physical and chemical and biological systems”. This initial framework, while commendable in its time, has been superseded by theoretical and methodological perspectives that are transdisciplinary in nature and that call for engagement at all levels of a research project’s development, implementation, interpretation and reporting with a range of social and physical sciences.

Frameworks for conducting human dimensions research have been developed by different organisations and individuals with various training, experience and agendas. In many cases the frameworks sit uncomfortably within the dominant research traditions of the academe and high quality examples of fully implemented and *successful*<sup>1</sup> application of published frameworks are scant (Carpenter *et al.*, 1999; Grant *et al.*, 2002).

<sup>1</sup> For our purposes we define ‘successful’ as outputs from the research entering the peer reviewed research publication stream. A further measure of success could be integration of the outcomes of such research into the policy (debate) arena.

In this report we present definitions of human dimensions and global environmental change, followed by a brief overview of the major thrusts of existing frameworks and country programmes in research on the human dimensions of global environmental change. We describe a framework for application in New Zealand and report on work already being done in New Zealand that is within the framework's structure. We believe that presentation of the framework and research will form an important basis for the identification of gaps in knowledge that may become priorities for the Foundation for Research Science and Technology (FRST) to address in their funding directives.

There has been a remarkable high level of scientific activity in the arena of global environmental change, but not its human dimensions. Under the rubrics of the International Geosphere-Biosphere Programme (IGBP), the World Climate Research Programme (WCRP) and the Intergovernmental Panel on Climate Change there has been a great deal of international cooperation among researchers in the atmospheric, earth and biological sciences (Intergovernmental Panel on Climate Change 2001; Houghton et al., 1990; Houghton, Intergovernmental Panel on Climate Change. Working Group 1. *et al.*, 1995). From the early days of scientific concern about global warming and ozone depletion there has also been some interest in the social implications of these processes because people are seen as both the cause of the effects and the subjects of their consequences (Kates et al. 1985; Clark and Munn 1986; Riebsame 1988). However, this interest, while it has persisted, has not always been sustained. An early attempt to develop a Human Dimensions Programme (HDP) to parallel the IGBP and the WCRP had only limited success. Recently, there has been renewed interest and a new version of HDP and an International Human Dimensions Programme (IHDP) has been established to build upon the work of the original organisation. As well, the IPCC has more aware of the need to consider human dimensions in its reports, as is UNEP for its Global Environment Outlook reporting.

In New Zealand, there is a relatively high level of public interest in global environmental change issues. In particular, there is considerable concern about ozone depletion and New Zealand's very high rates of skin cancer, and to a lesser extent there is concern about the implications of global warming on

**From the early days of scientific concern about global warming and ozone depletion there has also been interest in the social implications of these processes**

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**There is a relatively high level of public interest in global environmental change issues in New Zealand**



natural and social systems. As of 2005, this interest is not, however, reflected in a major research thrust within the social sciences. While a small flurry of activity on the human dimensions of global environmental change occurred in the late 1980s and early 1990s, such as through the climate change impacts and policy series of the Ministry for the Environment, it does not by 2005 appear to have been sustained. The one area where there is considerable research interest, supported by public funding, is in local and regional planning under the *Resource Management Act* (1991), which has the concept of “sustainable management” as its guiding principle (Ericksen, *et al.*, 2003).

Both generally and in New Zealand there is considerable research interest in global change themes, such as changes in the variety, range, proportions and distributions of life forms, land cover and land use change, toxification of ecosystems by pollution and changes in atmospheric conditions. However, the great majority of this research interest is in the natural and physical sciences, and is impact-based while little research is conducted on the human dimensions of these processes.

### ***The 1988 Symposium***

The first important activity involving social scientists in global change research was a symposium held late in 1988, which was sponsored by the Social Science Research Fund Committee (SSRFC). The symposium, *The Human Dynamics of Climate Change in New Zealand: Research Needs and Strategies*, identified a number of issues which its participants considered were important for climate change research in New Zealand. The first set of issues focused on the need for much closer examination of climate change information, including: how it is produced, who holds what information, the directions in which it flows, and how it can be most usefully made available to various users (community, policy makers, scientists, etc.). A second set of issues was concerned with the need for further research on the problems of the discontinuities that exist between disciplinary perspectives, especially where the research problem involves highly complex social and natural phenomena. The conference also identified two primary foci for social sciences research into climate change: 1) analysis at the global and national levels of the relations between “actors, power, policies and decision-making processes”; and 2) field-studies at the local and regional (sub-national regions) to investigate how people, institutions and climate interact. The conference concluded

**There is considerable research interest, supported by public funding, in local and regional planning under the 1991 Resource Management Act**

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**The first important activity involving social scientists in global change research was a symposium held late in 1988**

by advocating the establishment of a *Human Dimension of Climate Change in New Zealand Programme* (Social Science Research Fund Committee, 1989). While some of the participants in the Symposium have continued to carry out research on human dimensions of global environmental change, the establishment of the proposed programme did not eventuate, because SSRFC only had \$0.25 million year for its activities, there was no social science infrastructure in place like in the physical sciences to administer funds, and there was no follow through with the Social Science Crown Research Institute, which collapsed soon after its establishment in 1991.

### **3. Definitions**

Definitions of the terms ‘human dimensions’ and ‘global environmental change’ can vary widely and be interpreted in many contexts. Below are the interpretations used by various research programmes and organisations and the definitions we have used in our conceptual framework.

#### ***Human Dimensions***

Implicit in much of the work in human dimensions research is the notion of some kind of human-environment interrelationship long explored in geography and human ecology. This relationship ranges, depending on worldview, from an inseparable holism to a distinct and irrevocable dichotomy. There is a need to examine some of the underpinning assumptions about the human-environment (or culture-nature) relationship, especially those which influence research.

There is much debate in the literature on what constitutes ‘human dimensions’ research. For example, the International Human Dimensions Programme (IHDP) defines the human dimensions of global environmental change as the set of biophysical transformations of land, oceans and atmosphere, driven by an interwoven system of human activities and natural processes. The IHDP’s human dimensions comprise the causes and consequences of people’s individual and collective actions, including changes that lead to modifications of the earth’s physical and biological systems. These changes affect the quality of human life and sustainable development on a worldwide scale. Human

human-nature system and investigates how individuals and societal groups contribute to, are influenced by, and mitigate and respond to, changes that take place on a local, regional and global level (IHDP, 2002).

Miller (2000) cites several definitions of human dimensions. In the UCAR/NSF Cooperative Agreement, human dimensions of atmospheric science research includes research on:

- 1) the impacts of climate and meteorological processes on society, both directly and through impacts on natural systems;
- 2) anthropogenic influences on the climate system;
- 3) societies' ability to cope with climate-related impacts; and,
- 4) the use and value of meteorological information.

Miller also notes the NRC Committee on the Human Dimensions of Global Change definition as being:

. . . the effects of human activity on large physical and biological systems, the impacts of environmental change on people and societies, the responses of social systems to actual or anticipated environmental change, and the interactions among all these processes.

The Conceptual Framework we have adopted for this report defines "human dimensions" as:

- 1) Human impacts on the environment;
- 2) Human dimensions as drivers of global environmental change; and,
- 3) Behaviour modification in response to global environmental change.

This view of human dimensions is chosen for its inclusiveness and wide adoption throughout the international literature.

**Worldviews range from inseparable holism to distinct dichotomies**

**Changes in people's individual and collective actions affect the quality of human life**

**Globalisation is likely to be heavily implicated in global environmental change**

**Distinguishing the local from the global is becoming increasingly difficult**

### ***Global Environmental Change***

An important issue is what is meant by the term global environmental change. A key question is whether or not it is necessary to distinguish global from local or non-global forms of change, especially from the human dimension? It could be strongly argued that the processes of globalisation affect all societies and drive a great proportion of social and environmental change. Therefore, all change is in essence global. Global social and economic processes may indeed be more far reaching, pervasive, and detrimental than global environmental change. Moreover, processes of globalisation are likely to be heavily implicated in global environmental change. Such is the complexity of global linkages that distinguishing the local from the global is likely to become increasingly difficult.

The meaning of global environmental change can therefore be ambiguous. Examples of definitions include:

- Those environmental changes that occur at a global level and affect the total global system, and those that occur at local or regional levels, but have consequences for the total global system (UK Global Environmental Research (GER) Office and UK Inter-Agency Committee on Global Environmental Change, 1993);
- A term intended to encompass the full range of global issues and interactions concerning natural and human induced changes in the Earth's environment (Council, 1994);
- Changes in the global environment including alterations in climate, land productivity, oceans or other water resources, atmospheric chemistry, and ecological systems that may alter the capacity of the Earth to sustain life (The [US] Global Change Research Act of 1990; Council, 1994); and,
- Research that seeks to understand the integrated Earth system in order to: (i) identify, explain and predict natural and anthropogenic changes in the global environment; (ii) assess the potential regional and local impacts of those changes on natural and human systems; and (iii) provide a scientific basis for the development of appropriate technical, economic and societal mitigation/adaptation strategies (European Commission's European Network for Research in Global Change).

Our conceptual framework and assessment will be focusing on the impacts of global environmental change on New Zealand's socio-economic balances such as sustainable development, industrial development, human health and quality of life (among others) with a special emphasis on climate change and biodiversity. Thus, we have used the following definition of global environmental change:

Global environmental change research is an assessment of the impact of global change phenomena on the global, regional and local physical and social environment and in the context of past, present and future natural changes. Global environmental change research also includes research on how past, present and future activities in the local or regional physical and social environment impact on and cause changes in global phenomena and the global environment.

The *Encyclopaedia of Global Change* (Goudie and Cuff, 2002) deems global environmental change to be synonymous with global change. We do not suggest the same interchangeable use of these terms be adopted in New Zealand. Increasingly, global change is being subsumed under the rubric of globalisation therefore drawing emphasis away from the environmental parameters that should remain in focus.

More specific definitions of components within the genera of human dimensions research are detailed to establish common ground. The following definitions of mitigation, adaptation, anticipatory adaptation, ultimate and proximate causes and vulnerability are less controversial and are thus drawn directly from the human dimensions education program developed by Clark University (Archer and Turner II, 1999).

**Mitigation:** describes an action that prevents, limits, delays, or slows the rate of undesired impacts by acting either on the environmental system, the human proximate forces, or the human systems that drive environmental change. Using climate change as an example, humans could intervene on the environmental system by blocking solar radiation with orbiting particles that reflect solar

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**The meaning of global environmental change can be ambiguous**

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**The *Encyclopaedia of Global Change* deems global environmental change to be synonymous with global change**

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**Our conceptual framework and assessment will be focusing on the impacts of global environmental change on New Zealand's socio-economic balances**

radiation. Humans could also intervene on the proximate forces by regulating automobile use to control CO<sub>2</sub> emissions. Lastly, humans could intervene in human systems by investing in research on renewable energy sources.

**Adaptation:** To date there has been considerably more research into limitation options (with respect to climate change) than has been the case with adaptive processes. This is understandable: under the Framework Convention for Climate Change, countries are required to report on greenhouse gas emissions, deforestation rates and the like. As well there is considerably greater advocacy from environmentalists and other concerned groups for policy measures that will reduce the rates of environmental change and therefore offset the need for adaptation.

However, progress on limitation has been very slow and significant progress in achieving reductions in the rate of global change seems some way off. For countries which have little direct control over the rates of limitation of global change, adaptive preparedness should also be given priority. From the human dimensions perspective, priority areas for adaptation research should include building understanding of adaptation processes, rather than simply focussing on specific adaptations. For example, Figure 1 shows that the effects of global change are likely to range from direct effects (which are mostly in the form of environmental change) through indirect effects (which are mostly in the form of societal 'impacts'). Adapting to global change will involve choices as to the point of intervention (natural ecosystems through social systems). Societal adaptations are likely to be the more flexible (especially if environmental effects continue to occur), yet most research to date has focused on the environmental component.

Adaptation is another action that humans may undertake in response to environmental change. Adaptation includes activities such as blocking or adjusting to environmental changes. Blocking is an action that prevents the change from having an impact on a valued environmental system. Unlike mitigation, blocking does not prevent the undesired event from occurring; rather it prevents it from affecting something that human's value. For example, farmers may introduce drought resistant crops to block the effects of climate change on the agricultural system. Adjusting neither prevents a change from occurring, nor

**Achieving reductions in the rate of global change seems some way off**

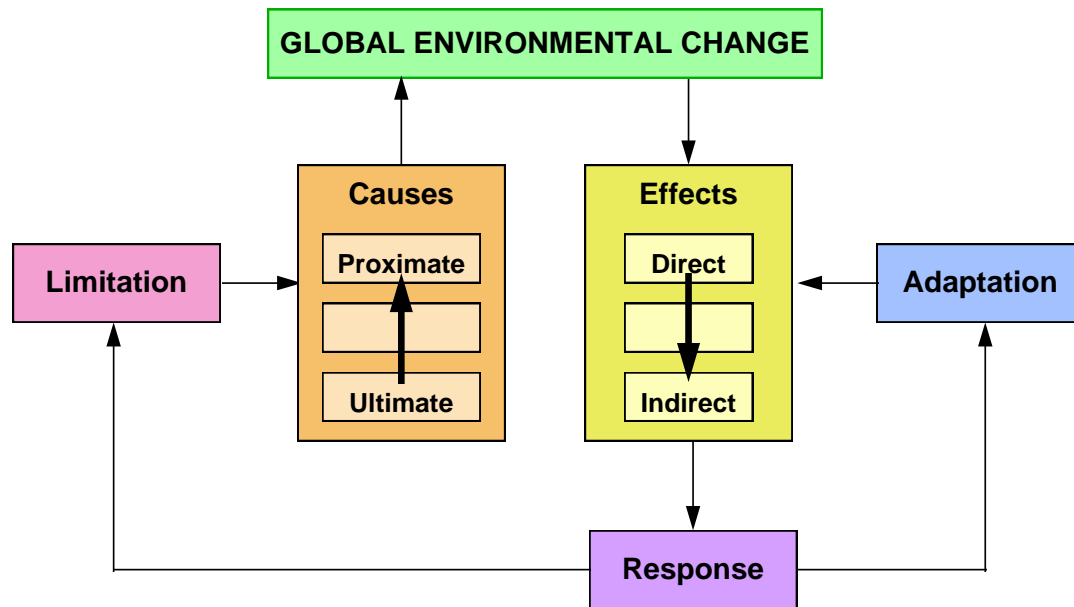
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**Adaptation is another action that humans may undertake in response to environmental change**

does it prevent it from affecting a valued environmental system. Rather, an adjustment is a response to the occurrence of the change. For example, humans may adjust to sea level rise by migrating away from low-lying coastal areas.

**Anticipatory Adaptation:** A variation of adaptation is anticipatory adaptation in which actions are undertaken to improve the ability of social systems to withstand environmental change before it occurs. For example, farmers may choose to diversify their agricultural systems by growing polycultures which may be more robust to the effects of environmental changes. When climate change occurs, the risk of total crop failure and possible famine would be reduced as a result of the anticipatory action taken by the farmer.

**Ultimate and Proximate Causes:** Much of the research focus on climate change effects has been on what might be termed direct (or first order) impacts (see Figure 1). This has resulted in an emphasis on earth science and biological science research activities at the expense of social science input. What research has been carried out with respect to adaptation has therefore tended to focus on physical or biological responses (e.g., coastal protection, development of resistant crops). Similarly, much of the research into limitation responses has been centred on technical solutions to greenhouse gas emission problems. As Figure 1 indicates, global change causes may be distinguished in terms of their immediacy. Thus, the proximate causes of global warming may be identified as increasing greenhouse gas emissions, deforestation and the like. However, when we examine the causes behind these processes we uncover other higher order factors such as increasing materialism and population growth. Ultimately, limiting global change is likely to result from changes to these higher order processes rather than those which are more proximate.



**Figure 1. An approach to the human dimensions of global change.** Both causes and effects of global change are shown as having multiple and hierarchical elements. Human dimensions may be found at the “top” of these hierarchies. For example the ultimate causes of global change are human in origin and the outcomes of global change effects are also very much effects on humans. Policy interventions in global change are likely to be more effective if focused on these human dimensions.

The following are critical questions to emerge:

- Why are the changes occurring?
- Why are societies at risk?
- How are societies and economies affected?
- Who and what are vulnerable?
- What is the existing capacity to respond?
- How can individuals, organisations and institutions respond more effectively?

**Much of the research into limitation responses has been centred on technical solutions to greenhouse gas emission problems**

**The adverse effects of global change will be unevenly distributed**



**The ultimate causes of global change are human in origin and the outcomes of global change effects are also very much effects on humans**

**Vulnerability:** An important aspect of human dimensions of global change research is that adverse effects of global change will be unevenly distributed. It follows that if those people or groups of people most likely to be negatively affected can be identified, in advance, some actions may be taken to prevent, reduce or ameliorate the negative outcomes. However, vulnerability has proven to be an elusive concept, one that is used very often, but rarely subjected to critical examination. Thus we have a term that means many things to different researchers. New Zealand is diverse physically, culturally, socio-economically and politically. How vulnerability is expressed will mirror this diversity and it is at this level that a large research gap exists.

#### 4. Existing Frameworks for Human Dimensions of Global Environmental Change

Human dimensions research on global environmental change has a long history which was only formalised the late 20<sup>th</sup> century through the work of the International Social Science Council (ISSC) Standing Committee on the Human Dimensions of Global Change. Prior understanding of the links between human activity and negative environmental outcomes date back to Plato's *Critias* (427-347 BC) when he described depleted Athenian soils as being unsuitable for the cultivation of timber (Jonkers 1989). In the Middle Ages (410-1485) laws were put into place in Europe to limit forest clearance in recognition of the deleterious effects of widespread deforestation. Soil erosion on a global scale was lamented prior to the Second World War (Jacks and Whyte, 1939). The link between local activities and wider environmental change expanded to global proportions in the mid-1950s with the publication of Thomas's (Thomas, et al., 1956) classic *Man's Role in Changing the Face of the Earth*. A second symposium and volume was produced in the late 1960s and at that time social scientists had a greater involvement and introduced demographic parameters, equity issues and the role of economics into equations of global environmental change (Meadows, 1972). In the late 1980s a third symposium was held and led to the publication of Turner's (1990) *The Earth as Transformed by Human Action* based on over 50 years of systematic social and environmental data collection.

At about the same time as Turner's volume appeared, the ISSC published a framework for developing and understanding the effects of human activities on the total earth system, in order to generate broad knowledge on the human dimensions of global environmental change. Over subsequent years the framework has been repeatedly referenced. There are a number of assumptions made by the ISSC in defining its framework for research. Broadly, it defines three fundamental driving factors: 1) the number of human beings and their distribution around the globe; 2) human needs and desires that are conditioned by psychological, cultural, economic and historical factors which motivate

**Human activity and negative environmental outcomes date back to Plato's *Critias* (427-347 BC)**

**There are three fundamental driving factors of global change: population, human needs and desires, and cultural, social, economic and political structures**

**The International Human Dimensions Programme focuses its programmes on examining anthropogenic causes of global change and impacts on people and society**

certain actors to act; and 3) the cultural, social, economic, and political structures and institutions that mediate that behaviour. Research topics identified as priorities included:

- the social dimensions of resource use;
- the perception and assessment of global environmental conditions and change; and,
- the impacts of local, national, and international social, economic, and political structures and institutions on the global environment.

