Community-Based Research: An Opportunity for Collaboration and Social Change

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COMMUNITY-BASED RESEARCH:

An Opportunity for Collaboration and Social Change

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ABSTRACT

Natural resource managers are facing increasing challenges as environmental degradation accelerates and the need to integrate a broad spectrum of community experiences into management decisions is increasingly recognised. To help meet these novel challenges, this study explores how professional researchers and communities can combine their skills and learn to work in partnerships to achieve shared management goals.

Community-based research involves people as citizen scientists, whereby citizens actively participate in research on local issues. The inclusive nature of community-based research has the ability to produce auxiliary benefits uncommon in conventional research. These include the development of social capital and social learning as the practice of citizen science empowers communities with new skills, knowledge and social networks, thus building capacity within communities to take an effective role in natural resource management. Community-based research also has the potential to enrich the range of management options available by increasing the breadth of accessible knowledge. However, despite much rhetoric about democratising science, little is known about the practice, value and problems of involving citizens as collaborators in natural resource management research projects.

This thesis presents the findings from a comparative survey of the attitudes to community-based research held by 'citizen' scientists, on the one hand, and 'expert' scientists and natural resource managers, on the other. It also draws upon a multi-site case study, set in a diverse urban-rural catchment, where an integrated research program was established for different natural resource management agencies to work with each other and community groups to develop research protocols so that community groups could participate in assessing the health of catchment areas. This involved scientists, natural resource managers and community education/extension officers working with established community groups to develop and trial modified scientific methods for the environmental monitoring of catchment and estuarine areas. This inter-agency/community project was continued as a case study site into the second and third years of research and was augmented in the second and third years by focusing on two of the initial community groups as second and third case study sites in their own right.

Synthesis of both survey and case study analysis reveals that, despite resource and attitudinal barriers, community-based research can ensure access to local knowledge and increased relevance of research. In addition, many participants most valued the increased feeling of connection towards their local environment and community. I argue that citizen/expert collaboration is key to successful community-based research and best achieved in an atmosphere of mutual respect where all participants are seen as *co-researchers*. However, participatory intentions are unlikely to be acted upon without sufficient opportunity. Thus, the process of research must be re-defined from that associated with positivist science to include a greater range of participants and activities in an adaptive manner. This more inclusive and reflective approach seems most likely to ensure the quality and utility of research data, the knowledge sharing and social learning, and the enjoyable atmosphere that underpin successful citizen/expert interactions. Certainly, the ability to draw upon and create social capital is vital.

The integration of these findings enabled the development of guidelines for effective collaboration between citizens and experts when addressing catchment management issues and undertaking participatory research.

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STATEMENT OF ORIGINALITY

This work has not previously been submitted for a degree or diploma in any university. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference in made in the thesis itself.

Signed:

Chapter 1

COMMUNITY-BASED RESEARCH

Introduction

1.1 BACKGROUND

The aim of this study is to investigate the nature of community-based catchment research in Australia. It focuses upon the role of citizens in science and decision-making as an essential part of catchment management in a civil society. Certainly, catchment managers are facing increasing challenges as water quality and availability declines and the need to integrate a broad spectrum of community experiences in management decisions is increasingly recognised. To help meet these novel challenges, this study explores how professional researchers, agency representatives and community members can combine their skills and learn to work in partnerships to achieve shared management goals.

A catchment is an area of land drained by a creek or river. Catchments are bounded by a watershed that separates water flowing in one catchment from that which flows in another. Because they represent a physically defined and integrated area, catchments are increasingly utilised as land and water management units. Human societies overlay these bio-physical systems and both are sustained by water flows. Indeed, all people that live on land live within a catchment and their daily activities influence the quality and quantity of the water flows (Australian Water Association, 2002).

Traditional catchment management has viewed water as a natural resource with a focus on its quantity and quality for human consumption. Thus, catchment management has been the domain of natural resource managers and scientists (experts) [see Chapter 2]. While there is evidence to suggest that the interaction between science and management is limited (eg Smith *et al.*, 2001), together these people represent what Chambers (1997:3) described as the 'upper system' of actors within a society. These are the people we have provided with the status and resources to ensure catchment health on our behalf. Their decisions and actions influence the lives of those in the 'lower system' of local people (citizens) (Chambers, 1997:3). Increasingly, however, this utilitarian and representative model of resource management underpinned by an exclusive reliance of positivist science as a way of knowing is proving unsustainable.

Freshwater is vital to human survival and the sustainability of the planet as a whole. Yet, throughout the world we live in such numbers and with such behaviours that millions of people are water impoverished and water tables are being lowered on every continent (Brown 2000). Freshwater (which amounts to less than one half of one percent of the world's total water stock) is being diverted, depleted, and polluted so fast that according to Barlow (1999) by the year 2025, two-thirds of the world's population will be living in a state of serious water deprivation. Brown argued that unless sustainability is embraced in catchment management these water shortages are set to become food shortages.

In Australia, the degradation has reached a point where The Standing Committee on Environment and Heritage (2000) cited the decline in the health of freshwater ecosystems (catchments) as one of Australia's most pressing social and environmental problems. National water audits released in February, 2001 revealed that more than a quarter of all our rivers and creeks are severely stressed and unlikely to keep pace with the increasing demands for water (Commonwealth of Australia 2001). More than 26 percent of rivers, streams and creeks had unsustainable amounts of water extracted from them, while an additional 30 percent of groundwater supplies were also being over-used (Commonwealth of Australia 2001).

Recognition of the human factor in catchment degradation and our undeniable links with the natural world has led many authors (eg Beck, 1992; Berkes & Folke, 1998; Agyeman & Evans, 2002) to emphasise the social nature of 'resource' management and the central role of people in 'environmental' issues. Indeed, we are still forming our relationship with the landscape and with each other (Dovers 2000). Consequently, there are calls for more integrated and participatory approaches to catchment management and research [see Chapter 2]. The integration of science and management has been achieved in some instances through the use of adaptive management, an approach to research that treats management interventions as experiments (see Lee, 1999). There is no standard model of adaptive management because management processes are determined by the particular context and setting [Iles, 1996 #270]. This represents a significant change to the way science and management are conducted and a move away from the notion of permanent solutions and objective truths towards a more dynamic and unpredictable reality. However, there is consensus that adaptive management still does not meaningfully involve the wider community - the catchment citizens (Johnson, 1999).

Fischer (2000:1) defined citizen participation as 'deliberation on issues affecting one's own life'. Similarly, Aristotle regarded a citizen as 'one who participates in power' (cited in Norris, 2001:307). Participation lies at the heart of democracy and notions of a civil society where the 'ultimate source of legitimacy lies with the citizen' (Ulrich, 2000:247). Participation takes many forms and can include everything from compulsory voting to community-based resource management (Dovers, 2000). Consistent with Aristotle's notion of a citizen, Arnstein (1969) argued that participation should be evaluated in terms of the power that is redistributed from agency to community. Her 'ladder of participation' illustrates that that participation strategies can range from 'manipulation' to full 'citizen control'. There is increasing evidence that many people are seeking full involvement and are not content to be consulted or involved in activities which they see as merely political exercises (Jackson 2001:136). Building on this emphasis on active and empowering forms of participation, and the need to form a closer relationship with our environment and fellow citizens, the focus of this thesis is participation in community-based research.

Community-based research is a variant of participatory research that explicitly acknowledges the need for active participation and the central role that must be played by the local community. In the context of this study, a community may be seen both as a geographical location *and* a societal space where citizens and experts can exercise their democratic rights and contribute to decision-making about the kind of society and environment they desire [Chapter 2]. Thus, in the catchment context, community is an inherently local concept. Community-based research has the potential to involve people as citizen scientists, whereby citizens actively participate in research concerning local issues. Whilst some definitions (see Chapter 2) state that community-based research can be conducted on behalf of the community, this study assumes as Foster (2002:39) that research *for* the community means exploring *with* the community in 'learning partnerships'.

Consequently, citizen science (see Irwin 1995) represents a partnership between community members and professional or 'expert' scientists (Pandolfi, 1999). Indeed, Sclove *et al* (1998) contend that collaboration between citizens and experts is one of the defining features of community-based research. In the context of this study it is based on several assumptions including the existence of a civil society, scientific relevance, citizen and expert equality, and individual responsibility for sustainability issues (Irwin, 1995; Ulrich, 2000).

Community-based research is often associated with public health issues (eg Sclove *et al.*, 1998). However, the links between environmental health and public health are becoming increasingly obvious (eg Neller, 2000) and reinforce that this is an appropriate approach for catchment issues. Certainly, Sclove (1997) stated that this is a democratic and community-grounded strategy that serves a community's interests, and encourages citizen participation at all levels.

There are several pragmatic and conceptual barriers to the involvement of citizens in science including the need for highly specialised and complex knowledge (Irwin, 1995; Ulrich, 2000), lack of an effective democracy (Saul, 1992), and limited community access to resources and time for volunteer activities (Carr, 2002). In addition, 'the community' is often used as a derogatory term where citizens in local communities are perceived by expert scientists as ignorant or irrational (Martin & Beder, 1993). Consequently, Davis (2001:3) noted a 'stigma' related to citizen data whereby measurements taken by volunteers and landowners are deemed to be 'deficient'. Indeed, despite much rhetoric about democratising science (eg Raloff 1998), relatively little is known about the practice, value and problems of involving citizens as collaborators in natural resource management research projects.

With regard to these advantages and limitations, this study explores how community-based research can be utilised to integrate the ideals of adaptive management and public participation in the form of citizen science. It examines the potential of citizen scientists to work with expert scientists and natural resource managers in improved research and management outcomes for catchment areas within Australia. A major concern is how local communities can mobilise themselves for collective action and equip themselves to make sustainable difference with the knowledge that they gain or hold already.

In essence, this concerns community-capacity building and involves developing the skills and confidence of citizens and experts to engage with each other in solving catchment issues. Part of this may involve what Ulrich (2001) termed 'core competencies', a suite of skills that citizens and experts must share if they wish to participate as equals in natural resource management. Indeed, social learning is an important aspect of capacity-building and interaction. Citizen competency can also be related to the concept of social capital - the societal 'glue' that binds us together as a cohesive society (Potapchuk *et al.*, 1997). Understandably, enhancing positive social capital is important in solving problems of collective responsibility. The attributes and mechanisms of social capital and social learning towards increased community capacity for participation in catchment research and management are discussed.

1.2 FOCUS OF THE STUDY

The central research questions of this study stem from the need to understand the nature of community-based catchment research as a social process embedded in a wider societal and resource management context dominated by professional scientists and resource managers (experts), and also as a local community (citizen) pursuit. The questions seek to understand the perceptions and experiences of community-based research from citizens and experts that work on catchment issues.

In this study the experts are members of the Cooperative Research Centre for Catchment Hydrology and the Cooperative Research Centre for Coastal Zone, Estuary and Waterway Management. Members of these research centres represent a range of scientists and resource managers from government agencies and tertiary academic institutions concerned with natural resource management (see Chapter 4). The citizens in this study are members of Waterwatch Australia and also Landcare groups that conduct Waterwatch activities (see Chapter 4). I focussed upon activities and participants located in or near the six focus catchments encompassed by the Catchment Hydrology and Coastal Cooperative Research Centres (Port Curtis, Fitzroy, Murrumbidgee, Goulburn-Broken, Yarra and Brisbane). Bounding the study in this way ensured a manageable number of participants and helped to establish a consistent framework for ease of comparison.

The social nature of catchment issues articulated in recent literature (eg Beck, 1992; Agyeman & Evans, 2002) led me to questions that were initially broad in scope as I sought to describe the perceptions and characteristics of citizens and experts involved in catchment research and management. I began with the following question to set the scene for the remainder of the study and to direct subsequent inquiry:

- How do community group members, scientists and agency professionals perceive the nature and purpose of community-based research in catchment management?

The second group of questions were at a much more local and personal level in an effort to understand in a more detailed manner the perceptions revealed by the initial questions. The major question was:

- What is the nature, purpose and outcome(s) of community-based research in selected case studies?

The third group of questions were designed to make explicit links between the wider societal context and the local or individual situation. The overarching question was:

- What aspects of community-based research influence social and environmental outcomes?

In establishing and understanding these connections the final question centred on guidelines for appropriate citizen/expert interactions in achieving catchment health. I asked:

- How can community-based research be utilised in environmental decision-making in a manner that optimises community and scientific/institutional involvement to achieve both social and environmental benefits?

1.3 RESEARCH APPROACH

The research questions of this study begin by establishing a relationship between citizens and research in catchment management and the relationship between citizens and experts as a part of this. These questions concern large-scale, structural features of social life (Patton, 1990). Subsequent research questions address the smaller-scale effects of this wider context at a local level. The combination of large and small-scale research questions and the aim to both establish and explore the relationships between these variables necessitated the need for both quantitative and qualitative methods. Having considered the characteristics of the positivist, interpretive and critical research paradigms (see Chapter 3) I decided to locate the study within both the positivist and interpretive research paradigms. The combination of these research paradigms may seem contradictory, however there is an increasing number of authors who state that this combination is complementary and can lead to a strengthened study (eg Jick, 1983; Chih Lin, 1998; Punch, 1998).

The study is conducted in four main phases. The first phase seeks to describe and understand the macro-context of community-based catchment research within the study areas. This involves an initial exploratory and qualitative phase to ground a large-scale quantitative survey questionnaire within the experiences of specialist scientists, resource managers and citizen scientists. The survey approach was utilised to highlight issues important to all groups and to provide a general understanding of, and context for, community-based catchment research.

The second phase aims to describe and understand the local and personal nature of community-based catchment research in a multi-site case study. This phase begins by concentrating on an inter-agency/community project and extends to studying two of the community groups from this initial project in more detail. I choose the interpretive approach to make sense of and to explore the emergent social issues within the case studies because this approach can 'uncover important parts of our humanity we lose in objective inquiry' (Keliher, 1994:6). In this sequence the case studies were informed by, and complementary to, the initial survey.

The third phase represents a synthesis of the survey and case study data so that the advantages of combining these distinctive approaches may be realised. This was the data interpretation phase of the study and was conducted using critical reflection. In Chapter 3 this is described as an iterative process where I cycle between the different sources and types of data to enhance my understanding. The fourth phase is the conclusion to the study and involved theorising from the case studies and wider Australian-global context indicated by the survey and literature review.

1.4 SIGNIFICANCE OF THE STUDY

This study is significant for several reasons that I have alluded to in providing a background for this research.

First, this study acknowledges that there is much rhetoric surrounding the democratisation of science (eg Raloff, 1998) and the transition to more participatory modes of science (eg Nowotny *et al*., 2001). There is little analysis of how citizens may be involved as on-going collaborators in research projects particularly in urban areas and so-called developed nations such as Australia (see Flower *et al*., 2000). In 'developed' nations the recent trend towards public participation tends to emphasis approaches that deal with discrete and specific issues (eg citizens' juries, science shops etc). There is minimal effort towards approaches that can cement continuous and lasting partnerships between different societal sectors. Indeed, much of the literature on participatory research stems from developing countries in rural settings (eg Gill, 1991; Chambers, 1994; Pretty, 1998). To understand how the successful principles of participatory research can be applied in developed and urban or semi-urban settings, this research deliberately focuses upon sustained and collaborative efforts by community groups linked to expert assistance within Australia.

Second, this study aims to describe and characterise the demographic nature of citizen and expert participants from two key societal groups that focus their efforts upon catchment health. While such studies of participants in community environmental groups have been conducted in the United States (eg Weber, 2000), little analysis has been conducted in Australia. The characterisation of the co-ordinators of Waterwatch groups compared to their counterparts in expert institutions gives this study a unique insight into the abilities of participants and the potential for collaboration. In this way, the study can also provide a quantitative basis for evaluating any perceptions that may be revealed or that emerge from literature regarding the nature of participants in community-based research.

Third, the study combines both quantitative and qualitative data regarding the nature of community groups. While much research has focussed on the quantitative outcomes of these groups in Australian natural resource management (eg Curtis *et al*., 2000 and http://www.nht.gov.au/overview.html) little qualitative research has been conducted. Thus, this study addresses a critical need for a qualitative understanding of the issues facing these groups and the factors affecting group effectiveness identified by Curtis *et al*. (2000). The more comprehensive understanding of why certain issues arise and the processes that precede certain outcomes should offer an improved basis for recommending practical solutions.

Finally, the combination of quantitative and qualitative approaches can provide depth to arguments that state that community-based research contributes towards social quality. Indeed, the qualitative description and analysis that is an integral part of this study can be utilised to construct a detailed account of social benefits to individuals and groups that cannot be measured or captured as vividly by quantitative methods alone.

1.5 OVERVIEW OF THESIS STRUCTURE

Chapter 2 provides a review of the literature related to this study. It includes both theoretical and empirical literature from the fields of knowledge management, natural resource management, public participation, environmental education, and social capital to establish a framework for evaluating the nature and role of community-based research in catchment issues. The review begins with an overview of the many social and environmental challenges facing humanity and then analyses traditional positivist (representative) and more recent post-normal (participatory) methodologies for solving such complex issues. Community-based research is explored as an example of participatory research with particular attention paid to its ability to create social capital and to build more sustainable communities. I also discuss the role of the individual practitioner and researcher to ensure a more meaningful review than that based wholly on the more abstract notion of differing methodologies and paradigms.

Chapter 3 outlines the research methodology, methods and techniques used in this study. The combination of both qualitative and quantitative methods is explained to validate the findings of the study and to establish trustworthiness. This chapter also describes the four phases of data collection and analysis including a targeted survey, a multi-site case study, synthesis of quantitative and qualitative data gained at macro and micro scales, and theorising from the study to produce guidelines for citizen/expert interaction in catchment research.

Chapter 4 provides a contextual overview of Waterwatch Australia, the Catchment Hydrology Cooperative Research Centre and the Coastal Zone, Estuary and Waterway Management Cooperative Research Centre. This overview is designed to provide a basis for understanding and interpreting the survey and case study data generated from my research with these organisations.

Chapter 5 and 6 present the findings of the study. Chapter 5 reports on the quantitative survey and describes the macro-context of community-based catchment research in Australia. This is augmented with qualitative data also gained through the survey process. Results are presented in graphical and tabular formats and enable a comparison of citizen and expert perceptions of community-based research and several demographic characteristics of citizens and experts involved in catchment research. Chapter 6 is an interpretive presentation of the citizen and expert experiences of community-based research within the multi-site case study. The findings of this section are expressed in the participants' own words as much as possible whilst retaining their anonymity.

Chapter 7 is the synthesis phase of the study and critically reviews the findings of Chapters 5 and 6 in light of the relevant literature. This Chapter seeks to understand the study results and to make clear the links between the macro and micro contexts of community-based research in catchment management.

Chapter 8 is the conclusion of the thesis. It centres on the nature of community-based research in an Australian catchment context, the role of citizens and experts in catchment research, the barriers to community-based research and citizen/expert interaction, and the outcomes of citizen participation in collaborative research. It also presents the implications and recommendations that flow from this research including the need for increased interaction between societal sectors and leadership in catchment management.

Chapter 2

COMMUNITY-BASED RESEARCH

A Literature Review

2.1 INTRODUCTION

This chapter presents a framework for viewing community-based research as one viable solution to the many current social crises that often manifest themselves as environmental crises. The framework is developed in three phases and draws upon relevant literature from both the natural and social sciences. The first phase identifies the social and environmental challenges that face humanity and points towards the underlying causes of the current patterns of social and environmental disharmony. The second phase analyses new paradigms that have emerged with the realisation that traditional methodologies for producing problem-solving knowledge and action have not been successful in ameliorating the crisis. Beginning with 'positivist science' and following the transition towards 'adaptive management' and the emerging practice of 'citizen science', these approaches are analysed to determine the approaches with the most potential to improve the conditions for sustainability. The last phase reviews community-based approaches to research and decision-making and the various discourses and assumptions that these approaches embody. Community-based research is also analysed with respect to its ability to create social capital and build more sustainable communities.

Throughout this sequence from positivist science to community-based research, which is by no means linear or meant to imply that these are mutually exclusive approaches, there is a special focus on the individual practitioner or researcher. This involves understanding the rise of the 'scientific expert' and then explaining the contrasting 'reflective practitioner' approach. The reflective approach is indicative of a paradigm shift in the production and distribution of knowledge through collective and social learning for sustainability.

The debates over sustainability are complex and have implications for all environments and sectors of society. This study focuses on catchment environments and is therefore primarily concerned with issues of water quality and how our approach to research impacts upon these environmental systems and, in turn, our social systems.

2.2 SOCIETAL CHALLENGES IN THE NEW MILLENNIUM

Recent reports on the state of the environment attest to the fact that key ecological systems are in decline.[1] For example the Arctic ice cap has thinned by 42 %, the coral reefs have been reduced by 27 % and the rainforests continue to be cleared at an alarming and unsustainable rate (Brown *et al*. 2001). However, freshwater ecosystems are the most impacted. Freshwater ecosystems cover only one percent of Earth's surface. Yet, they have lost a greater proportion of species and habitat types than any other land or oceanic ecosystem (Sustainable Development Information Service (SDIS), 2000). The serious nature of this loss is highlighted when we consider that fresh water is central to many ecological processes, is vital for human life, and has no substitute (Freeman and Ray, 2001). Discrete freshwater ecosystems are termed catchments.[2] The Australian Standing Committee on Environment and Heritage (2000) observed that evidence emerges on a daily basis to indicate that the environmental health of Australia's catchments is substandard. Salination is just one serious manifestation of this problem, which affects both land and people. For example, 5.7 million ha of farmland, 20,000 km of main roads and 1600 km of railway are at risk of being salt ravaged (Standing Committee on Environment and Heritage, 2000).

The degradation of major ecological systems has also led to an increasing number and severity of natural disasters.[3] Moreover, the global nature of the effects of these seemingly localised issues means that no one is immune. Thus, catchment degradation affects all Australians and is the individual responsibility of all citizens (Standing Committee on Environment and Heritage, 2000). Environmental degradation is expensive

[1] See UNEP 2002, WWI 2001, WRI 2001 – Millennium ecosystem assessment, and WWF 2002.
[2] See Chapter one for a definition.

and has cost the world $608 billion over the last decade - as much as the previous four decades combined (Brown *et al*. 2001). Within Australia, a report released by the Prime Minister, estimated that the annual cost of land and water degradation is $3.5 billion per annum, excluding the cost of pests and weeds (Howard 2000). Indeed, the Standing Committee on Environment and Heritage (2000) argued that:

> It is not overstating the matter to say that the ecologically sustainable use of Australia's catchment systems is the most pressing contemporary public policy issue facing the community (p.1).

In addition to these dramatic costs, our current ways of life and ensuing ecological degradation threatens many species with extinction on a daily basis.[4] The detrimental effects of modern life are no longer confined to sensitive species, the great apes or even frogs and amphibians, as many people are now equally threatened. In the global context the threat to human welfare is illustrated by Worldwatch reports that state over 1.2 billion people lack access to clean water (Worldwatch Institute 2001). This situation is recognised within Australia by the Standing Committee on Environment and Heritage (2000):

> All these problems impose additional and unavoidable costs upon the entire community. Those costs are not only financial, such as the cost of repairing the damage or the cost of lost production, but a social cost, as our rural communities lose viability and quality of life in our urban and rural communities is degraded (p.2).

Nonetheless, some people are incomparably richer than ever before through an unprecedented control over resources, knowledge and technology (Sen 2001:11). Globalisation causes power differentials where a small minority of economic actors wield great control over markets, technologies, policies and institutions (Pimbert, 2001:82). These inequities ensure that any benefits are out-weighed by increasing social crises introduced earlier. For many this includes the prevalence of preventable illness, needless hunger, premature mortality, unceasing illiteracy rates, social exclusion from decision-making processes that affect ones life and the denial of political liberty (Flower *et al*. 2000; Sen 2001). Consequently, many academics and practitioners [eg. Agyeman (1989), Fyfe

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[3] Disasters in freshwater ecosystems are likely to be particularly acute given that most inland cities are located on the banks of a river or lake (SDIS 2001) and that freshwater is a basic human necessity (World Resources 2000-2001).

[4] A report by the Sustainable Development Information Service (SDIS) reveals that current extinction rates are 100 to 1,000 times greater than experienced in pre-human times (SDIS, 2000. Global trends. URL: http://www.wri.org/trends/index.html accessed on 28/05/01).

(1999) and Sen (2001)] have conceded that today's world is one distinguished by marked differences in the wealth and quality of life among its inhabitants. Indeed, Nobel prize-winning economist, Amartya Sen, argued that the world is both 'remarkably comfortable' and at the same time 'thoroughly miserable' (Sen 2001:11). Furthermore, Bauman (1991) observed:

> That things are bad is not news: for a great many people things used to be bad at the best of times. What is truly new is that things that are bad for some people are seldom a worry for those for whom things are good. The latter have accepted and declared that there is little they can do that may improve the lot of others (p. 258).

This situation, coupled with the power inequities of globalisation, helps to explain the disparity between the magnitude and severity of environmental problems and the political will and action to solve them. Indeed, the rise of powerful transnational corporations means that 'the power to define reality rests less and less with governments and professionals' (Pimbert, 2001:82). Thus, the Worldwatch Institute (2001) has highlighted that as ecological decline accelerates, the political will to solve these problems is actually decelerating. Similarly, Ticknell (1993) stated that he 'has optimism of the intellect but pessimism of the will. In short, we have most of the means for coping with the problems we face, but are distinctly short on our readiness to use them' (quoted in Fyfe, 1999:182). Such apathy threatens the progress already made on environmental issues and provides a bleak outlook for future initiatives (Worldwatch Institute, 2001).

Berkes and Folke (1998) state that ecological systems and human systems are interconnected parts of the same system. They contend that ‘resource management’ is as much about people as it is about the management of resources (Berkes and Folke 1998:2). In addition, the political ecology literature indicates that social poverty is a major cause of environmental degradation (Bryant, 1992; Thrupp, 1993; Peet & Watts, 1996). Similarly, Agyeman and Evans (2002) have observed that:

> Wherever in the world environmental despoliation and degradation is happening, it is almost always linked to questions of social justice, equity, rights and people's quality of life in its widest sense (p.5).

Thus, environmental quality is inextricably linked to human equality (Agyeman and Evans, 2002). Consequently, sociologist Ulrich Beck (1992) has asserted that:

> Environmental problems are not problems of our surroundings, but in their origins and through their consequences - are thoroughly social problems, problems of people…nature is society and society is also nature (p.81).

Therefore, 'either we support the sustainability of the health of both people and the global environment or we will have neither' (Brown 1996, quoted in Neller 2000:90).

Agyeman and Evans (2002) have explained this causal link by analysing three related dimensions of social and environmental problems. The first is that societies with high levels of citizen equality (demonstrated through a more equal income distribution, greater civil liberties and political rights, and higher literacy levels) tend to have higher environmental quality (lower levels of air and water pollution, access to clean water and effective sanitation) than those with low levels of citizen equality. Their review of several studies found this to be true at both global and local levels. The second dimension to note is that environmental problems are felt disproportionately by the poor who are less able to afford options that avoid environmental degradation. In addition, Agyeman and Evans (2002) highlighted that this unequal distribution of 'environmental bads' is made more unjust by the fact that the poor are not the major polluters. Most environmental pollution and degradation is in fact caused by the more affluent sectors of society and the wealthy nations (Agyeman and Evans, 2002). The third dimension concerns sustainable development, in which Agyeman and Evans (2002) have placed emphasis on increased equity as 'a desirable and just social goal'. They believe that unless this is achieved, sustainability, which depends upon changes to high-consumption lifestyles and careful use of scare resources by all, is unlikely. Unfortunately, they concluded that:

> It will not be easy to achieve these changes in behaviour, not least because this demands acting against short-term self-interest in favour of as yet unborn generations and 'unseen others' who may live on the other side of the globe. The altruism demanded here will be difficult to secure, and will probably be impossible if there is not some measure of perceived equality in terms of sharing common futures and fates (p.6).

In light of the enormity and universal nature of environmental and social problems and our current unsuccessful reliance on technological, political and bureaucratic systems to solve them - a solution may reside in that often quoted, yet seldom applied, slogan 'think globally, act locally'. This slogan suggests that action must be collective before social change can occur and that such action must be initiated within local communities. As Neller (2000) and King and Hood (1999) have observed, local action is most likely because it is within local communities that the intrinsic links between individual quality of life, community well-being and ecosystem sustainability are most obvious and vital. In addition, solving such inseparable problems in a sustainable fashion requires *all* people to be educated and given the tools to understand humanity's 'life support systems' (Fyfe, 1999:182). Thus, there is a need for a 'genuine learning society' Foster (2002:39) where reality is constructed 'by and for citizens' (Pimbert, 2001:82).

However, critical education and universal knowledge distribution such as that advocated by Fyfe (1999), Pimbert (2001) and Foster (2002) do not appear to be common practice. For example, Richard Sclove of the LOKA institute has written about the production of elitist knowledge in research and decision-making. This knowledge remains privy to a select few and wittingly or unwittingly helps to maintain their privileged positions in society (Sclove, 1997). Sclove (1997) argued that this is one way that societal differences between people are sustained and emphasised. Similarly, Kamminga (1995) has highlighted the need to question the kinds of knowledge that we produce because this determines the power relations that we support and the kind of world that we live in. Following the arguments of Kamminga (1995), Fyfe (1999), and Sclove (1997), the scientific research approach may be seen as antithetical to the quest for sustainable solutions. Indeed, Sancho Gil (2001) has cautioned that:

> We should not forget physical laws. Very unbalanced systems do not last forever (p.392).

Harding (1998) also argued that even the most sophisticated scientific knowledge is inadequate by itself - the commitment of all citizens to sustainability is equally important. A socially responsible science must be integrated within and not apart from other human endeavours (Kamminga, 1995). Through our interactions, everyone is involved in the production of worldly knowledge and there is no single group of experts (Kamminga, 1995). Therefore, a major consideration in environmental and social sustainability concerns how local communities can mobilise for collective action and equip themselves with power necessary to make sustainable difference with the knowledge that they gain or hold already.

Foster (2002) proposed that such a strategy for sustainability involves social learning in a manner that advances society and not just individuals or collectives. Consequently, it requires society to be 'culturally mature as well as institutionally sophisticated' (Foster 2002:39). To enable this, Foster (2002) argued for a 'social intelligence contract' expressed through a relationship between education and other key social institutions. This would involve the effective disappearance of the distinction between people's working and learning lives and also a commitment to a learning model in the way society draws on research in its policy and decision-making (Foster, 2001). Certainly, learning by doing is often advocated as one of the most effective modes of learning and understanding. Thus, Foster (2002) concluded the following:

> In a genuine learning society providing or improving policy and management resources *for* users means exploring *with* users, through a wide range of interactive research and learning partnerships (p.39).

Indeed, there are many advocates for increased public participation in decision-making as a democratic approach towards more sustainable outcomes. However, participation comes in many guises [see Arnstein (1969) and Pretty (1994)] and forms [see Dovers (2000) and James (1999)].

In Australia, Neller (2000) has pointed out that participation varies significantly between regions and embodies several channels of communication and power. However, she emphasised that in almost no jurisdiction does the political commitment to community participation go beyond widespread consultation. Arnstein (1969) and Pretty (1994) have criticised consultation as a relatively insufficient and undemocratic form of participation as it is seldom aimed at improving the lot of those consulted. They have argued that its most common purpose is to justify decisions already made. Similarly, Neller (2000:87) asserted that there are as many points of access as there are for departure, leading to a loss of local experience, skills, information and motivation. This concern is echoed in the United Kingdom by Warburton (1997:51) who has observed that public participation in decision-making 'has become mainstream in principle but not universal in practice'. This same observation within Australia has led Dovers (2000) to call for the institutionalisation of participatory mechanisms so that they become normalised and not neglected or mis-applied.

Institutionalising participation so that it becomes normal practice and allows for public involvement that exceeds consultation requires a change in the way problems are conceptualised and ‘solved’. Berkes and Folke (1998) argued for the need to move away from an over-reliance on positivist scientific knowledge for decision-making. Instead, they promote the importance and ability of local communities to determine and adapt resource management practices to suit local circumstances. However, if science and management become more open and inclusive, both citizens, researchers and managers will have to redefine their roles (Shands, 1999). For example, managers will have to share decision-making and, in return, citizens and their communities will have to share responsibility for the final outcomes (Dovers, 2000; Shands, 1999). The following sections describe these changing roles and what may be required from all stakeholders if increased citizen participation in research and decision-making is utilised for sustainable catchment management.

2.3 CITIZENS AND EXPERTS IN THE KNOWLEDGE SOCIETY

Much of the sustainability debate is based on what we know about current social and environmental affairs. Indeed, knowledge forms the basis of our decision-making processes. Societal decision-making is swayed by economic or political knowledge and has been variously Market or State led. More recently, however, there have been calls for community-based or communitarian approaches to governance where the role of the citizen is central to knowledge and decision-making (Tam, 1998). This emphasis on knowledge and the power it both generates and reflects, especially in natural resource management issues such as catchment decision-making, leads me to situate the following discussion within the context of knowledge production and distribution.

The dominant form of knowledge production in the environmental arena since the 17th century has been positivist science. Thus, this research paradigm serves as the focus for discussion as its traditional role in society, methods of problem solving and participants are analysed. This is followed by an exploration of more recent research methodologies that emphasise the importance of public participation in the pursuit of sustainability. This 'new' science or as Funtowicz and Ravetz (1991) have termed it, 'post-normal' science, embraces uncertainty and incorporates values and public participation into the decision-making process. Post-normal science also allows for varying paradigms and subjectivity (Harding 1998:99). Harding (1999) argued that while uncertainty and subjectivity are part of all forms of science, only post-normal strategies explicitly acknowledge them. The post-normal methodologies discussed are adaptive management and citizen science. The inclusion of these strategies requires a re-examination of whose knowledge counts and how these alternative knowledge bases can be integrated into environmental decision-making. Emphasis is placed on the different types of knowledge, the uneven utilisation of various knowledge bases, and what this implies for the perceptions of different sources of knowledge. In addition to a sense of community, participatory approaches to science also demand a transition from the external expert stance towards a reflective practitioner approach. Therefore, this section concludes by analysing the essential aspects of this transition in the context of research for sustainable catchment communities.

2.3.1 *The Community in Environmental Issues: Rethinking Catchment Citizenship*

The rationale for 'post normal' approaches to science and increased public participation hinges on the concept of citizenship and how this is related to operational communities and the functioning and direction of society as a whole. In this section I seek to understand the concept of a contemporary community as it relates to citizenship and society within the context of catchment management.[5]

Bauman (1991:246) stated that postmodernity is the age of community. He spoke of the 'search for the community', 'invention of community', and 'imagining community'. But what is a community? Jakes and Anderson (2000) pointed out that community is defined in many different ways within the social sciences. For example, geographers define spatial aspects, economists emphasise markets, sociologists look at connections and networks, and others define communities of interest. More recently the media has even been referring to the ‘global community’. Certainly, globalisation has accelerated dramatically in the last 50 years (Castells, 1996, 1997, 1998) and is arguably responsible for eroding the more traditional concept of a community. Thus, although Hillery (1955) found 94 different definitions of community in the scientific literature, I concur with Carr (2002) that there must be many more by now. Bauman (1991:246) defined community 'as the uncanny mixture of difference and company, as uniqueness that is not paid for with loneliness, as contingency with roots, as freedom with certainty; one hopes it would provide a shelter.' Certainly, the concept is very broad and difficult to define. However, the notion of community is central to resource management as Lee *et al*. (1990) highlighted; 'human attitudes and values are vested within community and definitions of resources emerge

5 Remembering that natural resource management is first and foremost a 'people orientated' approach (Berkes and Folke 1998).

from community' (quoted in Jakes and Anderson, 2000). Therefore, it is important to define who we mean when we speak about 'involving the community' - too broad a definition makes the task overwhelming and ineffective, too narrow a definition may limit possibilities and exclude crucial input. Indeed, 'communities are bound together by shared beliefs, values, history and rituals; they have always walked a fine line between inclusiveness and exclusivity' (Suzuki 1997:172).

Until globalisation took hold it may have been illustrative to take an evolutionary perspective in order to understand the formation and constituents of community in this changing landscape. Using this perspective, Suzuki (1997) pointed out that the range of climatic and geophysical conditions has caused speciation such that every ecosystem contains a variety of species that possess a locally confined set of genes. Consequently, the genetic variation within a species in one catchment will differ from that within the same species in the next catchment. In this way, Suzuki (1997:136) demonstrated that every ecosystem is local. Consequently, the key to species survival is ability to adapt to local habitats. Thus, Suzuki (1997:8) contended that the key to human survival will be the local community.

I do not debate the need for a vibrant local community. Strong local communities are vital for participation in the face of decentralisation (Janicke, 1997). Furthermore, humans are a very social species and for 99 percent of our existence we have lived in small family groups as Suzuki (1997) noted:

> We have gathered together for reaffirmation of place, people and important stages in life, thereby inculcating a sense of belonging, an identity and a worldview (p.170).

Not surprisingly, the majority of the definitions in Hillery's (1955) review include the concept of place or area as a defining community feature. However, it is widely accepted that human society is changing dramatically. Over the past half-century, distance and time have shrunk with our increasing movement and use of technology. Rapid change has become the norm. Current lifestyles that emphasise high individual mobility and a corresponding lack of neighbourhood connections mean that many people no-longer associate with place-based definitions of community that may be, as Carr (2002) contended, a static or geographical feature of the countryside. Consequently, sociological literature refers to the community as a social organising concept (eg Minar and Greer 1969) where communities are defined through interest, race, religion and sexual preference, irrespective of geographical location. Thus, in the same way that a house is not necessarily a home, a catchment or even a subcatchment area is not automatically home to a community that actively contributes to a humanistic sense of place and plays an influential role in the life of its inhabitants.

Unfortunately, neither society nor community can be considered natural phenomena. Certainly, Bauman (1991:251) was not optimistic about the formation of a cohesive community or a wider society. He concluded that we are 'impotent to create that foundation which nature has not already provided'. Similarly, Sancho Gil (2001) accepted that societies are not something that are given, but concluded instead that:

> They [societies] are the process and result of thousands of decisions taken by different people that can affect all the rest, including their environment (p.393).

Sancho Gil (2001) continued that the results of such decisions not only affect people's lives, but also the will to finance particular research, the direction of which may be market or technology led and may be to the detriment of other perspectives on knowledge and technology. However, unlike Bauman, she argued that diversity among people in a society should not prevent us from building a balanced and just society. On the contrary, she concluded that such diversity could provide the essential ethical references as well as the fundamental knowledge and the educational opportunities, needed to empower people both to find their way in life and to be able to debate the models of society and citizenship that they would prefer.

In seeking the elements of a balanced and just society, Ogdin (1999) has listed the following characteristics as indicative of successful communities:

Boundary and exclusivity: a definition of those that are members and those that are not.
Purpose: a reason for being above and beyond just 'having a community'.
Rules: limits on members' behaviour with sanctions for non-compliance.
Commitment: caring by each member for others in the same community.
Self-determination: the freedom for members to decide autonomously how they will operate and whom they will admit to membership.

Reviewing these points we can understand how many academics [eg Abeles (2002) and Cash (2002)] have contemplated that community can be defined as a process rather than a place or even a product. In this way, notions of place become less relevant. Certainly, ideas of community and membership must be dynamic to be in any way comprehensive. The element of exclusivity (Ogdin, 1999) hints that the notion of community as something that is essentially 'good' can be compromised and may, for example, result in essentially undesirable groupings such as the Klu Klux Klan (see Foley, 1999). The other characteristic point of note is that of self-determinism. The ideals of self-determinism are aligned closely to those of democracy and can be realised through active citizenship. Citizenship as a dynamic process that operates within and extends from a community is discussed next.

Sancho Gil (2001) would argue that citizenship in this context does not refer to nationality, but to the rights and privileges that the citizen enjoys as a member of a community. It is more than a collection of behavioural principles based on common values and norms and is described by Sancho Gil (2001) as:

> Citizenship is a multifaceted idea: it is to be understood as a social practice, as a normative idea, and as a relational practice. It has democratic, egalitarian, intercultural and ecological dimensions (p.393).

Similarly, The European Commission (1996) has listed three identifiable characteristics of a common identity or citizenship in a 'civil society'. The first characteristic is that citizenship is related to the kind of society we desire. Therefore, it is a normative idea related to the concept of a civil society and its moral defence. The second characteristic sees citizenship as a dynamic process founded on democratic human rights with a sense of belonging shaped through differences, communication with others, conflict and negotiation. The third characteristic of citizenship is that it is located between the interfaces of the individual, the community and the state (or society) as a whole. This point is crucial to understanding citizenship as a political practice developed through people's social situation and political participation. It also points to the community as a platform from which citizens can collectively participate in decision-making at both local and national levels.

Therefore, following the argument of Carr (2002:18) where she noted that some academics have interpreted the return of community as a return to 'simplicity, romanticism, traditional values, local knowledge, populist agendas…a return to the past', I do not refer naively to 'an emancipated, historical rural or village lifestyle freed from the harshness of the landscape'. Instead, within the context of catchment management I wish to acknowledge community both as a geographical location *and* a societal space where citizens can exercise their democratic rights and contribute to decision-making about the kind of society and environment they wish to reside within.

Re-inscribing the geographical component conflicts with those I have cited that see community only as a process or a form of social organisation. However, in catchment management, because each ecosystem and each catchment is local and unique in physical structure, biological assemblages and cultural history, the physical location is important to consider. While information from one catchment system may be transferred to another it is difficult and meaningless to make generalisations in many instances (Suzuki, 1999). Moreover, in the face of a local environmental disaster where the effects would be borne by all present, members simply have no choice to which community they belong (aside from physical relocation).

The second part of the definition, the social situation of those present, is where members do have some choice. In a democratic society such as Australia, citizens have a choice to form the kind of community that can be used as a platform for social participation in societal direction. Again, it is important not to romanticise 'community', assuming that community members are 'naturally' inclined to environmentalism or equality (Kapoor, 2001). Nonetheless, in environmental issues, social participation can take many forms from voting to undertaking research to direct remedial or preventative action.[6] It is important to note that the more active forms of citizenship demand cognitive and communicative competence achieved through social and educational processes (European Commission 1996). It is also important to acknowledge that communities are multi-dimensional, containing within them differences, divisions, conflicts and inequalities (Kapoor, 2001). Therefore, an effective citizen contribution to decision-making should not involve coercing consensus to achieve single and permanent solutions (Kapoor, 2001). Rather, it should involve debate among participants to enable a temporary consensus if possible and multiple consensus when necessary (Kapoor, 2001). Kapoor (2001) proposed that this approach would probably involve a range of actions and meet the needs of plural audiences rather than the powerful majority. In addition, dynamic and multiple consensus would allow for an agreement to disagree, and mutual understanding among the diversity of participants. Thus, the definition or understanding of community embedded

[6] See Harding (1998) for a complete list of the range of ways to participate in environmental decision-making.

within the decision-making process can determine whether or not the process facilitates 'vibrant, increasingly autonomous and self-reliant local grouping of people' (Suzuki 1997:8) that can effectively contribute to any decisions made or actions taken. Indeed, these are the very people that can provide the context and meaning for decision-making and evaluation.

In summary, the process of globalisation has eroded the more traditional notions of community. This has caused a move away from place-based definitions of community to definitions that bound communities through interest and other means emphasising the notion of community as a process. Certainly, communities are dynamic and are unlikely to ever return to the form epitomised by a rural utopia. Yet, in the context of catchment management the localised nature of community cannot be escaped. In this context it is also vital to recognise local groupings of people and their right as members of a community within civil society to contribute to societal decision-making. It is also important not to romanticise community motivations or to see them as unidimensional.

The following sections explore how knowledge is produced for environmental decision-making and how community members can participate in this process. The effectiveness of such community participation is dependent on their capacity to participate (resources and competence). Thus, social learning and social capital become important precursors to, and outcomes of, democratic participation. Social learning is an inherent theme in much of the discussion and social capital as a means to build effective communities is discussed in the final section.

2.3.2 Knowledge: A Basis for Societal Decision-Making

2.3.2.1 What is knowledge?

Burroughs (1999) described knowledge as the primary currency in a public participation process. He contended that citizens are both consumers of knowledge and sources of it. Thus, the effective exchange of knowledge between citizens and experts forms the basis for improving inputs to environmental decision-making (Burroughs, 1999).

Knowledge can be distinguished from data, information and wisdom. A review of dictionary definitions gives the following meanings:

- **Wisdom** involves the ability to critically, or practically, apply experience and knowledge together.
- **Knowledge** concerns cognitive familiarity gained by experience and theoretical or practical understanding. In other words, to acquire knowledge we *learn* through study, instruction or experience.
- **Information** is processed and communicated data or items of knowledge.
- **Data** includes perceived facts and recorded measurements.

Vogt (1995) has conceptualised the relationship between these variables as a pyramid and illustrates that knowledge is more than data and observation alone (see Figure 2.1).

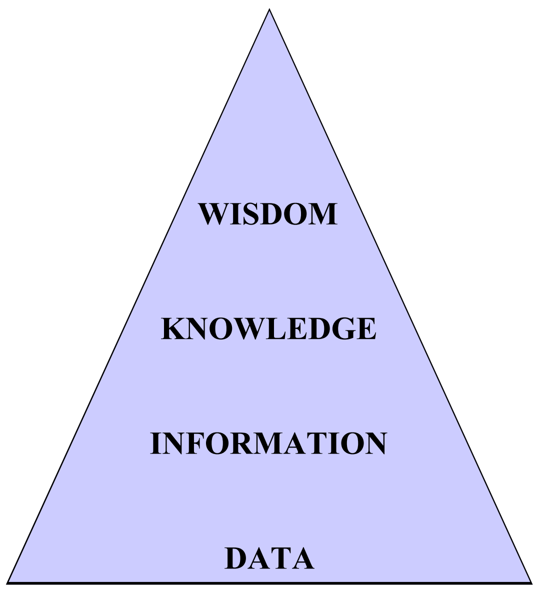

Figure 2.1 The knowledge pyramid from Vogt (1995)

Similarly, Davenport *et al*. (1998) contended that knowledge is information combined with experience, context, interpretation and reflection. Therefore, to use knowledge wisely information systems alone are insufficient. Consequently, Dent (2001:6) concluded that knowledge of the broader context is important and that more information is not necessarily better. Whilst more information may enhance learning, it is the interpretation of the information which is important (Senge *et al*.,1995 quoted in Dent, 2001). Thus, knowledge in decision-making involves understanding what information might mean for a specific context or issue.

From this definition it appears that decisions made remote from the location of concern or imposed externally on communities may lack context and have the potential to be based only on information rather than knowledge. Participation by all those affected (stakeholders) may be the most effective way of providing the context and understanding of issues that allow for wise decision-making based on sound knowledge.

2.3.2.2 Types of knowledge

Habermas (1972) outlined three different types of human knowledge and interest or 'knowledge constitutive interests'. These are the technical, practical and emancipatory or critical interests. Technical interest arises from the human need to control aspects of the physical world. Practical interest stems from an acknowledgment that we live in a social world as well as a physical one. Practical interest concerns the understanding that allows participation in cultural aspects of social life. Lastly, critical interest involves the need for individual thought and reason to be free from the constraints of authority and tradition. Such constraints prevent individuals and communities from acting as autonomous and self-directing agents. If society is to become truly civil (see Ulrich 2000) then its members must seek out, have access to, and possess all three distinct types of knowledge. Indeed, it was the view of philosophers John Stuart Mill and Jean Jacques Rousseau that by acquiring knowledge humans would be promised prosperity, emancipation and self-realisation (Roberts 1999:4).

These different types of knowledge are not secured in a single societal level, culture, race or religion - they can be acquired through a variety of equally valid sources and forms of education. Table 2.1 provides a brief introduction to the different sources of knowledge discussed later in this section.

Table 2.1 Sources of knowledge[7]

Sources of knowledge	
Expert knowledge	Knowledge from someone with specialised skills or experience in a particular field.
Scientific knowledge	A type of expert knowledge. This knowledge is usually obtained from someone that has undergone tertiary study at an educational institution. Such knowledge is derived from investigation and experimentation based on scientific theory principles and methodologies.
Local knowledge	Knowledge and information from people in a specific geographic position or place. This is often based on the experience of everyday life (e.g. local residents, local action groups, environmentalists, households and farmers).
Indigenous knowledge	This knowledge is held by indigenous groups and is culture-specific. It is based on traditional understanding and interaction with the natural environment.

Source: Harding (1998)

While there are a range of different sources of knowledge, many people rely on scientific and technical knowledge in isolation from others (Harding, 1998). Indeed, science often rules to the exclusion of other ways of knowing and thinking without major opposition (Fischer, 2000). However, Kloppenburg (1991) argued that these separate sources of knowledge can and should inform each other in a complementary manner. Thus, similar to the idea of exchange introduced by Burroughs (1999), Winklerprins (1999) asserted that dialogue is necessary between the two realities so that a more participatory approach to environmental management is possible. Nonetheless, in the context of water quality decisions, the interactions between the lay citizen audience and scientific or technical knowledge remain a major challenge to effective public participation (Burroughs, 1999).

This study focuses on how citizens can contribute to the search for sustainable solutions and contribute a kind of knowledge that Fischer (2000) contended the expert requires in solving pressing environmental problems. Thus, this study looks at citizen-expert interactions and how these can be better structured to enable integration of both citizen and expert knowledge. Indigenous knowledge is equally important and valid. Unfortunately, it is beyond the scope of this study to explore indigenous knowledge any further than that encompassed by either expert or local knowledge within the cases explored.

[7] Historically, the major difference between the scientific and other sources of knowledge sources has been that local and indigenous knowledge is predominantly qualitative rather than quantitative.

2.4 ONE WAY OF KNOWING: POSITIVIST SCIENCE AS A DOMINANT PARADIGM

Gregory and Miller (1998:20) stated that 'the social distinction between science and the public began with the institutionalisation of science as an activity with designated participants and with agreed rules and practices that separated it from other activities'. In reviewing the rise of traditional science and its incorporation into policy and the governance of society and natural resources, Burch (1999) contended that at the beginning of the twentieth century science became the means with which to control and exploit nature to provide a continuous stream of desired outputs. Kapoor (2001) has commented on the view of nature in this orthodox scientific paradigm:

> Nature, in this view of things, is separated from human experience so that human beings are able to exploit it without limit and consequence. It is seen as inert and passive: humans can 'manage' it, use it as a 'resource' or degrade it without fearing the after-effects (p.270).

Thus, because science provided the rationale and mystique that guided natural resource agencies, the consequent organisational structures and their members 'prescribed, proscribed, regulated, restricted, and manipulated human behaviour regarding their use of resources' (Burch 1999: viii). Managers and higher-level groups made top-down decisions riding roughshod over local realities, diversity and aesthetic concerns (Burch, 1999). Certainly, Bauman (1991:252) argued that modernity fulfilled its role by the 'bulldozing of all unauthorised difference and all wayward life-patterns…rendering deviation synonymous with diversity'. Science even promised to displace common sense (Stehr and Ericson, 1992). And, by the 1960s many classical social theorists (eg Lane 1966) predicted that social conduct would inevitably be driven by science and technology.

This traditional or positivist model of science has been the dominant scientific paradigm since the 17th century (Pretty, 1995a) and has been driven more recently by the Vienna Circle, a group of Austrian scientists founded in 1924. Kuhn (1970) defined positivism as the constellation of facts, theories, and methods suitable for textbook generalisation. Similarly, Wilson (1998:53) described science as 'the organised, systematic enterprise that gathers knowledge about the world and condenses the knowledge into testable laws and principles'. Moreover, it is distinguished from other forms of inquiry and pseudoscience by repeatability, economy, mensuration, heuristics and consilience (Wilson, 1998). In other words, science relies on achieving identical results in subsequent inquiry, the information must be simple and clear, and it must be able to be measured using accepted scales and thus, generalised. It should also stimulate further inquiry and maintain consistency with other proven explanations (Wilson 1998:53). In this way progress can be made incrementally by using experiments to refute hypotheses (Checkland, 2000).

Seen in this light the *raison d'être* of modern science is to discover, predict and control natural phenomena in a detached, objective (Pretty, 1995a) and subordinating (Bauman, 1991) manner. This implies an opposition to any metaphysical or theological claims that non-empirical research or experience can provide a valid basis for knowledge (Carr and Kemmis, 1986). Therefore, within this paradigm there exists an objective reality and immutable laws, where the exponents rely only on what their scientifically scrutinised senses can tell them (Pretty 1995; Roberts 1999:4). The following quotation from Wilson (1998) explains this underlying scientific rationale:

> Outside our heads there is free-standing reality…inside our heads is a reconstitution of reality based on sensory input and the self-assembly of concepts…the proper task of scientists is to diagnose and correct the misalignment (p.60-61).

However, as far back as Immanuel Kant (1724-1804) and Auguste Comte (1798-1857), philosophers have questioned whether it is actually possible for individuals to be objective about reality due to their social conditioning. Moreover, Hume argued that individuals cannot know everything, therefore they must continue with what is useful, using experience and the institutionalised form of this, tradition, as a guide (see Roberts 1999). Nonetheless, positivist science continues with this external notion of 'truth' and uses reductionist methods (described next) in its search.

2.4.1 Reductionism

The conceptual tool employed by positivist science is reductionism. A review of the natural science literature reveals that positivist science is reductionist in three ways. First, it is reductionist in its underlying methodology and focussed nature of research. Second, it is reductionist in its explanation whereby everything in science can be reduced to physics for an explanation (Checkland 2000:6). Moreover, by following the principle of Ockham's Razor, science chooses to use only the one, most simple and clear explanation (Wilson, 1998). Third, it is reductionist through its restriction of the participants in recognised research to qualified scientists. This is a major issue in this study and perhaps contributes to the other forms of scientific reductionism. Therefore, I shall only briefly refer to the first two forms of reductionism and concentrate on exploring the third.

Wilson (1998) described the first form of reductionism as the 'cutting edge' of science:

> It is the search strategy employed to find points of entry into otherwise impenetrably complex systems. Complexity is what interests scientists in the end, not simplicity. Reductionism is the way to understand it. The love of complexity without reductionism makes art; the love of complexity with reductionism makes science (p.54).

Thus, this approach to problem solving invariably reduces complex entities such as ecosystems into a number of discrete parts for simplicity of analysis (Hannigan, 1995; Suzuki 1999). Wilson (1998:54) admitted that reduction is the primary activity of science. However, he stressed that synthesis and integration, with regard to significance and value are also vital. Furthermore he stated that even the most narrowly focused researchers think about complexity constantly. However, Wilson (1998:183) later admitted that 'most people believe they know how they themselves think, how others think too, and even how institutions evolve. But they are wrong'. Commonly, reductionism means disregarding the sustaining connections between the component parts and not revisiting the whole for confirmation. Consequently, Stankey and Clark (1992) (cited in Clark *et al* 1999) contended that 'reductionism artificially constrains the way in which problems are defined as well as the search for solutions'. Thus, we know 'more and more about less and less' and the picture remains incomplete or as Suzuki (1999:18) proposed: the gaps in our knowledge are large enough for the planet to 'fall through'.

Scientists have been criticised for concentrating on learning what they think needs to be known oblivious to wider societal concerns or even other areas of science (Wilson, 1998:56). Indeed, Beck (1992:5) argued that they often produce laboratory-based models that produce questionable results, revealing their real-world naivety. Thus, Saul (1992:306) has noted that many scientists do not speak out on societal and environmental issues because they acknowledge that they are too poorly informed to make a contribution outside their narrow fields. However, this narrow focus is not peculiar to science alone - it is a criticism that can be levelled at most disciplines, professions and members of society, suggesting the need to involve a wider cross section of society in environmental debates.

Despite this acknowledgment, it is important to note that the current debate on environmental issues continues almost exclusively within the positivist paradigm and the tools and techniques utilised remain predominantly positivist. Environmental matters are still seen as 'highly technical' and only capable of being handled by 'professionals' (Joas, 2001:213). In addition, Beck (1992) observed that:

> It remains unrecognised that a social, cultural and political meaning is inherent in such scientific immiseration formulas…an understanding has crept in, according to which modernity is reduced to the frame of reference of technology and nature in the manner of perpetrator and victim (p.24-25).

Indeed, there is a prevalent lack of acknowledgment that all science is constructed within a particular social context (Beck 1992; Carr 1986; Pretty 1995). This oversight has restricted the participants in inquiry and leads us to the matter of expertise in environmental decision-making.

2.4.2 Expertise in Environmental Decision-Making

By disregarding the social, cultural and political context, the participants in positivist science are constrained to only a limited sector of society. The third form of scientific reductionism[8] means that research is frequently exclusive to only those with formally recognised scientific training (scientific experts). Advocates of this view of science believe that research can only be conducted by objective and impartial experts whose views are more reliable than 'merely another person' (Bauman, 1991:198). Thus, Fischer (2000) concluded that the tension between professional expertise and democratic governance is one of the most important political issues of our time.

Consistent with the already outlined scientific methodology, scientific experts emphasise specialised knowledge and are distinguished from intellectuals who possess general knowledge (Stehr 1992:124). Contrasting with intellectuals, experts 'examine specialised aspects of problems that blind them to other issues' (Pacey 1983:36). Expertise also concerns the possession, use and control of knowledge (Saul 1992:8). Thus, the current power wielded by experts relates not to how they use that knowledge, but rather to how they control its use (Saul 1992:8). According to Stehr (1992a) experts actually rely on a

[8] See Section 2.4.1 for an overview of scientific reductionism.

created disjuncture between common sense and expert knowledge. This is achieved primarily through the use of language, whereby the dominant scientific culture states that good science should be generally unintelligible to all but an elite (Gregory and Miller, 1998). Thus, Saul (1992:112) observed that the dialect of any expert - accountant, doctor, scientist or bureaucrat - is only available to those who become one. Consequently, knowledge has become distilled into distinct fields of expertise and exclusive dialects, between which there is an unsurprising lack of communication (Saul 1992). This has made general understanding and coordinated action near impossible and even distrusted (Saul 1992:8). Indeed, Dovers and Mobbs (2002) observed that:

> Ecology, policy processes and people (communities) have had few connections through which to communicate and work together; they have no common language and no frameworks for ongoing interaction to move beyond episodic interactions defined by conflict (p.1).

If we concur with Checkland (2000) that creating reality through language is what distinguishes us as uniquely human, we can understand how Saul (1992) concluded that the use of language as a means of societal separation is proof that experts sometimes see the public as a 'separate species' altogether. Moreover, by using language in this manner, the expert 'species' render themselves indispensable (Bauman, 1991):

> Direct access to science being barred to the ordinary person, a mediator (expert) is needed to translate personal, subjective needs into questions which can be answered in the impartial and reliable, but hermetically sealed, highly technical language of science, and to translate back the scientific verdict into practical advice for the layperson. A person can understand her [sic] needs, but only science knows the way of satisfying them (p.199).

Thus, experts who have organised society around complex structures and rendered universal understanding most difficult, increasingly dominate our reality (Saul 1992:7). Fischer (2000) concluded that such social and technical complexity is one of the most important factors in explaining the demise of the citizen's role in societal decision-making. Certainly, scientific expertise creates a number of elements that the ordinary citizen cannot hope to understand unless they have the time and resources to devote to such matters as an expert necessarily would. However, the citizen cannot disregard these elements either because they have woven themselves into the fabric of society in such a way that it costs to ignore them (eg. resource allocation, water quality parameters). Stehr (1992a) emphasised this point when he stated that:

> Modern man [sic] has a sense of being surrounded by an innumerable number of cultural elements, which are neither meaningless to him nor, in the final analysis, meaningful. In their mass they depress him, since he is not capable of assimilating them all, nor can he simply reject them, since after all, they belong potentially within the sphere of his cultural development (p.137).

Societal division into experts and non-experts also implies a negative image of the citizenry, whereby any rejection of expert advice is seen as a problem of knowledge deficit on behalf of an irrational public (Beck 1992:57). Similarly Saul (1992) observed a rising contempt for the citizen in accordance with the rise of the scientific expert. He proposed that this has reached a level where we are led by both elected and nonelected elites who do not believe in the value of the 'public's opinion' (Saul, 1992:34).

The reliance on experts has had many effects. For some it has effectively externalised the responsibility for the environment. Many 'people see society's economic, social and educational institutions as basically self-directing, with little need for their participation and with little necessity for them to communicate and argue over ends and means of the same institutions' (Apple 1976, quoted in Kirk, 1989:47). Thus, 'people rarely see the need for emancipation in their own lives, and only in particular circumstances in the lives of others' (Kirk 1989:47). However, many others increasingly distrust politicians, professionals and scientists, and are fearful that their way of life and knowing is being taken by external experts who assume they know best (Shaffer, 1999). By separating the 'knowers from the doers' experts have produced 'a fundamental insecurity about activities that people have successfully engaged in for tens of thousands of years (Vanderburg 1988:10). This has led Stehr (1992a) to call for more inquiry into how experts enable and restrict action, set standards, define what counts as knowledge, control knowledge, and determine the efficacy of knowledge.

According to Lee (1993) there are two alternatives if centralised expert control does not work - the market or decentralised power. However, Longstaff (2001) pointed out that both these approaches only serve people when individuals band together and act collectively. The following section examines challenges to positivism as a way of knowing and introduces approaches that rely on decentralised power in an effort to widen the knowledge base available to decision-makers and to give a voice to those previously marginalised.

2.5 CHALLENGES TO POSITIVISM: INTRODUCING OTHER WAYS OF KNOWING

Despite the dominance of positivist science portrayed in the preceding sections through the rise of the scientific expert and advancement of science into all spheres of life, Fay (1996:1-2) stated that positivist science has lost its once revered status and privileged position. Dissent from this framework has arisen for three main reasons. The first is that science is increasingly acknowledged as a social process determined by the values and structures of the scientific community (Blumenthal, 2000). Certainly, the ideology of science as impartial and objective even in complex social and political situations has been destroyed (Van den Daele, 1992). Van den Daele (1992) also observed increasing criticism of the technocratic arrogance, elitism and political bias demonstrated by experts over the last twenty years. Thus, expert authority is increasingly being questioned and public trust of such scientists and professionals is by no means assured (Stehr, 1992).

The second reason is that public confidence in science has been undermined through the abuses of science by governments and industry (eg nuclear weapons); the dangers of technology emanating from the natural sciences (eg. genetic engineering); and widespread awareness of other ways of knowing (Fay, 1996). Similarly, Van den Daele (1992) cited major catastrophes (eg thalidomide, Bhopal and Chernobyl) that have diminished public confidence in experts and have revealed that experts actually proceed with fragmentary and preliminary knowledge.

The third source of dissent highlighted by Blumenthal and Jannink (2000) is that researchers have begun to recognise the value of citizen knowledge in the search for solutions to local problems, giving rise to more collaborative models of research. Consequently, many academics and social commentators (eg. Habermas, 1972) have asserted that that science is just one way of knowing. The following quotation from Bauman (1991) explains this position:

> Modernity reaches that new stage…when it is able to face up to the fact that science, for all one knows and can know, is one story among many. 'To face up' means to accept that certainty is not to be, and yet persevere in the pursuit of knowledge (p.243-244).

Certainly, if western society's civilisation is as advanced as we would like to think, then there is no need to act as if all decisions are designed to establish certainties (Saul 1992:585). However, at this level of relative epistemological uncertainty, it is difficult to determine which investigative methodologies are appropriate, or which views of the nature of knowledge are most relevant (Harding, 1998:99). Therefore, it is important to note that although science may be criticised from several social standpoints, the preceding arguments are not necessarily anti-science. Indeed, science is one of the major cultural achievements of our species and it is this fact that makes it appropriate that it be subject to detailed social scrutiny (Gregory and Miller, 1998:249). It is under such social scrutiny that it has been argued that changes are needed to the ways such problems are conceptualised and 'solved'. It is here, where there is high uncertainty, high decision stakes, short time frames and different values, that many argue a 'new science' is needed (eg. Funtowicz and Ravetz, 1991, Nowotny, Scott and Gibbons, 2001).

Embracing uncertainty and incorporating values and public participation into the decision-making process is vital to the 'new' or as Funtowicz and Ravetz (1991) have termed it, 'post-normal' science. Nowotny, Scott and Gibbons (2001) have also written about the emergence of a new science, where the closer interaction between science and society results in context-sensitive science. Indeed, it involves the widening or democratisation of scientific peer communities (Funtowicz and Ravetz, 1991) so that there are more points of contact between citizens and experts (Gregory and Miller, 1998), although as Dovers and Mobbs (2002:5) cautioned, scientists may find this 'uncomfortable'. Nonetheless, post-normal science allows for varying paradigms, uncertainty and subjectivity, which are part of all forms of science (Harding 1998:99). In this way, post-normal science represents the transition from the culture of 'science' to the culture of 'research' observed by Latour (1998):

> Science is certainty; research is uncertainty. Science is supposed to be cold, straight and detached; research is warm, involving and risky. Science puts an end to the vagaries of human disputes; research creates controversies. Science produces objectivity by escaping as much as possible from the shackles of ideology, passions and emotions; research feeds on all of those to render objects of inquiry familiar (p.208-9).

Similarly, Nowotny *et al* (2001) argued that unlike science, research is diverse and heterogeneous. Thus, post-normal science is more akin to the notion of research and recognises that in dealing with uncertainty and limited time frames in complex environmental issues that input from a wider range of expertise and stakeholders with different knowledge bases and values systems is necessary. Such input is a vital precondition for the production of socially robust knowledge and socially distributed expertise (Nowotny *et al*., 2001). The concept of such public participation in environmental management is explored in the following section.

2.6 PARTICIPATORY INQUIRY AND DECISION MAKING

Citizen participation in community decision making is the essence of democracy and can be traced back to Plato's concepts of freedom of speech, assembly, voting and equal representation (Anon, 2000). However, because the concept of participation is not new, over its long history different meanings and utility for sometimes-conflicting purposes have evolved. It can now be argued that democracy has become much less participatory than originally intended and practised. Thus, many current forms of democracy are representative and limit the citizen's role to elections and voting which disregard the rational capabilities of the 'ordinary' citizen (Fischer, 2000). Indeed, theories of representative democracy treat public preferences as data to be considered by elected decision-makers (Korfmacher, 2001). For example, the Australian parliament began over 100 years ago promising to embrace the will of the people and epitomise democracy (Steketee, 2001). However, many including Steketee (2001) contend that this was only possible in the formative years, when no one party had a clear majority and firm allegiances were yet to be established. Today, many citizens believe that parliament does not serve the public interest by using a ritualised format where debate does not change 'pre-cooked' results (Steketee, 2001).

Saul (1992) highlighted that this 'pre-cooking' is partly a consequence of our obsession with expertise and efficiency. Moreover, that efficient decision making is characteristic of authoritarian governments rather than a functioning democracy. Nonetheless, it is inevitable that people will continue to demand to have a say and there are increasing demands for greater citizen participation whereby people can deliberate issues affecting their own lives (Fischer, 2000).

Public participation for community development has been used widely in developing nations since the 1940s (UNDP, 2000). More recently, public participation in environmental decision-making has been promoted as a primary means of reaching sustainable social and environmental outcomes, especially following the Bruntland Report in 1987 and the Rio de Janeiro Earth Summit in 1992. Researchers and decision-makers are increasingly recognising the importance of public participation in environmental decision-making. There is an emerging body of literature that supports a participatory approach that is decentralised, community orientated and holistic, and, thus, aimed at making environmental decision-making socially inclusive and environmentally sustainable (Kapoor, 2001). Certainly, 'watershed management, although dependent on science and engineering, is a process that is fundamentally social in nature' (Rhoads, Wilson, Urban and Herricks, 1999:298). Thus, such efforts should be consistent with the goals of participatory democracy and be as direct and local as possible (Korfmacher, 2001).

Democratic theory provides several arguments why the public should be involved in environmental decision-making. Korfmacher (2001) has noted that the most common rationales are democratic, substantive, and pragmatic:

> The democratic rationale emphasises the inherent value of public participation in decisions that affect the public. Recognising that in some cases citizens may have unique contributions to public decisions, the substantive rationale claims that citizens' values and technical knowledge should help to inform the final decision. The pragmatic justification for public participation emphasises that a public that has contributed to and been educated by the decision-making process is more likely to support the decision outcome and facilitate its implementation (p.163).

In this way, Fischer (2000:x) has proposed that 'participation not only gives meaning to democracy but also plays an important educational and psychological role in the social development of the individual citizen'. However, he observed that many see increased citizen participation as a dilemma whereby:

> Citizens do not have enough knowledge to participate meaningfully in technically orientated policy decisions, but it is difficult in a democracy to legitimately deny citizens a place at the decision-making table (p. x).

Similarly, the Australian Standing Committee on Environment and Heritage (2000) argued that the development of appropriate and coordinated catchment management solutions is hindered in part by stakeholders not being aware of factual matters. In addition to lack of expertise, Korfmacher (2001) has also noted several other reasons not to involve the public including risk of biased input, risk of delegitimisation, risk of overlegitimisation, misrepresentation of consensus, and insufficient influence. Indeed, the 'prospects for meaningful citizen participation in an age dominated by complexity and expertise are neither clear nor obvious' (Fischer 2000:1). Fischer (2000) contended that this problem could be largely addressed by focusing social and political inquiry at the level of the citizen rather than at the abstract level of the nation-state. He argued that instead of concentrating on citizen contributions to political institutions we should instead focus on citizen groups. Similarly, Saul (1992) concluded that community-based gatherings and participation in local issues through community groups are one of the few options available to citizens seeking to re-establish some form of democracy:

> All it would require is a realisation in the public mind that the decision-making process - is profoundly different from the administrative process. The two have no characteristics in common. One is organic and reflective. The other is linear and structured. One attempts to waste time usefully in order to understand and to build consensus. The other aims at speed and delivery. One is done of the people. The other is done for the people (p. 262).

Certainly, Fischer (2000) asserted that hard evidence demonstrates that the ordinary citizen is capable of much more participation than generally recognised or acknowledged. By interpreting the range of participation strategies in terms of underlying discourse, the next section begins by demonstrating the continuum of outcomes that participation may wittingly or unwittingly serve. Indeed, there are a plethora of participatory tools and techniques available for different purposes.

2.6.1 Interpreting public participation

Participation notoriously means different things to different people in different settings (Bhatnagar *et al*. 1996). However, participation is increasingly important in dealing with humanity's problems. As Nobel prize winner, Amartya Sen, stated in his Alfred Deakin lecture in Melbourne, May 15, 2001:

> The world needs more interaction, not less. The first step is to ask the questions that have to be asked. Doubts and protests do not have to be exactly right to be productive and fruitful. Their most immediate function is not to allow under-examined but critically important questions to pass by, in Francis Bacon's words, 'lightly without intervention'. We must do better than that. We owe it to the world.

In its broadest sense, participation includes everything from compulsory voting, lobbying, consumer choice, to membership in pressure groups and community-based monitoring or resource management (Dovers, 2000). However, as Jackson (2001:136) pointed out, contemporary stakeholders 'are looking for full involvement, not simply to be consulted as a political exercise'. Indeed, participation in community-based approaches to natural resource management can be viewed as a matter of principle, a means, or an end in itself (Bhatnagar *et al*. 1996).[9] When participation is viewed as a means, local people are involved in order to increase efficiency and gain support for external initiatives (Pretty, 1995a; UNDP, 2000). When participation is viewed as an end in itself, the goal then becomes the empowerment of people as they gain new skills, knowledge and experience that allows them to take greater responsibility for their development (UNDP, 2000). Certainly, these are not mutually exclusive and many strategies will contain a combination of these approaches (see Pretty, 1995).

Participatory approaches are becoming widespread in their application to solve social and environmental problems. Australia has a history of public participation in natural resource management with varying degrees of community and government initiative. Within Australia broad application is limited to citizens' juries (eg. James, 1999), consensus conferences (eg. Museum, 1999), deliberative polls (eg. www.i-id-a.com.au), community monitoring (eg. Waterwatch) and community-based natural resource management (eg. Landcare). In developing countries, participatory research approaches are popular and are practised much more widely (Pretty, 1998). Such broad application, although desirable, has resulted in the uncritical adoption of participatory processes (Arnstein 1969, Pretty 1998, and Dovers 2000) and had led some (eg. Flower, Micher and Rimkus 2000) to question whether this increasingly 'fashionable' process is genuine and actually improves the lives of local people. Thus, Pretty (1998) cautioned that:

> The term 'participation' has been used to justify the extension of control of the state as well as to build local capacity and self reliance; it has been used to justify external decisions as well as to devolve power and decision-making away from external agencies; it has been used for data collection as well as for interactive dialogue (p.255).

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[9] The effects of these vary and are explained on pp 41-43.

Table 2.2 summarises some of the main benefits and constraints of participation when applied in an environmental management context.

