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LAND DIALOGUES: Interdisciplinary research in dialogue with land

Creating change in agricultural landscapes: the need for a consilience approach

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Introduction *(Entrenched attitudes to landscapes and resources)*

The post-European landscape mosaic and farming systems of NSW, Australia have been developed and maintained as a result of political, social and economic drivers. Government land use policies have driven landscape changes for economic outcomes (scaled from individual to national benefits) operating under a social licence, albeit from a society characterised by a lack of interest. The common approach has been to use specialised knowledge, technology and chemical/physical inputs to drive (agro)-ecosystems towards optimisation of a narrow range of outputs *viz.* yield of food, fibre and forestry (Tyler 2008).

The short-term success of increasing yield in homogenous environments has tended to reinforce beliefs of human development being independent of nature and allowed a focus on increasing economic efficiency and the control of natural variation to predominate (Folke *et al*. 2002). There is little recognition that the drive for efficiency may reduce adaptive capacity. Where issues arise, the land use system is rarely questioned, there is just a chronic and simplistic optimism that technology and technological 'fixes' will appear and no fundamental changes are needed. Such attitudes are a function of the 'lock-in' nature of the system governed by the large investment of landholders, agribusiness, industry bodies, governments and research and extension scientists in the system (see Allison & Hobbs 2004).

Even with significant drivers as climate change or an increasing cost-price squeeze the major response is to look at adapting the system rather than transformation since the agents of change are locked-in to a system that gives them their raison d'etre and rewards their 'expert' base.

This is not simply a feature of Australian landscapes. Wilson (1998) described the guiding theme of Western civilisation as Exemptionalist indicating that we consider ourselves as exempt from the laws of nature. This line of thinking, while having its origins in Genesis (man having dominion over animals), was a significant theme in

Enlightenment thinking (we can use science to transform the landscape as we wish) and reinforced by the Protestant work ethic (God gives material reward for effort). The Enlightenment philosophy was simplified by Rackham (2006) into 'the belief that all the world's problems can be solved by a combination of science (or what is presented as being science) and government'. Rackham (2006) also interestingly noted that Enlightenment thinking opposed communal use of resources with cultivable land to be used for conventional agriculture by private landholders, that common land and other multiple land uses were bad, timber production should be organised by the state and local knowledge should be ignored or marginalised. Clearly, some of these ideas still resonate strongly today.

However, Wilson (1998) in his book on Consilience indicated that he believed the Enlightenment thinkers had 'got it mostly right' in suggesting a lawful universe, an intrinsic unity of knowledge (consilience) and the potential of indefinite human progress. While he does not immediately define progress, in a later chapter (page 98) he suggests that it is 'the production through time of increasingly complex and controlling organisms and societies' associated with the appearance of humanity. He noted that the impacts of progress through the high intelligence and culture of humans has resulted in grief for most pre-existing life forms! While the lawful universe is generally accepted and clearly the nature of progress needs significant questioning, it is the idea of unity of knowledge that is the most pertinent to the present search for innovative solutions to sustainable landscape use. Historically land use has been driven by politics and economics and reliant on a generally (passive) societal acceptance. Arguably, if change in the way we manage landscapes is to occur it needs to emanate from society and the question becomes 'how can they (society) be engaged to drive these changes? The present emphasis on biophysical science has not been successful in producing action and a more holistic approach incorporating other disciplines should be investigated.

Do we need to Change? *(The case for change)*

On a global scale the papers of Brundtland (1987), Vitousek *et.al* (1997) and Wackernagel *et al.* (2002) are just a few examples of strong cases for the lack of sustainability of current practices in environmental management, resource use and wealth distribution. Specifically, Wackernagel et al. (2002) calculated that humanity's collective demands exceeded the earth's regenerative capacity in the early 1980's and continues to do so. According to their preliminary and exploratory assessment across the needs for cropping, grazing, timber, fishing, infrastructure and energy, humanity's load corresponded to 70% of the capacity of the global biosphere in 1961, and grew to 120% in 1999.

At a local level Goldie *et al*. (2005) noted positive trends in Australia for environmental parameters such as urban air quality, increases in numbers of marine parks, improved domestic energy efficiency and declines in water use per capita. However, they also reported many off-site impacts of land-use and urbanisation including turbidity and nutrient loads in coastal waters and rivers; high per capita greenhouse gas emissions; continued loss of vegetative cover (and thus biodiversity); increased land surface temperatures; loss of coastal habitats; deterioration of groundwater; and the presence of a wide range of soil health issues such as acidity and salinity. These issues are further developed and quantified by Williams and Saunders (2005).