The above were to be explored through the investigation of seven sectors or themes:

- social dimensions of resource use;
- perception and assessment of global environmental conditions and change;
- impacts of local, national, and international social, economic and political structures and institutions;
- land use;
- energy production and consumption;
- industrial growth; and,
- environmental security and sustainable development (Jacobson and Price 1990).

The above seven themes are now the International Human Dimensions Programme's focused programmes with objectives of examining anthropogenic causes of global change, impacts on people and society, and social science research issues in the human dimensions (CIESEN 2003).

The National Research Council of the United States of America (1992) produced a programme on the human dimensions of global change at approximately the same time as the ISSC published their framework. The National Research Council's framework outlined the five principal elements for a comprehensive national research programme on the human dimensions of global change:

- 1) an enlarged programme of investigator-initiated research on the human dimensions of global change;
- 2) a programme of research targeted or focused on selected topics relating to the human dimensions of global change;
- 3) an ongoing federal programme for obtaining and disseminating relevant data;
- 4) a broad-gauged programme of fellowships to expand the pool of talented scientists working in this field; and,
- 5) a network of national centres dedicated to the conduct of research on the human dimensions of global change.

In order to achieve a full understanding of the human dimensions of global change the programme designers recommended research proceed simultaneously along the investigator initiated and targeted or focussed research paths. They also outlined 11 criteria for evaluating and choosing between proposals and seven areas for targeted research. The framework was designed for the American situation and oriented toward the National Science Foundation (NSF), federal agencies and private funding sources (Stern, et al., 1992).

The National Research Council framework has been reviewed and criticised by members of the natural and social scientific community. Some criticisms of this framework include: 1) its lack of detailed familiarity with the natural science background that is essential to the interdisciplinary research the committee advocates; 2) its uncritical acceptance of the way many natural scientists present global environmental change both as a research issue and as a policy concern; 3) its favouring the reductionist theory or nature-driven paradigm, totally ignoring the constructionist or society-driven perspective; 4) its view that building integrated models to study the human dimensions of global change is premature given current levels of knowledge; 5) its failure to aggregate or weight research criteria so as to establish priorities; 6) its lack of distinction between interdisciplinary and multidisciplinary research; and 7) its poor understanding of the existing capacity of the research community in this field (Rayner, 1992).

**To achieve a full understanding of the human dimensions of global change the programme designers recommended research proceed simultaneously**

**The National Research Council framework has been reviewed and criticised by members of the scientific community**

**The Foundation for Research,  
Science and Technology is also  
interested in developing its  
awareness and capacity for funding  
human dimensions research**

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The New Zealand Government, through the impetus of the Foundation for Research, Science and Technology, is also interested in developing its awareness of, and capacity for, funding human dimensions research for the benefit of society. In line with what is noted above, that social, cultural, economic, political and institutional elements are all at play in determining the trajectory, scale and pace of change. We have explored three disciplinary areas that are clearly linked with global change issues in New Zealand. These are the fields of economics, law and biological sciences. These reviews explore human dimensions research and frameworks for knowledge generation from the perspective of each discipline.

## 5. What Does the Economic Literature Say?

In economics a number of frameworks are concerned with defining what is included in human dimensions research, and how it is characterised, analysed and reported. The economics literature on the human dimensions of global change focuses on the following themes:

- the costs of global change and the cost of ameliorating global change (Stavins, 1997; Schelling, 1998; Swanson, 1995).
- comparison of attentive policy instruments in response to global change (Nordhaus, 1993a; Kosobud, 1994; Kolstal, 1996; Barbier, et al., 1994).
- analysis of the behaviour of individuals, firms, organisations, sectors and countries to global change (Barrett, 1998a; 1998b; Bohn, 1993; Mendelsohn, et al., 1994; Siebert, 2000).
- analysis of strategic responses to global change (Falk and Mendelsohn, 1993).

Arguably, one of the most coherent economic frameworks for understanding global change is that of global public goods as presented by Kaul, et al. (1999). This approach identifies final global public goods which are 'outcomes' rather than 'goods', and intermediate global public goods, such as international regimes, which contribute to the provision of final public goods.

Another important article is that of Miller (2000) who discusses how researchers frame environmental values. The paper identifies narration, modelling, canonisation and normalisation as four models, of societal processes by which framing can occur.

Economic analysis of the human dimensions of global change emphasises the following:

- behaviour which causes or contributes to global change;
- incentives that lead to behaviour which causes global change; and,
- evaluating alternative policies, goals, instruments and strategies that government can pursue.

**One of the most coherent economic frameworks for understanding global change is that of global public goods**

**Economic analysis of human dimensions emphasise behaviours, incentives and alternative pricing**

**Provision of public goods must address jurisdictional, participation and incentive gaps**

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**Human dimension research can be aimed at one of two levels**

Economic analysis using a public goods framework is helpful. It incorporates costs and benefits that are not recognised appropriately in market prices and which are not usually provided in optimal amounts by a market.

The efficient provision of global public goods requires the addressing of three gaps:

- a jurisdictional gap – the discrepancy between global boundaries of today's policy concerns and the essential national boundaries of policy-making;
- a participation gap – which results from the fact that we live in a multi-actor world but international co-operation is primarily inter-governmental; and,
- an incentive gap – because a moral argument is not enough for countries to correct their international spill-overs or to co-operate for the global public good (Kaul et al., 1999).

Human dimension research by economists is focused at two levels:

- level one focuses on human behaviour which has an environmental impact and the impact of changing the behaviour; and,
- level two focuses on the institutional context of the decisions by individual agents.

Level one research tends to focus on the incentives for agents to behave in adverse ways and the potential for alternative policies and management regimes to improve outcomes. Typical research work in this area is:

1. valuing the consequences of all tentative policy instruments;
2. valuing the benefits of investments in improving environmental outcomes;
3. comparing the performance of alternative resource/environmental management agencies and structures;

4. developing indicators to measure the performance of environmental programmes over time; and,
5. exploration of mechanisms to re-organise the economy-society to make it more sustainable.

The key researchers in this area in New Zealand are Cullen, G. Kerr, S. Kerr, Moyle, Meister, Sharp and Scrimgeour.

Level one research may or may not assume a global problem. It focuses on addressing local/national concerns which may be a manifestation of global concerns.

Level two research focuses on the global policy institutions. It considers how global policies are formulated, including the specification of goals, instruments and enforcement mechanisms. Work in this area has been dominated by people in the international agencies along with contributions from Barrett, Mendelsohn and others. There is no ongoing programme of research in this area in New Zealand, though Moyle has completed some work in relation to biodiversity.

**There is no ongoing programme of research in global policy institutions in New Zealand though Moyle has completed some work in relation to biodiversity**



## 6. What does the Law literature say?

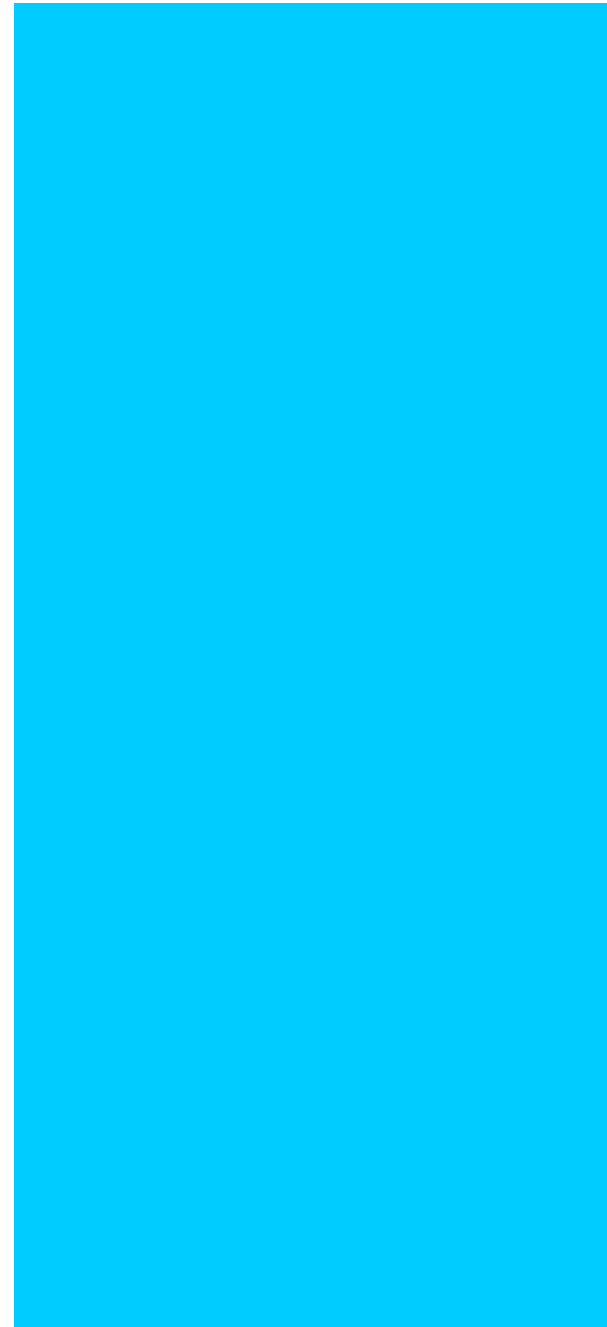
Discussions of human research dimensions within a legal basis is very difficult to assess to reach generalisations. The difficulties are primarily due to the fact that the law is tied to human dimensions at every step of society, with regard to not only environmental problems, but all considerations involving legislation. Indeed, fundamentally the law is entirely about human dimensions at one level or another. Despite this caveat, it is possible to select a number of areas in which various dimensions of human research, with a background of legal considerations, is becoming apparent. These involve human and legal issues of complexity in a diverse and uncertain world; the local-global paradigm; human rights; the concept of risk; and finally with regard to the possible overlap between security for the individual and environmental stress as a negative catalyst.

### ***Human and Legal Complexity in a Diverse World.***

It is acknowledged that 'simple' legal relationships are governed by complex social patterning. The legal system is not a universal, abstract, objective, and neutral construct created by particular actors. As such, there has been a gradual replacement of a positivist, empirical approach to legal research to one of realism which investigates the variability, contextuality, and complexity of expressions and behavioural manifestations of the law (Menkel-Meadow, 1990) which is in line with thinking on evolving transdisciplinary perspective involving human dimensions research.

Accordingly, multiple issues from compliance with agreements, through the customs and norms which underline society and the law it generates, within an environmental context, have come into play. At the centre of these theoretical discussions are both the environment, and how the individual fits into the bigger equation (Brown Weiss, 1999). Importantly, the bigger picture contains both previously unforeseen environmental problems that in themselves are deeply complex, as are any possible solutions (Slifer, 2000). These difficulties often reflect problems that may go to the heart of modern industrial society, and have

direct impact on all aspects of an individual's life (Orts, 1995, Boer, 1995; Meyers et al., 1996).



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direct impact on all aspects of an individual's life (Orts, 1995; Boer, 1995; Meyers et al., 1996).

The theories of how individuals fit in to the environmental context, the societies around them, and the laws designed to regulate are as diverse as the authors themselves (Rodgers, 1993). Overlaps of science, politics and multi-disciplinary attempts can be seen to further clarify (or muddy) theories (Dobson, et al., 2002; Kysar, 2003). Many commentators recognise the significance of philosophical value systems (typically coined as environmental ethics) that suggest a primary shift in the values and consciousness of the individuals involved is required (Meyers, et al., 1996; Taylor, 2000/2001).

With such a diverse mix of considerations at play, trying to factor in exactly how the human dimensions are reconciled is deeply problematic, as the entire area (from political ideologies and debates about local and international governance at the turn of the 21<sup>st</sup> century, through to evolving international environmental problems) – and not just various subsets within it, is in a state of flux (Dobson, et al., 2002).

### ***International Actions at a Local Level***

Amidst all this uncertainty, some patterns which may give guidance on human dimensions research are becoming apparent. The primary marker here is the well-known global/local connection in which individuals try to reconcile their own individual positions within much greater paradigms (Breckenridge, 1992). Within the decentralised local subset reside considerations pertaining to the laws surrounding them and their environmental interface. For example, much discussion considers the role and efficacy of 'command and control' law as instrument for environmental management (Richardson, 2000) and, the differences in society for individuals depending on their economic status (especially at the macro level — with the developed and developing country debate) (Boer, 1995).

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**Many of the human dimensions of environmental problems are involved in the concept of Environmental Impact Assessment**

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**Why, how, and to what extent should the public and their sentiments be involved in the environmental decision making process?**

Within this international area, discussions of individuals within the local context, often at differentiated economic positions, have led to a number of subsidiary considerations appearing. In particular, these relate to how individuals feed into debates about knowledge, practices, community organisation, and values (Breckenridge, 1992).

### ***Risk Assessment and Fundamental Rights***

A related area of legal research into the human dimension of environmental problems is the ability of a local community to assess levels of risk and participate in decisions that (may) affect the environment in which they live.

Many of the human dimensions of environmental problems (as they relate to the legal sphere) are involved in the concept of Environmental Impact Assessment (including ongoing assessment) as these measurements, by their very nature, take into account local effects and social/cultural-economic-environmental interactions (Gray, 2000; Karkkainen, 2002; Tilleman, 1995).

There has also been a focus in legal literature on the link between human rights and the environment (from local rules/norms, through municipal law, to international law). This includes ideals such as democracy/participation as well as the substantive right to good health and a safe and unspoilt environment (Juss, 1997; Palmer, 2002; Popovic, 1996). Clearly, any discussion of human rights is fundamentally focused upon the ideals of what the individual possesses, and how they relate to environmental protection. Accordingly, this area contains a clear link to human dimensions research.

However, time, costs, adequate/equitable representation, and increasingly complex science and technology necessitate further research to resolve fundamental questions about public participation in risk assessment: why, how, and to what extent should the public and their sentiments be involved in the environmental decision making process? There is also a question mark over the environmental outcomes of varying levels of participation (Green, 1999; Jones 1996). Quite clearly, all such questions revolving around notions of risk, or meaningful participation in environmental solutions, go directly to concerns about

the individual and their place in the larger social, political and ecological picture.

### ***Environmental Problems as a Socio-Economic Threat to Peace***

One of the evolving areas of human dimensions research involves the connection between the individual, the environment and conflict. Even localised environmental problems share common characteristics from nation to nation, and to the extent that these problems result in tensions domestically, while international stability can also be threatened. There is therefore a link between the environment and political stability and the prospects for peace in the world are intertwined with the resolution of environmental issues and the human dimensions underpinning environmental change (Button, 1992; Homer-Dixon, 1991; 1994).

It is also recognised that, when people destroy their environment and the objects within it, the social turmoil that is created forces many to become refugees and shift their burden from one area to another. Nothing may stop them as they are driven by necessity and the problems thus created can tip the ecological balance in other areas against nature (Coursen-Neff, 1998). Obviously, at this forefront, considerations of the individual and the environment they need take on a slightly different focus, as the issue becomes not just one of academic curiosity, but possibly survival itself.

**One of the evolving areas of human dimensions research involves the connection between the individual, the environment and conflict**

**In 1993 New Zealand ratified the International Convention on Biological Diversity (CBD)**

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**Human activities contribute to the loss of biodiversity therefore human dimensions research is fundamental to understanding the root causes of the erosion of biodiversity**

## **7. What Does the Biodiversity Literature Say?**

In 1993, New Zealand ratified the International Convention on Biological Diversity (CBD). The ratification of the Convention led to a series of introspective gazes into the status of biodiversity management and conservation across the country. This exercise culminated in the release in 1998 of a draft biodiversity strategy for the nation produced by the Department of Conservation and Ministry for the Environment. Broadly, two types of land require consideration with reference to the human dimensions of global environmental change and biodiversity. First is the endemic and introduced biodiversity of the nation that is found in parks, reserves, covenanted lands, and other lands under State and private forms of protection. Second is the biodiversity situated in the cultivated and highly modified landscapes. These biological resources form the backbone of the country's agricultural economy. In this section of the review we explore the international perspectives on the relationship between human dimensions research, global environmental change and issues of biodiversity loss, conservation and enhancement.

### ***International Perspectives***

Human activities contribute to the loss of biodiversity therefore human dimensions research is fundamental to understanding the root causes of the erosion of biodiversity (Jagar, 2001). In many cases, studies of the human causes of biodiversity loss have recognised that the researcher needed to come to terms with issues of socio-cultural belief systems, religious traditions, social history, and rights to property and resources.

As Brand (1997) documents, taken together the empirical findings of numerous studies acknowledge a high, and globally growing, concern about the environment. However, this environmental consciousness does not necessarily translate to environmentally sound behaviour. Empirical findings, in fact show that the effects of environmental knowledge and consciousness on behaviour are insignificant. Rather, other factors (e.g., psychological, economic, institutional, and contextual) are more likely to have an impact on actions.

Global biodiversity is therefore being lost at an accelerated rate. Conservation biologists have increased efforts to understand its decline and encourage its conservation. Biodiversity loss is viewed largely as a function of human activities. Specific human activities that may influence biodiversity loss, such as deforestation, have been empirically examined and found crucial (Forester and Machlis, 1996).

Yet, beyond these basic findings, the relationship between socioeconomic factors and biodiversity loss is not well understood. Soulé (1991) proposed six classes of human interference: habitat loss, habitat fragmentation, overexploitation of populations, introduced species and diseases, pollution, and climate change. For each, synergistic effects and complex feedback loops, time lags, and threshold effects are likely.

Underlying causes of biodiversity loss are no less complex, and they vary by social context. Regarding the biodiversity-rich Neotropics, Machlis (1992:164) notes that

... the causes of habitat destruction are ultimately linked to demographic patterns, national histories, land tenure rules, distribution of wealth, and the socio-political role of agricultural monocultures such as coffee, sugar, and now cocaine. The worldwide trends toward industrialisation, increased per capita energy consumption, and economic interdependence are also critical factors; understanding these socioeconomic trends is prerequisite for predicting the rate, extent, and consequences of biodiversity decline.

Potential driving forces of environmental degradation and ultimately biodiversity loss have been identified; these include human population growth, economic development and government policy (Figure 2).