Table 2.2 The advantages and disadvantages of public participation

Advantages	*Disadvantages*
Participation expands the knowledge and representation base. By bringing a broader spectrum of the community into the decision-making process, participation can: Increase the representation of community groups, especially marginalised groups including women, aboriginal people and cultural minorities. Indeed, the participatory approach focuses on developing mutual understanding and enabling as wide a consensus as possible. Build on a greater pool of knowledge and multiple perspectives from the diversity of stakeholders. This is essential in environmental matters where issues cross jurisdictional boundaries and a holistic approach is necessary. Local involvement can also extend projects and increase their effects. Incorporate local knowledge, experience and creativity and widen the range of available options. Indeed, community participation increases the efficiency of externally imposed projects by using local resources to make better use of external costs.	**The participation process can be used to manipulate greater numbers of people.** Participation may wittingly or unwittingly disadvantage those who get involved: Experts can manipulate public participation to obtain cheap labour and afford extensive fieldwork. Some contend that participation is a way of imposing an ideological perspective on others, rather than seeking benefits for local communities. If not carefully planned, participation can add to the costs and time of a project with no guaranteed final impact or improvement.
Participation assists transparency of communication and power relationships between stakeholders. Involving and communicating with all affected can avoid uncertainty and misinterpretation of issues. In the act of participation local community capacity and skill level is enhanced.	**Participation can cause conflict.** Participation can sometimes destabilise existing socio-political relationships and cause conflict that may threaten existing projects.
Participation can enhance iterative and cyclical approaches and ensure that solutions are based on local knowledge and understanding. By opening up the decision-making process, decision-makers and managers can build on community-wide experience and draw upon a wider feedback loop. Thus, activities will be more locally relevant and effective.	**Participation can be expensive in terms of time and financial expense to local people.** Where there is social inequity, processes of participation are seen as a luxury and expenditure not justifiable in the face of poverty.
Participation encourages local ownership, commitment and accountability. Local inclusion can help achieve sustainable outcomes by facilitating community ownership of projects and ensuring that activities towards sustainability are continued. Indeed, the outcomes of a collaborative effort are much more likely to be accepted by all stakeholders.	**Participation can place unfair demands on local communities.** Participation can also be used as a means of shifting the burden onto poorly resourced local communities and relinquishing national governments of their responsibility.
Participation can build community capacity and social capital. In addition to the skills acquired through the process of participation, the participatory approach can increase the knowledge that each stakeholder has about the actions of the others. This knowledge, together with the increased interaction can foster trust among stakeholders and contribute to positive forms of social capital.	**Participation can disempower communities.** If the participation process is manipulated, not developed within a supportive institutional framework (systematised) or lacks the resources for completion or continuation, participants can leave the process disillusioned having achieved little but expended much effort.

Source: Summarised from Anon, 2000, Blumenthal, 2000, Dovers, 2000, Kapoor 2001 and UNDP, 2000.

Table 2.3 illustrates that participation in environmental management is as much about knowledge as it is about power (Fischer, 2000; Kapoor, 2001). This observation led Kapoor (2001:274) to state that participation alone is often insufficient. Examples of participation reveal strategies that range from blatant manipulation to community empowerment and self-mobilisation. Sherry Arnstein was the first to define participation strategies on the basis of the distribution of power between community and agency (Arnstein 1969). Arnstein used the metaphor of a ladder of participation where each rung represents a different participation strategy defined by power distribution. The bottom rungs represent 'non-participation' and involve (1) manipulation and (2) therapy. These are followed by rungs (3) informing, (4) consultation and (5) placation, which are all described as 'degrees of tokenism'. The next rungs (6) partnership, (7) delegated power and (8) citizen control all represent a shift in the balance of power towards the community participants. Pretty (1995a) has adapted this typology to describe different approaches to participation in natural resource management (see Table 2.3).

Table 2.3 A typology of participation

Typology	*Characteristics of Each Type*
Manipulative participation	Participation is simply pretence.
Passive participation	People participate by being told what has been decided or has already happened. Information being shared belongs only to external professionals.
Participation by consultation	People participate by being consulted or by answering questions. Process does not concede any share in decision-making, and professionals are under no obligation to take on board people's views.
Bought participation	People participate in return for food, cash or other material incentives. Local people have no stake in prolonging technologies or practices when the incentives end.
Functional participation	Participation seen by external agencies as a means to achieve project goals, especially reduced costs. People may participate by forming groups to meet predetermined objectives related to the project.
Interactive participation	People participate in joint analysis, development of action plans and formation or strengthening of local groups or institutions. Learning methodologies used to seek multiple perspectives, and groups determine how available resources are used.
Self-mobilisation and self-reliance	People participate by taking initiatives independently of external institutions to change systems. They develop contacts with external institutions for resources and technical advice they need, but retain control over how resources are used.

SOURCE: PRETTY (1995A)

Dovers (2000) noted that participation is more complex than such ladders suggest. Some people may vary their level and intensity of participation whilst others may not wish to participate at all (Dovers, 2000). For example, James (1999) observed that public participation in national park planning and management in Australia ranges from passive participation (merely being informed about Park management) to interactive participation where the public are involved as co-decision makers alongside planners and scientists (for example, Great Barrier Reef Marine Park management).

However, such typologies are very useful for classifying the purpose and meaning of particular participation strategies from the perspectives of all stakeholder groups involved. It is important to note that most types, certainly the first four, undermine social capital. These methods can be used knowing that they will not lead to action or have continued positive effects on participant's lives (Pretty, 1998). It is only in the last rungs of the ladder that power is actually redistributed through negotiation between citizens and power-holders (Arnstein, 1969). Thus, Kapoor (2001) argued that communities that participate without being empowered to change, dismantle or even criticise power structures are largely engaging in a meaningless or even counter-productive activity. For example, if participation proceeds as if all participants have an equal say, naive to the fact that outside the process/activity, elites/experts wield power that can influence or silence the community's voice then participation becomes futile and disempowering (Kapoor, 2001). Thus, in analysing and planning participatory approaches it is extremely important to define the purpose and consequently the type of participation sought. If there is no real participation there is no learning and no development (Bopp, 1994). Indeed, seeking participation for no genuine purpose is a great way to alienate people and provoke cynicism and distrust (Dovers, 2000). Therefore, Coenen *et al*. (1998) and Sclove (1997) have argued that genuine participation must ensure that the community voice influences decision-making and makes a constructive difference.

Parkes and Panelli (2001) have applied these concerns to the conduct of participatory research. By reviewing the contribution that participatory action research can make to catchment management and community health, they have produced a typology of the relationships between the researcher and the researched population (see Table 2.4). The now obvious relationship between research and the people of the community of concern is important to consider when analysing community-based research projects.

Table 2.4 Types of participatory research

Mode of participation	*Involvement of local/researched people*	*Relationship of research to people*
Co-option	Token representatives are chosen but there is no real input or power sharing	On
Compliance	Tasks are assigned with incentives but outsiders decide the agenda and direct the actions	For
Consultation	Local opinions are sought but outsiders analyse and decide on the best course of action	For/with
Cooperation	Local people work together with outsiders to determine priorities but responsibility remains with outsiders for directing the process	With
Co-learning	Local people and outsiders share their knowledge to create new understandings and they work together to form action plans with outside facilitation	With/by
Collective action	Local people set their own agenda and mobilise to carry it out in the absence of outside initiators and with or without outside facilitators	By

Source: Parkes and Panelli (2001:88)

Thus far, I have looked at the questions of who participates and how in terms of stakeholders and power. It remains to be explored which stakeholders are included or excluded from the participatory process and where in the process their input can be facilitated. In the first instance, Kapoor (2001) has advocated for the participation of traditionally marginalised groups such as women and cultural minorities. Jackson (2001) has also produced a model of the stages of public involvement from case studies of the ‘planning for consensus’ approach to environmental resource management in British Columbia. He embraced Arnstein’s (1969) spectrum of public involvement and, similar to Dovers (2000), also identified the purpose of participation. Jackson's (2001) model (see Figure 2.2) begins with an initial analysis of: (1) identifying and analysing stakeholders; and (2) setting the appropriate objectives.

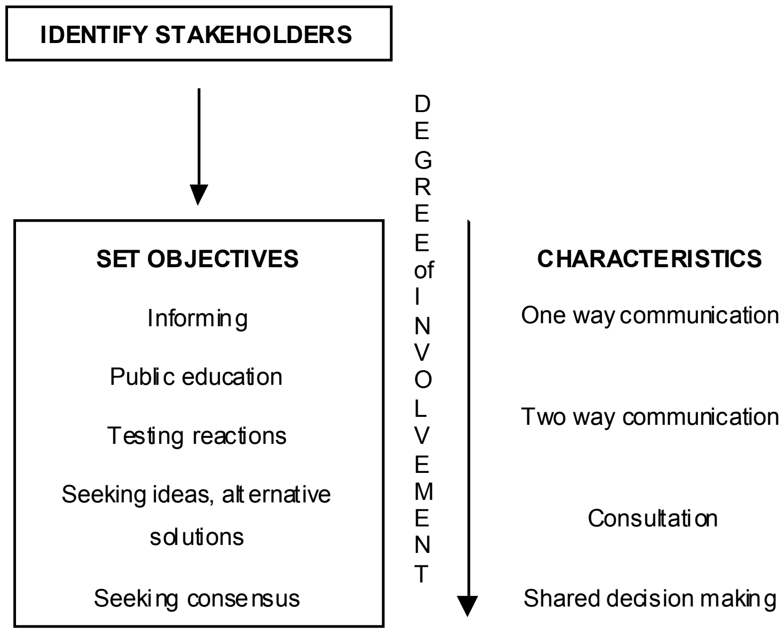

Figure 2.2 Stages of public involvement *(Source: Jackson, 2001)*

The interesting point to note about Jackson's model is that he defined stakeholders as 'those who believe themselves to have an interest or a stake, not those which the agenda deems to have a stake or would like to include' (Jackson, 2001:140). Consequently, he advocated contacting all stakeholders (eg aboriginal people, academics, business, environmental and public interest groups, professional and labour groups, community groups and interested citizens) in an issue and letting them 'self-select'. It should be reiterated that while it may be possible to bring all interested parties to the table with the best of intentions in terms of letting all have an equal say, there are several 'micro-power' processes at play within participatory spaces (Kapoor, 2001:274). For example, some participants may be more influential, articulate, or have access to more supportive resources. Others may be manipulative, misrepresent their positions or employ false evidence to influence or silence others (Kapoor, 2001). This is an important hurdle to acknowledge in all participatory approaches and may only be overcome by careful analysis and a redress of power inequalities through higher than normal representation of disadvantaged groups (Kapoor, 2001). In addition, it must be clear what is being sustained, for how long and for whom (Pretty, 1995a). In the second instance, where in the environmental decision-making process public participation can be facilitated, there is consensus that meaningful results are most likely when people are involved in all decision making stages - from definition through design and implementation to evaluation (Bressers *et al*. 1998; Kapoor 2001; and Pretty 1995).

Certainly, transparent and equitable participatory approaches to environmental decision-making appear to have many community development and, potentially, environmental benefits. However, there appear to be many barriers to achieving these goals, not least a more equitable distribution of power. Thus, if the kind of social equality that leads to environmental quality is a goal, then it will be important to structure the process so that the benefits are inclusive and contribute to the broader aims of democracy. It is also prudent to note that citizen participation is not presented as a silver bullet to all our problems. Other important factors are involved including property ownership rights (see Ostrom, 1999) and globalisation (see Howells, 1990). Nonetheless, citizens can and should contribute to the search for answers to these problems (Fischer, 2000). Certainly, increased participation means much more than larger numbers of people at meetings (Fischer, 2000). It involves introducing cultural rationality to the decision-making process. According to Fischer (2000) this will require integrating technology and culture and a reformulation of methodologies.

Such analyses of the involvement of citizen participatory strategies illustrate the importance of power in all forms of participatory research. They also illustrate the importance of learning as a specific aspect of research relationships such as those in community-based research where research is conducted with or by citizens. Thus, it is appropriate to consider power in understanding community-based research, but it is important to focus on social learning as the central and distinctive theoretical lens. The next sections focus on adaptive management and citizen science as two strategies that in combination represent a reformulation of methodologies to focus on social learning. These approaches may be capable of achieving society-wide benefits whilst targeting specific environmental issues.

2.7 ADAPTIVE MANAGEMENT

Adaptive management was initiated by C. S. Holling and colleagues at the University of British Columbia in the late 1960s and has continued into recent years. Gunderson, Holling and Light (1995) defined adaptive management as an inductive approach, relying on comparative studies that blend ecological theories with observation and with the design of planned interventions in nature and with the understanding of human response processes. An underlying assumption of this approach to natural resource management is a shift away from the positivist paradigm towards a more humble and reflexive strategy that involves public input, continual questioning and refinement in the face of ecological uncertainty. This section outlines key features of adaptive management, reviews its current application both around the world and within Australia, and explains some of the barriers and opportunities that this approach embodies.

Adaptive management may be viewed as an iterative and ongoing process, where management strategies are not thought of as static prescriptions but rather as 'living' frameworks which are continually built as understanding of the system increases (Ewing *et al*. 2000:454). This is consistent with Dovers' (2000) assertion that we are still forming our relationship with the landscape and each other. This acknowledgment has important implications for the way that we conduct natural resource management. It means that adaptation and action are always contingent on context (Dovers, 2000). Indeed, the imperfect human understanding of nature makes all of our interactions experimental (Dovers, 2000; Lee, 1993). Thus, adaptive management begins 'with the central tenet that management involves a continual learning process that cannot conveniently be separated into functions like 'research' and 'ongoing regulatory activities', and probably never converges to a state of blissful equilibrium involving full knowledge and optimum productivity' (Walters 1986:8). This is consistent with Lincoln and Guba's (1985:16) assertion that 'since all theories and other leading ideas of scientific history have, so far, been shown to be false and unacceptable, so surely will any theories that we expound today'. This introduces a degree of humility in claims for the 'ultimate truth' (Lincoln, 1985:16) and challenges many dominant natural resource management assumptions and practices. However, it does overcome the inertia common in addressing environmental dilemmas where managers may be waiting for more information to find the ever-elusive perfect solutions. As a result, it challenges the traditional concept of management that, in many cases, could not solve problems, or be creative in any way, only 'managing' symptoms or problems as they became evident (Saul, 1992:135).

Lee (1993) contended that failure in adaptive management decisions does not constitute failure among management, rather it allows for learning to contribute to the base of understanding. Furthermore, when 'solutions' are found, management is still treated as an experiment because nature is viewed as a dynamic process where static solutions will not suffice (see Figure 2.3). Just as biologists have learned that the most powerful survival principle of life is diversity; there is no single right way that works - there will be hundreds or thousands (Suzuki 1997:7). Thus, managers must be flexible to achieve their goals (Lee, 1993). By being flexible and recognising and embracing complexity, adaptive management represents a fundamental shift away form the reductionist focus of positivist science. Whilst, it still retains a repertoire of positivist tools, adaptive management uses them in the intact complexity of full-scale catchments or other ecosystems and does not reduce them to simplified and isolated laboratory experiments. Thus, it recognises the truth in a saying of Heinz von Foerster (cited in Checkland 2000):

> There is no management problem, however complex, which, if looked at in the right way, does not become even more complex (p.4).

The 'right way', as defined by adaptive management, is to work at catchment scale through a whole-system approach. Indeed, it recognises that 'the whole is more than the sum of its parts' and that complex wholes have properties unobtainable by the constituent parts in isolation (Checkland 2000:6).

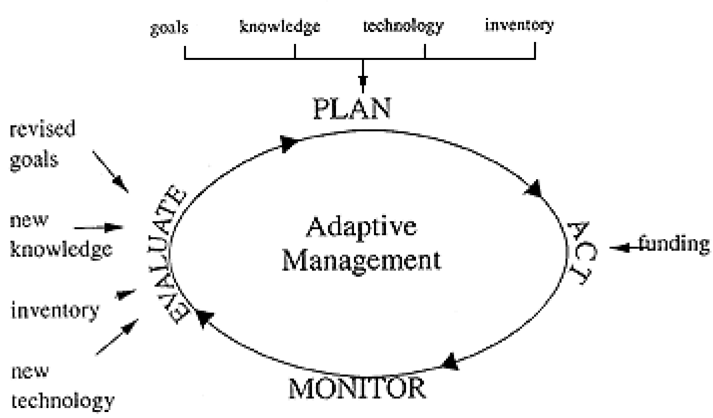

Figure 2.3 The basic adaptive management cycle *(Source: http://www.or.blm.gov/Medford/medford/adaptivemanagement.html)*

Adaptive management is increasingly being used around the world in environmental management. To date, adaptive management has been applied in forest management (eg. Shindler and Aldred Cheek 1999), salmon management (eg. Pinkerton 1999), national park management (eg. Rogers 1998), waterfowl harvesting (eg Johnson and Williams 1999), urban water issues (eg. Gilmour, Walkerden and Scandol 1999) and the focus of this study - catchment management (eg. Grayson, Doolan and Blake 1994, Ewing, Grayson and Argent 2000).

Adaptive management has only recently been practised in Australia and only a small number of these deal with catchment management. For example, water quality management in the Victorian Latrobe and Goulburn catchments (Grayson *et al*., 1994), water allocation in the Macquarie Marshes (Gilmour and Geering, 1991), urban water cycle management (Gilmour *et al*., 1999) and riparian research (Wilson *et al*., 1996). Ewing *et al* (2000) have provided an evaluation of the barriers and opportunities of the adaptive management approach used in integrated catchment management (ICM) within Australia. Community-led committees that facilitate community input and discussion underpin ICM. These groups are active in prioritising catchment issues and in developing and promoting management strategies (Ewing *et al*. 2000). Communities play a major part in developing management scenarios and providing input into the planning and modelling phases. Indeed, Dovers and Mobbs (2002) stated that:

> It is difficult to imagine that truly adaptive management will not demand anything other than *more, closer and longer* participation (p.6).

In addition, community input is also used in the development of regional ICM strategies, which involve partnerships between federal, state, and local governments and the community (Ewing *et al*. 2000). In their long-term evaluation of adaptive management in ICM in the Blackwood River Catchment, Western Australia, Ewing *et al*. (2000:444) found that directly involving the community in evaluating the biophysical, social, and economic values of the ecosystem made the planning, research and development tasks in catchment management 'unavoidably complex'.

Community integration appears to be one of the most crucial, yet difficult, aspects of the adaptive management process, placing novel demands on the researchers and management agencies. Consequently, even in the face of diminishing returns from traditional models, there remains an inherent tendency for natural resource agencies to 'side-step' the inclusion of citizens in ecosystem management (Burch 1999). Ewing *et al*. (2000) have also referred to the 'dilemma' of community participation in the traditionally science-centred decision-making processes. Following Grayson *et al*. (1997), it would appear that these reservations might be based upon inadequate information presentation. However, in terms of sustainability, the lack of integration of community information especially in the early planning and research phases seems more important. Indeed, the success of research and development is fundamentally dependent on the extent to which the outcomes are used in decision-making (Ewing *et al*. 2000). Likewise, the success of community-based research in improving environmental quality at the catchment scale.

To concentrate on the positive outcomes of adaptive management, Ewing *et al*. (2000) highlight that the process produces both tangible and intangible benefits. The tangible products include computer models, reports, and presentation packages. Perhaps more importantly however, the intangible ones include the development of common understanding and expectations, a transdisciplinary approach effective in bridging academic gaps, improved communication, direct stakeholder involvement, and a greater appreciation of the risks and uncertainties associated with management decisions (Ewing *et al*. 2000:446).

Another major hurdle to adaptive management is the explicit recognition it gives to uncertainty in ecosystem management. While, this provides its major strength - the humbleness and reflexivity to change and adapt in accordance with the social and biophysical environments - this dynamic vision does not sit well with those who oppose or refuse to recognise change. Despite the obvious crisis, many are 'deeply wedded' to traditional methodologies, disciplines and worldviews (Dovers, 2000). Unfortunately, the status quo to which they cling opposes learning, knowledge sharing (Dovers, 2000) and the recognition of uncertainty. Indeed, the issues of uncertainty and adaptation go beyond the application of adaptive management and threaten the idea of science as an immutable knowledge system. Consequently, Lee (1999) contended that adaptive management has been more influential as an idea than as a practical tool, despite the crucial nature of such social learning in future management.

Thus, there is consensus among critics of adaptive management that although it is 'scientifically sound' it is also 'socially challenged' (Johnson, 1999). The three social challenges for adaptive management identified by Johnson (1999) are (1) embracing risk as a part of management, (2) developing institutions that are amenable to adaptive management and (3) integrating stakeholders more effectively into decision-making. Greater knowledge of how citizens can actively participate in environmental decision-making in the form of citizen science (outlined next), and in particular, on-going community-based research may offer solutions to these challenges.

2.8 CITIZEN SCIENCE

Since the institutionalisation of science at the time of the 17th century scientific revolution, scientists have sought to draw a line between professional and amateur science (Gregory and Miller, 1998). This reflects the culture of 'expertise' described in Section 2.4.2. Nonetheless, science had become a popular amateur pastime by the 19th century and there were many examples of community groups who educated themselves outside of the formal education system and contributed in valuable ways to the understanding of our natural environment (Gregory and Miller, 1998). This tradition has continued and, today, there are many amateur ornithologists, geologists and astronomers that play an irreplaceable role in protecting species and contributing to our wider understanding. In addition, amateur natural historians (farmers, arborists, and fishers) are often first to warn of species decline or the impacts of introduced species and diseases (Gregory and Miller, 1998).

Citizen science (Irwin, 1995) in this section builds upon this amateur tradition and focuses on more recent ways to involve the public in science whereby citizen participation has the potential to influence the decision-making process. Citizen science in these examples is conducted in a manner more conducive to the necessary co-evolution of science and society articulated by Nowotny *et al* (2001) and more akin to the culture of research explained by Latour (1998) in Section 2.5. These more collaborative approaches to inquiry include participatory action research (eg. Fals-Borda and Anisur Rahman 1991; Foote Whyte 1991), consensus conferences (eg. McDonald 1999), citizens' juries (eg. James 1999), science shops (eg. Sclove, Scammell *et al*. 1998) and community-based research (eg. Sclove 1997) - the focus of this study where communities work alongside scientists and agency personnel as co-researchers. The following subsections explain the rationale underpinning citizen science (Irwin, 1995) as the wider context within which community-based research for catchment management is embedded.

Ulrich (2000) proposed that effective citizen participation in governance is vital in order to 'revive civil society' despite the increasing dominance and influence of science, bureaucracy and multi-national corporations. Unfortunately, current professional and scientific practice 'tends to render people incompetent in matters that affect their daily lives' (Ulrich, 2000:249). Citizen science in this context is based on several assumptions. The first is that we live in a civil society, defined by Ulrich (2000:247) as one that is democratic where 'ordinary people can effectively participate in decisions on matters of collective or public concern…and where the basic source of legitimacy lies with the individual citizen'. This means that citizens should be able to participate in decisions that effect their everyday lives.

The second assumption is that scientific decisions must be 'situated within the contexts of everyday life rather than seeking to impose (themselves) from the outside' (Irwin, 1995:181). Scientific knowledge is often criticised for lacking local application because science seeks replicability and the ability to generalise over very large scales. Suzuki (1999:18-19) laments that this dislocation from local or historical context means that the information gained is meaningless, purposeless and has no ability to affect the lives of those it should be informing.

The third assumption is that scientists and citizens can meet as *equals,* though not equally skilled individuals (Ulrich, 2000:247). It is important to note that practical knowledge about the environment traditionally, and often still, originates from the daily experience of community members (Hannigan, 1995). For example, Hannigan (1995) cited Sir Albert Howard (often regarded as the father of organic farming), who derived many of his ideas from peasant farmers in India to whom he referred to as his 'professors'. Many traditional and current flaws in scientific democracy stem from the implicit judgement that science is both superior to all other worldviews (Irwin, 1995:6) and can pass as a moral authority (Bauman, 1991:46). Salwasser (1999) made this clear when he stated:

> The role of science is to help people understand the estimated costs, benefits, and consequences of alternative courses. It is not the role of science to make people's value judgements for them (p.93).

Here we see the need to bound scientific inquiry with civic participation using the gyroscope advocated by Lee (1993). In this metaphor, science 'linked to human purpose is a compass, a way to gauge directions when sailing beyond the maps' and democratic citizen participation is a gyroscope 'a way to maintain our bearing through turbulent seas' (Lee, 1993:6).

The fourth assumption is that 'any kind of citizenship which neglects the knowledge held by citizen groups will be restricted in its practical possibilities' (Irwin, 1995:7). It is important to understand that citizens often hold knowledge inaccessible using more traditional research methods (Kruger and Shannon, 2000) and that this knowledge may greatly enhance the understanding of issues and the breadth of options available to overcome them.

The final assumption is that 'there will be no sustainability without a greater potential for citizens to take control of their own lives, health and environment' (Irwin, 1995:7). Funtowicz and Ravetz (1991) argued that broadening science to include a wider range of knowledge and source of inquiry could only be beneficial in achieving a democratic response to environmental dilemmas.

Nevertheless, there are several pragmatic and conceptual barriers to citizen science. These include the need for highly specialised and complex knowledge (Irwin, 1995; Ulrich, 2000), lack of an effective democracy (Saul, 1997), lack of community access to resources and limited community time for volunteer activities (Carr, 2002; Curtis, 2000). However, there are at least two further barriers that are directly attributable to the attitudes of scientists and agency professionals (experts). The first is that scientists often view citizens in local communities as ignorant, irrational, mislead or contrary. Moreover, that this is understood as a deficit in citizen knowledge rather than scientific conduct (Irwin 1995:4-5; Martin and Beder 1993). The second is that the majority of professionals feel that citizen participation is inefficient (Robinson, 1993; Ulrich, 2000). Often, the concerns of community members are seen as 'an expression of incompetence rather than of the existence of different valid ways to see the problem' (Ulrich 2000:248). This view runs counter to the need identified in previous sections to integrate diverse perspectives and ways of knowing. Consequently, (Stehr and Ericson, 1992) contend that many experts emphasise the exclusivity of their own knowledge as a way of maintaining their authority, hierarchy and influence, rather than seeking integration with community members.

Thus, citizen science concerns the conduct of community members, scientists, and agency professionals alike. Similarly, Irwin (1995) and Ulrich (2000) agree that community members should engage in learning that allows them to contribute in a meaningful and informed manner and that practitioners should be more reflective and act as a member of a civil society and not as a member of a privileged group. The reflective practitioner approach is discussed next and provides an insight into the conduct of both citizens and experts in the context of post-normal inquiry.

2.9 THE REFLECTIVE PRACTITIONER

> If I continue to believe as I have always believed,
> I will continue to act as I have always acted;
> and if I continue to act as I have always acted,
> I will continue to get what I have always gotten.
>
> Marilyn Ferguson

The evaluation of adaptive and participatory research approaches leads several authors to question the approach of the scientific expert. Arguably, it is difficult for experts to work with community members when traditional training and education have distanced them and where reflection and reflexivity have been excluded in their interactions because of the systematic assumption of realism in science (Beck 1992:4). Instead, Beck (1992:5) proposed that a reflexive learning process should recognise the context underpinning the scientific conclusions, draw out the social questions which now become obvious, and examine these with the range of other forms of knowledge held by people other than scientists. Being reflective involves both 'self-critical' and 'self-aware' forms of knowledge and understanding and challenges the traditional teacher-student or expert-citizen relationship (Fischer 2000; Irwin 1995:175-6). No longer is the teacher 'merely the one who teaches, but also one who is himself [sic] taught in the dialogue with students' (Freire, 1970:67). Certainly, if the scientific methodology changes then so must its exponents. This section introduces the post-normal researcher, the reflective practitioner.

The notion of reflective practice is based on the idea that skills cannot be acquired in isolation from context, unlike more technical strategies (Rose, 1992). Imel (1992:1) described reflective practice as a mode that integrates thought and action with reflection and involves critically analysing one's actions with the goal of improving professional practice. Argyris and Schon (1974) were some of the first to present such an alternative. They rejected the model of the technical expert who is presumed to know and claims to know, in favour of the reflective practitioner who assumes both the citizen and the professional has relevant knowledge (Argyris and Schon, 1974). Whereas the technical expert maintains an objective distance, the reflective practitioner seeks firsthand the client's ideas thoughts and feelings (Argyris and Schon, 1974).

Reflective practice has been popularised in the professional literature by Donald Schon's research published in 1983 and 1988. According to Schon (1988) there are two kinds of reflection: reflection on action, which occurs after the activity, and reflection in action, which occurs during the activity. Kottkamp (1990) referred to these modes as 'offline' and 'online', respectively, and contended that the 'online' mode may be more effective in improving professional practice. In the same way that adaptive management allows for experiment and adjustment in the real world situation, reflection in action allows for continued contextual learning. Schon (1983) contended that by reflection in action, a professional is freed from established theory and techniques and is able to devise a new method for each novel situation. In order to enhance general practice, a reflective practitioner must also be able to communicate such tacit knowledge and share professional skills (Osterman, 1990).

From an educational perspective, Ross (1989:22) has summarised the phases of the reflective process which are equally valid for any research topic or problem solving:

- Recognising a dilemma
- Responding to a dilemma by recognising both the similarities to other situations and the unique qualities of the particular situation
- Framing and reframing the dilemma
- Experimenting with the dilemma to discover the consequences and implications of various solutions
- Examining the intended and unintended consequences of an implemented solutions by determining whether the consequences are desirable or not.

These phases are consistent with the adaptive management approach, but what does this process demand of the individual researcher, practitioner or community group? Ulrich (2001) answered this question by contending that a reflective practitioner is one that is self-reflective, self-correcting and self-limiting. This requires much more than knowing what methodology to choose and how to apply it to the research question. For Ulrich (2001) a reflective practitioner will constantly refer to the following three practices throughout the research process. First, they would critically examine the role they are expected to play. Secondly, they would analyse which model of relating theory to practice is most suited to the research task. Thirdly, in practical situations the researcher would seek all stakeholders, and encourage their participation where feasible.

The first practice involves asking oneself what difference should this research make? What is the question that I am trying to answer? Ulrich (2001) stated that:

> Your personal vision of the difference that your research should make can drive the process of thinking about your research more effectively than any other kind of reflection (p.6).

The second practice involves being more concerned about the research outcome than the research methodology. This involves questioning the assumptions in supporting theories and practice so that the researcher's actions are consistent with their intent (Imel, 1992). Indeed, it is only through an awareness of the researcher's own assumptions that they can become conscious of any inconsistencies between their actions and aspirations (Osterman, 1990; Schon 1988).

The third practice, referred to by Ulrich (2001) as the pragmatic maxim, recognises that when research is on a topic as applied as catchment research, it will have implications for the world of social practice and also individual and collective lives. Thus, the researcher needs an in-depth understanding of the research topic as well as the kind of improvement that is required. Often this is best done by asking all those people whom will be affected in any way by the research recommendations. This involves considering all the implications of research within the inevitable boundary judgements and highlights the importance of asking the fundamental questions to which catchment research and management should respond. The reflective practitioner, unlike the technical expert realises that it is better to ask the right questions without having the answers than to have the answers without having asked, and continuing to ask, the right questions (Ulrich, 2001).

By considering the inevitable boundary judgements, Ulrich (2001) argued that we have answered the question of whose knowledge counts:

> The question of what counts as knowledge, then, is no longer a question of the quality of empirical observations and underpinning theoretical assumptions only; it is now also a question of the 'proper' bounding of the domain of observation and thus of the underpinning value judgements as to what ought to be considered the 'relevant' situation of concern. What counts as knowledge is always at the same time a question of what ought to count as knowledge. We can no longer ignore the practical-normative dimension or research or relegate it to a non-rational status (p.12).

The role of citizens in knowledge production and issues of democratic participation are central to the application of research to real-world or local issues where Ulrich (2001) argues that experts have no advantage over 'ordinary' citizens. This point alone seems to validate community-based research which is discussed next.

2.10 COMMUNITY-BASED RESEARCH

In the face of ineffective legal and economic strategies there is increasing recognition that *active* public participation is fundamental to changing societal behaviour and achieving sustainable development (Davis, 1996). Shifting from passive, consultative and incentive-driven forms of participation towards the more interactive end of the participation spectrum is vital (Pretty, 1995a). Certainly, increased public interaction 'relies on decentralisation, collaboration, citizen participation, and a holistic worldview that seeks to simultaneously promote environment, economy, and community' (Weber, 2000:237). Thus, this section concerns community-based research, an evolving form of participatory inquiry that seeks to involve a wider cross section of community in natural resource management. As this analysis reveals, community-based research is essentially about social learning and action - learning about ourselves, our relationship with others and the environment, and our potential active role in society. Public involvement in environmental decision-making should primarily be a form of social learning where the breadth of social actors goes beyond the traditional national governments and technical experts (Davis, 1996). Basic to community-based research is the link between knowledge and power (Fischer, 2000).

Implicitly, the participants in community-based research must be the subjects, and not the objects of the process (Bopp, 1994). Thus, the participants are viewed as citizen scientists.

I wish to acknowledge that citizen juries, consensus conferences, future search and the Dutch-based concept of science shops, are all useful citizen science strategies for solving specific environmental problems and may involve a representative cross-section of the community. Indeed, Ulrich (2000:250) observed that community learning is already occurring as citizens learn to make better use of the media and communication systems, organise themselves into new social movements, make efficient use of the legal system and engage in participatory forms of inquiry. However, unlike adaptive management and community-based research, their rigid formats and confined focus in terms of issue and time mean that they are indicative of a more representative than participatory approach to democracy and are less likely to sustain community capacity building. They leave the process and community ultimately vulnerable to external manipulation. Consequently, these final sections focus on community-based research and explore how its characteristic features could facilitate community capacity and cohesion whilst working to solve environmental issues.

2.10.1 Participatory research origins

Community-based research is a recent variant of what may be described as participatory inquiry or participatory research. Participatory research was initially inspired by critical theorists such as Paulo Freire (1970) and is characteristically identified with Third World communities (Fischer, 2000; Kapoor, 2001) seeking sustainable methods for subsistence agriculture (see Chambers 1994a; Chambers 1994b; Pretty 1995a; Pretty 1995b; Pretty 1998). Although, catchment management within Australia is conducted in a vastly different environmental and political setting, I would like to review the lessons from participatory research first, as it is a more established form of participatory inquiry that forms the foundation of community-based research as it is applied in this study.

Participatory research derives from activist participatory research, agroecosystem analysis, applied anthropology, systems farming and rapid rural appraisal (RRA) (Chambers, 1994a). Chambers (1994b) asserted that participatory research approaches enable local people to 'express, enhance, share and analyse their knowledge of life and conditions, to plan and to act'. The main tenets of this approach that distinguish it from positivist science have been outlined by Kapoor (2001):

> Whereas the orthodox scientific approach saw reality as universal and objective, the new approach sees it as socially constructed and culturally specific. 'Truth', 'fact' and 'cause-effect' are not revealed through the single lens of the outside 'expert', but constructed inter-subjectively through the multiple perspectives of all relevant program participants or 'stakeholders'. Rather than outside program managers and policy-makers unilaterally defining environmental programs, stakeholders are empowered, through a process of group learning and consensus building, to create and manage their own programs (p. 271).

In addition, Kapoor (2001) stated that local communities are encouraged to develop this participatory process on their own, or with the help of outsiders who act as facilitators of the process. In this way, Kapoor (2001) believed that the focus of research switches from efficiency to the process through which knowledge is acquired and decisions are taken. Ultimately, the politicisation and democratisation of the environmental management process assists the transition from expert dominance to citizen participation grounded in community values (Kapoor, 2001).

To date, the majority of examples of participatory research in environmental quality and community development arise from the South or developing nations. Despite its success in these countries, there is little research, and even less application of such research within Australia or other developed countries. Indeed, beyond the communication of particular participatory approaches there is little debate or assessment of the value that these approaches may have in the Northern setting (Flower *et al*. 2000).

Flower *et al* (2000) contended that while there are differences between the 'North' and the 'South' (the majority of Northern countries have established and stable governments, welfare assistance and some form of democracy), there is still poverty among the predominant wealth. Poverty in this instance is not merely an economic situation, but increasingly is recognised as featuring such factors as the prevalence of preventable illness, needless hunger, premature mortality, unceasing illiteracy rates, social exclusion from decision-making processes that affect peoples' lives, and the denial of political liberty (Flower *et al*. 2000; Sen, 2000). Moreover, whilst everyone of legal age may participate in national elections every three to four years, the globalisation of economies means that this form of participation does not lead to the control of people over their own lives that it once did (Flower *et al*. 2000). This augurs well for the emphasis of bottom-up approaches.

presents a summary of participatory research, derived from Chambers (1994a) and Pretty (1995a). These principles offer an insight into how this strategy involves communities and how it might be applied to community-based research within Australia or elsewhere. Participatory research, as with traditional science, has a defined methodology and involves systematic learning. Summarising the work of Pretty (1995a) and Chambers (1994b) highlights several principles that distinguish participatory research from positivist science and ensure that its findings are trustworthy (see Table 2.5).

Table 2.5 The principles of participatory research

Principle	*Rationale*
Inclusive stakeholder participation	Participation from all stakeholders is required before change can be effected.
A reversal of learning	Unlike traditional science, which attempts to teach people or to impose information and solutions, participatory practitioners learn from local people directly. Local insight on physical, technical and social matters are all important.
Offsetting biases	This is involves seeking multiple perspectives and ensuring that the nature of participation is democratic. Practitioners should actively seek all concerned in an 'unimposing' rather than 'important' manner. It is also an opportunity for practitioners to learn of community concerns equally from all sectors.
Contextual sustainability	Practitioners must recognise that context and individual values define sustainability. Thus, definitions of sustainability are unique to each specific community.
Rapid and progressive learning	Methodologies are flexible and adaptive in approach recognising that change is both constant and inevitable. Thus, it is key for social actors to have the capacity to continually learn and adapt. Indeed, problems are never entirely solved and are always vulnerable to uncertainty in this changing world.
Optimising tradeoffs	The costs of learning are always considered in relation to the relevance, quantity, accuracy and timeliness of the information.
Triangulating	This involves seeking information from a variety of sources so information can be assessed, compared, and ultimately validated. This can be achieved by variation in method, place, individual, time, discipline etc.
Self-critical awareness	Practitioners and facilitators must constantly examine their own actions and view error as an opportunity to learn.
Personal responsibility	Rather than following textbook generalisations or rigid rules, facilitators use their own judgement appropriate to the situation at hand.
Sharing	The sharing of information and ideas among the community and with external agents and other communities is encouraged.

Source: Adapted from Pretty (1995a) and Chambers (1994b)

These principles embrace the practicalities of citizen science, recognising that knowledge is socially constructed, and what communities need most are techniques and knowledge relevant to their unique personal situation. Consequently, participatory research provides solutions that community members can enact themselves. Thus, communities are empowered into greater self-reliance, confident in their own knowledge construction.

2.10.2 *Contemporary community-based research*

In recent times the principles of participatory research have been applied to a small but growing number of collaborative research methods in developed nations (Fischer, 2000). This approach is referred to as community-based research in the United States (Sclove *et al* 1998). This is the form of research focussed on in the rest of this study as it explicitly acknowledges the role of community - a social organisation vital to sustainability (see Section 2.3.1). Sclove *et al*. (1998) defined community-based research in this way:

> Community-based research is research that is conducted by, with, or for communities (eg. with civic, grassroots, or worker groups throughout civil society). This research differs from the bulk of the research and development conducted…which…is performed on behalf of business, the military, the federal government, or in pursuit of the scientific and academic communities' intellectual interests (p.1).

Community-based research is post-normal research that involves community groups keen to know the research results in order to achieve constructive social change through action (Sclove *et al*. 1998). Fischer (2000:xii) contended that such participation can 'bring forth new knowledge and ideas capable of creating and legitimating new interests, reshaping our understanding of existing interests, and, in the process, influencing the political pathways along which power and interests travel'. Consequently, community-based research has the ability to produce unanticipated and far-reaching auxiliary benefits (Sclove *et al*. 1998). For example, the increased relevance of locally-based research (eg Winkler Prins 1999); increased community support for research and management initiatives through facilitation of a common vision (eg Burroughs 1999: Kruger and Shannon 2000); a greater pool of knowledge to draw upon (eg Rhoads *et al* 1999); and, a more complete understanding of social systems and citizen empowerment (eg (Kruger and Shannon, 2000). Therefore, community-based research is unlikely to harm social and environmental systems and is more likely to prevent or remedy such degradation (Sclove *et al*. 1998).

This approach is championed in the United States by organisations such as the Loka Institute and people like Richard Sclove to deal with a variety of issues, most notably public health. It has been popularised by discrete cases including Woburn and Love Canal. However, it is equally suitable for application in natural resource and catchment management and academics, including Salwasser (1999), are now beginning to state that scientific research has a new and significant role to play in natural resource management.

It is not merely the objective collection of facts to be used in later top-down management, but rather a way to work with communities in seeking consensus decisions about management options. Thus, one of the defining features of community-based research is collaboration between experts and grassroots groups (Sclove *et al* 1998).

Local, grass-roots ecosystem management (GREM) is an environmental movement gaining momentum in the United States and is a recent example of community-based research. Weber (2000) stated that GREM represents a new challenge to the existing premises of natural resource management. GREM is qualitatively distinct from previous community environmental initiatives (eg. preservation and conservation) and represents a participatory research approach to environmental issues (Weber 2000):

> By relying on decentralisation, collaboration, and citizen participation, and by adopting a holistic worldview that seeks to meld ecology with economics and the needs of community in pursuit of symbiotic sustainability, grassroots ecosystem management (GREM) arrangements may be redefining the language of environmentalism. It is not the preservation environmentalism of John Muir, or the conservation environmentalism of either Gifford Pinchot or Aldo Leopold, much less the top-down environment over economy approach preferred by the contemporary environmental movement (p. 238).

Indeed, it is not the components that are novel, but their combination, choice of institution and approach to science and technology that transforms this into a distinctive community movement (Weber 2000:238). Weber (2000:238) stated that this new philosophical approach has wider implications for democracy and policy formation, while also recognising that despite its distinctiveness, there exists a functional interdependence with established natural resource institutions. For example, Alexandra *et al* (1996:18) proposed that community-based research and monitoring have a 'great capacity to deliver dense information, rich in detail at the appropriate scale to assist and improve environmental management' (cited in Harding, 1998:103). Indeed, these are all examples of what Nowotny *et al* (2001) described as 'strongly contextualised knowledge'. Nowotny *et al* (2001) stated that:

> It is important to emphasise that strong contextualisation not only shapes research agendas and priorities, but also influences research topics and methods. It enters into the process of knowledge production and therefore leaves visible traces in 'the science' itself. It does so by altering the perspectives of the researchers - and so their definitions of problems and of what constitutes valuable research (p. 132).

Thus, strong contextualisation thrives on communication and continued interaction, which may lead to new approaches or the definition of new problem areas (Nowotny *et al* 2001:132). Indeed, the role of environmental groups has developed from more traditional nature conservation to a more active representation. This has involved increasing memberships, financial resources and competence (Janicke, 1997). Table 2.6 from Janicke (1997) illustrates this development.

Table 2.6 Stages in community group capacity development

Stages in Capacity Development: Community Groups in Environmental Protection
Local organisations, no clear autonomous national interest organisation
Weak or non-professional national interest organisations
Strong and highly competent green organisations, playing a consultative role in political decisions
Green organisation also playing a consultative role in industry

Source: Adapted from Janicke (1997)

I have now presented a new role for community environmental groups, but who from the community actually participates and what skills and knowledge do they possess beyond the intrinsic and local? In addition, what are the constraints on this role and how is it perceived by experts?

2.10.3 Barriers to community-based research

The literature reveals that barriers to increased community-based research stem from two main sources. The first is that many experts have a negative perception of the citizenry whereby citizens are deemed incapable of undertaking worthwhile research. The second is that citizens lack sufficient resources to support valid research.

In the first instance, the public participation and citizen science literature suggest that scientists and agency professionals do not hold community members in high regard, generally viewing them as the lowest common denominator (see Martin and Beder 1993). This conceptual barrier stems from the deep-seated citizen/expert dichotomy that has been referred to in earlier sections (see Fischer 2000; Saul 1992). For example, community data is often considered inferior to 'scientific' or 'real' data. The irony of this concern is emphasised in Gill's paper entitled 'But how does it compare with 'real' data?' (Gill, 1991). Here Gill provided a comprehensive comparison of Nepalese farmers' perceptions of rainfall patterns with 20 years of daily rainfall data measured at a nearby rainfall station. Gill found that in many respects the farmers' description was more comprehensive than that provided by the averages from the rainfall station. Indeed, evidence shows high validity and reliability of local community information (Chambers, 1994b). Nevertheless, Pretty (1995a) observed that community approaches continue to be characterised as subjective, undisciplined, sloppy and informal. Agencies and scientists are yet to recognise that there is no absolute truth, only truth for a given time in a given context (Pretty, 1994). In addition, many authorities dismiss wider public involvement as less controllable, less precise and, therefore, likely to slow planning (Pretty, 1995b).

The above concerns represent a lack of understanding of community-based research participants - their knowledge, skills and dedication. Such limited scientific and agency understanding leads to threatening decision-making environments, community fear of agencies (Murray, 1954) and a lack of effective facilitation strategies (Funtowicz and Ravetz, 1993). Certainly, we appear to lack the alternative political culture and participatory institutions that Offe (1985) contended are basic to the efforts of community-based groups.

Weber (2000) provided an analysis of the types of people participating in such movements. In contrast to the dominant expert perceptions, he concluded that core members are citizens with time, resources, and a personal stake in the local community - in terms of finances, length of residence, children, or all three. In Weber's study, participants were commonly small business owners, professionals including lawyers, doctors, public land managers, retirees or they represented major stakeholders in environmental or economic decision-making within the community (eg. a local environment group or a major corporation) (Weber 2000:240). Moreover, core members, on average, had significantly more education and earn higher incomes than other citizens. In addition, 85% had college degrees with 21% of these being advanced degrees. Finally, that core members were often the 'old growth' of a community, having resided in the area for 20 or more years. Similarly, research by Beck (1992) has shown that members in local interest groups tend to be better educated and more likely to actively inform themselves than other community members. Thus, in local issue or risk positions, 'consciousness' (knowledge) determines 'being' with citizens becoming small, private, alternative experts in modernity or post-normal science (Beck 1992:53-61).

The growth in community-based research (environmental monitoring in particular) appears to blur the distinction between the different sources of knowledge (see Table 2.1). Increasingly, community groups are producing quantitative data on local environmental conditions and the relevance of local and indigenous knowledge in environmental decision-making is being recognised as complex environmental issues present novel challenges for 'expert' knowledge (Harding, 1998).

However, in addition to the attitudinal barriers already described, increases in community-based research are also hindered through lack of resources. The resource issues and barriers are undisputed and common to most volunteer movements. Certainly, Huitema (1998) is adamant that public participation requires money, expertise and support from authorities. This includes a budget to hire external experts or the means to network with other communities. Unfortunately, many (eg. Dovers, 2000) have observed that the current level of resourcing is inadequate to allow community-based research to 'solve' the complex, far-reaching environmental problems that communities are faced with.

2.10.4 Future issues for community-based research

To date there has been little evaluation in the literature of the extent and influence of community-based *research* (that is where community members are involved in *all* stages of the research process including problem definition, scoping, data collection, analysis and interpretation, action and finally evaluation) on natural resource decision-making or social capital. This is important to evaluate because as Pretty (1995), Bressers *et al*. (1998) and Kapoor (2001) have observed, the best results occur when people are involved in decision making during all stages of research - from definition to evaluation.

Within Australia, groups such as Landcare, Waterwatch, Coastcare, Bushcare and Saltwatch conduct community-based environmental research. These groups are shaped by the changing social and political contexts in which they are embedded and represent an extension or replacement of traditional community institutions including the Country Women's Association (CWA) and voluntary fire brigades (Dovers, 2000). Dovers (2000) cited problem agreement, community will and commitment, the provision of institutional arrangements and policy processes and programs, and the development of trust and partnerships between policy, science and community as key to the growth of such participation within Australia. Yet, community input from these groups is often confined to only one aspect of the research process. This commonly involves consultation or the provision of monitoring data and means that these forms of participation have little potential to empower communities. If environmental quality is to be sustained through increased social capital then following the arguments of Pretty (1995) and Bressers *et al*. (1998), the process of research is as important as the final 'solution'. This is clearly stated by Clark (1999):

> The process of planning is often more important then the plan itself; and the process we use to make decisions can be the key to whether the decision itself is understood and accepted… it will be necessary that it feature an open process that fairly considers all points of view and fosters mutual learning and an adaptive approach (p. 81-82).

However, this view begs several questions in addition to those already posed in the previous section on citizen science. If successful participation is defined as a process that ensures the community voice influences decision-making and makes a constructive difference to the communities involved (Sclove 1997; Coenen *et al*. 1998), where and how should the community be involved in environmental research to achieve this? Where are the optimum tradeoffs in participation, given limited time and resources? Certainly, finding effective ways of involving a wider cross-section of community is a fundamental challenge (Funtowicz and Ravetz 1993). Moreover, as community research becomes accepted by institutions, issues of scaling up and mainstreaming identified by Dovers (2000) and Flower *et al*. (2000) emerge. Future challenges will require the development of local processes that can contribute to larger scale processes and problem solving. Consideration must also be given to how participation can be supported by institutionalisation whilst still retaining the distinctive and diverse community elements prized by participatory advocates.

Indeed, there are many advantages and challenges associated with community-based research. Nonetheless, it appears that one of the greatest advantages of and opportunities for community-based research is its ability to foster the networks and interaction that underpin social capital. Social capital as a mechanism vital for achieving sustainable local communities is discussed next.

2.11 COMMUNITY-BASED RESEARCH AND SOCIAL CAPITAL

In the first section I proposed that ecological and human systems were in fact interconnected parts of the same system. Furthermore, that social poverty where people are excluded from societal decision-making processes is a major cause of environmental degradation. Thus, environmental problems through their origins and consequences are social problems (Beck 1992), with Agyeman and Evans (2002) highlighting that there can be no environmental quality without social quality. Indeed, resource management is really people management (Berkes and Folke, 1998). Therefore, the strategies that we employ towards sustainability will be largely social and will to a large extent depend on the functioning of our fundamental social organisation - the community. As Suzuki (1997) contended:

> Stable communities and neighbourhoods are a prerequisite for happiness, for productive and rewarding lives, for a crucial sense of security and belonging. They are a bottom line for the health and happiness of human beings (p.174).

Similarly, the main implication for the debate on sustainable development is that long-term strategies must include concepts for community capacity building and improving the conditions for environmental action. We must seek to build community (Janicke 1992). This assertion is consistent with Chapter 37 of Agenda 21, which states that:

> The ability of a country to follow sustainable development paths is determined to a large extent by the capacity of its people and its institutions as well as by its ecological and geographical conditions. Specifically, capacity-building encompasses the country's human, scientific, technological, organisational, institutional and resource capabilities.

Woolcock (1998:207) has also concluded that 'the structure of the state, the nature and extent of its involvement in civic and corporate life, and the organisation of society together constitute the key factors determining whether a country succeeds or fails in development'. Social capital is increasingly recognised as the galvanising link between the resource capabilities listed in Agenda 21. It is important because it shapes and defines the way social actors interact at all levels in society. Certainly, as both a precursor and consequence of successful policy, social capital provides a 'vital backdrop' for effective policy (Putnam, 1999). Indeed, 'the relations within and between social groups at different levels of society shape the prospects for sustainable, equitable growth and just, participatory governance' (Woolcock, 1998: 207).

In particular, social capital enhances community capacity for local problem solving by enabling greater community access to political participation (better education, political awareness etc.), and a simultaneous decline in top down approaches to governance (Sirianni and Friedland, 1995). Thus, Sirianni and Friedland (1995) argued that the communities that posses social capital have the ability to become 'elite-directing' rather than 'elite-directed' and can extend their citizen participation rights. In contrast, top-down approaches can only have limited effect on environmental problems that are diffuse, necessitate preventative changes and depend on social change (Sirianni and Friedland, 1995). Putnam (1995) also highlighted the important role that social capital plays in achieving a democracy. This is important in a time where the complexity of problems is steadily increasing whilst the capacity of hierarchical, regulatory and redistributive approaches to deal with these problems is proving futile (Sirianni and Friedland, 1995).

Using social capital, we can understand how individuals, groups and societies produce, distribute and use non-economic resources that are essential to profitably 'manoeuvring' within all social constructs (Foley and Edwards, 1999). Indeed, social capital investment enhances the benefits of investment in physical and human capital and demonstrates how non-monetary forms of capital can be powerful and influential (Portes, 1998; Putnam, 1999). This is borne out by James Coleman's research on private school success (Coleman, 1988). Here he concludes that individual academic success is attributable to parental and community involvement in school activities, rather than individual attributes or superior classroom teaching or facilities. Similarly, investments in environmental restoration or management are more effective if supportive community associations are also active. Thus, it is the social framework in which resources are embedded that is important in determining the utility to individuals and groups (Foley and Edwards, 1999).

Social capital is the key to unleashing the potential of community as a vibrant local network. Unfortunately, like all public goods social capital is undervalued and often under-provided by private interests or institutional externalities (Pretty, 1998). The costs of such a loss are not borne by the externalities, but rather the entire ecosystem and society pay (Pretty, 1998). Therefore, this section explores how social capital may accrue from community-based research. Indeed, Brosius *et al* (1998) concluded that the idea of community-based natural resource management offers great promise for addressing the link between concerns about social justice and environmental destruction.

2.11.1 Defining social capital

Social capital is not a new term, although it has gained recent popularity and application in a broader range of fields and settings than originally conceived. This had led to considerable debate over its meaning and uncritical application in certain contexts. Fukuyama (2001) provides a concise definition:

> Social capital is an instantiated informal norm that promotes co-operation between individuals. In the economic sphere it reduces transaction costs and in the political sphere it promotes the kind of associational life which is necessary for the success of limited government and modern democracy (p.7).

Social capital theory is useful for understanding local processes of resource mobilisation, economic development, and political structure (Foley and Edwards, 1999) and how collective action can be facilitated through co-ordination, communication and amplifying reputations (Putnam, 1995, 1999). This section does not attempt to develop a theory of social capital. Rather the central concepts of the evolving research on social capital are defined to illustrate firstly the democratic and empowerment benefits of social capital to communities, and secondly how community based research could potentially facilitate positive social capital.

As a conceptual introduction, social capital may be viewed as analogous to economic and human capital. Portes (1998) stated clearly that 'whereas economic capital is in people's bank accounts and human capital is inside their heads, social capital inheres in the structure of their relationships'. The WorldBank (2000) referred to social capital as 'the institutions, relationships, and norms that shape the quality and quantity of a society's social interactions'. It is more than the sum of individual community parts and has been described by Potapchuk *et al*. (1997) as the glue that holds a community together. Therefore, social capital is an ongoing process and not an outcome to be achieved (Flynn *et al*. 1994).

Social capital terminology originated in nineteenth-century sociology and has been attributed more recently to the work of Pierre Bourdieu and James Coleman. Bourdieu saw social capital as the benefits and opportunities accruing to people through membership in certain communities. Similarly, Coleman (1988) viewed it as a resource of individuals that emerges from their social connections and interpersonal relations. These are context dependent and social structural/relational approaches (see Foley and Edwards, 1999). Robert Putnam and Alejandro Portes have since been influential in developing social capital theory. To date the concept of social capital has been conceptually stretched from individuals to communities and even nations. Kilpatrick *et al*. (1998) proposed that although utilised by both groups and individuals it inherently belongs to groups. Consequently social capital has a variety of meanings and is widely cited in political, social and economic studies (Woolcock, 1998). Woolcock (1998:152) asserted that the term 'risks trying to explain too much with too little'. However, perhaps this last criticism is unfair. The shift away from individual to communities and nations reflects the interconnectedness and interdependence of these entities, which has been previously disregarded. This connectivity is further emphasised in modern times with the rise in communication and transport technologies and the consequent emergence of the global community.

There is widespread debate over the distinction between social capital requirements and utility and there appears to be a fine line between process and outcome. Portes (1998) accused several authors of making tautological statements by confusing social capital with the resources it makes accessible. He distinguished between (i) the possessors of social capital (those making the claims), (ii) the sources of social capital (those agreeing to these demands), and (iii) the resources themselves. Resources, trust, reciprocity and networks are all necessary components, but they are not independent of positive social relationships and cannot be considered as social capital alone (Woolcock 1998; Foley and Edwards 1999). Thus, they may indicate a certain type of social capital, but they do not represent social capital itself. For example, Foley and Edwards (1999) saw trust as a positive outcome, rather than a prerequisite of, social capital.

Foley and Edwards (1999) presented a coherent model of the components of social capital (Figure 2.4). In this model social capital requires both an awareness of the resource and a relationship that gives access to the available resource. As Kilpatrick *et al* (1998), Falk and Kilpatrick (1999) and Foley and Edwards (1999) have pointed out, potential social capital can only be determined by knowing the quantity and quality of the available resources. Thus, social capital is contextually dependent on its 'use value' and 'liquidity', or resources plus network access (Foley and Edwards, 1999). Unfortunately, neither access nor distribution of social resources is evenly distributed within society (Foley and Edwards, 1999).

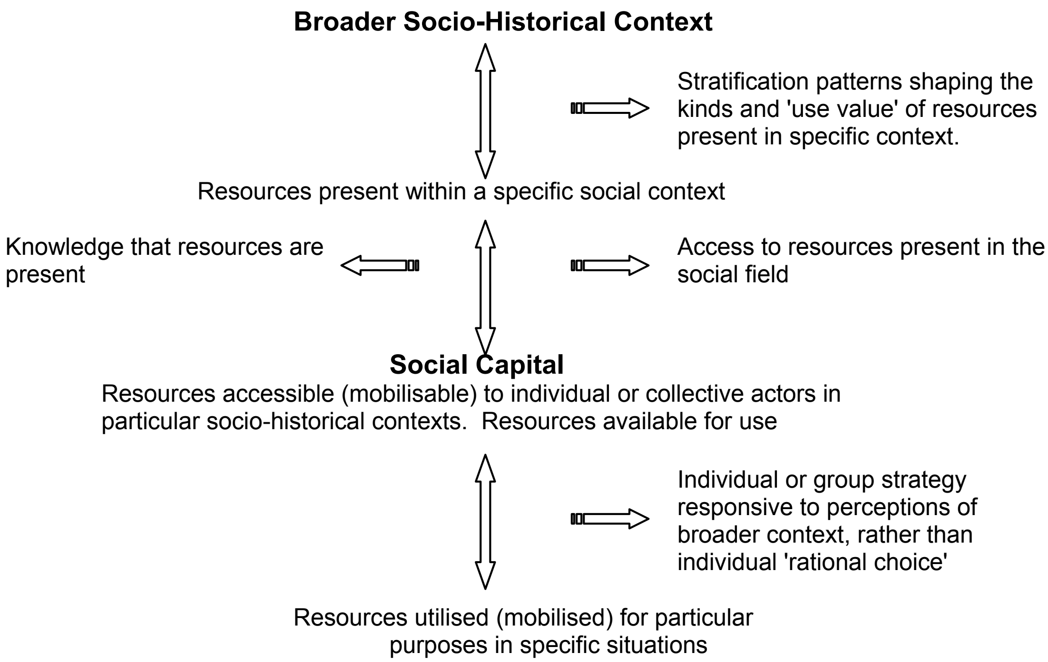

Figure 2.4 A model of social capital *(Source: Foley and Edwards (1999)*

Foley and Edwards' (1999) model is consistent with Woolcock's (1998) contention that definitions of social capital should focus on sources of social capital rather than consequences. In other words social capital is a process. Consequently different types of social capital arise between differing social contexts. These may be generally classified as either horizontal or vertical concepts of social capital (WorldBank, 2000).

Horizontal associations

Based on a narrow conception of community and a confined social context, these associations include only associations between similar individuals. Although unconstrained by geographic location, group membership is exclusive and likely to be contingent on race, religion or profession. Although these groups enhance co-operation and co-ordination among group members, there is a 'downside' to horizontal social capital (Portes and Landholt, 1996). In horizontal associations the benefits usually accrue to group members only and can actually hinder cultural development and work against society's collective interests. The same social ties that bind the group together also exclude outsiders (Portes and Landholt, 1996). Fukuyama (2001) extended this argument to state that such groups can produce abundant negative externalities for the society in which they are embedded. Examples include Jewish diamond merchants (Coleman, 1988), Ku Klux Klan and the Mafia (Fukuyama, 2001), and street gangs and drug cartels (World Bank 2000). Consequently, Fukuyama (2001) observed that social capital was less likely to be viewed as a social good compared to other forms of capital. Indeed, group cohesiveness often comes at the expense of ambivalence towards non-group members. This appears to be due to group members having a very narrow circle of trust (Fukuyama, 2001). Therefore, when measuring social capital it is very important to consider the true utility of social capital net of its external consequences (Fukuyama 2001:8).

Vertical and horizontal associations

These require a broader concept of community and may or may not be geographically defined. The important difference is that these associations include vertical as well as horizontal associations between groups and individuals. In this definition horizontal connections give communities identity and purpose, but vertical ties are also needed to overcome social divides (World Bank 2000). In this way cultural development is enhanced as networks are extended and information and resources are more widely distributed. Thus, if community-based research represents a collaborative effort between citizen scientists and expert scientists it appears to have the potential to facilitate cultural development.

Thus, it is important to define positive social capital in the context of this study where it is posed as an outcome of community based research and a precursor to environmental quality and where horizontal and vertical associations may be viewed as micro and macro level associations respectively. Woolcock (1998) concluded that positive outcomes prevail when social relations are attained at both levels and are 'optimised not maximised'. Indeed, Putnam has been widely criticised for ignoring the 'downside' of social capital (Portes and Landholt, 1996), avoiding politics and political structure (Foley and Edwards, 1996) and neglecting the influence of macro-economics on civic engagement (Skocpol 1996, cited in Foley and Edwards 1999). Kilpatrick and Falk (1999) argued that wider, external interactions are necessary if communities are to adapt and change. They proposed that a community with greater access to knowledge and resources from a broader cross-section of society has a wider pool of social capital to draw upon, and stands to gain potentially better outcomes. For example, in an organisation it is efficient to have workers who are at the sources of local knowledge authorised to make their own decisions, rather than referring up a managerial hierarchy (Fukuyama 2001:10). However, this is entirely dependent on the social capital of the workforce.

Woolcock (1998) highlighted the importance of a dynamic and co-operative relationship between top-down resources and grass-roots capacity building in order to solve problems or maximise opportunities. Therefore, if community-based research is going to contribute towards sustainable communities by producing social capital, it must contribute to an inclusive concept of social capital, one as Falk and Kilpatrick (1999) contended with 'the potential to contribute to the social, civic or economic well-being of a community-of-common-purpose'. Put simply, social capital should provide the means with which communities can achieve their collective goals.

2.11.2 The requirements of social capital

As discussed, the social capital process both requires and develops trust, rules or norms, reciprocity and networks between individuals and groups (Portes and Landholt 1996; Kilpatrick, Bell *et al*. 1998; Pretty 1998). Unlike conventional capital, social capital increases and self-reinforces with use, acting as a resource that enables people to achieve their personal goals (Potapchuk *et al*. 1997; Pretty 1998 and Putnam 1999). An explanation of each of these is required before we can set about understanding how each is interrelated and can be developed to build social capital.

Trust

Trust is considered a vital component in all literature covered. There is consensus that it takes time to build but is easily broken. Trust facilitates co-operation and lowers transaction costs (Pretty, 1998). This includes the trust we have of both individuals and the social structure that we are familiar with (Pretty, 1998). Where trust is present individuals have confidence in collective activity knowing that others will act as expected or in supportive ways (Bullen and Onyx 1998; Pretty 1998).

Reciprocity

Reciprocity refers to mutual exchanges between individuals and groups. Pretty (1998) identified specific reciprocity, which refers to immediate exchanges of equal value; and diffuse reciprocity that is continuous and balances out over time. The latter is best conceived using the analogy of a favour bank. Participating individuals can invest by giving and doing for others; safe in the knowledge that subsequently they may draw assistance on that favour in future. In other words 'I'll scratch your back if you'll scratch mine'. When favours are consistently returned, reciprocity increases trust. Indeed, Putnam (1999:76) stated that 'co-operation is most easily sustained through repeat play'.

Rules and social norms

Rules and social norms are important where collective action is desired. Mutually agreed rules express norms of behaviour that elevate group interests above those of individuals (Pretty, 1998) and ensure rational decision-making. An important point illustrated by Coleman (1988) is closure, or the existence of sufficient ties between a certain number of people to ensure the observance of norms. This is exemplified in his example of Jewish diamond traders in New York. If any member of this community defects the threat of ostracism from family, church and community ensures compliance (Coleman, 1988). This form of social control renders formal, institutional sanctions unnecessary (Bullen and Onyx, 1998).

Networks

Central to all definitions of social capital are the existence of comprehensive networks between individuals and groups. It is these networks which provide access to resources. Bullen and Onyx (1998) stressed that these must be equal and voluntary connections to ensure that citizens work collectively and not as individuals because individual actors do not generate social capital. The capacity to form networks between horizontal and vertical associations is vital to positive social capital.

Resources

Social capital may be viewed as a resource. However, using the definition developed from Foley and Edwards (1999) where social capital equals access plus resources, resources entail whatever communities require to achieve their goals. In the case of water quality this may be scientific knowledge, technical assistance and advice, equipment, funding, transport etc.

2.11.3 *Building community by fostering social capital*

Consistent with the decline in more traditional notions of community, social capital has been eroding in both rural (eg Pretty, 1998) and urban areas (eg Putnam, 1995) with a consequent decline in quality of life (evident in UNDP Survey[10]) and an increase in environmental degradation. Thus, it needs recreation with new approaches to policy and practice (Pretty, 1998). Despite considerable debate in the literature over definitions of social capital, there is little to suggest how it might be created or sustained (Falk and Kilpatrick, 1999). Indeed, Putnam (1995) referred to communities being 'blessed' with social capital. Certainly, 'communities become rich because they are civic, not the other way around' (Putnam, 1995). However, many academics (eg. Falk and Kilpatrick 1999) point out that social capital cannot be created unless sufficient opportunities are provided.

The previous section illustrated that trust, networks, norms and reciprocity are both vital to, and reinforced by, the ongoing construction process of social capital. However, it is less clear how these raw materials can be organised and assembled into a positive form of social capital - one that is ongoing and capable of effecting a positive change for local communities. In this process the definition of social capital encompasses the community as a whole and moves away from the individual focus of Bourdieu and Coleman. Thus, the benefits should accrue to all community members of society regardless of their membership. By its very nature, those who participate are likely to receive the greatest benefit, but in positive social capital this is never at the expense of those who do not.

Fukuyama (2001) pointed out that outsiders who have no local roots cannot foster social capital. This approach predominantly creates a hierarchy of local elites whose created associations diminish once the external funding ceases (Fukuyama, 2001). Therefore, it would seem prudent to nurture and maintain those networks already in existence. Portes (1998) defined several sources of social capital. In this analysis social capital is treated as a dependent variable (see Foley and Edwards 1999) with emphasis on the type of social organisation deemed to produce it. Certainly, in summarising Pierre Bourdieu's work, Portes (1998) stated that social networks are not natural and must be formed through strategies that institutionalise group relations and accrue other benefits.

To an extent all forms of social networks can provide resources to individuals and communities. However, interaction alone is insufficient to assume social capital (Falk and Kilpatrick 1999; Foley and Edwards 1999). Falk and Kilpatrick (1999) concluded that social capital can only be accumulated from local interactions. Larger scale interactions are noted as important but lacking in sufficient connections. Similarly, Rydin and Pennington (2000) suggested that the collective action requirement of social capital is most easily facilitated initially in small group settings. This enables trust to build up as individuals assess one another and learn how their actions will effect collective goals (Rydin and Pennington, 2000). From this they can learn how best to organise themselves to deal with more complex dilemmas (Rydin and Pennington, 2000). Thus, social capital must be built through local initiatives.

Continuity of interaction and continual development of group processes is also an important part of maintaining and developing social capital. Co-operative networks embody past success at working together and can serve as a 'template' for future interaction (Putnam, 1999). However, it cannot be assumed that pre-existing stocks of social capital are adequate for building capacities in new and more complex areas - even if existing networks have been effectively preserved and utilised (Sirianni and Friedland, 1995). Sirianni and Friedland (1995) observed that successful neighbourhood leaders and organisers in the United States have developed more diverse networks and trust-building strategies over the past two decades to increase collaboration to enable more comprehensive approaches in coping with the complexity of environmental problems.

So how can the framework necessary to allow the frequency and quality of interactions for positive social capital be provided? Putnam (1995) alluded to the importance of social organisations in his paper on America's declining social capital. Although more concerned with the outcomes of civic engagement or lack thereof, he demonstrates a decline in social capital attributable to the decline in voluntary social organisations including sporting, choral and religious groups. The social/collective aspect is particularly emphasised in his poignant portrayal of the decline in league bowling, which has been overcompensated for by an increase in solo bowling. In this instance, people are still bowling (taking action), however it is on an individual rather than a collective basis. Indeed, when Sirianni and

[10] 2003 Human Development Report by the UN Development Program (UNDP) [online] http://www.undp.org/hdr2003/.

Friedland (1995) stated that past environmental movements within the United States have been very effective at generating social capital, they do not mean membership limited to subscription-paying or individual protest events, but rather activist social networks and problem solving through collaboration and civic education. Similarly, Eva Cox stated in her 1995 Boyer Lecture in Australia that:

> We increase social capital by working *together* voluntarily in egalitarian organisations. Learning some of the rough and tumble of group processes also has the advantages of connecting us with others. We gossip, relate and create the warmth that comes from trusting (cited in Bullen and Onyx 1998).

Social organisations can also provide people with motivation and resources for action. According to Foley and Edwards (1999) these may be local, national or even international resources. Therefore, the particular social organisation in which social capital is embedded influences its 'use value' and determines the means by which access to specific social resources is enabled (Foley and Edwards, 1999).

The ability to learn is also vital in building social capital that enables citizens to actively participate in problem solving in scientific and political arenas. To ensure learning among a greater number and diversity of participants will require greater capacities for participatory learning and assessment (Sirianni and Friedland, 1995). Learning is also cited by Kilpatrick *et al*. (1998) in their example of Executive Link™ (a group of farm businesses) as a way of building social capital. In this instance, meeting for informal training and sharing of business expertise has lead to the development of a shared language, trust, personal development and an increased identification with the community.

Another important aspect in building social capital through social organisations is purpose. People must be working and learning together to achieve a common goal. Purpose galvanises and motivates individuals to work collectively and to develop a shared strategy. Purpose also directs learning and network formation. Furthermore, when interaction is embedded in meaningful social interaction, incentives for defection are reduced (Putnam, 1999).

The literature has shown that social capital is a dynamic process motivated by collective purpose. It is best constructed continuously within local organisations and often begins within local networks formed through a common purpose. Once the foundations of purpose and local networks have been laid, social capital requires continuous horizontal and vertical interaction and learning facilitated by trust, norms and reciprocity. Indeed, to be effective in solving new and complex social and environmental problems, communities must become organised and seek more diverse connections as the need arises. If these networks are not maintained it seems likely that the social capital structure would begin to crumble. In an age where traditional forms of social interaction are declining, community-based research (embodying purpose, learning, access to resources, and continuous social interaction) could be a valuable strategy for facilitating social capital to build sustainable communities.

2.12 CONCLUSION: TOWARDS A SYNTHESIS

Social and environmental dilemmas are increasing and, perhaps, nowhere are these more evident or more threatening than in freshwater ecosystems and catchments. In light of the inability of positivist science to solve ecological challenges and as awareness of the infinite complexity and unpredictability of ecosystems grows, 'post-normal' approaches have emerged. Indeed, the environmental crisis has compelled us to rethink scientific expertise and its relationship to public decision making (Fischer, 2000).

Positivist problem-solving methodologies deem such problems to be wholly technical and have relied almost exclusively on positivist science and technology to produce new knowledge and solutions. Consequently, society may be defined as a 'knowledge society' where only scientific knowledge influences and defines all facets of life (Stehr and Ericson, 1992c; Van den Daele, 1992). This has involved the displacement of other forms of knowledge, along with a growing number of, and dependence on, experts, advisers, and institutions that produce and distribute specialised knowledge (Stehr and Ericson, 1992c:6). Unfortunately, this has made it increasingly difficult for people to participate in an informed manner to societal decision-making. This has reached a point where people feel they have little control over their own lives and does not represent a sustainable situation.

In this regard, I have examined post-normal forms of inquiry that emphasise participatory approaches to research. This involves reassessing the validity of the citizen/expert dichotomy towards mutual exploration and the kind of participatory learning advanced by Paulo Freire (1970). In this sense, the expert serves as a 'facilitator' of public learning and political empowerment so that citizens may examine their own interests and make their own decisions (Fischer 2000:251). Fisher (2000) highlighted that this is as much a matter of power as it is an issue of knowledge production.

Consequently, knowledge production may be on the brink of a paradigm shift from positivist methodologies to more adaptive, naturalistic and participatory methodologies of inquiry, including 'adaptive management' and 'citizen science'. These approaches recognise that the challenges for those in natural resource management are increasing as environmental degradation accelerates and a more holistic view of the environment demands input from a wider cross section of the community. However, old habits die hard, and the research presented in this chapter has highlighted that conventional education and research has continued to distance the 'expert scientist' from local communities and the users of research. Indeed, there appears to remain entrenched an unwillingness to involve the public in environmental decision making, and public participation is often done in a superficial and disempowering manner.

Community-based research appears to be one strategy with the potential to utilise both adaptive management and citizen science approaches simultaneously. Because community-based research requires systematic work carried out by community groups alone or in partnership with professional researchers it has requirements and potential benefits unconsidered in more traditional approaches. This literature review indicates that successful community-based research requires a sense of local community fostered through high levels of social capital, increased public participation, and if carried out in partnership - a reflective practitioner rather than a technical expert approach. Because community-based research is an on-going, organised, and local process it appears to have the potential to contribute scientific information situated within the prevailing social context and to build social capital. Social capital in this instance is seen as a means of achieving social equality and therefore, environmental quality.

Indeed, I have spent much time discussing social capital, because it is arguably the mechanism and resource that we are trying to foster through increased public participation. The ambiguity of the terms: community, public participation and social capital underscore how little we know about ourselves. Indeed, we know little about other people's thoughts and emotions and it would be productive 'to invest in the understanding of others' mentalities, in common welfare, in the respect and recognition of others, to build a positive mirror for humankind' (Sancho Gil, 2001:393). Therefore, this research is foremost about social quality with a strong focus on the quality of our interactions with others and the environment. Indeed, the interaction in public participation is inherent in social capital. The form of interaction that occurs in positive social capital is essential for the formation of sustainable communities described in Section 2.3.1 - the locally-based social organisation that has the greatest potential to sustain us.

