Trying to understand 'why' people change land use

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Abstract

Our vision is to maintain and enhance biodiversity through land use changes, but the reality suggests that land use changes are often implicated in a continuing decline of biodiversity. If we gather information on land–use changes we can develop policies to ameliorate the negative effects of these changes on biodiversity; that is, we can devise topical solutions to treat the symptoms. But if we know 'why' people make these changes then we can influence the source of change — the decision-makers.

The investigation of 'why' starts with the change and works back to uncover the 'drivers'. After identifying what land use changes are important, the next investigation point is the landholder who decides to make a change. At this point the investigation fans out to include other factors. To make this study possible, the system is broken down into two interconnected models: a 'drivers model' and an overarching, hierarchical 'people–planet relationship model'. These models provide the theory for the groundwork in the four-year project 'Achieving biodiversity gains in conjunction with land use change.

This project requires an understanding of the drivers at the individual landholder level. Gaining this understanding requires a close study of individuals, the decisions they take and the reasons they give for taking these decisions. It also requires a study of local impact of 'mega-drivers'; the sources of which can range from regional, state and national phenomena to globalisation. A series of interviews aimed at understanding the drivers at the individual decision-maker level has been undertaken in the Rutherglen district. This preliminary work has provided useful information that will be used to design later parts of the study.

The project aims to develop an understanding of the land use decision system, especially an understanding about items that might encourage decision-makers to opt for land use changes that achieve better results for biodiversity. This should help to develop new policies that will lead to the maintenance of biodiversity in agricultural landscapes.

Keywords

biodiversity maintenance, fundamental human needs, land–use change, mega-drivers, personal drivers, policy development, isomorphism, sustainable development

Introduction

With an eye on helping to meet the global imperative of biodiversity maintenance and also on the need for sustainable agricultural production, a study entitled 'Achieving biodiversity gains in conjunction with land use change' was initiated to gather information about the 'drivers' of land use change in Victoria. The information on drivers could be used to develop policy aimed at encouraging the maintenance of biodiversity.

The study provides an opportunity to investigate the relationship between agricultural production and biodiversity maintenance. There are two questions in this relationship: (1) Which land uses are beneficial for biodiversity and which are harmful? (2) Why are these land uses chosen?

To help with the first question a land use change classification matrix (outlined later in this paper) has been devised. To answer the second question systematically, a set of nested models have been developed to help understand the drivers of land use change (the drivers model) and the role of drivers in the relationship between human society and the environment (the 'people–planet relationship model').

The drivers model and the people–planet relationship model provide the theoretical framework for the project. The two nested parts of the drivers model ('mega-drivers' and

'personal drivers') are discussed. Alternative approaches to fundamental human needs, which are vital aspects of personal drivers, are reviewed. The relationship between the people–planet relationship model and sustainable development is discussed. Finally, an outline of the initial phase of the ESAI project is provided, with a review of the land use change classification matrix and how the initial set of interviews used the fundamental human needs approach to develop information on personal drivers.

Destination determines what preparations are necessary

The destination for this study is knowledge about the drivers of land use change from which new policies on biodiversity maintenance can be devised. The caveat is that these policies meet sustainable development objectives (welfare and equity). The preparation required for the journey to get to this destination involves two things.

The first is the development of two models to help organise information in a way that opens up options. The drivers model and people–planet relationship model are outlined in this paper and will be developed and refined as the project proceeds.

The second is the development of an understanding about the kinds of policies that will facilitate biodiversity maintenance and also maintain welfare and equity — the objectives of sustainable development (Commonwealth of Australia 1992). This task lies ahead. Although it is not dealt with in this paper, the notion of policy gearing is mentioned later in this section because it is relevant to current work.

Background to land use change models

Generally one could say that most of the land use change in the last two centuries has been done to create 'wealth'. 'Wealth creation' for centuries has aimed at generating products that can be sold, and this puts land into the category of a 'producer good' used to produce products that eventually reach the consumer. The paradigm in 'wealth creation' is a cost reduction, the productivity-orientated approach of 'how to do more with less'. Producing more per person involves the vigorous application of science and technology; genetic engineering and gene patenting are recent phenomena, but typical of this paradigm[1]. Golüke (2002) refers to this paradigm as a 'material constrained' history of humanity. This global paradigm is resulting in the development of specific kinds of rural landscapes throughout the world, so that forest and woodland is converted to arable land or grazing land and looks the same whether it is in America, Brazil or Australia. The development paradigm is not likely to change in the foreseeable future, not even for 'sustainable development'. Lewis for instance, noted that US Newspaper over the 10 years prior to 1997 presented 'sustainable development' within the economic growth paradigm (Lewis 2000). However, the definition of 'wealth' seems to be expanding to include items that have intrinsic value, such as native flora and fauna, and the functioning of ecosystems that support production (ecosystem services). This view still has 'land' as a producer good, but also as a producer of 'ecosystem services' or items of aesthetic and recreational value, such as 'landscape beauty' or interesting flora and fauna, or a health-sustaining environment (McMichael and Beaglehole 2000), in addition to agricultural products and building sites.

Geographers have been modelling land use for some time. In reviewing current models, Verburg et al. (in press) noted that they have a unifying hypothesis 'that links the ecological and social realms … that humans respond to cues both from the physical environmental and from the socio-cultural contexts and behave to increase both economic and socio-cultural well-being.' From this, the modellers select socio-economic and biophysical variables as driving factors for land use change. These selected variables are generally classified as (1) socio-economic drivers, (2) biophysical drivers, and (3) proximate drivers (Verburg et al. in press), which could be interpreted as 'profitability', 'soil quality' and 'distance to market' respectively. The behavioural component of this hypothesis seems to be treated as a synonym of 'market forces'.

[1] Given population growth, the application of agricultural technologies all around the world, ie the 'Green Revolution' has been termed 'forest-saving agriculture', as the alternative to production intensification would have been forest clearing (Swaminathan 2000).

Irwin and Geoghegan (2001), for example, suggested that understanding the human behaviour component is achieved by understanding the economic process that underlies land use change. They concluded that theories of spatial behaviours need to be developed within the field of spatial econometrics, to complement their counterpart in time series econometrics. Bastian et al. (2002) used geographic information systems data and a hedonic price model to estimate the impact of amenity and agricultural productivity on land values in Wyoming. 'Results of this study indicate that remote agricultural lands, which include wildlife habitat, angling opportunities and scenic vistas, command higher prices per acre than those which primarily possess agricultural production capacity.' Thus they conclude that 'Amenity rich lands may be at risk for conversion from agricultural and open space function to residential use.'

However, maintaining the perspective of land as a 'producer good' restricts the creation of new ideas about land and the biodiversity it originally supported. The growth paradigm is neither the only one that is available nor the only one currently in use.[2] Markets exist for all sorts of things and can be used with great effect for many processes, including of course, allocating resources between competing uses. Energy conservationists, for example, have long advocated increasing market involvement based around rental rather than purchase (Jalas 2001), but despite these various uses markets are not a panacea for dealing with everything. Many very important decisions are taken outside market mechanisms, even in market-driven economies. Justice and fairness, for example, are mainly outside the market system. These non-market areas are often dealt with through a range of ethical systems of belief. Because people hold to different ethical systems, what they believe to be appropriate 'moral behaviour' varies not only between people, but also between organisations and over time. However, the ongoing development of international treaties and agreements, such as international humanitarian agreements, and international criminal courts may be bringing consensus to the definition of moral behaviour. McDougal et al. (1994) noted that 'international agreements observably play a most important role in the establishment and maintenance both of a global constitutive process of authoritative decision and of a transnational public order in shaping and sharing of all values'. This ongoing process certainly applies to biodiversity issues. International opinion is often different from the national opinion and this created tension and disputes. Warren (2001) noted that as far back as 1974 the International Court of Justice ruled that states (i.e national governments) had an obligation to take account of conservation needs in fishing on the high sea. And recent evidence shows that a number of European Governments, through the Brussels Group, ran a secret campaign to sabotage the first global environmental summit in Stockholm held in 1972 (Eco-mole 2002). It was not until 1993 that the European Commission established a program aimed at maintaining the biodiversity and genetic resources of European agriculture (Agra Europe 1993).

'Drivers': the influences of change

With an eye on helping to meet the global imperative of biodiversity maintenance and also on the need for sustainable agricultural production, a study entitled 'Achieving biodiversity gains in conjunction with land use change' was initiated within the former Department of Natural Resources and Environment to gathering information about the drivers of land use change in Victoria. The meaning of the term 'drivers' is complex. In this study it is taken to mean everything that influences decisions about land use, and is broken down in the following way.

The forces in the growth paradigm that continue to shape agriculture land use practices worldwide could be considered as a component of 'mega-drivers'.[3] But the focus of this study

[2] The growth paradigm is dominant today but is self-defeating as costs, as well as benefits, grow exponentially. Many of the ideas in sustainable development have been around for centuries, and some are well established as institutions such as habeas corpus, fairness and justice, universal education, protection of aesthetics and public health. These institutions and the ideas that spawned them seem to be the bases for alternative paradigms. But organisations and practices emanating from these institutions are often sidelined by actions taken in pursuit of the growth development paradigm; it seems an ongoing battle.