While a greater environmental awareness may be expected in society through better education and increased sources and flows of information McMichael (2005) notes that most people passed through an educational system that was blind to the fundamental dependence of human societies on their natural resource base. Even in the year 2000 there was half a million hectares of native vegetation cleared in Australia *cf*. 100 million hectares estimated to have been cleared since European settlement (Goldie *et al.* 2005). Such losses should be viewed from a decrease in the environmental goods and services provided by biodiversity and the underpinning of resilience and other stability factors to ecosystems large and small termed

'Biodiversity Buffering' by Wackernagel *et al*. (2002). Wilson (1998) suggested that while 'we drown in information, we are starving for wisdom' and that synthesis (of information) was needed, in essence the creation of a new epistemology.
It should be acknowledged that Australian agriculture has generated considerable wealth since Federation (for example agricultural exports in 2014 were worth $44 billion) although Williams & Saunders (2005) suggest that this has not only been at significant cost to the environment but also with ever-declining terms of trade. These authors highlight the urgent need for less harmful land-use systems although recognising that the task of maintaining landscape integrity while providing profitable farming options is not simple. From an economic perspective the Australian Bureau of Agricultural and Resource Economics and Sciences (Moir & Morris 2011) recognised that agricultural industries faced a number of challenges if they were to continue to increase production. These were given as climate change, competition for resources and technological development to allow continuation of productivity advances arguably a somewhat narrow distillation of the situation.

Change and Change Management *(Why we don't change- hurdles to overcome)*
We all live by 'convenient mythologies' that often serve to help us avoid change. There are a number of common mythologies associated with agriculture and our use of landscapes and resources including tradition, food security, clean and green and 'if it ain't broke don't fix it'. These are often presented with an air of verisimilitude but even mild scrutiny will generally identify the flaws in the statements.

Tradition is used when we're asked to give up or stop doing something e.g. clearing, access to irrigation. There is a flexible definition of the length of time that constitutes a tradition at the convenience of the speaker. In the Australian context there is also little recognition that much longer traditions were in place prior to settlement.
Food security arises when the role and importance of agriculture is being discussed and generally in conjunction with some impending situation that may have an impact on landholders. While food security is important it is rarely defined in these situations. FAO (2003) give a definition *that food security is the situation where all*

people have physical and economic access to safe, sufficient and nutritious food that meets their dietary needs and food preferences for an active and healthy life. However, the term is often used in a producer-focussed context not as a consumer-focussed term. Additionally, many regions now describe themselves self-importantly as food bowls of Australia often as a means of protecting the status-quo. Notwithstanding its importance to the Australian economy, on a global scale Australia is a small producer with exports directed to high value markets and the oft-quoted 'feed the world' image is unfounded.

The use of 'clean and green' occurs when describing our agricultural systems and again in association with an impending potentially negative situation or decision. It frequently describes the end product rather than the production system which as previously noted is often beset with issues such as salinity, soil acidity, soil erosion, negative impacts on water quantity and quality, herbicide resistance and increasing dependence on fungicides and pesticides. Despite these features Moir & Morris (2011) suggest that Australia's biggest contribution to world food supplies is to provide technical assistance to food deficit countries!

'If it ain't broke don't fix it' is used to avoid recognising that there may be a problem or a better way of doing things (and hence subverts the need for change); it adopts a 'business as usual' approach because 'we're doing alright'; it maintains the narrow focus on resource use, economic growth and wealth generation and the use of market mechanisms for the efficient allocation of resources (Harris, 2007). These attitudes can partly be attributed to the conceptual blinkers developed through an education system focussed on the industrial revolution sciences of physics, chemistry and mathematics (McMichael 2005) which instilled a limitless growth and an exploitation mindset.

Although Williams and Saunders (2005) suggest that there has been a major change in the attitudes of landholders with the emergence of Landcare, the numbers of Landcare groups and membership of groups have undergone a significant decline

over the last decade particularly in cropping areas where arguably the need is greatest. In part, this has been a result of the withdrawal of funds away from community based organisations by governments in favour of discrete projects that can demonstrate short-term outputs (Robins & Kanowski 2011). This change in funding was associated with environmental issues being conceptualised as a form of market failure best addressed through market means. Similar thinking lay behind the INFFER system (Investment Framework for Environmental Resources) which used a quasi- benefit-cost analysis to determine which NRM issues should be funded (see for example Pannell *et al.* 2012). However, these simple output measures of success failed to recognise the complexity of natural systems although clearly they are an attractive method for bureaucrats who may have little understanding of landscape processes but a requirement or need to justify the disposal of funds.