How community-based research can be conducted in catchment management so that it is effective in achieving these benefits is the concern of the following chapters (see Figure 2.5). Indeed, as Fischer (2000) has suggested there is evidence that citizens are capable of participating much more than currently demonstrated. The challenge is therefore to 'explore the boundaries of the possible' (Fischer 2000:3).

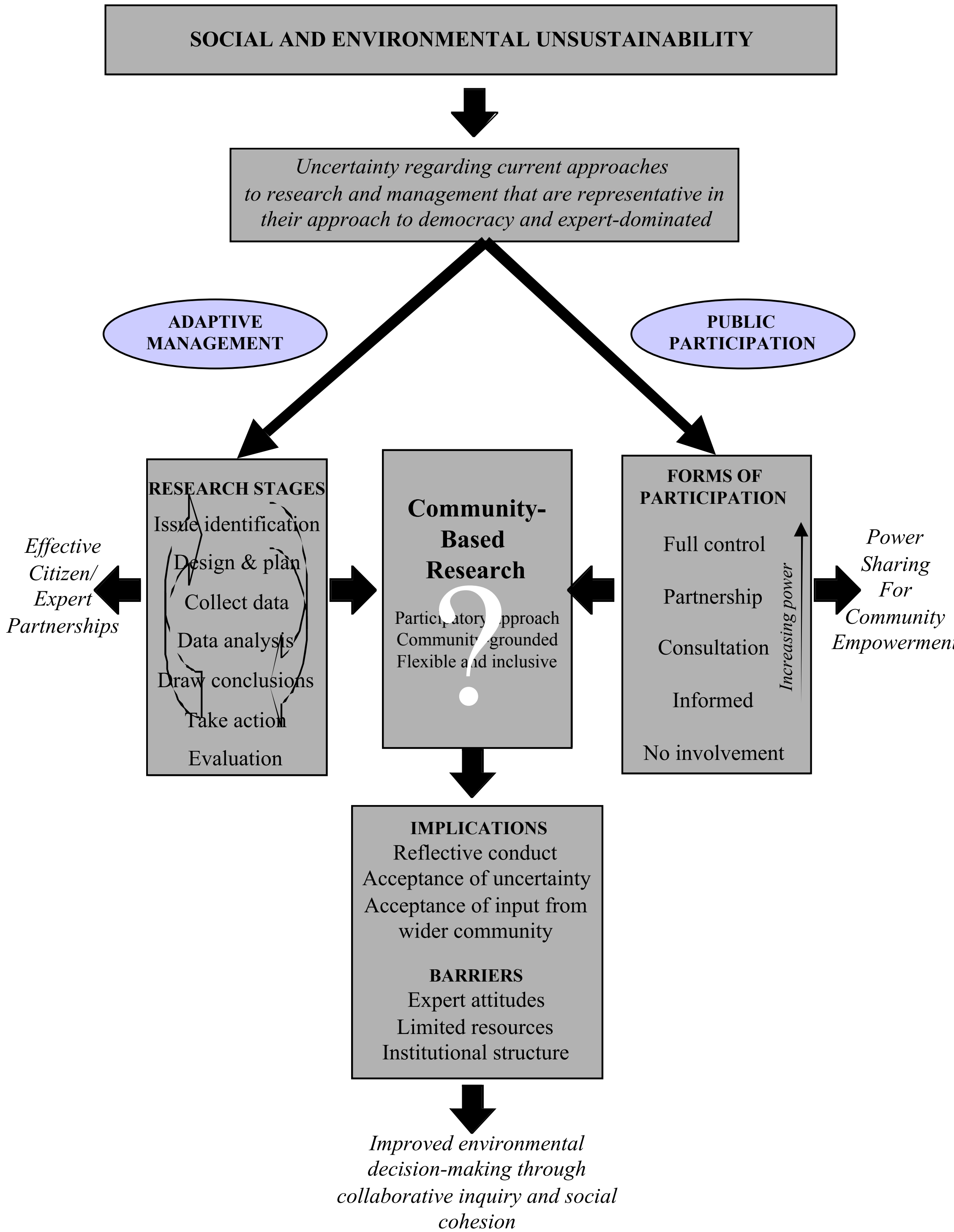

Figure 2.5 Implications of the literature review

Chapter 3

THE DESIGN OF THE STUDY

Choose your rules, your elements, your first principles. But choose them well so they enable you to inhale a world as real and wonderful and as ambiguous as is the actual truth.

David Rothenberg, 2001

3.1 INTRODUCTION

This chapter outlines the research methodology, methods and techniques that are used in this study as I seek to better understand how community-based research may be utilised towards catchment sustainability within Australia. Clarifying these three aspects of the study design helps to meet the research principles that Howe and Eisenhart (1990:6-9) have cited as important in maintaining an appropriate standard of research. This involves: (i) understanding one's values through alertness to, and coherence of, background assumptions, (ii) congruity between research questions and design, and, (iii) the effective use of relevant data collection and analysis techniques. Indeed, it is important to reveal the reasons and assumptions underpinning each selection to ensure transparency and to explain why particular methodologies are favoured or lend themselves well to the research questions being pursued.

This study is in part a reflection of my personal experiences, the experiences of participants, my professional discipline, and the review of literature in Chapter 2. Indeed, research methodologies are based on assumptions held by the researcher and determine what research is and how it should be conducted (Potter, 1996). In essence, they reveal the broad philosophical perspective from which the research takes place. Consequently, this chapter begins by revealing the theoretical framework that guides this study and frames the research questions as influenced by my epistemological orientation and how I view the world and the acquisition of knowledge (Winegardner, 2001).

The quantitative and qualitative methods and a description of the portfolio of techniques used for data gathering and analysis are then discussed. I also explain the complementarity of these methods for this study and how I attended to issues of validity, trustworthiness and ethics in each distinct phase in this study.

3.2 THE FOCUS OF THE STUDY

At the beginning of the study I possessed training and experience in the disciplines and positivist research approaches of biological and environmental science. More recently - due to an emerging understanding of the limitations of this method of environmental problem solving (Sclove, 1997; Berkes & Folke, 1998) - I embarked on the study of environmental education and social change. Consistent with Head (1998), I have come to be more inspired by questions of social learning and change associated with sustainability than with short-term concerns for limiting environmental damage, as important as these are.

The problem to be investigated stems from the proposition that current political, economic and social processes for addressing the serious social and environmental problems facing humanity are not keeping pace with the increasingly rapid rate of social and environmental degradation. As environmental and social degradation are very broad topics, in this study I have chosen to focus upon the more manageable area of freshwater degradation and its social context, catchment management. This was not an arbitrary selection. To the contrary, as fresh water is vital to human survival and the sustainability of the planet as a whole it presents an extremely worthwhile focus. Moreover, this study contends that a comprehensive, holistic and interdisciplinary approach is required to solve these hydrological problems. If part of the solution lies in community-based strategies, community members must become more involved and traditional narrow disciplines must be broadened not only to encompass other academic fields but also community knowledge (Fischer, 2000).

The research is based upon two assumptions. The first is that actions detrimental to the environment are embedded in social institutions and ways of life, an assumption supported by research (for example, Rayner and Malone 1997). The second assumption is that community-based research has the potential to empower communities to seek sustainable alternatives through local participation in science and decision making. It is the second assumption in particular that will be put to the test in this study.

Historically, research has been conducted on behalf of private enterprise, the military, national governments, or scientific intellectual interest (Sclove 1997). Sclove (1997) argued that this research approach favours elite groups and maintains their privileged positions and is undemocratic in character. To counter this undemocratic model, various forms of public participation have been practiced. Community-based research, in particular, involves people as citizen scientists. A citizen scientist is someone who actively participates in research concerning local issues. This is commonly conceptualised as participation in environmental monitoring, but may involve action at any stage of research - from formulating the questions to determining conclusions. To date, community-based research has been practised widely and successfully in developing nations (see Chambers 1994a; Chambers 1994b; Gill 1991; Pretty 1994; Pretty 1995a; Pretty 1995b; Pretty 1998) and only to a very limited and less formal extent within Australia and other developed nations (see Dovers, 2000 and Flower, 2000).

There are at least five reasons why community-based or participatory research is not practiced more widely in developed nations. The first is the dominance of the positivist paradigm in research, which discounts non-empirical research or experience as a valid basis for knowledge (Carr and Kemmis 1986). The second flows from this and relates to the view that only those with formal qualifications are capable of participating in problem-solving through research (Saul, 1992; Sclove, 1997). However, these beliefs ignore the notions that people can become qualified through experience not just formal qualifications and that such experiential knowledge can be valuable. The third is increasing social degradation where people are excluded from decision-making processes that affect their own lives (Flower *et al* 2000). The fourth stems from past abuse of public participation strategies (see Arnstein, 1969 and Pretty, 1995), and the fifth arises from perceptions held by some that participation can add to the costs and time of a project with no guaranteed final impact or improvement (Anon, 2000; Dovers, 2000: UNDP, 2000; and Robinson 1993).

Given these general assertions, this study explores the possibilities and barriers for community-based research in catchment management within Australia. To date it remains unknown which factors are the most significant barriers to, or the most supportive of, community-based research in Australia and how these might be overcome or emphasised. There is also little analysis of the capabilities or goals of community groups involved in catchment research and how these might relate to those of professional researchers working in similar areas. In particular, this study seeks to analyse the purposes and potential of community-based research in catchment management. This is explored with a view to developing a model of the types of catchment issues, the range of appropriate research tasks and the support structures needed to ensure that maximum benefits are obtained from community-based research when it is used. Benefits from this form of research are explored and defined in terms of improved environmental quality and increased social capital or community empowerment.

Meaningful public participation in solving environmental issues is increasingly appropriate and crucial as it is recognised that social problems cause environmental problems and that these are the responsibility of all citizens and cannot be solved by traditional scientific methods and its exponents alone.

3.3 THE RESEARCH QUESTIONS

Following the assumptions and observations outlined above, the major research questions and sub-questions for this study on community-based research are:

- **How do community group members, scientists and agency professionals perceive the nature and purpose of community-based research in catchment management?**
    - *What is the pattern of similarities and differences in perceptions held by scientists, agency professionals and community groups to community-based research?*
    - *What factors influence these perceptions?*
- **What is the nature, purpose and outcome(s) of community-based research in selected case studies?**
    - *How are the community-based research projects initiated?*

- *What motivations underpin participation in these community-based catchment research projects?*
- *What research tasks do the community groups undertake?*
- *Why are these tasks chosen?*
- *What skills do the groups have or find they need?*
- *Where do they obtain support?*
- *What are the attitudes of scientists and agency professionals to these community-based projects?*
- *What other opportunities and constraints do they face?*
- *What factors influence the sustainability of these community-based research projects?*
- *What are the social and environmental outcomes of community-based research projects?*

- **What aspects of community-based research influence social and environmental outcomes?**

  - *What effect do individual and group motivations have on social and environmental outcomes?*
  - *How do the perceptions of scientists and agency professionals affect the process and outcomes of community-based environmental research?*
  - *To what extent is influence on outcomes dependent on the approach to research in which community groups are involved?*
  - *To what extent do practical constraints (eg. time, funding, technical ability, access to equipment, access to research site) affect the outcomes?*

- **How can community-based research be utilised in environmental decision-making in a manner that optimises community and scientific/institutional involvement to achieve both social capital and environmental benefits?**

3.4 RESEARCH METHODOLOGY AND METHOD

Three distinct research paradigms influence contemporary research relevant to this study: positivism, interpretivism, and critical science. For this study, each has been evaluated in terms of the advantages and disadvantages they offer in assisting to answer the research questions. Some of these strengths and weaknesses will now be outlined. The positivist tradition seeks to explain, predict and control (Carr and Kemmis 1986). According to Carr and Kemmis (1986), within this paradigm the researcher strives to take an objective view of reality and believes that 'truth' can be determined by maintaining a detached stance. Information gained from positivist research is distinctively quantitative in nature. Interpretive and critical researchers, to the contrary, seek understanding of the meanings of perceptions, experiences and actions, and recognise that knowledge is both subjective and socially constructed (Carr and Kemmis 1986). In addition, researchers using the critical science approach take an emancipatory interest and seek social change (Robottom and Hart, 1993). Table 3.1 provides a comparison of these three approaches.

Table 3.1 Contrasting views underlying alternative research paradigms

Underlying assumptions and beliefs about:	*Positivism*	*Interpretivism*	*Critical Science*
Purpose(s) of research	Discover laws and generalisations which explain reality and allow to predict and control	Understand and interpret daily occurrences and social structures as well as the meanings people give to the phenomena	Emancipate people through critique of ideologies that promote inequity and through change in personal understanding and action that lead to transformation of self-consciousness and social conditions
Nature of reality (ontology)	Single, givens, fragmentable, tangible, measurable, convergent	Multiple, constructed through human interaction, holistic divergent	Multiple, constructed through human interaction, holistic divergent, social and economic; embedded in issues of equity and hegemony
Nature of knowledge (epistemology)	Events are explained based upon knowable facts, real causes or simultaneous effects; law-like regularities exist	Events are understood through mental process of interpretation which is influenced by and interacts with social context – mutual simultaneous shaping	Events are understood within social and economic context with emphasis on ideological critique and praxis
Relationship between knower and the known	Independent, dualism	Interrelated, dialogic	Interrelated, influenced by society and commitment to emancipation
Role of values in research	Value free	Value bounded	Value bounded; ideological critique and concern for inequities

Source: Cantrell (1993:83-84)

The information that arises from both interpretive and critical approaches differs from positivist research in that it is primarily qualitative and focuses upon words instead of numbers (Miles & Huberman, 1994). The quantitative approach involves representative samples that allow the researcher to generalise to a larger population. Whereas, the qualitative approach uses small, information-rich samples selected purposefully to allow the researcher to focus on issues important to the study. For the former, once established, the same sample is used for the duration of the study. For the latter, samples change throughout the study through serial selection (one sample leads to another) in order to extend, test and fill in information (Lincoln and Guba, 1985:201). According to Miles and Huberman (1994) confidence is achieved by observing behaviour in its natural setting. Consequently, interpretive and critical data are mediated primarily through the researcher as distinct from a questionnaire, or computer analysis, and the end product is narrative and descriptive using words and pictures rather than numbers (Winegardner, 2001). Guba *et al* (1981) highlighted that researchers are characterised by responsiveness to context and sensitivity to non verbals, and by the ability to consider the total context, adapt techniques to the circumstances, process data immediately, clarify and summarise as the study evolves, and explore anomalous responses. Because the underlying assumptions of each are different, the paradigm within which the research is located will guide the methods used and the tests of truth applied.

Having considered the characteristics of each of these research paradigms, I decided to locate the study within both the positivist and interpretive research paradigms. I began with an initial exploratory and qualitative phase to ground a large-scale quantitative survey questionnaire within the experiences of both specialist scientists and community researchers. The survey was then followed by a small-scale, but in-depth, interpretive case study. The survey approach to inquiry was chosen to highlight issues important to both groups and to provide a general understanding of, and context for, community-based catchment research. While the interpretive approach was chosen to make sense of and to explore the emergent social issues within the case studies because this approach can 'uncover important parts of our humanity we lose in objective inquiry' (Kelliher, 1994:6). In this sequence the case studies will be informed by, and complementary to, the initial survey. Figure 3.1 is a simplified illustration of this research design that links qualitative and quantitative data (adapted from Miles and Huberman, 1994:41).

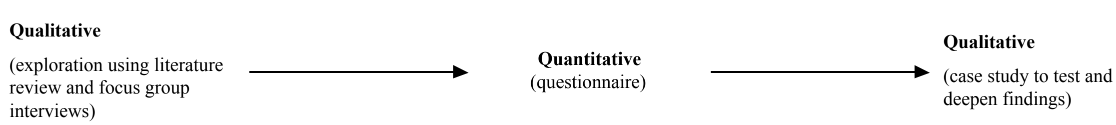

Figure 3.1 Research design linking qualitative and quantitative data

Given the contrasting assumptions in each paradigm, this combination may seem a contradictory approach. However, Miles and Huberman (1994:40) argued that 'numbers and words are *both* needed if we are to understand the world'. Furthermore, Chih Lin

(1998:163) stated that 'it is like looking at the same picture in two different ways'. She argued that it is the differences between positivist and interpretivist positions that make their combination so effective:

> It is precisely because the logics of inference are different, and suited for answering different questions, that research combining both logics is effective. Positivist work can identify the existence of causal relationships that are present in data, with some degree of probability. What it cannot do is to explain how the mechanism implied by a particular causal relationship works. Interpretivist work, by contrast, can produce detailed examinations of causal mechanisms in the specific case, explaining how particular variables interact (p.163).

Similarly, Patton (1990) stated:

> Rather than believing that one must choose to align with one paradigm or the other, I advocate a paradigm of choices. A paradigm of choices rejects methodological orthodoxy in favour of methodological appropriateness as the primary criterion for judging methodological quality. The issue then becomes not whether one has uniformly adhered to prescribed canons of either logical-positivism or phenomenology but whether one has made sensible methods decisions given the purpose of the inquiry, the questions being investigated, and the resources available. The paradigm of choices recognizes that different methods are appropriate for different situations (p.38-39).

Using Patton's criteria of methodological appropriateness, I believe that using both positivist and interpretive approaches can enhance the quality of this study and I concur with Chih Lin (1998), Jick (1983) and Punch (1998) who have argued that these two approaches are complementary and can lead to a strengthened study. The following reasons listed by Punch (1998) further explain my reasons for linking these two approaches. First, quantitative research is especially efficient at getting to the 'structural' features of social life, while qualitative studies are usually stronger in terms of 'processual' aspects - by bringing them together, a single study can have both these strengths. Quantitative research can study large-scale, structural features of social life, while qualitative research can address small-scale behavioural effects. Second, quantitative research readily allows the researcher to establish relationships among variables, but it is less able to explore the reasons for those relationships. A qualitative study is useful in explaining the factors underlying the broad relationships that are established. Third, the combination of approaches can increase the validity of findings by triangulation because the results from one type of study may be checked against the findings from another type. Fourth, the combination may also help to balance the perspectives of the researcher and the subjects. While it is difficult to generalise, it can be asserted that quantitative research may tend to be driven by the researcher's concerns, whereas qualitative research tends to take the subject's perspective as the beginning point. Last, by adding some quantitative evidence it may be possible to generalise the findings from qualitative research. Indeed, 'this combination does more than add substantive content that neither approach could create alone' (Chih Lin, 1998:163).

3.4.1 Research Phases

Acknowledging the value of using positivist and interpretive approaches in combination, this study has been conducted in four phases. Each phase is designed to answer one of the major research questions outlined earlier, although it is acknowledged that these questions are interrelated (see Figure 3.2).

Phase 1. Describing and understanding the macro-context of community-based catchment research within the study areas. This involves a large-scale quantitative survey of expert scientists from the Catchment Hydrology and Coastal Cooperative Research Centres (CRCs), and citizen scientists (Waterwatch Coordinators) from the six Australian focus catchments encompassed by these two CRCs: Port Curtis, Fitzroy, Murrumbidgee, Goulburn-Broken, Yarra and Brisbane.

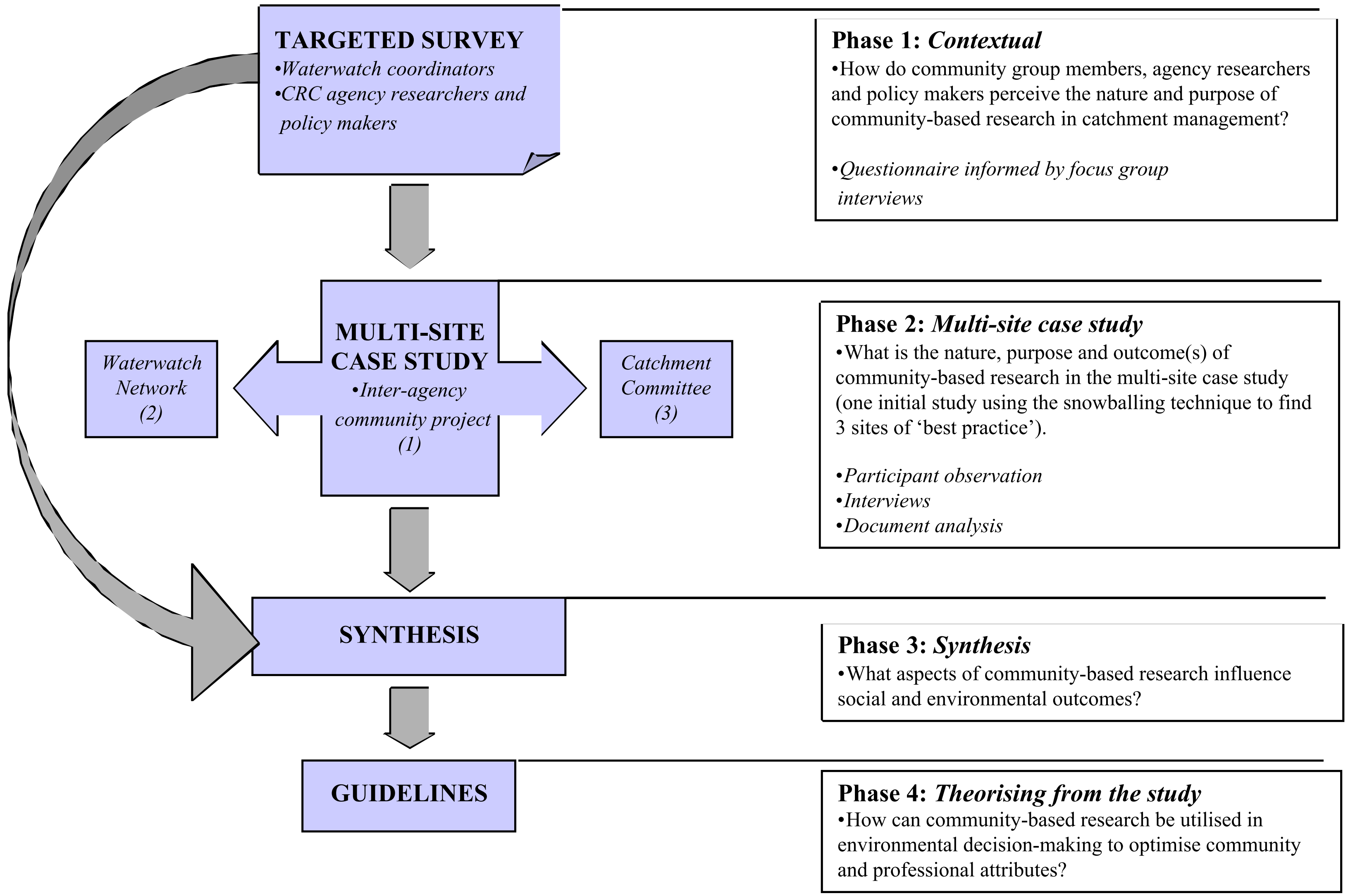

Figure 3.2 Research phases

Phase 2. Describing and understanding the local and personal nature of community-based catchment research in a multi-site case study. The second phase uses an interpretive case study approach to study a multi-site case of community-based research in catchment management. This study began with a Commonwealth (national) Government funded project designed to enable Queensland national resource management agencies and their representatives to work with community groups that are currently undertaking, or keen to commence, catchment and estuarine monitoring. From this initial study, two community groups were chosen in a 'snowballing' manner to further investigate this approach.

Phase 3. Synthesis of case studies and survey interpretation. The third phase involves a synthesis of the quantitative analysis from phase one together with the qualitative analysis from phase two, with the intention of realising the potential of combining these distinct approaches in the complementary manner outlined by Punch (1998) above.

Phase 4. Theorising from case studies and wider Australian-global context indicated by survey and literature. The fourth and final phase involves formulating a model of the relationship between catchment issues and the range of research tasks appropriate for community members. This will assist in the development of any support structures needed to ensure that maximum benefits are obtained whenever community-based research is utilised.

In all phases I distinguish between 'citizens' and 'experts'. In some respects this is an arbitrary distinction maintained for consistency throughout the thesis. I could have used the terms 'amateur' and 'professional' or 'community' and 'agency' and it is possible to challenge this distinction altogether. Indeed, the question of such a dichotomy is central to my thesis. However, to study such issues I have begun with a distinction explained by Chambers (1997). Chambers (1997:2-3) distinguished between actors in the 'upper' system of organisation and communication whose decisions and actions impinge on those from the 'lower' system of local rural and urban people and places. Relating his argument to this study, the extension officer working for a natural resource management department, may not identify with a scientist working in a different department or an academic institution; nor her with him. Nonetheless, they are both in a similar position with the power to make, or effectively contribute to, decision-making that affects catchment systems and the lives of local people. The following sections describe in detail the particular networks and organisations that participants in this study named as either 'citizens' or 'experts' belong. They are referred to after this point without inverted commas.

3.4.2 *Phase 1* - *Survey questionnaire*

Phase 1 is positivist and quantitative in nature and includes (1) a targeted questionnaire of expert scientists from the: Catchment Hydrology, and Coastal Zone, Estuary and Waterway Management Cooperative Research Centres and (2) a targeted questionnaire of citizen scientists (Waterwatch coordinators) that are located in the focus catchments of the two Cooperative Research Centres.

These surveys took the format of a KAP (Knowledge, Attitudes and Practice) questionnaire and were informed by the literature and several focus group sessions with Catchment and Coastal Cooperative Research Centre scientists, agency professionals and community group representatives involved in catchment issues. The purpose was to determine the macro-context of community-based catchment research.

3.4.2.1 Sample selection

The sampling method used is described as targeted or purposive sampling (Babbie, 1990; Babbie, 2001; de Vaus, 2002). It is appropriate to use this form of non-probability sampling in this study where the research questions concern a specific section of the population and where a multistage sample design is used to compare pre-determined groups within the population - namely citizen and expert scientists conducting catchment research. While such a design does not provide a good description of citizen and expert scientists as a whole, it does provide useful comparative data for the catchment-based focus of this study.

Waterwatch coordinators were chosen to represent the citizen scientists in the sample population. Waterwatch was chosen because it is one of Australia's largest and most widespread grassroots catchment initiatives. More information on Waterwatch Australia can be found in Chapter 4, suffice to say it operates in 200 Australian catchments with over 3000 groups. The majority of Waterwatch coordinators are core group members and are active in the environmental monitoring activities of Waterwatch. Because the local coordinators have an overview of the monitoring activities, experience in conducting the monitoring and are typically the members whose role is to seek expert assistance, they were chosen as an appropriate sampling level and consistent sampling unit for the survey.

Members of the Catchment Hydrology and Coastal Zone Cooperative Research Centres (CRCs) were chosen to represent the expert scientists in the survey sample. These Centres were chosen because like Waterwatch they focus their research activities in catchment and coastal areas, however their exponents to date are exclusively highly educated professionals and thus, contrast to the amateur nature of Waterwatch participants. Therefore, the Waterwatch Coordinators and CRC scientists adequately represent the citizen/expert dichotomy outlined in the literature review.

To ensure consistency of issues in the target populations and to maintain a manageable sample size, only citizens and experts that conducted their catchment activities in, or very near, the 6 focus catchments of the research centres were included in the sampling frame.

3.4.2.2 Knowledge, attitudes and practice (KAP) survey method

The KAP approach to questionnaire construction has several appealing analytic features and is used widely in public health issues and studies where attitudes and behaviours are the focus of the research (Price, 2003). It is based on a questionnaire used in a sample that is representative of the population being studied. A KAP survey collects information about perceptions by asking a structured and predetermined set of questions (http://www.unu.edu/unupress/food2/UIN04E/uin04e03.htm). This approach includes questions on a respondent's attitude towards a topic or issue (community-based research in this instance) and questions that also determine a respondent's knowledge of, and experience with the issue. Analysis of KAP survey data enables description and quantification of respondents' knowledge, attitudes and practice, and it also enables comparisons between response categories. By establishing relationships between the three KAP categories this approach can determine how these attributes affect each other and can subsequently provide an insight in why a particular respondent may have a particular attitude or level of knowledge (see Graeff *et al.,* 1993). For example, superficial analysis of pilot responses revealed that respondents with high levels of experience with community groups also had positive attitudes towards community-based research.

Conversely, respondents with little or no experience with community groups had predominantly negative attitudes towards community-based research.

The majority of survey questions were closed and had pre-defined response categories. The use of closed response categories facilitates data analysis in allowing the results from different respondents to be easily compared. The knowledge questions were formatted with True/False response categories. All attitudinal and practice questions were written using a 5 point Likert-scale response category ranging from strongly disagree to strongly agree except two questions, which used 5 levels of involvement in an analogous manner. These ranged from no involvement to full involvement. The final section included standard demographic questions. The demographic response categories were consistent with the Australian Bureau of Statistics (ABS) to allow for national comparisons. In several places throughout the survey there was an opportunity for respondents to make comments or to indicate their unique position.

There were 7 main stages in this survey phase summarised in Figure 3.3. The first stage focussed on defining important attitudes and issues related to community-based research for inclusion in the questionnaire. This involved a review of the related literature and focus group interviews with specialist scientists and community researchers working on catchment-based topics. The second stage utilised the information from these sources to construct the questionnaire. In this stage, I heeded advice from several textbooks, academics working in associated fields and several agency and community representatives. In the third stage, I trialed the survey with respondents analogous to those targeted in this study. The results of this pilot survey led me to delete several questions that now seemed redundant (stage 4). The fifth stage involved implementing the survey and consisted of introductory letters/e-mails and reminders as well as distributing the questionnaire itself. Finally, the returned questionnaires were analysed using the quantitative methods described later in this section.

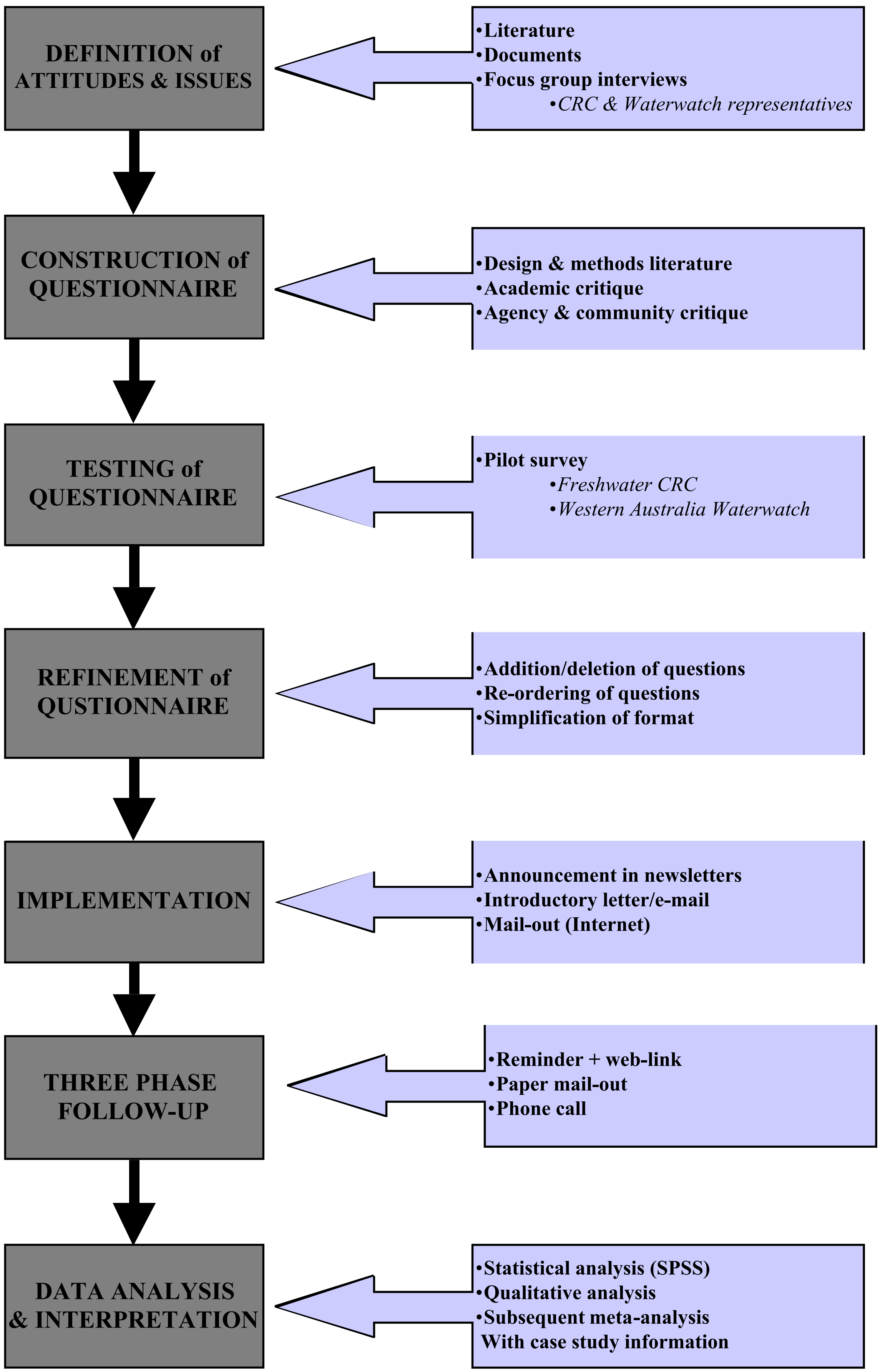

Figure 3.3 Survey design, implementation and analysis

3.4.2.3 Focus group interviews to inform questionnaire response categories

The closed response questions were designed to ensure that the categories or statements were an accurate reflection of the potential responses. In other words it was intended that the respondent would be able to respond in a similar fashion given the same questions if open-ended responses were possible so that there was not a perception of being manipulated by narrow predefined categories. To ensure that the response categories were valid the researcher used a three-step process. First, a review of literature was used to generate potential responses and attitudinal statements. Second, the researcher conducted three focus group interviews with Coastal and Catchment Cooperative Research Centre scientists and agency professionals (as representative of expert scientists) and Waterwatch Coordinators (as representative of citizen scientists). This involved asking the participants general questions very similar to those intended for the survey (see Appendix A). Participants were asked to respond in a 'brainstorming' manner and these responses were recorded with the assistance of another researcher acting as scribe (see Appendix A). This approach generated the majority of response categories. Each focus group consisted of ten participants and lasted for approximately one hour. Given the potential for sensitive or controversial topics to arise, the focus groups only comprised participants from either Waterwatch or one of the research centres. As Hoppe et al. (1995) and O'Brien (1993) point out such separation can enhance discussion. Third, an initial pilot survey with open-ended response categories was sent to a sample of the target population. All responses were categorised and used in the closed responses in the final version of the survey. This approach also helped to formulate further questions on topics that were obviously important issues for the target population.

2.1.1.1 Internet survey format and considerations

Electronic or Internet survey methods are becoming popular in quantitative research (Dillman, 2000; de Vaus, 2002). Like Dillman (2000:252-352) they appealed to me because they eliminate the need for paper, postage, mail-out, and data entry costs. They also have the potential to reduce the time for implementation from weeks to hours. There were other decisions to make related to the two main formats available, email and web surveys. A review of survey literature assisted in guiding the final approach taken. Watt (2001), Dillman (2000) and Batinic (1997) highlighted that although Web and email surveys have much in common, Web surveys have many advantages over email surveys.

These include the potential to utilise visual and audio effects, various interaction capabilities, and the ability to download information directly into a database or statistics software package, by which input errors are reduced. Watt (2001) also pointed out the ease with which an Internet survey can be quickly modified. For example, he suggested that early data returns may suggest additional questions that should be asked. Such changes can be made within minutes. However, Dillman (2000) and de Vaus (2002) cautioned over the use of electronic surveys where respondents do not have access to Internet technology or the computer skills to complete the survey in such a format. There are also concerns that individual computers or browsers used by respondents may distort the appearance of electronic survey formats.

Eventually, the Web was chosen as an appropriate platform for this survey for several reasons. First, the survey was targeted and the researcher wanted to survey an entire population (Coastal and Catchment CRC researchers and agency professionals and Waterwatch coordinators in the same focus catchments). By using electronic survey methods the implementation time and the close correspondence between sample size and survey costs were dramatically reduced, making it feasible to survey the entire population (Dillman 2000:353). Second, all targeted respondents had email addresses and ready access to the Web. Therefore, given their 'online' status and the integral nature of computer use in their vocations it was assumed that they all possessed the necessary computer skills to complete a Web survey. Third, it allowed for the use of coloured text and graphics considered too expensive to include in paper versions. Finally, the data could be downloaded directly from the Web into a universal spreadsheet reducing the likelihood of error from data entry and ensuring that responses remained confidential.

The survey was designed initially on paper and then taken to a professional web-designer that re-presented each question in a conventional format similar to that used on the paper version. At this point the Web survey was programmed to automatically download responses into an Excel spreadsheet. Full colour was used for the graphics and a simple, consistent use of colour was used for the rest of the questionnaire. Three types of answer choices were used (1) drop-down boxes with lists of answer choices, (2) horizontal answer circles specifying a scale or a true/false response and (3) text boxes allowing the respondent to type in their individual text (see Appendix A). The format allowed only one response per question - the respondent could change their mind, but not put two answers for one question. The input information was automatically sent to a background program when the "submit" button was clicked. This was located on an Internet server where the answers of the participants were directly written into a database, and forwarded to the researcher's e-mail address for back-up purposes. Once the 'submit' button was clicked the program also generated a thank you and an acknowledgments page that was sent back to the participant.

2.1.1.1 Pilot survey

Pre-testing of the questionnaire was undertaken with a sample of members from the Cooperative Centre for Freshwater Research and Waterwatch Coordinators in Western Australia. These groups were chosen because they closely resembled the target populations without the potential for any overlap of members that could bias final survey responses. Respondents were informed that this was the first phase in a larger study and asked to indicate how long it took to complete the survey and if any particular problems were incurred. No problems were identified with the current wording of any questions or the survey structure.

However, several people noted the lengthy format and suggested reducing the number of questions. Sense would suggest that a questionnaire be no longer than necessary (de Vaus, 2002). And, as Dillman (2000) argued, going beyond 12 pages is likely to adversely affect response rates. Therefore, it was considered prudent to listen to the concerns of those in the pilot survey and to reduce the number of questions and pages.

Questions were eliminated using the pilot responses on three counts: variation, meaning and redundancy. de Vaus (2002) stated that variation in responses is important in exploratory surveys. If most people give similar answers to a question, it will not detect variances in the population and will be of little use in later analysis (de Vaus, 2002). Several questions appeared to have obvious answers and there was no variation in pilot responses so these were removed. It is also important to ensure that questions are unambiguous. Several questions were also removed because the respondents did not appear to understand the question making their answers meaningless. Lastly, if two questions measure virtually the same thing, then only one is needed in the final questionnaire (de Vaus, 2002). Therefore, several questions were removed on the basis of redundancy.

2.1.1.1 Survey implementation

The survey was implemented using principles similar to Dillman's (2000:367-371) 'multiple contact strategy'. The survey was first announced or advertised in the latest e-newsletter of all target populations. This included a brief description of the study, my background, supervisors and sponsors, and indicated that invited participants would be contacted via an e-mail message containing a live link to the Web survey (see Appendix A). Following this the Web-link was sent out with a covering e-mail message that again gave a brief description of the scope and purpose of the study and my background and sponsors. It also stated that all responses were entirely confidential and would only be released as summaries in which no individuals could be identified. I also stressed that respondents should not spend too much time on any one question, preferably retaining their first responses (see Appendix A). One week after the initial contact a thank you/reminder note was sent to all members of the target population and, on Dillman’s (2000) advice, this also included the link to the Web survey for those recipients who no-longer had the last message. Dillman found that including the link again (or a replacement questionnaire) resulted in a higher response rate.

Several respondents expressed frustration with the Internet format due to browser incompatibility. Acknowledging this difficulty, instead of a third follow-up email, all members of the target group that had not yet responded in any way were sent a hard-copy version of the questionnaire. All questionnaires included another covering letter and a pre-paid return envelope. All were numbered on the bottom right hand corner and respondents were assured that these numbers were only for use in assisting any necessary follow-up actions to increase the response rate. Therefore, the numbers were removed immediately as each survey was returned and the respondents' names were removed from the follow-up mailing list.

Members of the target populations responded in virtually equal numbers to both the Internet and postal versions of the questionnaire highlighting the advantages of using a multi-mode approach (Dillman, 2000). However, de Vaus (2002) pointed out that whilst the multi-mode approach may allow a more representative sample it introduces a new problem. Questionnaire responses are now subject to mode effects. In other words, the mode of administration (Internet versus postal) may have affected the way people responded (de Vaus, 2002). However, a review of responses between formats showed no apparent differences in the type of response aside from the preference in mode of response. Therefore, the multi-mode approach was considered appropriate in this instance to increase the representativeness of the sample.

2.1.1.1 Response rate

de Vaus (2002) noted that the success of a survey is often measured by the response rate obtained. Certainly, it is unlikely that all members of the sample will return their questionnaires and therefore response bias is a concern (Babbie, 2001). However, there is agreement that response rates vary widely (Babbie, 1990; Dillman, 2000; Babbie, 2001; de Vaus, 2002). Babbie (1990) provided the following general rules of thumb that should be followed:

> A response rate of at least 50% is generally considered adequate for analysis and reporting. A response rate of at least 60% is considered good, and a response rate of 70% or more is very good (p.222).

Babbie (1990) also noted that a demonstrated lack of bias is far more important than a high response rate.

For all groups surveyed the response rate was calculated by dividing the number of returned surveys by the number of group members (less unreachable and ineligible members) (Dillman, 2000; de Vaus, 2002). There were 55 Waterwatch coordinators conducting activities in the focus catchment areas at the time of this study. These were identified through the Waterwatch Australia website and contact with the Statewide coordinators where possible. Table 3.2 indicates that the coordinators, who represent the citizen scientists in this study, responded to the questionnaire at what Babbie (1990) would consider a *very good* rate of 71%.

Table 3.2 Citizen scientist response rate

Citizen scientists	*Completed survey*	*Not qualified*	*No response*	*Total*
Citizen scientist	39	1	15	55
Percentage	71	2	27	100

At the time of survey implementation 408 expert scientists were active members of both Cooperative Research Centres. The expert scientists responded at a rate of 43% with a further 5% reporting that they felt unqualified to respond to the issues presented in the survey. Table 3.3 shows that the expert scientists from the Coastal Zone CRC were less likely to respond. Telephone contact with this group revealed that they had recently been asked to respond to a number of surveys and that 'survey burnout' had prevented them from responding rather than any factors relating specifically to the questionnaire. Therefore, the low response rate does not represent response bias and is adequate for analysis.

Table 3.3 Expert scientist response rate

Expert scientists	*Completed survey*	*Not qualified*	*No response*	*Total*
Catchment hydrology	108	18	91	217
Coastal zone	67	4	120	191
Percentage	43	5	52	100

2.1.1.1 Data analysis

The purpose of data analysis is to simplify the data collected so that any patterns can easily be seen and that the underlying influences on these patterns may be revealed. Certainly, de Vaus (2002) and Morgan and Griego (1998) have pointed out that the type of statistics that are appropriate for any given study will be determined by the research questions or the purpose of the study and the level of measurement used to collect the data.

As outlined in Section 3.3 the purpose of the survey instrument was to determine how citizens and experts perceive the nature and purpose of community-based research in catchment management, how these perceptions differ or are similar and what factors influence these perceptions. Therefore, the initial data analysis techniques will be descriptive and some will seek to determine whether a smaller set of variables can be used to replace sections of the data set. Subsequent data analysis will determine any underlying dimensions using bivariate correlations and multiple regression techniques.

Qualitative analysis of any comments or anecdotes supplied will be used to enrich the descriptive and analytical statistics and to deepen the understanding of any derived variables or equations.

This section describes the methods used to code and analyse the data and explains the rationale underpinning the choice of each method.

Statistical methods

All data analyses were performed using SPSS version 10 for Mackintosh. In most instances variables were analysed using the original questionnaire categories and displayed in a comparative manner between citizen and expert scientists. Univariate, bivariate and multivariate techniques were used where appropriate. The mean was used as the measure of central tendency and percentages were used instead of frequencies given the comparative nature of the research questions and the unequal population sizes between the two groups. Confidence intervals were used to assess the range of opinions within and between groups for several variables. Mean scores of groups on numerical indexes were also compared. Furthermore, correlation coefficients and multiple regression equations were used to measure linear associations between two or more variables.

There is considerable debate in the literature concerning the treatment of scores derived from attitude scales as interval data. This is important to determine as it influences the use of statistical tests to determine the significance of any bivariate relationships. Inferential statistical tests may be parametric or non-parametric. While the former is more powerful, it relies on the data being normally distributed and that the data be an interval measure where the actual distance between scores can be measured and regarded as being approximately equal (Morgan & Griego, 1998; Babbie, 2001). Non-parametric tests are unaffected by the distribution of the data and can be used for ordinal scale data where the data is ranked or there are unequal intervals between categories.

Morgan and Griego (1998) highlighted that many social scientists treat scale data as interval rather than ordinal. However, they argue that most statisticians would treat such data as ordinal and use non-parametric tests instead of the widely used parametric tests. In this study it could be argued that the scale data are approximately interval, although in one or a small number of instances the distributions were skewed from the normal distribution and indicative of ordinal scale data. In light of this controversy, both parametric and non-parametric statistics were calculated. The interpretation of the resulting statistic was the same for each test. Therefore, the choice of tests has no impact on the results of this study and the more conservative choice of non-parametric tests was chosen to allow for a consistent presentation of results (see Neuman 1996). A significance level of 0.01 was utilised for all comparisons.

Section 3.4.2.7 shows that 39 citizen representatives and 175 expert representatives completed surveys. However, sample size may vary between analyses due to missing data. In this study missing data occurred due to respondents missing or declining to answer certain questions or because some questions did not require a response from all respondents (see Beaumont, 1999). Sample sizes are indicated for each table and figure in the analysis of survey data in Chapter 5.

The following paragraphs describe how each section of the questionnaire was analysed, interpreted, and displayed for ease of explanation in Chapter 5. Describing the progression from raw data through analysis and interpretation increases the transparency of the process and helps to validate final conclusions.

Demographic measurement

All demographic variables were analysed using the original questionnaire categories and displayed in a comparative manner between citizen and expert scientists.

Perceptions of community involvement in catchment management

These variables were also analysed using the original questionnaire categories, which were subsequently re-ordered into a more logical sequence. The mean scores and standard deviations for both citizen and expert scientists were calculated and any significant differences were calculated using the Mann-Whitney *U*-test for equality of means.

Perceptions of community involvement and participation in catchment research

Using the original questionnaire matrix of variables concerning where and how in the research process citizen and expert scientists should participate, the 95% confidence intervals were calculated for each variable and presented as a comparative error bar graph. This enabled the easy identification of any patterns in the data and any differences between groups.

Knowledge of community-based research

Eleven true/false questions were used to assess respondents' knowledge of community-based catchment research within Australia and therefore the majority of questions concerned Waterwatch. Mean knowledge score across all questions was calculated for each group. The percentage of correct answers to each question for each group was also determined to preserve the richness of the data set. Statistically significant differences were determined between the overall mean scores of both groups and between each question. In addition to these initial analyses, the knowledge data had to be in a suitable format to allow correlation and multivariate analysis with the attitudinal indexes and frequency on interaction (described next). Therefore, the scores out of eleven had to become consistent with the attitudinal indexes, which ranged from -2 through +2. The knowledge scores could have been easily assigned a value consistent with the indexes by simply dividing the number of questions by 4 (a zero score, which indicated uncertainty in the other indexes is meaningless in this new knowledge scale where only a true/false answer was permitted). However, an equal 4-way division of scores from 1 through 11 would not have adequately represented relative knowledge levels, given that it is difficult to tell even using a pilot study how difficult or easy the respondents are likely to find the questions. Therefore, the quartiles were calculated and these levels were used to code the knowledge scores consistent with the attitudinal indexes.

Attitudes towards community-based research

The questionnaire included three series of questions that related to attitudes towards aspects of community-based research. These included community-based research data quality and utility, barriers and advantages. The attitudinal indexes were derived from Likert-type items. Responses were scored on a 5-point scale where a negative response to community-based research scored -2 through to +2 for a very positive response. Responses that neither agreed nor disagreed with the item scored 0.

To ensure index reliability and internal consistency, all conceptually-linked items in the questionnaire were grouped and then the internal consistency of each conceptual scale was validated using the statistic Cronbach's alpha (see Morgan and Griego 1998). Items were excluded from each of the scales until the index reliability maximised this statistic. Only when the statistic was maximised were the scale items summed to make a composite score. Cronbach alpha scores for the three indexes presented in Chapter 5 ranged from 0.61 to 0.88. As with other reliability coefficients, Morgan and Griego (1998) asserted that alpha should be above 0.70, however, they contend that it is common for published scales to have alphas in 0.60-0.69 range. Therefore, the alpha range calculated for the indexes in this study is adequate and can be considered reliable for interpretation.

Further analysis compared citizen and expert attitudinal stances by measuring the significant differences between the indexes for each group and determining which items were responsible for the greatest variation between groups.

Experience of community-based research

For ease of analysis and consistency with the previous sections, the frequency of interaction data was collapsed from the six categories listed in the questionnaire to four (low, medium, high and never). Therefore, after calculating the percentages for each type of interaction the data were scored from -2 for no interaction through to +2 for high levels of interaction.

A major research question identified in Section 3.3 concerned the influencing factors on citizen and expert perceptions of community-based research and its potential future. Stepwise multiple regression was used to determine the influencing factors on the dominant attitudinal stances represented by the three indexes, the type and experience of interaction, and the likelihood of future interaction. This method selects the variable with the highest bivariate correlation with the outcome variable. It then examines the semipartial correlations and enters the predictor variable with the highest semipartial correlation. This process continues until the remaining variables make no significant difference to the multiple correlation (R) (see Morgan and Greigo, 1998). Stepwise regression allows the selection of variables one at a time and overcomes the problem of two related variables cancelling out each other (Morgan and Greigo, 1998). Bivariate correlation coefficients (Spearman's coefficient, r_s) were also calculated to augment the analysis. In essence, these calculations determine the relationship between respondents' knowledge, attitudes and practice or experience.

Community-based research: future intentions

The future intentions and needs of citizens and experts are explored and compared using the mean score and standard deviation for each item. This section also tabulates the range of projects that groups and individuals have been involved in (see Tables 5.6 and 5.11).

2.1.1.1 Reliability and validity

The strength of quantitative research is reliability (Tolich and Davidson 1999). To ensure reliability, the surveys were standardised enabling each data collection to be compared and, eventually, generalised to the target population.

Two factors were central in assessing the validity of the questionnaires. First, whether respondents who completed the questionnaires did so accurately and second, whether those who did not reply would have answered according to the distribution of those who did (Cohen 1989: 116). To address the first factor, it was decided that further selected interviewing would be used to check accuracy. Questionnaires are often criticised for eliciting shallow responses, therefore to strengthen the validity, follow-up interviews included questions relating to the questionnaire responses. To address the second concern, a portion of non-respondents were contacted to determine the reasons for their decline and to compare the replies of respondents and non-respondents. The researcher sought to be reassured that the non-response was not related to the survey topic or the questions asked, in other words, that the sample is unbiased.

2.1.1.1 Ethics

All questionnaires included an accurate description of the study and sponsors. No questionnaire was intended to include any leading or psychologically threatening questions. All participation was on a volunteer, confidential and anonymous basis. Findings from the survey were released and written only as summaries in which no individual names or answers could be identified. Summaries and reports were sent and/or presented to each participating organisation.

*1.2.1 **Phase 2** - Interpretive Case study*

Phase 2 takes an interpretive approach and uses a multi-site case study to answer research question 2 and to inform phases 3 and 4. This approach utilises the researcher as the 'primary instrument' (Merriam, 1988:19) of data collection and contrasts with Phase 1, which utilised a survey instrument. Thus, data was gathered and produced through my interaction with participants as I sought to ask questions, seek new insights and assess current events (Robson, 1993). The aim of this phase is to understand on a small, but detailed scale, the nature, purpose and outcomes of community-based research.

Kerridge, (1998:6) asserted that this personal notion of environmentalism challenges the literature to show 'how it feels, here and now'. Indeed, this purpose is consistent with a major theme running through this study 'think globally, act locally' or, as Kerridge, (1998:6) stated, to 'make contact between the public and the private'.

3.4.3.1 The underlying interpretive research methodology and case study approach

The data for this study were gathered, analysed and discussed with the participants within an interpretivist paradigm (see Table 3.1). The interpretive paradigm is particularly suited to this phase of the study because it allows: (1) the use of case study (Yin, 1988) and naturalistic inquiry approaches (Lincoln & Guba, 1985); (2) close collaboration between researcher and study participants (Haigh, 2000); (3) acknowledgment and exploration of different groups and projects; and (4) the affirmation of the significance of the participants' knowledge (Haigh, 2000). Thus, interpretivism allowed for an in-depth exploration of the perceptions and attitudes revealed on a more superficial basis in Phase 1.

Key to this part of the study is a substantive understanding of community-based research on catchment issues. My aim was to provide a rich description of events in which the experiences of the participants were interpreted from their own perspective (Robson, 1993). I was concerned with the participants' thoughts, feelings and beliefs on reflection of their experiences, values and behaviour (Hughes 1998:6). This involved seeking the perceptions of individual participants and is best described as a subjective approach. Following Cantrell (1993), values will be an inherent part of this second phase because it is based upon social interaction. This is consistent with the interpretive paradigm and is supported by Fetterman (1988) who argued that:

> What people believe to be true is more important than any objective reality; people act on what they believe. Moreover, there are real consequences to their actions (p.18).

My research questions were exploratory and I did not require control over the events (Robson, 1993). However, I needed an approach which gave me access to the reality of community-based research so that I could interpret meanings within a 'natural setting' (Cantrell, 1993; Miles & Huberman, 1994). According to Yin (1998) a case study approach was ideal for this exploratory study where I intended to conduct the research in a real life and dynamic context. He defined the case study process as:

> An empirical study that investigates a contemporary phenomenon within its real-life context; when the boundaries between the phenomenon and context are not clearly evident; and in which multiple sources of evidence are used (p.23).

Reviewing Yin (1994:3), this approach allowed my study 'to retain the holistic and meaningful characteristics of real-life' community-based research. It also allowed me to 'reveal the multiplicity of factors which interacted to produce the unique character' of community-based research (Yin 1988:82). In this way, some researchers (eg Winegardner, 2001) see significant value in the ability of case studies to suggest a range of possibilities for a future, which cannot be assumed to be a projection of the past.

3.4.3.2 Selecting a multi-site case

The literature demonstrates that case studies are inherently variable depending on the research purpose, the size of the study unit, the underlying methodological paradigm and data collection techniques used (Haigh, 2000). Patton (1990) stated that in both interpretive and critical (qualitative methodologies) sample size is determined by the purpose of the study rather than paradigmatic laws. Thus, I had to be pragmatic and assess what I needed to know, what would be useful, credible and possible within the constraints of time and resources (see Patton, 1990:184 and Stake, 1994b:238). Given these constraints on sample size in detailed interpretive inquiry, sample selection becomes very important. Patton (1990) elaborated upon this point:

> The validity, meaningfulness, and insights generated from qualitative inquiry have more to do with the information-richness of the cases selected and the observational/analytical capabilities of the researcher than with sample size (p.185).

According to Merriam (1988), the most appropriate case sampling strategy for qualitative research is non-probability sampling, of which two widely used methods are purposeful and theoretical sampling. This study uses purposeful sampling where the cases chosen represent 'exceptional examples' (Gall *et al* 1966) of community-based research because I wanted to inform guidelines for best-practice or optimum results. Therefore, use of typical or less successful cases is avoided because they are less likely to provide this sort of information.

The case study site or 'bounded system of research' (Haigh, 2000) that I studied in the first year included all participants in a Commonwealth Government funded project which sought to develop water-quality monitoring methods for community groups. This project was a joint initiative involving steering committee representatives from the Queensland Department of Primary Industries, Department of Natural Resources and Mines and the Environmental Protection Agency, with the project officer being employed by the Department of Natural Resources and Mines. This project aimed to incorporate knowledge from community groups, agency representatives and scientific researchers in order to develop standardised monitoring protocols for community groups in coastal and estuarine areas. This involved an initial trial period with selected Queensland community groups before involving further groups. Once verified by consultation and experimentation with community groups, the final protocols will be incorporated into the Waterwatch Queensland and Waterwatch Australia manuals.

This inter-agency/community project was continued as a case study site into the second and third years of research and was augmented in the second and third years by focusing on two of the initial community groups as second and third case study sites in their own right. Thus, the inquiry had now become a multi-site case study with the first year's case site suggesting more focussed directions of inquiry for the study in the second and third years. This method of non-probability sampling using networks is described by (Sarantakos, 1993) as 'snowballing' and is appropriate for this study where I have used participants to identify sites which they considered successful and 'information rich' (Earles, 2002). Similarly, Miles and Huberman (1994) have observed that samples in qualitative studies often evolve once fieldwork begins. They would describe the approach used here as 'conceptually-driven sequential sampling' and contend that this sampling technique (both within and across cases) 'puts flesh on the bones of general constructs and their relationships' (Miles and Huberman, 1994:27).

Indeed, the second and third case study sites have been chosen because the groups at these sites routinely undertake tasks from the entire research spectrum concerning catchment water quality. They also exhibit research functions in excess of that commonly carried out by most community environmental groups in South-East Queensland, and in the context of this study are considered 'exceptional cases' (Gall *et al* 1966). This approach is consistent with the theory-driven aspect of this research that seeks to produce guidelines for successful community-based research. In addition, the groups' research is conducted with varying degrees of scientific and agency professional direction and assistance. Thus, they may be classified as community-based researchers and allow an interpretive analysis of the form of participation that unfolds and the dominant context within which public participation in catchment decision-making takes place.

3.4.3.3 Case study data collection techniques

Case study research involves a combination of several different research techniques. The data collection techniques used in this study included semi-structured or focused interviews, participant observation and document analysis. I also kept a diary over the period of participant observation and interviewing which included additional notes relating to the research context that arose from my reflection about the context and activities that had been observed. Consistent with Merriam's (1988) observation that rarely are all three strategies used equally, this study predominantly relied upon semi-structured interviews. Participant observation was used to inform interviews and to help establish a rapport with interviewees, while document analysis provided additional contextual information.

Participant observation

The relationship between myself and the participating scientists, agency representatives and community members is a significant aspect of this research which took place in field settings where I was either at an environmental monitoring site or in the 'shop-front' premises of a community group. Therefore, it is important to address the question posed by Haigh (2000) that is whether the researcher is carrying out participant observation, or is acting as an observer who is participating. See Table 3.4 for a continuum of observational states.

Table 3.4 A continuum of participant observation

Pure Participant	*Participant As Observer*	*Observer As Participant*	*Pure Observer*

Source: Cantrell (1993:94)

According to Haigh (2000), when undertaking pure participant observation, the researcher is entirely involved in the activities of the current research situation whereas participation by an observer enables a 'looser connection' by the researcher with the situation. In the latter instance 'the need to be there as an observer is recognised, but there is no need for the researcher to feel constrained to share in the activities of the researched in a direct and complete way' (Burgess 1985: 25). In this study, I joined the agency representative and community group members in their field interactions and daily processes within the community group, with note taken of dialogue, non-verbal communication, behaviour, physical setting, events and activities. Notes were written in a notebook either during the interaction where appropriate or in the carpark as soon as the observation period had finished. These were transferred to a computer file each night with additional reflections added. Reflections included my feelings, reactions, and personal meaning (Cantrell 1993). In this instance, I was more of a participant who observed (assistant, learner, conversationalist) as required and requested by the agency representative and community group (Haigh, 2000). Indeed, both community groups remarked at how I had 'fitted in'.

Several of the advantages of participant observation discussed by Cantrell (1993:95) apply to this study. The first is that it provided me with direct, first-hand experience of events as they occurred. The second is that it guarded against selective perceptions by allowing me to gain an overview of the research site. The third is that I was able to learn with participants. Consequently, I increased my knowledge of local catchment issues and at the same time enhanced my understanding of community-based research.

Cantrell (1993) also highlighted that observation can be disadvantageous by altering the research setting, being time consuming and producing too much data. To some extent these concerns are all relevant to this study. However, I felt that because I had managed to integrate whilst still being known as a researcher that this was an invaluable stage early in the case study to inform further inquiry, particularly when formulating interview questions and seeking reactions to certain events. Indeed, it enabled me to build up trust and a rapport between participants that greatly enhanced my interviews in the later stages of the case study.

Focused interviews

Whereas participant observation had allowed me to 'walk in the shoes' of those conducting community-based research, the use of focused interviews enabled me to access unobservable data in participants' own words (Cantrell 1999:93). According to Cantrell (1993) this technique gives an insight into how participants interpret and understand the processes and activities that they are engaged in.

Several academics (eg Guba *et al*., 1981 and Patton, 1990) have stated that interview formats also vary along a continuum, ranging from structured to unstructured. In structured interviews, the interviewer uses pre-formulated questions in accordance with a pre-determined definition of the problem. In unstructured interviews, it is the respondent who defines the problem and interview structure. Although there is some debate over which is the best approach, most authors conclude that the research purpose will guide the researcher in choosing the most appropriate approach for a given study.

In this study I used semi-structured interviews, beginning interviews with open-ended questions and continuing to narrow and expand on topics as dictated by the responses. In this way I could explore issues identified earlier in the literature, quantitative survey and participant observation. I could also compare data across respondents whilst retaining the ability to explore novel issues identified by the respondent during the interview.

I personally conducted and tape-recorded all interviews. Use of a tape-recorder 'freed' my mind from note-taking and allowed thoughtful response to new information and the reformation of some questions or the development of new ones during the interview. Haigh (2000) highlighted that this personal approach enables data analysis to occur with a full understanding of the interview context. Initial interviews were conducted with a general interview guide, which I had trialed with several respondents. All subsequent interviews were conducted on a more informal and conversational basis with a list of issues rather than an interview guide. I felt that the later approach was more effective in obtaining the respondents' perspectives in their own words. All interview transcripts/summaries were returned to the participants in the form of a letter to check the accuracy of the transcription and the researcher's interpretation of the data. I also gave all core participants a copy of the finished chapter and invited them to comment on the validity of my interpretations and to engage in my analysis of their words and situation. However, most participants felt that my analysis accurately described their thoughts and feelings at the time of the study and were satisfied contributing only to the data collection phase. Similar to Earles (2002), I sensed that although participants felt that the study was valuable and that a reflective process was necessary for their projects and groups, most participants did not have time to participate further. Indeed, it appeared that 'conceptual musing was a luxury in their positions' (Earles, 2002:12).

Document analysis

As with other research strategies, contemporary literature held a range of advice and cautions that I heeded in gathering documentation or 'paper data' (Cantrell, 1993:97). Burns (1990:319) cautioned that documents may be inaccurate and that it is important to remember that they may have been edited with a specific audience or purpose in mind. However, many authors [eg Burns, (1990), Cantrell (1993) and Patton (1990)] agreed that documents provide accessible and reliable information, which can confirm or provide greater detail on observations and interview responses. They are also an opportunity to gain different perspectives on similar issues.

From each site I collected annual reports, newsletters, agendas, internal and external communications, policy documents, newspaper articles, books and papers written by participants, and educational pamphlets produced by the groups. Many of these were retrospective and I sourced them from the records kept by each group. However, many were also collected as events happened during participant observation or provided by interviewees to provide a visual and detailed explanation of certain points they wished to make. I also used 'electronic data' (e-mail) and I was fortunate to be included on the standard e-mail lists of the case sites concerned for the duration of the study. This included external communications, agendas, newsletters and digital photos. Thus, I was able to use the combination of these documents to build a longer-term picture of community-based research and to clarify other sources of data.

3.4.3.4 Case records

The data produced through the case study techniques of participant observation, focused interviews and document analysis were collated into a case record for each case study site (see Appendix B for a list of contents and a sample of each of these where appropriate). The concept of a case record to describe the organisation of field notes or 'case data' was developed by (Stenhouse, 1978, 1982). A case record is an 'edited, ordered, indexed and public version of the case data' (Ruduck & Hopkins, 1985:102). There are three main advantages of compiling a case record. The first advantage is that it provides the researcher with an ordered set of data that the researcher can critically peruse in order to present the case study. The second benefit is that a comprehensive case record that ensures the confidentiality of participants can provide a means of validating interpretations in qualitative research. Until recently, case data has not been made public. This has made it difficult to assess the trustworthiness of the qualitative researcher's account. Stenhouse (1982) asserted that case records are the qualitative researcher's parallel to publicly accessible primary source materials in historical research:

> The…primary sources of history are essentially documents or artefacts in the public domain and the inference of facts from the sources is verified by virtue of their being accessible to a number of professional historians who discuss their status and implications…Thus replication is a matter of revisitation of the record (p. 43)

Finally, the creation of a case record provides a public archive of text for future interpretations of the case data. This may also allow the analysis of such data by a different researcher employing a different interpretive framework. Thus, the development of a case record is a process that can contribute to the development, review and refinement of theory in qualitative research.

3.4.3.5 Case analysis and presentation

The analysis of the findings of this study began when the first data were collected and continued until the written chapter was completed. Several authors (eg Miles and Huberman, 1994 and Winegardner, 2001) have explained that this is an iterative process where the emerging insights and tentative hypotheses direct the next phase of data collection. This leads to refinement of questions, collection of more data, which leads to more insights, and so on. The endpoint is decided by the researcher when no new knowledge is forthcoming (saturation/redundancy). Consequently, I, as an interpretive researcher, constantly needed to find the balance between recognizing new information relevant to the current study and finding new information relevant to the focus of another or secondary study (Cantrell 1993).

The exploratory research questions outlined earlier in this chapter were used as a guide ensuring that I remained focussed whilst looking for additional and emergent issues. For reporting a multiple-case study, most texts (eg Gall *et al*., 1966) recommend reporting the results for each case in a rich style or using thick description, and also providing a cross-case analysis, that recognises consistencies and differences in constructs, themes, and patterns across the cases. Given the over-lapping and networked nature of several core participants in this case study[11], and the focus on the citizen/expert dichotomy I chose what Miles and Huberman (1994:176) would describe as a mixed strategy for analysis. In this instance, 'citizens' and 'experts' became my cases and I coded these separately (case-orientated strategy) and then looked for themes that cut across cases after coding (variable-orientated strategy). Thus, I retained the case dynamics of Site 1 (experts) and Sites 2 and 3 (citizen networks) and was able to compare patterns between citizens and experts and also explore themes that relate to community-based research as a sometimes collaborative activity between these two groups of people. Indeed, Miles and Huberman (1994:177) stated that the integration of case-orientated and variable-orientated strategies is desirable.

According to Gall *et al* (1966) there are two dominant styles of case study reporting; analytic reporting and reflective reporting. The former is more objective and inappropriate for this interpretive study. Reflective reporting uses literary devices to bring the case alive, and the researcher's voice is clearly heard in the report (Winegardner, 2001). Certainly, the presentation that flows from my interaction with these networks of citizens and experts concerned with catchment health reflects my interpretation of events and my collection of the words and thoughts of these participants. Indeed, Denzin and Lincoln (1994) have emphasised the role of the researcher in this incremental process:

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[11] The networked nature of the multi-site case study enabled me to view the same participants in several different settings. Indeed, several participants (especially experts) over-lapped between the sites as they interacted with different community groups. In presenting their words and activities all participants are referred to as either an expert or a citizen with note taken of the site in which I first encountered them and where they spent much of their time. Thus, all experts are referred to at Site 1 and all citizens at Sites 2 and 3. These sites are some geographical distance from each other. However, they were all part of the same initial project and Waterwatch network. Therefore, most comments (except where noted) are based upon this interactive experience.

> Qualitative research is endlessly creative and interpretive. The researcher does not leave the field with mountains of empirical materials and then easily write up his or her findings. Qualitative interpretations are constructed (p.14).

However, I felt that a crucial role of this study was to provide a voice for those who had agreed to participate in my study. I considered that the best literary technique to bring the case alive for the reader and to ensure accuracy was to use verbatim quotations from participants as much as possible. Thus, the story that I have constructed in Chapter 6 is told by many actors while I have taken the role of the reflective narrator. I worked and reworked the organisation of verbatim quotes, information from documents and participant observation around the emerging themes made clear through coding until I had constructed a coherent story. Comparative matrices between citizens and experts were used to summarise some sections and diagrams were used for clarity of descriptions in others. Stake (1994b) described this process of knowledge transfer from researcher to reader:

> In private and personal ways, ideas are structured, highlighted, subordinated, connected, embedded in contexts, embedded with illustration, laced with favour and doubt (p.240).

Consequently, my case description, analysis and presentation have evolved through the process of writing the final chapter and are based upon the ideology outlined at the beginning of this chapter. In this way, Eisner (1985 cited in Stake, 1994) has asserted that the case context facilitates learning through two pedagogical methods. The first is by teaching what I, as the researcher have learned (teaching didactically) and, the second, is by providing material for the readers to learn on their own (discovery learning) (Stake, 1994b:240). Nevertheless, it is still the researcher that decides what to present. Thus, it is timely to discuss issues of validity and reliability.

3.4.3.6 Issues of validity and reliability

Questions of validity seek to ensure that the researcher is measuring what he or she thinks they are measuring. In contrast to the survey approach utilised in Phase 1 of this study, case study research does not seek to generalise, but to provide a precise (valid) description of behaviour at the research location (Tolich and Davidson, 1999). Thus, Haigh (2000) has observed that interpretive researchers are seeking quality of insight:

> For interpretive researchers working with descriptive data, it is inappropriate to apply quantitative criteria of validity such as the number of the participants or the

> number of times the data is analysed by independent researchers. It is the quality of the insight from people who have a direct involvement that is important rather than the number of people who hold that view (http://www.ace.ac.nz/learning/science/articles/a5.asp).

Winegardner (2001) argued that in the interpretive (post-positivist) approach, there is little distinction between validity and reliability. Both are assessed in context rather than against an external and objective standard. According to Winegardner (2001) reliability is less a function of replicability and more a function of credibility of the researcher's knowledge claims and acknowledgment of his or her central role and biases in the research. Similarly, Lather (1986) noted the need for credibility in openly ideological research:

> Once we recognise that just as there is no neutral education there is no neutral research, we no longer need to apologise for unabashedly ideological research and its open commitment to using research to criticise and change the status quo. The development of data credibility checks to protect our research and theory construction from our enthusiasms, however, is essential in our efforts to create a self-reflexive human science (p.67).

This is best described by Guba (1981) as trustworthiness of findings. Several ways, to ensure trustworthiness including construct validity, triangulation, face validity, and reflexivity are particularly pertinent to this study. My continued interaction and communication with primary contacts at each case study site were essential to the efficacy of all these techniques.

Construct validity

Construct validity refers to agreement between the theoretical basis and concepts in a particular research project and the methods used in the study. This is explained by Trochim (2002):

> When we claim construct validity, we're essentially claiming that our pattern - how things operate in reality - corresponds with our theoretical pattern - how we think the world works (http://trochim.human.cornell.edu/kb/c).

To achieve construct validity, Carmines and Zeller (1991:23) described three steps that they believe should be followed. The first is clarification of the theoretical relationships that relate to the study. The second is examination of the empirical relationships between the measures of the concepts. Finally, empirical evidence must be interpreted in terms of how it clarifies the construct validity of the particular methods. In a dynamic case study, Lather (1986:67) noted that this involves a 'systematised reflexivity' to establish how *a priori* theory has been changed in light of new data and enhances the theoretical contribution of a study. I concur with Trochim (2002) that in many ways, construct validity is an overarching quality that encompasses the other types of validity. Put simply, it involves ensuring appropriate means of data collection for a particular study (Thomas, 1990:5). In this study, I used multiple sources and types of data and continually had participants reviewing my analysis and final presentation. I also continually made comparisons between my theoretical and ideological basis and the story told by the data as it emerged from this study. This process and its integral relationship to the following forms of validity are now described in more detail.

Triangulation

The technique of triangulation of findings is often employed to strengthen case study validity (Denzin, 1978). Triangulation is used to generate a variety of data so that the researcher can corroborate the information in several ways. Cantrell (1993) listed four methods of triangulation: using different data sources; using different researchers; using the different perspectives of various theories to interpret data and using multiple methods of data collection. Data can also be collected over varying temporal and spatial dimensions.

To strengthen the credibility of this study, I studied three case sites and involved a range of participants in each. Moreover, the information was gained using a combination of interviews, participant observation and document analysis. The pattern of data collection employed involved contact over a period of two or more years in various circumstances and locations because it was planned that if different sources of information make similar comments, then I could have an enhanced confidence of validity (Tolich and Davidson 1999). Indeed, Bryan (cited in Hill, 1984) stated that the logical integration of data from different sources and different methods of analysis into a single and consistent interpretation increases the validity of qualitative data.

Face validity

Face validity is another technique that I used to ensure validity and reliability. This involved returning interview transcripts and/or summaries annotated with follow-up questions back to participants for comment and clarification. Traditionally, this is referred to as 'member checking' (Guba *et al.*, 1981). All participants had an opportunity to change transcripts and/or summaries by adding more information to clarify points they had made or deleting comments. Miles and Huberman (1994) also observed that this reciprocal process can enhance shared reflection. Certainly, in this study it enriched subsequent interviews and conversations with participants throughout the duration of the study. In addition, to this early feedback, I also felt that it was important to send any analysis, drafts and final chapters to core participants in order to ensure transparency and that the participants' information was being used in the intended context. Again, Miles and Huberman (1994) have also supported the notion of gaining feedback at this higher level of inference.

Reflexivity

Reflexivity involves a questioning approach to participant responses and to one's own assumptions (Carr and Kemmis, 1986). Ruby (1980) argued that practicing reflexivity involves revealing one's underlying epistemological assumptions that affect the research process and final presentation. In this study, I used such reflexivity to enhance the validity of the synthesis of observation, the review of academic literature, and the design of the research (Haigh, 2000). This encompasses Winegardner's (2001) attention to researcher positioning where the researcher is sensitive to how he or she relates to a particular case. I found that the best way to achieve this was to keep note of changes to my personal belief systems and understandings.