**Biodiversity loss is viewed largely as a function of human activities**

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**The causes of habitat destruction are ultimately linked to demographic patterns, national histories, land tenure rules, distribution of wealth, and the socio-political role of agricultural monocultures such as coffee, sugar, and now cocaine**



**Biodiversity loss is both an ecological reality and a socially constructed problem**

**Conservation of biodiversity can play an important role in stabilising the global climate system**

Purely biological approaches to understanding biodiversity loss are limited to analyses of proximate causes. Socioeconomic approaches avoid critical biophysical and ecological conditions. Biodiversity loss is both an ecological reality and a socially constructed problem. As several authors suggest, and Forester and Machlis summarise (1996:1254), “interdisciplinary research is required if the complex pathways through which human actions affect biodiversity are to be better understood” (Figure 2).

After nearly a decade of so-called human dimension of global change research Wiedemann (1995) found that the research process and end results were strangely “people-free”. In many studies the concrete actors’ and their motives, attitudes, social barriers and interactions between these variables appeared to be insignificant. Throughout the world there are similar complaints about the remoteness between policy makers and researchers: the researchers do not know what the policy makers require and policy makers are similarly ignorant of what researchers might be capable of reliably and accurately providing.

#### ***IPCC and UNFCCC Perspectives***

In 2001 a European experts workshop on climate protection and conservation of biodiversity was held in Germany in preparation for the formulation of a technical paper on climate change and biodiversity for the IPCC. At this meeting it was noted that the UNFCCC aimed to prevent dangerous anthropogenic interference with the climate system so that ecosystems could adapt naturally to climate change and to ensure global food production. While climate scientists continue to refine models of interactions and feedback mechanisms on the global climate model it is becoming clear that conservation of biodiversity can play an important role in stabilising the global climate system. The loss of biodiversity can greatly limit the service functions of ecosystems and limit capacity for food production or carbon sequestration potential. Synergies of special significance for biodiversity and climate have been identified for certain ecosystems, including forest, wetlands and savannah grasslands and the service functions of such ecosystems to help protect the climate should be stated as an additional aim for nature conservation.

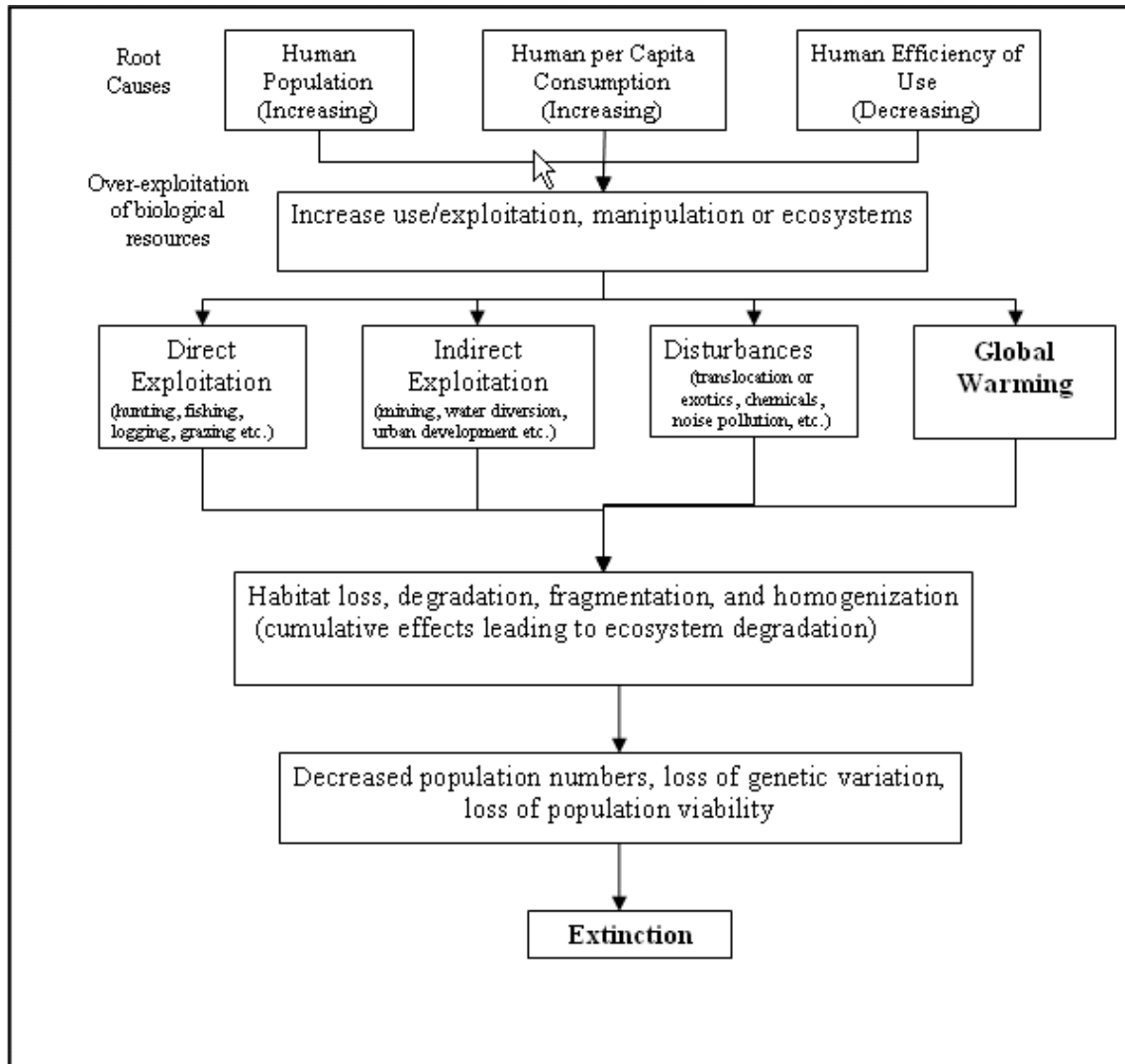


Figure 2: Model depicting relationships between root causes, over-exploitation of resources, and loss of biodiversity (Noss and Cooperrider, 1994:51).

**Global warming, i.e. climate change, is increasing viewed as a critical element in biodiversity loss**

**The Convention on Biological Diversity provide useful guidance for the integration of biodiversity considerations into the design and implementation of climate change adaptation programmes**

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**The structure and function of ecosystems thus form an expression of society's valuation of resources**

Climate change effects on biodiversity have to be considered in the context of other threats/pressures, such as land-use change and resource over-exploitation. Ecosystem approaches of the Convention on Biological Diversity provide useful guidance for the integration of biodiversity considerations into the design and implementation of climate change adaptation programmes and policies. Measures to reduce vulnerability to climate change can have both positive and negative impacts on biodiversity. It is therefore necessary to assess all options through public consultation to ensure wide debate and development and implementation of the most appropriate climate change adaptation measures.

### ***Specific Cases of Integrating Human Dimensions and Biodiversity Research***

To assess ecosystem function and integrity, some understanding of the human dimension is necessary. There are two critical aspects of the human dimension (which parallel other areas of human dimensions research): factors that drive, and can be used to predict and better understand human activities; and factors that characterise the impacts of those activities on ecosystems (Brown, 2001). The drivers of human activity are often intangible in character such as aesthetics or profit motive. The resulting impacts can be very tangible structures or activities on the landscape. Human activity therefore is a critical component of each and every ecosystem. The structure and function of ecosystems thus form an expression of society's valuation of resources and subsequently drive human activity. For example, as Brown (2001) aptly noted "the presence of a pristine or high quality landscape that drives development nearby, can lead to the degradation of the quality of that latter landscape."

This complex interrelationship between society, and its human dimension, and the biodiversity with which it interacts has led to the recognition of some overarching principles regarding human dimensions and biodiversity. These include:

- 1) an understanding that no location is without human influence and incorporating humans into models;
- 2) identifying and developing science-based solutions to anthropogenic problems, including for example over-fishing, coral reef destruction, deforestation;
- 3) agrobiodiversity (especially advances in saving agrobiodiversity *in situ*);
- 4) environmental economics – concept of biodiversity for use, which has yielded a marketing tool for conservation; and,
- 5) recognition of value of biodiversity in addition to value as use (e.g., faiths) (IBOY, 2001).

The group of researchers that convened for the International Biodiversity Observation Year (IBOY) Conference in 2001 recognised significant barriers to the understanding and conservation of biodiversity. They postulated that this was owing to the fact that:

- economic values of biodiversity were not quantified or agreed upon;
- management strategies for conservation lacked a clear consensus on whether society should focus on protected areas, conserve within human communities, or manage all because we affect all; and finally,

**No location is without human influence**

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**Management strategies for conservation lacked a clear consensus**

**The relationship between conservation and sustainability is not well established in the academe or in communities**

**There is an identified need for an emphasis on transdisciplinary research**

- the relationship between conservation and sustainability was not well established in the academe or in communities. It was questioned whether they were compatible, linked or separate.

Given the above gaps in the knowledge-base the group proposed that the following human dimensions of biodiversity research themes be prioritised:

- importance of biodiversity for human health;
- development and sustainability;
- biodiversity economics;
- conservation; and,
- role of biodiversity in restoration.

There is also a need to assess the impact of global change on biodiversity, namely climate change, landuse change, atmospheric change and invasive species. The IBOY group believed these needed to be addressed by exploring:

- the value of theorising (modelling) or monitoring to evaluate global biodiversity change;
- determine which systems to study to be more effective when problems arise;
- develop assessments of vulnerability of species/ecosystems to change; and,
- develop criteria for interpreting change, at local, regional and global scales, and their significance.

As with many such groups and, in the context of human dimensions research in general, there was an identified need for an emphasis on transdisciplinary research which could bring together taxonomists, ecologists, anthropologists

and geographers, for example, to conduct formal biodiversity studies. This it was thought could result in more integrated pictures of biodiversity to emerge that would have a strong human dimensions element. It was stated that there was a growing recognition that value was gained by combining skills and disciplines in research endeavours. Information was increasingly being shared across academic and community groups and this could be nurtured. Use of indigenous classification and knowledge systems was growing. And parataxonomy<sup>2</sup> was opening up university departments leading to more participatory research.

The IBOY group provided the following useful example of how human dimensions of biodiversity research could open up avenues for greater understanding and new perspectives of the value of biodiversity.

Consider, for example, a wetland with the capability to remove nitrogen from the surface waters by denitrification. If that wetland was far removed from human activity and as a result waters entering the wetland are nutrient-poor, denitrification potential is of relatively low value. The stable wetland might be of a greater value as a waterfowl habitat. But place that same wetland in an agricultural region, upstream from an estuary or coastal embayment showing signs of stress from eutrophication, and the particular values ascribed for that same wetland may change dramatically. Now the capacity of this landscape element for nitrate removal is of far greater value and benefit to humans. In both situations, the physical and ecological processes have not changed, but societal values have. Thus, evaluation of landscape condition requires information on both ecosystem services derived from the landscape and human geography.

An international workshop held in Germany in 2002 focused on biodiversity in the cultural landscape. One outcome of the conference (Wolters, 2002) was the publication of eight major topics for research, two of which were directly related to human dimensions of global environmental change:

**There is growing recognition that value can be gained by combining skills and disciplines in research endeavours**

**Physical and ecological processes may not change, but societal values can**

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<sup>2</sup> The term parataxonomy was coined by Daniel Janzen (1991) to describe the jobs held by assistants to taxonomists. For example, nurses and paramedics are not doctors but without them doctors would be overwhelmed. Thus the idea is to save the doctors to do the work they are highly trained to do while others can complete the other, no less important, tasks.

**Nature conservation practices are not sustainable if they are not compatible with social, technical and economic development**

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**The working group also identified a need to address tradeoffs between biodiversity management following from ecological insights and interests of both society and stakeholders and provide options for conflict management**

- socio-cultural and economic aspects of biodiversity; and,
- biodiversity changes as a result of past, present and possibly future natural and anthropogenic changes in global environmental conditions.

At the same conference it was noted that climate change could alter factors such as landscape properties, abiotic conditions, the distribution of resources or management regimes. Thus, it was expressed that there was an urgent need to verify the validity of present rules considering the dynamics of the environmental conditions driven by global change. Socio-cultural and economic aspects of biodiversity were also noted as being in need of integration (Wolters, 2002).

It was decided that ecological rules developed at the BIOLOG Europe Conference must be verified with respect to their applicability in management and policy at a European scale. Nature conservation practices are not sustainable if they cannot be maintained or continued over longer time periods and if they are not compatible with social, technical and economic development. Therefore, in the European context it was thought that future development of each landscape's modern land-use techniques, economic restrictions, and political decisions had to be considered in each research project. The working group also identified a need to address tradeoffs between biodiversity management following from ecological insights and interests of both society and stakeholders and provide options for conflict management.

A biodiversity conservation and ecosystem functioning perspective — identified with the human dimension working group — noted the need to study the relationship between current approaches of biodiversity conservation and the human dimension. There are different possible objectives for consideration which are positively or negatively related to land-use (intensity). For example, an increasing proportion of the human population is living in large cities and landscapes become more important for recreation. Semi-natural areas may thus contribute to the quality of life. However, people prefer to recreate in richly structured and biologically diverse landscapes, whereas intensively used agricultural landscapes are rarely visited for these purposes. The working group asked “how is the spectrum of uses ranging from intensively managed

agriculture landscapes up to landscapes with nearly complete exclusion of land-uses related to the spectrum of ecosystem services? What are the eco-region-specific priorities?”

### ***Legal dimension of management tools***

A working group at the BIOLOG Europe Conference discussed how multi-functional goals can be turned into praxis, i.e., the socio-economic implementation design. Generally two approaches were identified to be conceivable: 1) the “command and control” approach, which addresses property rights, e.g., with respect to the use of biological components; 2) the “market-based” approach, which makes use of the price mechanism based taxes and subsidies. Although, there is no general solution to optimal resource management, it was thought that the BIOLOG projects had the potential to address these questions by simultaneously integrating ecological and socio-economical factors in case-specific scenarios and models (Wolters, 2002).

### ***Agricultural Biodiversity in New Zealand***

For the purposes of the CBD, one aspect that must be considered is agricultural biological diversity, which means the variability among living organisms associated with cultivating crops and raising animals and the ecological systems they are a part of. This includes diversity within species and between species, and of entire ecosystems. The imperative to conserve agricultural biodiversity is motivated by its intrinsic value, but partly also by a wish to sustain highly productive agriculture to support societies in the face of considerable problems. It is commonly recognised that biodiversity can be organised into ecological hierarchies of landscapes, ecological systems, communities and species. It is this classification system that determines the way research, policy and management units are recognised.

A predominantly multi-species approach is taken to safeguard processes and functions of ecosystems and a transdisciplinary approach is essential to find lasting solutions to environmental problems. Bottom-up, local, participatory

**Variability among living organisms associated with cultivating crops and raising animals and the ecological systems they are a part of must also be considered**

**The imperative to conserve agricultural biodiversity is motivated by its intrinsic value**



**Ecosystem Management is especially relevant with rural community environmental philosophies and practices**

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**Biodiversity abounds in lowland, fertile and warm sites like those predominantly under agricultural management**

action methods are seen as the best chance to achieve socially, economically and ecologically sustainable solutions. Inclusion of humans as part of ecosystems leads to corollaries that human-excluded preserves are but one approach to biodiversity conservation and that the human use of resources is not necessarily dangerous to ecosystem health. Ecosystem Management is especially relevant with rural community environmental philosophies and practices. This perspective offers an opportunity for significant gains for agricultural biodiversity in New Zealand where private ownership predominates and individual owner's environmental stewardship must take the place of the centralised top-down approach to conservation exercised by the Department of Conservation on public lands. Despite its value, ecosystem management has thus far been poorly applied to address the conservation of New Zealand's biodiversity. This is partly a reflection of a conservation philosophy formed in reaction to our pioneer history of broad-scale clearance of natural habitats for extensive production.

An appropriate emergency response then to this habitat despoliation was imposition of an allocation model of preservation for conservation in one place and use elsewhere. Unfortunately, an 'integration model' (where wise use protects or even enhances biodiversity) has been neglected despite the halting of broad-scale habitat destruction. The Ministry of Agriculture and Forestry (MAF) must make an effort to advocate and inform New Zealand society of the urgent need to integrate sustainable use and protection or enhancement, and of the need to value and care for highly managed and modified landscapes. If this is not done the opportunity to sustain biodiversity over the majority of New Zealand could be missed.

Agricultural landscapes are where most people see and interact with plants and animals so responsible environmental stewardship there offers the best chance of building a sustainable land-ethic. Biodiversity abounds in lowland, fertile and warm sites like those predominantly under agricultural management. Widespread localised endemism, particularly as seen in invertebrates, dictates that protection and enhancement must extend into these landscapes to stop the slide of yet more species to extinction. A need to better understand the biodiversity attributes of the systems that are recognised by land managers by obtaining comparative data on insect communities and active management to

control introduced predators must be continually applied. It is thought that a particular emphasis must be placed on biosecurity.<sup>3</sup>

Removal of grazing stock from some areas is needed to safeguard population recruitment of indigenous plants. Biocontrol is potentially particularly effective and valuable. New Zealand plants are particularly vulnerable to disturbance by fire. Habitat restoration is critical in agricultural landscapes. MAF can also facilitate a broadening and maturation of New Zealand's conservation philosophy in a way that will connect its people to the land (the human dimension) and a responsible land ethic.

Neglect of a biodiversity perspective in research of agricultural landscapes has led to a huge knowledge gaps on how to best protect and enhance biodiversity as quickly and cheaply as possible. A comprehensive research portfolio has been advocated that is transdisciplinary and incorporates principles of Ecosystem Management. There is thus a need to evaluate ecological effects of homogenisation and intensification of land use and to include research on the obstacles or barriers to rigorous management of biodiversity within farming systems.

The increasing intensity and frequency of extreme climatic events resulting from global warming increases both the influx of exotic organisms and their opportunities for establishment in New Zealand. Extensive transformation of the New Zealand habitat contributes to the establishment of exotic species in this country, as seen with insects associated with Australian eucalypts. New Zealand is both nearby and downwind of Australia and the expansion of Eucalyptus spp. plantations here has increased the probability of wind-borne immigrants landing in a suitable receiving community.

The latter is a result of physiological changes consequent on more extreme abiotic conditions. There is now general international acknowledgement of the

**The future will require a broadening and maturation of New Zealand's conservation philosophy in a way that will connects its people to the land (the human dimension)**

**The increasing intensity and frequency of extreme climatic events resulting from global warming increases both the influx of exotic organisms and their opportunities for establishment in New Zealand**

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<sup>3</sup> Impacts of alien invasive species on agricultural genetic resources, native wild species and ecosystem diversity, is being undertaken in some OECD Member countries, where the problem is especially acute (e.g. New Zealand).