[3] Mega-drivers are things that can influence decision-makers but over which they do not have control. They represent opportunities. So for an individual farmer, mega-drivers include things such as the tax system, commodity price, animal welfare regulations, research information, education, the existence of markets, interest rates, availability of

is in maintaining biodiversity in agricultural landscapes, which necessitates understanding 'drivers' at the scale at which biodiversity is actually lost, which is at the individual decision-maker scale — the family farm, farming company and local land manager. Biodiversity in agricultural landscapes is maintained or lost as a consequence of the collective impacts of actions taken by local decision-makers. Thus an understanding of how mega-drivers are interpreted at a farm level, by the local decision-maker, is important. The suggestion is that individual decision-makers interpret mega-drivers through their own unique set of life-long goals or ambitions, referred to here as their 'personal drivers'. The ideas around these drivers and the hierarchical relationship between mega-drivers and personal drivers make up the driver model. For example, if a decision-maker has an ambition of developing a very large grape growing business as one of their personal drivers (ambitions), then they will search the mega-drivers for opportunities for achieving this ambition and take up the relevant ones. If the mega-drivers allow 'large grape-growing businesses to exist' then it is likely that the decision-maker will achieve their ambition. The decision-maker's neighbour with similar farming resources but without this ambition as a personal driver is unlikely to develop a large grape-growing business even though they are exposed to the same set of mega-drivers. The suggestion is that land use decisions are created through the interaction between personal drivers and mega-drivers. This study is in its early stages. An initial set of interviews with landholders was conducted in 2002 as a first step towards understanding drivers at the farm level. The interview material shed some light on drivers and provided guidance for a second series of interviews, to be held in 2003. The interview material included the reasons why decision-makers use land in a particular way. The personal driver element in these reasons is usually quite clear, but the mega-driver elements are very often not stated. There may be many reasons for this: two are suggested here. First, most mega-drivers have been influencing actions for a long time and are accepted as 'just the way the world is'. Only recent changes seem to get discussed. Second, most mega-drivers seem either neutral or negative to local decision-makers, who have to take positive action to deliver their needs or ambitions by working with, around or through mega-drivers.

How drivers relate to society and the environment

Developing an understanding of drivers requires an understanding of how the driver model fits into the people–planet relationship model, which is an overarching model of the relationship between people and their environment. The model has three components:

1 On one side, the local environment of land, biodiversity and ecological processes.
2 On the other side, the local community of families, organisations and societal processes such as markets, taxes and information.
3 The link between the two sides.

Thus it is a relationship model: it focuses on the relationship between the two sides (people - environment). The suggestion in this paper is that the delivery of fundamental human needs can be used as the linking process. Thus people obtain their needs using a mix of things from both the society and the environment. The decision-making unit that has the primary impact on biodiversity is the landholder (farming family). The model suggests that the drivers that influence landholders' decisions stem from a desire to do things to meet the fundamental needs of their family, and this embodies influential information and ideas from the 'mega-drivers' as well as information about the environment. Personal ambitions and goals come from the mixing of fundamental needs and unique personal things, such as intelligence and experiences. This helps to explain why people try to satisfy their needs in different ways and also prioritise their needs in different ways.

advice, technologies, subsidies, transport infrastructure and so on. The more power and influence a decision-maker has the fewer the mega-divers. Thus many of the things that are mega-drivers for the individual farmers such as tax rates and laws are not mega-drivers for governments because they have the power to change laws and tax rates. The things that they can change are not mega-drivers to them but mechanisms they use to influence or control the people they govern.

Most of this model is shown in Figures 1 and 2. The first diagram shows the overarching relationship at the local level. The second diagram shows the driver system in more detail. Later diagrams in this paper will expand Figure 1 from the local level to the global level. The purpose of these models is to organise the gathering and interpretation of information from decision-makers and other sources within the system.

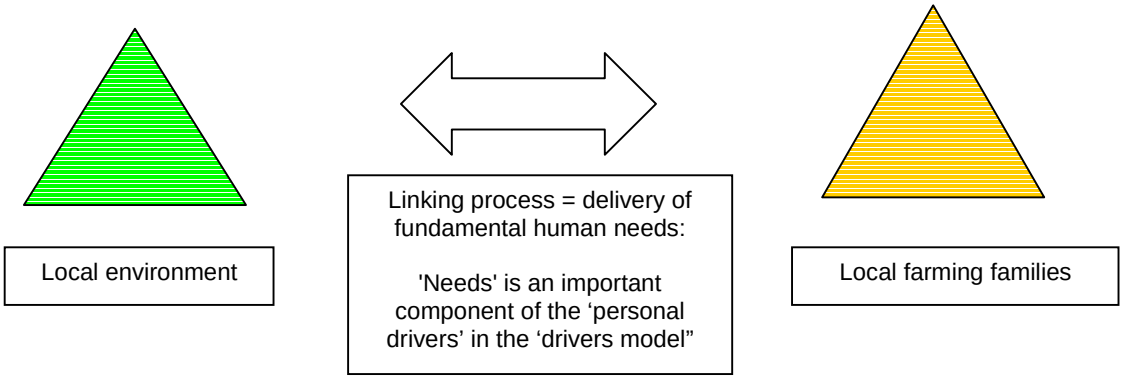

Figure 1 Local relationship between the farming family and local farmland and resources.

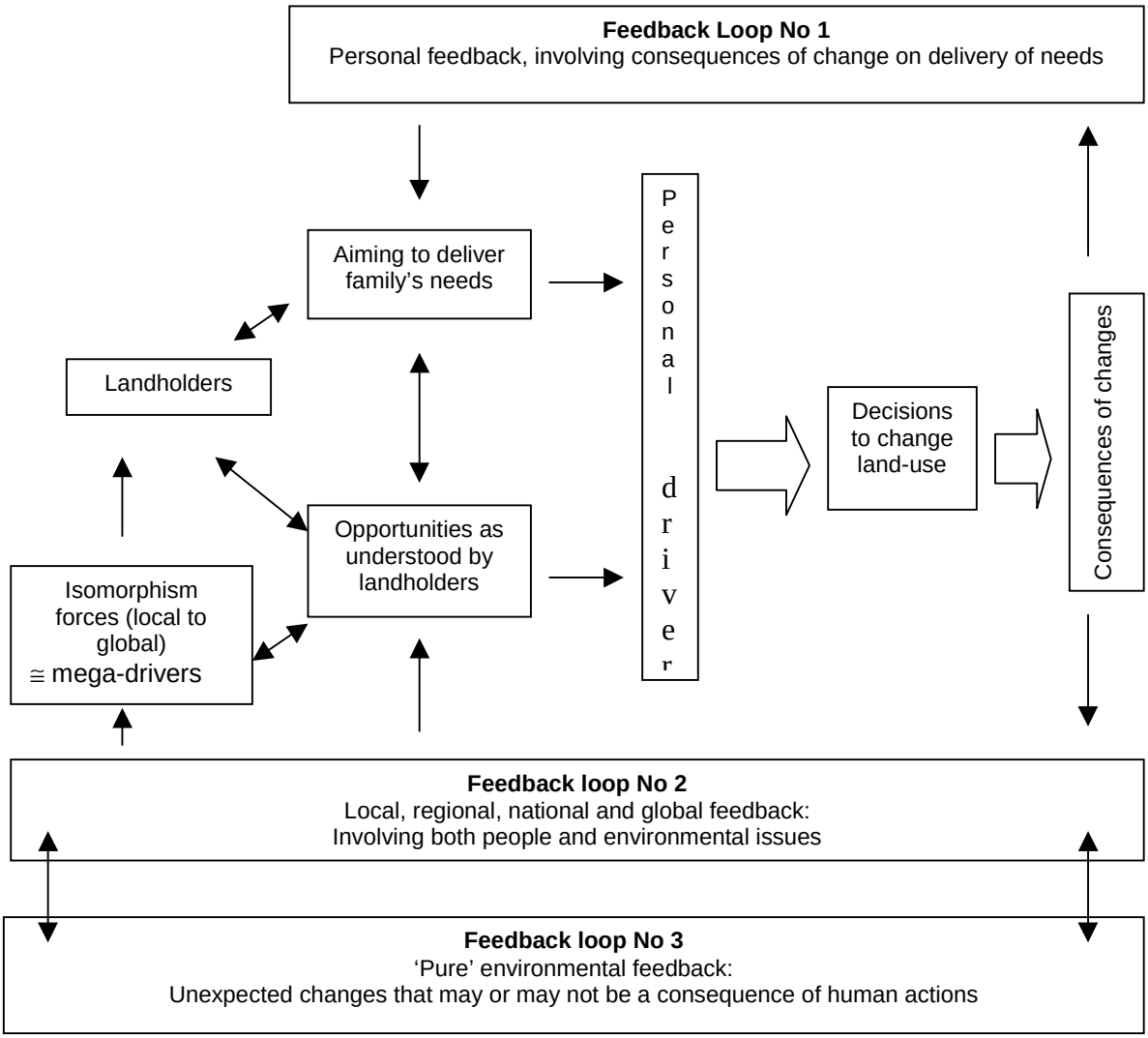

Figure 2 The system of drivers.