3.4.3.7 Issues of ethics

Miles and Huberman (1994:288) have highlighted the social and personal nature of qualitative research by stating that researchers cannot focus on the quality of the knowledge produced as if its truth were all that counts. Similarly, Stake (1994a) observed the following:

> Qualitative researchers are guests in the private spaces of the world. Their manners should be good and their code of ethics strict (p.244).

Thus, Miles and Huberman (1994:288) proposed that researchers should consider the morality of their actions with respect to the people whose lives are being studied. Some of the main ethical concerns of pertinence to this current research are voluntary participation, informed consent, confidentiality and the need to eliminate any potential harm to participants.

All case study participation was on a volunteer, confidential and anonymous basis. Where possible, I gained signed consent and provided an information sheet prior to commencing all interviews and participant observation. The information sheet provided details of the purpose of the study, the likely outputs from the study, participant expectations and also stated that participants were free to withdraw from the study at any time (see Appendix B). However, as Miles and Huberman (1994) noted, this was not always possible given the dynamic and sometimes opportunistic nature of case study research. In such instances, I gave a verbal description of my study and sent participants an information sheet. In the instance of participant observation, the key participants were given a copy of the research proposal and all other participants were informed verbally of my position, sponsors and purpose of the study.

Referring to participants only as either an expert or a citizen including a numerical site reference protected confidentiality and anonymity (eg Citizen B/Site 2). All participants had access to interview transcripts, and were able to make changes to interview transcripts and summaries (member checks). Draft reports and data analyses were also sent to key participants to confirm findings and to increase the transparency of the research process.

The above-mentioned processes of informed consent, attention to issues of confidentiality and anonymity, should allow the findings from this research to contribute to guidelines regarding the interaction between scientists, agency representatives and community group members in community-based research without causing the participants any foreseeable harm.

*3.4.4 **Phase 3** - Synthesis*

The analysis of the data from the survey (Phase 1) and case study (Phase 2) is presented in Chapters 5 and 6, respectively. However, as indicated in Section 3.4, a multi-method study, comprising positivist and interpretive investigations, was designed in order to balance the type of knowledge capable of being 'discovered' from these different approaches. Integrating these two sets of findings provides for a richer and more insightful depiction of the state of community-based research in catchment management in Australia than the individual chapters can provide. Therefore, Phase 3 of the study was a synthesis of the two sets of data [Chapter 7].

The synthesis was the data interpretation phase of the study. This was conducted through the process of "critical reflection". Critical reflection, in fact, refers to all the processes of analysis and interpretation in which I engaged in order to reach an understanding of the state of community-based research in catchment management in Australia. Figure 3.2 shows this synthesis as the filter through which data from Phases 1 and 2 were processed. However, the two dimensional nature of the diagrammatic summary of the process belies its complexity as data collection, analysis and interpretation occurred simultaneously. As Woods (1986) explained:

> As one observes, interviews, makes up field notes and the research diary, one does not simply 'record'. There is also reflection, which in turn informs subsequent data collection.... The closer we can bind then together, therefore, through triangulation, escalation, interaction, or whatever, the stronger the eventual product (p.120).

Lacey described this process as a "spiral of understanding" in which insights are "escalated" by moving them "backwards and forwards between observation and analysis and understanding" (in Woods, 1986:120). Thus, the construction of the questionnaire was guided by my interpretation of the pilot focus groups, existing literature on survey technique and responses to the pilot survey. Similarly, during the case study I was mindful of, and sought participants' explanations of, patterns that were emerging in the statistical analysis of the questionnaire data.

As the study progressed I also sought participants' explanations on issues that arose from case study analysis. In some instances I was able to formalise this process through repeated interviews with the same participants - at other times this was best described as an on-going discussion between myself and participants as I joined in group activities as a participant observer over an extended period of time. This allowed joint reflection on previous discussions and a more analytical response from participants regarding changes over time. For example, I was able to interview some participants several times and to reflect with them on the group or project progress and the personal learning and growth that had occurred through these experiences.

According to Kemmis (1987) critical reflection involves the systematic examination of the historical and contemporary contexts of particular practices and an uncovering of the interests served by them. Thus, critical reflection is more than an objective blending of data from two or more sources. It provides data interpretation with a critical edge (see Table 3.1). As Kemmis noted, data interpretation through critical reflection:

> ... involves a form of critique, which is ... capable of analysing and challenging the institutional structures in which practitioners work.... (I)t looks 'inwards' at the conceptual principles (theories, understandings) which inform the social life of particular groups and 'outwards' at the social and historical processes by which ideas, social structures and ways of working are formed.... A central aspect of critical reflection … is always to examine the extent to which … institutions sustain, and the extent to which they make vulnerable, the … values and traditions they are intended to serve (pp. 75-79).

Concepts such as adaptive management, power, social capital, reflective practice, and social learning from the literature review were used to locate the data from the survey and the case study within the socio-cultural context of community-based research in catchment management in Australia. It is this form of theory-driven reflection which enables the researcher to go beyond the confines of "what is going on in the data" (Glaser, 1978:94) to theorise from the study.

Critical reflection was required at a number of stages in the research process. It was required of the researcher as a constant state of mind during the collection and interpretation of data as described above. It was required of participants in the case study, also. The products of critical reflection by the researcher were returned to them for negotiation and reinterpretation. Participants were also invited to reflect on the data presented to them and to respond in oral and written forms of their choosing. They were invited to indicate areas of agreement, to add or emphasise points they believed had not been given due regard, and to negotiate points of disagreement.

*3.4.5 **Phase 4** - Theorising from the study*

The synthesis and critical review of the findings of the study presented in Chapter 7 enabled Phase 4, theorising from the study. Theorising was done with a practical intent to provide guidelines for the conduct of community-based catchment research in Australia. Recognition of the diversity of catchment contexts and potential participants in research led to the formulation of general guidelines as well as recommendations specifically for community groups, specialist scientists and agency representatives. The implications for academic researchers also form an essential part of the theory development phase in an effort to contribute to the on-going refinement of techniques, particularly for dynamic and unpredictable contexts such as those represented in this study.

3.5 CONCLUSION

This chapter has outlined the research methods, data gathering techniques and guiding paradigms of the study. It described the research questions of the study and the four phases of research that were used to answer these by combining quantitative (positivist) and qualitative (interpretive) approaches in a complementary manner. The next Chapter (4) describes the citizen and expert groups at the centre of the study in more detail to provide a context for the presentation of the survey analysis in Chapter 5 and the case study portrayal in Chapter 6. The synthesis of these chapters is presented in Chapter 7, while the conclusion to the study and recommendations for further research are described in Chapter 8.

Chapter

4

CONTEXTUAL OVERVIEW OF SURVEY PARTICIPANTS

Waterwatch, Cooperative Research Centre for Catchment Hydrology and the Cooperative Research Centre for Coastal Zone, Estuary and Waterway Management

4.1 INTRODUCTION

This chapter reviews Waterwatch Australia, the Catchment Hydrology CRC and the Coastal CRC as three distinct research programs that conduct activities focussed on Australian catchments. The purpose of this section is two-fold. First, it seeks to provide a contextual overview for each program as a basis for understanding and interpreting the survey and case-study analysis. It summarises the mission statements, goals, activities, membership and partners of each organisation to allow a better understanding of the broad aims and processes of each group. Second, it takes a comparative view of these programs to highlight important differences in program goals, research outcomes and participants to determine how these programs contribute towards citizen science as a community-based approach to achieving sustainability. Information for these overviews was compiled and summarised from recent literature and the web sites and annual reports of Waterwatch Australia (http://www.waterwatch.org.au), the Cooperative Research Centre for Catchment Hydrology (http://www.catchment.crc.org.au), and the Cooperative Research Centre for Coastal Zone, Estuary & Waterway Management (http://www.coastal.crc.org.au). Additional information and contemporary research on the Australian Landcare program and other environmental stewardship groups are also summarised as one community group in this study was also endorsed as a Landcare group and both groups undertook roles and activities associated with this program. Certainly, many Waterwatch groups are closely linked with Landcare and other catchment-based community groups and some combine both programs and a range of groups in taking a networked, integrated and whole of catchment approach to their objectives and tasks.

4.2 WATERWATCH AUSTRALIA

Waterwatch was initiated by the Commonwealth (Federal) Government in 1993 in response to growing public concern over declining water quality evident by rising salinity levels and the increased prevalence of blue-green algal blooms.

Waterwatch, like Landcare is supported in part through Australia's Natural Heritage Trust (NHT) and sponsorship from regional and local partnerships. The Federal Government set up the Natural Heritage Trust in 1997 with proceeds from the privatisation of Telstra, the national communications company. The Trust is designed to support community groups undertaking projects to help restore and conserve Australia's environment and national resources. In the 2001 Federal Budget, the Government announced a five year funding extension and contributed an additional $1 billion to the Trust. Of this sum, the Government states that it expects to spend at least $350 million on improving water quality in Australia (http://www.nht.gov.au/overview.html). Dwyer and Wissing (2001) state that Waterwatch has also generated much support from the private sector, State/Territory governments, community groups, and local governments. The result of this support is that on average, one dollar from the Waterwatch program is met by four dollars contributed from these other sources (Dwyer and Wissing, 2001:3).

4.2.1 Objectives

Waterwatch is a national community water-monitoring program designed to encourage widespread involvement of Australians in the active protection and management of their waterways and catchments. It has the following specific objectives:

An increased awareness and understanding of the importance of healthy waterways and the relationship to land uses within the catchment
Communities monitoring their local waterways
Community involvement in planning and action to address waterway and catchment issues
Effective partnerships between all sectors of the community working towards healthy waterways
Financial and institutional support for the Waterwatch Australia network

Waterwatch is a dynamic network where people can participate as individuals or part of local school or community groups. Collectively, network participants undertake a variety of biological and habitat assessments as well as physical and chemical tests in order to describe and understand the health of their waterways and catchment so that they can take constructive actions to rectify water quality problems.

4.2.2 Program organisation and participants

Waterwatch is administered by the Sustainable Water Section of Environment Australia and acts like an 'umbrella' scheme where each State or Territory has a Waterwatch Facilitator and each interested region has local Waterwatch coordinators. The local coordinators are responsible for setting up and supporting groups in their area. They have access to resources including technical manuals, quality assurance and quality control protocols and data management tools. Their role is to provide on-going group support by providing resources and advice. Most, if not all, coordinators are also active participants in monitoring activities and are core group members. Because the local coordinators have an overview of the monitoring activities, experience in conducting the monitoring and are typically the members whose role is to seek expert assistance, they were chosen as an appropriate sampling level and consistent sampling unit for the survey.

Certainly, the program has many volunteers and this has contributed to its considerable education and awareness-raising abilities. Waterwatch also aims to create awareness of water quality issues by encouraging group partnerships with water authorities, local councils, local schools, universities, business and industry. These partnerships are an important source of bridging social capital where groups are encouraged not only to partner with groups who will take a 'hands on' approach and become directly involved in the monitoring, but also those groups who can participate by providing equipment, expertise, sponsorship, or promotional opportunities.

4.2.3 Research goals

Groups typically form in response to a local issue and therefore group aims and activities are varied and reflect the diversity of environmental issues faced across catchments. The web site lists the following potential monitoring aims:

Check on regulatory compliance
Document long term or one off problems
Track trends or changes in the waterway
Establish benchmark monitoring
Promote community awareness of the importance of waterways and the impact of water quality decline
A combination of the above

Most groups begin by forming a technical advisory committee to consider aims, methods, equipment, training needs and data interpretation. Once these are established, groups typically assess the status of their catchment and determine long term trends in water quality. From this level of understanding, groups can then take remedial action to alleviate any problems or commence more complex monitoring projects.

4.2.4 Research activities and techniques

Participants learn, monitor and take action to promote the health of their waterways using the following techniques (http//www.waterwatch.org.au):

Learning about water monitoring techniques
Observing daily and seasonal changes in a waterway
Comparing water quality records with other groups of government agencies
Examining water quality and waterway habitat
Surveying wildlife to help determine water quality
Gathering and recording scientific data
Reporting results to participants, sponsors and the community
Replanting native vegetation along waterways
Removing weeds or litter from waterways
Encouraging businesses, farmers, households or individuals to evaluate their activities and minimise waterway pollution
Organising information days
Organising public meetings or displays on water quality issues
Publishing newsletters, gaining media coverage and promoting healthy waterways

Where groups are involved in the gathering and recording of scientific data, groups use nationally adopted protocols for nine parameters (macroinvertebrates, dissolved oxygen, temperature, pH, conductivity, turbidity, reactive phosphorus, nitrogen and riparian habitat assessment). Data is recorded using nationally agreed units and national site code systems. These national monitoring procedures and data confidence guidelines ensure that community data is being collected with quality assurance. To allow the data to be pooled, analysed and interpreted at the catchment level and beyond, Waterwatch has developed a national database where groups can enter their data in standardised format that allows for nationwide interpretation.

4.2.5 Current status

Many authors believe that heightened awareness and concern for environmental issues within Australia and a growing realisation that we are fast approaching our sustainable ecological limits has lead to increased community participation in monitoring, on ground action and decision making concerning natural resource management (eg Dwyer and Wissing 2001:1). From this initial enthusiasm, the web site reports that Waterwatch is now one of Australia's most successful grassroots environmental initiatives and contributes significantly to the protection of waterways and meeting the community involvement aspects of the National Water Quality Management Strategy and associated Action Plans.

Waterwatch operates in 200 catchments with over 3000 groups and it is estimated that regular monitoring occurs in over 5000 sites nationally (http://www.waterwatch.org.au). Similarly, Curtis and De Lacy (1996) reported that Landcare groups commonly operate at catchment or subcatchment scales. Their review of previous research indicates that groups hold meetings to discuss issues, identify priorities, develop action strategies, and to debate issues with guest speakers; hold field days and demonstrations; engage in educational and promotional activities; organise conferences; write newsletters, field guides and media releases; participate in on-ground work involving seed collection and tree planting, constructing salinity and erosion control structures, pest and weed control, fencing to limit stock access to waterways and to protect wildlife corridors; groups are also involved in catchment and property planning and well and writing submissions for government funding (Curtis and De Lacy, 1996:121).

Dwyer and Wissing (2001) concluded that the success of the Waterwatch network accrues from strong local partnerships. Members in these partnerships are based in schools, community groups, government, catchment management authorities and industry. Increasingly, co-ordinators have also fostered the involvement of TAFE ecology students, Green Corps groups, community biomonitoring groups, Landcare groups and local government (Dwyer and Wissing, 2001:4). Therefore, they represent a broad cross section of the community and encompass a diversity of views. Indeed, Carr (2002) highlighted in her profile of several Australian stewardship groups[12] that members were drawn from segments of wider society and encompassed a range of educational levels and cultural heritages. The network of Waterwatchers in Australia is supported by over 130 regional coordinators who provide practical support for groups (Dwyer and Wissing, 2001:2). In the mid term review of Natural Heritage Trust projects, Buxton and Goodwin (1999) found that these coordinators were the most important part of the program and they

[12] Carr's research focussed upon local stewardship groups. Carr (2002) defines these groups as those that take an 'action-protection' role to care for their local environment (ie water quality monitoring group, Landcare group, catchment management group etc).

are described by Dwyer and Wissing (2001:2) as the 'glue' between participants within a catchment.

Consistent with Dwyer and Wissing (2001), Carr (2002:57) concluded that motivation to join such groups/networks is stronger when individuals perceive a threat to the vitality and integrity of their families, property or community. Table 4.1 lists the reasons Carr (2002) found motivated members to join the groups in her study.

Table 4.1 Motivation for involvement in Australian stewardship groups

Concern with a problem	To exchange ideas and information
Power of the group	To care for the country
To learn	Self-interest
Altruism	To have a say
Involvement and belonging	Social interaction

Source: Carr (2002)

Motivation to continue involvement changes over time and is often related to personal circumstances and the relationships developed with other members (Carr, 2002:57-8). One source of continuing motivation of particular relevance to this study is the use of community data in natural resource management decisions. Dwyer and Gowland (2001:3-4) observed that 'an important step in the growth and cohesion' of a Waterwatch group is to progress from monitoring and identifying potential water quality problems to having community monitoring data validated and used by resource management agencies.

However, criticism from professional scientists (see Caiger and Coad, 2001) is often a major hurdle to the evolution of community groups that conduct research. Caiger and Coad (2001:7) pointed out that in some cases professional concerns are valid if the monitoring program is not scientifically robust. Nonetheless, they also stated that such concerns often represent a misunderstanding between community members, professional scientists and resource managers. In many instances, it is not the quality of the data that is at fault, but that the way in which it has been used is not consistent with initial community monitoring objectives (Caiger and Coad 2001:7). Dwyer and Gowland (2001:4) have noted that scepticism of community data is diminishing through the creation of partnerships with natural resource management agencies. They cite one case study, Maroochy Waterwatch (Queensland), where agency staff worked closely with group members to replicate and 'shadow' the monitoring undertaken by the group to ensure data

confidence. This partnership process enabled community data to be included in an official government Environmental Impact Statement (EIS) in Queensland for the first time.
In addition to data quality and utility concerns, Carr (2002:58) observed that lack of time for participation in group activities is the major restriction on individual participation and ultimately group success. She stated that this is often caused by 'over-commitment' and competing demands on participant time from paid employment, housework, business and family commitments. While, these represent typical barriers to voluntarism (Carr, 2002:58) many authors (eg Carr, 2002; Curtis and Lockwood, 2000; Martin *et al*., 1992) have questioned if these demands actually represent a shift in the burden of responsibility for action from government to local communities. Curtis (1998) in his study of the closely related and often integrated Landcare program, concluded that while a range of approaches has been utilised towards environmental sustainability within Australia, investment has been directed heavily towards voluntary approaches. Consequently, there are concerns that "we" are expecting community groups to do too much (Carr, 2002:58).

The number of such groups and the intensity of their effort indicates a considerable increase in local activity (Carr, 2002:104). However, given the serious and intractable nature of many of Australia's environmental problems including dryland salinity, soil erosion and declining water quality, perhaps it is not a question of asking the community to do too much, but rather failing to provide adequate support. Indeed, Carr (2002:104) argues that 'governments' lack of support for stewardship activity merits closer consideration'. Similarly, several authors in reviewing the Landcare program after the recent 'decade of Landcare' (1990-2000) revealed ongoing and serious group support issues. These included: inadequate provision of money or materials to manage land and water degradation; limited support for leadership and management training for group leaders; inadequate support for group coordination; burnout of volunteer participants; insufficient leadership succession planning; and ineffective setting of priorities and catchment planning (Alexander, 1995; Byron *et al*., 2001; Curtis, 1998, 2000; Lockie, 1992).

Consistently, research has shown that community-based or participatory approaches (Dwyer and Gowland, 2001) and community-agency partnerships are vital to program success (Carr, 2002; Curtis, 1998; Curtis and Lockwood, 2000; Dwyer and Gowland, 2001; Dwyer and Wissing, 2000, 2001). However, developing and maintaining such partnerships has proved difficult and takes much sustained effort (Dwyer and Wissing, 2001). It is acknowledged that such partnerships need to be beneficial and 'not just partnerships in name' (Dwyer and Wissing, 2001:4). According to Curtis (1998) the combination of inadequate support for group management issues and the reluctance of federal funding sources to allow long-term funding for employment of group coordinators, now understood to be of critical importance in sustaining effective partnerships, represent a major threat to agency-community partnerships.

Despite these issues and impediments, research has shown that Waterwatch and Landcare groups can result in positive social and environmental changes within local communities. For example, from the latest Victorian Landcare group survey and previous surveys Curtis, (1998) concluded that:

> Landcare has been effective in mobilising the participation of a large section of the rural population; embracing an extensive range of community development activities likely to increase awareness of issues, enhance landholder skills and knowledge, and foster the development of a stewardship ethic; and has undertaken considerable on-ground work likely to have an impact upon land and water degradation at the local scale. There have also been some observable improvements in environmental conditions of some catchments (p. 571).

Similarly, Dwyer and Gowland (2001) have also observed positive outcomes and, in particular, social change through the environmental action taken as a result of community monitoring:

> Waterwatchers in various parts of the country have achieved positive outcomes for both biodiversity and sustainability through involving the community in monitoring and reporting about the condition of our waterways, on ground activities, learning experiences and celebratory events (p. 1).

Dwyer and Gowland (2001:1) also stated that Waterwatch is increasingly influencing the wider natural resource management framework by having activities and data included in management strategies and action plans and by undertaking community education. Thus, Waterwatch appears to be a way for the Commonwealth Government to work with State/Territory governments and community groups to encourage community-based solutions to environmental and social problems if effective partnerships can be sustained between these groups and their representatives. In focussing upon catchment health and water quality, this research looks at partnerships between citizen researchers in Waterwatch and associated Landcare groups and specialised scientists working in government agencies and academic institutions encompassed by two Cooperative

Research Centres that also examine issues surrounding water quality (see Sections 4.3 and 4.4).

4.2.6 *Messages to the scientific community*

This section concludes by presenting messages from Waterwatch coordinators to the scientific community. The Second National Waterwatch Conference was held at Griffith University, Brisbane, 20 - 24 November 2000. It was an important chance for members to share knowledge and experiences and to provide professional development opportunities for program coordinators. It was also a chance for members to articulate what they felt were important messages for the scientific community if community involvement in Australian catchment care is to advance (see following list).

Waterwatch is moving into the mainstream - our data is credible and accepted by many and is being used
We are useful
Do not be threatened by Waterwatch data
Community data is community data
We need your help
We provide the anchoring strategies to reality
Problems are so mammoth - we need to work together
We are the eyes and ears of the catchment

These messages provide an indication of how members view the role and ability of Waterwatch in catchment research and how these are complementary to those of the scientific community. These messages are not a challenge to professional researchers, but rather a call for the recognition of a valid community role in research, and the need for citizen/expert collaboration in achieving catchment health.

4.3 COOPERATIVE RESEARCH CENTRE FOR CATCHMENT HYDROLOGY

The CRC for Catchment Hydrology is a cooperative venture in public good research and is one of over 60 Cooperative Research Centres established by the Commonwealth Government since 1991. The CRC program aims to facilitate high quality research that is undertaken in collaboration with relevant industry partners. Key program objectives include the rapid uptake of research outcomes by industry, protection and commercialisation of intellectual property, and provision of education and training to increase Australia's available skill base. The vision of the CRC for Catchment Hydrology in particular is 'sustainable management of the nation's water resources through adoption of an integrated approach to land-use, water allocation, hydrologic risk, and environmental values'.

4.3.1 Objectives

In achieving their vision the Catchment Hydrology CRC has the following 6 main objectives:

- To mount a quality research program, targeted to meet national objectives in catchment hydrology, by focussing on achieving predictive capability at a whole-of-catchment scale
- To maximise the synergies of collaboration among its parties and with related organisations
- To involve end-users in the identification, formulation, conduct, and utilisation of its research activities
- To provide training to increase awareness of, and the national skill base available in, catchment hydrology
- To train and equip postgraduate students as future leaders in land and water management
- To seek to sustain continuity of research effort in catchment hydrology consistent with the widespread and persistent nature of land and water problems

4.3.2 Program organisation and participants

The Catchment Hydrology CRC has over 200 members. These are listed below and include scientific researchers, policy makers and water managers from 7 rural land and water managers in eastern Australia, two of the largest urban water authorities in Australia, the major CSIRO division concerning land and water research, three universities and Australia's national meteorological and hydrological body.

- Brisbane City Council
- Bureau of Meteorology
- CSIRO Land and Water
- Department of Land and Water Conservation, NSW
- Department of Natural Resources and Environment, Victoria
- Department of Natural Resources and Mines, Queensland
- Goulburn-Murray Water
- Griffith University
- Melbourne Water
- Monash University
- Murray-Darling Basin Commission
- Southern Rural Water
- The University of Melbourne
- Wimmera Mallee Water

The CRC also has strong cooperative linkages with SA Water and State Forests of NSW HYDRO on particular projects of interest.

The CRC operates in 5 focus catchments (Brisbane River, Queensland; Yarra River, Victoria; Fitzroy River, Queensland; Goulburn-Broken River, Victoria; Murrumbidgee River, New South Wales) and has 8 different research programs each with their own projects (outlined under research goals). To ensure accountability, the CRC maintains strong collaboration and communication linkages between Programs, Projects and Focus Catchments. Certainly, between all parties there are extensive databases that support the research initiatives and have the extension capability to assist in a two-way information flow. CRC policy and strategic directions are set and monitored by the governing board, which consists of an independent chair, representatives from each party and two independent members.

4.3.3 *Research goals*

The CRC's primary goal is to deliver the capability to manage catchments by producing a decision support system that can predict catchment behaviour. The system would predict the movement of water, particulates, and solutes from land to rivers, linking climatic regime, vegetation, soil, and water management in an integrated package. Such a system would enable catchment managers to evaluate the outcomes of policy decisions at whole-of-catchment and regional scales. To achieve this the CRC is focussing on the following industry-identified issues:

Water allocation (sustainable allocation of water resources and more efficient water use)
Land-use impacts on river (addressing the consequences of past land clearing practices)
Climate variability (the potential to reduce hydrologic risk)
Urban runoff quality (the potential to improve the water quality of urban rivers and bays)
River restoration (to prevent and remediate stream degradation)

The key criterion the CRC will use to assess its effectiveness is the level of adoption of research outcomes. To facilitate increased adoption the CRC intends to directly involve catchment managers and community groups in the research within each focus catchment. Moreover, the CRC is exploring options to overcome the social and economic barriers to research uptake and adoption. One of these options is an education and training program linked to CRC research. This program concerns the professional development of staff, post-graduate studies, and school and community-based education.

4.3.4 *Research activities*

Table 4.2 lists the research activities undertaken for each of the research programs.

Table 4.2 Catchment Hydrology CRC research programs and activities

Predicting Catchment Behaviour Development of a catchment modelling toolkit Scaling procedures to support process-based modelling at large scales
Land-use Impacts on Rivers Sediment movement, physical habitat and water quality in large river systems Managing pollutant delivery in dryland upland catchments Predicting the effects of land use changes on catchment water yield and Stream salinity Nitrogen and carbon dynamics in riparian buffer zones
Sustainable Water Allocation Integration of water balance, climatic and economic models Enhancement of the water market reform process
Urban Stormwater Quality Stormwater pollutant sources, pathways and impacts Stormwater best management practices
Climate Variability Modelling and forecasting hydroclimate variables in space and time National data bank of stochastic climate and streamflow models
River Restoration Developing criteria and concepts for planning the evaluation of stream rehabilitation projects Optimising urban stream rehabilitation planning and execution Restoration ecology in the Granite Creeks, Victoria Evaluation of riparian revegetation in a south-east Queensland catchment Hydraulics and performance of fishways in Australian streams
Education and Training Capacity building, education and training Public participation and community change

Source: ***http://www.catchment.crc.org.au***

4.3.5 Current status

The Catchment Hydrology is a well-established CRC and in its second term of funding from the Federal Government, the new CRC (1999-2006) builds on the successes of the previous centre. The new CRC takes a slightly different approach to research and places the research emphasis on catchments rather than hydrology. Consequently, it is adopting a multi-issue and multi-disciplinary approach to research that recognises the holistic nature of catchments.

All core projects approved and resourced by the Board for a three-year period are on target and independent review panels have deemed these to be quality research projects with widespread application. Indeed, the CRC is well on the way towards finalising a catchment model for south-east Queensland as part of the South East Queensland Regional Water Quality Management Strategy (SEQRWQMS) and a Decision Support System for urban catchments. Certainly, the CRC intends to deliver the catchment hydrology management capability promised to land and water managers within the first three-year research period of the new CRC.

The CRC has nearly filled their quota of staff and postgraduate students and reports a high degree of cooperation with the Coastal and Freshwater Ecology CRCs and involvement from a number of small to medium enterprises (SMES). The CRC has also attracted external funding for strategic associated/additional projects which represent a collaborative effort between organisations and departments including the Murray-Darling Basin Commission (MDBC) and the Department of Agriculture, Fisheries, and Forestry (AFFA).

During 2001-2002 the CRC underwent its second year review as part of the Commonwealth funding requirements. The independent review assessed the quality of the science, Board governance, CRC management, communication and adoption, and education and training. The CRC had a favourable review on all aspects. Certainly, Russell Mein (former Director) states that 'the spirit of goodwill in this CRC is one of its greatest strengths'. Moreover, that 'a lot of the CRC's success will depend on how well we integrate people, ideas and research outputs'.

4.4 COOPERATIVE RESEARCH CENTRE FOR COASTAL ZONE, ESTUARY & WATERWAY MANAGEMENT

The Cooperative Research Centre for Coastal Zone, Estuary and Waterway Management (Coastal CRC) began on 1 July, 1999 with Commonwealth Government funding. It is an unincorporated joint venture between several partners who contribute skills in research, extension, education, policy, planning and regulation. The Centre also encourages stakeholder input including local knowledge, sector views, experience, culture, issue analysis, commercialisation, and commitment for implementation. The Centre concedes that all these skills are necessary to achieve sustainability.

4.4.1 Objectives

The Coastal CRC aims to 'bridge the gaps' and its mission is 'to deliver decision-making tools, understanding and knowledge necessary for the effective management and ecosystem health of coastal zones, estuaries and waterways'. In achieving this mission, The Draft Strategy Statement 2001-2004 (2001) outlines three key elements of the CRC's underlying philosophy:

An integrative big picture for **science**
A participatory approach with **society** and
Capture of the benefits of **synergy** in understanding, decision-making and action

Certainly, the CRC is seeking the understanding that comes from an integrated knowledge (based on sound theoretical understanding, data and observations) that is framed within a social, economic and bio-physical context. The CRC hopes to achieve this through linkages between projects and with stakeholders. The Centre also embraces participatory approaches to science rather than the more traditional one-way mode of communication. Similar to the Catchment Hydrology CRC, this Centre sees that working with local groups will give effective options for adoption and implementation. The CRC is also committed to collaborating with other CRCs, agencies, and stakeholder groups relevant to the Coastal Zone.

4.4.2 Program organisation and participants

The Coastal CRC is based in Indooroopilly, Brisbane and has almost 200 members from the following core partners:

Australian Geological Survey Organisation
Brisbane City Council
Central Queensland University
CSIRO
Griffith University
James Cook University
Department of Natural Resources and Mines, Queensland
Department of Primary Industries, Queensland
Queensland Environmental Protection Agency
The University of Queensland
Additional Associate and Affiliate organisations

The CRC operates in 3 focus catchments (Fitzroy, Port Curtis, Brisbane River and Moreton Bay) and has 5 different research themes each with their own projects (outlined under research goals). The Centre is also carrying out a National Estuary Audit and is assessing the status of more than 900 estuaries around Australia. A Governing Board oversees the CRC with representatives from the four universities, user groups and independent members. The board regulates all Centre operations and determines policy, strategic direction and financial arrangements.

4.4.3 Research goals

In seeking to 'bridge the gaps' Centre research concentrates on the following five interlinked themes:

Decision frameworks
Citizen science and education
Planning and management
Ecosystem processes
Assessment and monitoring

Through these research themes the centre hopes to provide a range of benefits for stakeholders and the community. In particular, the centre aims to provide:

Ready access to coastal zone knowledge on ecosystem processes
Increased skill availability and level
The capacity to predict long term impacts of coastal zone strategies and developments using simulation models
Improved planning, decision making and management of coastal issues
Toolkits that facilitate the above-mentioned aims

4.4.4 Research activities

Table 4.3 lists the research activities undertaken for each of the 5 research themes.

Table 4.3 Coastal CRC research programs and activities

Decision frameworks	
Decision frameworks and toolkits Data management and access	Environmental planning
Citizen science and education	
Knowledge seeking and attitude change Toolbox of citizen science strategies Education and capacity building	Postgraduate education Communication
Planning and management	
River turbidity Functional ecology of wetlands	Effluent management Planning and management of natural variability of open coastlines
Ecosystem processes	
Bremer River Pilot Study Estuarine habitats	Receiving water quality model calibration Integrated coastal modelling
Monitoring and assessment	
Eco-health monitoring Spatial and temporal analysis Remote sensing	Automated monitoring Pest biota Historical coastlines Australia-wide estuary assessment

Source: **http://www.coastal.crc.org.au**

4.4.5 Current status

The Draft Strategy Statement (2001) lists three broad performance indicators for the Centre:

- What have we achieved in terms of impacts (changes to quality of life, institutions, ecosystem health or Australia's future), outcomes (adoption and application of CRC research) and outputs (quality and quantity of CRC research and activities)?
- How well did Centre activities contribute to these achievements?

- How well were resources and opportunities managed?

The Coastal CRC is now in its third year of operation and is focussing on the integration of project outputs, toolkits and their application. It is also marketing the CRC and establishing networks and new projects to address emerging issues in knowledge gaps, study areas and commercial opportunities. International collaborations and national and international application of research is sought in the following year. Detailed performance indicators are contained within the Annual Report, 2000-2001. The following achievements are deemed to be of particular interest by the Chief Executive Officer, Dr Roger Shaw:

- Draft report for the National Land and Water Resources Audit's Estuary Assessment
- Established collaborative national networks with coastal stakeholder groups
- Completed outputs for contract projects in improving waterway ecosystem health
- Provided scholarships and/or support for 27 postgraduate students
- Developed an integrated water quality monitoring strategy in collaboration with local Port Curtis stakeholders
- Undertook surveys of introduced marine pests in designing a national marine pest management decision support system
- Established a science and training partnership with the International Geosphere-Biosphere Program

At this point it is also important to note that the first case study presented in Chapter 6 is an associate project of the Coastal CRC. This project involves representatives from the Queensland Department of Primary Industries, the Environmental Protection Agency, the Department of Natural Resources and Mines and several community groups (including Waterwatch and Landcare) towards formulating a suite of estuarine monitoring protocols for inclusion in the Waterwatch technical manual.

4.5 DISCUSSION

The review of these programs has highlighted some important differences and similarities between these programs. Table 4.4 compares the research dimensions of each program.

Table 4.4 Comparison of research dimensions

Program	*Waterwatch Australia*	*Catchment Hydrology CRC*	*Coastal CRC*
Research issue identification	Locally identified	Industry identified	Stakeholder identified
Research goals			Decision-making tools, understanding and knowledge to 'bridge the gaps'.
Type of research	Descriptive	Descriptive & predictive	Descriptive & predictive
Scope of research	Local, national*	Local, regional, national, international	Local, regional, national, international
Participants	Local community members	Professional researchers and decision makers	Professional researchers and decision makers**
Indicators of research success	Community participation, awareness and understanding for effective community action toward catchment health	Level of adoption of research outcomes	Decision-making tools, understanding and knowledge for effective ecosystem management and ecosystem health
Partnerships (formal)	Natural resource authorities, local councils, local schools, universities, business and industry	Natural resource authorities, local councils, universities, business and industry	Natural resource authorities, local councils, universities, peak community environmental advisory groups, business and industry
Funding	Commonwealth Government & partnerships	Commonwealth Government & partnerships	Commonwealth Government & partnerships

* Participants conduct regular monitoring at sites around Australia and this is collated on a National database.
** This represents the current situation, as the CRC progresses it intends to increase community involvement in research.

All groups conduct research activities in catchment and/or coastal areas and have been initiated with Commonwealth Government funding and thus represent public good ventures. The differences lie in the research goals, number and nature of participants and level of funding.

Waterwatch is a community-based venture where the research tasks are identified and carried out by local community members. It takes a participatory view of research and catchment care such that learning and action occur simultaneously. Research is typically descriptive and centred around water quality monitoring and habitat assessments. In contrast, CRC research is much more industry or stakeholder driven as the centres seek to provide predictive models or tools for use by land, water and coastal managers. This means that the research outcomes although based on local research are typically regional in scope. Certainly, the Coastal CRC involves community groups as one of its identified stakeholders. However, unlike Waterwatch, which seeks widespread community involvement in research, both centres pride themselves in attracting the involvement of world-class researchers and seek the uptake and adoption of research outcomes by industry and stakeholders rather than the remedial local action sought by community groups.

Additional funding for all programs is provided through various partnerships and represents both in kind and financial assistance. Generally, the funding from both Commonwealth and partnership sources is much greater for the cooperative research centres than it is for Waterwatch.

There is potential for future research to explore the similarities and differences between these two research centres as the Coastal CRC develops beyond its early stages and progresses towards the participatory approach which underpins its recent annual report. However, in this study which explores the citizen/expert dichotomy in research and focuses on the culture of the core participants in research, the research centres have more in common than their perceived differences. Therefore, it is appropriate that they be grouped together to represent the experts in this equation and compared to Waterwatch participants who represent the citizens.

Chapter 5

CITIZEN & EXPERT PERCEPTIONS of CBR

Results of a Survey

5.1 INTRODUCTION

This chapter presents the results and discussion from the survey of citizen and expert perceptions of the nature and purpose of community-based research within the six focus catchments encompassed by the Catchment Hydrology and Coastal Cooperative Research Centres (Port Curtis, Fitzroy, Murrumbidgee, Goulburn-Broken, Yarra and Brisbane). In this survey, Waterwatch coordinators were selected to represent the citizen perspective both as organisers and core members of community groups that conduct catchment research, ie they are the 'citizen scientists' sampled for the survey. Scientists and policy makers within the partner universities, CSIRO, and resource management agencies from the above-mentioned research centres represent the 'expert scientists' sampled for the survey. In surveying both groups, this chapter aims to describe and analyse the macro-context of community-based catchment research within the study areas and to provide empirical evidence for the answers to the research questions in phase one of the study. The chapter describes expert and citizen perceptions of citizen roles in catchment care and research, desired levels of citizen participation in research, and the dominant facilitators and barriers of increased citizen science. Understanding these perceptions is important for the future of citizen science and community-based research. Therefore, this chapter concludes by exploring the influences on the future intentions of both citizen and expert scientists.

Section 5.2 provides a demographic snapshot of the survey respondents and builds on Chapter 4 to describe the characteristics of each group and to provide a quantitative basis for critically evaluating the citizen/expert dichotomy that is outlined in the literature review.

Section 5.3 explores general perceptions of community involvement in catchment management from the perspective of both expert and citizen scientists. The discussion concerns the responsibility for catchment care and is followed by an evaluation of the various roles that community groups can play in catchment research and management.

Given that a possible role might be research, Section 5.4 seeks to determine how and where in the catchment research and management process citizen and expert scientists should be involved. It relates research tasks (using stages consistent with the adaptive management approach outlined in Chapter 2) to level of participation (based on Arnstein's (1969) ladder of participation) for each task. The citizen and expert perceptions of their own and each other's involvement are discussed to characterise the expected or preferred situation when these groups conduct research.

The fifth section assesses the level of knowledge concerning Australian community-based catchment research held by experts and community representatives. Respondents' mean scores are used to compare expert and citizen knowledge levels across all items. They are also used on an item by item basis as an indication of attitude towards certain aspects of community-based research.

Section 5.6 discusses three attitude indexes derived from analysis of responses to questions formed as Likert scales. The indices provide an indication of expert and citizen attitudes towards the quality and utility of community-based research data, the barriers facing groups seeking to undertake this form of research, and the advantages that accrue distinctively from community-based research.

Section 5.7 presents the experiences of expert and citizen scientists that have undertaken community-based research. It also explores the future intentions of both groups and determines the main factors influencing future collaboration.

Each section concludes with a qualitative analysis of the participant comments and anecdotes when provided with the opportunity to provide their opinions or to describe their community-based research experiences.

5.2 COMPARATIVE CITIZEN AND EXPERT SCIENTIST DEMOGRAPHY

Comparative participant demography is presented in this section to build on the conceptual overview of each group presented in Chapter 4 and to assess the validity of any stereotypes encountered previously in the literature review or subsequently in any of the survey responses.

Chapter 2 illustrated that scientists have long enjoyed the benefits of working in a profession with high public prestige and influence (Khan, 1988). Despite the increasing challenges to this privileged position, 'the community' often remains a derogatory term where citizens in local communities are perceived by expert scientists as ignorant or irrational (Martin & Beder, 1993). Of the literature reviewed, there are few reports on the demographic characteristics of participants in community environmental groups. However, they challenge the stereotype that Martin and Beder describe and reveal that core community group members often have a higher level of education and higher incomes on average than other citizens (Weber, 2000). They also have a personal stake in the local community and are often the 'old growth' of a community, having resided in an area for 20 years or more (see Weber, 2000). The following sections explore these and other perceptions of the expert and citizen scientists in catchment research.

5.2.1 Educational level of citizen and expert scientists

Figure 5.1 shows that expert scientists are highly qualified with 97% of respondents holding a tertiary degree, 71% of which are at the post-graduate level. However, 75% of citizen scientists also hold tertiary degrees with 21% at the postgraduate level. A further 15% also have undergraduate diplomas. Certainly, both expert and citizen scientist levels of educational attainment appear to be well above the national average. This concurs very closely with Sperry's (1997, cited in Weber, 2000) research conducted in the United States where it was reported that 74% of community members were college graduates. Weber (2000) reports 85% of respondents hold college degrees and 21% of these were advanced degrees. The current research indicates that citizen co-ordinators involved in community environmental groups have higher than average levels of education.

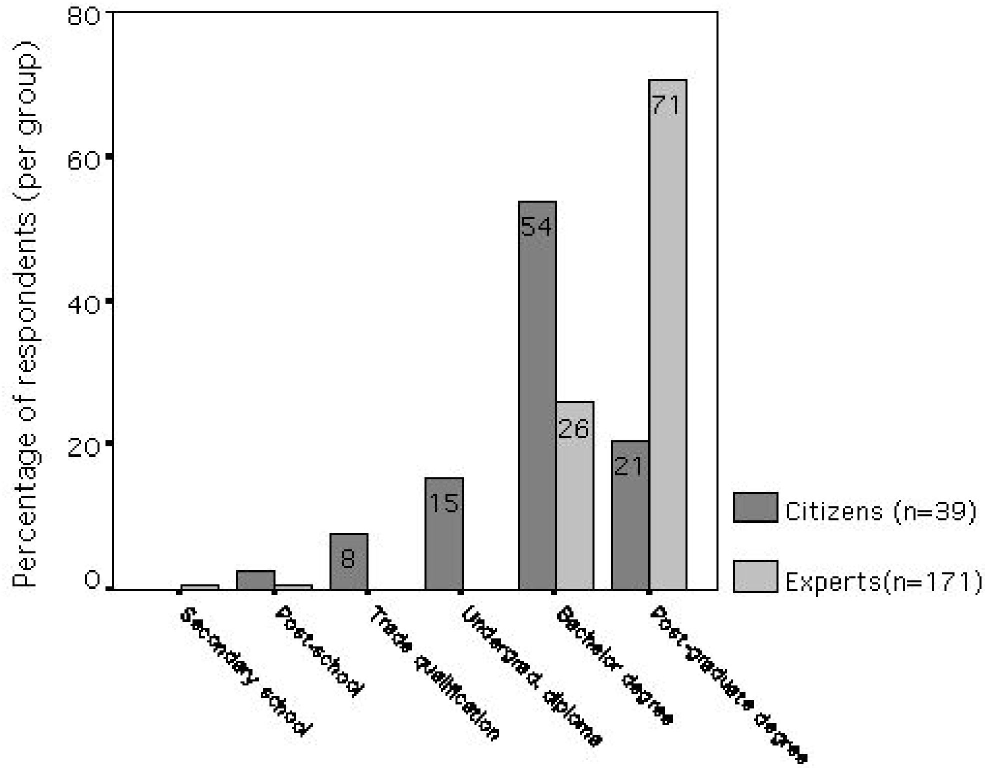


Figure 5.1 Educational level of citizen and expert scientists

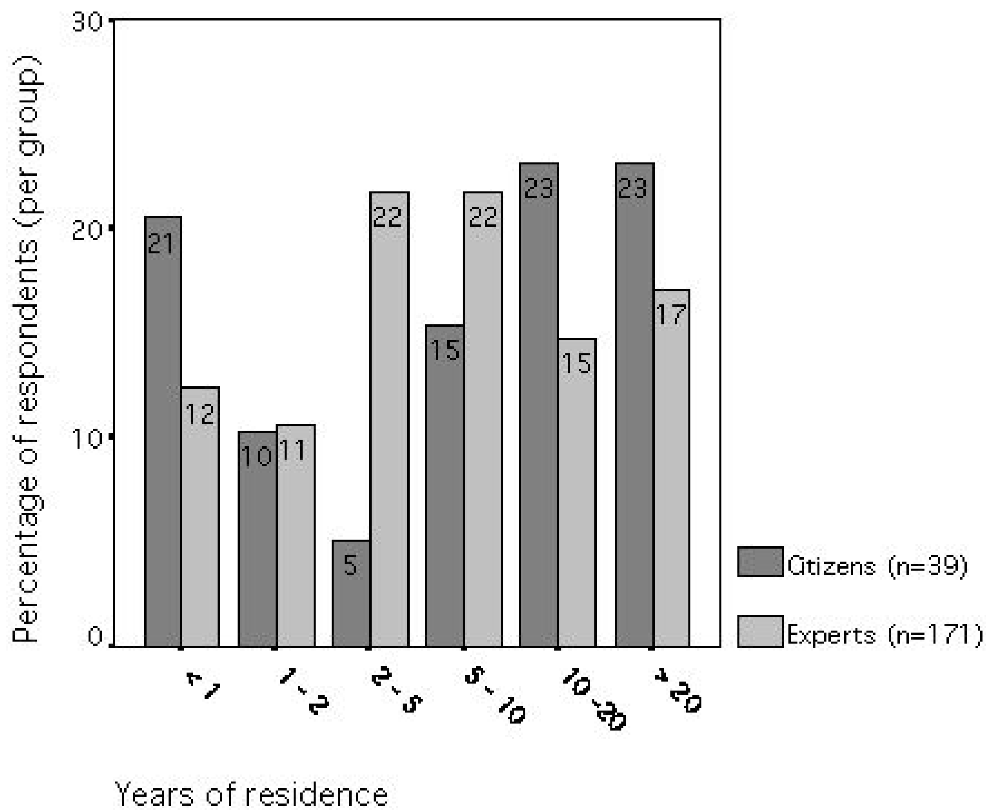


Figure 5.2 Length of residence in current community

5.2.2 *Length of residence in current community*

In attempting to understand potential motivations for involvement in catchment research and management, respondents were asked to state how long they had lived in their current community. A number of authors (eg. Carr 2002 and Weber 2000) state that citizens often participate in community environmental groups because they have developed a sense of stewardship, or attachment and responsibility towards an area that is enhanced by spending long periods of time in one community. Weber (2000) determined that most of the core community participants had lived locally in the study area for over 20 years. Figure 5.2 shows that in this survey community participants are just as likely to have lived in an area for less than one year (21%) than they are to have lived there for over 20 (23%). Thus, there appears to be more to the level of community participation in community-based research than a sense of attachment to a specific place. The following case studies explore this relationship in more detail (see Chapter 6).

5.2.3 *Length of time in current occupation*

Figure 5.3 illustrates the length of time experts report being in their current employment. This is distributed evenly over all time categories and is indicative of a stable profession with long-term career prospects. In contrast, 38% of respondents identified as co-ordinators report being employed in their current occupation for less than a year. Two possible reasons for this are the low-paid and therefore financially stressful nature of co-ordinator positions, and an unusually high number of new co-ordinators in areas that have previously not been involved in Waterwatch.

5.2.4 *Gender of citizen and expert scientists*

Figure 5.4 indicates that there are more females involved in community-based research than males (64% versus 36%). In contrast the gender of expert scientists is male dominated (77% of expert respondents are male). There is a great deal of literature concerning occupational gender bias and the influences of gender on levels of environmental concern (eg Agarval 1992; Plumwood 1986). While these gender issues are outside the core aims of this survey, they are taken up by several participants in the case studies and discussed in Chapter 6. Thus, it is suffice to note in this section that neither point is identified in the annual reports of any of these groups

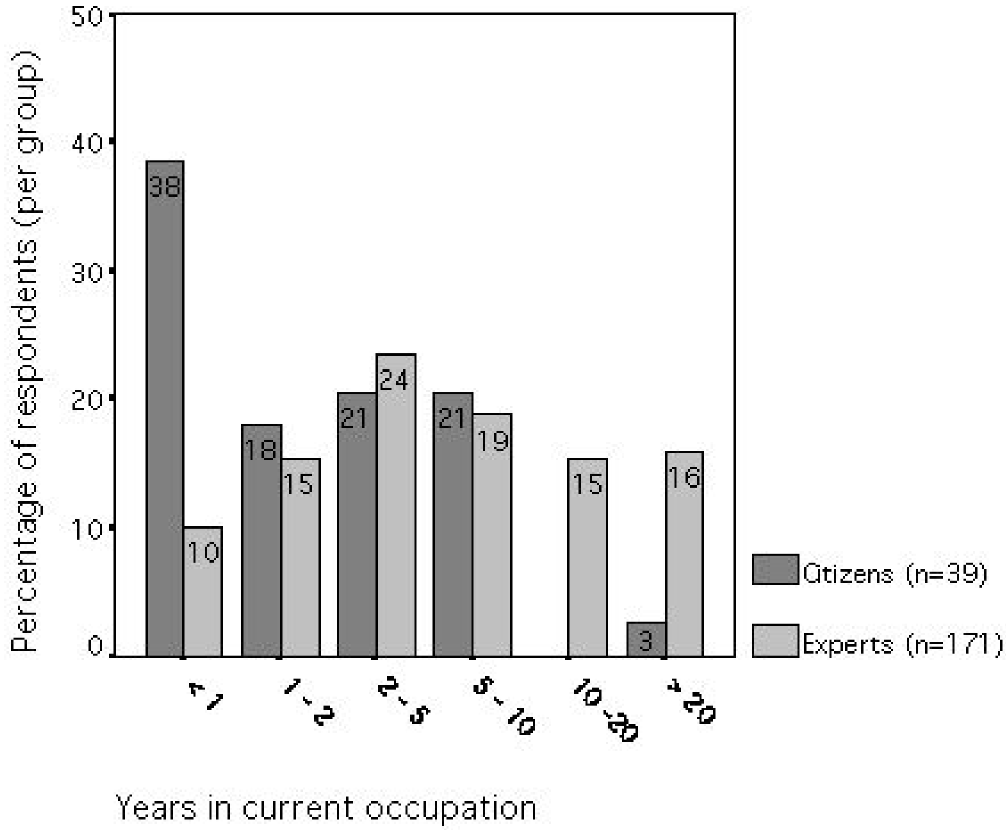


Figure 5.3 Length of time in current occupation

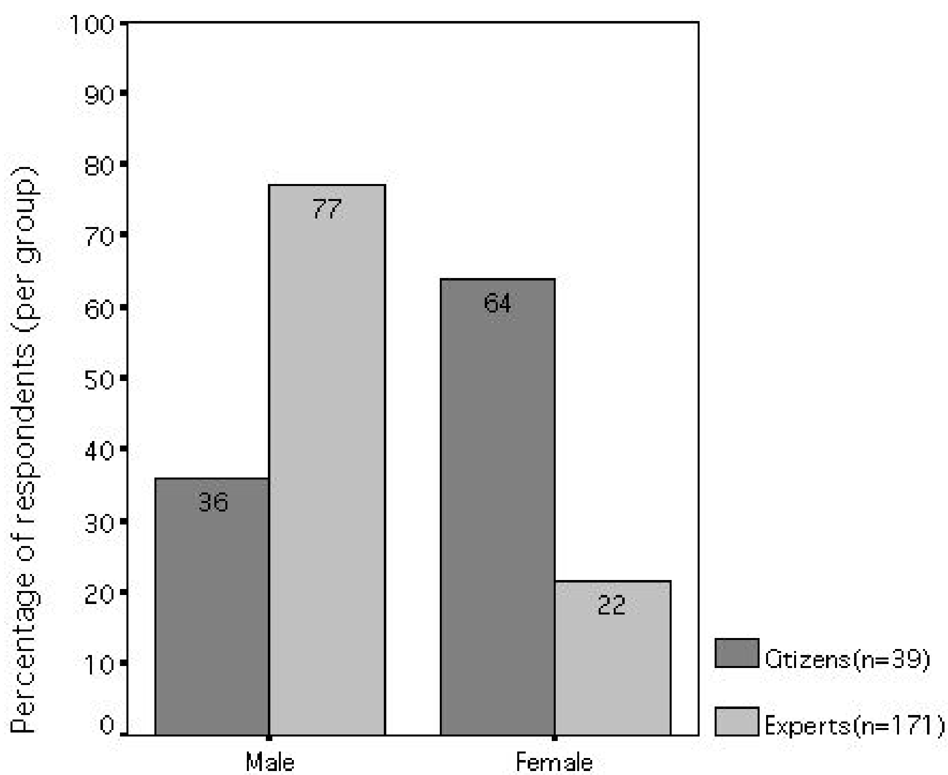


Figure 5.4 Gender of citizen and expert scientists

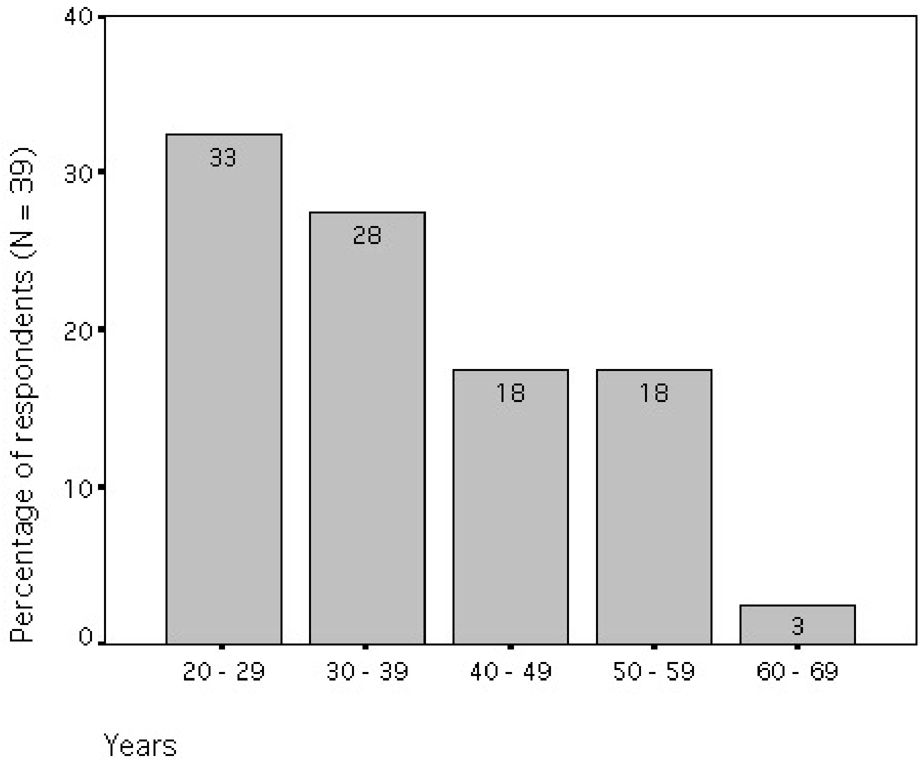


Figure 5.5 Age structure of citizen scientists

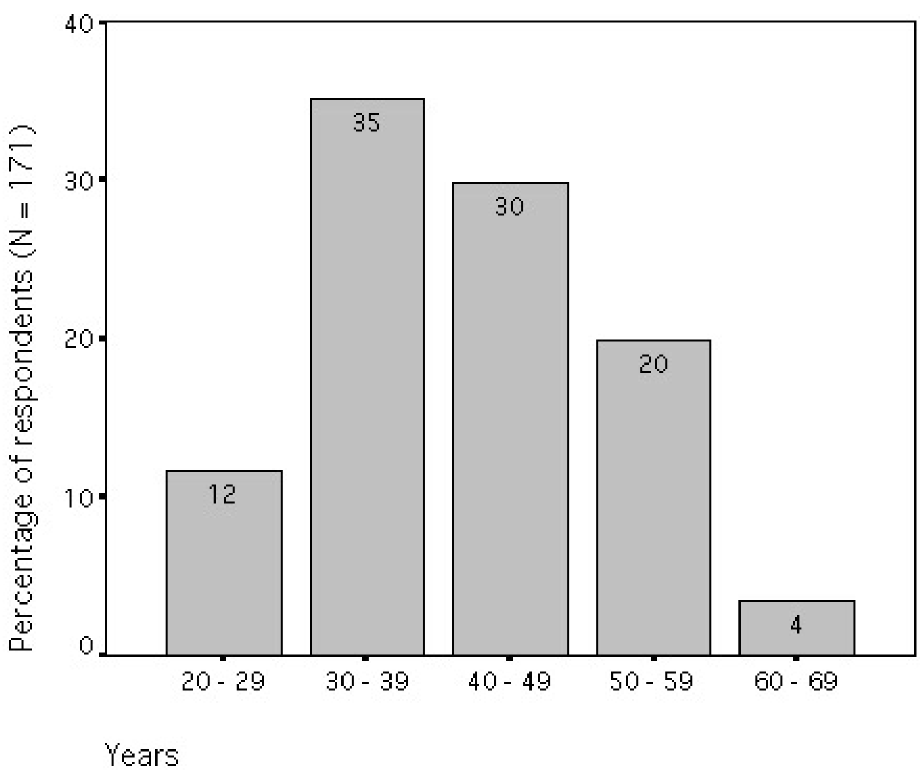


Figure 5.6 Age structure of expert scientists

5.2.5 *Ages of citizen and expert scientists*

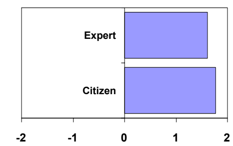
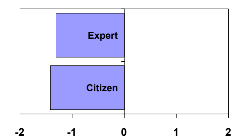
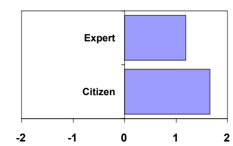
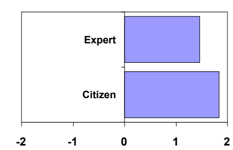
The community coordinators are generally younger than their expert counterparts with 61% being under the age of forty. Interestingly, however, they have almost identical percentages of members over 50 (see Figures 5.5 and 5.6). These demographic results challenge the dominant stereotype of participants in community groups as poorly educated, predominantly elderly citizens that only participate out of a parochial interest in an area through long-term residence. In contrast, co-ordinators have higher than average levels of education with 75% holding a tertiary qualification. Sixty one percent of community coordinators are under the age of forty and 33% of the whole sample are classified in the 20-29 year age group. These results also indicate that attachment to a certain location through time spent in one area is not the only source of motivation for involvement in local environmental groups. Indeed, a noticeable proportion (21%) of participants have lived in the local area for less than a year indicating that other factors are also important in determining participation in community environmental groups. In addition, there are differences between the gender composition and length of time in occupation between citizen and expert scientists, with citizen scientists having a much greater proportion of female members and much shorter time spans in occupation. These important differences are explored in further detail in Chapter 6.

5.3 COMMUNITY INVOLVEMENT IN CATCHMENT MANAGEMENT

To provide an indication of the roles and level of responsibility for catchment health assumed by citizens and experts, participants were asked to state their opinion on a series of statements measured by standard 5 point Likert scales (see Table 5.1).

Most respondents indicated strongly that not only expert scientists and managers are responsible for catchment management, but rather that the entire community is responsible. Moreover, the majority of respondents state that there needs to be more citizen involvement in catchment management and that the community are vital to encouraging such involvement. Whilst there are no statistically significant ($p>0.01$) differences between expert and citizen perceptions of responsibility for catchment health, citizens are significantly ($p<0.01$) more positive towards community involvement than experts (Table 5.1).

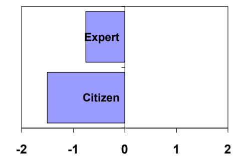
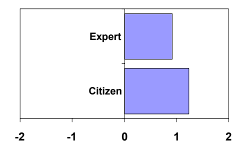
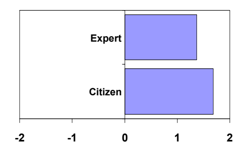
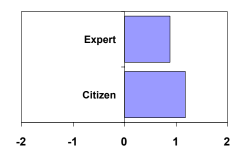
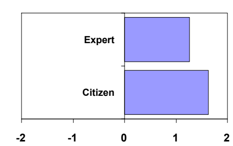
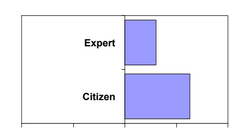
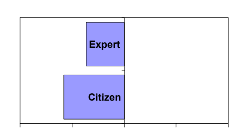
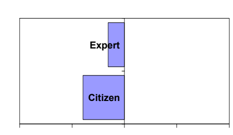
Table 5.1 Comparative perceptions of the responsibility for catchment issues

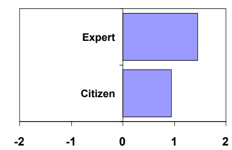
Catchment management issue	*Expert perception (n = 175) Mean (SD)*	*Citizen perception (n = 38) Mean (SD)*	*Graphical representation*
The entire community is responsible for catchment health	1.61 (0.61)	1.77 (0.63)	
Only expert scientists and managers are responsible for catchment management	-1.31 (0.76)	-1.42 (0.92)	
There needs to be more community involvement in catchment management	1.19 (0.77)	1.66 (0.53)**	
The community are vital to encouraging citizen involvement in catchment care	1.46 (0.62)	1.84 (0.49)**	

**Mean score calculated from response categories where -2 = strongly disagree, -1= mostly disagree, 0 = neither agree nor disagree, 1 = mostly agree, 2 = strongly agree*
***Significant difference p < 0.01 (Mann-Whitney U-test for equality of means) (see Appendix C)*

Table 5.2 looks at the ways in which citizens as part of community groups can play a role in catchment management. The impetus for exploring various citizen roles arose from two concerns identified and discussed in the literature, and focus group interviews conducted as part of this research. The first was that education and awareness raising are the only roles that community groups can play in catchment management, and that if research is considered a suitable role then citizen participation is limited to monitoring. Co-ordinators were concerned that Waterwatch is 'pigeon-holed' as an 'education only' program and that this detracts from its role in monitoring and taking action to improve catchment health. They were also concerned that this perception fails to recognise that environmental action and education occur simultaneously in participatory processes and cannot be separated.

Table 5.2 Perceptions of the roles for citizen scientists in catchment management

Citizen role in catchment management	*Expert perception (n = 175) Mean (SD)*	*Citizen perception (n = 38) Mean (SD)*	*Graphical representation*
Education and/or awareness raising are the only roles that community groups can play in catchment management	- 0.76 (0.86)	-1.50 (0.60)**	
Community groups can play an important role in evaluating Government catchment management initiatives	0.92 (0.77)	1.24 (0.58)	
Community groups are important for carrying out on ground remedial action (eg tree planting)	1.37 (0.71)	1.68 (0.53)**	
Community groups can play an important role by 'ground-truthing' expert research data	0.89 (0.89)	1.18 (0.73)	
By alerting the relevant authorities of any catchment problems, community groups play a vital 'watch dog' role in catchment management	1.26 (0.68)	1.63 (0.63)**	
As researchers, community groups play an important role in catchment management	0.61 (1.00)	1.26 (0.86)**	
Community groups only provide a valuable contribution to the monitoring or data collection stage of research	- 0.73 (0.98)	- 1.16 (1.08)**	
It is inappropriate that community groups be involved in all stages of catchment research	- 0.31 (1.24)	- 0.79 (1.30)	

Citizen role in catchment management	*Expert perception (n = 175) Mean (SD)*	*Citizen perception (n = 38) Mean (SD)*	*Graphical representation*
Community-based research does not replace detailed scientific study	1.45 (0.76)	0.95 (1.01)**	

**Mean score calculated from response categories where -2 = strongly disagree, -1= mostly disagree, 0 = neither agree nor disagree, 1 = mostly agree, 2 = strongly agree*
***Significant mean difference p < 0.01 (Mann-Whitney U-test for equality of means) (see Appendix C)*

The survey shows that both expert and citizen respondents agree that education and awareness raising are not the only roles that community members can undertake. Other viable roles include evaluating Government catchment management initiatives, carrying out on-ground remedial action, ground-truthing expert research, acting as catchment 'watch-dogs' and as researchers. Certainly, both groups respond positively towards all of these potential roles, however, using the Mann-Whitney *U* test for two independent samples (see Table 5.2) the citizens are significantly ($p<0.01$) more positive. Indeed, experts are more positive towards the on-ground work and alerting roles of community than they are on the evaluation, ground-truthing or research roles. Whether these responses reflect expert opinion of the capacity of community groups to undertake these roles or a potential expert/citizen conflict in role is unclear from the analysis. However, the results do indicate the potential for community groups to be involved in all stages of research beyond monitoring and caution that this does not replace detailed scientific study.

A number of expert scientists also commented on the roles that community members could undertake in catchment management. They agree that community groups play a valuable education and awareness-raising role in catchment management, but are cautious about the citizen role in research. They cite the importance of assessing the citizen role on a project basis, with particular regard to the scale and severity of the issue, individual group aims, skill level and ability to ensure data quality. These points are illustrated by the following quotes:

> There is definitely a role for community-based monitoring in catchment management. The challenge lies in defining this role. Community research has a valuable educational/awareness-raising role. Community generated data, as long as it is aligned with a solid QA/QC program can fill information gaps, identify issues and, in some instances, contribute to SOER. (Expert scientist)

> I think the role the community plays (or can play in order to achieve ownership and empowerment) needs to be carefully judged on a project by project basis. So many factors influence this decision, from the strength of the community group to the project aims and objectives. (Expert scientist)

> The involvement of community depends on the study. If it is a major study (eg impact of greenhouse on water resources of the Murray Darling Basin), the role of community groups is low to negligible in the research, but [they can be] involved in the outcomes. If it is improvement of a small to medium creek for water quality and biodiversity it must be very high as this will require action. The real delineation is the scale of the project and the level of skill required (eg 1 day of field sampling followed by 20 days of lab work rules out any effective community research involvement). They do not have the time or the skills for the lab work, this needs a full time job and a PhD. (Expert scientist)

There are also differences of opinion amongst expert scientists on the importance of the citizen role in research. Some feel that the citizen role is unimportant and very limited, while others feel that it is an important role that should embody collaboration between citizens and experts. For example:

> I found many of your questions skewed with the use of important. For example, I agree that the community should have a role in various research activities but I do not believe that they should have an important role. (Expert scientist)

> The community's role in undertaking research to establish cause and effect relationships that are vital for management decision making is limited, as is the community's role in designing sampling programs and experiments to provide answers for complex questions. (Expert scientist)

> Community-based research related to catchment management is very important. However, the decision making should not be fully based on community research. Often there is a conflict of interest involved and therefore scientific research in collaboration with the community is important. (Expert scientist)

In addition to environmental monitoring, an expert scientist pointed out that another valuable citizen role in catchment management and research is in determining community values:

> An often-overlooked community-monitoring role is in establishing community values. (Expert scientist)

In summary, these results indicate the potential of community groups to participate in research and help to frame the place of citizen science in catchment research. All respondents agree that the community as a whole is responsible for catchment health and that through community groups we can encourage the necessary increased citizen participation. Citizen participation can embody many different roles and is not confined to education and awareness. Both groups believe that research is a valid role and that citizens can contribute at any stage to this process in a complementary manner that does not negate the need for research by expert scientists. However, there is some disagreement on the importance of the community's role in research. Expert scientists caution that community groups and projects vary considerably in their nature and that both these variables should be taken into account when deciding on an appropriate citizen role in catchment issues.

5.4 COMMUNITY INVOLVEMENT AND PARTICIPATION IN CATCHMENT RESEARCH

The previous section indicated a number of valid roles that citizens as part of community groups could play in catchment health. This section, consistent with the study focuses on the role of community groups in research as citizen scientists and explores where in the research process (consistent with an adaptive management approach) community members can be involved and what level of participation is appropriate for each research stage. As the literature review revealed, participation means different things to different people (Cuthbertson, 1983; Pretty, 1995; Bhatnagar *et al*., 1996). This section attempts to describe what both groups mean when they talk about involvement in research and what level of participation they feel is appropriate for each group.

Respondents were asked to indicate where in the research process from identifying issues to evaluating management initiatives they thought citizens and experts should be involved. They were also asked to state the appropriate level of involvement for each stage from no involvement to full control (see Figures 5.7 & 5.8).

For both community and expert participation in research the citizen and expert responses are remarkably similar with no statistically significant differences between them (see Appendix C). However, the expert responses demonstrate a much more socialised response with much less within-group variability. Both groups indicate that experts should take a partnership approach to all research stages with the community except for designing methodology, analysing data, and drawing conclusions where responses shifted towards full expert control (Figure 5.8).

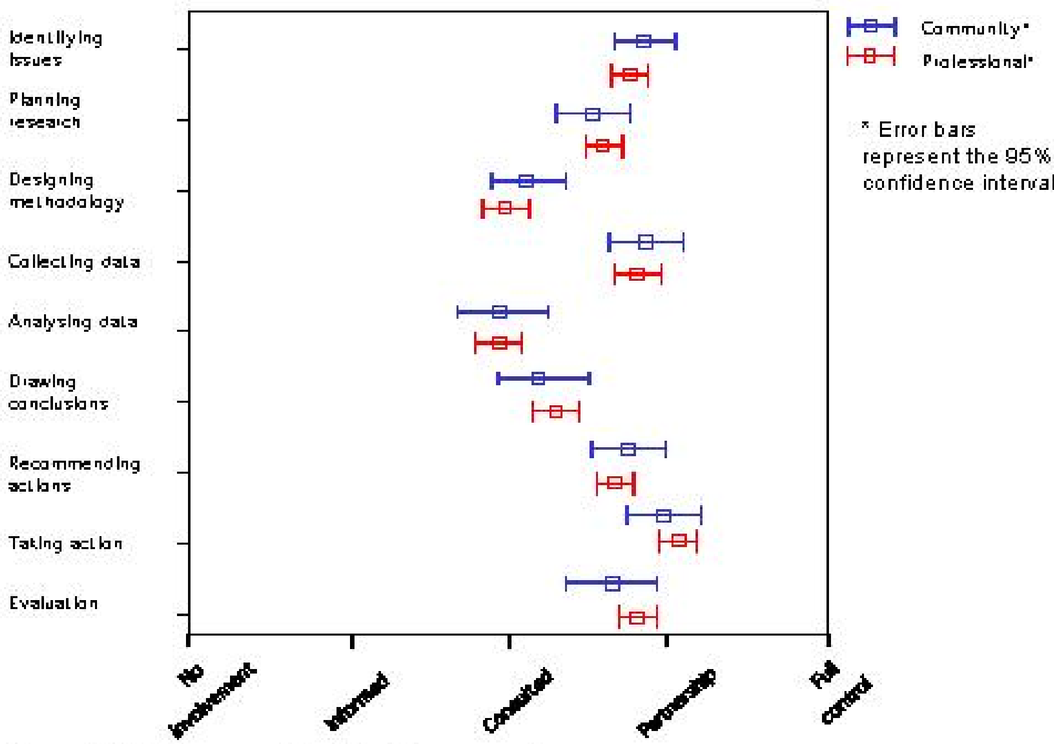


Figure 5.7 Citizen participation in research

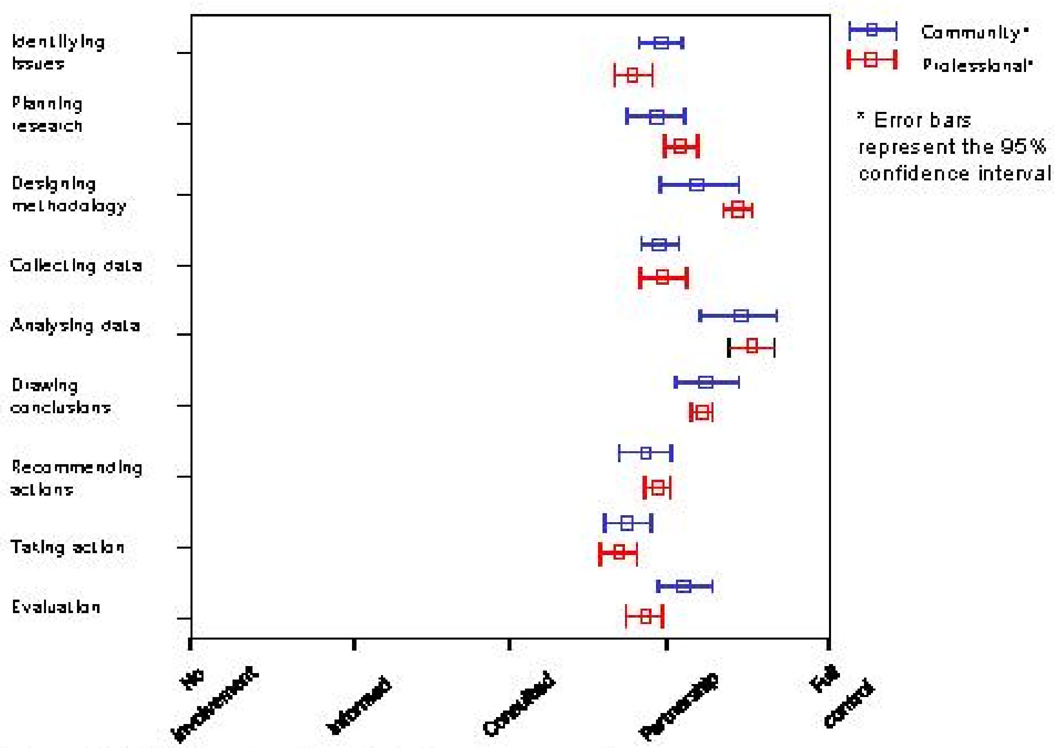


Figure 5.8 Professional participation in research

The perceptions of appropriate citizen involvement in research appear to give them less control over the process compared to that of experts with most of the responses favouring participation between the consultation and partnership levels. Identifying issues, collecting data and taking action are perceived to be the stages in research where both groups feel the community could participate in partnership with experts. Responses to citizen participation in planning research, recommending actions and evaluation responses lie midway between consultation and partnership, whilst designing methodology, analysing data and drawing conclusions tend more towards the consultation end of the participation spectrum (see Figure 5.7).