**Unfortunately agricultural activities, which in themselves represent an under-recognised human dimension, indirectly contribute to escalating risks of unwanted introductions and therefore New Zealand's agricultural biodiversity commitments must consider biosecurity as paramount**

applicability of Manion's (1981) three-factor model of plant health decline within indigenous systems (Mueller-Dombois, 1987). The model includes predisposing, inciting and contributing factors and has been documented in New Zealand with the widespread decline of beech forests following the 1972-73 spring droughts (Hosking and Butcheson, 1986; 1988; Hosking, 1993). Essentially older trees and those on sites with low moisture retention capability (predisposing factors) were physiologically shocked by drought over the leaf-flushing period (inciting factor), and their nutritional potential to insects and pathogens (contributing factors) was increased. The sequence is also seen in interactions at the individual plant level during normal successional progress (e.g. Hutcheson, 1991) where insects are seen to supply mechanisms for ecosystem adaptability. A wide range of examples of changing nutritional potential within biotic systems in association with changing environmental factors is discussed by White (1993). The same general model is broad enough to be applied (with varied emphasis) to situations involving new distributions of organisms and even to situations where combination of formally geographically isolated microbial strains results in more virulent pathogenic interactions, e.g., chestnut blight.

The overarching importance of active control of exotic predators and competitors underscores the critical importance of our biosecurity measures to ensure that yet more destructive new organisms do not establish in New Zealand. Unfortunately agricultural activities, which in themselves represent an under recognised human dimension, indirectly contribute to escalating risks of unwanted introductions and therefore New Zealand's agricultural biodiversity commitments must consider biosecurity as paramount.

Not all damaging organisms are insects and the border security and potential response protocols on discovery of a new organism is already well organised. Increasing travel by humans and traffic of their goods is escalating the sequence of challenge to our border surveillance, but there are also other contributors to increased risk.

Unlike vegetation in semi-arid regions like Australia, New Zealand's vegetation

has not been subjected to frequent or intense burning. Most of New Zealand's endemic plants are therefore not adapted to cope with the increased fire frequency that can ensue with human occupation. Fires lit by Māori, prior to European colonisation, had a huge effect on New Zealand's landscapes and the ongoing deliberate use of fire or unintended fires associated with agriculture have potentially devastating impacts on native vegetation communities. Evaluation of fire risk and effects will therefore be an unusually important consideration for New Zealand's agricultural biodiversity.

There is therefore a strong need for integration of conservation and production concerns in New Zealand biodiversity management.

Concern for our native biota and in particular the vascular plants and birds, has dominated New Zealand's historical conservation practise and policy. This has resulted in a separation of conservation and production in terms of issues, research, management and geographic areas. A land 'allocation model' of conservation (actually preservation) in one place and use in another place has been envisaged rather than an 'integration model' where use and conservation happen on the same land. The allocation approach was a necessary phase in the development of conservation of New Zealand biodiversity. The exploitation of New Zealand's environment was central to a natural reaction against the previous excess. The first reaction manifested itself as a strong emphasis on preservation of indigenous systems. There was also a need to act quickly using a top-down preservation approach to halt widespread, state-handed despoliation of habitats. This is largely the position New Zealand is in today with land segregated into 'productive' land and 'conservation' estates. Much of the rhetoric relates to a belief that, on any piece of land humans face a choice between two mutually exclusive goals – either use, or protection.

Those that agree with the allocation model believe that it works or has the potential to work. However, there is a growing membership within the science policy and environmental movements which question whether it is working, or can work, and whether the assumptions underlying it have any validity in fact. They advocate an approach, or at least an acknowledgement of a pluralism of approaches, to environmental management that is more integrative of society,

**Evaluation of fire risk and effects will therefore be an important consideration for New Zealand's agricultural biodiversity**

**Some advocate an environmental management philosophy that is more integrative of society**

**Seventy percent of the opportunity for conservation therefore rests outside the conservation estate, where people live and engage in economic activities**

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**The dichotomies of culture vs. natured indigenous vs. exotic, use vs. reserves in many ways represent this crisis of identity**

and less dependent on human-excluded reserves as the dominant and, sometimes the only tool available to protect and restore biodiversity.

Reservation alone puts biodiversity at risk simply by restricting the area and embedded micro-habitat variation designated solely to conservation through preservation. Seventy percent of the opportunity for conservation therefore rests outside the conservation estate. Active management to enhance biodiversity in the majority of New Zealand is at stake when considering whether or not to mount a strong CBD initiative for agricultural biodiversity. That 70% is potentially particularly important for New Zealand's biodiversity because it is predominantly the lowland fertile sites where biodiversity is greatest. Promulgation of biodiversity in such areas must greatly reduce risks of extinction of several endemic species, especially those relatively small and cryptic species that are crucial to ecosystem function – the invertebrates.

### ***Building public support and ecological responsibility***

Fostering conservation in managed landscapes where people live and interact with wildlife day by day offers opportunities to change attitudes in support of conservation. Hands-on involvement in decision making to foster biodiversity will accelerate building of a land ethic. Recognition is a fundamental step for people to take personal responsibility for New Zealand's conservation rather than simply paying conservation taxes and leaving a government department like DOC to manage distant reserves. Such a programme has great potential to de-polarise current conservation/production debate and to provide guidance for efforts to sustain biodiversity across the New Zealand landscape.

The increased advocacy of a more human-inclusive environmental management in New Zealand stems partly from a growing concern that the dichotomy between preserves and production; culture and nature; 'exotic' and indigenous; is failing to achieve environmental goals. But that advocacy for change is also motivated by a sociological concern. The dichotomies of culture vs. nature, indigenous vs. exotic, use vs. reserves in many ways represent this crisis of identity which many New Zealanders face.

## 8. A Conceptual Framework for Human Dimensions of Global Environmental Change in New Zealand

### *A History*

Scientific inquiry has a long tradition which strongly influences how today's researcher engages with the problems of the world. It is our disciplines that often constrain us by limiting our training and capacity for 'seeing' problems in other, and potentially innovative, ways. Our disciplines date to a 19<sup>th</sup> century construct that resulted from the 'scientification' of knowledge, i.e., the industrial revolution and technological advancement. The modern universities reinforce the historical origin of disciplines by continuing to recruit students to 'their' discipline and as an attempt to produce specialists for industry and increasingly the professional fields like law and management.

The social sciences inherited the structures of the physical sciences including the disciplinary structures. The physical sciences have had unifying concepts such as positivism to link them and facilitate some, of what would today be termed, transdisciplinary approaches. The social sciences in contrast have lacked any unifying theoretical thread or threads and have therefore lagged behind in their ability to move forthrightly toward more transdisciplinary approaches to problem solving (see Figure 3). A binary represented by a common language versus specialist language can be used to define the physical and social sciences respectively. Disciplines foster relative internal harmony by fostering a community sharing within fairly well defined and monitored boundaries. They exhibit a range of 'tolerated' worldviews and these are reproduced through the training of students within individual disciplines. This is done through a range of shared epistemological assumptions, such as objects of study, units and levels of analysis, and what constitutes evidence.

**It is our disciplines that often constrain us by limiting our training and capacity for 'seeing'**

**The social sciences have lacked any unifying theoretical thread or threads**

**Multidisciplinary research draws on actors from different disciplines to work on a specific problem**

<b>Traditional Disciplines</b>	<b>Basic Unit of Analysis</b>
Psychology	Individual psyche
Sociology	Society
Anthropology	Culture
Economics	Economy
Political Science	The State/power
History	Time
Geography	Space

**Figure 3:** Examples of traditional social sciences disciplines and their basic units of analysis.

### ***Multi-disciplinary Research***

Confusion can enter into the discussion of what constitutes an integrated research methodology or approach. Multidisciplinary research draws on actors from different disciplines to work on a specific problem. However, with this approach the identified problem is addressed from within the bounds of each discipline with all the assumptions inherent in inquiry emanating from that discipline. These assumptions are either not challenged or are argued by skilled disciplinarians and are permitted to remain intact as research proceeds to address the problem. Insights from different disciplines are used to solve a problem(s), yet practitioners are rarely aware of either the contradictions in

evidence used to come to an understanding of the problem or the arguments used to explain the problem, i.e. differing views of the relevance and value of evidence. Regardless of these problems they need not be resolved for multidisciplinary research to occur. Clearly there are limitations to this approach when complex problems are to be addressed.

### ***Transdisciplinary Research***

Transdisciplinary research may come in two forms. One is where all formal knowledge and practices which transcend one discipline — Geography being an excellent example — with its tradition of a physical-cultural binary are integrated in one formalized approach to a problem. For example, the political ecology or liberation ecology approach represents an attempt at a theoretical merging of the physical and cultural traditions within geography (Watts 1983a; Peet and Watts, 1996), but it is not without its critics (Hayward, 1994; Watts and Peet, 1996).

However, more commonly and in the context of this review, we are concerned with the more comprehensive and complex notion of transdisciplinary research that addresses specific problems, in fact defines the problem itself, through a 'strict interdisciplinary' practice whereby methods and theoretical assumptions of two or more disciplines are integrated into a single framework before research proceeds. Some examples of transdisciplinary disciplines can be found in place in academic institutions (see Figure 4).

Therefore 'true' interdisciplinary research must work on problems that require basic knowledge and insights from at least two disciplines. For this approach to succeed each member must have a 'full and fluent' understanding of the other disciplines' 'worldview/assumptions' when defining a problem for research and determining methodological issues and what constitutes evidence. Any epistemological conflicts that emerge must be resolved to the satisfaction of all disciplines involved. One measure of success of the approach may be the results of the inquiry entering the core literature of all disciplines involved.

**'True' interdisciplinary research must work on problems that require basic knowledge and insights from at least two disciplines**

**One measure of success of the approach may be the results of the inquiry entering the core literature of all disciplines involved**



**Post-positivism, post-modernism, post-structuralism and post-colonialism represent important epistemological challenges to individual disciplines**

<b>Transdisciplinary</b>	<b>Basic Unit of Analysis</b>
Women's studies	Women
Urban studies	The city
Environmental studies	The environment
African-American studies	Africa-centered
Native studies	Aboriginal-centered
Gay-Queer studies	Gay-centred
Geography	Society and environment

**Figure 4: Examples of interdisciplinary groups and their basic units of analysis**

### ***Why is Transdisciplinary Research Important?***

The social sciences have been heavily influenced in the last 20 years by the emergence of the four Posts: post-positivism, post-modernism, post-structuralism and post-colonialism. These concepts represent important epistemological challenges to individual disciplines and the theoretical concepts that underpin them. The adoption of transdisciplinary perspectives in problem solving opens up the potential for the ideas that have permeated the social sciences to be aired and potentially integrated with other disciplines, especially those such as economics and political science where they have had the least effect, but where

a high proportion of information used in decision-making is derived. The merging of ideas within a transdisciplinary approach should not be construed to be a threat to any one discipline. It is the benefit of shared experience and robust debate on the merits of particular approaches to specific problems that should gain eminence without denigrating disciplinary approaches which will remain highly relevant in advancing traditional research threads which will also inform transdisciplinary approaches.

**A transdisciplinary approach should not be construed to be a threat to any one discipline**

**The human dimensions research stream is distinctive and requires an innovative approach**

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**Research questions should be addressed through a process which strives to document, understand, predict, and assess the science to yield results relevant to the needs of decision makers**

## **9. A Specific Framework for New Zealand**

The committee charged with defining a New Zealand specific research agenda for the human dimensions of global environmental change is in agreement with the general scientific community that this research stream is distinctive and requires an innovative approach. As is evidenced by the review of international literature and the tenor emanating from New Zealand some common themes have emerged and they have relevance when defining the broad underlying assumptions regarding human dimensions research. These include, but are not limited to, the following:

- A problem-based approach is most appropriate as it diminishes the likelihood of disciplinary blinders and multidisciplinary versus transdisciplinary research occurring.
- This kind of work requires a particular type of researcher with the ability to see other points of view and the aptitude to work toward consensus. This notion is supported in a recent working paper by Kerr (2003) of Motu Research.
- There is a need for multiple methods to address specific problems.
- Research questions should be addressed through a process which strives to document, understand, predict, and assess the science in a way that yields results that are relevant to the needs of decision-makers.

### ***The New Zealand Climate Change Programme***

The New Zealand Climate Change Programme was initiated in 1989 by the Ministry for the Environment. It incorporated three thematic working groups focusing on climate science, 'impacts', and policy. A fourth group, representing the interests of Māori, participated in all aspects of the programme. The impacts, policy and Māori working groups included a number of social scientists (several of whom had positions as policy analysts in government departments). The report of

the impacts working group included nine recommendations, four of which had human dimensions (Ministry for the Environment, 1990a), such as information assembly and storage, monitoring, increasing knowledge of society-climate interactions, and building public awareness.

The report of the policy working group also had a strong human dimensions component including an examination of 'generic limitation options', such as social and behavioural measures, planning measures, market measures and legislative and regulatory measures. While numerous technical issues are discussed in the listing of specific limitation options (e.g., vehicle emissions standards), many behavioural responses are also considered (e.g. fuel efficient driving). The report also included a discussion of adaptation processes which focused on the factors that might influence either individuals or organisations to adapt to climate change effects rather than the actual adaptive actions which might be required (Ministry for the Environment, 1990).

### ***Sustainable Management and Sustainable Development***

A major boost to research on sustainability came with the Resource Management Law Reform process (1988 1990) culminating in the *Resource Management Act* (1991), which replaced some 75 earlier laws on resource use, planning, and the environment. The cornerstone of the Act is the *sustainable management* of natural and physical resources, while at the same time providing for socio-economic well-being and other quality of life issues. The focus is on sustainability and the widespread and far reaching influence of the Act has encouraged a number of researchers to investigate its implementation, explore the meanings of the term sustainable management among different actors, and evaluate the likely success of the Act in bringing about sustainable resource management outcomes (Ericksen, et al., 2003). While much of the sustainability research has an emphasis on resource *management*, there has also been considerable research on what is perceived (in New Zealand) as the broader theme of sustainable development. This may increase as the *Resource Management Act* settles in and broader issues of sustainable development (such as the environmental, economic, social, and cultural well-being of communities) become of central interest under the new *Local Government Act* (2002).

**A major boost to research on sustainability came with the Resource Management Law Reform process**

**The bulk of research expenditure is for projects in which atmospheric science is the major disciplinary grouping**

Under the rubric of sustainability, probably the greatest funding support is given to research in the natural and physical sciences with foci on sustainable land management, sustainable agriculture and sustainable forestry. Human dimensions research in these areas is much more restricted.

### ***Global Change Research Funding in New Zealand***

One way of evaluating the importance of the various disciplinary groupings in global change research is by comparing their respective funding allocations. Table 1 compares the distribution of funding (between the financial years 1995-96 and 2000-01) among broad disciplinary groupings, for climate change research in New Zealand. It also divides the types of research into three categories: climate change processes, effects, and responses. The table shows that overall funding increased during this period from \$16.4 million to \$22.9 million. Most of this funding was through the Public Good Science Fund (PGSF) of the Foundation for Research, Science and Technology (FRST), which distributes contestable funding for science projects in New Zealand.<sup>4</sup> The remaining funding was from the private sector and the universities (non-PGSF funded research).

As Table 1 and Figure 5 show, the bulk of research expenditure is for projects in which atmospheric science is the major disciplinary grouping. It is also significant that over 50 percent of the expenditure in 2000-01 is in the area of climate change processes. The second most significant of the disciplinary groupings is broadly categorised as biological science which accounts for a third of the research expenditure on climate change. The most significant disciplinary groupings in relation to responses research have been categorised as biological research concerned with carbon sequestration and technology-oriented research reflecting mostly work into energy and industrial processes that might contribute to reductions in greenhouse gas emissions.

<sup>4</sup> The main research institutions in New Zealand are the Crown Research Institutes (CRI) and the Universities. The CRIs are essentially state owned enterprises made up of parts of the former Department of Scientific and Industrial Research (DSIR). The CRI are expected to operate as commercial entities and to return a profit to the government. Whereas previously DSIR Divisions were guaranteed funding, the CRIs must compete among each other, with the Universities (which have also lost guaranteed funding) and the private sector. Under this regime one CRI has failed: The Social Science Research Institute, because it was so poorly resourced.

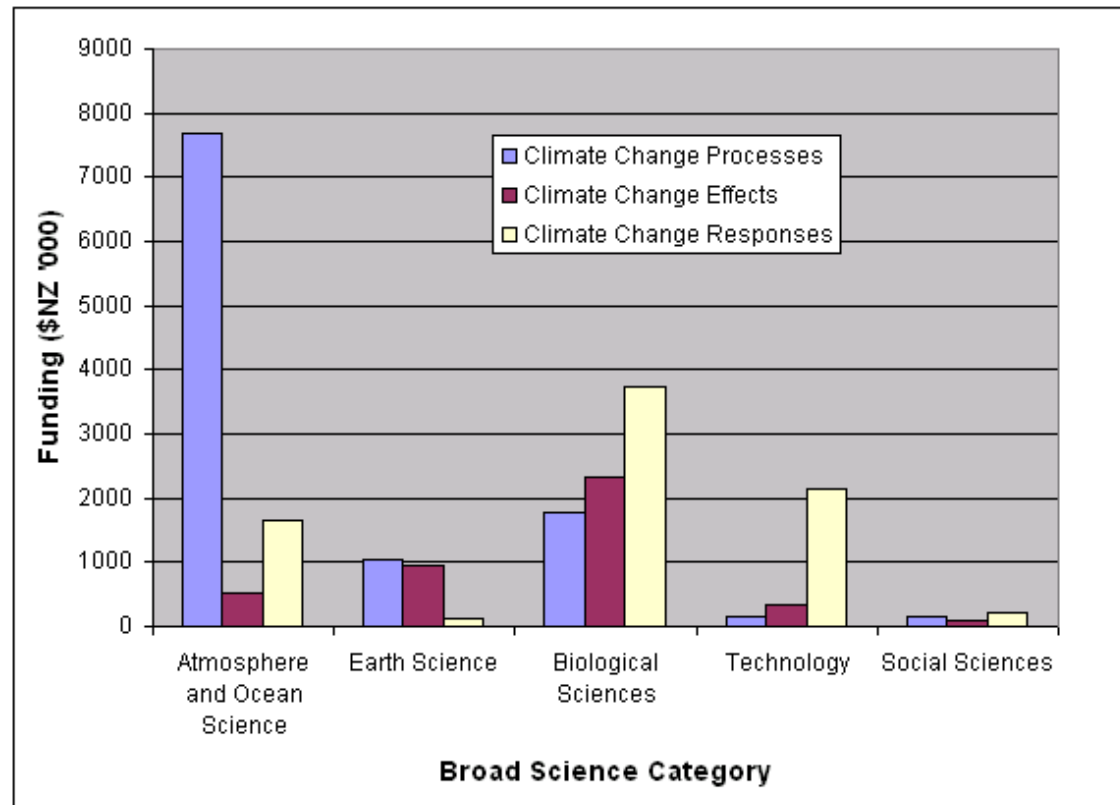
The importance attached to social science is clearly very low. While there has been growth in the amount from \$226,000 to \$476,000, it still accounts for only a little more than two percent of climate change research funding. Of this allocation most appears to be for economic research, such as evaluation of economic instruments for greenhouse gas reduction or assessing the economic impacts of possible greenhouse gas reduction policies. It should be noted that this figure may tend to underestimate social sciences research on global change in New Zealand. It is quite likely that surveys of research efforts have not included all social sciences projects as social sciences researchers may not all be adequately included in global change science networks. In addition, there is some policy development work on human dimensions of global change being carried out in government departments that might not be included as 'research'. Nevertheless, it is quite clear that input from the social sciences into global change research is extremely light.<sup>5</sup>

**The importance attached to social science is clearly very low**

	Atmosphere and Ocean Sciences	Earth Sciences	Biological Sciences	Tech- nology	Social Sciences	Total
1995-96						
\$NZ million	8.045	2.322	4.028	1.740	0.226	16.361
Percent	49.2	14.2	24.6	10.6	1.4	
2000-01						
\$NZ million	9.856	2.072	7.830	2.625	0.476	22.859
Percent	43.1	9.1	34.2	11.5	2.1	

**Table 1:** Expenditure on Climate Change Research in New Zealand, 1995-96 and 2000-01 compared.

<sup>5</sup> If global warming leads to changes in mean conditions and the extremes (variation around the mean) is largely due to human behaviour and if the impacts of those changes are as much socio-economic as bio-physical then perhaps the proportion of research funding ought to approach 50 percent for human dimensions.