The 'driver' system, shown in Figure 2 has at least three feedback loops:

Loop 1 A personal feedback in which the landholders (the decision-makers) evaluate the consequences of their decisions in terms of delivering their fundamental needs.

Loop 2 A local, regional, national and global feedback loop system that can take years or decades to work and involves both people issues and environmental issues.

Loop 3 A 'pure environmental' feedback. This is the real thing (environmental consequences) and is not necessarily understood by people. It could have a delay factor of decades or centuries.

The closest people get to interpreting and understanding environmental issues occurs in feedback loop 2. As environmental understanding improves, the feedback in loop 2 becomes more accurate and perhaps speeds up, but we cannot presume to know all the ramification of change (hence the inclusion feedback loop 3).

The drivers model is more complex than has been shown in Figure 2. However, starting with 'personal drivers' and moving to the right takes one to 'land use change', with its consequences. The landholder can evaluate how these consequences meet their needs (feedback loop 1), and society can make its evaluation via feedback loop 2. Meanwhile the Earth changes, and although we do not know exactly what these changes are, they are represented by feedback loop 3. The consequences in loops 1 and 2 either meet expectations or they do not. If they do not (which would be more usual), then there is a new round of changes that come from the dissatisfaction people feel. These dissatisfactions encourage landholders to try new things and also lead into change in the mega-drivers, which flow onto opportunities and complete the cycle, ready for a new cycle.

The operation of this framework model tentatively suggests that people's livelihoods (all fundamental human needs) are derived from within the systems of relationships that exist within communities and between society and the environment. People's needs mostly come indirectly from the environment through arrangements with other people. These arrangements can be complex and are not easily understood. For example, some decisions relate to future and past generations. De-Shalit (1995) suggested that, within a community, people have a responsibility for resource allocation for several generations, but people always have a humanitarian obligation to far distant generations and members of other communities.[4] The system works without individuals having to understand it. People can rely on the self-organising ability of other people working in different parts of the social/community systems and also on the self-organising that occurs within environmental systems. The drivers for land use change (land use relates to people's livelihoods) lie within these relationships. Changing these drivers purposively to achieve a specific outcome (such as biodiversity maintenance) within sustainable development objectives requires an understanding of the structure and function of the system.

Using 'fundamental human needs' is a way of opening out and exploring why an individual undertook a land use change. It is not about trying to establish a cause–effect relationship. There is no assumption that a particular behaviour was caused by a 'need'. The 'needs' approach is not trying to establish scientific explanations but rather helps to provide an interpretations of events to create understanding. Springborg (1981) supported this approach. In discussing human needs and a specific behaviour, she note that '… in any given case the evidence we would require to establish a causal link between the hypothesised need and the overt behaviour is unavailable due to the private, and to a certain degree unconscious, nature of these processes'.

Assumptions in this study

The study makes three assumptions. The first is that people do things, such as make changes to land use or land management, for logical reasons. The second assumption is that we can find out what those reasons are. We handle these two assumptions in a framework based on the idea that

[4] Some authors take the responsibility to extremes by suggesting that humans have the responsibility to ensure life from Earth survives in a billion years time when the Sun's expansion incinerates the Earth by finding and moving 'life' to another planet (eg Tonn 2002). This seems ridiculous except it is an element in the NASA Mars missions and their annual funding is substantial.

people do things to meet their fundamental human needs[5] and the way they do it varies according to (1) their internal motivations and (2) the opportunities they see. We are taking personal drivers to mean 'motivation', and action occurs when motivation is coupled with 'opportunity' but recognise that other things might be involved in how this system operates. Opportunity lies in the combination of (1) mega-drivers that are seen and understood by decision-takers (like taking advantage of the bush tender scheme) and (2) resources that decision-takers can control (managing areas that qualify in the BushTender scheme). Clearly, if a mega-driver exists in the wider world but is not noticed or understood by a local decision-maker (i.e. it is not in their local world) it cannot influence their decision and is therefore not a mega-driver for that decision-maker. (For example, people who have not heard about the BushTender scheme are not going to be able to take advantage of it.) We are also assuming that mega-drivers, although they can be very forceful, do not always influence decisions. Individual people can go against mega-drivers, at least for a time or to some extent, and still operate successfully in society.

The third assumption is that understanding the driver model will provide basic information for developing policies in future that will improve the effectiveness of dealing with the relationship between land use change and biodiversity maintenance.

Policy gearing

The ultimate purpose of this work is to improve biodiversity maintenance in rural landscapes. There may be many ways of doing this, but the process available to the state government is to influence decision-makers on the land. The state government could use various mechanisms to influence decision-makers that we can characterise as 'policy'. From a decision-maker's perspective this state government policy would represent a mega-driver and to be effective this policy would have to harmonise with personal drivers in a way that influences what decisions-makers do with the land and resources they control. Biodiversity maintenance is an outcome that is not emerging from the current operation of the existing very complex land management and production systems. Some parts of these systems will have to be change to improve biodiversity maintenance. Within any system there are leverage points where a small change in one thing within a complex system can produce a big change in everything else[6]. Finding leverage point in these very complex land management and production systems is not easy and knowing which way they should be moved is also hard. In addition there may be many different leverage points with various degrees of effectiveness. Thus policies aimed at maintaining biodiversity are not going to be equally effective, some have greater influence than others. During this study it may be possible for the researchers to identify leverage points and determine their relative effectiveness if they consciously look for them.

Being able to provide policy developers in state government with information about the kinds of policy that would replace or change the drivers of land use change at highly levered points in complex land management and production systems would be a valuable outcome from this study.

A first step would be developing a fuller understanding of the theories about systems and leverage points. Meadows (1997) wrote about the importance of finding leverage points to control systems effectively. She listed ten items of increasing leverage, and twelve in a follow-up paper (Meadows 1998a). Taxes, incentive payments and subsidies are the least geared, and paradigm and system goals are among the most highly levered points for controlling systems. Altering the drivers of land use change such as 'the rules of the system'[7] and the 'power of self-organisation' could represents action at the more highly geared end of her list.

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[5] Fundamental human needs are not the same as 'wants' as explained later.

[6] The classic example of a leverage point occurs in a building's heating system with duel objectives of economy and comfort. The addition of a small amount of insulation in the building can make a huge difference to achieving both economy and comfort. The leverage point is insulation and the direction needed is adding insulation.

[7] 'Super windows' provide an example of policy gearing. Super windows with very high insulating properties are not generally used in Australia. If tenancy rules were changed so that landlords of office buildings were responsible for heating and cooling costs in their buildings rather than the tenant, then almost all new buildings would use 'super

The second step would involve reviewing the land management and production systems being investigated to identify leverage points and indicating which would be most effective. Robertson and Hull (2001) support this purposive approach. In referring to conservation biology they advise that 'people who produce, review, and apply conservation knowledge should explicitly evaluate it for its ability to influence conservation decisions'. Looking for effective leverage points, and deciding the direction in which they should be moved, may be unwritten responsibilities of researchers.

Finding the reasons for land use change

Mega-drivers, isomorphism

We know from archaeology that land use changed from hunting and gathering to agriculture in many parts of the Old World, and that agriculture itself changes and continues to change considerably over time. Over this period of a few thousand years we have not changed genetically, but we are changing our arrangements to make use of changing information and institutions. In Australia these changes are a matter of historical record. Ideas and reasons for ongoing changes are not entirely local but often come from abroad, with some minor changes to facilitate local application.

Observation suggests that although different people often do different things with the land they manage, overall there is a great deal of similarity in how land is managed in any one decade. We can surmise from this that the drivers in that decade are similar too. This paper suggests that the trends in landscape change may reflect the widely accepted growth paradigm, which encourages the use of, and improvement to, information (technology) and social arrangements (notably productivity) to increase production, and that increasing globalisation is intensifying these trends. These forces are encouraging agricultural development along similar lines wherever they occur. For example, there are wheat farms in both Australia and North America exporting the same grains to the same destinations for the same uses. In addition, the organisation of a wheat farm in Victoria is fairly similar to that in the USA or Canada, as are the organisations selling to and buying from the wheat farms, and increasingly so. In some cases they may actually be the same transnational corporations. The forces creating this similarity can come from market competition (forcing down prices), but they can also come from the organisations themselves working to gain legitimacy and market position (Mizruchi and Fein 1999).