These results emphasise the possibility for valid citizen participation in all stages of research. Moreover, that catchment research should be approached as a partnership between citizens and experts in all stages except during methodological design, and data analysis from research. In these stages, the results indicate that it is more appropriate that the community be consulted and that the experts retain control.

For all forms of participation, and especially the partnership approach, it is desirable that both groups have knowledge of their own and each other's capabilities. Knowledge or perceived knowledge of such capabilities can also be used to indicate the dominant attitudes towards a group in concert with attitudinal statements. The following section assesses knowledge of community-based research; first, as a potential indicator of dominant attitudes towards community-based research and second, as an influence on these same attitudes.

5.5 KNOWLEDGE OF COMMUNITY-BASED RESEARCH

A set of true/false questions about Waterwatch was used to assess the level of knowledge concerning community-based catchment research within Australia. Waterwatch was chosen as the focus for these questions because it represents the largest and most widely distributed network of catchment-focussed citizen scientists. It is also monitored enabling the creation of a series of true/false questions that have verified answers.

Chapter 3 reported that expert scientists from the Cooperative Research Centres responded at an acceptable rate of 43% and citizen scientists at a rate of 71%. However, a further 5% of experts returned questionnaires stating that they felt unqualified to respond due to lack of community-based knowledge and experience. The following statements are illustrative of those who cited lack of knowledge as a reason for non-response (numbers in parentheses indicate number of similar comments).

> I have no knowledge of this subject - absolutely. I cannot respond in any helpful way. (7)

> I have virtually no idea what the groups you refer to do nor how they operate. (2)

From the eleven questions asked (see Appendix A), an independent samples test reveals that the coordinators' mean knowledge score of 8.7 (SD = 1.66) is significantly higher than the expert scientists' mean score of 6.9 (SD = 1.98), (Mann-Whitney $U = 1709.5$, $p < 0.01$) (see Figures 5.9 & 5.10). While this difference is to be expected given the vocations of each group, the item by item analysis of percentage of correct answers (see Figure 5.11) and statistically significant differences between groups (see Table 5.3) provides an additional indication of perceptions towards aspects of community-based research.

Both expert and community representatives have high levels of knowledge regarding the participants, inter-group collaboration and the general trend in numbers of community groups that conduct community-based research. However, the experts know little about the national network of Waterwatch and the quality control guidelines and checks that are part of the Waterwatch program. Both groups exhibit least knowledge about the number of Waterwatch groups operating within Australia.

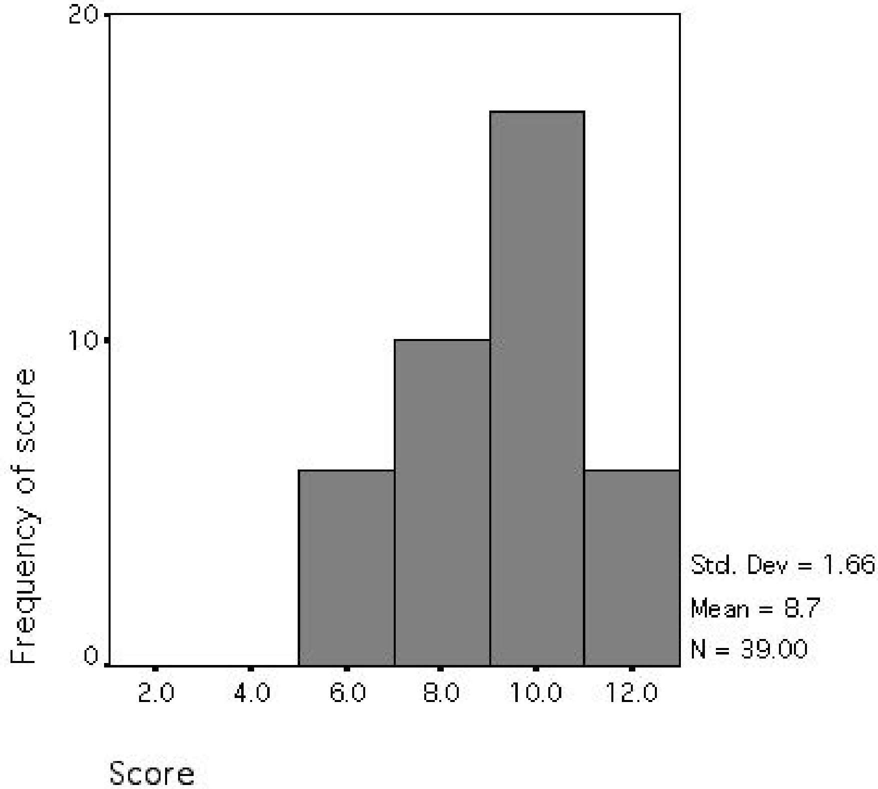


Figure 5.9 Citizen scientists' knowledge score

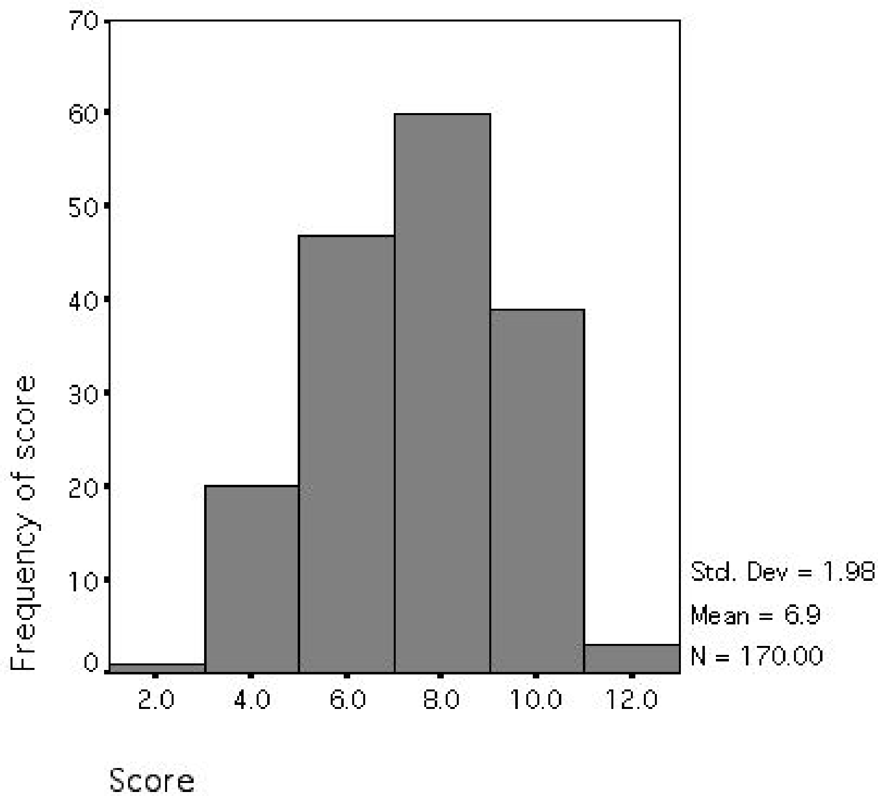


Figure 5.10 Expert scientists' knowledge score

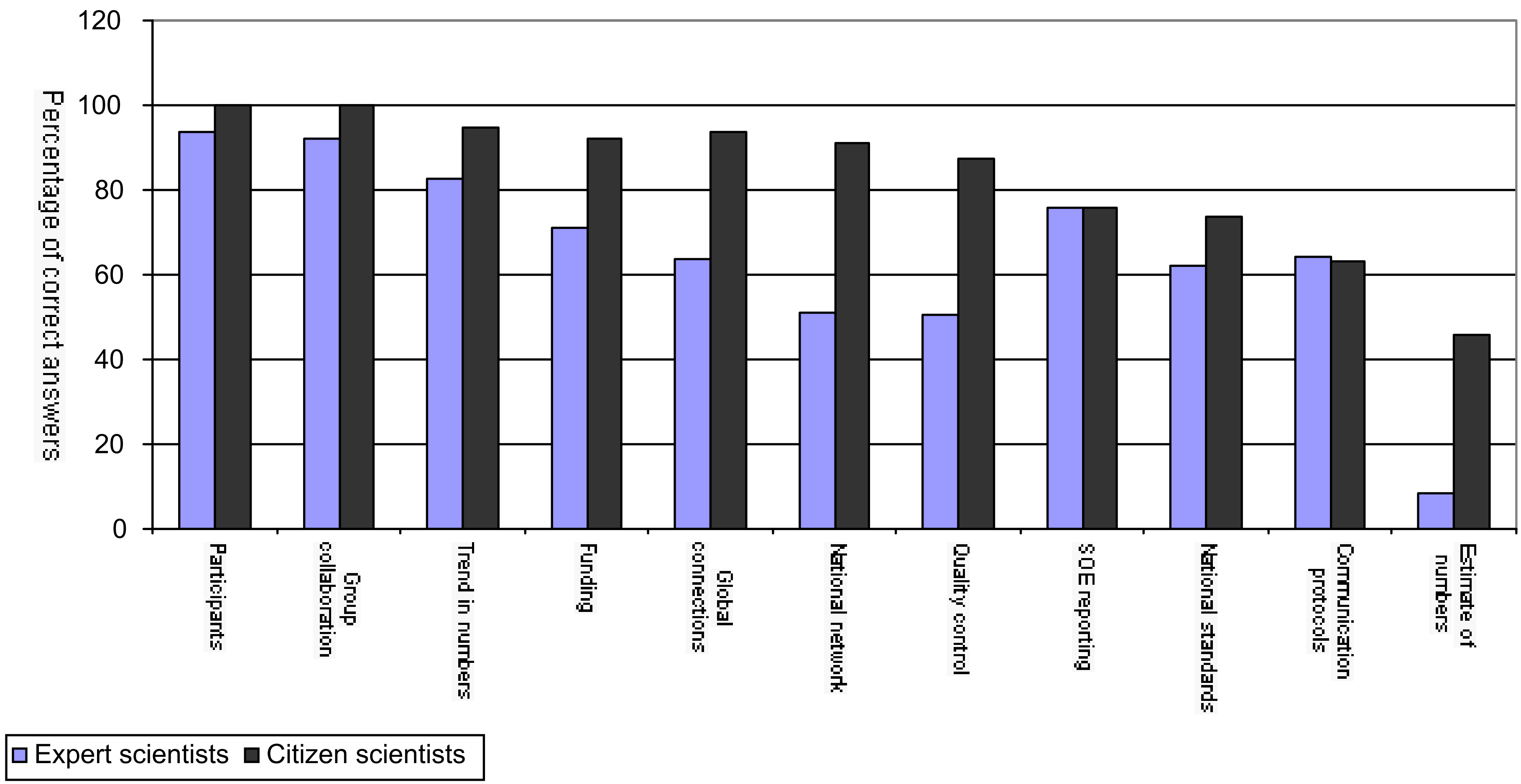


Figure 5.11 Knowledge of Waterwatch within Australia

Statistically significant differences in response are found between the questions on quality control, funding, the national network, international connections and number of groups (see Table 5.3).

Table 5.3 Mann-Whitney *U*-test, expert and citizen scientist knowledge of Waterwatch within Australia (significant ($p<0.01$) differences only)

	Mann-Whitney *U*-test	
	U	2-tailed *p*
Quality control	2006.5	.000
Funding	2571.0	.006
International connections	1861.5	.001
National network	1615.5	.000
Number of groups	1899.0	.000

From these results, the number of groups, quality control, and the idea of Waterwatch as a national network with international connections emerge as the most contentious issues between citizen and expert scientists' knowledge of Waterwatch. For these issues the levels of expert knowledge are low and significantly so when compared to that of citizens. Certainly, both groups knew least about the numbers participating nationwide in Waterwatch. Less than 48% of the citizen scientists could accurately estimate the number of groups nationwide. This is perhaps indicative of a dynamic network where local groups communicate frequently between each other at a state level, but are less likely to interact frequently at a national level except through the Statewide coordinator. In addition, less than 10% of the expert scientists provided an accurate estimate of Waterwatch group numbers. If this is related to their limited knowledge of the national and international network connections of Waterwatch, it appears that expert scientists have a localised perception of Waterwatch that does not accurately reflect the extent of this network.

Consistent with the expert reservations concerning community-based research outlined in Chapter 2, the quality control of data collected by community groups is a major factor in the differences in perception of community-based research between citizen and expert scientists. It should be noted that the questions asked about the existence of quality control protocols and checks and not the quality of the actual data collected. While these are not synonymous, it is prudent to assume that they are indicative of each other. Therefore, with 50% of experts indicating that Waterwatch does not have any such guidelines, it is likely that a similar proportion would also question the data quality of this network.

5.6 ATTITUDES TOWARDS COMMUNITY-BASED RESEARCH

The previous sections have portrayed catchment health as a community-wide issue where the responsibility should be borne by all. However, of the literature reviewed this is an uncommon situation, and perhaps impractical in a representative democracy where experts have been assigned the task, status and resources to bear this responsibility. Nonetheless, current environmental and social dilemmas have caused many to question the representative expert model in favour of more participatory models for research and management. Accordingly, the majority of respondents favoured a partnership approach to many of the research stages in Section 5.4. However, participation and partnership are problematic terms and processes and notoriously mean different things to different people. Certainly, conflicting attitudes concerning the quality assurance of community data and the extent of the Waterwatch network emerge in Section 5.5. Quality control/assurance is a major influencing factor on data utility and in turn citizen motivation to participate. Therefore, ensuring data quality has become one of the major hurdles to a partnership approach and increased community-based research. Thus, this is now explored in more detail in combination with other dominant attitudes.

To characterise the dimensions of citizen and expert scientists' attitudes towards community-based research, this section presents attitudinal indexes derived from Likert-type items. Constructing these indexes involved conceptually linking items and then excluding items until the index reliability maximised the Cronbach's alpha value, a measure of the internal consistency of the index items (Morgan & Griego, 1998). This method uses a combination of face validity and reliability analysis to identify items and optimise scale reliability. Therefore, the three indexes constructed should provide a valid indication of expert and citizen attitudes towards the quality and utility of community-based research data, the barriers facing groups seeking to undertake this form of research, and the distinct opportunities afforded by community-based research. In order to conserve the richness of the data the index items are also represented in graphical form where the responses to each index item (questionnaire statement) are indicated.

5.6.1 *Quality and utility of community-based research*

Participation in environmental movements is often motivated initially by a strong desire to create positive changes towards environmental health. Depending on the group the goals may be changes in either the biophysical or the social environments or both. Collectively, the Waterwatch network focuses on both biophysical and social environments by undertaking education, awareness, revegetation and environmental research (primarily through water quality monitoring). As highlighted in the literature review, participation can be viewed either as an end in itself or a means to an end (Pretty, 1995; Bhatnagar *et al*., 1996). The goals of Waterwatch (see Chapter 4) indicate that for this network these goals are inseparable. In other words, the participants in Waterwatch that undertake water quality monitoring are not merely conducting scientific tests for the joy of it, they have a distinct purpose in mind - positive environmental change. In order for change to occur as a result of environmental monitoring, the data must be collected in a valid and verifiable manner and then used to inform policy or as a basis for remedial action. However, only a small number of groups have had their data used in State of the Environment reporting. The majority of groups collect data that experts are unwilling to use because experts believe it lacks quality assurance and cannot be utilised as an accurate predictor of ecosystem health. The literature (eg Gill 1991) and initial focus group interviews indicate that the major hurdle to community data utilisation is that it cannot be trusted to be of sufficient quality for environmental decision-making. Thus, citizen scientists appear to be denied a significant source of motivation for participation in environmental groups that conduct research.

The first index consisted of eleven items used to indicate respondents' perception of the quality and utility of community-based research data. Figure 5.12 shows that citizen scientists are generally positive towards the data quality of community-based research (mean=1, std. dev.=0.56). The experts as a group are still marginally positive towards the data quality (mean=0.22, std. dev.= 0.66). However, the difference in expert and citizen responses towards the quality and utility of community-based research data is statistically significant (Mann-Whitney$U$ = 1228.0, p=0.000). Figure 5.14 provides a more detailed look at the citizen and expert attitudes towards the quality and utility of community data. Consistent with the perception of community-wide responsibility for catchment health, the majority of respondents feel that not just expert data should be used in catchment

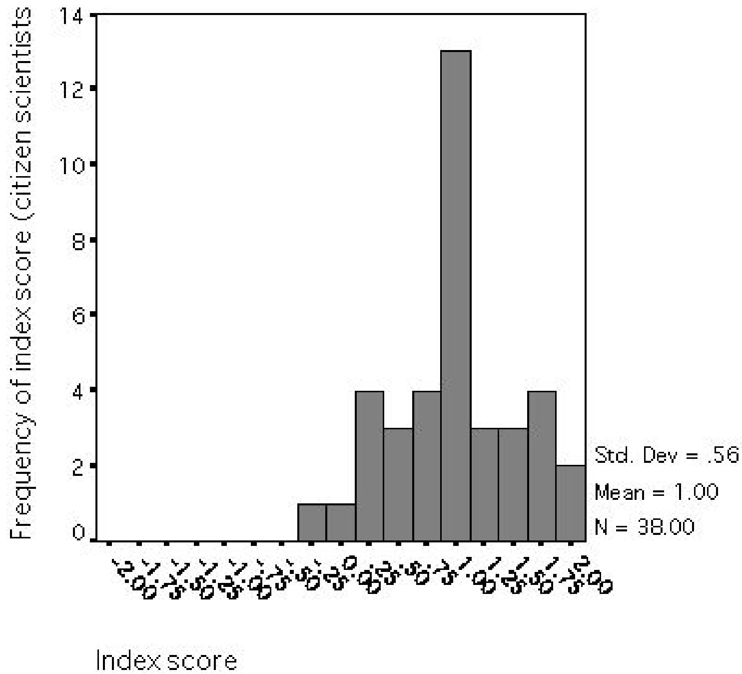


Figure 5.12 Index of citizen scientists' attitude towards the quality and utility of community-based research

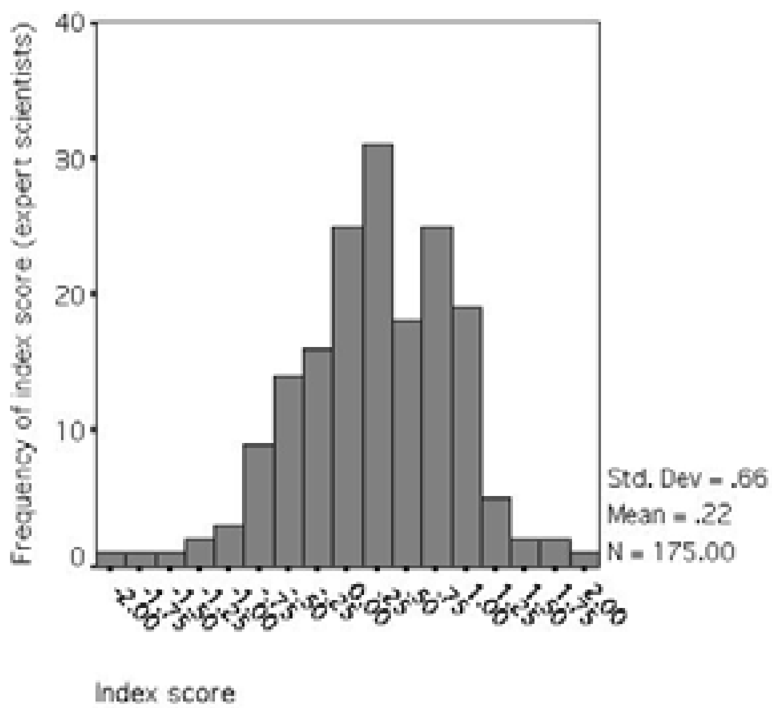


Figure 5.13 Index of expert scientists' attitude towards the quality and utility of community-based research

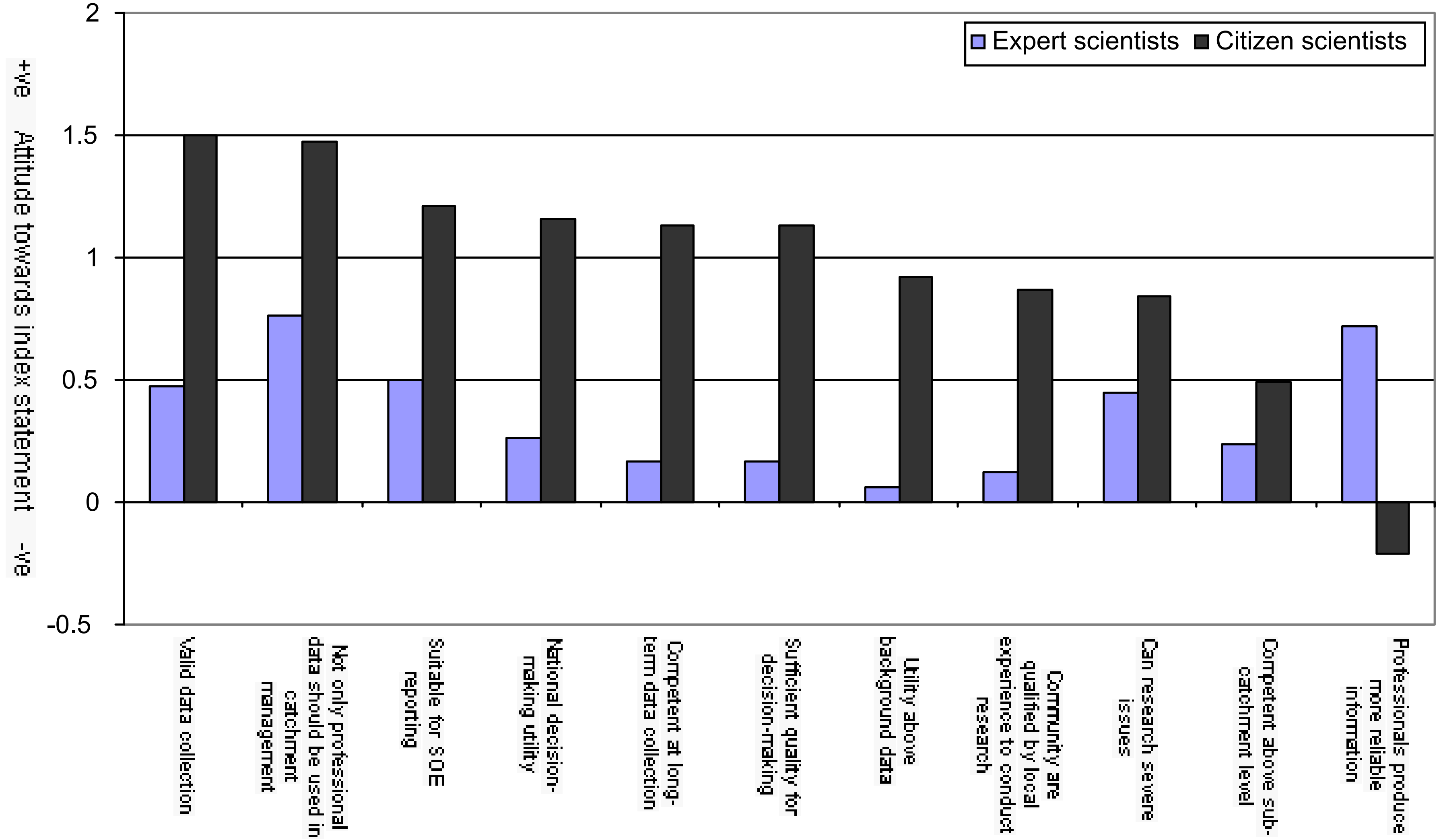


Figure 5.14 Comparative perceptions of the quality and utility of community-based research

management. Moreover, that most community groups can collect valid data that is suitable for State of the Environment reporting. However, there is much less certainty among experts of the capability of citizens to conduct research above the sub-catchment level or to research severe issues. There is also minimal expert support for community data having utility above background data or for decision-making. Certainly, expert responses towards community data are positive, however they are significantly lower than citizen responses and, in disagreement with the citizens, are quick to state that experts produce more reliable information.

Many expert scientists commented on the quality and utility of community-collected data, with the majority stating that the quality of community data was poor. Poor data quality was attributed to lack of group objectives, equipment, organisation, enthusiasm and commitment. In addition, one respondent (see comments below) stated that they had never seen a published paper that had utilised community data, therefore, to their way of thinking community data has never contributed to improved environmental understanding. This implies that for research to be valid and to contribute to increased scientific understanding, it must be published in accordance with guidelines imposed by the scientific community. Certainly, experts believe that community-based research needs to become more 'scientized' before it can be accepted and utilised, as the following statements indicate:

> My experience 'with' community groups is that they are very poor at collecting useful data over a reasonable period of time. I think it is misleading to tell community groups they can help the environment by collecting data, trained scientists struggle to do this - so how can a community group hope to do rigorous and useful research. The implementation of research recommendations is another matter and this is where the community are excellent. Their efforts should be concentrated here and not on collecting worthless, inconsistent water chemistry data that is not quality controlled. (Expert scientist)

> Currently, the quality of the data collected are questionable. There needs to be standardisation in data collection gear and methods and a good quality control/quality assurance needs to be in place (eg training, calibration etc.). Community groups need to be clear what their objectives are. Many start off and remain as 'educational awareness groups' and collect data/do research for this purpose. If they are serious about research and monitoring/assessment they need to be better organised equipped and committed. Otherwise the quality will always be questionable (Expert scientist)

> I have had to handle a lot of data collected by individuals and members of groups. I have found that the standards of collection are very poor. It is very

> rare to get a competent data collector, and even rarer to get one who is willing to keep on collecting after the first few weeks of enthusiasm (Expert scientist)

> Community-based data collection has never contributed to ANY improved SCIENTIFIC understanding of the environment. I have waited for years to see a published paper that would disprove this - but I am yet to see one (Expert scientist)

> Community based research, I believe needs to be enhanced to become more rigorous and in line with expert scientific methods before it is accepted by research experts (and government environmental reporting bodies) as a relevant and valid means of catchment management research. Both the community scientists and expert researchers have to agree on how they can better help each other (Expert scientist)

Several expert scientists state that local community members know much about their surrounding environment and that it is important to access this knowledge. Such community data would not have as much validity as that collected by experts, but a few are prepared to report community findings if the community source of the data is clearly indicated. For example:

> I don't place very much credence in community group measurements of turbidity in streams unless I know details of sampling/instrumentation/analysis etc. However, I do believe people know a lot about their environments. Finding the best way to tap that knowledge is the key (Expert scientist)

> I would happily report the results of a community based survey as `the results of a community based survey', but would not weight, say, microorganism identification the same as that done by specialists in the field (Expert scientist)

This section indicates that expert scientists are more uncertain about community data quality than citizen scientists. This point is illustrated by the difference in index score and emphasised by the many comments provided by expert scientists that question community data quality. At first it seems inconsistent that both expert and citizen scientists agree (to an extent) that not only expert data should be used in catchment management, but that experts state that citizen data lacks sufficient quality for decision-making, especially where serious or whole-of-catchment scale issues are concerned. In disagreement with citizen scientists, experts are unanimous that they produce more reliable information. The misgivings on behalf of the expert scientists arise when community-data is scrutinised by the same indicators that expert research is ie publication in a peer-reviewed and reputable journal. However, an analysis of the comments provided by several expert scientists reveals that many experts consider that there are other, more effective ways that the community can be involved in research aside from environmental monitoring. These include implementing research recommendations and providing local environmental knowledge. In addition, several expert scientists are prepared to use community data if it is identified as such and agree that community members hold local knowledge valuable to successful catchment management. Indeed, one respondent called for an agreement on how citizen and expert scientists can help each other.

5.6.2 Barriers to community-based research

The second index of dominant perceptions concentrated on community group and citizen attributes that may form barriers to increased community-based research. Using an index of 10 items (see Appendix C) both groups have low mean scores and that expert scientists have a predominantly negative attitude towards community-based research (see Figure 5.16). There is a statistically significant difference (Mann-Whitney U = 2233.5, p=0.003) between the mean citizen and expert index scores of 0.11 and -0.13 respectively. Figure 5.17 illustrates that experts perceive more barriers to community-based research than citizens do with disagreement on the potential of group educational level and organisation to provide an impediment to community groups wishing to undertake valid research. Both groups agree that the high turnover rate of volunteers, volunteer burnout, limited access to technical equipment, citizen inability to see issues above the local level and having different research goals to those of experts provide barriers to community-based research. However, both groups agree that citizens have the necessary training capability and commitment to be successful in research. Furthermore, that community-based research is suited to the purposes of expert research despite having different research goals.

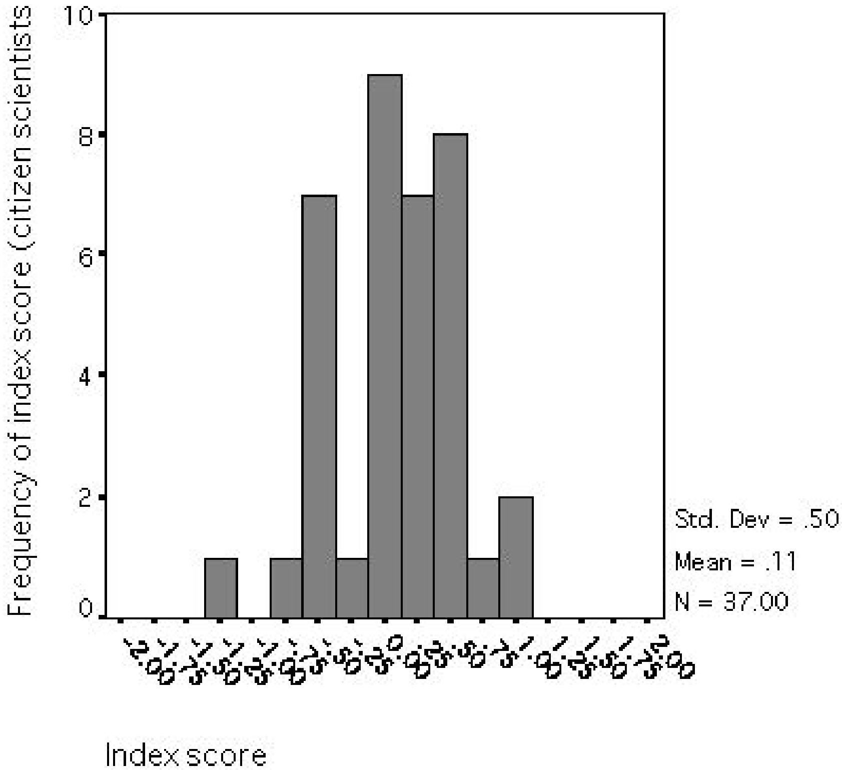


Figure 5.15 Index of citizen scientists' attitudes towards the barriers of community-based research

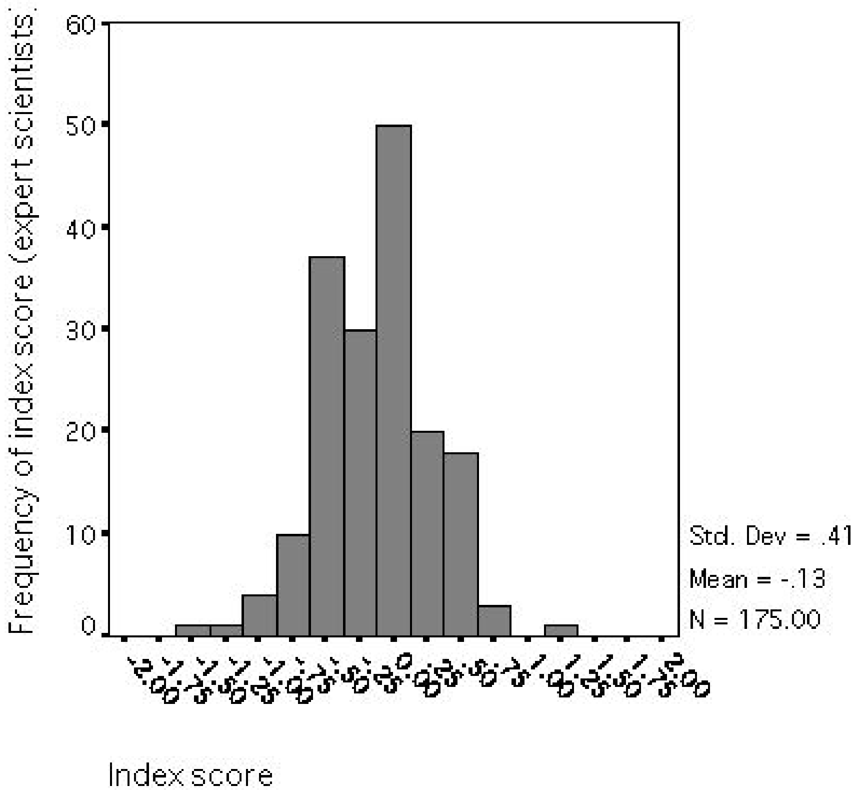


Figure 5.16 Index of expert scientists' attitudes towards the barriers of community-based research

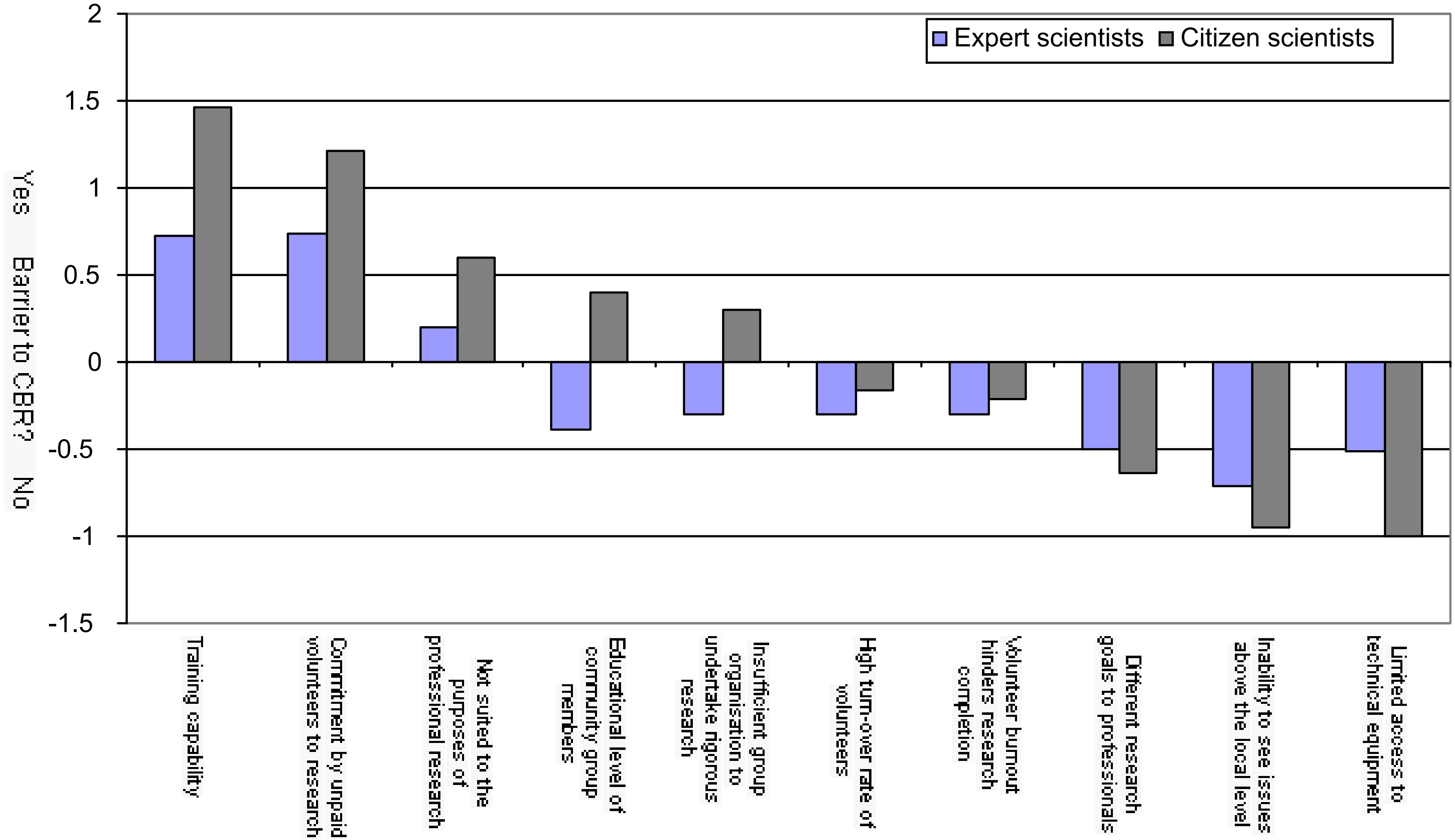


Figure 5.17 Comparative perceptions of the barriers to community-based research

A number of expert and community scientists commented on these barriers and highlighted others not included in the survey. Limited time and funding for community-based activities dominate the discussion on barriers to community-based research and are important to both expert and citizen scientists. The following statements illustrate these points:

> Assisting community groups is usually unfunded. It is therefore hard to justify spending significant amounts of time on these projects without making other funding (usually very tight) subsidise this. Some funding should be made available for experts to apply for to assist community groups. NHT funding has in some cases done this. Community groups (and the community in general) can underestimate the complexity of ecology and the difficulty in separating factors in a system such as a river or a wetland. This can create conflict in what they perceive a 'scientist' can tell them and what is possible with limited resources can in fact achieve. The relationship between community groups and expert scientists needs to be a long term one to get the best outcome. Short-term consultancies tend to leave both parties feeling nothing was achieved and can be built upon (Expert scientist)
>
> This process obviously is time-consuming and expensive, but worthwhile if a major decision is to be taken (Expert scientist)
>
> Community groups need more money, training and recognition for the work they do. Community groups should not be seen as "free tree planters" (Expert scientist)
>
> I think that achieving reliable community research is generally more expensive than the equivalent research organisation research, and its adoption will still depend on whether the results are what the leaders in the community want them to be - if they are adverse to their agendas, they still get ignored (Expert scientist)
>
> Much time and money is being invested in community groups. The funders are willing to fund coordinators but baulk at funding technical people to assist the groups, even where this is a relatively small portion of the overall budget. This is like making a cake but not giving it any icing. You have 90% of it but without the remaining 10% to make it complete it is not really satisfying. Community groups constantly ask for my help with technical direction but without funding I can't give it. They miss out and so do I and, so does the quality of the information they collect. The small amount of extra funding required to provide technical advice would substantially improve community outputs and the education they receive in the process (Expert scientist)
>
> Lack of resources including equipment and expensive purchasing costs has limited/prohibited some schools monitoring by themselves. Community-based scientists and volunteers should be given some remuneration. While it may not be to the level of scientists, it should be something eg $10/hr plus money for petrol. This would encourage more people to participate. Surely it is better than the dole (Citizen scientist)

For one expert scientist, there are irreconcilable differences between the worldviews and motivations of community-based and expert scientists. In this instance, community members are perceived as suspicious and self-centred individuals that have a very narrow view of catchment issues. Certainly, in the tradition of 'patch protection' this comment seems to imply that both groups should remain within their chosen vocations and conduct their activities in isolation. For example:

> There is a simple divide between the worldview of community-based 'scientists' and university trained scientists. Community people only do this activity in their local area out of very parochial and self-centred interest. To them, the only catchment or river worthy of investigation is the one flowing past their back door. They get a shock when the expert regards 'their' river as 'just another river' - the investigation of which is only useful for revealing generalisations about processes. They can't understand that people can operate without a selfish view of the world. Thus, they remain suspicious of experts. I strongly hold the view that science is for expert scientists, and that farming is for expert farmers (I don't sit on a committee that tells them what to grow and when). It is not possible to distil 5 + years of training into a weekend workshop (Expert scientist)

Other expert respondents contend that group member commitment is a key factor in the success or failure of community-based research:

> From my experience, I have found that quality of research varies depending on the commitment of the group members quite often. Basically, the individuals that make up the group seem to be quite significant (Expert scientist)

Another expert scientist states that community group capabilities are dependent on group member skills education and knowledge:

> Whether or not community groups are capable of objective scientific research depends on their skills, education and knowledge. They can provide useful data and can assist usefully in the conduct of research whatever their background, however. They can also assist scientists in their understanding of issues and processes (Expert scientist)

From the citizen perspective, there is concern about bias against non-expert-collected data and lack of effective strategies linked to the monitoring process. One coordinator also notes that practical assistance is 'non-existent' and fears that without expert help their efforts may be wasted. For example:

> The value of trend-indicative monitoring is to trigger ICM/council-level responses. However, this process is blocked if (1) no ICM strategy exists, (2) there is a lack of understanding at the ICM level that catchment management is a PROCESS not a document (the strategy), and (3) there is bias against non-scientist-collected data ie community field kit data. (Citizen scientist)

> More input is required from expert agencies to ensure that we are on the right track. With our Waterwatch results in particular, we require confirmation that we are on the right track and we also need more assistance with quality control and assurance from experts. But who is willing to give us this support in the field? State agencies eg. EPA, say they are supportive of our efforts, but practical assistance is non-existent (Citizen scientist)

Similarly, one expert scientist also cites the importance of experts giving feedback to community groups:

> Virtually every community member that I have spoken to has been disappointed about the lack of feedback from individuals and agencies about research work that had been carried out on their properties in the past. My aim now is to write to every landowner and provide them with results, to encourage them to participate in future research (Expert scientist)

In addition to the above comments, which were all covered by questions in the survey, there is also expert concern that community group members do not adequately reflect the views of the community as a whole. For example, one expert scientist notes:

> Those who participate in community-based research are often people that are passionate about a particular local issue and therefore often do not reflect the needs and views of the community as a whole (Expert scientist)

These results reveal that barriers to community-based research lie in both the citizen and expert camps. The index and analysis of questionnaire statements reveals that the expert perceptions of the barriers to community-based research are generally greater and sometimes different to those of citizen scientists. In contrast to the citizen perception, experts consider that citizens participating in research lack the necessary educational qualifications and organisational skills to undertake rigorous research. This augments the view outlined in the literature that experts have a superior self-perception (Saul, 1992; Martin & Beder, 1993) and that the community, however well-intentioned and committed, still lack the wherewithal and objectivity to effectively participate in research. Consequently, citizen scientists are concerned about expert bias against their data and lack of opportunities for expert assistance to overcome this. Fortunately, experts are becoming increasingly aware of the need to provide quality feedback to community groups. In addition, there is consensus among citizens and experts that volunteer burnout, turnover, research goals, limited perspective and access to technical assistance and equipment are significant barriers. This indicates that these are very real and prevalent barriers, which are not easily overcome by community groups in isolation from expert networks. However, both groups have minimal time and funding for community-based research. Experts feel that to justify time with community groups that it should be explicitly written into their job descriptions and that the community should also receive some remuneration and not seen as 'free-tree-planters'.

5.6.3 *Advantages of community-based research*

The third index of attitude towards community-based research focuses on the advantages of this form of research that are perhaps uncommon in more traditional forms of research where the exponents are exclusively expert scientists. The index of thirteen items reveals positive attitudinal stances from citizens and experts with means of 1.15 (SD = 0.35) and 0.75 (SD = 0.53) respectively (see Figures 5.18 and 5.19). Consistent with the previous indexes, the difference between the citizen and expert perceptions is statistically significant (Mann-Whitney*U* =0 1766, *p*=0.000). A detailed examination of index items demonstrated that both groups are most positive towards the access to local knowledge, increased local relevance of research and the increased citizen/expert collaboration advantages of community-based research (see Figure 5.20). They also agree that community-based research is capable of citizen empowerment, increased citizen ownership of research projects, improved environmental management and allowing more intensive sampling over a wider area. There is also consensus that community-based research lends support to information gathered by expert scientists and that experts can learn much from the community. There is less certainty, especially among expert respondents that community-based research provides the best way to access local catchment knowledge and is a more socially aware form of inquiry than most catchment research. Moreover, experts disagree with citizens that community-based research is a reliable way to get answers directly from the environment without having access to experts. There is also disagreement on the cost-effectiveness of community research with only experts perceiving it as cost-effective (see Figure 5.20).

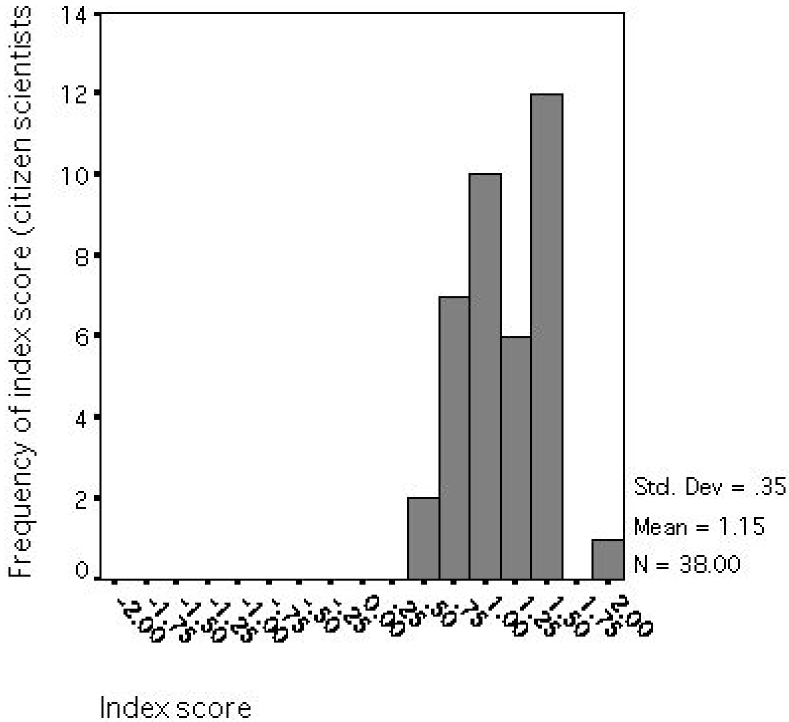


Figure 5.18 Index of citizen scientists' attitudes towards the advantages of community-based research

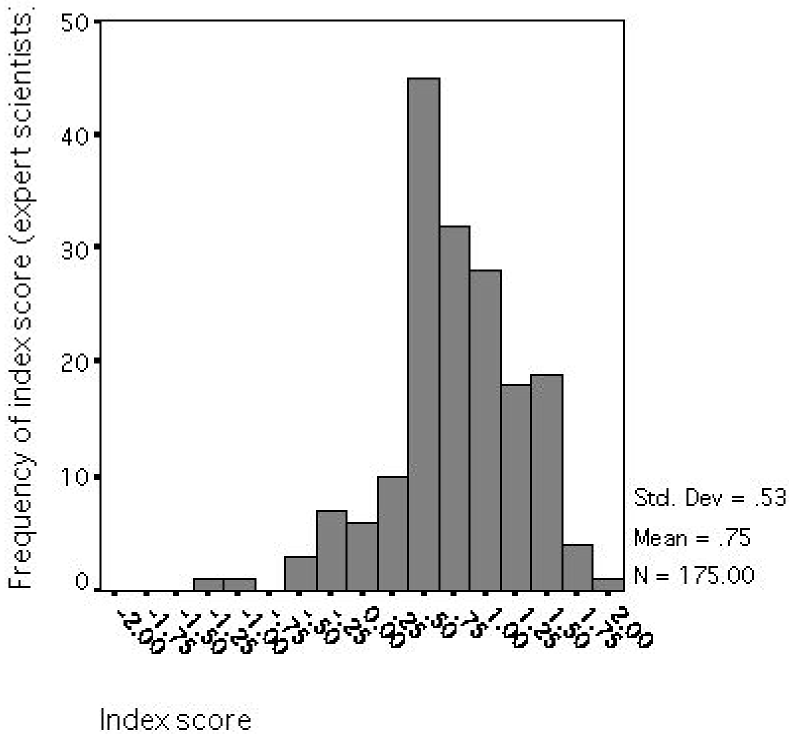


Figure 5.19 Index of expert scientists' attitudes towards the advantages of community-based research

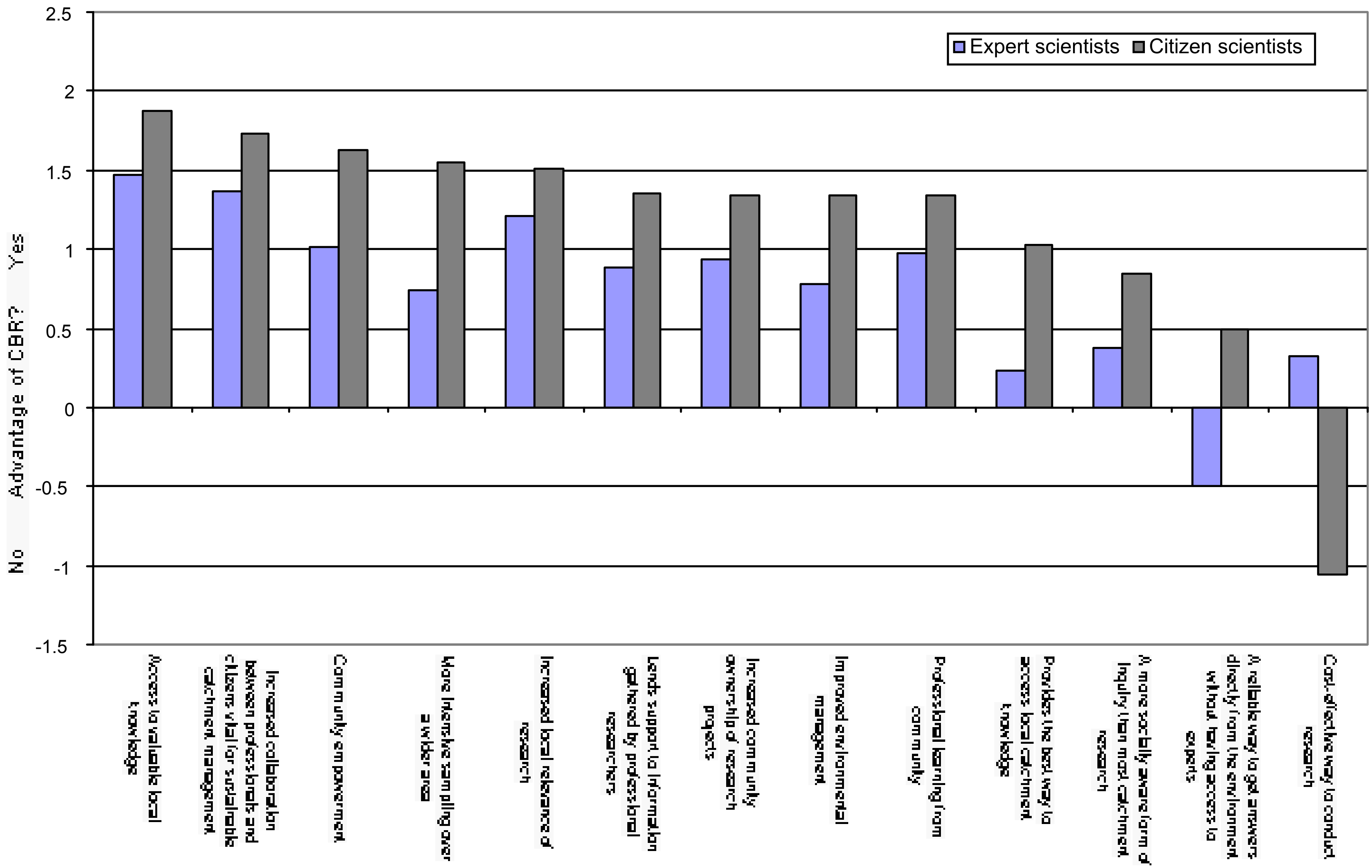


Figure 5.20 Comparative perceptions of the advantages of community-based research

Many respondents also noted the advantages they saw or had experienced through community-based research. One expert scientist felt that community-based research facilitated citizen ownership of issues and solutions:

> I think community-based research allows the community who might be part of the problem studied, to become part of the solution. This encourages participation and success in the research when they can see that there is assistance and outside interest in helping them overcome some issue, and broaden their focus from their own local problems to their surrounding environment (Expert scientist)

Both experts and citizens state that it allows more frequent and broad scale data to be collected. For example:

> Collecting frequent broad scale data to describe catchment attributes such as variations in water quality would be very difficult and expensive without the use of community/volunteer monitoring (Expert scientist)
>
> As a modeller, I have to say that the extra data some of these groups provide is frequently invaluable (Expert scientist)
>
> Waterwatch in far north Queensland collects baseline catchment level data and this is often the only data being collected on a waterway (Citizen scientist)

Experts also indicate that citizen/expert partnerships allow more holistic information to be gathered:

> With suitable training and protocols most interested community members can undertake some fundamental research. More important perhaps is the great benefit to be derived by both scientists and the community from effective partnerships in these endeavours especially when biophysical, social, economic and environmental factors and interrelationships are explored and developed (Expert scientist)

In addition, several respondents cite advantages of citizen/expert collaboration including increased research relevance and mutual learning:

> Expert scientists are (generally) interest driven and often fail to engage on the real problems facing communities. The same is said for experts in government agencies. Community-based groups (and their support staff) often fail to recognise the underlying problems they are confronting through lack of knowledge and understanding. Getting the two together is the only way to recognise and engage the problems. But this is NOT a half-day visit! It requires scientists to leave their comfort zones and spend weeks to months working with community groups (and vice versa) (Expert scientist)
>
> Community-based research should build on and complement detailed scientific study - the two have value and both should be a part of and inform catchment management (Expert scientist)
>
> Research cannot be carried out in isolation from the community. All too often the basic issues and parameters are missed impacting on the whole research.

> This results in the scientists being labelled as incompetent and being assigned low integrity. Scientists need to use the local community to better understand the problems, gain their trust which will make implementing new fix-it ideas and technology much easier (Expert scientist)

Consistent with the index response, experts state that with sufficient preparation, community-based research is a cost-effective way to conduct long-term research. For example:

> In bird biodiversity work - community surveys are probably the only long-term cost-effective way of making progress. This is because there are many good amateur bird watchers and there has been a lot of effort put into devising and analysing appropriate survey methods (Expert scientist)

These results indicate that there are many advantages that accrue from community-based research and that these are complementary to more traditional forms of research undertaken by experts. Some of the more obvious advantages are access to local knowledge, increased collaboration, community empowerment, and increased data collection. However, citizen respondents caution that this is not a cost-effective way to conduct research and are perhaps concerned that community groups could be perceived as a form of free labour. Consistent with the expert reservations indicated in the previous sections, the experts again state that community-based research is unreliable if conducted in isolation from experts.

5.7 EXPERIENCE OF COMMUNITY-BASED RESEARCH

It is widely accepted that knowledge of and attitudes towards activities such as community-based research are likely to be influenced by individual experience with such a process. Therefore, this section begins by determining the level and type of experience that citizens and experts have had with this form of research. It aims to quantify the frequency of interaction, the role played during interaction and the experience of interaction. It also seeks to understand the influences on likelihood of future interaction and the attitudinal stances determined in the previous sections.

5.7.1 *Expert experience of community-based research*

Table 5.4 indicates the frequency of interaction for several different types of research interaction that expert scientists could have had with community groups that conduct research. As a general indication, the level of interaction is minimal except for giving informal advice. Despite the low levels of interaction the percentage of experts intent on future interaction with community groups in the next twelve months is high with 43.4% of respondents stating that they are very likely to commence or continue interaction (Table 5.7). Moreover, 60% of respondents said that the interaction with community groups had been a positive experience (Table 5.5).

Table 5.4 Frequency of expert interaction with community groups

Type of research interaction	*Frequency of interaction (percentage & number of respondents)*			
	Low (once a year)	Medium (monthly to biannually)	High (weekly)	Never
Paid consultant	10.3 (18)	20.0 (35)	3.4 (6)	65.7 (115)
Informal (unpaid) adviser	16.6 (29)	43.4 (76)	5.1 (9)	34.3 (60)
As a co-scientist working in partnership with community group members	19.4 (34)	30.9 (54)	6.3 (11)	42.3 (74)
As a community member/local resident	18.9 (33)	19.4 (34)	3.4 (6)	57.7 (101)
As a scientist studying community groups	5.1 (9)	10.9 (19)	5.1 (9)	78.3 (137)
As the principal scientist working with and directing the research of community groups	8 (14)	10.9 (19)	4.0 (7)	76.6 (134)

Table 5.5 Expert experience of community-based research interaction

Research experience	*Experience of interaction (percentage & number of respondents)*				
	Very negative	Mildly negative	Neither positive or negative	Mildly positive	Very positive
Which best describes your experience working with a community group?	9.7 (17)	4.0 (7)	17.7 (31)	21.7 (38)	38.3 (67)

To enable a richer understanding of expert scientists' experience with community groups, Table 5.6 provides a sample of the range of citizen/expert interactions that expert respondents have been involved in to date.

Table 5.6 Examples of community/expert research interactions provided by expert scientists and agency representatives

- Integrated water quality monitoring project
- As a presenter of results to community groups
- In a consultative way as part of the Sydney Catchment Authority Audit team
- Advised Landcare on construction of salinity bores
- Financial contribution to the Waterwatch program and request of data collection from sites
- Emergency planning and flood mitigation works
- Advice on land management projects undertaken by the community in a developing country
- Marine ecosystem management strategy evaluation
- Management of sediment sources and sinks
- Forest harvesting
- Technical advice on land reclamation methods
- Education on process understanding
- Stream rehabilitation projects and works conducted by community with monitoring by expert scientists
- Dealing with community reference panels on large-scale water management issues.
- Preparing landuse/landcover maps for catchment care groups and research for the Surfrider Foundation
- Seagrass Watch - observer of field trials, looking for best-practice models for wider application to other habitat monitoring by community groups. Fisheries Action Program - funded project scoping community-based habitat monitoring in Qld.
- CCS project - developing standardised monitoring protocols for estuarine and marine community-based monitoring
- Fisheries Action Program - funded project scoping community-based habitat monitoring in Qld.
- National Land and Water Resources Audit - Implementation Project that attempted to integrate catchment health, landuse and capacity to change by landowners.
- Work in bushland weeding as a community member.
- Coordinating bird surveys - as a scientist.
- Giving public seminars and talks to a wide variety of community groups
- PhD study
- Collaborative, action-oriented research into `teaching and learning for environmental advocacy' involving several state and national environmental NGOs.

In addition to these interactive examples, several expert scientists commented in more detail regarding their research interactions. These comments highlight the importance of citizen/expert interaction and collaboration in research:

> Interaction is fundamental to our research. It varies from research into the interests, values etc of different community groups to involving community groups as reference groups and involving them directly in research activities - usually research design and data interpretation (Expert scientist)

> The Area Water Board monitor and conduct research in the Valley. The Waterwatch volunteers in the Valley have been able to extend the number of sites which are monitored and have also been able to give other information regarding fish sightings, weed occurrences etc. It is planned to have the Water Board present some of their findings to the volunteer group in the next few months and to have information sharing as a regular occurrence (Expert scientist)

In contrast to previous comments that questioned the quality and biased nature of community-based research, one expert scientist emphasised the importance of involving community groups to increase the relevance and utility of research:

> My aim is to have the project direction controlled by the end users, in a similar manner as if they had appointed us as consultants to design the tools themselves. This approach has met with unanimous support from the end-users we have spoken to. Interestingly, taking this approach has met with some "resistance" from within the organisation here, where there is a belief that these tools could be designed on a whiteboard somewhere in Sydney, then developed and then "provided" to the community. My personal feeling is that without the relevant community groups directing the research, anything we develop will ultimately end up on a bookshelf somewhere unused (Expert scientist)

However, several expert scientists had not had a pleasant experience when interacting with community groups. For example:

> I went to a workshop where members of a community group rambled at length and fought amongst themselves. The meeting ran 2 hours over time and I hit a kangaroo on the way back to work! This somewhat soured my attitude towards community groups (Expert scientist)

> [My experience with community groups can be described as] patchy at best, at times frustrating, and occasionally bewildering (Expert scientist)

These comments illustrate that expert scientists have had both positive and negative experiences with community groups. However, many contend that citizen/expert interaction is fundamental to catchment research and, in contrast to previous sections, that it increases the relevance and utility of research outcomes. Consistent with these comments, Table 5.7 illustrates that over 43% of expert scientists intend to continue or commence interaction with citizen scientists in research.

Table 5.7 Likelihood of expert future interaction with citizen scientists

Future intentions	*Likelihood of future interaction (percentage & number of respondents)*				
	Not at all likely	Minor likelihood	Don't know	Moderate likelihood	Very likely
Are you likely to commence or continue your interaction with community groups in the next twelve months?	8.6 (15)	22.9 (40)	0.6 (1)	22.3 (39)	43.4 (76)

To further explore expert scientists' intentions to interact with community groups in the future, Table 5.8 considers the willingness and ability of expert scientists to assist community groups when conducting catchment research.

Table 5.8 Expert scientists' perceptions of involvement with citizen scientists

Community-based Research Issue	*Mean score**	*Standard deviation*
Willing to assist training community groups in catchment research methods and techniques	0.63	0.95
Willing to provide accessible advice	1.05	0.69
Prepared to publicise or promote community-based research	0.18	1.02
Keen to provide technical equipment for community-based research	0.53	0.99
The involvement of community groups often makes an issue more complex	0.44	0.91
Integrating community-based research into my research projects would complicate my job	0.72	0.96
Prepared to integrate relevant community data into my research projects	- 0.33	1.24
Only prepared to use data collected by expert scientists to support theories or recommendations	0.35	1.13
Community involvement is a good way to show the public element of research	0.41	1.05
I would work more with community groups if I had more time	0.81	0.85
I would find more interaction with community groups rewarding	0.95	0.85

**Mean score (calculated from response categories where -2 = strongly disagree, -1= mostly disagree, 0 = neither agree nor disagree, 1 = mostly agree, 2 = strongly agree)*

Consistent with Section 5.7, which showed that giving advice is the most common form of interaction between citizens and experts, Table 5.8 indicates that experts are most prepared to provide accessible advice. To an extent, they are also prepared to provide training and technical equipment. However, experts are only prepared to use data sourced from experts to support theories or recommendation and are not prepared to integrate relevant community data into their own research projects. There also appears to be a perception that the involvement of community groups in expert research would make research issues more complex and complicate research tasks. Nonetheless, expert scientists consider that they would find working with community groups rewarding and more would do so if they had sufficient time and resources (see Table 5.8).

5.7.1.1 Influences on future interaction from a expert perspective

To determine the influences of knowledge, attitude, interaction frequency and type, and experience of interaction on likelihood of future interaction, a stepwise multiple regression of these variables was computed. Stepwise regression determined that only interaction as an informal adviser and experience of interaction are significant predictor variables ($F = 19.9$, $df = 2, 137$, $p < 0.001$, $R^2 = 0.21$) of likely future interaction. The multiple regression equation is:

$$FI = 0.658 + 0.303\,a + 0.294\,b$$

Where FI is the likelihood of future interaction, a is the frequency of interaction as an informal adviser, and b is experience of the interaction. In other words, increased likelihood of future interaction is associated with frequent interaction as an informal adviser and a positive experience of interaction. Certainly, a positive experience is more likely to encourage further interaction than a negative one. Experts possibly favour interaction as an informal adviser because it is inexpensive in terms of time, effort and expense. The significance of these as predictor variables is also supported by Spearman's correlation coefficient (r_s). In this instance significant positive correlations are found between likelihood of future interaction and interaction as an informal adviser ($r_s = 0.411$, $n = 161$, $p < 0.01$ (1-tailed) and positive interaction experience ($r_s = 0.304$, $n = 156$, $p < 0.01$ (1-tailed).

Because experience of interaction is a significant predictor variable of future interaction and one that could have also been influenced by pre-existing attitudes, level of knowledge or the role played in the interaction, the potential of these influences on this variable are also explored. Stepwise multiple regression of the type of interaction, attitudinal stance and knowledge level against experience of interaction reveals that only interaction as co-researcher is a significant predictor ($F = 26.2$, $df = 147$, $p < 0.001$, $R^2 = 0.15$) of experts having a positive experience with community groups when conducting community-based research. Again this finding is supported by a significant Spearman correlation coefficient (r_s = 0.424, n = 157, p < 0.01 (1-tailed).

Of all the different types of interaction analysed in this section, interaction as a co-researcher is arguably the only interaction type where participants are forced to see each other as equals when conducting research. Even when experts participate as a community member or local resident, I suspect that their expert status still remains, even if only in the eyes of the other participants. These results suggest that if collaborative community-based research is to persist or increase, it must not require too much effort and in the process engender positive experiences amongst experts. This is best achieved if the experts exist in the research setting as co-researchers where their status is clearly equal to that of the citizen participants. This finding also has important implications for the concept of a true partnership, which is the favoured approach to research indicated by the majority of respondents in Section 4.3.

5.7.2 *Citizen experience of community-based research*

Citizen participants in community groups all report frequent levels of interaction with experts (see Table 5.9). Indeed, all had requested informal advice and many had provided their research data. The majority of respondents are very positive about such interactions and over 75% are likely to commence or continue interaction (see Tables 5.10 & 5.12).

Table 5.9 Community interaction with expert scientists

Type of research interaction	*Frequency of interaction (percentage & number of respondents)*			
	Low (once a year)	Medium (monthly to biannually)	High (weekly)	Never
Paying for information or expert assistance	21.1 (8)	21.1 (8)	7.9 (3)	39.5 (15)
Requesting informal advice	2.6 (1)	65.8 (25)	21.1 (8)	-
As co-researchers working in partnership with scientists or agency experts	15.8 (6)	50 (19)	7.9 (3)	13.2 (5)
As fellow community members/local residents	15.8 (6)	36.8 (14)	18.4 (7)	10.5 (4)
As the subject of external research	5.3 (2)	36.8 (14)	28.9 (11)	15.8 (6)
Working with and having the research directed by a scientist or expert from a university of Government department	26.3 (10)	26.3 (10)	10.5 (4)	21 .1 (8)
Providing research data on a one-way basis	34.2 (13)	44.7 (17)	2.6 (1)	5.3 (2)
Sharing research data on a mutual basis	18.4 (7)	42.1 (16)	5.3 (2)	18.4 (7)

Table 5.10 Community experience with expert scientists

Research Experience	*Experience of interaction (percentage & number of respondents)*				
	Very negative	Mildly negative	Neither positive or negative	Mildly positive	Very positive
Which best describes your experience working with an expert researcher?	-	2.6 (1)	5.3 (2)	18.4 (7)	63.2 (24)

To facilitate a more comprehensive understanding of citizen scientists' experience with expert scientists, Table 5.11 illustrates the range of citizen/expert interactions that community respondents have been involved in.

Table 5.11 Examples of citizen/expert research interactions provided by citizen scientists

- Participation in environmental impact assessment
- Reporting adverse water quality readings to the EPA and City Council
- Organised information days for High School students
- Assisted with writing an academic research paper on community collected data confidence
- Receiving advice on testing water samples.
- Daily work with the Local Catchment Management Authority
- Prepatory work with the Australian Platypus Conservancy for Platypus Watch
- Providing research reports and data on a specific location
- Providing water quality data for projects (2)
- Received advice on invertebrate identification from the EPA
- Received collaboration on results of monitoring of farm dams and river from Wimmera Mallee Water
- Received information on groundwater effects on stream in local areas to help explain readings by monitors and to help develop new educational materials for use of monitoring results in classroom education from the CRC for Groundwater Research
- Assisted with acid sulfate research
- Seagrass watch monitoring (EPA)
- Exchanged data about "hotspots" on Eprapah Creek
- Extensive liaison with the scientific community to develop field guides and resources
- Collaboration on a strategic monitoring program for nutrients in drains
- Expert development
- Addressing *E. coli* issues
- Addressing mangrove die-back
- Providing macroinvertebrate data
- Development of new monitoring techniques eg. estuarine and coastal water quality monitoring techniques
- Sharing of data and consultation about site selection, methodology and equipment.

Several citizen scientists also commented on their experiences with expert scientists and their agencies. The following comments highlight the importance of forming strong links between community groups and expert institutions:

> Melbourne Water has recently agreed in principle to utilise Waterwatch data in their water quality database. Provided the data was quality coded as community data MW were happy about its inclusion. There was, however, a lack of awareness about the Waterwatch program, and how much data has been collected. The WW data will fill a lot of "gaps" particularly in bug data, which is limited due to funds available for testing. With the emphasis on QA/QC Waterwatch has added credibility to their data. I think it is important to keep Waterwatch placed within agencies (such as Melbourne Water) so that community links can be continually built (Citizen scientist)

> As a Waterwatch coordinator, I work very closely with the local CMA. They use me and my network as a means to obtain data on catchments that they specifically need. [This] is how two community groups started up over two years ago and [we are] growing stronger. We share data with the CMA and regularly report. As a Waterwatch coordinator I constantly consult to see what type of information they want and then try to organise volunteers to collect this. It is a two way street, I use their resources, facilities and they use our database and data. Groups are subjected to regular quality control and equipment checks to ensure accurate data is collected. (Citizen scientist)

In these examples, community initiatives have gained increased support in terms of intellectual and material resources, and agency programs have increased the breadth and intensity of data collection to a level unobtainable through agency resources alone. Thus, strong citizen/expert partnerships can produce positive outcomes for both groups. These comments are consistent with those from expert scientists and are supported by the high proportion of citizen scientists likely to interact with experts in the future (Table 5.12).

Table 5.12 Likelihood of future community interaction with expert scientists

Future intentions	*Likelihood of future interaction (percentage & number of respondents)*				
	Not at all likely	Minor likelihood	Don't know	Moderate likelihood	Very likely
Are you likely to commence or continue your interaction with such scientists in the next twelve months?	2.6 (1)	10.5 (4)	5.3 (2)	21.1 (8)	55.3 (21)

To further explore citizen scientists' intentions to interact with community groups in the future, Table 5.13 considers the experiences that community groups have had with research and expert scientists and what this means for future collaborative efforts.

Table 5.13 Citizen scientists' perceptions of involvement with expert scientists

Community-based Research Issue	*Mean score**	*Standard deviation*
Most water management agencies are unreceptive to our concerns	- 0.81	0.89
Scientists and agencies are reluctant to use our data	0.58	1.02
Scientists and agencies do not know how to interpret our data	-0.64	0.83
Scientists and agencies are reluctant to give us any assistance	- 0.38	1.06
I would appreciate some recognition for the research that we conduct from expert scientists and agencies	1.41	0.60
Rigorous data collection to increase data quality takes the enjoyment out of monitoring	- 0.57	0.90
I would like to be involved in more stages of research other than monitoring	0.95	0.71
It is hard to convince scientists and local authorities of the value of our work	0.55	1.09
I would appreciate more direction from expert scientists and agencies to ensure that our research is useful	1.14	0.80

**Mean score (calculated from response categories where -2 = strongly disagree, -1= mostly disagree, 0 = neither agree nor disagree, 1 = mostly agree, 2 = strongly agree)*

Of the potential factors determined from focus groups, only half of them appear to reflect general experience. Certainly, citizens would like to be involved in more stages of research than monitoring, but experts appear reluctant to use community groups' data and it is hard to convince experts of the value of citizen research. Consequently, citizens would appreciate more recognition for current community-based research and more direction to ensure the utility of future research. The following comments are illustrative of how the community feels they should interact with experts in catchment management:

> Expert scientists can play a more active role in educating community groups on catchment issues. Groups are generally happy to have any help, advice or information. (Citizen scientist)

> For community-based research to be successful there needs to be a strong link with expert agencies. Expert agencies need to be able to supply community groups with the knowledge and equipment to achieve management plans. (Citizen scientist)

5.7.2.1 Influences on future interaction from a community perspective

Stepwise multiple regression was calculated to determine the influence of knowledge, attitude, type and experience of interaction on citizen scientists' likelihood of future interaction with expert scientists. In this instance, interaction as a co-researcher and having research directed by a expert are the roles that predict future interaction ($F = 7.72$, $df = 2,28$, $p < 0.01$, $R^2 = 0.32$). The multiple regression equation is:

$FI = 1.215 + 0.295\,c + 0.304\,d$

Where *FI* is the likelihood of future interaction, *c* is the frequency of interaction where an expert directed the research and *d* is the frequency of the interaction where community members participate as co-researchers. In other words, from the citizen perspective increased likelihood of future interaction is associated with frequent interaction where the research is directed by experts and where they can participate as co-researchers. These findings are supported by significant Spearman correlation coefficients between expertly directed research ($r_s = 0.506$, $n = 32$, $p < 0.01$ (1-tailed) and interaction as a co-researcher ($r_s = 0.522$, $n = 33$, $p < 0.01$ (1-tailed).

Consistent with the expert response, neither attitudinal stance (as indicated by the three indexes) nor level of knowledge predicts the likelihood of future interaction. However, unlike the expert response, the experience of interaction does not predict likelihood of future interaction. Nevertheless, I believe that the influences on experience are still important to explore. Stepwise multiple regression of the type of interaction, attitudinal stance and knowledge level against experience of interaction reveals that only interaction as a co-researcher is a significant predictor ($F = 6.76$, $df = 1,27$, $p \leq 0.01$, $R^2 = 0.17$) of citizens having a positive experience with experts when conducting community-based research. Again, this is supported by a significant Spearman correlation coefficient ($r_s = 0.467$, $n = 32$, $p < 0.01$ (1-tailed).

In addition, community representatives were also asked about the provision of their research data. Focus group interviews had revealed that the approach to community data provision was a community concern with many feeling that they were providing data on a one-way basis. Certainly, over 81% of the citizen scientists report providing data to expert scientists in this manner. In contrast, 66% report sharing data on a mutual basis with experts and it is this approach to data provision that is significantly correlated to increased likelihood of future interaction ($r_s = 0.540$, $n = 32$, $p < 0.01$ (1-tailed), and experience of interaction ($r_s = 0.472$, $n = 31$, $p < 0.01$ (1-tailed). To explore the effect of approach to data provision on citizens' future intentions and experience to date, the one-way and two-way approaches were inserted into the regression model. This time the only significant predictor of likelihood of future interaction ($F = 12.84$, $df = 1,27$, $p < 0.01$, $R^2 = 0.30$) and positive experience during interaction ($F = 8.28$, $df = 1,27$, $p < 0.01$, $R^2 = 0.21$) is sharing data on a mutual basis.