**Figure 5: Distribution of funding for climate change research in New Zealand (2000-01).** Note that this has been calculated from a table of research projects and classification has been based solely on the research project titles. For this reason the figure should be considered as indicative.

### ***Information on National/Regional Strategies for Human Dimensions Research***

Human dimensions research in New Zealand is limited. Currently, there is no Government-sponsored 'Human Dimensions Programme' in the country despite the existence of a healthy interest in global environmental change in the physical, natural and technological sciences. The opportunities set forth by the New Zealand Climate Change Programme 15 years ago have not been taken, and work conducted on human dimensions has therefore been piecemeal and be fragmented. Although one University research centre has been established to focus on the human dimensions of global environmental change -- the International Global Change Institute (IGCI) at the University of Waikato.

### ***Reasons for Neglect of Human Dimensions Work in the Social Sciences***

There are a number of reasons for the lack of human dimensions research among New Zealand's social scientists.

**Funding:** As indicated in the previous section, the social sciences is not given high priority in the funding of science research. With priorities remaining focused on the physical and natural mechanisms of global change and their physical and natural effects, it is difficult for social scientists to compete for global change funding and even more so for human dimensions research related to global change. One factor influencing this situation is that much social science is often carried out in low budget projects, by university staff for example, with the major inputs being time and labour. Social scientists, have as a result, become less adept at obtaining funding than their physical and natural science counterparts in universities.

The government's research strategy for the next five years does indicate a slight increase in funding for social research, but the proportion of the total has remained very low (for example, the Society and Culture component only accounted for only 3.4 percent of the proposed budget for 2000/01).

**Currently there is no 'Human Dimensions Programme' in the country**

**Much social science research is often carried out in low budget projects**



**In 2001, 66 percent of the Foundation's research funds targeted biological, physical and chemical processes of climate change**

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**The Foundation has alerted the research community to its desire to shift its research investment**

The recent strategic report on the Foundation's climate change investment portfolio (2002) typifies the concerns raised above. In 2001, 66 percent of the Foundation's research funds targeted biological, physical and chemical processes of climate change. A further 19 percent addressed the productive sectors and research on the likely effects of climate change and potential pathways to mitigation in the agriculture, forestry and horticulture industries. The remaining 15 percent was divided unequally between energy sustainability (8 percent), hazards, climate and variability (5 percent), transport (1 percent), buildings (1 percent) and health (less than 1 percent). Critically, human dimensions research was not mentioned within this portfolio but was 'tacked on' in the accompanying text to the tune of \$743,000 (FRST, 2001). These monies were to be allocated to support the following research areas (FRST, 2001:12):

- Improving knowledge of how human beliefs, behaviour and actions influence climate variability and change, and are influenced by them.
- Improving integrated assessments of climate variations and change that incorporate human dimensions as both effects and drivers of change.
- Improving knowledge of how human behaviour and actions influence the composition management of greenhouse gases.
- Improving knowledge of the role played by socio-economic drivers of global change.
- Linking socio-demographic factors and physical characteristics to energy use.
- Identifying factors to change people's transport use.

Each of the six areas of research is large and the \$0.74 million dollars allocated across them therefore a pittance. Admittedly, the Foundation has alerted the research community to its desire to shift its research investment "more strongly towards Effects and Responses", but not at the detriment of processes research, but rather through the redirection of monies from other SPO, such as wealth creation and biodiversity (with consultation) (FRST, 2001:3).

In the Foundation's view Processes-based research addresses the following:

Understanding variability and likely future change in the New Zealand atmosphere and climate system. Includes: basic atmospheric processes, responsible for changes in our climate and weather systems, and development of predictive models; greenhouse gas fluxes; effect of the ocean on biogeochemical cycles and transport of heat, water and other materials in the climate system; role of land surfaces and vegetation in biogeochemical cycles and the climate system (FRST, 2001:19).

As noted in an earlier section of this report, process-based research can also be highly relevant in human dimensions research, in the context of decision-making for adaptation and barriers to effective implementation of adaptive and mitigation strategies. As of 2003, the Foundation's perspective on process-based research was firmly linked to the physical and natural sciences.

The Effects-based research is more nuanced in that it has the scope to include human dimensions research. As defined by the Foundation Effects-based research includes:

Improved understanding of the sensitivities of physical, biological and social systems to changes in climate. Includes: sensitivity of fundamental biological processes systems, the natural environment, the coasts, the built environment, and human health to changes in atmospheric composition and climate; risk assessment including integrated impact assessment to identify sensitive systems, regions or sectors; and analysis of effects on New Zealand economy and international markets (FRST, 2001:19).

**Process-based research can also be highly relevant in the human dimensions area**

**Effects-based research is more nuanced in that it has the scope to include human dimensions research**

**The majority of social scientists do not give high priority to environmental issues**

The final category is Response-based research, defined by the Foundation as:

Establishing a scientific basis for: effective adaptations to climate change; sustainable practices to manage human impacts on the climate system, and responses which mitigate greenhouse gas emissions. Includes: human behaviours underlying greenhouse gas emissions and ways of reducing them; inventories of greenhouse gases and reduction options; identification of options for sensitive sectors to reduce negative impacts of climate change, including agriculture, built environment and human health; and analysis of the economic and social impacts of mitigation and adaptation options (FRST, 2001:19, 20).

This final category is most open for interpretation in reference to human dimensions-type research, however, to date the investment in this area has been the smallest. This has been linked not only to the paucity of money invested in this area but also owing to the fragmented academic and disciplinary environment that could potentially deliver on these priorities. Regardless of the current state of play, the Foundation has repeatedly signalled its intent to bolster the Effects and Response research portfolios (FRST, 2001).

**Other social sciences priorities:** While there is no survey material available, it is probably reasonable to suggest that the majority of social scientists do not give high priority to environmental issues. This reflects a variety of factors. One important influence is that many disciplines in the social sciences do not have a history of concern for environmental issues. Indeed, some have deliberately sought to avoid involvement in the study of human interaction with the environment, reflecting the wariness in the social sciences that studies of

human interactions with the environment may fall into the 'trap' of environmental determinism.<sup>6</sup> Equally importantly, many social scientists are concerned with other social problems such as poverty and inequality. While the case can be made that these problems are not unrelated to environmental issues, the researchers concerned often find their research interests more immediate and pressing.

**Interdisciplinary apathy:** There are difficulties in engaging in transdisciplinary research within the social sciences, just as there are within the natural and physical sciences. Informed by different paradigms which set out their respective topics of study, scale of study and methods of study, scientists from different disciplines have tremendous problems taking an interdisciplinary or transdisciplinary approach. If these problems remain within the broad categories of science, it is likely to be even more difficult for social scientists and natural and physical scientists to engage successfully, and with equity, in joint research. Moreover, there is a tendency for social science research to be considered as not having the same authority as research in the natural and physical sciences. Thus, often in priority setting, level of influence over policy makers, and in status within research projects, 'hard' science is privileged over 'soft' science, although some social scientists argue they deal with the 'hard' problems.

Notwithstanding these trends, there have been very significant developments in the social sciences over the past decade. Much of this has seen rejection, especially by younger social scientists, of the positivist methodologies in social research that was adapted long ago from the natural sciences, where it is most appropriate. There has been an accompanying critique of the privileged positions held by the so called 'hard' sciences as compared to the so-called 'soft' sciences. Given these developments, contemporary social science work on global environmental issues is as likely to be an examination and hearty critique of power structures that privilege some groups (including those involved in research) and discriminate against others. It is unlikely that such researchers will be willing or interested in serving as minor partners in a large and predominantly 'hard' science driven research agenda.

**Many social scientists are concerned with other social problems such as poverty and inequality**

**There is a tendency for social science research to be considered as not having the same authority as research in the natural and physical sciences**

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<sup>6</sup> Environmental determinism is the doctrine, largely discredited in early 20th century, that patterns of human behaviour, and cultural and social attributes are determined by the environment in which the cultural group or society is situated.

**While mega-collaboration on research is laudable and should be fostered when appropriate, it can not come at the loss of individual research that can also lead to significant scientific gains**

**Policy:** It follows from the preceding discussion that, to date, most environmental policy stems from concerns raised by natural and physical scientists (although often mediated through public debate and public expressions of concern). Accordingly, the agendas for environmental research to inform policy development are often set by the natural and physical science community. The Social sciences are often considered to be not relevant to the issue.

A matrix has been devised to guide the process of defining problems associated with global environmental change. We do not propose a narrow, top down approach to the definition of priority setting for research in the impacts of global environmental change on New Zealand's climate or biodiversity, which are two strands we have been charged to address. While mega-collaboration on research is laudable and should be fostered when appropriate, it can not come at the loss of individual research that can also lead to significant scientific gains. This has been recently highlighted in the EU where the opening up of research through an 'expressions of interest' process resulted in a huge influx of research proposals but with very few showing signs of collaborative effort (2002). It will take time and concerted effort on behalf of the Foundation to foster, nurture and support research that fulfils the transdisciplinary criteria defined in this report.

## 10. Gaps in the Human Dimensions of Global Environmental Change and Biodiversity Research in New Zealand

### *International Context*

Some issues in the study of the impacts of greenhouse gas induced climate change at the scale of international investigations will influence New Zealand. We briefly detail these gaps in the research.

Parry (2002) provides a useful review of the gaps in research across the globe. He considers there to be substantial gaps in our knowledge of potential impacts in different parts of the world, including New Zealand nationally, regionally and at community and household levels. Moreover, there is an almost complete lack of information on how impacts could shift under varying socio-economic development scenarios and resulting different greenhouse gas mitigation strategies. The economic costs and robust analysis to substantiate the claims for investing in adaptation to avoid future, even higher costs of disaster recovery and adaptation, are seriously under theorised. All these areas were highlighted in the Intergovernmental Panel on Climate Change (IPCC) in its Third Assessment (IPCC, 2001a-d). Where studies have been done, the coordination with other researchers and studies is only weakly developed thus compromising the opportunity for wider generalisations to be made.

Within the International Human Dimensions Programme on Global Environmental Change four broad research gaps have been identified (Jager, 2003) and these, in part, mirror the findings from our survey of New Zealand stakeholders on gaps and priorities for research.

**There is an almost complete lack of information on how impacts could shift under varying socio-economic development scenarios and resulting different greenhouse gas mitigation strategies**

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**The findings of the IHDP mirror findings from New Zealand's stakeholders regarding priorities for human dimensions research**

**Much of what we do at present is based on assumptions about human behaviour, human-environment interaction and global interrelationships**

The four gaps are:

- 1) Vulnerability and resilience and how do systems function to produce sustainable outcomes in the face of biological and social change;
- 2) Thresholds and transitions and how little is known of environment and social thresholds so that they may be avoided and, when exceeded, be managed to limit disruption;
- 3) Governance and how the activities of institutions governing change manage the human dimension component emerging within global environmental change; and;
- 4) Learning and adaptation and how these can be fostered so as to better manage the challenges to come with global environment change.

Very little explicitly human dimensions research has been conducted in New Zealand. Accordingly there are needs in virtually all areas. In the list which follows, the emphasis is therefore placed on broader research gaps rather than listing specific sectoral or disciplinary requirements.

### ***General Needs for Research***

The human dimensions of global change research issues have received little critical evaluation. While practical considerations regarding human dimensions are of great importance, it is equally essential that we do not lose sight of the philosophical implications of global change issues. Much of what we do at present is based on assumptions about human behaviour, human-environment interaction and global interrelationships which have not all been exposed to examination: indeed much remains implicit in the writing and research on human dimensions. These needs have been canvassed previously and many are still highly relevant (Lawrence, 2000).

**Notions of vulnerability:** One of the major thrusts of global change research concerns identifying those people and places deemed to be vulnerable to the effects of global change. The aim of such research is ostensibly to reduce vulnerability. However, the concept of vulnerability is very much under-theorised. It is used frequently, but often with a variety of meanings. There is also need for care in our methods of identifying the vulnerable. This may be seen as a very power laden process in which the vulnerable are given very little representation. There is thus a need for developing methodologies which allow for ample participation by those who are, themselves, deemed vulnerable.

**Encouragement of a variety of approaches:** The idea that a meta-model of human behaviour can be coupled to a model of atmospheric behaviour is at best out of fashion in much of contemporary social science. The issues are extremely complex, social science is changing rapidly, and new approaches and methods are being developed with some rapidity and old and existing models are being subjected to much critique. This is not an unhealthy set of circumstances and developing a rigid programme of research activities may foreclose future opportunities for real gains in human dimensions research.

**Baseline studies:** Baseline studies on the 'state of society' are an important pre-condition if we are to be able to investigate processes of societal change, be they influenced by global or other changes. The requirement is perhaps more one of coordination and synthesis of ongoing work rather than a massive programme of new research, although gaps in information and understanding may well be identified. Such baseline should be informed by the Task Group on Scenarios for Climate Impact Assessment created in 1998 so that results can be integrated with other baseline studies for the generation of regional and global views of adaptation options (Parry, 2002).

**Vulnerability research:** An important aspect of human dimensions of global change research is that adverse effects of global change will be unevenly distributed. It follows that if those people or groups of people most likely to be negatively affected can be identified, in advance, some actions may be taken to prevent, reduce or ameliorate the negative outcomes. However, vulnerability

**The concept of vulnerability is very much undertheorised**

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**Baseline studies on the 'state of society' are an important pre-condition if we are to be able to investigate processes of societal change**



**How vulnerability is expressed will mirror the physical, cultural, socio-economic and political diversity of the Nation and it is at this level that a large research gap exists**

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**A key element in response to global change is the control and flow of information**

has proven to be an elusive concept, one that is used very often but rarely subjected to critical examination. Thus we have a term that means many things to different researchers. New Zealand is diverse physically, culturally, socio-economically and politically. How vulnerability is expressed will mirror this diversity and it is at this level that a large research gap exists.

**Scale of research:** Global change, by its very nature, is a scale problem involving the linking of processes which operate at a global level with those which occur locally. Unravelling the linkages is particularly difficult. Nevertheless, if progress is to be made in understanding the human dimensions of global change, both in terms of cause and effect, these scale issues need to be addressed. This is particularly important for smaller countries such as New Zealand (and its Pacific Island neighbours) as they will have little leverage, in terms of their causative inputs, upon global change outcomes.

**Other change:** One of the great problems for human dimensions research is that societies are subject to a huge range of factors giving rise to change, bringing about stress, negative effects for some members of societies and heightening inequality within and among societies. Much effort is needed to develop ways of identifying the different influences upon societal change and determining the significance of the influences as well as how they may interact.

**Information in global change:** A key element in response to global change is the control and flow of information among scientists, policy makers and the general public. Research is needed on the nature of such flows, what information exists and is available, what information is needed by the various actors, and how information can be made accessible for all users.

**Terminology:** There is looseness in much of the global change terminology. This reflects translation problems in an interdisciplinary research arena. However, it is imperative that some terms that are particularly important in human dimensions research are clarified. Chief among these are notions of impact and effect, vulnerability, adaptation and adjustment.

## 11. Identified Research Priorities in New Zealand

Thirteen strategic research areas were identified by our research, and their presentation as priorities to the Foundation is a fundamental component of this project. A research methodology was developed and applied to attain the list of research priorities. The methodology is detailed below prior to the presentation of results.

### Methodology

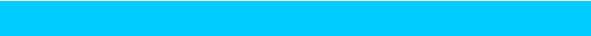
A modified Delphi technique was used to analyse and focus the considerable number of research questions to emerge through the face-to-face interview process used to gather data.

Delphi techniques are commonly used when gathering expert opinions and for future forecasting. Commonly, mailed surveys are used to both collect data and when collating and summarising the replies. In this way, a number of cycles can be used to gain focus and prioritisation on issues being addressed. As noted, a modified Delphi technique was used.

Face-to-face interviews were used to gather the initial suite of research questions from a chosen group of participants. Participants were chosen using snowballing techniques and through referrals from an expert group involved in overseeing the project. Thirty-eight interviews were conducted with researchers, field staff, and decision-makers within public institutions, non-government organisations, academia, consultancies, crown research institutes and individual contractors. It was important that each participant have a history of participation in human dimensions and/or climate change activities. The list of participants was therefore checked against various databases of participants of climate change forums held in New Zealand over the last three years. The names of the participants will remain confidential. Each interviewee was informed of the ethical guidelines pertaining to research involving human subjects as mandated by the University of Waikato. Interviewees were presented with informed consent

**Face-to-face interviews were used to gather the initial suite of research questions**

**Thirty-eight interviews were conducted and two hui were held**



**A seventy-eight percent return rate was accomplished**

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**In the face-to-face interviews, participants were asked about past and current research that included a human dimension**

forms which were signed by the interviewee and interviewer.

Another round of data collection was conducted with Māori. This included both individual face-to-face interviews and two hui. One hui was held in Rotorua and a second in Wellington. The groups represented in the hui included Ngati Awa, Ngai Tai, Nga Tahi, Whanau-a-Apanui, Whakatohea, Ngai Tuhoe, Ngati Tuwharetoa, Te Arawa, Ngati Porou, Ngati Kahungunu and Ngai Tamanuhiri.

Data collection techniques were similar in all instances. The nature of the project was explained as was the methodology for data collection, feedback and reflection. The face-to-face interviews took between 60 and 90 minutes. Discussion and recording centred on the information, methodological and knowledge-based impediments to decision-making with respect to opportunities for either preventing or adapting to changes in climate and biodiversity (see Appendix 2 for a copy of the interview schedule). Responses were written up as the interview progressed and were later typed and returned (by post with self-addressed stamp envelopes to facilitate their return) to the participant for confirmation of what was recorded and for feedback on the priorities for research and rationale for the assertion that the research was required.