This second kind of phenomenon is referred to as 'institutional isomorphism' (that is, institutions having a similar form). DiMaggio and Powell (1991) proposed three mechanisms though which this occurs: normative isomorphism, mimetic isomorphism, and coercive isomorphism. While the concept of institutional isomorphism was developed to help explain modern organisational activity in general, it can be applied to agriculture. The suggestion in this paper is that institutional isomorphism is an appropriate way of investigating the mega-drivers. This is not saying that the project has the objective of describing all the items and processes throughout the world that influence the systems in which Australian agriculture plays a part. Isomorphism is to be used in this project to help understand the nature of a range of mega-drivers that influence the particular land uses and management practices that have significant impacts, both positive and negative, on biodiversity maintenance in Victorian agricultural landscapes. The initial focus is dryland farming land uses and practices in a study area in north-eastern Victoria.

windows' as they would be a very profitable investment. (A change in tenancy rules would change the objectives of landlords.) Also greenhouse gas production would be reduced, as the landlords' energy bills decline. Lesser-geared options would include subsidies for energy efficient design, a star rating for buildings, progressive energy tariffs or running an 'energy advice service'.

Institutional isomorphism

Three mechanisms driving institutional isomorphism

1. Normative isomorphism

When organisations use the same information sources, they end up developing similar arrangements and structures. This is normative isomorphism, and it is driven by professionalism. The sources of new advice for farmers may be limited because of the small number of consultants who help farmers. These people could be providing scientific, technological, business or planning advice. There are also a limited number of educational institutions that train advisers and farmers. Furthermore, these advisers may be relying on a limited range of sources of information and on few sources of research. Similarly, banks and financial advisers would be tending to give their customers similar advice. Literature would also be limited at any one time and would tend to focus on particular issues and particular approaches. This means that if a farmer wants to 'modernise' the farm, and gets advice from professionals, then the farm is very likely to be changed in the same way as other farms at the time. New advice tends to be cognitive and is building on the farmers' experience of how to farm and run a business that may be founded on instruction given 30 or 40 years ago, given the usual age of farm decision-makers. Perhaps then the giving and receiving of professional advice in agriculture is very consistent and tends towards uniform action.

2. Mimetic isomorphism

When managers are unsure what to do, they tend to copy what successful organisations are doing. This is mimetic isomorphism, and it is driven by uncertainty and risk aversion. There is always risks involved in making changes to land use. There is a wide range of risks. For example, some could be physical (the change might not work), marketing (the new product sells for less), financial (interest rates rise or the exchange rate falls), or temporal (a new project may be too expensive in terms of management time to establish). To ameliorate these risks, people tend to copy what successful people are doing. Looking over the fence, farm visits, demonstration farms and trials, the farming press, and discussion groups are fertile sources of information for mimetic isomorphism.

3. Coercive isomorphism

When different organisations face the same pressures, they tend to develop the same responses and similar structures. This is coercive isomorphism, for which there are two driving forces. The first comes from other organisations. The main source is related to the operation of the supply chain. Farmers are between large multinational suppliers of requirements — including machinery, seed and chemicals such as Monsanto's 'Roundup Ready' cotton, corn, soybeans and canola (Monsanto 2001) — and large purchasers (agribusinesses). Farmers have to conform if they are going to do business and this often means reducing selling price and increasing investment to maintain income. Quality systems are effective in improving environmental performance (case studies by Wells and Galbraith 2001). ISO-certified quality systems have become a coercive force in many business supply chains, because buyers will only deal with quality-endorsed organisations. The trend in agriculture is towards using environmental management systems (EMSs), and this may eventually become an important sales requirement (i.e. 'clean and green' and based on ISO 14001). Lodge (2000) discussed the international origins of some aspects of institutional isomorphism using examples from German Europeanisation. This international aspect may be an especially important factor in Victoria because of the export orientation of much of Australian agriculture. There are also other forces that push farm businesses towards uniformity, such as financial institution requirements, insurance requirements, regulatory requirements, and legal requirements in terms of contracts and standards of behaviour. Coercion is an important tool for governments as they tend to be the 'rule-setters', and these rules affect all aspects of farm life, from whether there is a school, a doctor, a research station, a subsidy, transport infrastructure, a minimum wage, irrigation, a controlled market, through to poverty prevention and retirement options.

The second force driving coercive isomorphism is the cultural expectations of society. This may be important in encouraging conservation activities if the farmers feel that society expects them to be conservation-conscious. These two forces are linked, because social expectations may be backed up by coercion from other organisations such as government. These may also be some coercion at a community level in the social hierarchy. Curry (2000), for example, noted similarities in agricultural systems in different communities in the USA that share particular world views (based on religious beliefs).

Institutional isomorphism in analysis

Many of the mechanisms that lead to isomorphism are incremental changes that, in the long term, may not provide for farmers' welfare nor produce a sustainable society or environment. But the three mechanisms of isomorphism, and the power they have, provide a base for evaluating mechanisms, approaches and policy aimed at sustainable development outcomes — perhaps giving an indication of what has to be overcome.

A consideration of normative isomorphism could lead researchers to review the advice of consultants about land use, and the basis of this advice. Mimetic isomorphism could lead to a consideration of risk and land use change. Coercive isomorphism could lead to a review of legislation, commercial power in the supply chain, and ownership and control of business arrangements and resources. The distinction between these three aspects of institutional isomorphism is analytical and may not be easily seen as distinct entities in practice. For example, a land use change may be partly made on professional advice, partly out of fear of the unknown, and partly as a consequence of trying to meet the buyer's requirements. Mizruchi and Fein (1999) analysed 26 isomorphism studies and noted that the majority did not use all three aspects. They concluded that this could lead to a limited and biased picture of the processes involved, and a failure to describe the phenomenon being studied. Thus it seems important that all three forms of institutional isomorphism should be considered in developing an understanding the mega-drivers that are influencing land use change in the study area.

Isomorphic forces become effective in terms of biodiversity when they influence landholders' decisions. Landholders can comply, promote, select between or resist isomorphic forces. It is their decisions, as the final decision-makers, that actually affect biodiversity. How the landholders interpret and respond to isomorphic forces is the essential information required in this study, and it will be obtained from the interviews with farm decision-maker. While isomorphism provides a study approach for understanding why farms and organisations might have similar organisational forms and processes, it is not sufficient because the forces leading to isomorphism are only inherent properties of the system that leads to land use and biodiversity impacts. The emergent properties[8] of the system come from the interaction of these forces with the other parts of the system. The suggestion is that the other important part of the system is the set of fundamental human needs that farm decision-makers are trying to satisfy. Fundamental human needs, like the forces of isomorphism, are also only inherent properties of the system; it is the interaction of these two parts that leads to the actual behaviour of farm decision-makers. The model suggested for the system is an expansion of the overarching relationship at the local level outlined earlier (see Figure 1). The link is still 'fundamental human needs', but they now link all societies with all of the world's environments.

In summary, a word description of this simple model so far is as follows. The farm decision-maker takes action at the intersection of two major systems: people matters and planet matters. The information and resources from both systems have to be used to make things work. At the centre of the decision-makers' world is their desire to live, which in this model is described as wanting to have one's fundamental human needs met over one's life time. They are influenced in how they achieve this by social forces from people matters (world's society) that are broken down for the purposes of analysis into three isomorphic forces. Isomorphism is chosen an the analytical tool because there seems to be a uniformity in how people try to deliver

[8] Emergent properties of a system are those things that are a consequence of the operation of the system. Speed for instance is an emergent property of flying an aeroplane while the inherent properties of a plane are aluminium alloys, wheels, wings and so on.

their needs at any one time, which suggests there may be uniformity in the things that influence behaviours at any one time. On the other side is the huge system referred to as planet matters. The actions that farm decision-makers take change incrementally both planet and people matters, as the actions of everyone else on the planet does. Thus planet and people matters evolve. However, in this study the focus is on the action of the farm decision-makers and the conservation of biodiversity in their agricultural landscapes. This focus constrains the investigation to those forces that seem relevant to biodiversity maintenance in the local landscape of the study area. But further explanation is needed.

Expanding the overarching model to global proportions

The framework set out in Figure 1 can be expanded to global proportions by increasing the two pyramids to include issues of (1) social importance at an international level, and (2) global environmental importance. The linking mechanism is still the same except that we acknowledge that personal drivers (based on the desire to meet fundamental needs) are nested within mega-drivers. Within this linking mechanism of drivers, the idea of fundamental human needs is still the basic tie between the two major elements of society (people matters) and environment (planet matters).

'People matters' refers to all the hierarchical arrangements in human society, including Australian society. This can be visualised as a pyramid that includes human institutions at the base, information, technology, and organisations, up to individual families at the apex of the pyramid (Figure 3).

'Planet matters' refers to what exists in the world's environment. It too can be visualised as a pyramid with the world's ecological processes at the base (atmosphere, oceans), leading up to continents with local areas at the top of the pyramid (Figure 4).

The term 'fundamental human needs' refers to those things people need at various times in their lives to live fully as humans.[9] They are things they need to fulfil their potential.

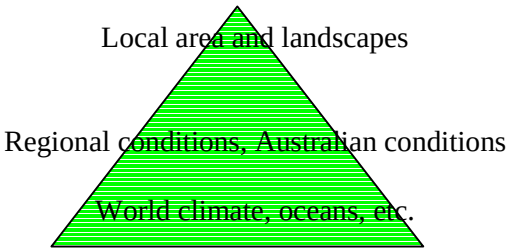


Figure 3 The 'planet matters' pyramid.