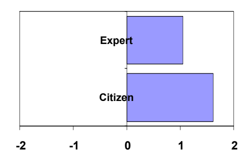
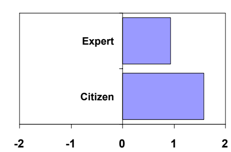
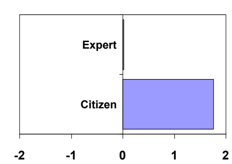
Citizens conducting research in community groups interact frequently with expert scientists. Most often they are seeking informal advice or are working in partnership with expert scientists as co-researchers. To a lesser extent, they have also worked with experts as fellow community members or as the subjects of external research projects. Community groups also frequently provide expert scientists with research data on a one-way and, to a lesser extent, reciprocal basis. Generally, citizen responses are very positive towards their interactions with expert scientists and are likely to continue such interaction.

Interaction as a co-researcher or having the research directed by an expert scientist are the only roles that influence likelihood of future interaction. Interaction as a co-researcher is also the only role that predicts a positive research interaction experience. However, sharing of data on a mutual basis appears to be an even more powerful predictor of both future interaction and experience. Certainly, citizens do not want to waste their time when conducting research and perhaps where it is directed by an expert scientist they feel more certain of the ultimate utility of their efforts. Nevertheless, where both parties are perceived as co-researchers in rhetoric and in reality the data is shared on a mutual basis, the most positive experiences are had and the likelihood of future interaction is maximised.

5.7.3 Comparative research intentions

When combined with the experts' experience it is clear that for sustainable and positive research interactions between experts and citizens, both parties must be perceived and to act as equals. There is also an indication that for experts it is important the experience be positive if it is to continue. Conversely, citizens are more likely to be motivated by conducting quality research that can be utilised and shared on mutual basis with experts. Certainly, Table 5.14 describes a situation where both citizen and expert scientists welcome the involvement of each other in their respective catchment research and would like to approach any research involvement in the manner of a partnership. However, an independent samples test reveals that the citizens are significantly more receptive to these ideas than experts ($p < 0.01$). Moreover, there is a statistically significant difference between these groups when questioned about the willingness to share research data ($p < 0.01$) with experts being uncertain about this prospect.

Table 5.14 Comparative future research intentions

Future research intentions	*Expert perception (n = 175) Mean* (SD)*	*Citizen perception (n = 38) Mean* (SD)*	*Graphical representation*
I welcome the involvement of scientists and agency experts/community groups in our catchment research	1.05 (0.77)	1.62 (0.49)**	
I would like to develop a partnership approach to research with scientists and agencies/community groups	0.94 (0.76)	1.58 (0.55)**	
I would willingly share our research data with scientists and agencies/community groups	0.02 (1.22)	1.76 (0.49)**	

**Mean score calculated from response categories where -2 = strongly disagree, -1= mostly disagree, 0 = neither agree nor disagree, 1 = mostly agree, 2 = strongly agree*
***Significant mean difference at the 0.01 level of significance (Mann Whitney U-test) (see Appendix C)*

At this point, the results consistently indicate that the reciprocal sharing of research data is very important to community groups and an indicator of a partnership approach where citizen and expert participants are seen as equals. The reluctance of expert scientists to share their data with community groups questions their concept of a partnership. It is also likely to threaten any collaborative efforts with citizen scientists that place great importance on openness through reciprocal data sharing. Nonetheless, there are other aspects to collaborative research and many other ways that experts can and have assisted community groups.

In summary, this section has revealed that many positive research interactions and collaborative links already exist between citizen and expert scientists. These cover a variety of issues and range from sediment management to Platypus monitoring. In most interactions, community groups provide experts with data and experts provide advice, education and training, information, and financial support. However, there are still significant barriers to increased community-based research. Expert scientists' low opinion of the quality of community-based data and reluctance to use community data or to share data form the greatest hurdles. These barriers are consistent with all previous sections and the literature review. Nonetheless, there is a theme starting to emerge that despite these barriers, the combination of citizen and expert scientists can achieve research outcomes unobtainable by either group alone ie the sum of the whole is greater than any constituent parts.

5.8 FURTHER ISSUES

In addition to the factors raised in the questionnaire, a number of comments focus on two re-occurring themes; first, that community groups are inherently variable making any general questions difficult to answer, and second, that the citizen/expert dichotomy has to be challenged. As the following comments illustrate, these two themes are intimately related.

Despite the wording of questions so that respondents could state *what they thought the situation should be* as opposed to *what they knew was currently the case*, some respondents had difficultly answering many of the questions. These respondents believe that groups and issues or projects vary so considerably that it is difficult to form a general impression and that any opinion offered needs several qualifying statements ('ifs and buts'). For example:

> Many of the questions are hard to answer, especially regarding data collection. Some types of data can be adequately collected by community groups and others cannot. [The] success of community-based research will depend on the type of research, data collected, political agendas etc. (Expert scientist)
>
> Many of these questions vary considerably between groups and activities. Different groups also have access to different resources and have different skill bases… it is extremely difficult to make generalisations about community groups given their diversity. (Expert scientist)
>
> I found the questions too black and white... There are many instances where I found myself saying "it depends..." or "Under these circumstances..." (Expert scientist)

> There are obviously a lot of "ifs" that need to be incorporated in the real world. (Expert scientist)

Interestingly, only one of the citizen scientists talked about group variability:

> It was difficult to answer some of the community-based volunteer questions as there is a wide range and it is hard to classify them into one area. Some are at a higher level and standard than others, these I feel are best targeted for higher quality data reporting and the others are better suited to the community awareness/education side of monitoring the environment. (Citizen scientist)

The notion of inherent community and issue variability also made many expert scientists question the validity of a citizen/expert dichotomy.

> There are more subtle variations than this binary situation…the world is not black and white. (Expert scientist)

> The assumption that all community groups respond equally to catchment issues has to be challenged- I am not sure that the artificial separation of expert scientists and community scientists is valid. (Expert scientist)

Only one respondent demonstrated the spirit of a public good venture and challenged the citizen/expert dichotomy on the basis of end-user involvement in successful research.

> It's been well recognised in some sectors (eg agriculture) that successful research DEMANDS the involvement of end-users. In this respect, the divide between 'community' and 'expert' research or 'lay/local' and 'expert' knowledge becomes very suspect. (Expert scientist)

As these results suggest, there is variability among community groups and citizen scientists in terms of the tasks they undertake and the quality of the research they produce. In the instance of Waterwatch groups, much of this variability is caused by groups having different goals. Chapter 4 indicated that whilst some groups focus on quality research, others remain focused on education and awareness. Indeed, the network of community groups plays a number of roles and undertakes a range of tasks in catchment management. Nonetheless, it is interesting to note that variability is only noted among citizen scientists and not expert scientists. Moreover, that citizen and community group variability is used to question the utility of community-based research. This criticism of community-based research is in contrast to previous concerns that have highlighted differences between citizen and expert research by using the same assessment criteria as that used for expert-conducted science. I do not agree that the same indicators should be used when assessing the value of citizen and expert science for they are different, however, I simply wish to point out that by only noting variability among citizen scientists that a double standard seems to be applied by these respondents. Conversely, other respondents argue that it is not easy to separate citizens and experts and question the validity of the dichotomy presented.

5.9 SUMMARY

5.9.1 *Summary of survey process*

A comprehensive questionnaire informed by several focus groups and current literature was used to survey citizen and expert scientists' perceptions of and experience with community-based catchment research. The survey was targeted and sent only to expert scientists in the Catchment Hydrology and Coastal Zone Cooperative Research Centres and citizen scientists in the Waterwatch network that conduct research in the same focus catchment areas. Implementation of the survey followed Dillman's Total Design Method (Dillman, 2000), which utilises a multiple contact strategy. Over the survey period, both Internet and postal modes of delivery were used to increase the representativeness of the sample and to achieve an acceptable response rate for each group. A total of 214 completed surveys were returned and analysed in comparative manner between expert and citizen scientists.

5.9.2 *Summary of survey findings*

The responsibility for catchment issues in our representative democracy has traditionally been assigned to experts. Accordingly, experts have been assigned the status and resources to undertake this task. In light of the failure of this approach and the recognition that catchment health is the responsibility of all citizens, there are increasing calls for more participatory approaches to research and management. This chapter has explored the potential of community-based research towards increased public participation and improved research and management outcomes. In this instance, community-based research represents a partnership between citizen and expert scientists.

Waterwatch Australia and the Catchment Hydrology and Coastal Zone Cooperative Research Centres were all initiated with Commonwealth Government funding and designed to promote catchment health within Australia. Waterwatch is a community-based network that conducts a variety of activities towards catchment health. Waterwatch members are predominantly volunteers and their participation in catchment research and management can be described as amateur, henceforth in this study they are referred to as 'citizen scientists'. Waterwatch seeks to involve a broad cross section of the community in its activities and to form partnerships with agencies that can assist them in achieving their catchment management goals. Members in the Cooperative Research Centres are exclusively professional and most are highly qualified researchers, therefore in this study they have been referred to as 'expert scientists'. They seek to produce high quality research that is directed and utilised by their industry partners and identified stakeholders.

Certainly, Waterwatch is community-based and has a broader set of goals and a wider target audience than the Cooperative Research Centres. Nonetheless, one of its goals is environmental monitoring and many groups undertake this on regular basis. However, the amateur status of its participants further tainted with the derogatory perception of 'the community' often means that the data collected is not accepted by expert scientists and never used to inform policy or remedial environmental actions. Section 5.1 explored the demography of both citizen and expert scientists to determine whether this inferior regard for participants in community environmental groups as researchers is valid. The demographic results showed that citizen scientists are highly educated, female dominated, cover a range of age groups, and a significant proportion are as likely to have lived in an area for less than a year than they are to have lived there for over 10. In addition, citizen scientists have much shorter time spans in their occupation as Waterwatch Coordinators, than experts did as professional researchers. These results undermine the derogatory perception of community participants as poorly educated and only motivated by a parochial interest in an area of long-term residence.

Section 5.2 sought to frame the role of citizen scientists and community groups in catchment management. There was no debate over the community-wide responsibility for catchment health, with expert and citizen scientists agreeing that the community has a role to play in catchment management. The challenge as one respondent noted, lay in defining this role. The results validated many different roles beyond education and awareness. Moreover, both groups stated that research was a valid role and that citizens could contribute at any stage to this process in a manner that does not negate the need for research by expert scientists. It should be noted that while both groups responded to the research role in a positive manner, expert responses were significantly lower than those of citizens. Accordingly, there was disagreement on the importance of the community's role in research, with many expert scientists concluding that community groups and projects vary considerably and that both these variables should be taken into account when deciding on an appropriate citizen role in catchment issues.

Mindful of the cautious options available to citizen scientists in research, Section 5.4 explored where and how in the research process citizen and expert scientists should be involved. The responses from both groups were remarkably similar and emphasised the possibility for valid citizen participation in all stages of research. Specifically, respondents considered that catchment research should be conducted as a citizen/expert partnership in all research stages except methodological design, data analysis and drawing conclusions where the community should be consulted and the experts retain control. Certainly, there was no conflict, disagreement or sense of competition between citizens and experts regarding citizen participation in the research process. However, forewarned by the literature review that partnership is a contentious term, the remaining sections explored this concept with regard to the citizen/expert dichotomy. Thus, they explored citizen and expert scientists' knowledge, attitudes and experience with this favoured, albeit rare, approach to catchment research.

Not surprisingly the citizen scientists scored significantly higher when questioned about community-based catchment research within Australia. What is surprising is that with so many experts wanting to conduct research in partnership with community groups that over 5% of expert scientists stated that they had virtually no idea what Waterwatch was or how it operated. Furthermore, those that did answer these questions appeared to have a very localised perception of Waterwatch that did not recognise the number of groups, the national network or any international connections. In addition, only 50% of experts knew that Waterwatch had quality control guidelines. This last point becomes very important in the following sections where quality control of community data becomes a contentious issue between citizen and expert scientists.

The three indexes of attitudes towards community-based research all revealed that citizen scientists are significantly more positive towards this form of research than expert scientists. The first index considered the major barrier to community-based research: community data quality and utility. Generally, expert scientists scrutinised community data using the same criteria that their research would be assessed with. Consequently, most expert comments were very negative towards the value of community data. Only a few experts were prepared to use community data if it were identified as such and stated that community members held local knowledge valuable to successful catchment management.

The second index focussed on citizen and group attributes that may form barriers to community-based research. In contrast to the citizen perception, experts stated that community participants were hindered in their ability to conduct rigorous research through lack of educational qualifications and group organisation. Consequently, citizen scientists were concerned about expert bias against their data and lack of opportunities for expert assistance to overcome this. However, there was consensus among citizens and experts that volunteer burnout, turnover, research goals, limited perspective and access to technical assistance and equipment are significant barriers. Moreover, that both groups have minimal time and funding for community-based research.

The third index concentrated on the advantages of community-based research and revealed that access to local knowledge, increased relevance of research and increased citizen/expert collaboration were the most popular advantages of community-based research among both groups. Again, expert scientists indicated that community-based research is unreliable if conducted in isolation from experts. In addition, citizen scientists cautioned that community-based research is not a cost-effective way to conduct research.

Section 5.7 provided a context for the level of knowledge and dominant attitudinal stances determined in the previous sections by describing the current level and type of interaction between citizen and expert scientists. It also explored the likelihood of any future interaction and the dominant influences on this from both citizen and expert perspectives. Generally, expert interaction with community groups was very low and consisted of giving informal advice. In contrast, all citizen scientists reported frequent interaction with expert scientists. Most often they were asking for advice, but many had also supplied data. For experts to continue their interactions with community groups it was important that it be inexpensive in terms of time and effort and expense. It was also important that the interaction was an enjoyable experience and this was best achieved if the expert assumed the role of a co-researcher. On the other hand, knowing that they were conducting quality research that could be utilised and shared on a mutual basis with experts motivated citizen scientists. This was best achieved by participating as a co-researcher and also by having the research directed by an expert. Therefore, the most positive outcomes occur when both parties are perceived as, and act as, equals. This involves working in complementary partnerships to ensure the quality and utility of data and the sharing of research data.

Throughout the survey expert scientists were reluctant to comment on topics outside their area of interest or expertise. They were also keen to qualify many statements with regard to the ability of specific groups, the severity of the research issue and the complexity of the research task. Certainly, they were uneasy about community group variability. This caution may be pragmatic (Saul, 1992), but unfortunately it appears to have stifled their willingness to express what *should* be or to think beyond everyday realities and discuss future possibilities. Indeed, the best way to predict the future is to create it, and to be creative you need to think beyond the current situation. Therefore, individual knowledge levels of the current situation should not prevent us from stating how we think it should be. Only a few expert scientists viewed such variability in a more positive light. For these respondents, citizen variability made them question the validity of the citizen/expert dichotomy and to argue for the involvement of end-users in research. Such citizen involvement is consistent with the prevalence of calls for a collaborative approach to catchment research.

In summary, citizen and expert scientists both have valid roles to play in catchment research and management. However, their contributions are distinct and their validity should not be assessed using the same criteria. Community-based research has the potential to produce positive outcomes for entire communities *if* effectively linked to expert research and assistance. This will require a change in attitudes, extra time, funding and commitment from all involved.

5.10 IMPLICATIONS (TENTATIVE)

This chapter has presented analysis on where and how citizens can contribute to catchment management, with particular regard to their role in research. There are many implications that arise from this analysis and some of the more important ones for this study are described below.

Demography

- Citizen coordinators form a well-educated sector of the citizenry and cannot be dismissed as ignorant.

- Citizen participation in community environmental groups is only partly motivated through a sense of attachment to, and a history in an area. There are other factors operating that motivate people very new to an area to participate. However, in contrast to expert organisations many community groups experience a high turnover of coordinators and members. Therefore, it is important to understand the motivations underpinning these recent participants and how to maintain their continued participation. This will require more detailed study and is explored in the following chapters.

- Unlike expert scientists, citizen scientists are predominantly women. Therefore, their involvement in science is important to encourage as a way to redress the balance towards gender equality in the production of knowledge.

- Both citizen and expert scientists represent a variety of age groups and therefore have potential to reach a broad cross section of the community.

Knowledge of community-based research

- Expert knowledge of community-based research is very low. For effective citizen/expert partnerships it is important that experts develop a deeper understanding of citizen efforts, needs and goals. This will embody a broader picture of citizen scientists as a network of community groups with national and international links.

Citizen roles in catchment health

- The role of citizens in catchment health extends well beyond education and awareness-raising. However, this will involve enhancing the community capacity to undertake these additional roles and willingness on behalf of the community to bear the associated responsibility. Experts will also have to increase their capacity and ability to work with citizens in committed and equal partnerships.

Citizen participation in catchment research

- If research is conceived in an adaptive management style, then there are opportunities for citizens to participate in all research stages. There is no competition for power or research tasks between citizen and expert scientists. Citizens strive to be seen as co-researchers - not co-scientists, and do not wish to compete with expert scientists in research. Therefore, in a research partnership neither group has cause to fear that their territory or integrity is threatened.

Attitudes towards citizen scientists and community-based research

- There are conflicting attitudes towards the barriers to and opportunities for community-based research. Some of these may be based on fact, and others may be caused through a lack of appreciation or acknowledgment. In the first instance, practical ways of overcoming barriers and enhancing opportunities must be negotiated between citizens and experts. This will involve an appreciation of the different, but complementary skills of each group. In the second instance, attitudinal change is required and will involve a deeper understanding of community-based research and the motivations that underpin citizen science. It will also require acceptance of a broader definition of research, a redefinition of successful research, acceptance of a wider range of viewpoints and research outcomes, and a demonstration of the benefits to each group and society as a whole.

Experience of community-based research and influences on future interaction

- Citizen/expert interactions to date cover a wide range of issues and projects and this is likely to continue. However, likelihood of future interaction can be maximised with regard to several features of participation. Citizens and experts must enter the research setting as co-researchers. This means that citizens and experts much perceive each other as equals and be prepared demonstrate this fact in practice. One of the best ways to achieve this is for expert scientists to assist the research process so that data can be shared on a mutual basis and utilised in decision-making. Certainly, neither citizens nor experts have time or funds to waste. This also has wider implications in terms of reassessing job descriptions and funding allocations.

- It is common for experts to discredit or disregard community information because it does not always meet the requirements of expert research. This misses the point that quality community-based research is different from expert research, but still valid. Thus, it is misleading to assess community research with the same criteria as expert research and inappropriate to disregard community data on this basis. Therefore, all participants should have an equal opportunity to contribute to the research process in a manner that optimises their unique abilities.

Citizen/expert dichotomy and collaborative contribution to catchment and community health

- Variability among community groups is well recognised and many experts view this as a significant limiting factor in community involvement in research. These experts do not mention variability among expert scientists. This implies a double standard and the need to recognise of the advantages of variability. For example, increased resilience, flexibility and a host of auxiliary research outcomes.

- Such variability can also be used to question the validity of a citizen/expert dichotomy in research, whereby successful research demands the input of both groups. Therefore, variability should be embraced in participation and citizen science as unpredictability is in adaptive management. Where it is a strength it should be emphasised, where it is a liability it should be acknowledged and reassessed.

- The strength of citizen science lies not only in trend-indicative research, but also in a contribution to the community as a whole. For example, citizen scientists can collect valid catchment data with an intensity, and on a scale, unobtainable by expert scientists alone. However, by using a community network that is *linked to expert assistance* to conduct such research, community-based research can also empower communities, increase the local relevance and ownership of research, lend support to information gathered by experts and result in improved environmental management.

Chapter 6

CITIZEN & EXPERT EXPERIENCES OF CBR
LEARNING FROM A MULTI-SITE CASE STUDY

6.1 INTRODUCTION

This chapter builds upon the literature review and survey components of this study reported in previous chapters to provide an experiential perspective of the issues raised thus far. It does this through a qualitative case study of the research being undertaken by several community groups, which accords with the slogan 'think globally, act locally' introduced in Chapter 1. Thus, while the literature review and survey represent the global or broader context within which this study is located, the case study reported in this chapter represents the more local and personal aspect as I attend to the voices of actual participants in community-based research.

This case study examines the complexities of citizen participation in catchment research and management in South East Queensland, Australia. It concentrates on the initiation of community-based research projects, the motivations that underpin citizen and expert involvement, the research tasks undertaken, and community group skills and support that were involved. It also examines the attitudes to community-based research projects held by scientists and agency professionals and other opportunities and constraints faced by community groups. Finally it assesses the factors that influence the sustainability of community-based research projects and identifies the social and environmental outcomes of this form of research.

The multi-site case study is situated in a diverse urban-rural catchment context where an integrated research program was established for natural resource management agencies to work with each other and community groups to develop research protocols so that community groups could participate in assessing the health of estuarine areas. This involved scientists, natural resource managers and community education/extension officers working with established community groups to develop and trial modified scientific methods for the environmental monitoring of catchment and estuarine areas. This enabled a longitudinal study of the citizen/expert interactions through participant observation in the field and later through expert reflection in a series of interviews throughout the project. Data from my investigation of this project is referred to as 'Site 1' in this report.

As explained in Chapter 3, I also spent extended periods of time with two community groups involved in the inter-agency/community project to strengthen my understanding of the daily process of community-based research. These groups were chosen in a snowballing manner from the initial project as they represented two well-established groups with a strong focus on water quality research. In addition, they are widely regarded as two of the most successful groups within South East Queensland. These two groups are referred to as 'Site 2' and 'Site 3' in this report.

Reporting on the experiences of participants in the case study is a sensitive issue as community-based catchment research and management reflect serious environmental issues and often involve very personal experiences and responses. For example, some community groups are challenging major industries and developers over environmental issues that will ultimately result in court proceedings. Other participants have openly expressed views that are inconsistent with, or that challenge, agency or group policy. In addition, several participants expressed a very deep and emotional attachment to nature that they felt would be ridiculed by some sectors of society. This account uses extracts from interviews with study participants as much as possible in order to preserve the richness of these personal views and experiences. However, to maintain the anonymity of those concerned, I have identified them only as either ‘expert’ or ‘citizen’ participants with relevant information on participants provided by noting the case study site (eg 'Citizen A/Site 1' or 'Expert C/Site 1').

6.2 COMMUNITY-BASED CATCHMENT RESEARCH IN QUEENSLAND: A MULTI-SITE CASE STUDY

6.2.1 The Sites

The three sites for the case study are located within Queensland - one of the fastest growing States in Australia with an annual population increase of 61,000 or 1.7%. The case study sites are located in the south-east corner of the State where the largest population increases have occurred. For example, Brisbane and Gold Coast grew by 17,200 and 13,000, respectively, in 2000-2001 while Maroochy and Pine River shires also recorded significant percentage population gains (Australian Bureau of Statistics 2002). Indeed, the Australian Bureau of Statistics (ABS) reports that Australians are increasingly drawn to inner city and coastal living (ABS 2002). Certainly, the popularity of this region relates to its warm climate, rich flora and fauna, vast coastline, relaxed lifestyle and a seemingly endless number of sunny days. However, the rapid population growth rate threatens this relaxed lifestyle and places ever-increasing demands on scarce water supplies. From the catchment headwaters through the estuaries and out to the sea, there is growing concern over the quality and quantity of the water and natural amenities of this sub-tropical region.

Queensland Waterwatch groups and State Natural Resource Management agencies (see Chapter 4) all concentrate on community-wide projects to remediate the negative social and environmental impacts that arise through a decline in water quality. Increasingly, there is recognition on all sides that a collaborative approach is needed to achieve long-term, sustainable outcomes. Indeed, several case study participants stated:

> No matter what the community does, if really big industries don't start to do something and take responsibility as well, we'll never get anywhere. *Expert A/Site 1.*
>
> I think it's a whole society responsibility. That's my personal view. I think the latest things I've been involved with such as ICM…give me a clear indication that the responsibility is society-wide. The governments can't do anything on their current budgets to try and reverse some of the degradation of the environment that is the current status. *Expert E/Site 1.*

In light of the value of an integrated approach with the community, the Queensland Department of Natural Resources and Mines (DNRM) [host agency to Waterwatch Queensland], the Environmental Protection Agency (EPA) and the Department of Primary

Industries (DPI) have attempted to work with community groups on various research projects that concern water quality and ecosystem sustainability. This is where Site 1 is located - at the centre of an inter-agency project to conduct research with established community groups.

This community/agency project arose from catchment monitoring needs identified by interested community groups and several staff in government agencies. While the goal of the project was to model participatory research, it has been largely agency-directed because of institutional constraints imposed by the broad geographical scale of Queensland and the level of funding (only one project officer). Thus, its organisational structure is hierarchical, linear and based on committees and individuals that have specific tasks and responsibilities (see Figure 6.1).

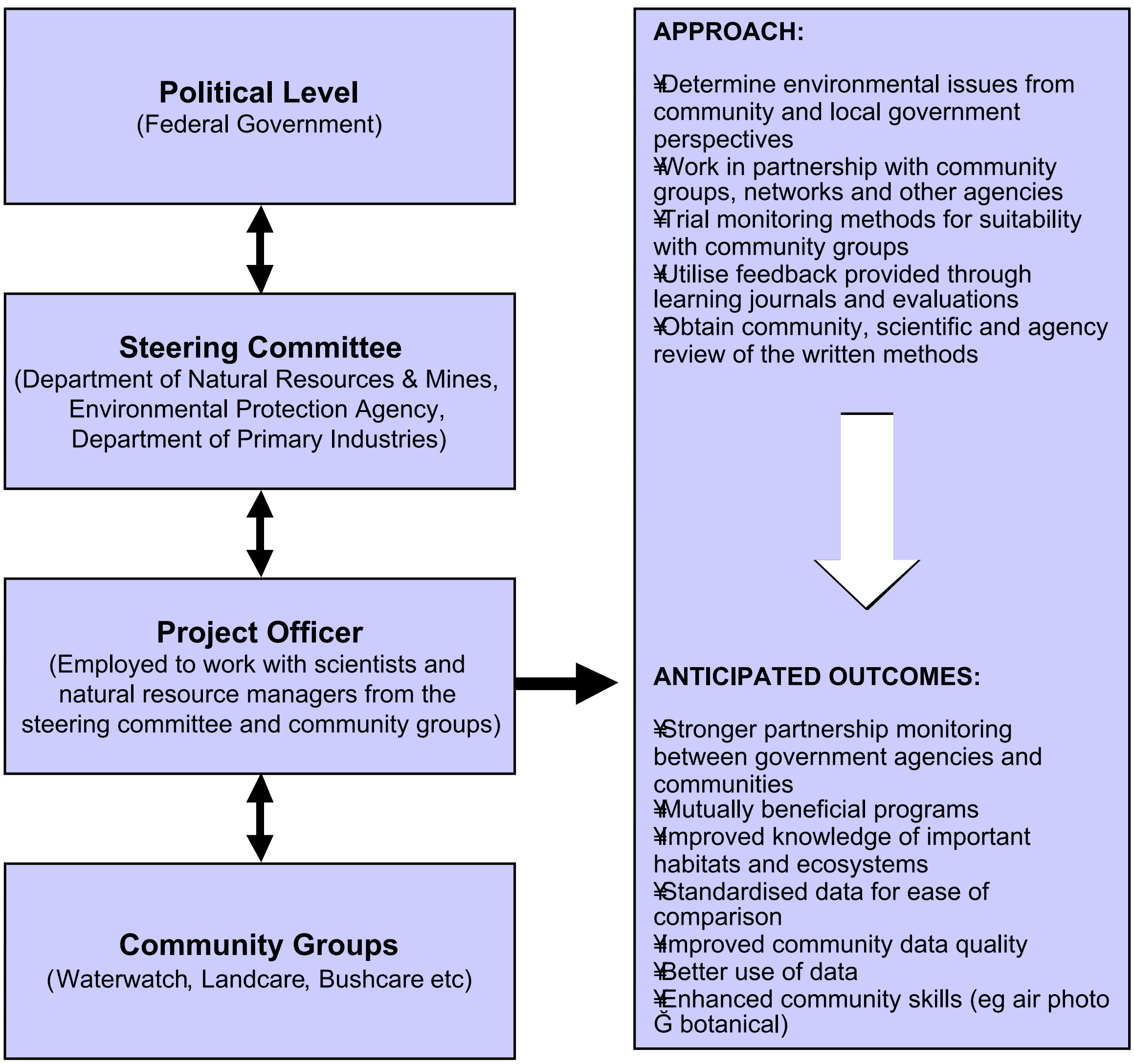


Figure 6.1 Agency-led community project organisational structure

Consistent with many community projects, the Commonwealth (national) Government provided funding through the Natural Heritage Trust. While one expert participant described the Commonwealth role as 'bean counters', in this instance it was the Commonwealth Government that first saw synergies between the different State agency proposals and elected to provide funding only for an inter-agency project. One agency expert described the formation of the project and the rationale for collaboration:

> The impetus came from Waterwatch in its very early establishment in terms of the need for this process to occur… we developed the application on behalf of the Waterwatch Queensland Steering Committee two and a half years ago. At the same time DPI Fisheries had developed a similar proposal. The State Assessment Panel for Coast and Clean Seas said, "We like these projects – put them together". So we put them together and all resubmitted through the State Assessment Panel - a single project, which was a far better idea than DPI running one and Waterwatch running the other. This has led to the impetus that DPI have been invited to become part of the steering committee for Waterwatch Queensland, which makes it now genuinely cross-agency and cross community. So the need had been expressed some time ago. The foresight of the coordinator at the time saw the opportunity to be met through this project and then there were the two projects (DPI's and ours) that were brought together into a single project, with a steering group consisting of EPA, DNR and DPI. *Expert B/Site 1.*

The Steering Committee comprising representatives from all three agencies directed the project, oversaw research direction, fulfilled Federal Government Reporting requirements and provided scientific and managerial support to the Project Officer. It was the Project Officer's role to work with the Steering Committee, scientific advisers and also community groups in achieving the project goals. As Figure 6.1 illustrates, the Project Officer was the primary, and in many instances, the only point of contact between agency experts and community groups. The project officer, in particular, had much previous experience working with community groups and was very skilled in working with community members and explaining scientific concepts to those without a scientific background or expertise in monitoring.

Sites 2 and 3 are located within two well-established community environmental groups that were involved in the research project described for Site 1. Similar to the agency/scientific approach, the community groups have a management or executive committee to oversee group direction and a coordinator to work with the volunteers and organise various projects or to assist project officers. However, in contrast to the organisational structure adopted by agencies, community groups are much less structured and include a greater range of participants in their approach to research (see Figure 6.2).

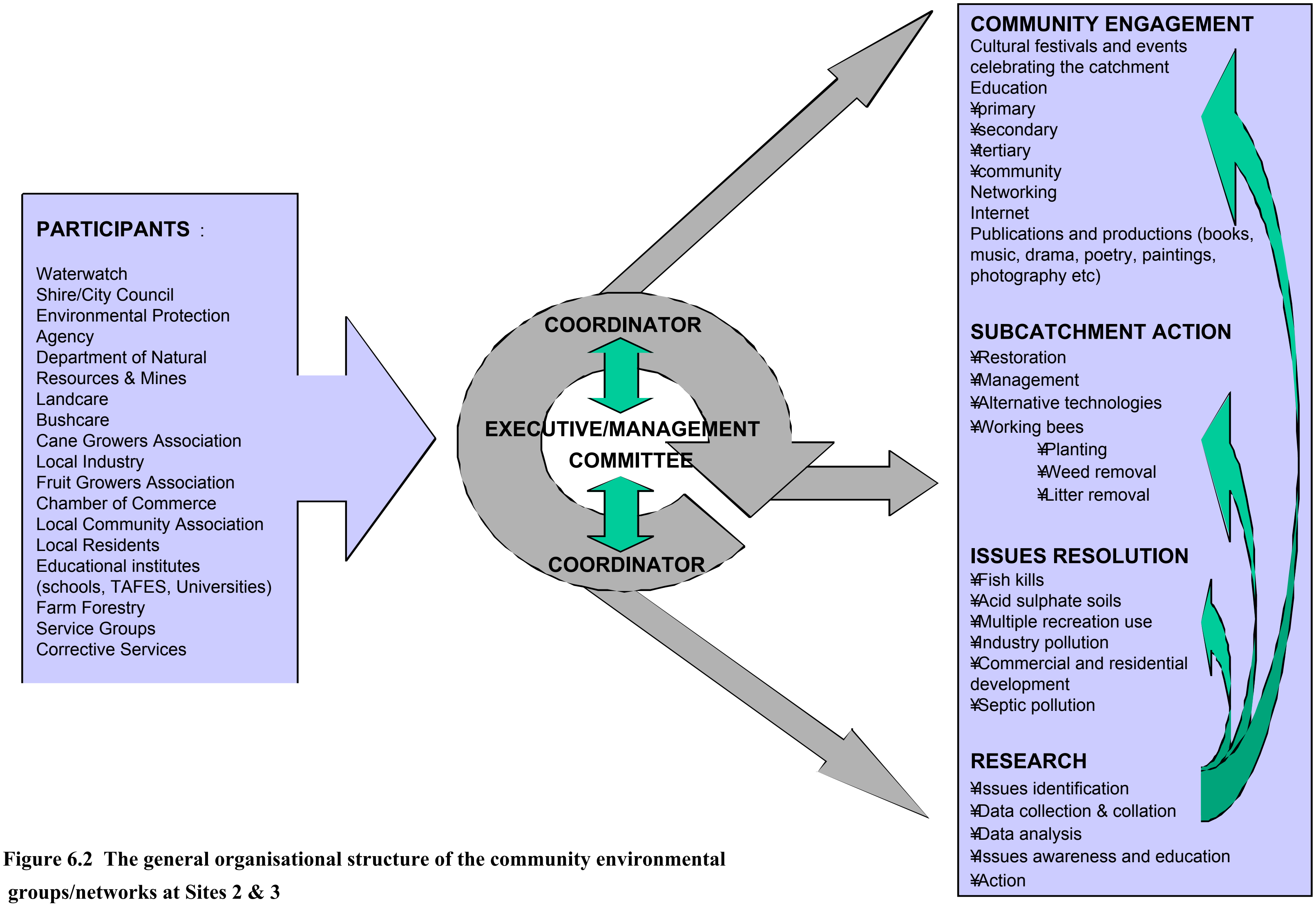


Figure 6.2 The general organisational structure of the community environmental groups/networks at Sites 2 & 3

Indeed, one citizen participant stated that the community group operated on what this person described as a 'disorganised unity basis':

> The community-type outfits here work best from my observation on a disorganised unity basis. In other words, they create growth from their disorganisation. If you try to make them clinically clean, people would lose interest. It's like a rolling river and everything just goes together and expands and contracts and expands and contracts - it gives it all its ideas and flows and thoughts, which is totally at odds to where I've come from - so it's a different culture. *Citizen H/Site 3.*

Consistent with this view of community group projects as naturally evolving entities, one citizen participant spoke of the importance of openness and networking and the sometimes-surprising results that are achieved:

> Once you are out there and you express your interest and you place yourself in those places where you can contact people and people can contact you, then a lot of it just seems to snowball. If you've got that understanding that networking is so important and you really enjoy doing that and you situate yourself for that to happen, then that just seems to be such a natural thing that it happens. That to me is the wonder and splendour of how things move along in a project or in a group situation. At the beginning of it, you could never predict what was going to happen, but when you have that sort of openness and that willingness to make the connections - I guess it is like planting seeds in a garden, all these things sort of spring up unexpectedly. *Citizen M/Site 3.*

The wide range of participants is illustrated in Figure 6.2. However, at both Sites 2 & 3 the community members felt that it was important not to get too 'big and uncontrolled'. For example:

> It's a matter of not getting too big too quickly. I always believe the slower you grow the better. You're around for longer if you grow slowly and evolve with really good grassroots. Because we haven't sought huge funding early on and bitten off more than we could chew, we've actually managed to keep a handle on everything and to grow as the energy is there rather than forcing the energy to come. Always the right people walk in at the right time, it just always happens. *Citizen G/Site 3.*

Indeed, they preferred to 'maintain a friendly atmosphere and keep operations lean in order to do a small number of things well'. They also believed that it was also important that people were not expected to participate beyond their physical abilities.

The collective organisational structure depicted in Figure 6.2 represents a vital feature of the community groups at Sites 2 and 3. Physically, the group provides a 'mutual meeting place' that facilitates open and honest communication between all participants. One group member described the importance of maintaining meaningful relationships and experiences in volunteer networks:

> In volunteer organisations the relationship is and must be very different to those in paid employment. People are no-longer working for monetary rewards, but rather the rewards are found in the experiences and the relationships that occur. *Citizen G/Site 3.*

In addition, one citizen highlighted the necessarily long-term view taken by participants in community groups:

> The community-based outfit has to take very much a long-term view, because nothing is immediate, it's more a matter of three steps forward two steps back. If you were to try and measure that against any other yardstick you'd be disappointed. It's a bit like growing a tree, you plant 6 trees 5 might survive and 1 might die, but that's not is not the end of the world. With the other 5 you have to be very patient and very nurturing to let them grow and it takes a number of years before you can see the results. So you have to be a very patient person and take a long-term view of things if you want to get the most out of your association with an environmental outfit like Waterwatch. *Citizen H/Site 3.*

Certainly, Figure 6.2 lists some of the more tangible processes and outcomes of this organisational framework, which is emerging as a long-term and networked approach with many diverse participants and outcomes.

The remainder of this chapter utilises information from these three sites to build a detailed picture of community-based research in action. I begin by presenting the general perceptions held by citizens and experts in the three sites of the pressures on water-quality and where they believed responsibility for environmental degradation and remediation to lie (Section 6.3). Section 6.4 explores the sources of motivation for those involved in community-based research. Section 6.5 details the range of activities and approach to research undertaken by community participants in catchment research and management. Section 6.6 explores the opportunities and constraints faced by community groups that undertake catchment research. Finally, Section 6.7 discusses both the social and environmental outcomes of community-based research and how success is defined in this form of research.

6.3 CATCHMENT HEALTH: PERCEPTIONS OF PRESSURES AND RESPONSIBILITIES

A concern for catchment health and a desire to address the pressures on catchment systems are integral to the rationale underpinning community-based catchment research. This concern was based upon an understanding of the human causes of catchment problems. Indeed, there was a strong feeling among project participants at all three case study sites that the actions of people are the principal cause of all problems - social and environmental - with catchment and ecosystem degradation being no exception. For example:

> It's humans that are the problem – nothing else. All the problems in the world are caused by humans – either directly or indirectly. *Expert B/Site 1.*

For one expert respondent population size was the cause of most detrimental impacts:

> The major pressures? Well human impacts basically, human pressures - too many people. *Expert E/Site 1.*

There was no expressed understanding of the relationship between different lifestyle choices and technologies in this view of population numbers as the cause of human impact. Citizen participants also agreed that 'urban pressures are enormous'. However, as one citizen pointed out, it is our continued disrespect for the catchment that is most destructive:

> It's our historical attitude towards the river - one of general cultural disrespect. It started to be treated like a drain and it has continued to be treated like a drain. *Citizen G/Site 3.*

By taking a historical perspective, this person considered that you could not just blame the developers or the farmers of today because their actions represent a prevailing attitude with much earlier origins. Similarly, expert respondents attributed blame for environmental degradation in a very general manner, not distinguishing between the activities and impacts of different sectors of society. Distinctions within the community only appeared when levels of environmental awareness and active interest in environmental remediation were considered. For example, people concerned about the environment were regarded as a minority group by expert scientists and only a small sector of society was considered to be actively interested in environmental quality. These sentiments were summarised by one expert participant:

> It's just people in general. We place all the pressure on ecosystem resources with everything that we do. I still think there is a majority of the population that still have no idea about their impact. I don't really think that any programs have reached the broader public, other than interested individuals. You do get to a certain amount through schools, events and community-based field days etc. But the majority of people who live their life day to day - I don't think that we've had a huge effect. *Expert A/Site 1.*

The main reason for such environmental apathy was attributed to an over-reliance on Government and science and a corresponding lack of individual responsibility and self-awareness such that many people are simply unaware of their individual impacts. For several participants this attitude appeared to stem from the historical role of government as 'paternalistic' and an 'unrealistic citizen expectation of what taxes buy':

> They just think that Government and science will solve their problems for them and that if they put this in the drain that it will get cleaned up anyway. They don't see all the links - they don't even think about it. They say "well I'm paying for it so I might as well put it in the drain anyway." I don't know how you change all of those people. *Expert A/Site 1.*

> A lot of people say 'I pay my taxes'. I think there's an unrealistic expectation of what the taxes buy. *Expert B/Site1.*

Indeed, one expert participant felt that community responsibility was accommodated through the political process and resulted in representative positions where such responsibility was assigned as part of a government agency's role:

> I guess the community has a responsibility for everything that happens in society. This is just one small element of it. No more or less than they might care about child abuse or poker machines or whatever it might be. It is all part of the political process. The only reason I'm sitting here [in a scientific monitoring division of a government department] is the political pressure for protection of the environment. Otherwise the Government wouldn't put any dollars into it. *Expert C/Site1.*

By way of contrast, some experts and citizens articulated the need for a much more participatory conception of governance and the political process. Consistent with the view that environmental degradation is caused by everyone, they considered that environmental health was the responsibility of everyone. To this end, these respondents felt that the role of Government was changing. For example:

> Everybody is responsible for ecosystem health. Some members of the community would say Government and that's traditionally been the paradigm from which people have been working, but that's changing. Communities are wanting to have a say…That paternalistic role of Government has changed and will change even further. It will be budget-driven and with the realisation that

> Government can't solve problems... The role of Government is changing quite dramatically and it will be a Government that sets standards and it will be a Government that maybe facilitates outcomes rather than actually being the sole provider. That's a hard road for people to take. *Expert B/Site1.*

Some citizens interpreted the 'don't care' attitude of many members of the public as a form of political despondency caused by low levels of community confidence in the efficacy of their political representatives and political processes more generally. Consistent with some experts, many citizen participants felt that increased public participation was necessary to overcome such apathy towards environmental issues and the current political processes to solve them. These citizens argued the urgent need for the community to take a much more active or participatory role in both policy decisions and on-the-ground works:

> One of the things about Australians is that they are politically despondent. We say that the politicians aren't going to do anything, but until we hector and badger them of course they won't, because they don't know what we want done. We don't write to our politician the way we should, they can only go to so many meetings to try and gauge our feelings. *Citizen C/Site 2.*

> We're planting trees here while someone else is bulldozing them somewhere else. We're fighting a losing battle here. Someone has got to do something - not just throw their hands up in the air. *Citizen D/Site 2.*

6.3.1 Summary

Both citizens and experts believed that people are the major cause of environmental degradation. For some this was through population growth; for some it represented a general cultural disrespect for natural environments; for others it was through lack of environmental awareness and an over-reliance on Government and science. Consequently, the responsibility for reversing such degradation was considered to be society-wide. There appear to be two perceptions of how such societal responsibility may be enacted. The first is through the political process whereby political pressure from the community can ensure that experts are funded to hold positions of responsibility. The second is through collective action both by and on behalf of the community, industry, Government and scientists. The following sections build upon the notion of collective responsibility and action towards catchment health and how this is influenced by the emerging tussle between representative and participatory forms of democracy.

6.4 INVOLVEMENT IN COMMUNITY-BASED RESEARCH: CITIZEN AND EXPERT MOTIVATIONS

This section analyses the range of ways in which community-based research projects are initiated and the motivations that underpin participation in these projects from both the citizen and expert perspective. These motivations are significant because they influence the approach to catchment research undertaken, the types of citizen/expert interactions that occur, and the outcomes that accrue from this form of research. An understanding of citizen scientist motivations is also significant as they help explain why only a small section of this population is prepared to take action on issues that the previous section deemed to be the responsibility of society as a whole. Indeed, understanding the influences on this active community sector could be instrumental in expanding citizen participation in important catchment and other natural resource management activities. Similarly, understanding the motivations of expert scientists may reveal additional incentives for encouraging collaborative research.

6.4.1 Expert motivations

Expert scientists and agency representatives were motivated to involve citizens in natural resource management for two main reasons. The first is that they viewed current approaches to natural resource management as less effective than they could be. Related to this, the second is that they believed commitment from the wider community to be vital in achieving ecological sustainability. Aspects of these two views are summarised in Table 6.1 which shows that experts were driven by a desire to change current natural resource management processes towards more effective approaches that necessarily involved the wider community. Indeed, the following two comments are quite representative of this group:

> We're told it's time to change business as usual. We can't keep on doing business as usual because future use of our estuarine and coastal resources will be unsustainable. How you communicate that to the wider community and get them to adopt on their own/voluntarily a charter of change is a major difficulty. *Expert E/Site 1.*
>
> There are a lot of environmental issues that can't be solved by legislation and we have to rely on peer pressure in the community. *Expert B/Site 1.*

Despite the strength of this view, widespread community commitment to sustainability was identified as a major challenge to natural resource management:

> An essential question is how to address the lack of commitment by the wider community. [This is] not just a question for me, but the whole natural resource management framework!! *Expert E/Site 1.*

> To get the majority to take it up is the hard bit… it's society as a whole - it's got to permeate through society and that takes time. *Expert B/Site 1.*

In this context, community-based research was viewed as one more approach towards societal change:

> Every little bit helps to push people. There is no one magic thing. You have to keep hacking away at it, until you make a difference. *Expert B/Site 1.*

However, experts identified several reasons why they sought to involve the community specifically in catchment research. These motivations included: (i) a belief in the potential of community monitoring; (ii) value-adding to existing community activities; (iii) increased ability to conduct more intensive research on a greater scale; (iv) increased access to local knowledge and contextual information; (v) direction and increased support for expert research activities; (vi) increased access to funding; and (vii) high levels of community interest.

First, they believed in the potential or value of community participants and their monitoring data as a 'great resource'. For example:

> We could see some use or potential in getting Waterwatch groups to do some monitoring. I've had experience with Waterwatch for a number of years. The other part is the fact that I'm involved with my own job in monitoring – so I'm very much involved in that whole area. *Expert C/Site 1.*

> There are some highly skilled people in the community and highly driven people who are capable of a lot of things and are willing to do it for nothing. It's a great resource to have. *Expert D/Site 1.*

Certainly, they acknowledged that community participants in environmental groups are often highly skilled and knowledgeable in scientific methods:

> What we don't realise that is within these groups are people like ourselves that are also community volunteers. Some of our groups have retired scientists in them and industrial chemists. *Expert A/Site 1.*

> Remember that the community is us. Particularly within the coastal area, there is a lot of knowledge and skills and it's a case of tapping and harnessing it and supporting where is it, but not presuming anything. *Expert B/Site 1.*

For others, the value resides in their potential to add to what community groups are already undertaking:

> To make use of the fact they are already out there -just value adding to what they are doing - and it costs virtually nothing. *Expert C/Site 1.*

> We weren't looking so much to expand on the education side of things, but rather to include groups in a process where they felt that their data was having more value than sitting on an excel spreadsheet or a database and not being used for management purposes. *Expert E/Site 1.*

> It's widening the suite of tools available for communities to be genuine participants in environmental monitoring. *Expert B/Site 1.*

Other experts were motivated by the benefits of access to the data collected by community groups and the enhanced opportunities for conducting broad-spectrum monitoring through an increase in the number of monitored sites. By using local community members to monitor the environment, experts considered that both the 'manpower' available to collect data and also the efficiency with which it is collected could be increased. For example:

> If we want to do fairly broad, wide-spectrum monitoring (the Government can never do that anyway) you really have to involve the local people to do it. It's really a question of manpower…From where I'm sitting (in a scientific group within a Government Agency) I'm particularly interested in getting group data out of it, because then we can report on the state of the environment with that data. If we could get 500 sites instead of 50 sites monitored, it's obviously going to give us a much better basis for making statements about how our waterways are going. *Expert C/Site 1.*

> Research organisations or government departments just don't have the resources to get in there and monitor all these areas. If you use the community who know the area and places to go, there is potential to get in there and have a look. *Expert D/Site 1.*

In addition, one expert considered that community members have a unique ability to provide contextual information beyond the data that are currently collected:

> The positive side is that there are people who have lived in the area if not for all, a lot of their life and they know the area well. They know the issues well and with a bit of training they can be sent out to collect valuable things (providing they've got the interest and they've got some sort of goal or are getting something out of the program). *Expert D/Site 1.*

> I think there's data, but there's also information. Society has been saying for too long that we seem to collect a lot of data and little information. Maybe that is something that community monitoring can start to gather - more information. *Expert D/Site 1.*

Consequently, community data was also valued as a source of support for expert research. For example:

> We're looking more broadly to embrace the data that might be collected by community groups or by industries and the broader community in general. If there's information out there that can lend support or we can use for reporting on fisheries habitats in the long term, that's what we're after. *Expert E/Site 1.*

Expert scientists felt they could use community data in two main ways. The first was as background, trend or indicative data to help focus or provide direction for further expert research. The second was to validate or support existing scientific data. These points are highlighted in the following quotation:

> I think there's probably a couple of levels that we can use such information: background information to help identify where the gaps are or where the main work and focus has been and, secondly, to validate some of the more scientific data that's out there (looking at specific questions regarding habitat or resources). *Expert E/Site 1.*

In addition, one expert participant felt that community participation was a good way to show the 'public good' aspect of research that is required for accessing increasingly scarce funding:

> The Government dollars for monitoring for everything are shrinking and being taken away… If you're being purely pragmatic about it, to get funding without some sort of community involvement is pretty hard these days, if there isn't some public good component or angle to it. Having community groups is a good way of achieving that. *Expert C/Site 1.*

Interestingly, however, one factor overrode all of these perceived benefits in importance in the minds of expert researchers who had previous experience with Waterwatch groups and even those recently acquainted with them through the joint agency project. Consistently, these scientists said that they were motivated to continue their involvement because of the high levels of community interest. As one stated:

> The community is interested anyway – you couldn't even think about doing this project if the community weren't interested in doing it. *Expert C/Site 1.*

This section has summarised the motivations that underpin expert participation in natural resource management and community-based research. The interviews in this case study indicate that experts believe that changes are necessary to current natural resource management practices because a whole of community approach is vital to achieving sustainability. However, widespread community commitment is a major challenge with experts stating that no one approach is sufficient to reach all community sectors. Community-based research was viewed as one important approach with several features that make it attractive to experts seeking enhanced environmental monitoring capabilities and access to local knowledge (see Table 6.1).

Table 6.1 Expert motivations for involvement in community-based research

Sources of Expert Motivation	Example of Motivation for Involvement in Community-based Research
Recognition of community interest	*The community is interested anyway.*
Belief in the potential of community monitoring	*We could see some use or potential.*
Value-adding to existing community activities	*Value-adding to what they are doing.*
Increased ability to monitor at a greater scale and intensity	*We could get 500 sites instead of 50 sites monitored.*
Increased access to local knowledge and contextual information	*They know the area well. They know the issues well.*
Increased context for expert research activities	*Background information to help identify where the gaps are.*
Increased support for expert research activities	*To validate some of the more scientific data that's out there.*
Increased access to funding	*To get funding without some sort of community involvement is pretty hard.*

6.4.2 *Citizen motivations*

Interviews with community members in the three study sites revealed a wide variety of motivations underpinning community interest and participation in catchment research and management. These motivations included: (i) general environmental interest; (ii) local environmental concern; (iii) a desire to take environmental action; (iv) a previous or desired environmental vocation; (v) a desire for environmental skills and knowledge; (vi) a spiritual connection to the local environment and community; (vii) concern for fellow and future community members; (viii) the need to promote connections between government, industry and community; and (ix) the desire to undertake voluntary activities for personal fulfilment especially social connection. It is important to note that in many instances these guiding motivations were often coupled with an opportunity (for example retirement, redundancy, study, and financial assistance) before these motivations were translated into active participation.

The first source of motivation expressed by many citizen participants was a general environmental concern and ethic rather than an attachment to a specific place or interest in a particular issue. For example:

> Making lots of money is not my priority in life – it's like doing lots of things and getting involved. My focus is on being able to contribute to saving the environment. *Citizen F/Site 2.*

As noted in the introduction, only a change in lifestyle (eg redundancy) had enabled many participants to act upon these environmental interests:

> I've always been interested in nature, wildlife and that sort of thing. When I was retrenched from work I was very much at a loose end and I needed to find something to fill my days. I did this through volunteering Queensland…This one just appealed…and I've been here ever since. *Citizen C/Site 2.*

One sub-group of people were obliged to participate in voluntary work as a condition for receiving a government stipend or another kind of financial benefit.[13] However it is important to note that in these instances environmental interest still determined the field of 'voluntary' work and often resulted in voluntary participation beyond any financial requirements. Thus:

> It's people working together with a common love for nature – it's like everyone cares. Everyone is here because they care. The ones who are here because they are forced to be by Centrelink or whatever – they don't last very long. You see them come and go – the ones who care about it stay. *Citizen F/Site 2.*

> I had to do voluntary work and I had to pick something so I thought I might as well pick something that interests me. I have always been interested in wildlife, that's why I picked this and I quite enjoy it. I had already done a lot of water testing previously, but a different type. So I saw this and thought I'd be into that. It all ties in with the environment anyway, that's the reason I started, but now that I don't really have to this any more. I'm on a pension, but I still like to do as much as I can because I enjoy doing it – whenever I can spare the time. *Citizen D/Site 2.*

The second source of citizen motivation is a response to a specific local issue similar to the impetus for the infamous cases of Love Canal and Woburn.[14] In these instances community members are faced directly with a reduction in the quality of the local environment. Some are seeking proof to force mitigation of the impacts and others wish to use the results of research to improve their own and other's understanding of the issue. Certainly, many of the following participants mention problems literally on their back doorsteps:

> A creek runs through the property that we live on and I guess that is one of the main reasons – having it right on our doorstep. We're actually up fairly high in the headwaters, while there are some issues there, it's pretty natural through our

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[13] These participants were usually part of the Voluntary Work Initiative, Youth Allowance or Newstart programs run by Centrelink. People in these programs can choose to undertake volunteer work for a not-for-profit organisation instead of looking for paid work or as a means of fulfilling the mutual obligations initiative. See the Centrelink website: http://www.govolunteer.com.au/volunteer/content/centrelink.htm for more details.

[14] Love Canal, New York (1979) and Woburn, Massachusetts (1981) are the sites of the most publicised instances of civil action against toxic contamination and subsequent community health risks within the United States.

> part, but I can recognise some other problems as you go further down. *Citizen M/Site 3.*

Two conversations with group participants in the field illustrate the significance of local issues as a source of motivation. The first was with a retired couple who had recently moved into the local area. They arrived at the Waterwatch shopfront with their first set of monitoring results and a water-testing kit. They told me that their concern was for the quality of the water running through their property that was deteriorating following their neighbour damming the river upstream (Participant observation/Day 1/Site 3). The second conversation was with one of the citizen participants at a monitoring trial. She stated that she had become involved after a mangrove tree outside a local restaurant had been chopped down because someone felt it was spoiling the sea view. This participant felt that the tree was a significant local feature and that it should not have been cut down. As a result of this local issue, she now wanted to learn more about mangroves and contribute to their preservation (Participant observation/Day 2/Site 1).

A third source of motivation was the desire to do something *active* in promoting environmental health and to translate awareness, policy, previous training and/or experience into action. For example:

> The thought that in the end we are making a difference, because we're not policy makers and we're not up there deciding what is going to happen. We are actually out there doing it. Actually implementing their policies and trying to wind our way through the legalities of trying to get integrated catchment management. *Citizen B/Site2.*

The fourth source of motivation was previous vocational experience with environmental issues or water quality testing and a desire to continue or rekindle this previous interest:

> I'm recently retired from an academic background in agriculture and community development. I was particularly interested to get into something that was about the community and with an agriculture/environmental background. *Citizen L/Site 3.*
>
> I went to Volunteering Queensland…and there was water quality testing. I used to work for the Water Resources Department in the Northern Territory doing microbiological testing of the water supply and also out in the field sampling. *Citizen F/Site 2.*
>
> My background is Environmental Education. So I was looking for a way to express that. I've always had the idea that catchment care would be a really interesting area to get into. It integrates so many different aspects, networking of different stakeholders and it encompasses a lot of different aspects of the environment within it. So while I didn't always consciously realise that that was

> what I wanted to do - it had always been a very strong interest in the back of my mind. *Citizen M/Site 3.*

Like many others, this person's professional background meant that she was able to respond to the encouragement and opportunity provided by the group coordinator. She went on to say that:

> I thought I'd just drop in and get to know what is happening here and get to know Waterwatch and I met [the coordinator]. Really through their encouragement and making the connection between my interest and what was possibly needed on the Creek that connection was made. *Citizen M/Site 3.*

By way of contrast, the vocations of other citizen researchers meant that they were often seeking a chance to do something 'different in their lives'. For example:

> Because I work in that all week I don't want to do that in my spare time. I want to go and do something else that I don't get a chance to do. If I went to a group, I don't want to bring that work life to a group…I want to do something completely different. *Expert A/Site 1.*

> After 30-odd years in the finance industry, I wanted to get as far away from that as possible so I got in touch with Volunteering Queensland on the Internet. *Citizen H/Site 3.*

The fifth source of citizen motivation was the desire to learn new skills and knowledge that enabled participants to be effective community members whatever community they might find themselves in:

> My plan in the next couple of years is to move to country, because I've always lived in the city…go out and live in the bush. I want to be able to take skills with me there and be able to be an effective member of whatever community I am living in. I want to be able to be an effective member of the local Landcare group or implement strategies to start saving, or regeneration, or whatever needs to be done. Wherever I go, I want to be able to be a part of it in an informed way and a knowledgeable way. *Citizen F/Site 2.*

Certainly, community environmental groups were considered great places to learn about environmental interests, gain new skills, meet new people and make contacts in the local area. Thus, while many people remain as constant members, many others use such groups as a transitional stepping stone and their participation is ephemeral in nature. Indeed:

> I find that you have a high turnover of people and that's mainly because of the society around them. If people are looking for work, they find this a good place to park themselves for a while until they can find something of a more permanent nature is what I observe. *Citizen H/Site 3.*

> I'm new to the area so I want to make some contacts in environmental work and hopefully in activities associated with river care, river rehabilitation and ultimately

> those contacts would lead me to some work. Just getting involved with the community and meeting some people. *Citizen N/Site 3.*

The sixth citizen motivation involved a deep spiritual connection to specific places, people and the native flora and fauna. One participant (Citizen P/Site 3) spoke of discovering a strong Aboriginal connection that inspired him to undertake restorative projects along the creek. This person spoke of being overwhelmed with sadness when finding the Mother Tree (a very old Blue Quandong of special significance to aboriginal people) standing with many of its branches broken and dead, but with a few still alive and producing seed:

> I just felt a lot of sadness for aboriginal people, for their loss of culture and loss of identity. In a way, when you see things like that it inspires you to work on healing. I got a message from that. It's like us when we have sadness it gives us a starting point to look for happiness. *Citizen P/Site 3.*

Like many others, this participant found that his restorative actions were healing towards both the creek and himself:

> I find it very healing - that's what I feel about this working down in the creek. I was put here to help the planet to heal and therefore heal myself. *Citizen P/Site 3.*

Consequently, many citizens spoke of the interconnectedness of all things and were optimistic about their ability to promote personal, community and environmental healing for the benefit of future generations. For example:

> There are always opportunities for making life better than what it is and that's what I hope we are doing down here. I feel as though my kids and grandchildren will be able to inherit something as least as good as what it was when I left. *Citizen P/Site 3.*

One participant felt that maintaining hope was the most important aspect in overcoming social and environmental degradation. Certainly, the connection between healthy communities and healthy streams and rivers motivated this person to work with both water and people:

> The water reflects so much about the human spirit and vice versa. So if we're going to have healthy communities and healthy minds, and really manifest what we want to manifest in terms of a cohesive community then we've got to look at the water and how it interacts with our spirit. The hope aspect is just so important - being able to have this office and share stories of hope and to see people's faces light up and see their despair lessen, that is probably the reason I exist. *Citizen G/Site 3.*

Such interconnectedness also related to the links between community, Government and industry. Therefore, this participant also spoke of being motivated by a desire to ensure that the connections between these parties were clear and honest to ensure the validity of all citizen efforts:

> It is really important that our data be valid and that it is worthwhile and that it can have a voice. They are my motivators - to give community members a voice as well as hope and to make that voice as open and honest as possible. *Citizen G/Site3.*

In addition, this person felt that it was important to maintain effective communication in the other direction - from Government and industry to community:

> To be a conduit in the other direction from Government, industry, through to community as well - to make sure that those channels are clear and that they don't get muddied and that they get facilitated so that the processes are as quick as possible. The communication channels are as quick as possible. So I see myself as not a filter, but a conduit. *Citizen G/Site3.*

The final source of motivation was a desire to undertake voluntary activities for personal fulfilment especially social connection. For one person this related to her sense of social responsibility and need for a sense of community:

> I decided to do volunteering because I've always thought that it would be a good thing to do and I hadn't done anything before. *Citizen F/Site 2.*

> It's been very valuable for me coming here. It's good for tapping into that feeling of community and working with people for a common goal and all that sort of stuff. Without payment - working for other reasons other than getting paid. *Citizen participant F/Site 2.*

Many people continued to participate for the joy of doing something with others that was both useful and fulfilling. These people considered that the quality of the social interactions and the conversations made it all worthwhile. Sometimes they talked about local issues and other times national or even global, but in every conversation there was something that someone was passionate about. One person stated that they had rarely felt such fulfilment in their previous occupations:

> Most people in their employment (particularly older people) are square pegs in round holes. I never really had the luxury of being employed in doing something that I was really interested in - it didn't happen. In my generation when you left school you grabbed any job that you could and you stuck to it. *Citizen C/Site 2.*

> I get a buzz of using the time that I don't really need to have at home profitably and even with some appreciation from others and have the warm fuzzy feeling that what I am doing is worthwhile - purely selfish on my part. *Citizen C/Site 2.*

Despite this wide range of motivations, a small number of expert researchers who had experience with several community groups expressed negative perceptions about the motivations of citizens on some projects. These experts believe that some citizens are motivated by a narrow desire for political power and attention rather than environmental or community issues. For example:

> There are some people who are looking for clout-like positions, and there are other people who just want to make a difference. Inevitably, those people are required and you'll see the same faces at a lot of community things. *Expert B/Site 1.*

> Sometimes people are motivated for the wrong reasons, deep green sort of people they get a bit difficult to handle – they get a little piece of information and rush off to the press. There has to be some basic consensus of role, otherwise it just gets out of hand and causes more problems...Some people use the environment as a political tool. They want to get in the press every week about some sort of environmental thing, which normally speaking isn't the way to solve things. *Expert C/Site 2.*

The motivations that underpin citizen participation in community-based research are summarised in Table 6.2. These are very personal motivations and consequently they are quite diverse. No citizens expressed the narrow desire for political power and attention that some experts had experienced with community group members. In contrast, the citizen motivations were often complex with some participants expressing several different sources of motivation coupled with an opportunity. However, there was an overriding desire to take collective action on behalf of the environment and in many instances this translated into concern for fellow and future community members.

Table 6.2 Citizen motivations for involvement in community-based research

Sources of Citizen Motivation	Example of Motivation for Involvement in Community-based Research
General environmental concern	*My focus is on being able to contribute to saving the environment.*
Local environmental concern	*That is one of the main reasons - having it [a polluted creek] right on our doorstep.*
Desire to take action towards environmental health	*Someone has got to do something - not just throw their hands up in the air.*
A previous or desired environmental vocation	*I want to make some contacts in environmental work.*
A desire for environmental skills and knowledge	*Wherever I go, I want to be able to be a part of it in an informed way and a knowledgeable way.*
A spiritual connection to the local environment and indigenous community	*When we have sadness, it gives us a starting point to look for happiness.*
Concern for fellow community members	*The most important thing is maintaining hope in humans.*
Concern for future generations	*I feel as though my kids and grandchildren will be able to inherit something.*
To facilitate communication between government, community and industry	*To give community members a voice.* *To be a conduit in the other direction from Government, industry, through to community as well.*
Personal fulfilment	*I never really had the luxury of being employed in doing something that I was really interested in - it didn't happen.*
Desire to undertake voluntary activities	*I have always thought that it [volunteering] would be a good thing to do.*
To develop social connections within a community	*Getting involved with the community and meeting some people.*

6.4.3 *Summary*

These results illustrate that both experts and citizens are motivated by a desire to achieve sustainability. However, when these groups work together in the manner of community-based research this overarching concern for sustainability is manifest in different ways. These ways might be said to be along a continuum from utilitarian to communitarian but linked by a conservation/environmental ethic. As Figure 6.3 shows most expert scientists in their vocational roles (as scientists and resource managers) tended to value community-based research in terms of the scientific and economic utility of citizen participation and data. Whereas many citizens tended to value an increase in their personal and collective capacity to make tangible differences to the quality of local environments and community well-being. This reflects a communitarian social and environmental ethic similar to O'Riordan's concept of ecocentrism (O'Riordan, 1981). It is important to note that this dichotomy is not representative of the personal philosophy of the experts involved, but rather that dictated or permissible in their roles as scientists and resource managers that work with diverse community groups often in areas far from their own community. One agency representative described this vocational constraint:

> It is true that those guys [expert scientists] have got one purpose and that is to monitor water quality to the best level of data confidence that they possibly can. It's not really their imperative to have communities involved or knowing about water quality and I think that's a bit remiss, but I understand that that's their job. *Expert A/Site 1.*

However, they acknowledged the beginnings of a culture shift within science as the number of people that see a role for community monitoring increases:

> Some of them are really good they are really trying to engage community people and work with them - but it would be like trying to make me into a scientist tomorrow! There is a huge big culture change in there and I think it's changing - even in the last couple of years - the number of people who at least acknowledge community as having a role in monitoring has changed. *Expert A/Site 1.*

Nonetheless, Figure 6.3 illustrates that expert scientists tend to frame sustainability in terms of natural resources while citizens make less of a distinction between 'the environment' and 'the community' and tend to view sustainability in much more holistic terms.

EXPERT MOTIVATIONS	Increased funding access More data More information (local/contextual) Validate scientific data Value-adding Community interest Desire to make changes towards sustainability
CITIZEN MOTIVATIONS	General environmental concern Local environmental concern Desire to take environmental action Environmental jobs (previous or desired) Environmental skills and knowledge (learning) Spiritual connection to environment and community Concern for fellow and future community members Desire to promote connections between government, community and industry Personal fulfilment Desire to undertake voluntary activities Social connections

UTILITARIANISM /VOCATIONAL

Economic

Scientific

ENVIRONMENTALISM

ECOCENTRISM

Participants/Activists

Self-reliance/Soft technologists

Deep environmentalists & spiritualists

COMMUNITARIANISM

Figure 6.3 Classification of motivations for involvement in research

6.5 COMMUNITY-BASED RESEARCH: APPROACH AND ACTIVITIES

This section analyses the range of community-based research activities undertaken by the groups in this case study. It is important to understand how these groups conduct research projects because the approaches to research they follow influences who participates, the type of activities that are undertaken and the outcomes that accrue. It also affects how these groups interact with their local environment, other community members, scientists and resource management agencies and institutions. The activities undertaken by each group in each catchment are different. However, the participants in this study believed that there were 'certain templates that you could use and certain things that you could learn from each other' (Citizen G/Site 3). Thus, this section presents what I and the participants in this case study have learned about approaches to community-based research.

6.5.1 A '*situation improvement cycle*'

Interviews with community members in the three study sites revealed active citizen participation in numerous catchment research projects with varying levels of expert assistance. The citizen approach to research in this case study was best described by one participant when he called it a 'situation improvement cycle'. It was community grounded and involved community participation throughout the entire research process. To understand this approach and how community participation can be achieved throughout the entire research process I asked group members how they conducted their catchment research projects. The following quotation illustrates how the community members I spoke to in this case study conceptualise catchment research:

> We talk about a situation improvement cycle rather than a problem-solving cycle, because problem solving tends to suggest that there is something wrong and that we are going to fix it and that will be the end of it. But that is not the case - it should be an ongoing process. *Citizen L/Site 3.*

Indeed, the community approach to catchment research was 'improvement' focused and necessarily 'on-going'. One participant (*Citizen L/Site 3)* described this approach to research using the issue of Platypus as an example. He explained that it involved four main questions asked within a continuous cycle of activity: (i) what is there; (ii) what does it mean; (iii) what will we do; and, (iv) how will we do it?

The first question concerns issue definition and asks - what is there? This stage involves 'taking stock and inventory of what the issue is about'. In this example, the group began literally with an 'around the table discussion' and decided that the issue they would research was declining Platypus numbers. Other issues that the community groups at Sites 2 and 3 have addressed include: fish kills; acid sulphate soils; multiple recreation use; industry pollution; commercial and residential development; septic pollution; and community awareness. Both citizens and experts saw bringing all concerned parties to the table and involving everyone from the start as a vital first step in community-based projects:

> If the community aren’t involved at the start, or represented - it’s not participatory research. They just then become lackeys. If you want to build ownership of projects in community, they have to be involved from the ground. It’s no use scientists saying 'this is how you do it, now do you want to be involved?' They need to be part of that initial process. *Expert B/Site1.*
>
> I think the public should be involved from the start, the very first thing - what is the issue? What are you monitoring for? What are you trying to measure? That's where I'd involve them. *Expert D/Site 1.*
>
> This [Waterwatch] group here is very, very concerned about working with the community, about making the community aware of what's its doing, having community support for what its doing. *Citizen L/Site 3.*

Because this process is often very localised and people can contribute on an equal basis, one expert participant noted that in participatory projects she 'walked a thin line on being in Government and out of Government' *(Expert A/Site1).*

The second question seeks to better understand the issue of concern and asks - what does it mean? At this point the group begins to collect information in 'both formal and informal ways'. In this example, information was collected on Platypus habitat requirements and the impacts of pollution etc.

The third question is concerned with making choices about future scenarios and asks - what will we do? It was at this stage that one expert commented that much of his interaction with community groups was spent 'helping them to use the data' because he felt that it was 'no good collecting it unless you use it' (Expert C/Site 1). In addition to analysis and interpretation, the groups at Sites 2 and 3 also sought application of the information towards improving the situation (eg increasing the number of Platypus). To this end the group generates a number of options through analysis of all the data collected and decides upon the most worthwhile scenarios. At this point 'all sorts of analytic techniques are used from straight out financial analysis to SWOT analysis' (Citizen L/Site 3).

The fourth question is closely tied to taking action and asks - how will we achieve the desired outcomes? This involves formulating an action plan that corresponds to the general direction decided upon at earlier stages. Subsequent action may include habitat restoration, the implementation of alternative technologies, or awareness-raising activities. This last step brings the community group back to the first question once again, where the group reflects upon the status of the issue and assesses any change in the situation (see Figure 6.4).

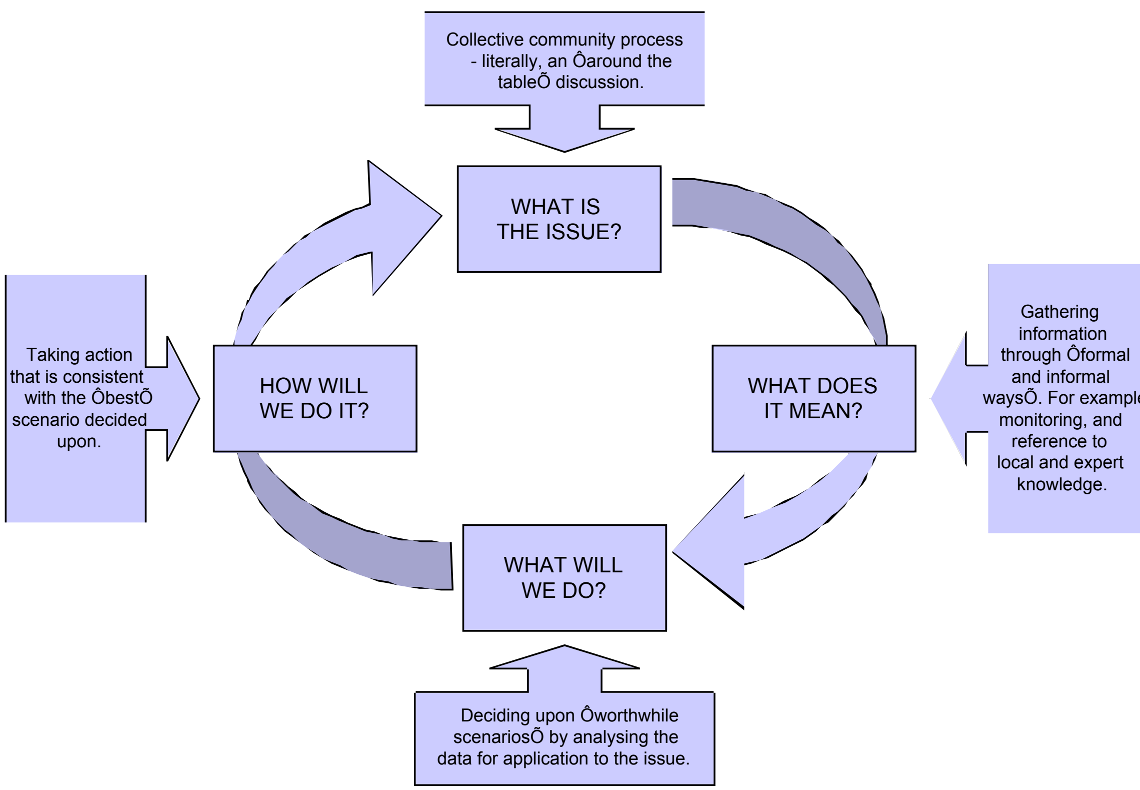


Figure 6.4 The 'situation improvement' cycle utilised by community groups conducting research

Consistent with the cyclical and on-going approach the group repeats this process until the desired situation is reached:

> The idea of this doing something, it will bring you back here (to the question stage) to a slightly better position. If there were 10 Platypus here, hopefully by this time you have got them up to 20 and you keep going round and round until you get your 100 or whatever it is that you're after. *Citizen L/Site 3.*

By continually undertaking the four questioning steps depicted in Figure 6.5 for a range of issues, citizen participants considered that they were the 'eyes and ears' of a catchment and aware of important local issues from both a scientific and a social perspective. Thus:

> There are two sorts of science involved. There is pure science to do with matter and then there is a social science to do with people - it's sort of melding them both together. *Citizen H/Site 3.*

Undoubtedly, the location of community groups and their ability to conduct research with a network were considered major advantages of the community-based research projects in this case study. For example:

> The beauty of Waterwatch in a sense is that they are here, they are local, they have got a lot of detailed information, plus a lot of contacts. *Citizen L/Site 3.*

> We learn just as much from the community groups – they tell me stuff all the time that we don't know about. It's great. They're out there and they see all these things happening. *Expert A/Site1.*

For one participant, these features meant that the coordinator was especially well placed to know what further research should be undertaken:

> [The coordinator] has got her finger on the pulse in not only measuring things, but also seeing what is happening on the ground and talking to people. Therefore, [the coordinator] has a foundation for knowing what research is required. *Citizen N/Site 3.*

In this way, the community approach to research demonstrated at these sites is based on social learning and was best described as:

> Very much experiential, it's going out there and seeing what is there and being concerned enough to try and learn about it in both formal and informal ways. *Citizen L/Site 3.*

Accordingly, the group members interacted directly with the environment, formally with staff from the local University, technical staff on Council and other agencies, and informally through their extensive network of local residents. Such meaningful social interaction was why several participants I spoke to stated that they most valued this collaborative approach to research.