A seventy-eight percent return rate was accomplished. Those surveys that were not returned were not rejected. They often contained information that paralleled comments made by others and if this was the case then it strengthened the case for the prioritisation of some research over another.

The other aspects of the project required comprehensive literature reviews and searches. In the face-to-face interviews, participants were asked about past and current research that included a human dimension. This approach proved to be valuable as much of the very limited human dimensions research is conducted by individuals and institutions that lie outside the Foundation's funding and reporting mechanisms. An attempt was made to itemise the research. The list is not a comprehensive reflection of the breadth and depth of human dimensions research undertaken in New Zealand, but it is indicative of where there is activity.

Academic collaborators provided input on the relationship between economics, law and biological sciences (biodiversity studies, in particular) research and human dimensions of global environmental change internationally and in New Zealand.

The overall framework for human dimensions research was compiled from a wide range of international literature and experience.

All the components of the study have been reviewed by a panel of both New Zealand and internationally-based experts.

**The framework for human dimensions research was compiled from a wide range of international literature and experience**

**The range of research conducted in the human dimensions of global environmental change field may be considerable but unrecognised**

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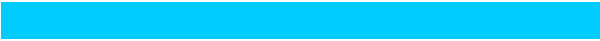
**It may also be worthwhile to consider the merits of designating a research unit as the depository of research references**

## **12. Recent Human Dimensions Research in New Zealand**

It is difficult to categorise human dimensions with disciplinary labels. Rather we have listed in table form the research that has either been recently completed or is ongoing. Some research will have occurred that is extremely difficult to capture in an exercise of this type. Namely, the research conducted with University Departments is often funded by internal money or is part of student projects and thus is not necessarily tied to large research contracts which are more readily traced. The range of research conducted in the human dimensions of global environmental change field may be considerable, but unrecognised.

The Foundation may wish to consider the merits of exploring in depth the range of research conducted in University Departments or as part of consultancies and other research outcomes in this area. In the future it may also be worthwhile to consider the merits of designating a research unit as the depository of research references (at minimum) of all research conducted in the human dimensions of global environmental change field in New Zealand. There are numerous examples of such one-stop-shops, for example, the Bibliography of Agriculture in Papua New Guinea, which is a searchable Endnote database with over 12,000 references. This site is known globally as the one place to feed references from recent work in this field and to begin literature searches for the named topic in Papua New Guinea. The site is maintained by the Land Management Group at the Australian National University.

In Table 2 that follows is a list of human dimensions research completed or underway as of 2005. This list is followed by research needs.



**Table 2: Sample of human dimensions of global environmental change research completed and underway in New Zealand as of 2005**

<b>Principal Investigator (Affiliation)</b>	<b>Project Title</b>	<b>Focus</b>
Gavin Kenny (Earthwise Consulting)	Adapting to climate change in eastern New Zealand	Farmers' perspectives on climate change and long-term planning for adaptation
Nathan Taylor (Otago Energy Studies Program)	The effectiveness of energy efficiency upgrades to state housing in southern New Zealand	Improving home heating and social-subjective improvements in occupants
Nathan Taylor (Otago Energy Studies Program)	Cost/benefit analysis of energy efficiency upgrades to state housing around Dunedin	Performance of upgrades for energy efficiency with economic analysis of value of upgrading versus costs for homeowners
Alistair Woodward	Climate change and human health in the Asia Pacific region: who will be most vulnerable?	Shifts in vulnerability of populations to ill health as related to climate change
Alistair Woodward, Simon Hales and Neil de Wet (Wellington School of Medicine, Otago University (Woodward and Hales)) International Global Change Institute (de Wet)	What does climate change mean for human health?	Potential effects of climate change on human health and concepts of thresholds and benefits to be derived by mitigation of greenhouse gases



Landcare Research	Human Dimensions of Biodiversity Management	To develop greater understanding of biophysical processes, better technological tools, and improved social mechanisms to assist communities become more effective biodiversity managers in human landscapes, and thereby lead to a halt in biodiversity decline
NIWA	Adapting To Climate Change Impacts: What Role For Local Government	Role of local government in dealing with the effects of climate change
International Global Change Institute	Hotspots I and II	Vulnerability of New Zealanders to new diseases as a result of new disease vectors becoming established as a result of climate change
International Global Change Institute	Climpacts 1 and 2	The research strategy of the CLIMPACTS programme has been to develop sequentially capacities for national, site-specific, and regional assessments of climate change effects

## **Research Needs – Outcomes**

The opportunity for experts in the field of human dimensions of climate change and biodiversity to express their personal beliefs on the areas of critical need for research was quickly grasped. Most interviewees volunteered that they greatly appreciated the opportunity to discuss human dimensions research and their personal perspective on where the needs were greatest. As more interviews were completed there was a growing consensus on specific needs. We present a broad overview of the number of questions generated and then the first order classification of these questions. Later, specific questions and a ranking are provided.

A total of 258 questions related to the topic were generated and covered both Māori and non-Māori perspectives. The questions generated in the interviews were very specific and some examples are provided to give flavour to the outcome from the initial data gathering exercise:

- a) What non-economic benefits accrue to Māori as a result of preservation of wetlands (and other environmentally significant lands) and therefore what is at risk to be lost as a result of changes to these lands that may occur as a result of climate change and shifts in the stock of biodiversity and fragmentation of such environmentally important landscapes?
- b) How do we first assess the capacity of communities to adapt to and, also mitigate greenhouse gasses to diminish longer term impacts of climate change and how can that capacity be enhanced at the individual and community level?
- c) What are the informational needs of policy makers that will assist in linking their thinking to wider issues of mitigation and adaptation to climate change?
- d) What mechanisms can be employed to encourage planners and policy makers to include climate change in their work and not consider it as an optional extra?

**Interviewees volunteered that they greatly appreciated the opportunity to discuss human dimensions research and their personal perspective**

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**A total of 258 questions related to the topic were generated and covered both Māori and non-Māori perspectives**

**Three categories were provided to the interviewees: informational, methodological and knowledge-based**

**Knowledge and information are closely related**

### ***Classifying the Nature of the Questions Generated***

The interviewers collected two additional pieces of information when gathering the potential research questions. It was felt that questions required context and that as research questions they should satisfy perceived (through expert opinion) needs of a particular individual or group. Therefore respondents were asked to classify the nature of their questions using three criteria. These criteria, while discrete, were not interpreted as exclusive. In many cases questions related to more than one classification and, as will be seen, when the questions are consolidated and articulated as researchable questions of appropriate breadth and depth for consideration by the Foundation, the value of the initial categorisation fades.

Three categories were provided to the interviewees: informational, methodological and knowledge-based (denoted as I, K, M in Tables 3 and 4 below). To reiterate, the question posed to interviewees was this: *What are the impediments to effective decision-making and actions regarding the prevention, reversal or adaptation to global environmental changes in the New Zealand context?* Informational questions would address the types of information needed, for example, by councils to better manage adaptation and mitigation issues with the population they serve. Methodological questions would typically focus on how research to address the vulnerability and adaptive capacity of individuals and organisations could be carried out in New Zealand. The third and final category would capture the questions that focused on the gaps in knowledge pertaining to the human dimensions issues in the context of adaptation and mitigation.

Clearly, knowledge and information are closely related. However we would argue that knowledge is differentiated from information in that the former represents a body of known things that is generated by research, learning or education and requires a clear understanding of the context in which it was generated. Information is the useable form of knowledge. Wilson (2002) defines knowledge as “what we know: knowledge involves the mental processes of comprehension, understanding and learning that go on in the mind and only in the mind, however much they involve interaction with the world outside the mind,

and interaction with others.” It is transformed knowledge that can be used by individuals and organisations to either achieve an objective or influence behaviour. Knowledge, again as described by Wilson (2002), becomes information when it is expressed through “oral, written, graphic, gestural or through ‘body language’”.

In the macro analysis, the initial 258 questions were sorted into 12 broad categories. A separate categorisation, again to 12 broad categories was conducted on the 55 questions garnered through the hui process.<sup>7</sup> In the case of the non-Māori interviewees, these ranged in related sub-questions from the top category with 34 related sub-questions to the smallest discernable grouping with seven related sub-questions. For the Māori component, the range was much tighter, as to be expected, with between 11 and 2 responses related to each broad category. The broad categories are depicted in Tables 3 and 4.

**The initial 258 questions were sorted into 12 broad categories**

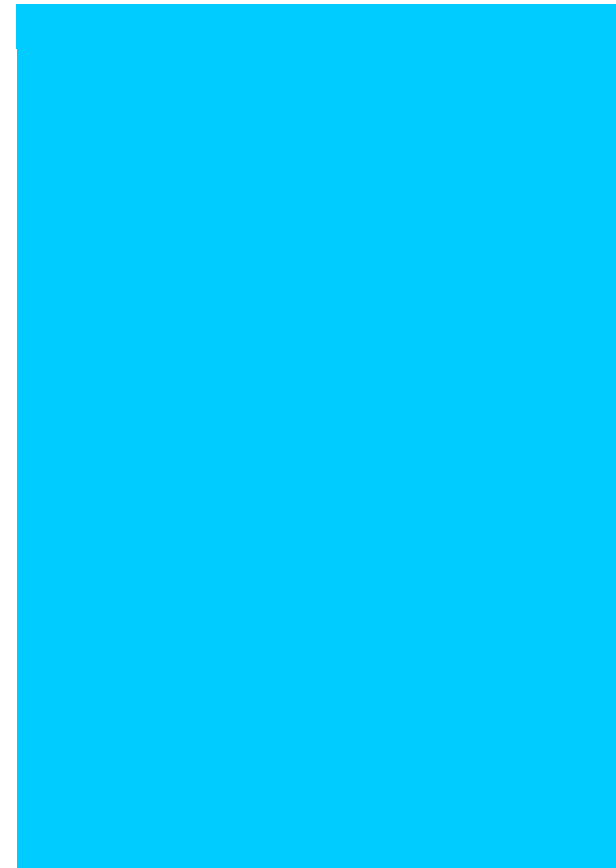
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<sup>7</sup> The fact that the Māori and non-Māori interview process resulted in the identification of 12 broad categories of researchable area was a coincidence and not an expected outcome of the research process.

Table 3.0: Themes in Pakeha/European research prerogatives with reference to mitigation and adaptation to climate change and biodiversity.

<b>Over-arching issues in need of examination</b>	<b>Number of responses N=204</b>	<b>I'</b>	<b>K'</b>	<b>M'</b>
Knowledge on assessing perception and monitoring shifts in perception of risk and vulnerability and attaining a general understanding of society's views at all levels (from individuals to groups and communities) of climate change and biodiversity and where education fits within the process of changing these perceptions?	34	4	27	3
How to more efficiently and effectively create information from knowledge and provide better data storage and sharing of knowledge and information related to climate change across cultural and socio-economic units.	25	7	17	15
How to better understand specific issues (action research) related to climate change and biodiversity and then to better adapt to it and create appropriate mitigation strategies.	24	1	18	13

How decision-making and policy formulation work with regard to climate change and how to better monitor policy changes, implementation of policy and its short and long-term impacts?	22	5	11	6
What role could be played by transdisciplinary and integrated research in human dimensions investigations and how does this relate to the development of better knowledge, and by association, better and more useful information for decision makers? And what capacity can be found in New Zealand to conduct human dimensions research in all its permutations?	21	3	4	17
How do economic and other drivers of change influence the direction of adaptation and mitigation activities?	15	2	15	3
How do today's institutions work and how do their structures and management styles influence adaptation and mitigation policy formulation and implementation? Are new institutions necessary to manage adaptation to and mitigation of climate change?	14	17	1	1

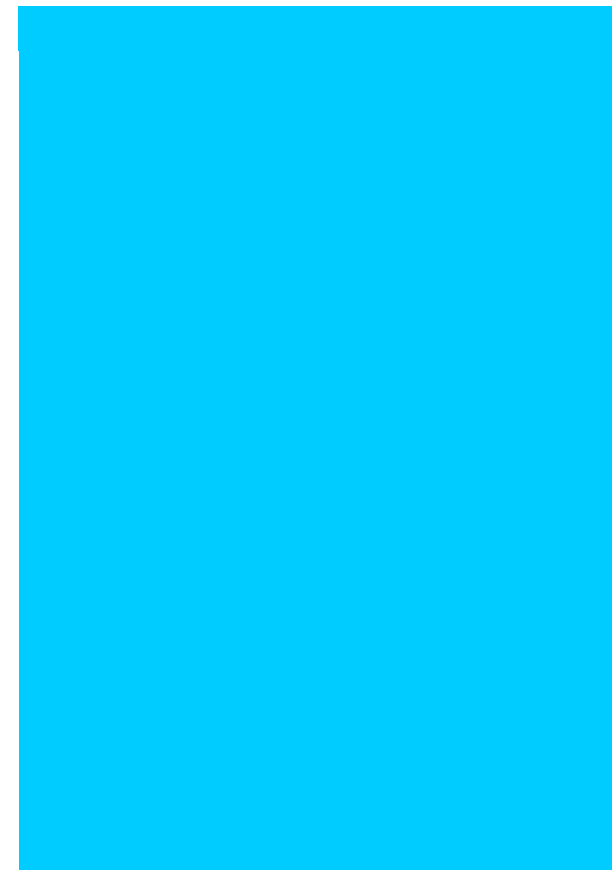


Research in specific sectors, such as fishing, forestry, agriculture, tourism, that have a human dimensions component and where such research can promote better adaptation and mitigation strategies.	14	0	15	2
How are biosecurity and biodiversity issues and ecosystems intertwined and then influenced by potential climate change in New Zealand's future and how does the cultural perception of this alter behaviour?	11	0	9	2
The role of international institutions, events, trade policies, conventions in effectuating impacts on behaviour and policy development in New Zealand and the links all these areas have with climate change and biodiversity.	10	1	7	2
How do indigenous knowledge systems, in their widest sense, and modern scientific concepts inter-relate in both understanding the nature of climate change and related impact on biodiversity and in formulating appropriate interventions?	7	3	7	0
How will risk, resilience and vulnerability and the potential for social conflict of, and between, individuals and communities be influenced by climate change?	7	0	5	2

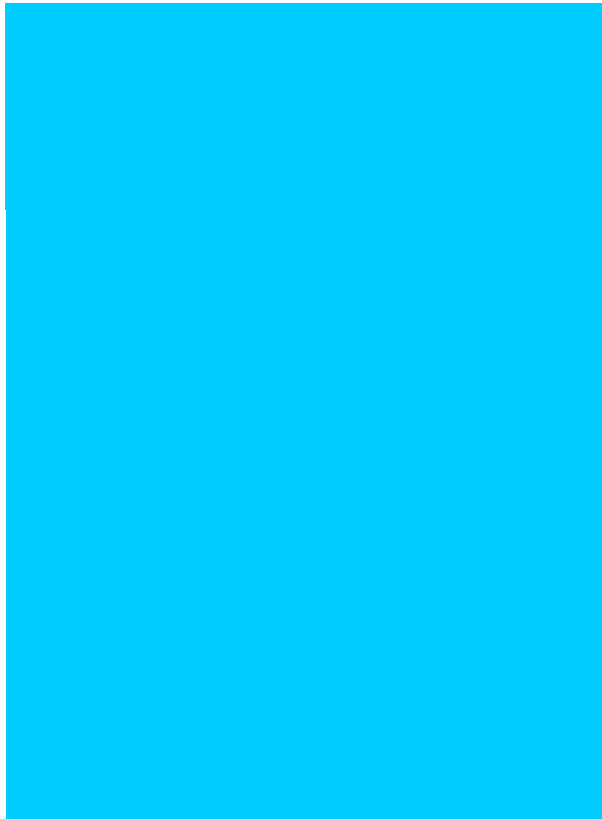
\* The sum of I, K and M often exceeds the number of responses in any particular row owing to the cross-cutting nature of the question as posed (for example, a question has knowledge and informational elements).

**Table 4:** Themes in Māori research prerogatives with reference to mitigation and adaptation to climate change and biodiversity.

Over-arching issues in need of examination	Number of responses N=55	I'	K'	M'
What economic and non-economic values accrue to Māori from natural resource control, management and utilisation and how might these values shift and thus impact on Māori communities with climate change?	11	7	8	1
What methods are appropriate when working in collaboration with Māori in setting priorities and devising implementation strategies for adapting to climate change?	6	2	1	4
What influence does the build-up of greenhouse gases have on whakapapa of the tonga of Māori and what impacts might this have on Māori development under climate change?	6	3	5	-
What networks, both formal and informal, work in Māori communities? Why do they work and how can they be used to transmit information on climate change impacts and adaptation and mitigation?	5	3	2	3







How are waterway and forestry development decisions made in relation to climate change and how do all the forestry-related and water body issues of Kyoto, forest management, fire risk and flooding and low flow relate to climate change, adaptation and mitigation?	5	1	3	2
In what ways can governance at all levels be influenced by and influence policy making with regard to planning for adaptation to climate change and mitigation activities and how can these processes be designed so that Maori gain more control?	4	3	2	-
How do barriers imposed by the court system and legislation limit capacity of Māori individuals and iwi to plan to adapt to climate change and does this place Māori at greater risk?	4	4	2	-
How can research to be carried out on the human dimensions of climate change be more cognisant of the needs and aspirations of Māori communities (and their specific places) and thus be more responsive to the needs of Māori and their distinctive environmental situations and resources?	4	4	-	-

What depth of knowledge is already held by Māori with regard to the environment and change, in that environment and how can this knowledge enter into the decision-making process for adaptation and mitigation and how can this knowledge be protected from exploitation?	4	2	3	1
How can western generated knowledge be transformed into information accessible to Māori communities to improve their capacity for adaptation to climate change and mitigation of greenhouse gases?	3	1	1	2
Government policy is critical to the setting of adaptation strategies by Māori as is the impact of government policy on current activities. How might government policy regarding adaptation and mitigation to climate change either be influenced by, or affect Māori?	3	2	3	-
What perceptions of climate change are currently held by Māori and how does their location and economic activities (urban, rural sectoral) influence this perception and capacity for adaptation?	2	1	2	-

### ***Convergence and Divergence***

When viewed as a whole, the research themes to emerge from the two cultural groups defined for this study had considerable common ground. We have identified five areas of 'convergence' that are worthy of note.

A dominant theme was the potential role for transdisciplinary research in the overall human dimensions research process. It was generally viewed that such an approach offered opportunities in bringing together people with different worldviews and theoretical perspectives so as to adopt approaches and methodologies in human dimensions research that not only draw more heavily on

**The research themes to emerge from the two cultural groups defined for this study had considerable common ground**

**There was a consensus on the need to consider specific sectoral interests and how these might be altered by climate change**

local conditions, experiences and practicalities but are capable of linking these local phenomena and understanding of process to larger, exogenous systems, potentially reaching institutional, political and economic affairs at a global scale.