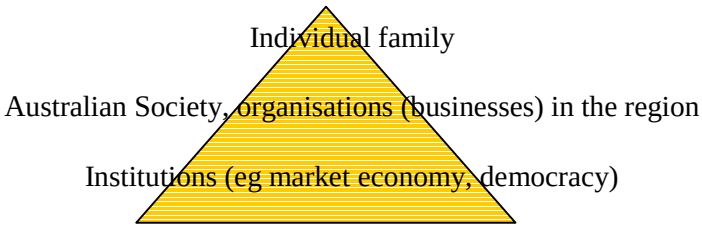


Figure 4 The 'people matters' pyramid.

[9] Needs are different from wants. Max-Neef developed a 'needs theory' with three steps: needs / satisfiers / material entities (eg subsistence need / eating satisfier / Mars bars material entity). He showed that focusing on particular material entities (want satisfaction) often led to imbalance in needs or even prevented the delivery of that need (Max-Neef 1991). People tend to focus on material entities related to subsistence need (ie income) and protection need (police and health) and end up trying to buy their other needs (such as love and identity) and living in an over protected state (a police state with strict censorship) both of which are dysfunctional. Destruction of renewable resources happens and would seem to be due more to (1) ignoring the range of needs and focusing on just two - ever more subsistence and ever more protection, and (2) ignoring the ongoing nature of needs, than to be due to having needs and fulfilling them.

This model suggests that each family and each environmental area would have its own unique pyramid. But it is only the apices that are unique. Moving down the hierarchy in each pyramid would involve encountering increasing commonality, so that towards the base all people matters pyramids would be similar and all planet matter pyramids would be similar.

In outline this simple picture of the relationship between people and the environment is this: people respond to their immediate environment, which comprises both the physical world of planet matters and the human world of people matters. For example, a farmer's crop depends on climate, soils, pests and seed (i.e. on planet matters) but also on the existence of agricultural markets, property rights, law and order, bank facilities and farm machinery (i.e. on people matters). The link between planet matters and people matters is human needs. People have been developing people matters and adapting planet matters for thousands of years in order to meet their needs. Fundamental human needs are stable but people are continually developing new ways of meeting their fundamental needs[10]. These various different ways of meeting fundamental needs and the consequent variety of goods people and societies develop may explain why some authors suggest that needs are culturally defined (Douglas and Isherwood 1979).

The relationship between people and planet matters

The expansion to people and planet matters facilitates the handling of sustainable development ideas (Farmar-Bowers 2001). These ideas require a global perspective and global arrangements in terms of environmental issues (e.g. climate change) and social issues (e.g. human rights) especially in terms of equity. These ideas imply dramatic changes; Padilla (2002) has outlined some that concern intergenerational equity.

The institutions that form the basis of current Australian people matters include law and order, democratic government, human rights, ethical systems, and the market economy[11]. These institutions are closely aligned with other western institutions and are relatively stable although the organisations within them are less durable. For example, the market economy is an institution with ongoing values, but business organisations come and go; only a few survive more than a couple of decades. The arrangements in people matters include information flows. This suggests that some institutional changes can rather rapidly influence the individual family, and visa versa. The individual family at the apex of the pyramid is focused mainly on the people matters that lie close to home; for example, a farming family in the Rutherglen region would work with others in the region to earn a living, and also shop and socialise. They may also be part of a wider community and share feeling and sentiments with other community members, even if these others are overseas or are from different generations (de-Shalit 1995). Although much diversity is potentially available within the operation of people matters, the general trends in how things operate (what normally happens) is constrained by the current mega-divers. The sources of mega-drivers are dispersed throughout the people matters pyramid.

Hierarchical relationship between planet matters and people matters

People matters are really part of planet matters in that people live on the planet, depend on it and are part of it. We separate 'people matters' out because of our interest. Instead of 'people' other species or group could be individualised in this way. And this applies within 'people matters' so the peak of the pyramid for a study could be an individual farming family (as in our case) or an organisation such as the Murray Darling Basin Commission (although their 'personal drivers' would not be based on fundamental human needs). We can show this relationship diagrammatically using the two pyramids (the relative sizes are irrelevant; the pyramids represent ideas, not reality).

[10] Not always successfully. Nuclear weapons, police states and cruel dictatorships are unfortunate over-kills of the fundamental human need for protection.

[11] Institutions are entities that have purposes and values that extend beyond the task at hand. 'An institution is seen to have two primary characteristics. It is an instrument for action. It has inherent value to its recipients, beyond its mere instrumentality' (McGill 1995, p 65).

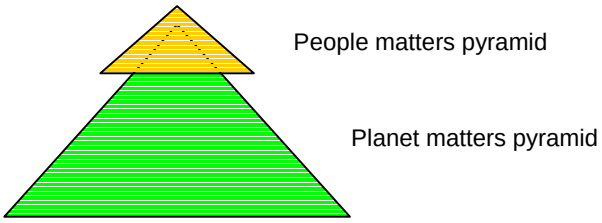
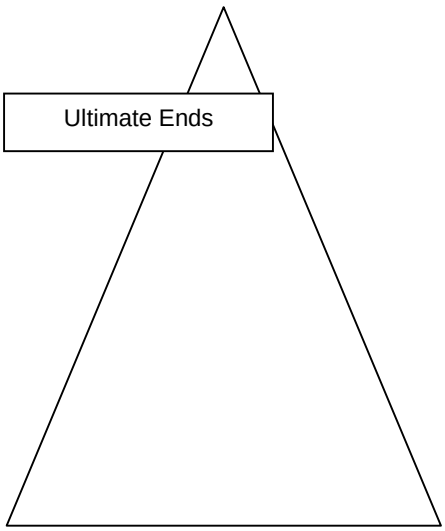


Figure 5 The relationship between the planet and people matters pyramids.

People matters are shown at the apex of planet matters in the hierarchy because people depend on 'planet matters' for the opportunity to exist but the planet does not depend on people. That is, in general planet matters can survive without people but people cannot survive without planet matters. Wilber (2000a,b) discussed hierarchical relationships at length, outlining the spiral of development and suggesting that the ingredients of hierarchies are holons[12]. The flexibility and adaptability within agricultural systems that allows production to continue despite significant economic and physical annual and seasonal fluctuations depends on self-managing business entities; farms and systems can be described as holonic. Farm businesses are whole entities yet they are also parts of the agricultural production or land management systems. Wilber's 'full spectrum approach' helps to provide an integral vision of first-person (individual), second-person (social) and third-person (planet matters) realities. This provides a valuable alternative but parallel model that later in the project could be used to broaden the researchers' understanding of the relationships between mega-drivers, personal drivers and regional planet matters. The 'planet–people matters' model is hierarchical and addresses the relationship between the people and planet matter hierarchies. It could be referred to as a 'hierarchical people–planet relationship model', and its role in this project is to provide a framework for organising information.

This hierarchical relationship is well known in the literature. For example, Daly developed this kind of hierarchical pyramid in the 1980s, but he amalgamated planet matters and people matters so his pyramid looked somewhat different. Meadows (1998b) added information on fundamental human needs to help make it a framework for indicators of sustainable development. Her version of the Daly pyramid helps to illustrate how our models are linked to sustainable development ideas.



Well-being	
	Happiness, harmony, fulfilment, self-respect, self-realisation, community, identity, transcendence, enlightenment
Human capital and social capital	
	Health, wealth, leisure, mobility, knowledge, communication, consumer goods.
Built capital and human capital	
	Labour, tools, factories, processes raw materials
Natural capital	
	Solar energy, the biosphere, earth materials, the biochemical cycles

Figure 6 The Daly triangle: a framework for sustainable development Indicators (from Meadows 1998b, p. 42).

[12] A term coined by Arthur Koestler in *The Ghost in the Machine* (1967). A holon is a whole, yet part of other wholes — cells in a body, bodies in a community — so reality is composed of whole/parts or holons.

Musters et al. (1998) also used ideas about hierarchies. They proposed an approach or model, for regional planning using 'socio-environmental systems' based on hierarchical organisations of human activities. They suggested that defining a basic system allows knowledge to be brought together, and helps to clarify how this knowledge can be applied and discover what remains to be discovered. However they noted that systems were not routinely defined: 'This absence of paying attention to crucial basics enlarges the confusion and uncertainties about sustainable development' (Muster et al. 1998). In order to avoid the confusion Muster refers to, we have gone to some length to develop our models for understanding land use change and sustainable development in our study. Muster's model might not be relevant for land use change, however, for although called a 'socio-environmental system' it amalgamates the people and environmental factors, assuming 'that describing human activities includes describing the natural processes that are affected by these activities' (Muster et al. 1998). This may be true for most things, but an independent environmental feedback loop would help developers appreciate that within the model unexpected environmental outcomes occur.

Life for people is a cooperative venture, and our interaction with other people is fundamental as this is the means by which people get many of their needs fulfilled. This interaction is initially and importantly face-to-face between people, but as society gets more complex the interaction spreads so that cooperation is often with unknown people; For example, you might buy a television made in South Korea, then use it to watch programs made in Hollywood, relying on electricity generated in the Latrobe Valley. Globalisation is making the system much more complex, because it spreads out geographically it becomes much less complex in terms of organisations as 'less efficient systems' fall by the wayside (i.e. isomorphism increases).