Monitoring is essential to the functioning of the 'situation improvement cycle' for two reasons. The first is that it keeps members attuned to the health of the local catchment and can highlight issues that need attention. The second is that it enables accurate evaluation of and reflection on the outcomes of research projects. Thus, it is both an exploratory and a reflective tool and is used by the groups in this case study to construct a continuous picture of catchment health.

In the first instance, the community group at Site 2 has a team of citizen monitors that conduct weekly water quality testing using a Horiba multi-probe instrument. This group covers more than 30 sites in the catchment over a 5-week period. The group at Site 3 also use a multi-probe instrument and involve 60 individuals/families to monitor over 140 sites within the local catchment on a monthly basis. The instruments used by both groups are capable of 'Level one tests' and measure pH, dissolved oxygen, turbidity, temperature and conductivity. The group at Site 3 have gained independent recognition of data quality from the Environmental Protection Agency and participate in regular 'shadow testing' to maintain this high standard. Their data has been used for Government reporting, catchment planning and private consultancy and is considered valuable trend indicative information. At some sites participants from both groups also undertook 'Level two tests' of free reactive phosphate and nitrate. At Site 2 these tests were done *in situ* and at Site 3 the coordinator and a core group of volunteers had been trained in the use of a Hach DR 2000 spectrophotometer.

In the second instance, monitoring and evaluation is focussed on self or group reflection on the project process and outcomes. Thus, an important part of this interactive learning cycle is reflection at each stage. The following statement captures the reflective approach to research undertaken by many citizen participants:

> The most important thing in many respects is to improve your own ability to learn and to improve future situations so that you become more and more skilled each time you do it and you start to ask yourself a lot of these questions. What did I do? How did I do it? It's a reflective process all the time that is really important for your own development. A really good learner is somebody that acknowledges that it is a never-ending process. *Citizen L/Site 3.*

However, such reflection need not be internalised and can be a process used by all involved and shared with the wider community. Therefore, awareness-raising activities or cultural events celebrating the catchment are included as part of the research cycle because the community groups believed that sharing their reflective experiences with the wider community was as important as revegetation or other management practices when seeking positive environmental change. In this way, community groups can also be considered the voice of the catchment. For example, when asked about the most important roles and activities that were undertaken by the groups through research, one citizen participant listed the following important tasks:

> Awareness, environmental advocacy, challenging ideas, trying to get reviews of city plans and stuff like that. Doing a strategic plan for the creek - networking with other people - getting a network going. It's not really what we're doing on the ground…a really good thing, but it's not the most important. *Citizen A/Site 2.*

Consequently, many participants made clear links between positive social and positive environmental change (see Section 6.7) and were involved in planning and educational activities to 'get the messages of their research out there' (Citizen A /Site 2). To this end, both groups in this study were involved in developing a catchment management plan for their local catchment as well as contributing to local and State Government planning decisions. They had also organised a diverse variety of community awareness activities (festivals, planting days and conferences), formal education opportunities (school groups, local TAFES and universities), publications (information pamphlets and monthly newsletters) and electronic resources (web-sites and email networks). In addition, they had also produced a range of artistic works including public artworks and music compact discs. Thus:

> People can contribute on a very broad scale. It doesn't have to be just in the field or with planting. It's all things - data processing, word processing and all sorts of stuff. It's been very valuable for me to be able to use my skills in drawing as a form of contributing. *Citizen F/Site 2.*

The groups felt that such a diversity of approaches was necessary to ensure that they were not 'just preaching to [and involving] the converted all of the time':

> A lot of people in the environment movement are a little bit reticent about going to the coalface where people might not agree with them. I think we have got to start doing that now. Getting a pat on the back from your own peers and people that are like-minded - we don't have to be feeling that we are doing the right thing all of the time. We have got to do the important things. We have got to go and confront these ideas that are wrong and try and get them thinking. *Citizen A/Site2.*

They also believed that social change would be more likely if they were able to reach people on many different levels, especially through the heart:

> I've always been a strong believer that we're not actually going to achieve the changes that we need through the head. It's through the heart that we're going to make the deep cultural changes. That's why we put together the Waterwatch CD and Splash! We're getting to them on lots and lots of different levels and very much involving the community groups in their own communities and then bringing them together. *Citizen G/Site 3.*

One participant noted that indigenous input was particularly moving:

> To have the indigenous input at that last Splash! was just so beautiful it was just the most moving day, everyone was just in tears - it was just unbelievable. *Citizen G/Site 3.*

6.5.2 Summary

Acting on the need for a variety of approaches to achieve social change, the community groups in this case study organise and produce a range of awareness-raising events, educational opportunities, publications, electronic resources, and artistic works. These cohesive and informative activities are designed to involve everyone in the community and are underpinned by collaborative catchment research. The community approach to research identified in this study was best described by one participant as a 'situation improvement cycle' where group members participate in all stages of research:

> You name it; we do it - from start to finish! *Citizen E/Site 2.*

The situation improvement cycle demands a continuous approach to research that incorporates information from both the natural and the social sciences. Through the community-based organisational structure and location of the groups they are well placed to define and understand local catchment issues. Indeed, the groups and networks that are formed need to be sensitive to the local catchment and sustainable through the resources that are available:

> The catchments are so different and it depends on where the energy has come from in the first place, what industries are there to support. You need to look within each subcatchment to see what industries will help fund it, because it can't just be Government or voluntary, it needs to be also industry. Every subcatchment is different and so the spark comes from a different point and gets carried by different personalities, so it's necessarily different. It has to be tailored to what energies are available and what money is available. *Citizen G/Site 3.*

While the community groups are capable of conducting autonomous research, they tend to draw conclusions and take action based on information from a variety of citizen and expert sources. Thus, the most effective approaches to community-based research were considered to be local and collaborative where activity was needed from scientists, community members and agency representatives. For example:

> They are quite happy to do what they can, but they can't act in isolation and they can't be very effective in isolation. They do need to be supported and I think you do get many, many times back as a management agency what you put in if you do bring the community groups into an equal partnership. *Expert E/Site 1.*

> You really need both I think. It is like a triangle of activity. [The Waterwatch coordinator] is here at the community side of that triangle and the scientific [representative] is another point of that triangle and government agencies are another point. There might be some more actually, but just that concept that you can't achieve the whole thing without activity at each of those focuses. *Citizen N/Site 3.*

The overarching purpose of the community-based research conducted in these case study sites is to improve a situation whilst enhancing the ability of participants to improve future situations through social learning. Monitoring is a key aspect of this approach and enables accurate evaluation of research outcomes as well as keeping members aware of dynamic catchment issues. Therefore, the research process utilised by these community groups is inherently participatory, reflective and applied to the local catchment and community.

6.6 OPPORTUNITIES AND CONSTRAINTS

Consistent with the experiences of many grassroots organisations, the community groups in this case study encountered a multitude of opportunities and constraints when conducting their catchment-based activities and seeking positive changes towards sustainability. There is often a healthy tension between opportunities and constraints because both positive and negative outcomes can often arise from the same underlying issue. How these issues are manifest within each group can be used to distinguish between sustainable and unsustainable group approaches. Consequently, it is instructive to understand how constraints on community efforts can be overcome and actually lead to increased opportunities. Thus, I have analysed these two seemingly opposing themes together. The diverse array of opportunities and constraints that arose in interviews with expert scientists, agency representatives and community members at the three study sites may be categorised into three groups, namely: (i) societal/political; (ii) practical; and (iii) perceptual. However, these issues are quite interrelated and they are separated into discrete categories here for ease of explanation only.

6.6.1 Socio-political opportunities and constraints

A supportive community and political system are essential precursors for effective and sustainable community-based research. Section 6.3 demonstrated that respondents believed that community pressure could influence political decisions. However, if the wider community do not see environmental issues as a priority then this will be reflected in a low level of community participation, minimal industry support and poor representation in the political decisions that are made. For example, both agency, scientific and community representatives expressed difficulty at some point in accessing committed participants for environmental projects. The following quotation summarises the experience of one expert respondent with respect to participation in community monitoring:

> The thing about community in general is that they have other priorities…your little project might be right at the bottom…that's the downside to community monitoring. *Expert D/Site 1.*

Certain industries can also be criticised for their apparent lack of environmental concern, particularly with respect to waterway pollution. The negative effects of their actions on the environment and community group efforts is described below by one expert participant:

> The community groups can go out and plant a thousand trees, monitor for ten years, replant riparian vegetation and mangroves and all sorts of things, and then industry groups could still be pumping whatever they want into a waterway or destroying hectares of land for new industry or using wetlands. *Expert A/Site 1.*

Respondents stated that such societal apathy and environmental abuse often translated into unsupportive political decisions. The comments of one citizen participant describe the effect of an indifferent social context:

> There are a lot of factors militating against you. For example, vandalism, fire and the 'don't care' attitude of people and even governments…It's really lack of interest. The electorate always leads the politicians in the decisions that are made - if they are contentious about their role. *Citizen C/Site 2.*

Limited community awareness of and participation in environmental issues were identified by respondents as a major hurdle and source of frustration. Indeed:

> I sense some frustration that we will probably be talking about decades if not centuries, rather than a 5 or 10 year time line. Getting access to people's awareness and willingness to become motivated, that's what I would see as a potential blockage. *Citizen M/Site 3.*

Thus, one citizen participant stated that a despairing outcome of such minimal environmental appreciation and disrespect for the efforts of others was the gratuitous destruction of environmental rehabilitation sites. The quotation below describes an all too common experience for volunteers particularly within urban catchments:

> It hard when they [revegetation plants] get vandalised, burnt, or ripped out. You wonder why you bother then. You think why are we doing this? They have nothing better to do. They killed every plant in one place - whipersnipered or broke them off. We tie red tape, but that's like a red flag to a bull to some people - they go along and rip them out. It's terrible. *Citizen D/Site 2.*

However, one participant (Citizen B/Site 2) I spoke to believed that it was only a small minority of adolescents that vandalised revegetation sites. To remedy this situation, group members took the opportunity to visit schools where they gave catchment talks and involved the students in planting in the hope of giving them a greater understanding of how to care for catchment ecosystems and a sense of ownership of local environmental projects.

In addition to these community-level factors, some participants considered that political mechanisms 'above the community' limited the voice of concerned citizens in political decision-making. For example:

> We would like that to happen more often - for those people to be a real voice for what's happening in their community, but often political things push them back down again. So they are often empowered, but it's all the mechanisms above community that keep them where they are. *Expert A/Site 1.*

This person continued to explain that the governing institutions did not regard community monitoring or citizen data as important, despite high levels of community interest and committed participation in some regions. She felt that this cycle of empowerment and disempowerment made it difficult to convince people to continue their participation:

> So you have this community who are really interested and they get empowered to a certain degree and then you see them get disempowered. Sometimes I think we're aiding disempowerment, because we've given people so much knowledge and they try to do something with it and they get knocked back. *Expert A/Site 1.*

Certainly, one expert explained that community members do not like wasting their time or having their skills denigrated:

> The community doesn't like to be used just to waste their time. They like to feel that they're making a contribution and that through what they do that they might make a difference. So I think it's really important that we do not kid the community. I think it's also important that we don't denigrate the skills that they have. I've heard that the community doesn't equal the lowest common denominator necessarily. *Expert B/Site 1*.

Section 6.5 demonstrated that the community groups and networks in this study put much effort into their research and, consistent with the Waterwatch ethos, the citizen participants owned the data they had collected. Thus, 'Waterwatch Queensland is not just a lot of lackeys for scientists to get information from' (Expert B/Site 1). However, there was wide consensus that few people would continue if participation did not 'make a difference'. The expert respondent below explains the importance of achieving outcomes from participation:

> People really need to feel that what they're doing is making a difference. The analogy I'd liken it to is going to a meeting. If people go to meetings that achieve nothing, after a while you decide you won't to the meeting because why bother? If people don't feel that what they're doing is valued, then why continue? *Expert B/Site 1.*

Many of these comments indicate that frequently there is a less than effective relationship between citizen efforts and changes in governmental decision-making. Shortcomings were noted by citizens, scientists and agency representatives. Several participants discuss these as perceptual or personal issues. However, in a socio-political context, a short-term focus in the strategies and outlook of Government was noted as a major constraint:

> Government needs to look past the political side of it, past the three years and vote-gaining things, because that impedes effectiveness. *Expert A/Site 1.*

This wider political context where citizen input into decision making is not always valued, means that financial assistance for community group activities is often limited. The following words from one expert illustrate this point:

> We just don't pay them enough. Basically the value that they provide isn't given sufficient weight at this stage. *Expert C/Site 1.*

Low and insecure levels of funding were repeatedly cited as the major barrier to community-based research. For example:

> Dollars are limited - that's always the first one. *Expert A/Site 1.*

> To me at the moment the biggest barrier is lack of funding. *Citizen B/Site 2.*

Despite the widespread perception that programs such as Waterwatch are funded through State or Federal Government, financial assistance from these sources is 'only start-up money' for the groups and networks to then gain other partners at a regional level. Waterwatch grants do not fund the purchase of scientific equipment or other important costs of group activities (eg rent, fuel and planning and administrative personnel). Instead, these grants are designed to facilitate partnerships with local stakeholders so that the research conducted by community members is locally relevant and supported:

> It's a limitation, but it's also effective in getting people to think about making partnerships with Council and other people in a particular region. *Expert A/Site 1.*

Several community group coordinators argued that applying for funding through the Federal Government's Natural Heritage Trust (NHT) was a very time consuming task that required detailed grant applications. In fact, applying for funding from any source took much time and energy and left little for the activities considered most important to group members (Citizen A/Site 2). In addition, the groups that had made partners at a regional level and received funding from industry were concerned about potential conflicts of interest that could make them less effective if the industry became a source of water pollution.

In summary, the localised and participatory nature of community-based research means that the groups in this case study are unavoidably influenced by the dominant socio-political context. This implies that if the wider community does not consider catchment issues a priority and/or are politically despondent and inactive then this apathy will adversely affect volunteer numbers and the value that is placed upon community-based research by those with political power. The participants in this case study considered that they were working within a wider community context that was largely apathetic about environmental issues. Consequently, funding community-based efforts was not seen as a priority in the three years that political parties may remain in office unchallenged. Building partnerships at local or regional levels between community groups, agencies and industry was advocated as one way of overcoming limited community and governmental support. However, this can leave groups open to manipulation by controlling financial interests and can mean that groups are forced to spend much time and energy sourcing sincere funding and support rather than conducting their core activities. Despite these impediments, community members put much energy into education and maintained that societal awareness and support for the environment and their activities were growing. Thus, one citizen participant reflected on recent positive changes in this way:

> The general awareness of environmental problems and issues is getting a higher profile compared to the 80's when it was considered a bit left field, radical and only for tree-huggers and activists. I think it has become more mainstream in the last 15 years or so and more accepted. *Citizen B/Site 2.*

6.6.2 Practical opportunities and constraints

A major barrier for those working towards catchment sustainability is the enormity of the task in a practical sense. One citizen participant described the measure of this undertaking:

> The first thing that springs to mind is the sheer amount of work that needs to be done. There is more than just this one office can achieve…We're all really busy…out there working with the rivers and water quality and doing something - the action side. It could be pretty overwhelming if you allowed yourself to think that way. *Citizen N/Site 3.*

A shortage of resources to undertake the practical work that is needed is thus a key issue in dealing with problems of this scale. As explained above, the limited financial assistance for community-based catchment research is a critical concern that places two further practical constraints on community-based research activities. The first is that it reduces the time available for both citizens and experts to participate in volunteer activities. The second is that it restricts community access to the technical equipment and assistance necessary to conduct rigorous research. This is especially relevant where accurate physical and chemical parameters are required to assess water quality. Indeed, 'there is any amount of things that can be done: it is just a matter of having the funding to enable sufficient time, people and other resources' (Citizen H/Site 3).

Both groups in this case study could only afford to pay one coordinator[15] whilst other members[16] had to maintain normal working hours in addition to their voluntary tasks. This

[15] In some cases funding was accessed for additional project officers to work on specific tasks. However, this funding was project specific and usually only lasted for a period of a few months.
[16] Centrelink recipients are expected to volunteer in addition to looking and applying for job vacancies.

helps explain the relatively low levels of community involvement and why many people can only afford to volunteer for a short time:

> Time is a real issue. We tend to think that the community has an enormous amount of time, yet the community is us. (So time, the fact that people are working.) *Expert B/Site 1.*

One expert explained that this often means the same people volunteer for each activity or issue:

> I'd like to have community monitoring networks everywhere, but in some regions where you've got small populations, it's the same people that are involved in everything and they just don't have the time to do this. *Expert A/Site 1.*

In addition, community groups are often expected to contribute their time, ideas and information 'for free' during consultation. However, several citizens (eg Citizen A/Site 2 and Citizen G/Site 3) stated that to participate effectively and to give the same consideration to issues as paid experts requires extra funding. One citizen spoke about the cycle of limited funding and limited time:

> If I had time to sit down and contact a few politicians and things like that, something may turn up, but at the moment it is hard to get your head around a lot of things. It's getting harder for me to focus. There are just so many issues coming into our office. *Citizen A/Site 2.*

Consequently, representatives from both community groups in this case study stated that they needed funding for more personnel:

> I need another employed person. One person employed on an NHT project to be a catchment coordinator is fine, but when you are running a volunteer core…it's a lot of work to make sure that they have something worthwhile to do and making sure that they are getting some feedback from what they are doing and feeling as though they are not wasting their time. It's a big responsibility. *Citizen A/Site 2.*
>
> Even if we could get three project officers working that would just be magical, absolutely magical. *Citizen G/Site 3.*

Obviously, a coordinator is vital to the efficient functioning of these groups. Yet, one participant noted that funding for administration tasks was even more difficult to access:

> A lot of the funding that you get does not have an administration component in it - it has purely got to be for the hands on practical side of things, but unless you've got the coordinator there to pull it all together, it just doesn't get off the ground. *Citizen H/Site 3.*

The second major issue that stems from low levels of funding is restricted community group access to technical equipment and assistance. Expert respondents in particular, noted a lack of resources within community groups:

> It's just lack of resources in lots of cases - they are just terribly short of resources - it's really hard for them… I suspect that there are some people that just won't keep on going after a while - they will give it away because it's just all too hard. *Expert C/Site 1.*

Lack of technical resources was often related to water quality monitoring tasks and there were many interview comments from experts that questioned the value of community data because of the type of equipment that community groups have access to. For example, one expert stated that a major barrier to community monitoring was:

> Accessible equipment that's good quality for physico – chemical testing – because it's usually expensive. *Expert B/Site1.*

This respondent noted that biological tests were less expensive. Nonetheless, the quality of community data is a major issue in community-based research. This issue is taken up by several participants at the end of this section where it is related to funding and a range of other factors.

Citizens also noted that they required computers, printers, vehicles and tools as well as funding for the running, maintenance and supervisory costs of such equipment. Consistent with the difficulty in accessing administration funding, community groups also experienced difficulty in finding funding for these operating costs:

> At the moment we haven't got an official vehicle. We're using two of my vehicles, which is ridiculous and we're using our own volunteer's vehicles and we've got to pay them $10 a hit to get into field - so we're paying though petrol tickets and that is really draining us. You can't get grants for petrol, rent or a field officer to take these volunteers. *Citizen A/Site 2.*

Despite the pervasive effect of money in these barriers and issues, several citizens and experts refused to be financially constrained and, instead, sought partnerships that would provide them with the necessary group solidarity and technical assistance to be successful. Unquestionably, people are central in community-based approaches. Therefore, respondents stated that strong partnerships had been formed between volunteers and they were pursued between citizens and experts:

> We have struggled [financially] as a group, but it's thanks to the goodwill of all the volunteers that no one has ever really questioned any of it. *Citizen G/Site 3.*

> Extra funding would be fabulous but in all reality it's not going to happen - we've got to be creative. I don't worry about it any more. I just get on and do it…I've been trying to think of other ways that we can get the technical support and the data confidence without necessarily having to have the funding or a person to make that happen…That's why I've looked at these other partnership approaches with [expert scientists]. I've been trying to get this agency/community monitoring because I see that as a way of meeting some of those needs. *Expert A/Site 1.*

The sum of these practical constraints, most notably the massive scale of the task and minimal resources, places volunteers under enormous pressure. Consequently, the experts in this study observed that 'burnout' was prevalent in many community-based catchment endeavours:

> I see a lot of decisions being devolved to communities and I think that's good, but I also think that they're asking communities to do too much. There is not enough energy and support in communities to do all of those things. It's not just this Department - it's every department…It's the same people within a community that do all those things and it's just too much - they get burnt out. *Expert A/Site 1.*

> Burnout is a major community issue, particularly within the Landcare and Catchment Management Community. *Expert B/Site 1.*

Again, people - by providing both volunteer and expert assistance - appear to be a vital component in overcoming these practical hurdles. However, limited time for volunteer activities following limited financial assistance makes voluntary participation and partnerships between citizens and experts difficult to achieve. In addition, many citizens and experts lack awareness of community-based activities and many experts do not hold community-based research in high regard. This leads us to the third source of opportunities and constraints faced by community groups - expert perceptions of community group abilities and in particular the validity of community data.

6.6.3 *Perceptions as opportunities and constraints*

Personal perceptions and responses to the perceptions of others can affect community-based activities. Sentiments expressed by both citizens and experts in this case study indicate that in certain situations the terms 'community' and 'expert' have negative connotations. Understanding why participants hold these perceptions is a first step towards overcoming such ill-fated views that can hinder community-based research.

Several examples provided by respondents also demonstrated that these negative perceptions can be transformed into learning and collaborative opportunities.

6.6.3.1 Personal perceptions

Community volunteers who work for little or no financial reward often feel that they are not valuable in any sense. Until recently, this has mostly affected women - the traditional majority in the voluntary workforce. However, as the paid workforce increasingly devalues older people, men in this age group frequently suffer from low self-esteem also. Core participants from both community groups in this case study noted this increasing trend:

> I am particularly concerned about middle-aged men and depression. They often are the ones that we deal with and have really hit rock bottom and they tend not to have as much buoyancy as females. *Citizen G/Site 3.*

> Of the volunteers that come here from the look for work scheme - they appreciate what they're doing because they are not going out there every single week and looking for 8 jobs a fortnight when they know that because of their age that they are not going to get the work. *Citizen B/Site 2.*

Several participants were very good at encouraging such volunteers and finding ways to utilise their existing skills or to acquire new skills through re-training. Consequently, the catchment groups provide a great opportunity for individuals to regain or discover a sense of personal worth:

> A lot of volunteers do sell themselves short and put themselves down and don't expect to be paid properly because they don't think they are worth it, all these funny issues of self worth. It is something that volunteers do share and [one community participant] has really helped a lot with that. They coach a lot of people, making sure we don't undervalue ourselves. That's very important for us all to hear. Especially for women, they tend to do a lot of things voluntarily. *Citizen G/Site 3.*

> That has been to me the greatest joy to see that age group of men feel some sense of worth and purpose and move on and there are so many unbelievable valuable clever talented human beings that are just waiting to do something and as long as go put the energies and the passions in the right direction and give them hope you just never know what's going to happen. *Citizen G/Site 3.*

Group leadership appears to be an important opportunity in assisting volunteers to reach their full potential and achieve or maintain positive self and group perception. Therefore, leadership is an important factor in ensuring group sustainability. Several conversations with participants in the field revealed two main approaches to group leadership. In the first approach, the management committee and coordinator led by example and exhibited strong leadership. For example:

> I find myself leading from the front rather than directing too much. Instead of telling someone to go do something, I go and do it myself and say 'come give us hand'. It seems to be better. It's a pretty good philosophy I reckon. Give us a hand - this log's too bloody heavy - get on the end of it. It's the same with the load in here. I've got to be seen to be working - not just sitting back in the chair telling people what to do - I've got to be active too. There is too much planning from afar going on in Australia. *Citizen A/Site B.*

Observing this approach, one expert stated that:

> I think that your program is only as good as your coordinator and a different coordinator can change the whole focus or feel of the network or the Waterwatch program wherever it is happening and that's just life isn't it? *Expert A/Site 1.*

The dilemma with such reliance upon strong leaders is that activities are unlikely to be sustainable if the coordinator leaves or the management committee changes. By way of contrast, one coordinator sought to practise a second approach in which the coordinator acting as a facilitator and encouraged group members to take responsibility for specific projects or tasks, this coordinator modestly stated that the network was only as good as the participants. In fact, both coordinators were very proud of their group members and often talked about how capable they were (Participant observation/Site 3/Day 4 and Participant observation/Site 2/Day 13). However, despite praise for members (and modesty about her leadership skills), the coordinator at Site 2 conceded that group activities needed someone to drive the process - 'a driver'. All people are different and some need constant guidance while others need very little - it is a matter of finding the right level and involves nurturing participants (Participant observation/Site 3/Day 4). Indeed, both approaches require the sincere recognition of the value of volunteer input from the management/executive committee or coordinator. Therefore, the coordinator is pivotal in each of these leadership styles and requires great social and technical skill to coordinate group activities and to foster relationships both internal and external to the group.

6.6.3.2 Expert perception

The perceptions of experts towards community groups or their data and the perceptions of citizens towards experts can also affect community-based research. For example, the community groups in this case study that conducted catchment research had worked hard to achieve a level of credibility that was financially and scientifically valuable:

> I just feel like we've actually done our apprenticeship as a group and I feel like I have done my apprenticeship and it's time now that we could attract a little bit more funding. *Citizen G/Site 3.*

The Queensland Environmental Protection Agency (EPA) and private consultants have used community data from this group in their State of the Environment reporting (see Section 6.5). Yet, both citizen and expert respondents felt that some expert scientists still had a low opinion of the value of community efforts and were not interested in collaborative research. Several participants found this situation difficult to comprehend and lamented the negative expert perception of citizen efforts. For example:

> That [negative] sort of attitude, despite the fact that EPA and DNR have gone through these results and they have said they are good. I think that they [the Council] have got plenty of problems and too often they look on us as another problem rather than a support. *Citizen L/Site 3.*

One expert pointed out the irony of this situation by revealing that some employees from these same expert agencies were also participants in these community groups:

> There are a lot of [government department] employees here who are in community groups. It really bugs me when people say, oh "the community". But I tell them – you're part of the community… I know for a fact that in some of our groups there are people who are retired Ph.D. scientists, ex bug experts. So in those groups they've got this really fantastic level of expertise. So there's nothing wrong with what they're doing – it's based on very sound principles – that negative perception really bothers me. *Expert A/Site 1.*

The negative perception of some expert scientists can be a limitation, but not all experts disregard the value of community input with some actively promoting community participation. There appear to be two dominant paradigms under which experts in scientific institutions and natural resource management agencies operate - one paradigm that embraces participatory and inclusive approaches and another that supports managerialist and exclusive methods. For example:

> There is a real polarisation, but there are some really good people who have a bit of both, which is what we're really looking for. But you can see some real differences. *Expert A/Site 1.*

The latter paradigm is recognised by many citizen participants as a significant barrier to collaborative partnerships. Citizen participants explained that experts working within a managerialist and exclusive paradigm were difficult to work and share knowledge with because they appeared arrogant. The following statements are quite illustrative of how some citizen participants perceive expert attitudes towards community-based research:

> Experts have a sort of aloofness and smugness that only they know it and what would they (the community) know and who cares what they know, because I'm the one with the proper knowledge and I've got the qualifications to prove it. *Citizen C/Site 2.*

> An arrogance that is borne on the notion that if you are going to get good test results then you've got to be a 4 year science graduate. *Citizen L/Site 3.*

A key finding in the review of literature in Chapter 2 and the survey in Chapter 5 was the low regard in which many experts held the scientific research data of community groups. Consistent with these findings, many community participants had experienced cynicism towards their research and stated that it made community input into decision-making difficult. For example:

> It would be great if we could have some sort of input, but getting them to realise that our research is valid and not completely off the mark is what we need. Volunteers do all the research that we do here. A lot of them are amateur's. So it can be a bit difficult to be taken seriously in the scheme of things. A lot them are qualified by their sheer experience. They know what they are talking about, but they don't have that piece of paper. So that means that they are not acknowledged as well as someone who has been to university and has got that little bit of paper. It's just something that you have to fight against. You've got to get the professionals to realise that community is doing something worthwhile and that we are making a contribution and a difference. *Citizen B/Site 2.*

Consequently, one community participant believed that what appeared to be arrogance was in fact, intellectual insecurity or jealousy where knowledge was used for 'self-aggrandisement' and only shared once published under an expert guise. He considered that this lead to 'fruitless' citizen/expert interactions:

> A lot of it is insecurity. I'm not saying that everybody is tarred with the same brush but a lot are. In a lot of cases there is jealously of knowledge. A lot of people want to use the knowledge they have for self-aggrandisement. *Citizen C/Site 2.*

This person also noted that experts had much greater access to funding and resources. Therefore, he considered that the expert approach would be so different to that of community groups that experts would not be interested in community activities:

> We think they are not interested in what we are doing. They would attack the problem from a totally difference perspective - hopefully with lots of money and resources, whilst we are just plugging along poking little seedlings in the ground and doing what we can to stop the soil from washing away. *Citizen C/Site 2.*

These differences do not augur well for collaboration between citizens and experts. This participant considered that community groups were unlikely to support expert activities considering them a waste of resources if coupled with a lack of communication:

> If they explained what their approach was and why they came to the conclusion that they have - we'd probably be more amenable. I'm not saying that we're directly antagonistic to what they're doing, but in a lot of cases we think that it is a waste of time and effort and a lot of money. *Citizen C/Site 2.*

In recognising this disjuncture, this person supported the need for increased citizen/expert interaction although he was doubtful that it would ever occur:

> It's not going to happen. It's a kind of academic snobbery. I'm not saying that they regard us as the great unwashed, but it is something approaching that. They think they know what is best for the planet and they just go ahead and do it. *Citizen C/Site 2*

Considering all of these statements it is possible to see perceptual barriers on behalf of both citizens and experts. One expert stated that such distance was best overcome through increased community/agency/scientific interaction:

> The more we have involvement with communities in science projects, the more impact we can have on the scientists in terms of valuing community involvement - because there is still a fair degree of arrogance within the scientific community. *Expert B/Site 1.*

In addition, one citizen participant with extensive academic experience highlighted that community groups provided great opportunities for researchers to work on relevant and applied issues:

> I think there are massive opportunities for research in universities and research groups to work on real issues rather than just sit back in their own little labs and design things, under an umbrella. *Citizen L/Site 3.*

Participants felt that their local experiential knowledge and their established networks were a great advantage in research, particularly if used in combination with agency or academic research. Thus:

> For any researcher who is looking at wetlands [for example] there are some good scenarios here that they could work on and that would be real. They could come back and present something at the end that might actually be applied. It's a blending. I think the beauty of that style is that it is real and you talk to real people. *Citizen L/Site 3.*

To facilitate such 'a blending' of citizen and expert approaches, one citizen participant stated that taking on the 'status of a victim' was pointless and that community groups 'would not get anywhere by whingeing' (Citizen G/Site 3). This person argued that it was important to take a positive view and for citizens to support those experts they felt were acting appropriately. For example:

> It is easy to be critical and a lot of those in the environment movement are, but I know what [government] jobs are like. They have got constraints in the bureaucracy…most of them are hard working even if they are not on side. What we have to do (whether we like it or not) is give ammunition to the people who can help us inside these bureaucracies - feed them community support and information that they can act on. With a bit of luck they can push that to a ministerial level to get some changes made. *Citizen A/Site 2.*

In this way, the most successful groups and citizen/expert partnerships were (i) respectful of territory; (ii) non-judgemental and appreciative of the need for diversity; and (iii) honest. In the first instance, both citizens and experts learned to recognise territories or geographical, intellectual, legislative and personality boundaries. One citizen explained that geographical constraints were least important in collaboration:

> There is a geographical territory…but we're talking more about intellectual boundaries and legislative boundaries and personality boundaries. Some things you'll say to some people that you won't say to others…It's a matter of standing back and sizing things up before you go rushing in there. *Citizen G/Site 3.*

Community participants noted that such conflict could occur between community groups as well as between community groups and agencies or other institutions. For example, new agency employees often reacted negatively towards their catchment activities perceiving the group or network as 'a threat to their territory'. One participant explained the possible causes of this dissidence:

> Sometimes it's a threat of funding. For example, the environment branch in Council might see that if they are doing monitoring and we're doing monitoring, there's a double up and we might go for the same money that they are going for. Or there might be a conflict on who sets the benchmarks and who has to fork out the money and who had got the power here. It can be a whole range of issues of territory. *Citizen G/Site 3.*

Some representatives were much more welcoming and, through repeated assurance, many positive partnerships had been made. Accordingly:

> In the end they realise that we're in here for the long haul, we're not going anywhere, that we're genuine and we're not trying to usurp their territory. Once you've got that sorted then you can work on from there. *Citizen G/Site 3.*

Rather than viewing territory as a barrier, the group members patiently worked out respectful ways of approaching these boundaries to enable collaboration:

> We all understand each other's territory. Territory is absolutely basic to all this, appreciating and respecting territory. First of all recognising it, working out where your boundaries are and then respecting it and then working out the protocols that you need to approach somebody's territory. *Citizen G/Site 3.*

The second important aspect of collaboration and an effective way of overcoming disparate attitudes, was to take a non-judgemental approach and to welcome participants from all sectors:

> To be effective in river management you need to appreciate people as they are and not have a value judgement about them. You just appreciate them for who they are and then try and work with them as much as possible. Their belief systems are what ever they are and thankfully we're all different. *Citizen G/Site 3.*

> That's what I love about [the coordinator], her willingness to just invite people on board. *Citizen M/Site 3.*

In the third instance, honesty from all parties in terms of their abilities and agenda was considered vital in partnership formation. By admitting their limitations, community participants were keen to learn from, and welcoming of, expert assistance:

> The most important thing with Government agencies is not for us to act as though we're perfect and they appreciate that we understand our limitations and that we're wanting to learn and that we see them as helping us and that's it's a partnership thing. *Citizen G/Site 3.*

Citizen participants also stated that honesty in purpose assisted collaborative efforts by removing the tendency for people to fear the unknown. One conversation I had with a participant in the field revealed that reliability was also an important part of honesty and that to facilitate trust you had to do the things that you said you would, or be there when expected (Participant observation/Site 3/Day 6). Thus:

> The only way to get around it is to get to know the people and for them not to be fearful of your agenda. Also, lay your agenda clearly on the table, make it very clear what you are aiming for - these are very clear strategies that we want to pursue and as long as everyone knows that. *Citizen G/Site 3.*

A successful example of a citizen/expert partnership following these steps is demonstrated by the group at Site 3 and concerns one of their core activities - water quality monitoring. This involves shadow testing with dedicated quality assurance project officers through the Environmental Protection Agency (EPA) and the Natural Heritage Trust (NHT) and strategic sites monitored through a Waterwatch/EPA/NHT partnership. Another recent example focuses on groundwater monitoring and involves Natural Resources and Mines, Waterwatch and Landcare to utilise both community and government department resources to monitor groundwater quality. In this way, the community intended to inform the Water Resource Plan, which, at this stage, does not include groundwater considerations because there is no data on this water source (Community Group Newsletter, 11/02).

6.6.4 Community data: An example of multiple opportunities and constraints

The core activities of many catchment-based community groups, particularly Waterwatch, involve monitoring water quality. However, the literature review in Chapter 2 (for example Gill, 1991), the survey in Chapter 5, and the sentiments expressed earlier in this section indicate that expert concerns about the reliability of community data are a significant barrier to citizen participation in catchment research and management. I have chosen to present the issues surrounding community data to conclude this section because they provide an example of how the interrelated issues discussed above can combine to form a re-occurring barrier to community-based research.

Several experts were concerned over the variability between community groups and the scientific value of the data they collect. For example:

> There are a few groups in Waterwatch, not many, who have got quite good data, but there are not many of them yet. *Expert C/Site 1.*

> They all have their own techniques, but whether its got much scientific rigour about it is another question. *Expert D/Site 1.*

However, one expert with considerable community experience stated that governments should provide increased technical support to groups to ensure the data confidence that they demand, if they are interested in using community data:

> The biggest hurdle we've got to overcome with community groups is that quality assurance…We could do with better technical support and access to labs…They [expert scientists] whinge because the data's not credible, but no one will come out and support you. *Expert A/Site 1.*

Given sufficient support, data quality could be one of the community groups' greatest opportunities. For example:

> Data quality is becoming increasingly important as more people start to value and want access to the community data. Even within Government Departments - they are starting to value community monitoring. *Expert A/Site 1.*

> I think if community groups can demonstrate that they have good quality assurance then a lot of scientists will change their attitudes towards community monitoring - let's hope so. *Expert D/Site 1.*

One expert participant had evidence that several Waterwatch groups had overcome the data quality hurdle and were collecting data of professional standard:

> I got some of the scientists who were doing monitoring in Queensland to ring some of the Waterwatch coordinators and do a bit of shadow testing with them. I know that at least [one community group] can do dissolved oxygen with a little Hark dissolved test kit as well as the guys with the $15,000 machine…I try to encourage that approach - it's not a hard thing for someone to take a bit of time and go and work with a community person. *Expert A/Site 1.*

Certainly, expert assistance can be very beneficial for many community groups and several expert participants were keen to provide a range of opportunities for citizen participants:

> Whatever they do needs to be scientific, scientifically tested. There needs to be some sort of rigour to it. What we're trying to do is provide some options for them in that regard. If they have the intention and technical capacity to embrace more rigorous types of scientific monitoring, I'd like to give them the opportunity and to at least have those protocols available for them. *Expert E/Site 1.*

However, as already highlighted, such assistance is not always forthcoming and presents another barrier to community groups in achieving quality assurance or the recognition of quality assurance. For example:

> If you try and tell them that maybe they should go and do some shadow testing with them (that's like an extra phone call) or they can't go on the day that they want to go, or they might actually have to negotiate with the community person and go at a time that suits them - all those logistical things are a real problem. *Expert A/Site 1.*

One expert scientist pointed out that data quality concerns were often over the recording process than the actual readings and values collected in many cases:

> It could be really good data, but you don't know that because they can't prove it to you. They don't have that written down. Quality assurance involves actually documenting what you do - a lot of them don't have that…If you knew how much error there was in the data you could make a judgement as to whether you could use the data or not. If you don't even know what it is - what can you do? That's the problem with using this sort of data. *Expert C/Site 1.*

Furthermore, many of the limitations of community data were not perceived to be due to any lack of group skills, but rather a lack of the more accurate equipment utilised by expert scientists:

> They are only using Hark type tests, which are only of limited precision anyway. So in a sense it's not really their fault. It's just the method, but they can't really afford machines to get a more accurate picture. They rely on these things which really aren't that good - and that's just inherent in the Hark methods. *Expert C/Site 1.*

This lead one expert to consider that community data was 'too simple' to integrate with scientific data:

> No - it's too simple. I mean it's got some use, but it's only really relevant to their local area. That was my impression anyway. *Expert D/Site 1.*

Nonetheless, citizens and some experts believed that the focus on the quality of community data in terms of precision and accuracy should not obscure the purpose of their research. For example:

> Even if it's not to the nth degree perfect that a scientist would want it - the community-generated data still gives you a picture or trend. *Expert A/Site 1.*

One expert scientist felt that it was important to look beyond the physical and chemical parameters and for community groups to look at biological communities and the environment that they are actually trying to preserve:

> Ultimately you're trying to protect the environment. You're not trying to protect the amount of nitrate in the water; you're trying to protect the fish. So phys-chem things are important in that they tend to track you back to what the problem is – so you have to have some of those in. The communities themselves need to measure the direct impact on the animals. *Expert C/Site 1.*

This aside, the community groups at Sites 2 and 3 acknowledged that their research may not be as precise as that conducted by expert scientists:

> I'm fully aware that community data has limitations and that we have got a lot to learn. Even though I am trained as a biochemist, I'm not fantastically good on really scientific methodology in so far as committing to paper the most absolutely perfect, spot on way of doing things. I don't think of every single detail and it's great to have folk around me that do prod me on that and say 'hey what about this and this and this' and actually through this network we actually come out with a pretty good outcome. *Citizen G/Site 3.*

However, by using the critical and reflective group process described above, the citizens in this study felt that their research approach (see Section 6.5), based upon a greater number of monitoring sites, gave a valid indication of catchment health:

> We have a much broader coverage of sites through time so the picture we develop may be not be as absolutely, perfectly accurate and as magnificently

> designed, but in some way through all of that, the sheer breadth of data tells a story that you can't negate. *Citizen G/Site 3.*

6.6.5 Summary

People - their human strengths and weaknesses, are an overriding factor in all of these issues. At the socio-political level this is manifest through levels of societal interest. Participants considered that this alone could affect political decision making and consequently the level of funding with which they could expect to carry out their tasks and activities. Undeniably, the previous sections have revealed high levels of interest and motivation within the groups in this case study. However, they are still affected by the surrounding society and cannot act in isolation. The resultant low level of funding is a daily hurdle for most groups and affects the time that they have to volunteer and the resources that they can access. In addition, there are personal issues of self-worth where volunteers suffer from low self-esteem and perceptual barriers where citizens, experts and even other community groups are reluctant to work together. While many of these perceptual barriers remain for those persisting under a representative paradigm, the community groups in this study had fostered successful partnerships over time by ensuring data quality, being respectful of territory, non-judgemental, honest and reliable. Indeed, the citizen and expert participants in this study are contributing to a much more participatory and collaborative approach by working with each other to overcome the negative perceptions that have traditionally prevented these synergistic opportunities. It is apparent that these successful group approaches are best sustained through supportive and nurturing leadership and citizen/expert networks.

6.7 SOCIAL AND ENVIRONMENTAL OUTCOMES OF COMMUNITY-BASED RESEARCH

A key theme in the review of literature in Chapter 2 was the contrast between the contributions of positivist science and the destructive effects of social inequality and environmental degradation that have accompanied the mis-application of this way of knowing. Consequently, the outcomes of community-based research are important to define as they delineate this approach from the familiar positivist paradigm and help justify this collaborative alternative. Indeed, advocates and practitioners of community-based research are often asked to define the outcomes by scientists and agency representatives who may be interested in, or required to seek, wider community involvement. Financial supporters are also keen to be assured of their investment. Frequently, community environmental groups are asked to quantify their outcomes by detailing how many trees they have planted, how many weeds have been removed or sprayed, or how many sites have been monitored. However, this narrow focus on easily quantifiable measures misses the many diverse and pervasive outcomes of community-based research. The cyclical and on-going nature of community-based research described in Section 6.5 illustrated that the outcomes of community-based research are as much a starting point as they are an endpoint. Accordingly, this section demonstrates that there are numerous social and environmental outcomes along the way and that these are often inextricably linked. Many of these are intangible and difficult to explain. However, they are no less important for this. As one citizen participant explained:

> We're into evaluating and monitoring everything that we do, but it is hard to evaluate the good things that you do - the important things you do - they are intangible. Someone might do something in five years time, it might be choosing a solar water heater…or saving a few trees, or attending a seminar, or donating some money to some environmental cause or voting the right way - intangible. So how do you say you've done well? Some will walk away and not do anything. I have just got a good gut feeling about these things we do. *Citizen A/Site 2.*

This section describes the outcomes of community-based research evidenced in this case study with a view to providing an understanding of the ways in which these are both similar to, and distinct from, those of positivist science. For ease of explanation, the outcomes have been categorised into three interconnected thematic categories that coalesce into community-level outcomes: (i) issues awareness and action; (ii) on-ground action; and (iii) participant transformation.

6.7.1 Issues awareness and action

Many group members in this case study had been, or were, currently, involved in conflict resolution activities that concerned political lobbying and making objections against what they considered ill-advised local actions by developers and industry. Issues that the groups had tackled include: residential development, acid sulphate soils, fish kills, septic pollution, unsustainable recreational fishing, and riparian degradation. As one participant stated:

> There are just so many issues coming into our office - people wanting us to do things and development applications - the legal things. *Citizen A/Site 2.*

A great deal of citizen activity was required to achieve outcomes on such issues. This involved major public awareness campaigns as well as bringing issues to the attention of government agencies, regulatory authorities and politicians. The complex legal nature of many such issues prevents in-depth descriptions of them here. Nonetheless, the groups at both Sites 2 and 3 had prevented several development proposals while their actions 'pulling things together in a good scientific way' had led to fines and penalties against pollution-causing industries (*Citizen A/Site 2)*.

6.7.2 *On-ground action*

Much community action is devoted towards the restoration of subcatchment areas through tree planting, weed and litter removal and associated maintenance tasks. While the outcomes of these actions can be spectacular and easy to see, they often represent a major personal and physical commitment over a long time period. For example:

> There is a photo up at the Waterwatch office on one of the walls - a picture looking right down the creek here and it just looks like a bomb scene. Like it's totally desolate, like a moon- scape. There are photos up there now that I've taken since, and you can't see past the park now because it's all vegetated. So it's vegetated all down along the bank on this side and all around [the] Park, we planted in there about 10 years, so it's got a really good growth up and a dense forest. It just shows the changes that we can make - it's possible to improve things. *Citizen P/Site 3.*

> I've been out planting once and I really found it hard work. It was hot and the ground was hard. In places it was like rock and like glue in other places (because we were planting in the bottom of a gully). We honestly couldn't break up the soil to anything much smaller than a fist. We poked these plants in and I thought 'these plants are going to die'. We went back a few weeks later and the mortality rate was very, very low. Something like 98 % of the things grew and looked really good…I felt the hard yakka of that day quite profoundly for the next couple of weeks, but [citizen participants] who are obviously fitter than me do this every week for a couple of days. *Citizen C/Site 2.*

Despite these successes, group members pointed out that restoration does not produce 'quick results' and that 'you learn to be patient when you are a gardener' (Participant observation/Site 2/Day 11). Such patience can be very rewarding:

> It's rewarding when you see it a year later and everything is grown and you think it's worthwhile after all. *Citizen D/Site 2.*

In addition to the visual amenity provided by revegetation, community groups were also careful to restore the ecological functioning of areas by replacing barren areas or weed species with trees that also encouraged and sustained native animal species. Hence:

> We are using a tree list of about 300 indigenous species because there are a lot of camphor laurels along here. We are replacing them with a lot of berry-producing trees to attract back the doves, pigeons and fig birds. *Citizen P/Site 3.*

In some instances, streamside restoration as well as the construction of public parklands and walkways had also assisted in restoring the social functioning or the community spirit of areas. For example, one person talked about how changes to the natural and built environment through community-based research activities had proven to be very effective in raising awareness and opening up avenues of communication throughout the whole community:

> When this started off that was like a desert there that park. Nobody used it except for drug dealers, because the High School is just over here. They used to come down, because nobody came down here. So we started planting trees (that was about 10 or 12 years ago), then the adventure playground in the last the couple of years and then the walkways around. You start doing things and then you see other things that can be done too. It's about growing your own culture in your own town, which is your community. We can make our own culture here and hopefully enough people in the community pick up the vibes. *Citizen P/Site 3.*

6.7.3 Participant transformation

Both citizens and experts described positive personal transformations through their involvement in community-based research. They talked about learning a variety of new skills and knowledge, and developing new or stronger relationships with people and places. Consequently, they had increased their level of self-awareness, understanding of catchment issues and sense of community. Most participants related this positive transformation to the benefits of social learning through participation or collective action. Participants reported learning in three main areas including: (a) local catchment processes and information; (b) the nature of contemporary community environmental groups; and (c) more about themselves and their connection to their local community and natural environment.

(a) Local catchment processes and information

The majority of participants stated that they had learned a variety of catchment-based skills and knowledge both informally through active participation and formally by attending courses run or funded by the community group. One participant stated that 'it was a sad day when you didn't learn something new' and considered that his participation was 'a most enjoyable form of on-going education' (Citizen participant C/Site 2). Several participants explained how despite always having been interested in environmental issues and living very close to nature that their level of environmental awareness had greatly increased following participation in community-based research activities:

> You see what you're looking for. If you're not looking for those things, you can live your whole life oblivious to the wildlife or the things around you. To be able to go behind those houses in that built-up area - you walk a few feet through that bush area and see a pale-headed rosella, and pythons, and all sorts of things right on your back door step. I bet the residents don't even know they are there… I'm not laying any blame, because I was one of them too. I had a peripheral awareness and interest, but I had never pursued it. *Citizen F/Site 2.*

> I've got a background in Environmental Education and I had some awareness of catchment issues, but only some. I've been on a curve like that [tilts arm skyward] and I've loved that. And not theoretical, learning on the job - I think that's so valuable. *Citizen M/Site 3.*

Most people reported an increased level of awareness concerning the nature of catchments in general and also the issues that related to their local catchment. For example:

> It has really raised my awareness of the catchment area and the issues that pertain to it and the problems…Before I came here I was totally ignorant of most of the catchment - or what the catchment was - I know a few more things. *Citizen F/Site 2.*

> The main things [learned from participation] are about the district and about the watercourses. The systems here and sources of pollution and degradation. The main [aspects are] technical in a sense. *Citizen L/Site 3.*

One expert stated that awareness did not lead to understanding or action. Instead, she referred to research that showed action leading to awareness and understanding:

> There's an understanding that community have, but we're not happy with just an understanding, we need them to be empowered to make a difference. I'm very aware that awareness doesn't lead to understanding or action. Often people say that you have awareness first, but research is showing that this is not the case, that you can often change people's knowledge and understanding by changing their behaviours. *Expert B/Site 1.*

Thus, when participants reflected on their involvement in community group activities, they often noted a consequent change in their way of thinking and acting. For example:

> I think that my [sense of environmental attachment] has been very much challenged, from my previous thought patterns and has been very beneficial. The things that I have learned here I can now put into practice and effect at the place where I live, so I think that that is a very practical side to being involved and that becomes relevant to your life. *Citizen H/Site 3.*

Unquestionably, the learning associated with community-based research is experiential and cannot be separated from the act of participation:

> There are two things: one is the monitoring and one is the education and awareness. A lot of the education comes through monitoring anyway - I don't see that those two things are separate. By getting people out there and monitoring and getting information about their creek, they're learning at the same time...it's learning through involvement. *Expert A/Site 1.*

While some participants were able to learn through direct interaction with the environment, many people stated that they learned much from the other participants as they shared experiences and anecdotal information. For example:

> The three of us are all very 'birdy' people and not only bring identification into it but little anecdotes that we know, which we tell the others in case they don't know and they'll tell us things. *Citizen C/Site 2.*
>
> Just since February this year, from going out in the company of people like that - I've learned a lot just from being with them. I think it is just wonderful and that has really inspired me. *Citizen F/Site 2*.
>
> We seem to work well together…we have this passion for nature and wildlife, but our interests lie in slightly different directions. Whilst my knowledge of raptors is fairly abysmal - [one volunteer's] more than makes up for it - along with her enthusiasm for the subject. And [another volunteer] is really an all-rounder. There's not much you can stump him with, be it fish, plants, animals or various combinations or interactions of each of them. I don't really know what formal education he has in this direction but it's really quite formidable his knowledge. *Citizen C/Site 2.*

One participant also talked about learning from experts when they worked together on more extensive monitoring projects:

> On the bigger monitoring projects we've learnt a lot. We're learning all the time and we want to do that. We want to work with them [government agencies]. *Citizen G/Site 3.*

(b) The nature of contemporary community environmental groups

In the second instance, both citizen and expert participants had learned about the collaborative and active nature of catchment-based community groups. In many instances, this conflicted with the previous perceptions held by participants. One person stated that he had learned:

> How the new age environment movement is trying to work with the community, with all sectors of government in a cooperative way. Whereas my impression has always been that they try to be confrontational (I realise that there are still some out there that work that way). *Citizen H/Site 3.*

By working contentiously and honestly community members had also established trust between certain agencies and themselves:

> They [government agencies] appreciate that we try to do things well and that we try to be honest and genuine and that we don't elaborate or exaggerate. I think its been through a history of sticking to the facts and making sure those facts get heard. I guess they've built up a level of trust and I've built a level of trust in certain government offices and there are certain government offices that I won't go near, because you don't trust them and you work that out - it's just a people thing. *Citizen G/Site 3.*

> The other thing that I have learnt was a lot more about the practical side of things with the different catchment groups - where they do their testing which is the basis of Waterwatch, but then they move onto revegetation and regeneration. *Citizen H/Site 3.*

Definitely, some participants were surprised at the amount of work achieved by community groups. For example:

> I've always been a bit of a greenie, but I've never actually taken the time to really look at anything like this organisation (the Waterwatch organisation) and what it does and really to be a bit impressed by the amount of work that it does. Particularly, with its water-monitoring families all over the place that are regularly taking readings. *Citizen L/Site 3.*

These skills can also build the capacity within groups to participate more effectively in decision-making and contribute to a more participatory form of democracy whereby the benefits can extend to the wider community. Undoubtedly:

> It's not just the monitoring - it's the bringing together of people and teaching them how to participate more effectively in decision-making. *Expert A/Site 1.*

(c) Self-awareness: making connections

In the third instance, people felt that their active participation had enabled them to learn more about themselves and their connection to the environment and the local community. For example:

> I guess working in the creek it was just a natural progression of becoming more connected and in touch with myself and in nature, so I have really learnt a lot

> about myself. Who I am, what I am. It's a spiritual connection and it's very real. *Citizen P/Site 3.*

> When you're learning by doing you have a sense of ownership around the issues, rather than it being book orientated or theoretical - when you're actually at a community level and you're involved in doing something your connection is tangible basically. *Citizen M/Site 3.*

> I find it very connecting. I feel connected with my true self through nature and that's what in Western Society we've lost that in the last couple of hundred years. We've become disconnected from the land. *Citizen P/Site 3.*

Increased self-awareness meant that many people were now able to work in a society that had previously discarded or ignored their potential contribution:

> Being over the age of 50 really goes against you - even though you've another 10-20 years of work in you. Younger people - some of them tend to become a bit disheartened, but when we've given them the training and the support that they need, they seem to say 'oh, yes that is something that I can do'. *Citizen B/Site 2.*

Heightened awareness of the interconnectedness between people and the environment also has the potential to overwhelm or depress people as they become increasingly aware of environmental and social ills within a catchment. For example, one participant told me that he had learned that most of the plants in his garden were weeds and environmental pests while another stated that she now had little time for some neighbourhood children after seeing them repeatedly set fire to revegetation attempts. However, most participants expressed strong feelings of empowerment and happiness as a result of their local involvements:

> Some people go and look at a sunrise or a sunset, well it's that same sort of thing. I get messages from Kookaburras and different animals. I look at a Brahminy kite and I see him or her just floating around and I just feel really a nice sense of inner peace and harmony and freedom. I feel freedom inside because I'm relating directly to what that bird represents, it represents freedom - so I'm connecting with all these different things. *Citizen P/Site 3.*

These intangible outcomes were particularly valued and great cause for joy among both citizen and expert participants:

> How do you express such an awesome feeling? The joy of connectedness and the feeling of empowerment in knowing that what you are doing has a long-term impact. *Citizen M/Site 3.*

> You get that feeling from [a Waterwatch] group - nothing can describe that. I've been there and I love it. I just come away with the biggest buzz - as if this is all worthwhile. When you get really caught up in science and agency stuff, sometimes you get really dejected. Then the next day you speak to one of the

> coordinators, or you're out at their group, and you think 'it is worthwhile - I know why we're doing it' and you see all that vibrancy. That's how I recharge my batteries. *Expert A/Site 1.*

Undoubtedly, people are central in community-based environmental research, and when asked about the most enjoyable outcomes of participation, most citizens talked about 'the people' and the quality of the social interaction inherent in community-based research. The following quotation expresses the feelings of many participants:

> The diversity of what happens here, the minds of the people who come in and either give their time or come in and visit here, their backgrounds, what they contribute - just being able to listen to them...It's fascinating, especially the people, the people and their backgrounds. *Citizen H/Site.*

The learning described in the three areas above can be described as both experiential and social. Whilst many changes that arise from such participatory learning are difficult to detect or measure, both citizens and experts stated that they had noted changes in the language and vocabulary of the participants as their understanding increased. For one expert, this transformative influence on citizen participants heightened the need for citizens and experts to work together to achieve mutual understanding:

> You change people's language as well as their understanding of what's happening…I think the language aspect is really important and that's often what people don't realise. Sometimes I say to the scientists 'yes, but 10 years ago community people would never have used that language and now they do and as they come up with new indicators they should be working with us because you're increasing people's knowledge and changing knowledge all the time. *Expert A/Site 1.*

Two conversations with one group participant in the field illustrate the significance of developing a 'shared language and expressions' between scientists and the community. This person felt that it was important to use scientific language to be accurate and precise, but not exclusive or superior. She considered that scientists needed to learn to understand the language of local communities better. To this end, she felt the need to develop a common language between scientists and the community (*Participant observation/Site 3/Day 2)*. The use of scientific language had given members of this network a 'common' and 'objective' language that facilitated mutual understanding of issues and connected disparate people in much the same way as tributaries within a catchment 'forced separate streams to flow together'. Therefore, this participant considered that the beauty of science was that it made language objective thereby removing any blame or emotion and allowing seemingly disparate groups to work together (*Participant observation/Site 3/Day 7).*

6.7.4 Summary

There are many diverse outcomes that arise from the community-based research activities undertaken by the participants in this study. The most familiar and tangible are revegetated streamsides and gullies, water quality monitoring data and educational/celebratory materials and events concerned with catchment health. Related to achieving these outcomes are a number of personal and cultural transformations that were equally or more important to the participants in this case study. By working collectively and with nature in their local communities, participants noted positive personal changes in themselves and other community members through social learning. Thus, participants learned through interaction with the environment (experiential) and other people (social). Some participants considered that this kind of learning or capacity-building enabled group members to participate more effectively in decision-making. Undoubtedly, the use of scientific investigation had given these participants a common and objective language that allowed them to work harmoniously with expert scientists, farmers and agency representatives. However, many participants expressed that the greatest outcome was the opportunity to learn more about themselves and to strengthen their connection to the environment and local community.

6.8 SUMMARY

6.8.1 Summary of case study process

This phase of the study took an interpretive approach to understand on a small, but detailed scale, the nature, purpose and outcomes of community-based research in a multi-site case study. Interpretivism, where I, the researcher was the 'primary instrument' (Merriam, 1988:19) of data collection allowed for an in-depth exploration of the perceptions and attitudes revealed on a more superficial basis in Phase 1. The selected case study encompassed an inter-agency/community research project (Site 1), and two well-established catchment community groups in South East Queensland (Sites 2 & 3). I began with the inter-agency/community project and continued this as a case study site into the second and third years of research. This was augmented in the second and third years by focusing on two of the initial community groups as second and third case study sites in their own right. This method of non-probability sampling using networks is described by (Sarantakos, 1993) as 'snowballing' and was appropriate for this study where I used participants to identify sites which they considered successful and 'information rich' (Earles, 2002).

The data collection techniques used in this study included semi-structured interviews, participant observation and document analysis. Consistent with Merriam's (1988) observation that rarely are all three strategies used equally, semi-structured interviews formed the basis of this account. Participant observation was used to inform interviews and helped to establish a rapport with interviewees, while document analysis provided additional contextual information.

To ensure the trustworthiness of these findings I followed the principles of construct validity, triangulation, face validity, and reflexivity (see Chapter 3). My continued interaction and communication with primary contacts at each case study site enhanced the efficacy of these techniques.

6.8.2 Summary of case study findings

Growing concern over the quality and quantity of the water and natural amenities of Queensland in light of recent population increases has heightened awareness of the need to remediate the negative social and environmental impacts that arise through a decline in water quality. To better understand how a collaborative approach can lead to more sustainable outcomes, this chapter focussed upon community groups involved in the Queensland Waterwatch program and State Natural Resource Management agencies undertaking a participatory approach to catchment health.

The first case study site concerned an inter-agency project initiated to conduct participatory research with established community groups. The second and third case study sites were located within two well-established community environmental groups that were involved to varying degrees in the research project described for Site 1. All expert participants involved in the project at Site 1 were committed to, and skilled in using a participatory approach to research. However, the project became largely agency-directed because of institutional constraints imposed by the broad geographical scale of Queensland and the level of funding (only one project officer). Consequently, much of the remainder of the chapter described the activities and outcomes of the community groups as successful entities in their own right. In contrast to the organisational structure adopted by the agencies, the community groups were more flexible in their structure and included a wider cross section of the community in their approach to research.

Both citizens and experts believed that people are the major cause of environmental degradation and, therefore, that the responsibility for reversing such degradation is society-wide. There were two perceptions of how such societal responsibility may be enacted. The first was through the political process whereby political pressure from the community can ensure that experts are funded to hold positions of responsibility. The second, and focus of this chapter, was through collective action both by and on behalf of the community, industry, government and scientists.

The interviews in this case study indicated that these experts are motivated to undertake a collaborative approach because they believe that a 'whole of community' approach is vital to achieving sustainability. Community-based research was viewed as *one* important approach towards widespread community commitment with several features that make it attractive to experts seeking enhanced environmental monitoring capabilities and access to local knowledge. Citizens expressed a diverse range of personal motivations that were often coupled with an opportunity to participate. The primary motivation underpinning much community participation was an overriding desire to take collective *action* on behalf of the environment. This concern often extended to regard for fellow and future community members. These results illustrate that the common desire of experts and citizens for sustainability is manifest in different ways. These are best described along a continuum from utilitarian to communitarian motivations but linked by a conservation/environmental ethic. In this description, experts scientists tend to frame sustainability in terms of natural resources while citizens appear to make less of a distinction between 'the environment' and 'the community' and view sustainability in more holistic terms. As explained earlier, these differences may not represent the personal philosophy of the experts involved, but rather that feasible in their roles as scientists and resource managers who work with a range community groups often distant from their own community.

The diversity of participant motivations coupled with an understanding of the need to involve the wider community in achieving sustainability, lead the community groups in this study to undertake a great variety of activities including awareness-raising events, educational opportunities, publications, electronic resources, and artistic works. These cohesive and informative activities are designed to involve everyone in the community and are underpinned by collaborative catchment research. The aim of the community-based research conducted in these case study sites is to improve a situation whilst enhancing the ability of participants to improve future situations through social learning. Community members described this approach as a continuous 'situation improvement cycle'. Monitoring is a key aspect of this cycle and enables accurate evaluation of research outcomes as well as keeping members attuned to dynamic catchment issues by integrating information from both the natural and social sciences. Thus, the research process in these groups is participatory and reflective with participants stating that the most effective approaches to community-based research are local and collaborative with participation from scientists, community members and agency representatives.

The human strengths and weaknesses of people are central to all the issues faced by these groups embracing a social or community-based approach to research. There are three interrelated ways that people can contribute towards an opportunity for, or a constraint upon, the functioning of community-based research groups. The first is at the socio-political level where degree of societal interest affects political decision making and consequently the level of funding for groups. Lack of genuine enthusiasm from the wider society has lead to low and insecure levels of group funding, despite support from within groups and the surrounding community. Related to this, the second group of issues that arise are practical opportunities and constraints. In this instance, limited funding restricts the time that participants can afford to volunteer and also access to the technical equipment and assistance necessary to conduct rigorous research. The intractable nature of the task [catchment health] combined with minimal resources means that 'burnout' has become a major issue among coordinators and volunteers. The third constraint stems from negative citizen and expert perceptions of community-based research participants and outcomes, which can hinder collaboration, the utilisation of research outcomes, and group esteem. The human aspect in all of these constraints indicates that people are also vital to all opportunities. This chapter has shown that most, if not all, of these constraints can be overcome through increased participation from the wider community and increased interaction between citizens and experts facilitated by skilled coordinators sensitive to the needs of both volunteer and expert participants.

There are many outcomes that flow from community-based research. In this chapter I have described three main outcomes including issues awareness and action, on-ground action, and participant transformation. Certainly, there is a focus on taking action, and, from an external viewpoint, it is most easy to see [and count] trees being planted, water quality being tested, and litter being removed etc. This can give the false impression that these are one-off events and permanent solutions. In reality, these represent an on-going commitment to the health and wellbeing of a local catchment and its constituent people where participants are constantly implementing, maintaining and adapting 'solutions' as directed by their on-going research activities. This constant presence in the catchment appears to be an effective way of raising awareness and opening up channels of communication throughout the wider community. Thus, this approach to ecological restoration can also assist in restoring the social functioning or sense of community within subcatchment areas.

The basis for these community or catchment scale outcomes is transformation at a personal level through social and experiential learning. Participation that involves interaction with the environment and other people provides a diverse array of learning opportunities for participants to learn about local catchment processes and information in a variety of formal and informal ways. Nonetheless, many participants most valued learning more about, and fostering, their connection to the environment and local community. Such personal or cultural changes are often assumed to be difficult to evaluate or measure. However, many participants had begun to notice a change in the language and vocabulary of participants as their knowledge and understanding increased. Several participants believed that this represented the beginning of a common language between expert scientists and community members and was a vital step towards collaborative resolution of catchment issues.

6.9 IMPLICATIONS (TENTATIVE)

This chapter has presented a personal account of community-based research as experienced by citizens and experts working on catchment issues. These findings have implications for the conduct of catchment research and the role of local people and knowledge in achieving catchment health.

Catchment health: pressures and responsibilities

- The responsibility for catchment health is society-wide, yet respondents noted a low level of environmental awareness and participation in remedial and/or preventative measures. A few committed individuals are bearing the responsibility for the majority. This demands a shift from representative to participatory forms of democratic governance where leadership recognises and supports the small sector of society actively interested in environmental quality and encourages more people to participate.

Motivations for involvement in community-based/collaborative research

- Both citizen and expert scientists are motivated by an underlying desire to achieve sustainability. Community-based research is perceived as *one* important approach towards widespread community involvement that can produce positive outcomes for both citizen and expert participants.

- Experts tend to value this approach in utilitarian and scientific terms consistent with the conditions of their training and employment, while citizens express a range of personal motivations that tend to be more holistic. In defining sustainability citizens include concerns for both the environment and fellow community members. To prevent the constraints and limitations of approaches to collaborative research that are motivated solely by utilitarian or science-based desires, requires a re-definition of research and institutional changes that recognise the benefits of a communitarian approach.

Approaches to community-based/collaborative research

- Despite participatory intentions, institutional and financial constraints that apply to the broad geographical scale of projects developed by state natural resource management agencies ensure that agency-initiated projects tend to remain agency-led with a structured approach to collaborative research that is linear and hierarchical.

- Community-initiated projects are flexible, cyclical and seek local community involvement in a non-judgemental manner. Efforts are based upon an iterative questioning cycle that involves actively taking measures to improve a situation.

- Collaborative approaches need to recognise these differences. If agencies are serious about taking a participatory approach more time and personnel are required to work alongside community members to enable a more localised approach and effectively reduce the scale of these projects without compromising on their scope. There is also a need to become more flexible in recognition of community diversity. This may be fostered through two-way communication that reaches beyond individual project officers to managers and funders.

- Consistent monitoring and evaluation is vital to all community-based research activities and should integrate information from the natural and social sciences.

Community-based research: opportunities and constraints

- Community-based groups are unavoidably affected by societal apathy towards catchment issues. A chain reaction of barriers flow from this negative context including political indifference, low levels of funding, limited access to technical resources and support, cynicism towards community efforts, mistrust of experts, and burnout. Increased participation from all societal sectors facilitated by skilled coordinators is vital to overcoming these hurdles faced by community catchment groups.

Social and environmental outcomes of community-based research

- Community-based research groups regularly undertake restorative tasks in catchment areas and contribute to the visual amenity and ecological integrity of these systems.

- Community-based research groups regularly undertake education, awareness-raising and celebratory events that promote a greater understanding of and empathy for catchments and waterways.

- The social and environmental outcomes that accrue from these activities are inextricably linked and underpinned by participatory research and personal transformation. This recognition conflicts with arguments that social poverty must be alleviated before efforts towards environmental rehabilitation are possible. Conversely, ecological restoration can simultaneously facilitate personal well-being and a sense of community if conducted using a participatory and collaborative approach.

- Social and experiential learning through participation changes the language and vocabulary of participants. Some participants welcome scientific language as its objectivity removes any blame or emotion allowing disparate groups to communicate. However, scientific language is not accessible to many community members and precludes their involvement in a situation for which they are responsible. This heightens the need for citizens and experts to work together towards a common language and mutual understanding.

Chapter 7

COMMUNITY-BASED RESEARCH

A SYNTHESIS

7.1 INTRODUCTION

This chapter presents the insights from the synthesis phase of the study to understand the influences on community-based research within Australia and how these affect the conduct and outcomes of this form of participatory research when applied to catchment issues. Much of the discussion centres on the citizen/expert partnerships that are part of community-based research. The synthesis is guided by the literature reviewed in Chapter 2 and the key research questions that emanated from this review. It involves critical analysis of the findings from the comparative survey of the attitudes to community-based research held by citizen scientists, expert scientists and natural resource managers (phase 1) and the multi-site case study of the citizen and expert experiences of community-based research (phase 2). Kemmis (1987) states that critical reflection involves the systematic examination of the historical and contemporary contexts of particular practices and an uncovering of the interests served by them. By combining information collected using both positivist (large scale) and interpretive (small scale) approaches this chapter makes clear the link between local activities and the wider context within which they operate.

Integrating these quantitative and qualitative findings enables a richer and more insightful depiction of the state of community-based research in catchment management in Australia than the individual chapters can provide. The implications of these findings for working collaboratively with citizens and community groups on catchment issues and the approach to research necessary to ensure maximum benefit from community participation are discussed.

7.2 COMMUNITY-BASED RESEARCH IN AN AUSTRALIAN CATCHMENT CONTEXT

The recognition that ecosystem health is the responsibility of all citizens has led to increased calls for participatory approaches to research and management (eg Pretty 1994; Sclove 1997). Indeed, there are several compelling reasons why agencies, researchers and industry are interested in engaging the community in research activities. The most common rationales have been described by Korfmacher (2001) as democratic, substantive, and pragmatic. These reinscribe the inherent value of citizen participation in public decision making, citizens' values and knowledge, and citizen support. In this way, Fischer (2000:x) believes that 'participation not only gives meaning to democracy but also plays an important educational and psychological role in the social development of the individual citizen'.

In the Australian context, The Standing Committee on Environment and Heritage (2000) states that catchment degradation affects all Australians and is the individual responsibility of all citizens. Consequently, The National Water Quality Management Strategy emphasises the role of community members in achieving water quality objectives. However, increased community participation has proved difficult to achieve with Chris Davis, Executive Director of the Australian Water Association (AWA) drawing the two themes of this study together by stating that the 'two big issues facing our industry are monitoring water quality and engaging the community' (Davis 2001:3).

Chapter 2 suggests that adaptive management is an approach to resource management that may enable the co-operative inquiry, mutual responsibility, and citizen participation that Tam (1998) argues is necessary to support the communitarian compromise between state and market dominated approaches to natural resource management (see Adams and Hess 2001). This 'methodological innovation' (Lee 1999:3) was initiated by C. S. Holling and colleagues at the University of British Columbia in the late 1960s and has continued into recent years (Gunderson & Holling, 2001). Adaptive management is a response to recent scientific insights that interpret environmental issues such as managing water quality as dynamic, full of uncertainty and non-linear phenomena, and continually surprising (Iles 1996:288).

An underlying assumption of this approach to natural resource management is a shift away from an exclusive reliance on positivist research towards a more humble and reflexive strategy that involves public input, continual questioning and refinement in the face of ecological uncertainty (Gunderson, Holling & Light 1995). Iles (1996) notes that there is no standard model of adaptive management. Rather, management processes must be closely aligned to the particular context and setting. Despite the promise of this approach and the recognition that it is 'scientifically sound', Johnson (1999) points out that one of the major challenges is integrating stakeholders more effectively into decision making.

Citizen science (see Irwin 1995) represents a partnership between community members and professional or 'expert' scientists (Pandolfi, 1999). In the context of this study it is based on several assumptions including the existence of a civil society, scientific relevance, citizen and expert equality, and individual responsibility for sustainability issues (Irwin, 1995; Ulrich, 2000).