Change Agents *(and historical methods)*

Given the ecological simplicity of farming systems it is perhaps not surprising that research and extension methods are also simple. Research in Farming Systems does not usually seek to develop new systems, merely to make minor adjustments to current practices. In addition a significant proportion of the research is focussed on addressing symptoms resulting from previous research e.g. soil acidity, chemical resistant of target species, nutrient management and salinity. Extension has historically been transmissive and expert-based and generally followed a pattern of taking research results and delivering them to landholders via demonstrations, field days and the development of mixed-media resources. The aims were loosely aggregated around changes in awareness, attitude, knowledge, skills and practice but often involved the extension expert demonstrating their technical expertise rather than measuring change or adoption. Interestingly there was little attempt to include the financial implications of adopting the research being promoted, rather it was accepted to be more profitable since it was generally assumed to lead to higher yields.

Government extension officers, essentially change agents, operating in agricultural areas have been traditionally production-focussed with little consideration for natural resource management other than where it impinged on production potential. Resource degradation has rarely been factored into production costs with natural resource management being seen as a separate issue within the domain of other agencies. This thinking results from the studies and management of agricultural production and natural resources residing in separate jurisdictions and being divorced in most governments, agencies and institutions. Organisational management and funding models have exacerbated this situation by promoting intra- and inter-agency/organisation competition for resources rather than collaboration. While there are some recent changes, for example the creation of Local Land Services in NSW tasked with the dual roles of agriculture and natural resource management, success will depend on the resulting bricollage, management and the capacity to overcome path dependency (the 'tendency for a past or traditional practice or preference to continue even if better alternatives are available' (Peters *et al*. 2012)). There is a need to acknowledge that amalgamating agencies, functions or institutions is not an easy task since social, ecological and organisational histories have management implications and consequences.

More recently, at least in NSW, extension has been through structured learning packages incorporating adult education techniques including contextual material, participatory learning, reinforcement and multi-sensory techniques (Edwards *et al*. 2005; Keys *et al*. 2006). In relation to landscape management the development of the LANDSCAN^{R} course was aimed to allow landholders to assess their natural resources, identify exclusions and limitations and strengths/weaknesses of their landscape and to prioritise their management actions to balance production, profit and sustainability (Orchard and Hackney 2016). However, in LANDSCAN^{R} and all other courses the emphasis was largely restricted to technical and biophysical aspects reinforcing the theme that in an agricultural context current NRM strategies are focused on increasing resource productivity measured on limited dimensions

(e.g. maximum sustainable yield) and limited objectives (e.g. increased production or better water quality) (Tyler 2008).

In his review of approaches to applied research and learning Tyler (2008) included Adaptive Management and Social Learning methods. Briefly, Adaptive Management is learning from experience with formal interventions or experiments to test hypotheses. The process is essentially an iterative cycle linking science to action with critical appraisal of outcomes against theory and expectations and often simply described as 'Plan, Do, Monitor and Review' (Allan 2007; Tyler 2008). There is a focus on framing problems and questions, and developing protocols for monitoring, assessment and evaluation (Norton & Recknow 2006). However, more recent developments have emphasised the use of models and the acquisition of data to predict outcomes. Increasingly, complex model development as a process has overtaken modelling as a tool to test hypotheses with stakeholders and clients again being marginalised by 'experts'. There are other concerns about this approach such as the modelling of large-scale systems from small-scale data, the inability of models to account for emergent properties of complex systems and the framing of problems as wholly technical with single answers. In many respects this reliance on modelling is also an example of managing a fire with a thermometer (see Elliot 1998 p256).

Adaptive Management was generally delivered to groups of landholders and in some respects was linked to Social Learning. Although Social Learning has no particular clear definition, the term is employed to learning by social aggregates (groups, organisations and societies) and individuals conditioned by social interaction (Tyler 2008; Swartling *et al*. 2010). In an NRM context it focuses on shared learning and may be linked to Adaptive Management in the problem definition stage. From a pedagogical viewpoint it represents a move away from the transmissive expert-based teaching which characterises agricultural extension (Cundill & Fabricius 2009) although experts often insert themselves into a facilitation role. Both Communities of Place and Communities of Interest can be designated as social learning groups (Fischer 2001) with greatest outcomes achieved when 'place equals interest'.