A second area of convergence focused on policy, both its formulation and implementation. The formulation of policy, it was believed, needed to be examined in the context of research in human dimensions being more greatly reflected in policy making and the decision-making process with reference to policy formulation. The second concern that was highly researchable was the seeming aversion to solid analysis of the impacts of current policies that impact on mitigation and adaptation activities of individuals and communities and how and why they constrain or facilitate positive social change associated with climate change.

A third area of mutual concern addressed the formation of knowledge and the transformation of that knowledge — in whatever form — to useful and appropriate information to ameliorate the potential impacts of climate change and aid adaptation.

A fourth point of convergence was governance. This theme was broadly related to the need to investigate how institutions function and how and why they present barriers to more efficient application of mitigation and adaptation strategies.

There was a consensus on the need to consider specific sectoral interests and how these might be altered by climate change. These sectoral interests were narrowly defined as forestry, fishing and agriculture with an emphasis on the role to be played by New Zealand being a signatory to the Kyoto Protocol.

It is interesting to note that the issue of society's perceptions of climate change and associated perceived shifts in risk and vulnerability, was acknowledged by both groups of interviewees. However, the importance of this issue as reflected in the number of questions generated in this area was antithetical. For the non-Māori cohort there were 34 questions generated along this theme (a top ranking),

while amongst the Māori respondents only two questions were raised on this theme (ranking the lowest). This in itself is an interesting reflection perhaps of risk and vulnerability across two stakeholder groups.

There is also a strong differentiation between the two study groups in terms of the type of research required be it to fill a perceived informational, knowledge or methodological void. To a large degree the European/Pakeha perspective was dominated by knowledge-related research, with information and finally methodological issues a more distant third. In the Māori community a focus on informational needs outweighed those in the knowledge area and methodology, as in the European/Pakeha community was ranked third. The small sample of people surveyed for this report could certainly account for this bias. The prevalence of Māori in the survey who were engaged more closely in community activities and with a stronger understanding of the needs of those communities could also explain the discrepancy. This divergence should not be misinterpreted. There is a holism in the variety of responses and neither group, we believe, would deny the need or expect a privileging of one type of research above another as a result of this divergence. As discussed earlier, the knowledge/information binary is not always clearly understood. It is commonly the misuse of the term knowledge, i.e. so called knowledge management, that is confused and leads to misunderstanding.

### ***Reflections of Interviewees – Justification for Posing Research Themes***

As one might expect the justification for the advocating of particular research themes rests largely along experiential, disciplinary and sectoral lines. Planners, policy makers, academics, development practitioners and the other assorted people interviewed for this project were, regardless of their personal biases, interested in a broader justification for the work they proposed. Some did not advocate further research in perceptions and attitudes as this was felt to be an over-subscribed area. However, others felt that the approaches in this area were too macro in scale and failed to understand local contexts and the wide variation in perceptions and attitudes at multiple scales and across socio-economic and ethnic groupings.

**The European/Pakeha perspective was dominated by knowledge-related research**

**Māori in the survey were engaged more closely in community activities and therefore had a stronger understanding of the needs of those communities**

**It is encouraging to see many respondents link their research priorities to perceived research gaps**

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**Human dimension research is a dynamic area and the terrain can shift both within public and private and academic and lay groupings, with either the publication of a single article or through the influence of a single cataclysmic event**

These more nuanced type studies were therefore deemed critical prior to any type of intervention being taken; the results would form a baseline from which change should and could be closely monitored. This monitoring of impact was thought, in general, to be sadly lacking in the climate change adaptation and mitigation field.

It was encouraging to see many respondents link their research priorities to perceived research gaps. Occasionally, these research gaps were identified in the context of the international literature, but often it was in the context of New Zealand's needs. There was a strong scepticism of the applicability of importing research findings in many of the areas advocated for research from other countries or regions to fill gaps in New Zealand's understanding of the human dimensions of global environmental change.

### ***Conclusions***

The generation of nearly 300 specific researchable questions regarding the human dimensions of global environmental change from a relatively small group of experts in this area is both encouraging and daunting. We are encouraged by the depth of thinking and creativity in the New Zealand community currently struggling with the human dimensions conundrum. The distillation of such diverse ideas and perspective into a tight and extremely limited set of researchable issues was difficult and should only be considered indicative of the current perspectives in this area. This is a dynamic area and the terrain can shift both within public and private and academic and lay groupings; with either the publication of a single article or through the influence of a single cataclysmic event. What is abundantly clear is that a great deal is unknown in this area of human dimensions of global environmental change. There is a roadmap that is repeatedly advocated, and we have represented it here: transdisciplinary research, an emphasis on understanding barriers to adaptation and mitigation in all the forms in which it can be manifest (individual, community, society, governance, economics . . .); and the rapid transformation of knowledge in this area to information so that it can enter the policy making arena and have an impact in the lives of New Zealanders.

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## 14. Appendix One

### Human Dimensions of Global Environmental Change

#### Barriers That Inhibit Decision-Making With Respect To Opportunities For Preventing Or Adapting To Changes In Climate and Biodiversity

##### Questions to consider:

What are the impediments to effective decision-making and actions regarding the prevention, reversal or adaptation to global environmental changes in the New Zealand context?

What information (I), methods (M) and knowledge (K) are required, but currently not available, to help answer the following questions:

- How are human activities causing environmental change?
- Why are societies at risk?
- How are societies and economies affected?
- Who and what are vulnerable?
- What is the existing capacity to respond?
- How can individuals, organisations and institutions respond more effectively?

Questions (including rationale for question)	I / M / K	Rank	Rationale for research

## 15. Appendix Two

### Raw Data Derived From Interviews

Unique #	K (knowledge) M (methodology) I (information)	Question
1	M	How does local government determine the social and economic impact of climate and biodiversity changes?
2	K	Does the implementation of methodologies for determining the impacts and human dimensions of global environmental change work better if a top down or bottom up approach is used?
3	K	Is it more productive for councils to integrate climate change into individual work areas (e.g. waste water) or for each council to do individual reports for the council as a whole?
4	K	Is there a critical mass of researchers and institutional strength for human dimensions research in New Zealand?
5	M	How do we convince people it is “good research” to include human interactions and behaviour as an important part of policy development?
6	I	How can we improve the communication and uptake of “soft information” for decision making to make people better aware of the flow-on effects of activities?
7	I	How do people respond to information they are provided with when making decisions?
8	M	How can we quantify the drivers of global environmental change so we can compare and rank their importance?
9	K	How does human behaviour impact on biodiversity and how does biodiversity impact on society and the economy in New Zealand? (i.e. who and what are vulnerable)
10	K	How is vulnerability created?
11	M	How do we value ecosystem services in New Zealand?
12	M	How do we quantify the impacts of climate change relative to other pressures and what is the relevance of these impacts?
13	M	How do we create robust socio-economic scenarios, that include climate change impacts, for at least the next 50 years?
14	M/K	How do we measure the rate of change as a result of climate change vs. specific change? (i.e. how does human society react to bigger picture changes and what are the flow on effects of these changes?)
15	I	What mechanisms can be employed to encourage planners and policy makers to include climate change in their work and not consider it as an optional extra?
16	I/M	How does surplus information become part of a working body of knowledge and what is the best way



		of presenting information to promote this?
17	K	Is there a particular management style that encourages better awareness, understanding and acceptance of global environmental change issues?
18	K	How do we get people to see human dimensions research as robust and to not consider it as an optional extra for informing policy and decision-making?
19	M	How can we validate human dimensions research so that it is better accepted?
20	K	How do we motivate policy makers to recognise the gap in research of human behaviour and motivations and address this early on rather than be surprised by its existence?
21	I/K	Is there any evidence that early integration of human dimensions aspects in policy design does result in closer alignment of expected and actual outcomes?
22	K	If you survey policy for expected and actual outcomes is there any evidence that the way human dimensions was integrated has made a difference?
23	I	How can research results from studies of the human dimensions of global environmental change, both from the past and in the future be better disseminated to Māori?
24	I/K	What are the real benefits that will accrue to Māori communities by participation in human dimensions of global environmental change research?
25	I	Is there a need for a reference group in this area to adequately express iwi needs?
26	I/K	What position does Māori indigenous knowledge have within the human dimensions research perspective and how might this information be incorporated, valued and respected?
27	K	What sort of generational depth is held with respect to environmental knowledge of climate change and who can this be most appropriately used in research with and for Māori?
28	M	What can be done to improve the research on human dimensions of global environmental change in respect to inshore waters and fisheries without compromising marine research (which also needs more emphasis)?
29	K	How might biosecurity risks shift in the context of global environmental change and how will Māori communities be affected (shifts in vulnerability) by biophysical changes to resources impacted by species invasions?
30	I	How can Māori communities and their adaptation strategies be linked together to create better and more effective adaptation strategies to changes in global environmental conditions?
31	K	What are the likely economic costs to New Zealand to be derived from climate change?
32	K	What is the likely cost to New Zealand to adapt to climate change?
33	M/K	Which scenarios of climate change are most relevant to conditions in New Zealand when deriving both the economic impacts of climate change under status quo conditions and what are the costs of adapting?
34	K	What are the possible impacts of climate change and variability at various scales of human

		organisation and across different cultural groups?
35	K	What level(s) of risk are local communities willing to bear in the face of climate change?
36	K	How do people and communities change and adapt, specifically to climate change?
37	M/I	How can people and communities be assisted in adapting to climate change?
38	K	In what ways does government policy constrain changes in behaviour toward a perceived risk or threat of climate change?
39	M/I	How can appropriate government , non-government and peoples organisations, and individuals engage in an ethical manner in altering peoples' opinions about, for example energy use, to mitigate impacts of future climate change (can be applied to any aspect of adaptation/mitigation)?
40	I	What is the current state of knowledge of climate change held by New Zealand society?
41	M	What methods are required to monitor changes in perception over a longer period?
42	M	What methods can be used to ascribe cause for adaptation to climate change?
43	M	How can agencies that fund research in human dimensions of climate change and biodiversity facilitate the development of more transdisciplinary research and methods?
44	M	What methods can be used to integrate data from the physical sciences with the social science, for example economic modelling involving biophysical or climatic data?
45	M	How can we reduce the silo effect and increase and encourage cross-portfolio connections?
46	I/M	What methodologies can we employ to increase the distribution and uptake of information?
47	I/M	What are the best methodologies for finding out what people know and educating them on what they need/want to know?
48	M	How can we improve scientists understanding of social science and encourage them to ask appropriate questions that include social science in their research?
49	M	What methods can be employed to encourage cross-department and institution research and to encourage people to work together more efficiently?
50	M	Can we develop a methodology for collecting and storing human dimensions of global environmental change data that will make relevant data available to researchers working outside the specific research project?
51	K	Are the best people involved in human dimensions of global environmental change research and is the advice of the best people being sought for decision-making and policy formulation?
52	K	What are peoples understanding of the issues and the capacity of various organisations to deal with the issues?
53	M	What are the structural and management barriers to effective research?
54	K	How can we improve the uptake of research findings by end users?

55	M	How can we promote “collaboration with a common understanding”?
56	K	Why are changes occurring? <ul style="list-style-type: none"> <li>• Where is it?</li> <li>• What are the human impacts?</li> <li>• What is biodiversity?</li> <li>• How do we define it?</li> </ul>
57	K	What are people perceptions of the changes that have occurred or are occurring over time?
58	M	How can we pool together information and research across organisations to reduce duplication and promote collaboration? (e.g. “All-of-Government” and E-Government”)
59	M	How can we take better advantage of people’s “hidden” knowledge?
60	K	What are the institutional (legal, financial, organisational) impediments to responds to biosecurity incursions of dangerous pests and diseases that threaten New Zealand?
61	M	What type of modelling could be done to derive the consequences for environmental change for each region of New Zealand for the dairy industry (as a key economic activity) with the target of a 4 percent increase in productivity per annum?
62	M	What GIS software and methodologies are available or could be developed to model pests and disease organisms in order to assess their potential impact on settlements or primary production as they spread?
63	K	Does increasing agricultural efficiency of production increase the level of agricultural risk from biosecurity incursions?
64	K	How vulnerable or resilient are New Zealand’s key agricultural systems to global change, in its broadest sense (climate, economic, trade etc.) in the face of biosecurity incursions?
65	K	What role or impact does the fact that in New Zealand the greatest risk for a biosecurity incursion is through ports that are situated in urban areas (i.e. with urban populations at the initial entry point and as key players in halting the spread of a threat) while the primary economic impact of these incursions is borne by rural land managers?
66	K	Does institutional dependence versus indigenous or local knowledge and networks or different institutional arrangements (farmer to farmer versus farmer to fertiliser dealer) limit land managers’ ability to adapt to change?
67	I/K	How does knowledge get disseminated by different agents of change, for example, farmer to farmer versus government agencies like Hort Research and does this impact on land managers ability to adapt to change?
68	K	At what level do people change their behaviour in response to perceptions of climate change and where do they change deeper and longer term attitudes as they relate to the same phenomena?

69	M/I	How can those with information on climate change best inform or convey that information to encourage society to grasp a broader view of the potential impacts (both positive and negative) of climate change?
70	K	What social conflicts might emerge over resources and land management in relation to adaptation to climate change and how might these conflicts be mitigated?
71	K	How can society generalise or interface traditional values and ethics of indigenous peoples regarding resource management in the context of climate and change and biodiversity management with the values and attitudes of contemporary, modern society?
72	M/I	What methods of educational delivery for improved understanding of the human dimensions of climate change and biodiversity are most appropriate to specific cultural, linguistic and socio-economic groups?
73	K	What stereotypic views are held by specific sectors or individuals within society and how might these stereotypic views modify the adoption of adaptation and mitigation approaches to climate change?
74	K	How do individuals and social groups develop their value sets with reference to the environment and climate change?
75	K	What part of the aforementioned value set is derived from formal educational processes and what from other social interactions (family, whenua, peers) and how can that influence a person's or community's ability to adapt to climate change?
76	I/M	How can we increase awareness of data, research, and findings amongst the research community?
77	I/M	How can we improve the availability of data, such as the 1990 LCDB, so we can undertake modelling and change studies?
78	I/M	How can we increase the availability of information and methods to improve general ecology research on a wider spatial scale?
79	K	There is a gap in the research on modelling carbon sequestration in plantation forests across a range of ecological sectors
80	I	How can we improve the availability of historical data and promote collection of data so that it can be used by others and across a range of sectors?
81	M	How can we promote collaborative research where scientists are working with the best economists in the area and vice versa?
82	M	How can we promote better research methodologies so that scientists are not defining inappropriate roles for social scientists in a research project and vice versa?
83	M	Further research is needed to develop methodologies for human dimensions of global environmental change research as this is still an emerging area.
84	M	What methodologies can we use to model human land use choices at a broad spatial scale so as to help predict human behaviour?

85	I/M	How can we improve access to and sharing of data, such as that held by Statistics New Zealand and collected/used by research organisations, for human dimensions research?
86	K/M	How can we improve the capacity in New Zealand to undertake such research, especially in the quantitative research area?
87	I	How can we make better use of student research?
88	M	How can we promote better collaboration so that research assessing peoples responses includes quantitative social science researchers, sociologists, and political scientists?
89	M	What are the differences between science and social science research methods, and which methods are best applied to which situations?
90	M	How can we promote collaborative small group research on the human dimensions of global environmental change?
91	I/K	How can existing Māori cultural interests and practices be used to better manage land and biodiversity?
92	K	What do Māori do in terms of land use and land use change, and what is culturally expectable?
93	I	What is the best process for getting good ideas into policy and the policy effectively implemented?
94	I/K	Where do people get their information about climate change as a problem from and whom do they believe (motivation)?
95	K	What are the impacts of each fishing method and how can consideration of fishing impacts be a requirement that is implemented in the context of climate change?
96	K	What are the drivers in the relationship between the fishing industry and ministry of fisheries and how does this limit research on the marine environment in general and therefore also in the context of climate change?
97	K	Is policy being made using available and appropriate information?
98	K	Are there barriers in the fishing industry that are preventing researchers from speaking openly about their findings and possible environmental impacts?
99	I	How can we improve the willingness of researchers, in particular CRI's, to make their findings and information available to the public?
100	I	How can we facilitate involvement of public and people with non-extractive interested/values in decision making meetings and policy formulation and implementation?
101	K	How are decisions made at the ministerial level and what information informs and influences these decisions?
102	M	What alternatives could be used to measure national aggregates of well being and to measure national capital, biodiversity, and their losses?
103	K	What are the impediments to the adoption and implementation of these alternative indicators?
104	M	What methods can be used or developed to assess the extent to which people know or are aware of

		climate change and the relationship of this phenomenon with things of value to individuals in nature?
105	K	What are the long term economic costs of adaptation to climate change?
106	K	How do individuals trade-off current pleasure and activities with longer term impacts of those activities in a climate changed world?
107	K	What risks and impacts will climate change pose to natural resource conservation in New Zealand?
108	K	What are the coastal risks associated with climate change and how are these risks perceived by different stakeholders?
109	M	There are different levels of understanding, commitment and self-interest in society with reference to climate change and biodiversity. How do you take advantage of these different layers of knowledge, understanding and self-interest and develop consensus through linking the disparate parties together for positive adaptation and mitigation outcomes?
110	K	How resilient are communities to climate change and where are the resilient communities and the less resilient communities and why are some more resilient to others. Can lessons learned in resilient communities be transferred to less resilient communities, if not, why not?
111	K	To what extent are communities forward looking in their adaptation to climate change and if they are forward looking how far forward?
112	K	Who will pay (upfront) for the better environmental outcomes derived if we mitigate climate change and how prepared are communities to pay for longer term benefits?
113	M	What methods do we need to develop to facilitate longer term thinking in response to climate change and biodiversity?
114	M	What are the stepping stones in communicating to people about climate change so they feel empowered about the issue(s) and not scared by the possible ramifications of not adapting?
115	K	What sort of environment do New Zealander's want in 100 years time and how might that vision be distorted by climate change and biodiversity issues?
116	K	What are the time lags between perception of climate change and impacts and are their potential serious ramifications in the time lag concept for certain sectors of society (risk and vulnerability)?
117	K	How does society weigh up the value of biodiversity when the biodiversity itself poses a risk to society in a climate changes world (biodiversity harbouring disease vectors or emerging biosecurity threats real and yet to be encountered)?
118	K	How will recreational behaviour be altered by climate change and how will this impact on biodiversity and fragile environments used in recreation?
119	K	What new or enhanced biosecurity risks are posed to New Zealand as a result of climate change?
120	K	How do global environmental governance issues and agreements impact on the likelihood for preservation and/or conservation of albatross and other sea birds found in New Zealand's territorial waters?