People can interact with planet matters on their own but most of this interaction occurs in cooperation with other people. A farmer learns about how to farm from other people, and is able to farm because other people have set up markets, created farming machinery and so on. Thus a farmer's interaction with the land is via people matters. And like people matters, initially and importantly the interaction between people and 'planet matters' occurs in the local area. People breathe local air, drink local water, cultivate the land they stand on, and catch fish in the surrounding seas. The initial point for interaction between people and planet matters is local people (i.e. the family) and the local area (Figure 7).

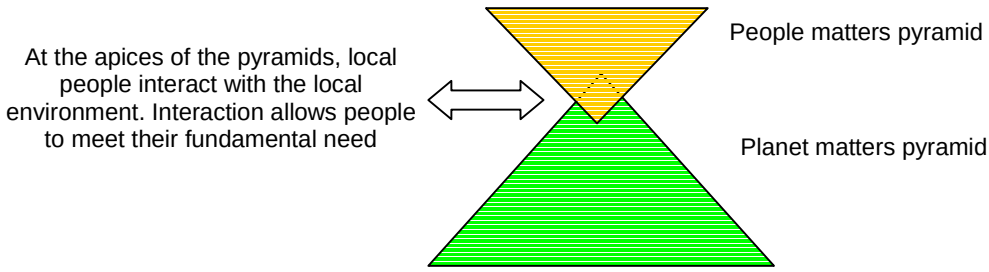


Figure 7 The relationship at the apices of the planet matters and people matters pyramids

At any one time, the interaction is between the family and local area. But what the person does is greatly influenced by what is in the rest of people matters, and the rest of planet matters influences what is available at the site. These influences include the nested or hierarchical model of drivers discussed earlier. The isomorphic forces, even at the global level, can come right down to influence local land use change. Some may exert an influence in a matter of decades (e.g. genetic engineering) while others may take longer. For example, Guertin (2001) in discussing poverty and energy requirements to meet human needs, noted the predicted sixfold energy growth in the developing nations in the Asia–Pacific region by. Increasing energy use by developing nations to help reduce poverty in the poor nations will require compensatory

reduction in developed nations if the overall global climate capacity is not to be exceeded. In discussing equity, Sachs et al. (1998) noted that the planet has the capacity to absorb about 14 billion tonnes of CO_2 annually, or about 2.2 tonnes per person if distributed equally. However, on average, Indians produce 0.8 tonnes of CO_2 per person of CO_2 annually, Egyptians 1.5 tonnes, and Chinese 2.0 tonnes; but Americans produce 20 tonnes, Germans 12 tonnes and Japanese 9 tonnes. Australians are about equivalent to Americans in CO_2 output. These seemingly distant events and an increase in equity consideration at a global level may reduce permissible CO_2 output in the future and so dramatically change the way farming can be conducted in Victoria. Veldkamp and Lambin (2001) supported this view and suggest that 'the Kyoto Protocol may drive significant changes in land use in the future'.

The arrangements people have made over the centuries have created the current relationship between people matters and planet matters. Through these arrangements people have been aiming to get their fundamental needs met.

Fundamental human needs

The 'logical reasons' people have (I suggest) for doing things that can lead to land use change is their desire to meet their fundamental human needs. Working to satisfy these needs is thus the internal reason (motivation) for human activities. Although a cooperative venture, individual societies and individual people vary in how successfully they meet their needs, and sometimes their activities over time are destructive for themselves and other people.

All people have fundamental needs, but how they go about meeting their needs varies according to the opportunities available to them. These opportunities can be classified into two interrelated groups:

1 What instruction they get from people matters that organise their society.
'Instruction' means the institutional arrangements, such as whether it is a democracy, supports elitism, is technologically progressive, has a market economy, a fair and honest political system, and so on. Overall, instruction is the message about what society decrees is permissible activity. Instructions lead to the development of specific kinds of technologies (but not others) and the relevant artefacts, such as equipment, materials and education. Instructions are very important, as current debates about genetic engineering,[13] nuclear technologies and stem cell research show.

2 What the decision-makers see as being available in the local area in terms of 'planet matters'. Different physical areas have different physical endowments, and people have to meet their needs accordingly. Farmers in some parts of Queensland can grow sugar cane, but this is not a good crop in Tasmania yet farming families in both Queensland and Tasmania can meet their income (subsistence) needs. They just do it in different ways.

What actually happens is a consequence of the combination of opportunity and need; that is, the combination of local planet matters, local people matters, and internal motivations within the person taking the action. This combination is what drives change.

Alternative versions of fundamental human needs

There are several ways of looking at fundamental needs. For example, Maslow (1998) defined a hierarchy of needs; from the bottom up they are biological, safety, attachment, esteem, cognitive, aesthetic, self-actualisation and transcendence. Once a person's lower-level needs are met, they can move on to address higher levels. The problem with Maslow's hierarchy is that one is never sure when low levels are satisfied because they tend to be comparative. Thus the focus tends to remain at the lower levels; improving income, housing, food, consumer goods, medical, police, security systems, military, spy satellites, star war programs, terrorist wars, and so on. This makes higher-level needs, such as understanding/cognitive (education and schools), hard to prioritise.

[13] For example, 'Roundup-ready canola'; see Monsanto (2001).

Another approach is the value areas system described by McDougal et al. (1980). Their eight value terms are shown in Table 1.

This system is sophisticated and relates very closely to the UN's Universal Declaration of Human Rights, but it is complicated to use. The practical difficulty lies in taking these value terms and expressing them in ways that can be applied to discuss the life long objectives of individual farming families. For this study, Max-Neef's nine fundamental human needs provide a useful approach that is comprehensive but easy to understand (Max-Neef 1992). These nine needs provide a way of opening the debate. They are not the definitive answer.

Table 1 Value terms. (Source: McDougal et al. 1980.)

Value term	**Meaning**
Respect	Freedom of choice, equity and recognition
Power	Making and influencing community decisions
Enlightenment	Gathering, processing, and disseminating information and knowledge
Well-being	Safety, health, and comfort
Wealth	Production, distribution, and consumption of goods and services; control of resources
Skill	Acquisition and exercise of capabilities in vocations, professions, and the arts
Affection	Intimacy, friendship, loyalty; positive sentiments
Rectitude	Participation in forming and applying norms of responsible conduct

Table 2 Fundamental human needs. (After Max-Neef 1992.)

Subsistence	Understanding	Creation
Protection	Participation	Identity
Affection	Leisure	Freedom

These are not hierarchical like Maslow's system, but subsistence needs and perhaps protection needs are primary, because without these people do not survive and so other needs would be irrelevant. After survival, the other seven needs are of equal importance. However, the last two (identity and freedom) have become important as societies have developed and impinged on individual identities and freedom.

These needs are essential for human welfare over a life time, and it is easy to think of anecdotal evidence to suggest that this is a reasonable proposition (i.e. which need would you happily forgo?). Proof may be difficult because it would be unethical to run experiments to prove that each need is fundamental to achieving a well-adjusted happy person (prison, of course is intended to restrict the delivery of some needs as a form of punishment). There may, however, be a growing appreciation of the importance of human needs, including in business. Somavia (2000) suggested that many corporations are already adopting a broader agenda and noted that 'business has a direct stake in putting human needs first'.

Although this study will use Max-Neef's approach, the other approaches and the idea of needs in general are central to the relationships within society and between society and the environment. Springborg (1981) showed that the idea of needs has had an important position in much of philosophical and political thought over the centuries.

Planet matters, people matters and sustainable development

Different aspects of the relationship between people matters and planet matters tend to be emphasised by different people at different times. This emphasis is partly described in the nine fundamental human needs. Thus the medical area (doctors and hospitals), pollution control industry, police, armed forces and intelligence agencies focus on protection; education and information technologies relate to the understanding need; and so on. Each area, although focusing on a particular need or needs, nevertheless touches on the complexities within the

relationships between of people matters and planet matters. Siegel suggests that in the Western world, growth in each special area is reaching the limits of human needs and is often counterproductive. This is in addition to reaching the limits of growth because of ecological limits. He noted that according to the Daly–Cobb Index of Sustainable Economic Welfare (ISWE), 'Americans' economic well being increased substantially during the 1950s and 1960s, levelled off from 1968 until the end of the 1970s, and declined after 1980' (Siegel 1998, 1999). Max-Neef developed similar ideas including a 'threshold hypothesis' surmising that after a threshold point, more economic growth is likely to lead to deterioration in the quality of life (Max-Neef 1995).