Certain Landcare and production groups may fall into this category. However, issues may arise through divergent interests of stakeholders and differences in expectations. Other problems may also be 'learning through the experience of others' where interpretation (of the experience) is subjective and 'data-free', and the need to recognise that the process is not deterministic and may be unpredictable and long-term.

Change methods *(Alternative complex models)*

While Adaptive Management is concerned with science/ecology and Social Learning emphasises human interactions, they both are still largely focussed on bio-physical aspects and technical solutions. As Walker *et al*. (2002) point out there is often a presumed ability that management outcomes can be predicted and that the manager is outside the system being managed. In contrast Resilience Theory posits that social-ecological systems such as agriculture and natural resource management are complex and unpredictable. Tyler (2008) proposed the Resilience Framework (Complex Adaptive Systems) as a means of addressing complex social-ecological systems that behave in a dynamic and cyclical fashion.

The major characteristics of complex systems include self-organisation (driven by feedback loops), non-linearity (threshold changes/on-off systems) and emergent properties (unpredictability). Change is the central feature rather than stability (cf. agricultural systems which are ecologically simple, where change is undesirable and external inputs are critical for 'stability'). The Resilience Framework (iterative phases of growth/exploitation, conservative, release and re-organisation) can be applied to a wide range of systems and organisations (Walker *et al*. 2004). These authors suggest that while the system dynamics of the growth/exploitation stage are reasonably predictable, during the conservative stage resources are increasingly locked-up and the system becomes less flexible. The capacity to absorb shocks is reduced and can lead to system collapse (release). The subsequent reorganisation may result in a system resembling the previous one or could be significantly different. Resilience thinking recognises change as essential for system well-being in

that it creates opportunity, strength and learning (Tyler 2008). The same author suggested that the features of resilient systems could be expressed as- redundancy is good, optimization courts disaster, diversity is critical and that managing for control and stability leads to turbulence and unpredictability.

While 'resilience' has been adopted as the new 'sustainability' word, grass-roots understanding is limited and the framework has yet to be widely captured as a means of delivering change. Partly this is due to there being no long-term target, no maximum sustainable yield and no 'ideal' situation, only a series of disturbances and short-term functional objectives. However, learning can result in 'managed' change in the sense that change is recognised as inevitable and while the specifics may not be predictable, promoting diversity and flexibility allows evolution in response to new drivers and situations. Some worthwhile insights may be gained from examining and understanding the drivers and impacts of historical change (Orchard & Orchard in press). One strategy, increasing the complexity of agricultural landscapes through enhancing (bio)-diversity, may realise benefits when certain levels of complexity are reached. For example, changes in insect spectra from pest to beneficial species have been recorded by increasing the floral density and duration.

Tyler (2008) suggested that there are common features of Adaptive Management, Social Learning and the Resilience Framework in that all three approaches are research based, use iterative learning and action, and need to engage multiple sources of knowledge across multiple organisations. However, in practice agricultural extension has rarely, if ever, been delivered using multiple sources of knowledge across multiple organisations.

The three methods all have elements of implied learning and behavioural change not only in the audience but in the 'delivery agents' too which may be undesirable in an organisational context. Organisations generally require conformity and predictability and are designed to resist philosophical change other than at a cosmetic level. However, given the inevitability of change, learning may be focussed towards

anticipation and improving adaptation processes i.e. change management. Incorporating strategic redundancy into organisations i.e. doing things/having features which may have no present value but can assist in future adaptation is not a characteristic of our present 'efficiency at all costs' organisations. All of the above approaches also require leadership and long-term commitment by organisations which, unfortunately, are generally characterised by having a narrow focus on short-term outputs.

A more recent framework noted by Tyler (2008) is Adaptive Co-management (ACM) that combines features of all the three previous approaches. ACM has recently been reviewed by Plummer *et al.* (2012) who suggested that the understanding of the process was imprecise, inconsistent and confused. Tyler (2008) saw the process as being characterized by an emphasis on long-term, collaborative institutional arrangements and shared learning and tasks across a range of scales. Key features include a shared vision and common focus; and distributed or joint control with a high degree of dialogue across multiple levels. The approach recognises many of the concepts of complex adaptive systems (multiple epistemologies, non-linearity) through to evolving institutional relationships characterised by flexibility, and iterative and ongoing interactions, including governance to support continual adaptation. The latter is challenging given legislative and sectoral mandates of agencies may be inflexible and even contradictory, and the potential non-alignment of institutional and organisational objectives.