121	K	How will climate change impacts in the environments of our trading partners affect the risk to biosecurity in New Zealand?
122	K	What are the links between species diversity management, watershed function and the impacts of floods and droughts?
123	K	How might the collapse of North American fish stocks lead to increased pressure on the fish resources of New Zealand?
124	K	What behavioural responses to management relate to changes in habitat derived from climate change and perceived shifts in biodiversity composition.
125	K	What are the implications of climate change for the composition and range of weed species in arable and conservancy lands?
126	K	How might climate change impact on control measures for the range of weed species identified in questions 7 above?
127	K	What are the implications for conservation of shore and wader bird species in the context of climate change, sea level rise and human encroachment into these species preferred environments?
128	K	How will fire risk shift with change in longer term climate?
129	K	Will new perspectives on fire management and containment need to be developed in a climatically altered New Zealand?
130	K	Land use change stemming from climate change may result in increased demand for ground water and stored water. How might these resources be accessed and developed and how might this impact on the preservation riverine and estuarine aquatic species and the environment and biodiversity in general?
131	K	What influence will climate change and being signatory to the Kyoto Protocol have on amendments to the Resource Management Act?
132	K	How will society react (i.e. human behaviour) to demands for either reduced energy consumption or development of alternative sources of power generation?
133	K	How might the government's energy policy in the context of compliance to the Kyoto Protocol result in impacts, positive or negative, on currently and potentially protected areas i.e. will there be ecological and biodiversity trade-offs to comply with the provisions of the Kyoto Protocol?
134	K	What do New Zealanders know and think about climate change?
135	K	What relationships are there between Māori and government in relation to carbon credits and if need be how can these relationships be improved through research?
136	I	What are the informational needs of policy makers that will assist in linking their thinking to wider issues of mitigation and adaptation to climate change?
137	K	What are the substantial things or information that can assist people in changing their behaviour with reference to climate change?

138	K	What futures are envisioned by New Zealanders and how might scenarios be constructed to achieve these futures in a climate-changed world?
139	I/M	How can society generate better understanding and successful relationships between government and implementers of government policy and end users and what type of information would assist in facilitating this outcome?
140	K	Does New Zealand possess adequate social science capacity to conduct robust and policy impacting research in the area of the human dimensions of climate change?
141	M	How do you develop an evaluation programme for monitoring policy outcomes and by doing so offer an effective way of looking at the effectiveness of implementation methods that are put into practice?
142	M	How do you get people in policy-making positions within government to link together for improved governance in relation to mitigating the risks and vulnerability to climate change?
143	M	How do you control for variability in the knowledge base across society in relation to climate change when doing human dimensions research?
144	K	What are the behavioural factors that influence a person's choice for residential location in relation to their primary working and recreating environments and what role does this have in influencing greenhouse gas emissions and future climate change?
145	M	There is an acknowledged 'deep' uncertainty of the breadth and depth of climate change and hence individuals, communities and sectoral risks and vulnerability. Given this uncertainty how is it to be managed when developing scenario-based research outcomes? How do we currently understand uncertainty (at many levels) and how methodologically can we understand and manage it for better outcomes?
146	M	How can climate adaptation and mitigation policy be designed so that it can incorporate people i.e. 'stakeholders' in the broadest sense in the context of learning, designing, reflecting and revisiting so that it is a more inclusive and iterative process?
147	M/K	How do we first assess the capacity of communities to adapt to and, also mitigate to diminish longer term impacts of climate change and how can that capacity be enhanced at the individual and community level?
148	K	How do we come to understand institutions in their current form and what must institutions look like and how might they operate in the future in order for them to be able to service society while accommodating the complexity and uncertainty incumbent in climate change?
149	M	What methodological issues must be addressed to construct integrated approaches that link various scales of research either already completed or designed to fill gaps in human dimensions of climate change knowledge?
150	K	What incentive structures are in place to foster adaptation and mitigation and what impact have they had?



151	K	How do policies developed outside New Zealand and then adopted through international negotiations impact on New Zealand and how can research programmes be developed in climate change to support new and better conceived and appropriate policies.
152	M	In what context is a model of vulnerability to climate change (as one example from a plethora of models) developed and to what extent can they be developed in a more nuanced form to reflect the complexity of human dimensions of climate change?
153	I	Which researchers have the capacity to effectively design, conduct and report on human dimensions of climate change and biodiversity research?
154	M	What time frames for conducting human dimensions research are appropriate and what flexibility in funding arrangements are appropriate so that cycles of learning can be assessed and evaluated for improved adaptation and mitigation measure design?
155	M	What methodologies are currently available and what new methodologies may need to be developed to assess the complexity of human dimensions research so as to improve the quality of outcomes?
156	K	How do we know what good adaptation is and how will we know i.e. what methodological and evaluation designs are most appropriate on a project by project basis?
157	K	How do we get individuals and communities involved in human dimensions research that will have direct relevance in their lives?
158	K	Why do people continue to infringe on biosecurity laws, when the impacts of biosecurity breaches could become more serious under climate change scenarios?
159	K	How are farmers responding to the risks posed by climate change?
160	K	What strategies have been used by land managers to overcome the impacts of climate change in the past, present and what might be used in the future?
161	I	What types of information referring to climate change should be transmitted to land managers and in what forms and with what frequency.
162	I/M	Who should be responsible for collating climate change information and getting it to land managers?
163	K	What are the behavioural drives behind land managers response to climate change?
164	K	Where does climate change enter into the decision making process for land managers deciding on changing land use in relation to a host of other issues such as markets, economics, and other business drivers?
165	I/M	How do you effectively communicate abstract concepts such as climate change and biodiversity to foster better and more informed decision making?
166	K	How can policy be most effectively developed in the climate change area to achieve the highest possible compliance?
167	K	How do you collect and effectively develop tacit knowledge on climate change to influence both policy makers and to effectively communicate that knowledge to others?

168	K	What information and knowledge is already available in relation to climate change and what are the gaps in our knowledge base and how can they be filled?
169	M	How do we get climate change information to decision makers?
170	M	How do we optimise the climate change information we already possess to be most efficient with what we already do have?
171	M	Who should and how do we construct metadata access to climate change data for the public and decision makers?
172	K	What drivers underlie peoples' decision to either work within the parameters of climate change i.e. either adapt or resist or fight change?
173	K	What are the human activities that are resulting in greenhouse gases being released to the atmosphere?
174	K	What climate change impacts (risks) are likely and where i.e. what are the regional/community differences in exposure to risk across New Zealand?
175	K	What does society know about the concept of adaptation to climate change? Does it enter into decision making regarding purchases, building skills and what is the availability of such information to society in general?
176	K	What do individuals/organisations know about their direct and indirect emissions and how they relate to fomenting or mitigating climate change?
177	I	Are there alternative technologies, techniques or practices that compare favourably with current activities in that they are affordable, accessible, equitable and efficient but assist in mitigating the impacts of climate change?
178	I	What case studies on adaptation and mitigation both in New Zealand and in the International arena can be drawn upon to educate society of possible alternatives to current practice?
179	K	How is climate change and biodiversity dealt with in the principle land management acts (RMA, LGA, BA) and what changes are required to these acts to accelerate adaptation and mitigation?
180	K	How do existing methods for hazard planning and management either hinder or help climate change adaptation or biodiversity protection?
181	K	How is climate change and biodiversity integrated into and across all government organisations and activities and how might this be improved?
182	K	Why doesn't government lead by example and practice what they legislate and recommend and how can government compliance with its own laws, regulations and guidelines be improved?
183	K/M	Which households and communities of New Zealand are most vulnerable to the impacts of climate change and how, methodologically, can a national priority list be developed to begin to systematically address the problem?
184	K	Do people think that climate change and biodiversity are important and if so how important in relation

		to other factors used in their decision making processes and is it important enough to change peoples' behaviour and attitudes?
185	K	How can biodiversity be used (augmented) to adapt to climate change i.e. carbon sinks and reduced heat island effects?
186	K/M	Are new methods of risk assessment required in an increasingly multi-cultural New Zealand?
187	K	How do different societies deal with risk and how do these differing perceptions of risk filter through to the planning process and implementation of planning outcomes?
188	K	What changes in land use and density of urban areas and lifestyle demands might be expected in a climate changed New Zealand and world?
189	K	How can New Zealand's built environment become Kyoto compliant (technologies, products and practices) given the large stock of existing infrastructure?
190	K	How do improvements in biodiversity and adaptation to climate change contribute to our overall goal of sustainability i.e. what interrelationships are there between elements of sustainability and biodiversity and climate change?
191	K	Why is tourism in New Zealand dominated by touring tourism that is highly dependent on transport and thus does not benefit the mitigation of climate change?
192	K	Why is mobility, especially the use of the private motor car demanded by New Zealanders?
193	K	What attributes do tourists have towards enjoying low-emission travel or supporting other environmental initiatives such as tree planting for the mitigation of greenhouse gasses?
194	K	How could we distinguish between benefits that tourists really seek on their holiday (e.g. relaxation, freedom) and means that they use to achieve these benefits (e.g. hiking or campervan) and could the same benefits be achieved with less environmental impact and hence a mitigation of greenhouse gasses?
195	K	Is the tourism sector at risk in the face of changing climate and would this result in changes in tourism patterns?
196	K	What will be the effect of a carbon tax on tourism, both from a potential national tax and also international levees?
197	K	How can new land planting be stimulated, and restored to former levels?
198	K	Supplementary questions. A) What have been the main drivers behind new-land planting, and how are these changing? B) What caused new-land planting rates to rise from 15 400 ha/yr in 1992 (mainly by large corporates) to 98 200 ha in 1995 (mainly by small companies, investment partnerships and individuals including farm foresters)? C) What caused the progressive drop-off in new-land planting since 1995?
199	M	How can carbon credits be calculated to a degree of accuracy, transparency and verifiability necessary to satisfy both international agencies and the purchasing entity?

200	M	Supplementary questions: A) How are we to establish a 1990 baseline, in order to guarantee that the “Kyoto” land was non-forest at the time, and if so, the prior carbon content of the land? B) Given that satellite imagery can detect forest planting only when trees are 5-6 years old, how can the ascertain the area of Kyoto Forest in 2008 and 2012? C) Given that data will need to be location-specific, how can we deduct harvesting, and add new planting, that occurs in the 2008-2012 period? D) Given that NZ no longer has a major agency that can measure and model tree growth (especially radiata pine on farm sites or non-radiata), how is the quantity and growth of stemwood to be quantified? E) How is the volume of stemwood to be converted to the carbon present in all biomass (branches, leaves, roots, litter, understorey, etc)?
201	K	Given that afforestation has many environmental advantages relative to agriculture (reduces soil erosion, improves water quality, sequesters carbon dioxide, does not emit methane or nitrous oxide, improves biodiversity) what are the cultural and institutional impediments to increased afforestation?
202	K	Can biofuels be made cost-competitive to fossil fuels?
203	K	Supplementary question. Are there any wood wastes (eg at processing plant, at landing site in forest, or dispersed in the forest) that are currently underutilized for Bioenergy but which should be cost competitive under the present price structure?

### Māori Views

#	K, M or I	Raw Data
1	K	What are the linkages between Maturanga Māori and scientific views of climate change?
2	K	What differentiation is there in different Māori groups (urban, rural, sectoral) and perceptions of the effects of climate change on them?
3	K	What are the specific benefits to accrue to Māori as a result of changes in government policy regarding climate change?
4	K	What social impacts might Māori expect to experience as a result of changes in government policy in the area of climate change?
5	K/I	What are the social costs to Māori of the entire nation meeting its global obligations to Kyoto through increased taxation of carbon producing activities?
6	K	What value does intellectual property of different streams of Maturanga Māori (i.e. the spiritual dimension) have in policy development and in the over impact on the tonga of the individual and iwi?

7	K/I	How do greenhouse gases impact on the whakapapa of the tonga with reference to biodiversity of traditional food sources and fish and aquatic species which may not be able to be grown in traditional areas?
8	K	Have the effects of greenhouse gases altered the way that Māori interact with their natural environment?
9	K	If the traditional growing and collection areas for medicinal plants change owing to climate change will the new areas that emerge for their cultivation have the same spiritual significance (force) and value?
10	K/I	Where do Māori sit in relation to their treaty partner in developing policy for mitigating and adapting to climate change?
11	I	Where are Māori situated, at all levels of the decision-making process for climate change?
12	M	If carbon credits are to accrue as an outcome of the ratification of the Kyoto Protocol how will these rights be managed?
13	K	How do people develop priorities for incorporating underutilised land into forestry activities to assist in mitigating greenhouse effects?
14	K/I	Is there a need for a Māori climate change reference group in New Zealand?
15	K/I	What relationships do wetlands have with climate change and what information is available regarding wetlands in New Zealand that can be drawn upon for developing management plans for wetlands in the context of climate change?
16	K	What non-economic benefits accrue to Māori as a result of preservation of wetlands (and other environmentally significant lands) and therefore what is at risk to be lost as a result of changes to these lands that may occur as a result of climate change and shifts in the stock of biodiversity and fragmentation of such environmentally important landscapes?
17	K/I	What values do Māori hold toward wetlands (and other environmentally and spiritually significant lands) and how might these change with education regarding the risks to wetlands (and other environments) posed by changes in climate?
18	K/I	In what ways may wetlands and/or other environments be used as indicators of climate change in the context of the western scientific traditions and Māori traditional knowledge systems?
19	K/I	What historical changes have occurred with wetlands on Māori lands and how have these changes increased or decreased the risk of further potentially catastrophic changes to these wetlands resulting from climate change?

20	K	What are the indicators of biodiversity in Māori environmental knowledge system in contrast to the modernist scientific tradition and how might these different perspectives underpin perceptions of the level of risk to this biodiversity with global environmental change?
21	K	What are the cumulative effects of climate change on a range of critical environments to Māori and how does the knowledge of these effects shape human perceptions to risk?
22	M	What qualities and competencies does the New Zealand research community hold for engaging with the complexities of research in human dimensions of climate change with specific reference to Māori resources and communities?
23	I	What are the potential impacts of climate change affected extreme events to Māori communities and resources?
24	K/I	What adaptation strategies are best suited to application in Māori communities given the diversity in Māori capacity for adaptation and complexity of barriers to their adaptation?
25	M	How, in a methodological sense, can the science community better predict the longer term impacts of shifts in the mean climate and extreme events and how might this research be translated into information that can be used by Māori communities to facilitate planning for an uncertain future?
26	M	What comprehensive watershed management methods could be used to better understand watershed dynamics both biophysically and socially in relation to hazard impacts and management (flooding in highly managed basins such as Lake Taupo and the Waikato River) in the context of climate change related variability in extreme events?
27	K/I	What role might Māori communities wish to play in the management of rivers and water bodies and how might management and issues of liability for impacts be exasperated or mitigated by that management shift with climate change and increased risk of extreme events?
28	K	What are the social, political and institutional barriers to transforming currently marginal Māori lands to forestry (in whatever form) for mitigating greenhouse gases?
29	K	How are Māori going to be impacted by the Kyoto Protocol over the short and long term and how can the risks of adverse effects be minimised?
30	K/I	How might the reclassification of Māori lands under Nga Whenua Rahui (covenants) impact on the use of other lands in the context of climate change?
31	I	What barriers exist to the improvement of Māori participation in human dimensions research related to climate change and biodiversity?
32	K	What are the risks from climate change to the newly developing Aquaculture Management Areas?

33	K/I	What is the potential impact of climate change on kai moana and how is this risk altered by current and future management regimes and levels of exploitation of the resource?
34	M	What methodologies are culturally acceptable to Māori at the hapu and iwi level for documenting areas and sites of heritage value that are at risk of destruction or alteration as a result of climate change and sea level rise?
35	I	What barriers to adaptation to climate change and biodiversity are represented by the current state of governance over Māori lands, in particular in the functioning of the Māori Trust Boards and the relationship between decision-making for adaptation for climate change and capacity for considering plans for adaptation within the current structures and decision-making bodies of the Māori Land Court?
36	I	What capacity exists within Māori Trust Boards for considering the complex issues of human responses to the risk and vulnerabilities presented by climate change and how can capacity be enhanced?
37	M	There is a need for pre-consultations with iwi and hapu prior to capacity building exercises being initiated for human dimensions of climate change research. What are the appropriate methodological techniques to employ in these pre-consultation hui?
38	I	What are the aspirations of Māori with reference to social and economic development and how might these be altered by a better understanding of the potential risks and vulnerabilities to climate change and how might ownership of the development planning and implementation process be more inclusive of Māori?
39	I	How can Māori communities identify their own environmental projects and how might these projects contribute to the sequestering of greenhouse gases and moreover how can such self-help initiatives be recognised as a positive contribution to climate change adaptation and mitigation and thus foster positive feedback and reinforce the conservation ethos in Māori communities?
40	K/M	How can local knowledge, with reference to climate change and adaptation to the risks it poses, be incorporated into small scale and locally manageable adaptation initiatives that with success can then be built into longer term and larger scale initiatives?
41	I	How do you contextualise past, current and future environmental projects into the complex and broader issues of global environmental change to foster inclusions and confidence in one's own projects as having global significance?
42	I	How can project management capacity be enhanced for Māori communities to devise and implement innovative climate change and biodiversity research and adaptation initiatives?

43	I	What forms of climate change research are iwi relevant, user driven, transparent and user friendly?
44	K/I	What informal social networks for sharing knowledge and capacity are already in place and functioning well and why do they function well and how can they be drawn upon to enhance capacity for climate change and biodiversity research and mitigation and adaptation project development?
45	M/I	How might informal networks be enhanced and new networks formed within Māoridom to inform iwi of issues and then build knowledge and collaborative solutions to address the risks and opportunities stemming from climate change?
46	M	What methods do not work in collaboration with Māori when priority setting as to what adaptation options should be considered when confronting climate change?
47	M/I	What methods could be developed to enhance capacity for Māori groups to look forward in their land use planning rather than just at the present and to thus more fully embrace the concepts of climate change and biodiversity in that planning?
48	M/I	What opportunities and advantages could be gained by tying together a range of environment and climate issues such as Kyoto, biodiversity and climate change when addressing iwi and hapu groups so as to enhance co-learning and avoid over exposure to a range of seemingly critical but daunting issues?
49	K/I	What influences Māori decision-making in reference to cutting manuka and kanuka forest lands and what amount of that land could be put into production forests to act as carbon sinks?
50	K/I	How have Māori perceptions of the value of secondary forest products changed through time and how does this factor into mitigation scenarios for greenhouse gasses?
51	M/I	What new forest policy initiatives might be pursued to enhance the planting of marginal lands to forest species and to provide a more diverse range of opportunities for mitigation rather than barriers?
52	I	What alternative opportunities are represented by forestry that will enhance the sequestering of greenhouse gases while creating employment and income earning opportunities?
53	I	How might long-term planning for forestry be enhanced by recognition of both the risks and uncertainty of climate change scenarios and how might such a longer term vision involve wood processing and more control of that industry by Māori?
54	I	What regional variations in fire risk currently exist, how did this regional variability develop and what mitigation measures can be adopted to reduce the risk of loss of forests and biodiversity as the result of shifts in fire risk under changed climatic conditions?
55	K/I	What risks are experienced by Māori as a result of climate change that are determined, in part, by limitations placed on the capacity of Māori to adapt to climate change owing to legislation and court interpretation of that legislation?



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