Sustainable development as a set of ideas can be a tool for considering choice between different activities, investments and developments. Descriptions of sustainable development can emphasise any aspect of the relationship between 'people' and 'planet matters'. The Australian National Strategy for Sustainable Development emphasises in it core objectives (1) people's welfare and well being through economic development, (2) equity and (4) the protection of biodiversity and ecological processes (Commonwealth of Australia 1992). The Global Compact emphasises nine concepts: the human rights, the International Labour Organisation's standards and the Rio declarations (UN 2001, Global Compact Office 2002) (Table 3). These different descriptions tend to deal with items deep in the 'people matter pyramid' because they relate to society rather than the individual family but they touch fundamental needs. They deal with the economy rather than subsistence needs, with equity rather than participation need and so on. That there is not total agreement on the definition of sustainable development does not really matter. As Galtung argues in regards to human rights, 'it is in our interests to spin a dense normative web of norms by and large pointing in the same (basic human needs) direction' (Galtung 1994).

Table 3 The nine principles in the United Nations Global Compact. (Source: unglobal.compact.org)

Topic	Principle
Human rights	1 Support and respect the protection of international human rights within their sphere of influence.
	2 Make sure their own corporations are not complicit in human rights abuses.
Labour	3 Freedom of association and effective recognition of the right to collective bargaining.
	4 The elimination of all forms of forces and compulsory labour.
	5 The effective abolition of child labour.
	6 The elimination of discrimination in respect of employment and occupation
Environment	7 Support a precautionary approach to environmental challenges.
	8 Undertake initiatives to promote greater environmental responsibility.
	9 Encourage the development and diffusion of environmentally friendly technology.

Overall we may come to appreciate that people have different views of 'people matter' and that perhaps the best way to think of 'people matters' is as a amalgamation of all these. There is no one view that is 'right'. Thus a particular view is just one and not 'the view'. But as Galtung suggests, the important direction is towards meeting human needs over time. So we can view actions that damage or prevent the delivery of human needs over time as actions that do not move in the direction that Galtung suggests is in our interests.

Perhaps this idea can be illustrated in diagram below. The inference is that none of these individual views constitutes the whole. Focusing on economic matters for instance will not deliver all needs.

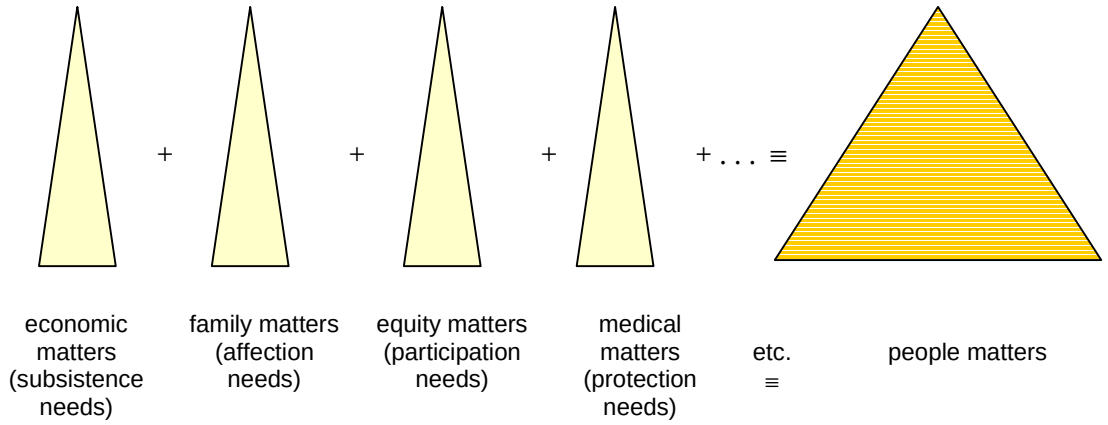


Figure 8 Pyramids within the people matters pyramid.

If 'people matters' could facilitate the long-term or perpetual delivery of all fundamental human needs to all people then it would be delivering sustainable development. Delivering these needs would automatically require the maintenance of planet matters because people matters depends on planet matters. Doppelt (2002), in discussing ethical theories, agrees with this dependence:

> 'Any traditional utilitarian or Rawlsian can easily explain and justify many such environmental imperatives of morality, or practical rationality - by appealing exclusively to the rights, interests, or utilities of present and future generations of human being alone.'

Although this project is ultimately aimed at delivering advice to state government policy-makers about biodiversity maintenance, which is an objective of sustainable development, it still has to do so within sustainable development ideas. Sustainable development ideas include processes as well as objectives. Just maintaining biodiversity is not sufficient for a 'sustainable development' accolade; it has to be maintained using processes that also maintain peoples' welfare and well-being and enhance inter-generational and intra-generational equity.[14] Swaminathan (2000), in discussing how science ought to respond to basic human needs, suggested using the Mahatma Gandhi test and this should be applied to this program too. The question is 'Recall the face of the poorest and the weakest man you have seen, and ask yourself, if the steps you contemplate are going to be of any use to him. Will he gain anything by it? Will it restore to him control over his own life and destiny?'

Fundamental human needs and biodiversity

People knowingly use a small proportion of biodiversity directly to meet their subsistence and protection needs. But these two needs require the maintenance of ecological processes, and maintaining these processes involves a much greater proportion of 'life' in terms of variety and quantity. Whether or not any life is really 'redundant' over and above the very low rate of natural extinction is questionable. It seems more likely that much of life on the planet (quantity and variety) is relevant to the maintenance, over the very long term (perhaps million years), of the ecological process that humans depend upon.

But there are seven other fundamental human needs to be considered, and these are mostly psychological. The delivery of these needs over time requires that life forms are maintained throughout the world. In fact, they require the maintenance of many other artefacts, both natural and of human origin. The need for understanding, for example, is so powerful that it leads to studies of topics that seem little connected to everyday life, such as palaeontology and

[14] Biodiversity maintenance can always get a 'environmental sustainability' accolade but only a 'sustainable development' accolade if it is achieved equitably.

astronomy. We know that people get enjoyment just from discovery, so there is no need to rationalise these benefits by reference to utilitarian values. The same applies to biodiversity: biodiversity helps people fulfil many of their psychological needs as well as physical needs of subsistence and protection. For instance, biodiversity can satisfy the following needs: understanding (see Reaka-Kudla et al. 1997), leisure (ecotourism, wilderness recreation, etc.), affection (caring), participation (involvement in biodiversity maintenance activities and organisations), creativity (e.g. writing, photography, painting and inspiration), and identity (sense of place). Biodiversity maintenance is also a strong element in the need for freedom, which can be interpreted as the ability to make plans and successfully deliver their objectives. Many plans not only depend on the stability and ongoing existence of life, but are related directly to biodiversity.

So these seven psychological needs are not irrelevant for biodiversity maintenance; they are extremely important and much more constant than the economic value of biodiversity, which fluctuates with the markets. 'As shown by the example of the faltering search for new drugs in the tropics, economic criteria of value are shifting, fluid, and utterly opportunistic in the practical application. This is the opposite of the value system needed to conserve biological diversity over the course of decades and centuries.' (Ehrenfeld 1988). The seven psychological human needs, potentially at least, seem to have the capacity to provide the value system that Ehrenfeld suggested is needed.

There was a period when even environmental researchers thought that biodiversity had to be valued in dollar terms to have a hope of being 'saved' (Commonwealth of Australia 1993). This was because of the mistaken belief that subsistence and protection needs were the only important needs (only rational needs, only utilitarian needs). Ehrenfeld noted this activity. 'It has become a kind of cottage industry, with dozens of us sitting at home at our word processors churning out economic, philosophical, and scientific reasons for or against keeping diversity' (Ehrenfeld 1988, page 212). Unfortunately having a dollar value results in being valuable in terms of 'use' and this is often counter productive for biodiversity maintenance[15].

Applying fundamental human needs in this study

The nine fundamental human needs provide the basis for questions to ask landholders about their reasons for undertaking specific land use changes. Instead of asking 'why' landholders changed their land use (which is a question that tends to get circular answers)[16] we can ask landholders how their land use changes relate to the delivery of needs for themselves and their family. A thorough analysis of their answers may suggest how individual are meeting their needs within the overall context of mega-drivers. Conformity of action suggests that a mega-driver is at work (and that mega-drivers are compatible with the delivery of personal needs). An individualistic response may indicate how somebody is going against the trends, perhaps to meet some specific need. With time, a clearer understanding of the relationship between actions and needs should develop. Once a degree of understanding is achieved, the approach could be use to evaluate how organisations are helping people get their needs met. A question set was used in the initial fieldwork for this study and is reported by McHugh and Macdonald (these proceedings). The question set will be further developed and used as a guide for more interviews in 2003.