Changing Systems (Threads to the future)

The National Climate Change Adaptation Research Facility has published Eight Principles of Adaptation Planning covering Social, Economic and Institutional Dimensions to guide the development of adaptation policy and the development of resilient systems *viz.* (i) Establishing shared responsibility for planning, (ii) being flexible, reflective and iterative, (iii) being consistent in messaging/messages, (iv) ensuring an equitable distribution of risk, (v) making trade-offs explicit, (vi) prioritising public goods, (vii) being mindful of greenhouse gas emissions, and (viii) recognising

that there are limits to adaptation (NCCARF AdaptNote- Theory, policy & practice in climate adaptation). While focussed on climate change these principles have the potential to be extrapolated across a range of situations.

Keath and Brown (2009) have listed and compared attributes of traditional and resilient urban water management regimes and these ideas can be extrapolated to landscape management (Table 1). There is clearly an assumed outcome of a more resilient regime using a systems approach with interconnections between a range of services being delivered to achieve multiple outcomes and benefits.

Increased resilience implies an adaptive capacity capable of responding to, and being prepared for, multiple future situations. Such systems are characterised by a level of "strategic redundancy" which contrasts with the historical management approach that has been towards optimisation for a 'most probable' future and hence potentially vulnerable to other future changes.

Table 1 Comparisons of traditional and resilient systems (modified from Keath and Brown 2009)

Attribute	**Traditional Regimes**	**Sustainable Regimes**
System Boundary	Maximum yield	Multiple purpose landscapes
Management Approach	Compartmentalisation and optimisation of single components	Adaptive, integrated, sustainable management of total system

Expertise	Narrow technical and economic focussed disciplines	Interdisciplinary, multi-stakeholder learning across social, technical, economic design, ecological spheres etc.
Service Delivery	Centralised, linear and predominantly technologically and economically based	Alternative, flexible solutions at multiple scales via suite of approaches (technical, social, economic, ecological etc.)
Role of public	Managed by government on behalf of communities	Co-management between government, industry and communities
Risk	Risk regulated and controlled by government	Risk shared and diversified via private and public instruments

Summary/key points so far

-Entrenched attitude that humans are independent of nature and/or that we can control nature;

-Landscape changes are driven by politics for economic outcomes under a social licence;

-Governments, landholders, agribusiness, industry bodies and research/extension staff have invested in the current system and are locked-in to it;

-The rate and trajectory of resource use highlights that a change in management is required;

-Research and extension responses to change are biophysical/technological and generally characterised by a ‘silo’ mentality;

-'The visual symptoms of (poor) land management are biophysical in nature and measured as financial consequences. Symptoms become the problem and biophysical solutions are sought. In most respects nothing changes- the land management system(s) remain in place and the underlying problems continue'.

What needs to change?

At present we operate on the limited equation of natural capital equals economic/financial capital. The role of science is to facilitate and increase the efficiency of the process with little attempt being made to make fundamental or transformative change or to consider incorporating human, cultural, social, and the diversity of knowledge capitals available. Hence, our current landscape management strategies are heavily dependent on technical solutions although the problems are driven by policy decisions for economic outcomes. Any move toward sustainability needs to recognise that the issues are not solely biophysical but much wider and should incorporate disciplines other than science. Indeed, Elliott (1998) notes that the role of the scientific community in environmental governance is not without scrutiny and cites Gudynas (1993) who highlights the *'scientific superiority complex' where scientists have claimed for themselves a mandate to 'determine the viable management of nature' by which the construction of environmental problems as 'strictly scientific and technical' serves not only to marginalise the social and political connotations of environmental degradation, but as a consequence privileges scientific knowledge and the scientific community.* Additional limitations to the sole reliance on scientists are given by Acheson (2006).

In his book 'Consilience' (consilience being defined as 'jumping together' of knowledge that leads to cross-disciplinary linkages and a common groundwork of explanation) Wilson (1998) suggests that there is a fundamental difference between scientists and scholars in the humanities in that the former make discoveries and create new knowledge while the latter usually interpret and explain existing knowledge. However, Bodin *et al*. (2011) suggest it is getting more difficult to justify a dichotomy between social and natural systems due to the intimate connections

between the biophysical environments and human health, the economy, social justice and national security.