Considering the biodiversity focus in the study

The focus for land use change is on those changes that have a special relevance to biodiversity maintenance in the landscape. These are likely to be different from land use changes that are significant for agricultural production. These changes can be positive or negative for

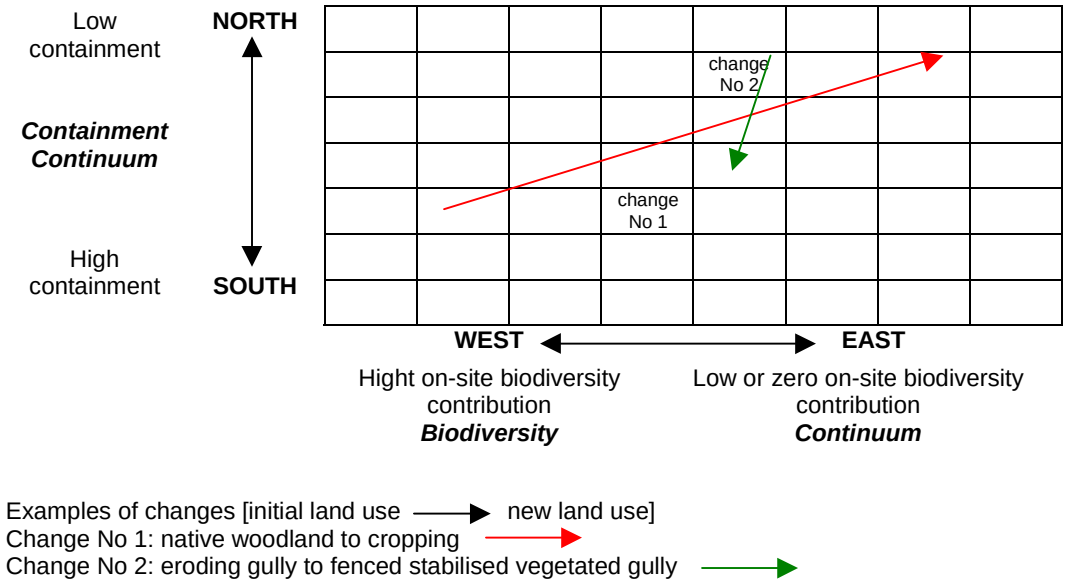
[15] For example, declining fish stocks lead to increased market prices, stimulating investment is fishing boats and catching effort which in turn expedites the fish stock decline.

[16] Patton noted that 'The infinite regression quality of "why" questions is part of the difficulty engendered by using them as part of an interview' (p. 363). And 'My cautions about the difficulties raised with "why" questions come from trying to analyse such questions when the responses covered such a multitude of dimensions that it was clear different people were responding to different things. This makes analysis unwieldy (Patton 2002, p. 365).

biodiversity. Knowing why both occur is important, since we wish to promote the positive changes and alter the negative changes so they become either neutral or positive for biodiversity. It is these special kinds of land use change that the study is focused upon and on which the questions relating to fundamental human needs are addressed. A land use change classification system was developed to help identify these special kinds of land use changes.

This classification system can be set out as a matrix (Figure 9). The horizontal axis (west to east) concerns on-site biodiversity. Sites containing high biodiversity value were placed on the western end and sites with low (or no) biodiversity on-site were placed on the eastern end. The vertical axis (south to north) concerned containment.[17] Sites that are highly contained (where the land use does not involve substantial inputs and outputs and so presumably has low off-site impacts) were placed on the southern end, and sites with low containment were placed in the northern end. Thus a land use that uses a lot of resources (irrigation, chemicals, fuel) and loses a lot of resources (soil erosion, drainage water, biomass, contaminants) is placed in the north. Containment relates indirectly to off-site biodiversity impacts. A natural, mature ecosystem would tend to have high containment and little off-site biodiversity impacts, whereas an eroding gully in an area affected by dryland salinity would have low containment and would tend to have downstream impacts on biodiversity. One of the problems is the lack of information on exactly what the containment position is with various land uses, and thus what off-site biodiversity impacts they have as a consequence. The scale of the system used for determining impacts can greatly affect the conclusions. Using a large scale is preferable but increases the cost of analysis. This scale issue is a problem with all environmental impact analyses and is frequently addressed in the literature on life-cycle analysis. Many of the issues involved in determining the environmental consequences of alternative practices of crop production have been discussed by Gregory et al. (2002).

Figure 9 Matrix for classifying land use change.



In this study five categories of land use change were considered important for biodiversity. These were the changes that potentially have the largest negative or positive impact on biodiversity on-site and off-site. Changes to land use that do not have much impact on biodiversity are of no concern in this study, even though they may have enormous impacts on other things such as farm profitability. These five categories are listed in Table 4.

[17] The term 'containment' is used as it refers to the notion of 'natural self-containment' indicating areas in which humans activities do not involve adding or taking out material such as adding fertiliser and / or irrigation water and taking out biomass and / or soil material. Containment thus related to human action (and consequences) and is not the same as the term 'leakiness'.

Table 4 The five categories of land use change with the greatest potential impact on biodiversity.

	Land use change from:	**Land use change to:**
1	South-west corner	Anywhere (south-west corner represents land uses that have high conservation value. Any change could reduce biodiversity and is of interest.)
2	Any substantial movement from west	East (reduction in on-site biodiversity)
3	Any substantial movement from east	West (improvement in on-site biodiversity)
4	Any substantial movement from south	North (potential reduction in off-site biodiversity)
5	Any substantial movement from north	South (potential improvement in off-site biodiversity)

This matrix can be applied at two scales: micro-scale changes and paddock-scale changes. Micro-scale changes equate with management changes where the same agricultural products are produced but different methods and inputs are used. The paddock-scale changes involved a major change in crop or system, or both. For example, changing from dryland to irrigation or dairy to vineyard would be paddock-scale changes.

This classification system encourages researchers to set out logically the biodiversity implications for relevant land uses. It also ensures that the focus is on land uses that are relevant for biodiversity maintenance. The classification system raises two important issues: (1) The need to have on-site information on the biodiversity impacts of a variety of land uses, and (2) The need to have information on the containment of various land uses and the biodiversity impacts of different containment positions. In other words, if a vineyard is established on a native pasture we need to know the biodiversity value of the grassland and the vineyard and the off-site biodiversity impacts of both the grassland and the vineyard (at least in general or comparative terms). It is absolutely vital to know the on-site and off-site biodiversity impacts of land uses in this project, because the intended outcome of the project is new policy that encourages the specific land uses that benefit biodiversity maintenance. For new policy to be effective, knowing which land uses or management practices to support or discourage is essential.

Although the models devised for this study could be used for any change related to sustainable development, the focus of this study is biodiversity maintenance through land use change. This is why we need to identify exactly the changes that are to be studied.

Conclusions

The study aims to contribute to the development of policy that will improve the maintenance of biodiversity in agricultural landscapes. This task requires the effective handling of complex multidisciplinary information over a number of years. The hierarchical people–planet relationship model, including the drivers model, is proposed as the basis for organising this information.

Some land use changes have important positive or negative impacts on biodiversity maintenance in the landscape. The first step in improving biodiversity outcomes in the landscape is to identify these changes and assign them to specific land uses and land management practices. The classification matrix developed for this project may provide a logical way of identifying and categorising the land use changes relevant to biodiversity maintenance.

The second step is to understand why these land use changes are made by landholders. The drivers theory being proposed in this project is that land use actions are taken by decision-makers who are matching the fundamental human needs of their family with the opportunities they see in their local environments (personal drivers). These opportunities relate to a combination of their understanding of the resources they have access to and mega-drivers they understand and have access to. Institutional isomorphism seems to provide a way of

investigating mega-drivers and involves analysing opportunities being presented to decision makers in terms of their normative, mimetic and coercive content. Within the umbrella of mega-drivers, an understanding of the drivers that are relevant to decisions made by individuals can be obtained by considering how the individual families seeks to meet their fundamental human needs by using a range of satisfiers and material goods (which may be culturally determined[18]). The field technique for this is farmer interviews using a question guide that covers the nine fundamental human needs. The drivers for the farming family' decisions on land use stem from (1) a desire to meet all nine fundamental needs, and (2) the opportunities the farmers believe are available to them. These opportunities relate to both local environmental conditions (which in this situation are the resources they control) and mega-drivers (acceptable behaviour, organisations, technologies, markets, etc.).

The system has two feedback loops that need to be investigated. One is at the family level, linking the consequences of their actions to the delivery of their needs. Some parts of this feedback may be speedy but other aspects may be spread over the family's life span (several generations). The other feedback loop is from the consequences of action (summed consequences) and feeds back to mega-drivers. This feedback loop is complex and has a social stream and also an environmental stream. There is also a third feedback loop (which cannot be investigated in this study) that is an extension of the environmental stream mentioned above. This third feedback loop is the true environmental feedback. It goes back to the Earth, not to humans. It can include environmental changes that are totally unexpected and may or may not be the consequences of human action.

The hierarchical relationships between people and the environment and the hierarchical relationships within societies and environment can be illustrated using 'people matter' and 'planet matter' pyramids. The suggested link between the pyramids is the desire of people to live and prosper. The system of drivers of land use change being investigated in this study lies principally with the people matters pyramid.

The third step in this project is to use this improved understanding of the drivers of land use change to devise policies that will alter the drivers at the landholder level sufficiently to improve outcomes for biodiversity within the context of sustainable development ideas. This purpose needs to be born in mind during the study to enable information to be gathered as the study progresses to facilitate developing geared policy changes.

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[18] Understanding the culture of the market into which products are sold is important. Thus there is no point trying to sell beef into a Hindu culture or alcohol to a Muslim nation.

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