Peters *et al*. (2012) highlighted that innovation is driven via interactions between diverse stakeholders (see also World Bank 2012) and hence innovation in sustainability, biodiversity and resource management needs a much broader base than biophysical science. As William and Saunders (2005) and Harris (2007) note, technology, data and information are only part of the story. Translating knowledge into policy or action depends on collaboration and communication between agencies, as well as social and economic considerations and even the values and beliefs of individuals. Harris (2007) also added that an understanding of ethics, values and context was required to establish a creative collaboration that linked science, governance, industry, the media and the community. Wilson (1998) was more emphatic in stating that we need to understand the fundamental principle that 'ethics is everything'.

Who needs to change?

McMichael *et al*. (2003) urgently called for a more integrated and consilient approach to sustainability if a collective vision was to be achieved. They suggested that the key disciplines were demography, economics, ecology and epidemiology but recognised that other social and natural sciences, engineering and the humanities needed to be engaged. McMichael (2005) later suggested that some mainstream disciplines failed to recognise that human sustenance, environmental stability and the flow of materials and services from nature were essential to good health, survival and social advance. He added that while recent 'thinking and attitudes to health saw it as a matter of individual choice, behaviour and access to health care', it was 'population shifts in human culture, technology and environmental demands that throughout history have altered the patterns of well-being, disease and survival'. It is apparent that the confused thinking on the management of natural resources regarding the ability to distinguish between cause-effect and problems-symptoms is embedded in many behavioural areas.

In essence substantial changes in societal attitudes to NRM and the social licence that allows present resource management practices to over-consume are required. Wilson (1998) called for students to understand the relationship between humanities and science and bemoaned the fact that only a minority of humanity students (30%) in the US were made to take a natural science course. However, it is likely that fewer science students take courses in humanities. There is a need for all of us to examine what we do and how we instil sustainability into our actions, teaching and learning and not just as a theoretical or academic exercise (McMichael *et al*. 2003). These authors suggested that purpose built institutions would be needed to encourage inter- and trans-disciplinary approaches to sustainability in order to overcome the constraints of traditional disciplinary domains and concepts. Ten years later Kauffman (2014) wrote that 'academic institutions in this century have increasingly devoted resources for multi-disciplinary and cooperative research programs to analyze complex problems from multiple perspectives'. Kauffman (2014) further indicated that '*as sustainability science has evolved, it has become increasingly integrative and trans-disciplinary integrating knowledge from multiple disciplines social, economic, and engineering sciences as well as local indigenous knowledge to develop robust solution-options. In consciously seeking to become more holistic, the community of sustainability scientists works with a plurality of epistemologies, languages, styles of research, and experience that lead to a variety of epistemic and normative stances and methods. The trend towards more holistic approaches to research for sustainability is reflected in the academic community's support for international negotiations to deal with the challenges of sustainable development and in a growing number of academic programs and scientific literature focused on sustainability issues'.* However, it is questionable as to whether this has made any significance difference in social, political or economic attitudes. On a global level much of the debate on reversing environmental decline has often been at the rhetoric level (Elliott 1998).

Who can change?

It may be both unnecessary and unproductive for 'purpose built institutions' to be created since these have the potential to become isolationist, elitist and irrelevant and merely set up new bureaucracies' and hierarchies. Such initiatives also assume that the problems associated with our use of resources and landscapes are unknown rather than the more pressing need to show the depth and breadth of existing problems, gain societal recognition and acceptance of these and implement change. In a similar vein Acheson (2006) suggested that natural resource management required effective institutions and discussed the options of managing through private property, central government or local level. However, there is an initial and urgent step of gaining recognition that intervention and management is required.
It is unlikely that initiatives will come from government or its agencies as these are focused on 'hip pocket' issues, short-term time frames (election cycles) and expediency. Exceptions to this are the Australian government funding of multi-organisation Co-operative Research Centres or The Climate Change and Adaptation Research Facility, although again there are questions about the degree of external (societal) impact and the limited range of disciplines included.

The expressed need for involving many disciplines indicates that the educational system in general and universities in particular should be at the forefront of change. Importantly their role is to develop leaders in society and hence the large influx of graduates into the workforce annually could have potentially wide-ranging effects. While sustainability should be a key element and embedded principle of all disciplines it is through trans-disciplinary initiatives that the greatest benefits will be realised as opportunities arise to share visions or achieve a shared vision. Dialogue should develop new ways of engagement and create new approaches, knowledge bases and epistemologies. Planning also requires us to think in much longer time frames. Usually we start in the 'now' and ask 'what's possible?' which invariably defaults to discussing what's not possible. The focus question is what should be?

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