However, there are several pragmatic and conceptual barriers to citizen science including the need for highly specialised and complex knowledge (Irwin, 1995; Ulrich, 2000), lack of an effective democracy (Saul, 1992), and limited community access to resources and time for volunteer activities (Carr, 2002). In addition, 'the community' is often used as a derogatory term where citizens in local communities are perceived by expert scientists as ignorant or irrational (Martin & Beder, 1993). Consequently, Davis (2001:3) notes a 'stigma' related to community data whereby measurements taken by volunteers and landowners are deemed to be 'deficient'.

With regard to these strengths and weaknesses, this chapter explores how community-based research can be utilised to integrate the ideals of adaptive management and public participation in the form of citizen science. It examines the potential of citizen scientists to work with expert scientists and natural resource managers in improved research and management outcomes for catchment areas within Australia. The discussion centres on three main themes arising from this study. The first is the need to understand collective responsibility in a catchment context and whether this is best achieved through representative or participatory forms of democracy. The second is the need to understand community-based research as *one* important approach towards ecological sustainability.

This involves defining the role of citizens in catchment issues, understanding the dominant motivations of both citizens and experts, and examining the strengths and weaknesses of this approach. Finally, the unifying outcomes of community-based research are discussed with respect to social and environmental connectivity.

7.2 CATCHMENT HEALTH: UNDERSTANDING COLLECTIVE RESPONSIBILITY

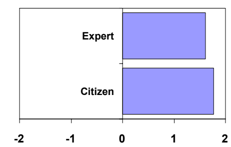
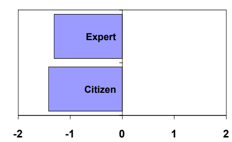
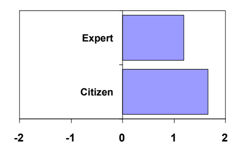
7.2.1 Human pressures and responsibilities

This study has reinforced that people are perceived as the major threat to catchment health through increases in population and destructive behaviours that stem from a 'general cultural disrespect' of waterways. The following statement is indicative of the feelings of the majority of participants interviewed for this study:

> It's humans that are the problem - nothing else. (*Expert participant - case study*)

Consequently, there was general agreement among the citizens and experts in Chapters 5 and 6 that the responsibility for catchment health is community-wide. Not only are expert scientists and natural resource managers accountable - the community has a role to play in catchment management (see Table 7.1).

Table 7.1 Comparative perceptions of the responsibility for catchment issues

Catchment management issue	*Expert perception (n = 175) Mean (SD)*	*Citizen perception (n = 38) Mean (SD)*	*Graphical representation*
The entire community is responsible for catchment health	1.61 (0.61)	1.77 (0.63)	
Only expert scientists and managers are responsible for catchment management	-1.31 (0.76)	-1.42 (0.92)	
There needs to be more community involvement in catchment management	1.19 (0.77)	1.66 (0.53)**	

**Mean score calculated from response categories where -2 = strongly disagree, -1= mostly disagree, 0 = neither agree nor disagree, 1 = mostly agree, 2 = strongly agree*
***Significant difference p < 0.01 (Mann-Whitney U-test for equality of means) (see Appendix C)*

The challenge, as one survey participant noted, lies in defining this role. This involves understanding what collective responsibility means in a practical sense for individuals so that they may effectively contribute towards catchment health.

7.2.2 Representative versus participatory responsibility

Chapters 5 and 6 demonstrate that there are two contrasting perceptions of how societal responsibility for catchment health may be enacted. The first approach is through the political process whereby political pressure from the community ensures that experts are assigned the status and resources to bear this responsibility. Indeed, one expert in Chapter 6 stated that his scientific position in a government department was 'all part of the political process'. Another expert described the implications of this representative argument for the roles of citizens and scientists using an agricultural context:

> There is a simple divide between the worldview of community-based 'scientists' and university trained scientists…I strongly hold the view that science is for expert scientists and that farming is for expert farmers. (*Expert participant - survey*)

These comments reinforce the positivist paradigm of research where only those with specialist training and formal positions conduct science in isolation from the wider community. The skills of other societal sectors are acknowledged, but in an atmosphere of positivism and representative democracy a collaborative approach is not desirable.

The second approach is through collaborative research that requires collective *action* from government, industry and community members. One citizen participant in Chapter 6 described this as 'a triangle of activity' where action was needed at all points. This need was echoed repeatedly in the survey and by case study participants who stated that sustainability could only be achieved by bringing these groups together. For example:

> Getting the two (expert scientists and community groups) together is the only way to recognise and engage the problems. (*Expert participant - survey*)

The collaborative or partnership approach is indicative of participatory notions of democracy and supports community-based approaches to catchment research and management.

The dominance of representative democracy and traditional problem-solving methodologies that rely upon positivist science conducted by experts to produce technological solutions, help to explain why case study participants observed a low level of community environmental awareness and participation in restoring or maintaining catchment health. A few committed individuals are bearing the responsibility for the majority. As one expert with considerable community participation experience observed:

> They [general population] don't see all the links - they don't even think about it. *(Expert participant - case study)*

Recognition of the social drivers of catchment degradation [Chapters 5 & 6] increasingly questions the value of positivist approaches that exclude citizen participation and highlights instead the need to emphasise participatory approaches to research. This demands that *leadership* recognises and supports the small sector of society actively interested in environmental quality and encourages more people to participate. The following statement by one community coordinator emphasises the role of leadership in mobilising the potential within communities to participate:

> There are so many unbelievable, valuable, clever, talented human beings that are just waiting to do something. As long as you put the energies and the

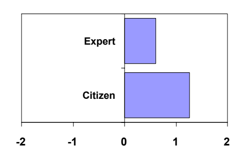
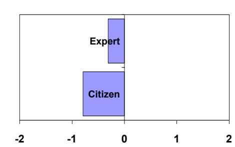
passions in the right direction and give them hope, you just never know what's going to happen - it's so exciting! (*Citizen participant - case study*)

7.3 COMMUNITY-BASED RESEARCH: ONE APPROACH TOWARDS SUSTAINABILITY

7.3.1 The role of citizens in catchment research

Building on the ideals of participatory democracy and 'post-normal' approaches to research as an important aspect of this, the majority of citizen and expert responses indicated that they believed (albeit cautiously) research to be a valid path for citizens to pursue towards catchment health (see Table 7.2).

Table 7.2 Perceptions of the role for citizens as researchers in catchment management

Citizen role in catchment management	*Expert perception (n = 175) Mean (SD)*	*Citizen perception (n = 38) Mean (SD)*	*Graphical representation*
As researchers, community groups play an important role in catchment management	0.61 (1.00)	1.26 (0.86)**	
It is inappropriate that community groups be involved in all stages of catchment research	- 0.31 (1.24)	- 0.79 (1.30)	

**Mean score calculated from response categories where -2 = strongly disagree, -1= mostly disagree, 0 = neither agree nor disagree, 1 = mostly agree, 2 = strongly agree*
***Significant mean difference p < 0.01 (Mann-Whitney U-test for equality of means) (see Appendix C)*

When research is conceived in a scientific or adaptive management style there are a number of defined steps in the research process [see Chapter 2]. Chapters 5 and 6 indicate that citizens have a valid role to play in each of these stages and that expert assistance in the design, analysis and conclusion stages of research is often desirable. Many respondents also emphasised the importance of involving all stakeholders at the *beginning* of projects to ensure a degree of ownership in the outcomes. More importantly, perhaps, is the development of research partnerships between citizens and experts where participants are seen as co-researchers [Chapter 5]. The following comment from an expert scientist illustrates this point:

> With suitable training and protocols most interested community members can undertake some fundamental research. More important perhaps is the great benefit to be derived by both scientists and the community from effective partnerships in these endeavours especially when biophysical, social, economic and environmental factors and interrelationships are explored and developed. (*Expert participant - survey*)

In such partnerships, all participants should be seen as equals though not equally skilled (Ulrich, 2000) and capable of contributing complementary knowledge. Indeed:

> Community-based research should build on and compliment detailed scientific study - the two have value and both should be part of and inform catchment management. (*Expert participant - survey*)

However, this study indicates that the formation of such harmonious and equitable partnerships is uncommon and hindered by many practical and perceptual barriers. For example, several experts stated that they had encountered institutional 'resistance' from within their organisations when attempting a more participatory approach [Chapters 5 and 6]. These respondents spoke about the need for more time, funding and changes to job descriptions that allowed for the integration of community-based research with that conducted by expert agencies or institutions. Of importance to the concept of co-research is the observation that citizens and expert scientists or their institutions often have a fundamentally different approach to knowledge production [Chapter 6]. These differences and the motivations underpinning them are important to understand in facilitating the citizen role of co-researcher and are discussed next.

7.3.2 A continuum of motivations for involvement in community-based research

This study has described a diverse range of motivations that compel citizens to participate in community-based research beyond parochialism and self-interest. Indeed, citizen participants surveyed in Chapter 5 were as likely to have lived in their current community for less than one year (21%) than they were to have lived there for over 20 (23%).

Chapter 6 illustrated that initial motivations are often coupled with an opportunity before good intentions translate into practice. For example, many people expressed a long-held environmental ethic, but only retirement or a change in occupation had made participation accessible. Both citizens and experts were motivated by an underlying desire for sustainability where community-based research was seen as *one* important approach towards achieving this by facilitating widespread community involvement. Hence:

> Every little bit helps to push people. There is no one magic thing. You have to keep hacking away at it, until you make a difference. *(Expert participant - case study)*

More immediate sources of impetus can be described along a continuum from utilitarian to communitarian motivations [Chapter 6]. In this sequence experts tend to value community-based research in scientific terms consistent with the conditions of their training and employment, while citizens express a range of personal motivations emphasising concerns for both the environment and fellow community members.

These findings suggest the need for the facilitation of more opportunities for people to participate in voluntary activities and research. Part of this may involve institutional changes that recognise the benefits of a communitarian approach to prevent the constraints and limitations of approaches to collaborative research that are motivated solely by utilitarian or science-based desires. The following points made by a research fellow give some indication of the kinds of institutional changes that may be required:

> To really incorporate community-based research into typical scientific research we need to have it explicitly included in our job duties and have time and funds provided…It cannot just be added on top of scientists' duties - it has to be an integrated part and those at higher levels have to realise that other components of our duties will have to be reduced. (*Expert participant - survey*)

7.3.3 Barriers to community-based research

In agreement with the barriers already mentioned, the survey indicated that current levels of research collaboration between citizens and experts beyond an informal exchange of advice are minimal. By their integrated nature, community-based groups are unavoidably affected by the surrounding social and environmental context. As one expert stated:

> It's all the mechanisms above community that keep them where they are. (*Expert participant - case study*)

Societal apathy towards catchment issues creates a negative context for the conduct of community-based research, which includes a cycle of political indifference, low levels of funding, limited access to technical resources and support, cynicism towards community efforts, mistrust of experts, a high turnover rate of volunteers and volunteer burnout

[Chapters 5 & 6]. This analysis supports the literature cited in Chapter 4 that these hurdles are prevalent and common to many community efforts. The order in which I have listed them implies a causal relationship between many of these barriers where the existence of one inevitably leads to another in a cyclic fashion.

Acknowledging the interrelationships between these variables is important in overcoming them. For example, limited funding was repeatedly cited as a major constraint on the activities of citizens and experts. Yet, closer analysis implies that this hurdle is not so much a question of money but of resources such as people, time and equipment.

While a range of approaches has been utilised towards environmental sustainability, within Australia investment has been directed heavily towards voluntary approaches (Curtis, 1998). A number of authors have questioned if this represents a shift in the burden of responsibility for action from government to local communities (eg Carr, 2002; Curtis and Lockwood, 2000; Martin *et al*., 1992). Consequently, Carr (2002:58) notes that there are concerns that 'we' are expecting community groups to do too much. Given the serious and intractable nature of many of Australia's environmental problems including dryland salinity, soil erosion and declining water quality, perhaps it is not a question of asking the community to do too much, but rather failing to provide adequate leadership, vision, and support. Thus, the re-occurring expression of 'limited funding' as the key constraint may be a simplistic view and, perhaps, an unfortunate negative consequence of the devolution of responsibility for natural resource management to under-resourced community groups without government policies that support the necessary social mobilisation.

Another re-occurring theme throughout this study was expert concern that community data lacks sufficient scientific rigour as a basis for decision-making. The sequence of barriers reveals that this is a complex issue and can only be adequately explained and addressed by acknowledging the interrelated and cumulative effect of all these hurdles [Chapter 6]. It is not the purpose of this study to validate or refute such concerns, but rather to understand how they arise and how they may be overcome. Concentrating on the ever-present question of community data quality, critical analysis suggests that many expert concerns may again be understood in light of a positivist worldview.

Chapter 2 illustrated that in the positivist paradigm, scientific conduct in environmental matters is based on external notions of 'truth' or objectivity where the concept of reliability through repeatability is vital. In this paradigm, science is viewed as highly technical and only suitable for conduct by those with specialist training separate from public activities. The following comments from one citizen indicate that this is symptomatic of the general relationship between lay and expert knowledge:

> It's all laymen's knowledge - none of it is through formal education. I've just always been interested…[However] like everything else, unless you have that piece of paper with proof of formal qualification, you've got nothing. You may have the best experience in the world and be able to out-do a lot of the young graduates, but unless you have that piece of paper you've got nothing really. (*Citizen participant - case study)*

These points support the division of society into experts and non-experts. From the positivist standpoint, it becomes clear why the amateur status of many citizen participants, the inclusion of a wide cross sector of the local community, and the consequent differences among community groups are referred to by some experts as *variability* and therefore weaknesses of community-based research.

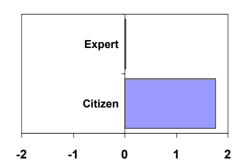
By way of contrast, the post-normal paradigm that embraces uncertainty appears to underpin the thoughts and actions of other experts and citizens. These respondents often spoke about such differences as *diversity*, which they viewed as strength to be celebrated in facing the unpredictable and complex task of catchment management. They maintained that greater participation improved the breadth of knowledge and range of options available to resource managers and, therefore the success of interventions. As one expert respondent stated 'successful research demands the involvement of end-users' [Chapter 5]. This observation led several survey respondents to question the validity of a citizen/expert dichotomy in catchment management altogether. These comments are consistent with calls from two experts in Chapter 6 for scientists to remember that 'the community is us'.

Despite recognition of the need for a unified approach, the data reveal that the proponents of these two paradigms in catchment management are often in competition and that neither has fully achieved the ideals of a participatory approach. Chapters 5 and 6 illustrate that this division is fuelled by at least two current trends in scientific research. The first is that funding for scientific research increasingly demands a public good component. This has caused insecurity among *some* experts that funding for 'pure' research is 'dwindling'. These misgivings have not gone unnoticed. Several citizens and experts stated that community efforts are hampered by jealous or fearful experts that discredit or ignore community efforts in the hope that this will strengthen their status as the sole providers of environmental knowledge brought to bear in catchment management. For example:

> A lot of it is insecurity. I'm not saying that everybody is tarred with the same brush but a lot are. In a lot of cases there is jealously of knowledge. A lot of people want to use the knowledge they have for self-aggrandisement. (*Citizen participant - case study)*

The second trend is the move towards data ownership or intellectual property. This may explain why experts surveyed were ambivalent towards sharing their data with community groups (see Table 7.3).

Table 7.3 Comparative future research intentions

Future research intentions	*Expert perception (n = 175) Mean* (SD)*	*Citizen perception (n = 38) Mean* (SD)*	*Graphical representation*
I would willingly share our research data with scientists and agencies/community groups	0.02 (1.22)	1.76 (0.49)**	

**Mean score calculated from response categories where -2 = strongly disagree, -1= mostly disagree, 0 = neither agree nor disagree, 1 = mostly agree, 2 = strongly agree*

***Significant mean difference at the 0.01 level of significance (Mann Whitney U-test) (see Appendix C)*

Most academic research institutions and research centres now advocate the enforcement of intellectual property. The survey did not reveal any influence of this on the conduct of community groups, however, this did appear in the principles of Waterwatch and in the case study. One of the tenets underpinning community-based research is a transparent and inclusive research process. There was much evidence of this in the case studies, for example:

> That's what I love about the coordinator - her willingness to just invite people on-board. *(Citizen participant - case study)*

Yet, the increasing tendency among some community group members in the case studies to adopt a proprietal attachment to 'their data' (a tendency reinforced by Waterwatch principles) is more a reflection of a positivist approach to research than a participatory one:

> Waterwatch Queensland has a very strong process that the community owns the data that they gather and the community give permission for that data to be used. *(Expert participant -case study)*

Respondents justified this stance by arguing that community ownership of data ensures that community members do not become 'lackeys for scientists to get information'. These points underscore the difficulty in escaping the positivist paradigm.

When knowledge becomes a means for 'self-aggrandisement' or something that is 'owned' rather than a basis for making sustainable decisions, this study implies that it becomes a source of individual power that represents either insecurity or arrogance [Chapter 6]. This situation is at odds with the ideals of interdependence and universal education described by Fyfe (1999), Pimbert (2001) and Foster (2002) where collectively constructed and shared knowledge is vital in the journey toward sustainability.

7.3.4 Community-based research: a transition?

Consistent with the diverse motivations expressed by citizen participants, the citizen projects at the case sites were community-initiated, flexible, cyclical and sought local community (including citizen and expert) involvement in an on-going, non-judgemental manner. One citizen participant described the process as being like a 'rolling river' which continually expanded and contracted. Efforts were based upon an iterative questioning cycle that involved actively taking measures to improve a situation. This was best described by another case study participant as a 'situation improvement cycle' [see Chapter 6]. Monitoring is essential to the functioning of this cycle to ensure that members are attuned to the health of the local catchment and to enable accurate evaluation of and reflection on the outcomes of research projects.

In contrast, the agency and expert scientist project reported in Chapter 6, was shaped by the institutional and financial constraints that apply to the broad geographical scale of projects developed by state natural resource management agencies. Despite participatory intentions, these constraints mean that such projects are often agency-initiated, remain largely agency-led, and are run with a structured approach to research that is linear and hierarchical.

The agency/expert scientist approach is indicative of current adaptive management projects where a wider range of people have been included in the research process, but the hurdles of effective public participation and local relevance remain (see Johnson, 1999). This study indicates that these constraints persevere because the institutional culture and broad geographical scale of such projects make it difficult to move beyond positivist and representative approaches. As one expert stated:

> There is a belief that these [management] tools could be designed on a whiteboard somewhere in Sydney, then developed and "provided" to the community. My personal feeling is that without the relevant community groups directing the research, anything we develop will ultimately end up on a bookshelf somewhere unused. (*Expert participant - survey*)

By way of contrast, the citizen approach to catchment issues signifies a culture of participation and a move towards a more post-normal form of inquiry. This appears to have been achieved by embedding research in the context of the local community. By having the research directed by local community concerns and conducted with community members, the 'dilemma of stakeholder input' described by several authors including Ewing *et al*. (2000) and Fischer (2000) can be largely overcome. As one citizen participant in the case study noted:

> The beauty of Waterwatch in a sense is that they are here, they are local, they have got a lot of detailed information, plus a lot of contacts. (*Citizen participant - case study)*

These differences may be further understood by the contrasting concepts of *research* and *science* described by Harding (1998), Latour (1998) and Nowotny *et al*. (2001) in Chapter 2. Following the arguments of these authors, research embraces uncertainty, subjectivity and diversity. It is therefore akin to a post-normal approach to inquiry. By way of contrast, science is a positivist approach to inquiry based on certainty and objectivity. Thus, it is appropriate to describe the role of citizen and expert participants in community-based research as co-researchers rather than co-scientists.

The key point in discussing these paradigms is that despite the emphasis on undertaking a partnership approach articulated by both citizens and experts in Chapter 5, only the kind of community-initiated projects described in Chapter 6 appear to be embarking upon a transition towards a paradigm that supports this approach. However, the barriers indicate that the difficulties do not lie in the 'new' approaches, but in escaping the established paradigm. Thus, Chapters 5 and 6 demonstrate that the citizen and expert approaches to inquiry are distinctive but share several features that undermine the notion of a 'simple' dichotomy. While the diversity of participants and adaptive nature of activities make these features difficult to qualify, these Chapters indicate that increased participation from all societal sectors and the development of networks that can lead to social capital are vital to integrating a greater diversity of knowledge, resources and people. It is this kind of integration that can give meaning to notions of collective responsibility (see Section 7.3).

Accordingly, many experts argued that interaction is 'fundamental' to catchment research by increasing the relevance and utility of research outcomes. In addition, 43% of expert scientists and 75% of citizen scientists intended to continue or commence research interaction [Chapter 5]. However, these beliefs and intentions are in contrast to the minimal level of research collaboration that typifies the current situation. Thus, it appears that without the transition, or cultural evolution, towards a participatory paradigm that supports these intentions effective public participation is likely to remain problematic.

7.3.5 Strengths of community-based research: facilitating co-research

Despite the pervasive nature of the constraints upon community-based research, this study has also revealed much support for community participation in research from both citizens and experts. Citizen participation has been described as a way to: provide sufficient data, compliment and increase the local relevance of expert data, better understand and implement research findings, and, key in the transition from problems to solutions by facilitating citizen/expert collaboration. The comments of one expert with considerable community experience further highlight the value of long-term Waterwatchers in understanding catchment processes:

> They are people who have a sense of place. They have an attachment to that waterway, they've seen it and they know what's happened to it. As well as doing these tests, they have an intrinsic knowledge of what's happened there. (*Expert participant - case study*)

Community-based research has also been instigated in personal and community development (capacity-building) by facilitating the kind of social and experiential learning that can empower people to become more effective participants in societal decision-making. Indeed:

> It all adds up to capacity-building, which leads to environmental quality. I don't know how to rank the outcomes, they are all mixed together…Some of our coordinators talk about what they do as community development. It's not just the monitoring - it's the bringing together of people and teaching them how to participate more effectively in decision-making. (*Expert participant - case study)*

At this point it is important to note that effective citizen/expert partnerships were repeatedly cited as integral to achieving these benefits. For example:

> It is very resource intensive and requires a great deal of coordination at statewide, regional and local levels. Community groups are quite happy to do what they can, but they can't act or be very successful in isolation. They need to be supported and I think you get many, many times back as a management agency what you put in if you form equal partnerships with community groups. (*Expert participant - case study*)

Consequently, it is important to understand how horizontal (within societal groups) and, particularly, vertical (between societal groups) partnerships can be fostered to achieve optimum benefits in catchment research. Combining information from Chapters 5 and 6 indicates that effective citizen/expert partnerships as co-researchers can be maximised with regard to several features of participation and process. The *main* features of importance to this study are (i) respect for similarity and difference, (ii) a diversity of participants and approaches; (iii) local relevance; (iv) honesty; (v) enjoyment; and (vi) time. These are all evidence of social capital and indicate that community-based research can draw upon these to enhance existing research practices.

(i) Respect for similarity and difference. Co-research involves citizens and experts working together. This study demonstrates that the best outcomes occur in an atmosphere of mutual respect. In many ways, respect for others and the environment underpins all of these features and involves recognising the skills and aspirations of all participants. This point is reinforced in Chapter 6 where several experts noted the extensive skills and knowledge held within local communities. For example:

> What we don't realise that is within these groups are people like ourselves that are also community volunteers. Some of our groups have retired scientists in them and industrial chemists. *(Expert participant - case study)*

Indeed, Chapter 5 illustrated that that 75% of the citizen scientists (Waterwatch coordinators) surveyed held tertiary degrees with 21% of these at the postgraduate level.

In the context of a research partnership, Chapter 5 also indicated that respect of others can be demonstrated by all participants entering the research setting as equals. Responses indicated that this could be achieved on a practical level by sharing data on a mutual basis and by ensuring that community data is collected in a way and with an understanding that it can be utilised in decision-making. Certainly, citizens do not want to be used and neither party has time to waste. The comments of an expert scientist in Chapter 6 illustrate these points:

> The community doesn't like to be used just to waste their time. They like to feel that they're making a contribution and that through what they do that they might make a difference. So I think it's really important that we do not kid the community. I think it's also important that we don't denigrate the skills that they have. (*Expert participant - case study)*

Respect can also be demonstrated by acknowledging difference or where territories lie. One citizen participant in Chapter 6 described that territories in community-based catchment research can be based upon geographical, intellectual, legislative or personality boundaries. Conflict regarding these can relate to other groups, agencies or institutions if appropriate protocols for coexistence are neither established nor observed. Consequently:

> Territory is absolutely basic to all this, appreciating and respecting territory. First of all recognising it, working out where your boundaries are and then respecting it, and then working out the protocols that you need to approach somebody's territory. (*Citizen participant - case study)*

Chapters 5 and 6 illustrate that issues of territory can relate to many aspects of research from funding allocations to determining appropriate research questions and projects.

(ii) *A diversity of participants and approaches.* Building on the notion of respect for difference, effective catchment management also requires a non-judgemental approach that recognises the need for a diversity of participants and approaches. Participants in Chapters 5 and 6 talked about the need to involve a wide cross-section of society and that this would require a range of approaches. One co-ordinator described how she was able to facilitate the involvement of disparate societal sectors:

> You just appreciate them for who they are and then try and work with them as much as possible. Their belief systems are what ever they are and thankfully we're all different. (*Citizen participant - case study*)

The recognition of the need for diversity is a starting point for the development of a range of partnerships and the strengthening of networks that can build positive social capital.

The formation of links between different or disparate societal sectors is important in ensuring the vertical associations of social capital that are a way for community groups to obtain resources that are inaccessible when associations remain horizontal. For example one expert observed that:

> The really strong programs have made good partnerships across different sectors. Where they've stayed really narrow in their focus - that's where nothing changes - you don't see that across-the-catchment recognition that there is Waterwatch activity happening. (*Expert participant - case study*)

Thus, diverse networks achieved through a diversity of participants are vital for overcoming many of the barriers to community-based research.

(iii) Local relevance through reflexivity and adaptive approaches. In the face of globalisation community-based research is unashamedly local. Chapter 5 illustrated that taking a local perspective, or 'parochialism' as one expert participant described it, is often considered a weakness of community-based research. Yet, at the same time the majority of survey and case study participants also valued this approach as a way to increase the local relevance of research. Drawing on the arguments of Pimbert (2001) (see Chapter 2) it appears that it is increasingly important to consider local realities in an effort to redress the power inequalities inherent in globalisation. The diversity of participants and catchments highlighted in this study, appear to demand a reflective facilitator and an adaptive approach. As one citizen commented, every subcatchment is different and approaches must be 'tailored' to the local ecosystem and personalities [Chapter 6].

(iv) Honesty. Honesty is an important feature of all successful partnerships. In catchment research, this study reveals that this centres on participant abilities and agenda. In the first instance, community participants stated that by recognising and admitting their limitations, that they were keen to learn from, and welcoming of, expert assistance. One case study participant stated that it was important for groups 'not to act as though we're perfect and that we're wanting to learn'. Similarly, experts in Chapters 5 and 6 felt that it was important that they did not 'mislead' the community in terms of what their participation could achieve as this could lead to 'disempowerment'. In the second instance, citizen participants stated that honesty in purpose assisted collaborative efforts by removing the tendency for people to fear the unknown. One citizen coordinator felt that honesty was

best achieved by maintaining 'un-muddied channels of communication' between community groups and agencies.

(v) *Enjoyment.* It is important that the process of participation remains enjoyable. This was highlighted from the expert perspective in Chapter 5 as a significant predictor of future interactions and emphasised as an important feature of participation in the case studies. While part of this involves a sense of humour - laughing instead of crying - enjoyment is also intimately related to achieving the previous factors and stems from a sense of satisfaction. Many case studies participants talked about the quality of the social interactions - 'the people', and having achieved change on-the-ground. One coordinator observed that it was important to celebrate the small successes along the way because major achievements are often longer-term. Indeed:

> The smallest interchange that can lead to a new awareness is real cause for joy.
> (*Citizen participant - case study*)

(vi) *Time.* Pertinent to all of these factors is time. The process of participation is time-consuming and requires much patience. As one expert emphasised, 'this is NOT a half-day visit'. Participation requires scientists and citizens to leave their 'comfort zones' and spend weeks to months working with each other [Chapter 5]. If agencies are serious about taking a participatory approach more time or personnel are required to work alongside community members to enable a more localised approach and effectively reduce the scale of these projects without compromising on their scope. Similarly, citizen participants talked about the necessity of taking a long-term view and an on-going approach [Chapter 6].

Chapter 6 indicates that it is the group coordinators and project officers that are pivotal to achieving these features and, as such, creating the networks of social capital within current organisational structures because they are often the primary points of contact between citizen and expert sectors. The final section explores evidence of these connections that have occurred through the processes of community-based research.

7.4 MAKING CONNECTIONS THROUGH COMMUNITY- BASED CATCHMENT RESEARCH

The interviews in Chapter 6 describe community-based research as very 'connecting' and indicate that this kind of approach has the potential to lessen societal division because it is based upon interdependence. One participant stated that the unifying nature of water is integral to the connection that participants repeatedly referred to:

> Everyone is searching for connection and the waterways do that. (*Citizen participant - case study*)

Indeed, the community groups in this study (as with the majority of Waterwatch and associated groups) identified themselves according to the surrounding catchment or sub-catchment by taking the name of the major river or creek draining that system. The physical and conceptual location of the groups in this study within the local community appears vital to facilitating connections between people and the environment. The ability of such groups to provide a point of contact and exchange through a local presence is highlighted in the following quotation:

> Their [Waterwatch network] position in involving the community in the issues is really important and the fact that they are getting measurements back - scientific raw data back from all these people, is a bonus in a way. Probably one of the major benefits is being a focus for community contribution. *(Community participant - case study)*

The remainder of this section analyses the cohesive outcomes of this point of community convergence.

7.4.1 *Towards a shared language and a common understanding: connecting with each other*

Language is an important and distinguishing feature of all cultures. Checkland (2000) observes that creating reality through language makes us uniquely human [see Chapter 2]. Language can be cohesive and indicative of a mutual understanding. This study illustrates that by working in the environment with others that learning can be simultaneously experiential and social. Both citizens and experts observed that such learning was reflected in the language and vocabulary of participants as their understanding and empathy increased. One way this is illustrated is by the increasing use of water-associated terms to describe a range of concepts and attributes. For example, earlier in this Chapter the concept of transparency was described as unmuddied, and group processes were described as being like a rolling river. Another aspect of language change is a recent increase in the use of scientific terms by members of the wider community to describe catchment attributes. For example:

> Probably ten years ago you wouldn't have had school kids and people in communities talking about turbidity…you change people's language as well as their understanding of what's happening. (*Expert participant - case study*)

Some participants welcomed these changes as the objectivity of scientific language allowed disparate groups to communicate without blame or emotion preventing understanding [Chapter 6]. However, it was also recognised that scientific language remains inaccessible to many community members and limits their understanding of a situation for which they are responsible. One case study participant commented that science was a 'great language' that enables people to speak about parameters that cannot always be easily seen. Nonetheless, this citizen participant also acknowledged that its 'jargonistic' style would 'leave many people behind' [Chapter 6]. In this way, language can be divisive or as Saul (1992) contends, a means of societal separation.

Consequently, there is a need for experts and community groups to better understand the language of each other. This point is further reinforced in this study not only by the use of esoteric language, but also by the ambiguity of several terms in common language. Chapter 5 illustrates that this is especially pertinent to the term 'partnership' [Chapter 5] and heightens the need for citizens and experts to work together towards a common language and a shared understanding.

7.4.2 A community of participants: connecting to each other

Key to the positive outcomes of community-based research presented in Chapters 5 and 6 is active participation by a network of individuals and groups that span the reaches of a catchment in a cohesive manner. As described for the concept of community in Chapter 2, catchment management is not a document - it is something people connected by waterways do (a process). As one Waterwatch coordinator stated:

> There is a lack of understanding at the integrated catchment management (ICM) level that catchment management is a PROCESS not a document. (*Citizen participant - survey*)

The comments of one citizen emphasise that such active participation can ensure people become a part of whatever community they may find themselves in:

> Community and culture mean the same thing to me. [This town] is called a boring place. Nothing to do. I feel it doesn't matter where you live, it's what you do. (*Citizen participant - case study*)

By undertaking community-based research focussed on catchment health people not only increased their connection to the social community but also the ecological community. The social and environmental outcomes that accrue from community-based research are inextricably linked and underpinned by personal transformation through participation. In this way, catchment health becomes synonymous with personal and community health:

> Down at the creek I have the realisation of interdependence between all beings. We are all of one spirit. I get excited about that because it gives me hope. We have a lot of problems in the world, but as long as you do the right thing and look after yourself, the rest will look after itself. (*Citizen participant - case study*)

Fostering this strong connection to a long-unrecognised part of ourselves appears key to overcoming the cultural disrespect that we have for our waterways and, by extension ourselves.

7.5 SUMMARY

The social drivers of ecosystem degradation determine that the responsibility for catchment health is collective. In a democratic nation collective responsibility can be either representative or participatory. This synthesis has shown that community-based research can only be an effective approach towards catchment sustainability when underpinned by participatory notions of democracy with *active* participation from government, industry and community. In the context of catchment health, this study has focussed on citizen and expert scientists as key players in each of these societal sectors and community-based research as *one* approach that can utilise the *complementary* skills of each to achieve outcomes unobtainable by either citizens or experts in isolation.

Certainly, many study participants advocated a partnership approach to catchment research and management. The collaborative approach to catchment issues described in this study as community-based research represents a move towards a post-normal form of inquiry. Post-normal science explicitly acknowledges uncertainty and subjectivity and seeks to incorporate values and public participation into the decision-making process

(Funtowicz & Ravetz, 1991; Harding, 1998). However, effective public participation and collaboration between citizens and experts remains problematic to many of these approaches (eg adaptive management and agency-initiated projects). This study indicates that this stems from a lack of leadership and the difficulty of changing from one paradigm to another. As Dovers (2000) notes, many are 'deeply wedded' to traditional methodologies, disciplines and worldviews. Consequently, there are skilled and enthusiastic individuals, but they are constrained by institutional inertia and inflexible vocational structures. Thus, several experts cited the need for institutional change including revised job descriptions to allow for greater citizen/expert interaction.

The hurdle of public participation appears to have been largely overcome by the community-initiated projects in this study by embedding research in the context of the local community. While this also ensures local relevance, the groups undertaking this approach face the time, money and resource limitations common to many volunteer endeavours. In addition, this study highlights that community-based research groups encounter further barriers that emanate from the dominant representative and positivist paradigm including societal apathy, institutional resistance, cynicism towards community participation and intellectual property or data ownership in scientific research.

Thus, the approach of these groups and some individuals signifies the *beginning* of a *transition* from the culture of science to the culture of research advocated by Latour (1998) to post-normal science described by Funtowicz & Ravetz (1993) and to mode 2 science promoted by Nowotny *et al*. (2001). Certain applications may lend themselves more obviously to one approach over another. However, catchment management where the responsibility is collective and the decision-making effects people's daily lives appears to demand a participatory approach. The challenge is to overcome the tension between the range of participants, their personalities and competing interests.

Human nature is evident in this challenge where the competitive existence of two paradigms (post normal and positivism) in a climate of change and scare funding seems to bring human weaknesses to the fore. Nonetheless, recognition of the human factors also points toward opportunities for collaboration and the need to instead capitalise on human strengths. Indeed, connectivity between people was repeatedly cited as an advantage of community-based research. The experiences of the citizens and experts offer an insight into several important processual features of community-based research to ensure that this approach is positive and includes connections between citizens and experts (vertical social capital). These features are respect, diversity, local relevance, honesty, enjoyment and time. They indicate a high degree of social capital and facilitate the development of a diverse array of networks in a non-hierarchical manner. Projects are flexible, centred on the on-going improvement of the local catchment and continually monitored and evaluated in a reflective manner.

The success of community-based and collaborative research can be difficult to evaluate in the short term beyond counting trees, meetings or water-quality data. The connectivity so valued by most participants where they felt more connected to other people *and* the environment is largely intangible. Nonetheless it is based upon an increased understanding of interdependence gained through the social and experiential learning inherent in participation. People had begun to create their own culture of participation that embodied a networked community of participants. This cultural evolution was evidenced in this study by a change in the language of participants to represent a greater understanding of science and empathy with the environment.

Chapter

8

CONCLUSION

An opportunity for collaboration and social change

8.1 INTRODUCTION

The critical state of Australia's natural resources with increasing salinity, biodiversity loss, declining water quality and quantity, coupled with a rise in social poverty has prompted many to question the way we conduct ourselves as a nation. The natural amenities and social culture of camaraderie and optimism have given way to an increasingly bleak outlook whereby environmental and social systems are equally degraded. Certainly, if I could find a word that described social and environmental systems as one, I would use it for they are inextricably linked. The failure to recognise this link is key to the current level of degradation. As Dovers rightly notes, we are still forming our relationship to the landscape and with each other (Dovers, 2000).

To this end, community participation has become a focus of natural resource management research and policy. A range of participatory approaches has been introduced and there is much rhetoric regarding the democratisation of science. Indeed, conventional approaches and social institutions have had the power to limit the opportunities of ordinary citizens making any 'engagement' full of unacceptable compromise. Many 'partnerships' have not ceded power equally to participants and the resulting social barriers have restricted relationships between citizens and experts.

This study has examined community-based catchment research as a participatory approach to natural resource management in Australia. Catchments are an appropriate scale for this study because in many ways they represent an ecological microcosm and are increasingly favoured as management units. It has explored perspectives on and experiences with this approach from both citizens and experts in an attempt to better understand how this approach may be utilised to facilitate interaction between people, different knowledge bases and the environment. It is based on the assumption that a better understanding of ourselves and our interdependence upon other people and the environment is a key element in fostering sustainable communities.

This final chapter begins by summarising the findings from the study organised by the main research questions (Section 8.2). The implications and recommendations that arise from answering these questions are presented in Section 8.3. Recommendations are provided for community groups, specialist scientists, NRM agency representatives and further research.

8.2 SUMMARY OF FINDINGS

8.2.1 Citizen and expert perceptions of the nature and purpose of community-based research in catchment management

The study commenced by exploring the social and macro context within which community-based research seeks to operate. Indeed, the perceptions of community-based research held by citizens and experts are likely to influence its implementation and how it is received by decision-makers.

The initial focus group interviews and large-scale survey revealed similarities and differences in perceptions held by scientists, agency professionals and community groups to community-based research. There was consensus over the community-wide responsibility for catchment health and the need for heightened community participation in catchment management. Many participants believed that increased community participation should go beyond education and awareness-raising activities. To this end, research was considered a valid role to which citizens could contribute at any stage in a manner that did not negate the need for research conducted by specialist (expert) scientists. Almost identical citizen and expert perceptions of where and how in the research process citizens and experts should be involved reinforced these points. Specifically, respondents considered that catchment research should be conducted as a citizen/expert partnership in all research stages except methods design, data analysis and drawing conclusions where respondents indicated that experts should retain control and that community members participate through consultation.

However, there was disagreement on the *importance* of the citizen role in research. Many expert scientists concluded that community groups and projects vary considerably and that both these variables should be taken into account when deciding on an appropriate citizen role in catchment issues. In addition, most expert comments were very negative towards the value of community data and only a few were prepared to utilise or integrate such data in their projects.

The survey data indicate that these negative perceptions towards community participation may be based on a limited knowledge of, and experience with, community-based research groups and a narrow view of what constitutes valid research. There were also expert reservations regarding the perceived lack of educational qualifications and organisational skills among community groups. Consequently, citizen respondents to the survey voiced concerns regarding expert bias against their data and lack of opportunities for expert assistance to overcome this. In accordance, there was consensus that both citizens and experts have limited time and funding to participate in community-based research.

Despite these barriers there was agreement that access to local knowledge, increased relevance of research and increased citizen/expert collaboration were distinct advantages of community-based research. Consistently, the majority of citizens and experts stated they were likely to commence or continue research interaction. Responses indicated that such collaboration is best achieved in an atmosphere of mutual respect where all parties are seen as co-researchers. This approach seems most likely to ensure the quality and utility of research data, the sharing of research data and the enjoyable atmosphere that appear to underpin successful citizen/expert interactions.

To provide a basis for evaluating some of the dominant perceptions revealed in the literature and survey, questions were also asked regarding the demography of participants. It is important to remember that at this broad scale only the characteristics of community coordinators could be accessed, however as core participants they provide a valid preliminary indication of the kinds of people that participate. These data showed that coordinators were highly educated (75% held tertiary degrees), female dominated, represented a range of age groups, and were as likely to have lived in an area for less than 1 year as they were to have lived for over 10. In addition, they had much shorter time spans in their occupation as Waterwatch coordinators than experts did as professional researchers.

8.2.2 The nature, purpose and outcomes of community-based research in the selected case studies

The multi-site case study sought the voices and experiences of actual participants in community-based research. It focussed upon two community groups involved in the Queensland Waterwatch program and a Coast and Clean Seas funded project which saw state natural resource management agencies pursuing a participatory approach to research with these and other community groups.

All case study participants believed people to be the major cause of environmental degradation and, consistent with the survey, that the responsibility for reversing such degradation is society-wide. However, participants held two contrasting perceptions of how such societal responsibility may be enacted. The first was representative in nature and supported the political process where experts are funded to hold positions of responsibility. The second was participatory in nature and supported collective action by community, government and scientists.

Relatedly, the case sites in this study revealed two different approaches to participatory research. The first approach was agency-led and was limited in its ability to represent 'true' participatory research by the institutional constraints imposed by the broad geographical scale of Queensland and the level of funding (only one project officer). The second approach was community-group-led and represented an on-going process with a more flexible structure.

Interviews demonstrated that both citizens and experts were motivated to participate in community-based research by an underlying desire for sustainability. However, this common source of motivation was manifest in different ways. These may be described along a continuum from utilitarian to communitarian motivations linked by a conservation/environmental ethic. In this description, expert motivations tended towards the utilitarian end of the spectrum. They appeared to be influenced by their vocational roles as scientists and resource managers where sustainability was defined in terms of natural resources and the community groups they worked with were often distant from their own community. Citizens, on the other hand, tended to frame sustainability in more holistic terms and expressed a diverse range of personal and local motivations and a desire to take action. By making less of a distinction between social and environmental systems many citizen motivations tended towards the communitarian end of the spectrum. An important point to note is that without sufficient opportunity these good intentions were unlikely to be acted upon.

The combination of diverse motivations and an understanding of the need to involve the wider community led the community groups in this case study to undertake a range of activities including environmental restoration, awareness-raising and celebratory events, formal and community education, publications, electronic resources and artistic works. These activities were all underpinned and integrated with collaborative catchment research. Indeed, the aim of research in these groups was to improve a situation whilst enhancing the ability of participants to improve future situations through social learning. One participant aptly described this continuous approach as a 'situation improvement cycle'. Monitoring the research outcomes (reflection and evaluation) and the dynamics of the local catchment situation drove this cycle. By involving community members, scientists, and agency representatives, these groups believed that they were able to 'meld' scientific and social information from the local region.

The human strengths and weaknesses of people were central to all of the issues faced by the groups undertaking community-based research in this study. There were at least three interrelated ways in which people could either facilitate or impede the functioning of community-based research groups. The first was through the socio-political process by influencing the level of funding available for community groups. Related to this, the second concerned practical opportunities and constraints that arise from the prevailing socio-political context. In these case sites, respondents stated that limited resources combined with the intractable nature of catchment health issues had caused high rates of 'burnout' among coordinators and volunteers. Finally, citizen and expert perceptions of community-based research participants and outcomes were shown to affect collaboration between citizens and experts, the utilisation of research outcomes and group esteem. Consequently, the most sustainable projects drew upon human strengths and encouraged participation from a range of citizens and experts facilitated by skilled coordinators. In other words, successful approaches both drew upon and created social capital.

The three main outcomes of community-based research demonstrated by this study were issues awareness and action, on-ground action, and participant transformation. These represent on-going activities within the catchment underpinned by an adaptive approach to research that involves social and experiential learning. Indeed, many participants most valued their increased feeling of connection to the local environment and community. These changes are often assumed to be intangible and difficult to evaluate, however there were detectable changes to the language used by participants and several respondents believed that this represented the beginning of a common language between citizens and experts.

8.2.3 Influences upon the conduct and outcomes of community-based research

Synthesis of the survey and case study data revealed that the wider context (societal and environmental) influences the conduct of community-based research which in turn affects the outcomes of this approach. The results indicated that community-based research is most effective when underpinned by a participatory notion of democracy that facilitates active participation from government, industry and community. This may be described as a post-normal form of inquiry (Funtowicz & Ravetz, 1991; Funtowicz & Ravetz, 1993) and is particularly appropriate for catchment issues where human influences dominate.

However, this study demonstrates that changing from a positivist and representative form of inquiry to a post-normal methodology in natural resource management is fraught with difficulties that affect the conduct of citizens and experts alike. Having been the dominant paradigm since the 17th century, positivism has shaped the way we construct and validate knowledge and is reflected in current institutional structures. Consequently, certain individuals and groups may change towards a more participatory approach but effective collaboration remains constrained by several features. These include: a lack of leadership; limited support (time, resources and people) for the devolution of the responsibility for action from government to community; inflexible institutional structures; and worldviews that have not kept pace with our dynamic environment. Accordingly, community-based research is hindered by a range of limitations common to many volunteer/community efforts as well as institutional resistance, cynicism towards community participation and data ownership.

Nonetheless, the approach of the groups and some expert scientists and agency representatives in this study signifies the beginning of a transition towards more participatory and equitable research methods. Such projects and approaches were flexible, focussed on situation improvement, and involved constant monitoring and evaluation through community networks. Citizens could be involved at any stage in the research process, however many respondents cautioned that this must involve participation at the *beginning* of projects. Participants noted that respect, diversity, local relevance, honesty, enjoyment and time are all important features of the conduct of community-based research and are also indicators of a successful approach. Indeed, they represent a high degree of social capital - arguably one of the most important precursors of a sustainable community.

8.3 IMPLICATIONS AND RECOMMENDATIONS

Recognition of the social drivers of ecosystem degradation and that the responsibility for catchment health is collective indicates that a participatory approach to catchment research and management that is inclusive, equitable, flexible (adaptive) and continuous is most likely to lead to sustainable outcomes. This study has focussed upon community-based catchment research as one approach with the potential to embody these desired features. In order for community-based research to meet these aims this study suggests that:

- Public participation needs to be focussed on ways to integrate diverse knowledges and collaborative efforts rather than simply as a mandated exercise.
- Community-based research can only be successful when underpinned by a participatory paradigm. The methods and perceptions associated with the positivist paradigm are inappropriate where issues demand collective responsibility and action.
- For community-based research to be accepted requires a broader definition of research, a re-definition of successful research, and acceptance of a wider range of viewpoints. The social and environmental outcomes of community-based research are inextricably linked and underpinned by social and experiential learning.

- The interaction between different societal sectors (drawing upon and creating social capital) is vital. Thus, there is a need to view diversity as a strength and to increase the opportunities for both citizens and experts to actively participate in collaborative research.
- Leadership (those in positions of power) should recognise and support the small sector of society actively interested in environmental quality and encourage more people to participate. Supporting community groups in taking on the responsibility for action must include a commitment of resources, time and personnel to overcome the re-occurring hurdle of 'limited funding'.
- Participants must be seen as co-researchers and equals in the research process. One way this can be demonstrated is through the sharing and utilisation of research data.
- Localism is important in the face of globalisation and does not represent narrow parochialism, but rather a scale at which it is possible to take effective action.

The following recommendations outline how community-based research may be facilitated and conducted by community groups, specialist scientists, NRM agency representatives, and research institutions to optimise community and scientific/institutional involvement in catchment decision-making to achieve more sustainable outcomes.

8.3.1 Recommendations for community groups undertaking collaborative research

Establish and maintain strong links with expert sectors (particularly specialist scientists and NRM agency representatives). Many experts are unaware of citizen activities, skills and the synergies of collaboration. Increased interaction is vital in improving communication and understanding between citizen and expert networks and overcoming the negative perceptions that can hinder effective partnerships. Networks that include experts and government agencies may also provide the necessary assistance (advice and equipment) that is unobtainable with current levels of funding.

Maintain links with a diversity of community sectors. This is an effective way of ensuring widespread community support for initiatives. Links with other community groups are also increasingly vital as funding bodies focus on regional and integrated projects.

Treat interactions with experts and other community group/members as valuable learning opportunities. The most successful groups in this study approached collaborative projects as an opportunity for all participants to learn from one another. Indeed, community-based research can be viewed as an on-going form of education and a contribution towards life-long learning.

Enter the research setting as a co-researcher. When undertaking participatory research, consider yourself an equal to all others involved. This involves an appreciation of the different, but complementary skills of all participants.

Maintain flexibility. This research has shown that the approach to research undertaken by community groups tends to be more flexible, less hierarchical and more adaptive to the local situation than many expert/institutional approaches. These distinctive features are important to retain particularly when part of the research cycle involves taking active measures to improve a situation.

Undertake regular monitoring and evaluation. Monitoring and evaluation of all research projects is vital to assessing progress and directing further research. Monitoring should begin at project commencement and be conducted in a consistent fashion that integrates information from both the natural and social sciences where possible.

Grow sustainably. Many groups have grown into substantial networks by making the connections outlined above, utilising local resources, and taking on additional tasks in a gradual fashion. This means setting goals within current limits (skills, time, equipment, funding & personnel) and building a supportive and sustainable base. This approach not only ensures quality in the projects that are undertaken, but also quality of the social interactions that are key in maintaining volunteer support.

8.3.2 Recommendations for specialist scientists and NRM agency representatives undertaking collaborative research

Develop a deeper understanding of citizen capabilities, needs and goals. Chapter 5 indicated that expert knowledge of community-based research groups is very low.

Effective partnerships are best based on an accurate understanding of all involved. For example, citizen coordinators should be recognised as a well-educated sector of the citizenry with national and international research links. In addition, the role of citizens in catchment health extends well beyond education and awareness-raising.

Establish strong links with existing local community groups. Existing groups are likely to have well-developed networks within the community and are most likely to have an understanding of important local issues. Increased interaction is also vital in improving communication and understanding between citizen and expert networks and overcoming the negative perceptions that hinder effective partnerships.

Ensure public participation at the beginning of participatory research projects. Participatory research is unlikely to be effective if community members have not been involved from the beginning of projects. Citizen involvement from the outset can ensure community ownership of the process and the outcomes.

Enter the research setting as a co-researcher. When undertaking participatory research, consider yourself an equal to all others involved. This involves an appreciation of the different, but complementary skills of all participants.

Treat interactions with community groups as valuable learning opportunities. Research and management projects should be based upon two-way learning.

Maintain regular feedback on all interactions. The provision of feedback to participants that have provided their time and knowledge is not only polite, but it also allows participants to validate the interpretation of the issues, and to reflect upon their circumstances in light the analysis. This may result in improved analysis and it also makes subsequent participation and joint reflection much more likely.

Appreciate the social nature of community-based research. Chapter 6 demonstrated that unlike specialist scientists and agency representatives, many community participants are motivated by the quality of social interactions that occur. To maintain community participation it is often important to facilitate such interaction and to recognise the local context of such research.

8.3.3 *Recommendations for research and management institutions*

Allocate sufficient time, resources and personnel for participatory projects. Successful participatory research is a time-consuming, personally demanding and on-going process. For example, the agency project featured in this study was unable to achieve a truly participatory process because it included only one project officer for the entire Queensland region. To achieve the level of personal interaction necessary for successful research requires a greater commitment of staff so that the scale of projects is reduced (per person) without diminishing their scope. One way this may be achieved is for all scientific/agency members of the project team to interact directly with community participants.

Modify job descriptions to explicitly include participatory requirements. It is difficult for employees to justify spending large amounts of time undertaking a participatory process if it is not part of their job description. Modifying job descriptions to include public participation is a first step in supporting this equitable endeavour.

Recognise and support groups and individuals that are successful in participatory research. Research and management institutions play an important leadership role and have the capacity to support community initiatives. If agencies and institutions are genuine in involving the wider community it is vital that potential collaborators and existing community efforts are supported.

Redefine concepts of research and successful research outcomes. Current catchment research appears closely aligned to the values of positivist science. However, there are indications that the adaptive management approach to research is becoming increasingly utilised in this dynamic field (see Chapter 2). To build on the use of this recent innovation in research, it is important that not only the process of research becomes more adaptive and accepts a wider range of viewpoints, but that the outcomes of successful research are also re-defined. For example, traditional catchment research has placed importance on the reliability of research findings and technological solutions. Participatory and community-based approaches to research are also concerned with reliability, but emphasis is also placed on validity, solutions that can be enacted locally and sustainably, and the building and strengthening of networks between people.

8.4 FURTHER RESEARCH

This study has built upon and compliments an increasing volume of research into environment and society and the role of community associations in ecological sustainability. It has focussed primarily on the interaction between citizens and experts in community-based research. While the aims of the current study have been achieved several other important areas requiring exploration have emerged. These are:

Leadership in catchment management. Chapter 7, in particular, highlighted the importance of leadership in catchment management. Leadership is an important aspect of social movements and social change. It is particularly important in community-based approaches to catchment management such as this study where members were motivated by a strong desire to 'take action'. The variable success of the projects in this study demonstrates that although there are leaders within our catchments and communities - individuals and groups that have proven knowledge and demonstrated ability - successful leadership in catchment management is neither endemic nor taught. Indeed, there has been little investigation into the nature of successful community group leadership. If community groups are to be effective in the task of catchment management when faced with regionalism and the devolution of responsibility from government to community, research is needed to capture the essential elements of successful leadership within community groups focussed upon catchment health.

Monitoring the things that count but cannot be counted. A re-occurring theme among community coordinators was a sense of frustration that they had no way of monitoring some of the most important outcomes of their work. Aside from a 'good gut feeling' coordinators were limited in their ability to provide evidence for changing the attitudes and behaviours of participants. In addition, evaluation is important in accessing scarce funds and is increasingly required over short time scales. For example, a funding acquittal for a restoration project may be required within 6 months of receiving the funding. In this time frame it is difficult to assess any changes to the biophysical nature of the area and almost impossible to determine the behavioural shifts that most coordinators felt were most important in assuring long-term sustainability. This study has described changes to the language and vocabulary of participants that represent an increasing environmental ethic. In addition, there are numerous measures of social capital. However, there is a need to develop evaluation measures that are tailored for community-based catchment groups. This may involve capturing both social and environmental changes over different time scales.

Establishing a better understanding of the characteristics of volunteers. While the case-sites in this study enabled an in-depth understanding of the volunteers in two community groups, the broader scale survey of the study only captured the nature of the group coordinators. While coordinators are core participants it would also be instructive for policy formation to explore on a wider basis the nature of environmental volunteers.

Institutionalising participation whilst still ensuring that it is community-grounded. Many of the recommendations of this study concern increased support for community groups. One solution appears to be the institutionalisation of participatory mechanisms (Dovers, 2000) so that they become normalised and not neglected or mis-applied. However, this study indicates that further research is required to understand how participation can be supported by institutionalisation whilst still retaining the distinctive and diverse community elements prized by participatory advocates.

APPENDIX A

Development and implementation of the survey questionnaire

The development and implementation of the survey questionnaire is explained in Chapter 3 (see Section 3.4.2). The following items were an essential part of the survey process utilised in this study.

FOCUS GROUP RESPONSES

Participants

SEQ Waterwatch Coordinators and Qld Regional Coordinator

Qld Coastal and Catchment Hydrology CRC Scientists and Agency Professionals

Question 1

Who is responsible for catchment health and management?

Community Response	*CRC Scientist and Agency Professional Response*
Catchment community	Everyone (*)
Local authorities	Local authorities (Council level)
Local, State and Federal legislators	Local, State and Federal Government - DNR, EPA, BCC and Shire Councils (*)
Planning departments	The courts
Local Govt. Natural Resource Managers	Catchment management groups
Environmental Groups	Other community groups
User Groups - water/soil/sand/recreation	Individuals - residents, landholders & recreational users
Industry Groups	Industry Groups - extractive/agriculture/tourism (*)
	Groups with legislative or statutory obligations

Comments: (from scientists and agency representatives)

**Group these into types and allow space for comments.*

It was also highlighted that governments have little control and are just tools through which communities can operate or achieve their goals.

Question 2
What tasks can local communities play in catchment management?

Community Response	*CRC Scientist and Agency Professional Response*
Feedback of Govt. initiatives & draft plans eg. evaluating the success of the above	Sustainable use
Decision-making re: catchment future	Developing a collective vision
Watchdogs for catchment stress	Waste management
Advocacy	Champion cause of environmentalism - it's OK being green and concerned about ecosystem health
Education	Establish norms and culture
Water quality monitoring	Tree planting
On-ground works	On-ground works
Networking	Brokerage between groups
Change agents of others' behaviour	Do the right thing
	Any role they choose
	Identifying aspirations
	Important lobbying role
	Involvement in group activities

Comments: (from scientists and agency representatives)
Perhaps say community groups rather than communities.
Perhaps say catchment care or health rather than catchment management.
What level of community is defined? Common interest, geographic, sectoral or land tenure? Scale and level of interest is dependent on the group and issue, which in turn influences the action taken.

Question 3
What research tasks can community groups and their members play to inform catchment management?

Community Response	*CRC Scientist and Agency Professional Response*
Water quality monitoring	Identifying problems
Floral and faunal inventories	Fieldwork
Ground-truthing - validating information produced by scientists	Validation
Providing and gathering historical and local knowledge	Involvement in data collection - community can interview community
Archiving data	Analysis of data
Specific research by special interest groups	Policy research
Design stage of research process	Develop protocol
Development of the overall research concept	Evaluation
Management	Adoption
	Communication
	Working out strategies and actions (without government)
	→ Need support (resourcing) depending on goals
	→ Funding by government is critical

Comments:
Community representatives: *There is a conflict between scientific and community research needs and interests. It was felt that a more cooperative research process was necessary. In particular, the groups need scientific assistance to establish their goals and some form of linking science to facilitate "putting it all together".*
Scientific and agency representatives: *This may be dependent on the innovation of the researcher.*
Need to define "research" see E O Wilson - "systematic collection and analysis of data".

Question 4
What topics in catchment management can community members best research?

Community Response	*CRC Scientist and Agency Professional Response*
Subjective and dependent on community	Interpretation
Local concerns and issues	Where there are clear and perceived interests
Any topic with help and facilitation	Local icon species
Phys/chem and biological parameters	Water quality/Sedimentation/Biodiversity

Social research - historical/behaviour change/public perception/social harmony/community composition change	History/Values/Legends Weed management Water use Ground truthing - information validation

Question 5

How does the geographic scale of a catchment affect the possibilities of community-based research?

Community Response	*CRC Scientist and Agency Professional Response*
Dependent on reach of particular group Large catchments can mean that it is only possible to get to a small number of sites in a day. This can be unrewarding and motivation is lost. Increased media coverage of bigger catchments/rivers can mean that these have more support	Human scales may not coincide with physical scales

Comments: (from community representatives)

Research *and design is affected more by the physical attributes and dimensions of the catchment than by catchment scale. For example, urbanisation was cited as a major influential factor on peoples' perceptions. Additionally, economic concerns were highlighted as decreasing resistance to subdivision. The increasing number and flux of new residents associated with increased urbanisation was thought to have two contrasting outcomes. New residents were thought to either have increased concern for their new surroundings or less concern than established long-term residents.*

Question 6

How do time factors affect the possibilities of community-based catchment research?

Community Response	*CRC Scientist and Agency Professional Response*
Difficult to maintain motivation over "the long haul" Linked to cultural calendar rather than natural rhythms or seasons Lack of sophisticated data-logging equipment to monitor continuously	Validation of models - may not be sampling frequently enough

Question 7

What can scientific researchers do to assist community-based research(ers)?

Community Response	*CRC Scientist and Agency Professional Response*
Appreciate and value community expertise Facilitate two-way communication Be prepared to have realistic timelines when involved in participatory research Provide training Provide understandable feedback Assist data quality by providing guidelines and method reviews Assist with value-adding by integrating community data into larger plans/projects Promote integration not hierarchies - resource sharing, design assistance, provision and maintenance of equipment/prevent duplication/integrate information/technical support and advice	Publicise success stories Accessibility for the community How can scientists and community people work together Training Interpretation Refocus methodologies to capture local understandings and ecological literacy Synthesis Mentoring Provide knowledge and experience Working with students

Question 8
What are the benefits of community-based research?

Community Response	*CRC Scientist and Agency Professional Response*
Cost sharing	Army of people/helpers
Locally significant research	Ensures the relevance of research
Recognition of volunteer efforts	Giving people the capacity to take control of their own lives and future
Provides a focus for research	Community priorities are actually reflected in research priorities
Provides a means for increasing the confidence in research programs.	Do not have to have the hardship of implementation
Ownership of issues in terms of both the problems and the solutions.	Adoption/ownership
Proposing solutions	Increased application
Program evaluation	Increased action
Community education	Increased learning Gaining knowledge to act
Holistic information not limited by govt. jurisdictions.	Integrates social, environmental, economic concerns
	Develops general community networks → Social capital Constant reality check when people are involved Better understanding of local environment

Comments: (from scientists and agency representatives)
There is a need to prepare communities for how much government is expecting the community to take on. There should not be too much devolution from community to government.

Question 9
What are the problems of community-based research?

Community Response	*CRC Scientist and Agency Professional Response*
Achieving agreement within the group	Community expectations
Gaining and maintaining community interest	Data quality - compromises research
Time constraints	Overheads → Spend more time talking
Hijacking by strong personalities	Researchers often have their own agendas, not necessarily consistent with that of managers or community needs. Objectives need to be made clear in the critical stages of research design and public participation
Achieving equal representation within the group	Community may not want to be involved
Communication - advising the community	Timelines of administrative structures do not match timelines of community-based research
Outcomes dependent on the form of consultation or involvement	Funding issues → Longevity
Cultural make-up - language difficulties	Community priorities change
Can produce too much/broad information beyond the scope of the inquiry	

Question 10
What are the barriers to having more community-based research?

Community Response	*CRC Scientist and Agency Professional Response*
Community overload due to devolution from many sectors onto the same groups - 'passing the buck' Individual burnout Lack of community interest - a major problem (99%)	Scientists have (practically must set) limits to the level of response and time available to give to community requests
Community research is ignored	Institutional barriers
Community research has negative connotations within the community and scientific fraternity	Scientists' perceptions
Lack of communication between community groups leading to overlap	Differences in scientific, management and community cultures → Perhaps linking these is not a good idea in their present form (eg. linking pure science with community-based research is not appropriate because these groups have very different agendas and are not complimentary. Thus, attempting to use them together would inevitably result in compromising one)

Comments: (from scientists and agency representatives)
Community-based research can be with or by communities, but it is questionable whether it can be done for communities.

Question 11
Further issues?

Community Response	*CRC Scientist and Agency Professional Response*
What type of personality does science? What is a good research process? Define using Arnstein's ladder. What percentage of the population has formal scientific training? What is research beyond empiricism?	See previous comments

QUESTIONNAIRE IMPLEMENTATION AND FORMAT

Announcement of survey questionnaire

The following announcement appeared in the newsletters and electronic lists of the organisations targeted for this study 2 weeks prior to the survey distribution.

> Soon to arrive in your email inbox is an on-line survey. This survey seeks to analyse the purposes and potential of community-based research in catchment management and will contribute to the Public Participation section of Program 8.2. The survey is being sent to all scientists and agency professionals in the Catchment Hydrology and Coastal Cooperative Research Centres, and Waterwatch coordinators in the CRC's focus catchments.
>
> We are inviting you to contribute to this confidential survey so that we can develop a model of the types of catchment issues, the range of appropriate research tasks and the support structures needed to ensure that maximum benefits result when community-based research is undertaken.
>
> This study is being conducted by Dana Thomsen as part of her Ph.D research. Dana has a Ph.D. scholarship from the Cooperative Research Centre for Catchment Hydrology and is enrolled in the Faculty of Environmental Science at Griffith University, where her supervisors are Associate Professor John Fien and Dr. Margaret Greenway.

Introductory letter/email sent to all potential survey participants

Australian School of Environmental Studies
Griffith University
Nathan, QLD 4111

27 August 2001

Dear [The Participant],

We are writing to you to ask for your help in completing an important research project on community-based research. We are interested in your attitudes about the purposes and potential of community-based research in catchment management. We have been working with agency representatives and scientists from the Catchment Hydrology and Coastal Cooperative Research Centre's (CRCs) and a small number of community members to get critical data through personal interviews, groups interviews and now in an Internet questionnaire.

This survey is part of my Ph.D. research for which I have a Ph.D. scholarship from the Cooperative Research Centre for Catchment Hydrology and I am enrolled in the Faculty of Environmental Science at Griffith University, where my supervisors are Associate Professor John Fien and Dr. Margaret Greenway.

I would like to invite you to participate in this study and to contribute your perceptions in the Internet survey that will be sent to you early next week. We have derived many of the questions you will see from these interviews of CRC scientists and community members involved in catchment management.

We are contacting Waterwatch Coordinators and Cooperative Research Centre scientists and agency professionals to ask for their opinions on community-based research. The aim is to analyse the purposes and potential of community-based research in catchment management, with a view to developing a model of the types of catchment issues, the range of appropriate research tasks and the support structures needed to ensure that maximum benefits are obtained from community-based research when it is used.

All participants will be sent a summary copy of the results and you may be assured of complete confidentiality. Findings from the survey will be released only as summaries in which no individual names or answers can be identified.

If you have any questions or comments about this study, we would be very happy to hear from you. Please call (07 - 3875 5546) or e-mail (d.thomsen@mailbox.gu.edu).

Thank you for your assistance.

Sincerely yours,
[Addresses and positions of candidate and supervisors]

Email sent to accompany questionnaire distribution

I would like to ask for your help in an important study on the purposes and potential of community-based research in catchment management. To assist this research I am inviting you to complete an Internet questionnaire about community-based research - you will have seen this advertised in the latest issue of [organisation's newsletter]. This is part of my Ph.D. research for which I have a Ph.D. scholarship from the Cooperative Research Centre for Catchment Hydrology and I am enrolled in the Faculty of Environmental Science at Griffith University, where my supervisors are Associate Professor John Fien and Dr. Margaret Greenway.

I aim to develop a model of the types of catchment issues, the range of appropriate research tasks and the support structures needed to ensure that maximum benefits are obtained from community-based research when it is used. To this end, I am sending [organisation] members this questionnaire link to invite them to contribute their perceptions.

Your responses will be completely confidential. Findings from the survey will be released only as summaries in which no individual names or answers can be identified. If you provide a name and address on the introductory page to receive a summary report, these will be removed and filed separately from the survey responses before the responses are viewed.

Please, try not to spend too much time on any one question. Your first reactions are probably your best responses. I would be most grateful if you could take the time to complete and submit the survey by September 10.

If you have any questions or comments about this study, we would be very happy to hear from you. Please call (07 - 3875 5546) or e-mail (d.thomsen@mailbox.gu.edu.au).

To begin the questionnaire please go to: http://www.coastal.crc.org.au/surveys/survey_dt_s2.html

Thank you – your time and responses are very much appreciated.

Sincerely yours,

Dana Thomsen
[Addresses and positions of candidate and supervisors]

Letter sent to accompany questionnaire mail-out

The following letter was sent to those potential participants unable to access the Internet.

Australian School of Environmental Studies
Griffith University
Nathan, QLD 4111

24 September 2001

Dear [Participant name],

I would like to ask for your help in an important study on the purposes and potential of community-based research in catchment management. To assist this research I am inviting you to complete the enclosed questionnaire about community-based research - you will have heard about this in an email sent to you several weeks ago. This survey is part of my Ph.D. research for which I have a Ph.D. scholarship from the Cooperative Research Centre for Catchment Hydrology and I am enrolled in the Faculty of Environmental Science at Griffith University, where my supervisors are Associate Professor John Fien and Dr. Margaret Greenway. I am also an associate student of the CRC for Coastal Zone Estuary and Waterway Management.

I aim to develop a model of the types of catchment issues, the range of appropriate research tasks and the support structures needed to ensure that maximum benefits are obtained from community-based research when it is used. To this end, I am sending [organisation] members this questionnaire to invite them to contribute their perceptions.

Your responses will be completely confidential. Findings from the survey will be released only as summaries in which no individual names or answers can be identified. The identification number on the front page of the report is only to check you off the mailing list and will be removed and filed separately from the survey responses before the responses are viewed.

Please, try not to spend too much time on any one question. Your first reactions are probably your best responses. I would be most grateful if you could take the time to complete and return the survey in the enclosed envelope by **October 14**. If you have any questions or comments about this study, we would be very happy to hear from you. Please call (07 - 3875 5546) or e-mail (d.thomsen@mailbox.gu.edu).

Thank you – your time and responses are very much appreciated.

Sincerely yours,

Dana Thomsen
[Addresses and positions of candidate and supervisors]

Thank you/reminder note sent to all survey participants

Good morning,

I am writing to thank all [organisation members] that completed an Internet questionnaire about community-based research in catchment management that I sent to you about two weeks ago. The responses I received were comprehensive and considered and I am grateful to those respondents.

To those [researchers/members] who have not yet responded please take this opportunity to do so. Please, try not to spend too much time on any one question. Your first reactions are probably your best responses. To begin the questionnaire go to:
http://www.coastal.crc.org.au/surveys/survey_dt_s2.html

If for some reason you prefer not to respond please let me know by a reply message to this [e-mail/letter]. It would be helpful to this study if you could include a reason for your non-response.

Your responses will be completely confidential. Findings from the survey will be released only as summaries in which no individual names or answers can be identified. If you provide a name and address on the last page to receive a copy of the summary report, these will be removed and filed separately from the survey responses before the responses are viewed.

If you have any questions or comments about this study, I would be very happy to hear from you. Please call (07 - 3875 5546) or e-mail (d.thomsen@mailbox.gu.edu.au).

Thank you – your time and responses are greatly appreciated.

Dana Thomsen
[Addresses and positions of candidate and supervisors]

Questionnaire format

The following pages contain a copy of the postal questionnaire. The Internet questionnaire was identical to this version in every respect except for the electronic platform. The questions asked of the Cooperative Research Centre Members and the Community Group Coordinators were consistent throughout the survey to enable a direct comparison. The only questions that differed were questions 8 and 9 where experts and citizens were asked questions relating to their perceptions and experiences of citizen/expert collaboration. This required reversing and re-wording some of the questions as guided by the focus group interviews. These revised questions (8 & 9) are listed as they appeared in the questionnaire formatted for community representatives on pages 332 and 333.

Community Group and Professional CRC Researcher Survey

Introduction

This questionnaire invites your views on the role and value of community-based research in catchment management. The information will contribute to a model of the relationship between catchment issues and the range of research tasks appropriate for community members. This will assist in the development of any support structures needed to ensure that maximum benefits are obtained whenever community-based research is utilised.

Definitions:

COMMUNITY-BASED RESEARCH

Community-based research is any systematic work carried out by community groups in which non-professional researchers perform one or more research-related activities. Community-based research may be carried out by community groups alone or in partnership with professional researchers.

COMMUNITY-BASED RESEARCHER

Any member of a local community undertaking research tasks, but who is not a professional researcher.

COMMUNITY GROUP

In this study, the community groups we are referring to include Waterwatch (Streamwatch in parts of NSW), Saltwatch, Landcare, Catchment committees and other similar community organisations.

1. These first questions concern the participation of community groups in Australian water quality issues. To the best of your knowledge please indicate whether the following statements are true or false. (Please circle your answer.)

Waterwatch groups are subject to quality control checks on monitoring tasks......................	False	True
Waterwatch does not have national standards for water quality monitoring.......................................	False	True
Waterwatch groups have specific protocols for the communication of monitoring results	False	True
Waterwatch is funded entirely by Federal & State Government funding	False	True
Waterwatch participants are mostly retirees	False	True
Waterwatch data has never been used in State of the Environment reporting	False	True
Landcare and other community groups often work with Waterwatch on water quality issues	False	True
The number of community groups that monitor water quality is decreasing	False	True
Waterwatch has no global or international connections to date...	False	True
Streamwatch, Waterwatch and Ribbons of Blue are all part of the same network	False	True

How many Waterwatch groups would you estimate to be nationwide? (Please circle your answer.)

	Fewer than 500	500-1000	1000-1500	1500-2000	2000-2500	Over 2500
Number of Waterwatch groups nationwide	1	2	3	4	5	6

2. For the following stages in catchment research and management, please indicate the type of involvement that you believe community groups should have. Please CIRCLE the answer closest to your opinion on the following statements.

	No involvement	Kept informed	Consulted	Involved as co-researchers (partnership approach with professionals)	Involved as independent researchers (full community control)
Identifying issues and/or problems in catchments	1	2	3	4	5
Planning catchment research (e.g. what should be studied)	1	2	3	4	5
Designing the methodology for research (e.g. how the research should be conducted)	1	2	3	4	5
Collecting relevant data for research and management	1	2	3	4	5
Analysing catchment research data	1	2	3	4	5
Drawing conclusions from catchment research	1	2	3	4	5
Recommending actions for catchment management	1	2	3	4	5
Taking appropriate action arising from catchment research	1	2	3	4	5
Evaluating management initiatives in catchments	1	2	3	4	5

3. For the following stages in catchment research and management, please indicate the type of involvement that you believe professional scientists and agency representatives should have. Please CIRCLE the answer closest to your opinion on the following statements.

	No involvement	Kept informed	Consulted	Involved as co-researchers (partnership approach with community)	Involved as independent researchers (full control)
Identifying issues and/or problems in catchments	1	2	3	4	5
Planning catchment research (e.g. what should be studied)	1	2	3	4	5
Designing the methodology for research (e.g. how the research should be conducted)	1	2	3	4	5
Collecting relevant data for research and management	1	2	3	4	5
Analysing catchment research data	1	2	3	4	5
Drawing conclusions from catchment research	1	2	3	4	5
Recommending actions for catchment management	1	2	3	4	5
Taking appropriate action arising from catchment research	1	2	3	4	5
Evaluating management initiatives in catchments	1	2	3	4	5

4. The following statements concern the research activities of community groups and the data that they produce. Please CIRCLE the answer closest to your opinion on the following statements.

	Strongly disagree	Mostly disagree	Neither agree nor disagree	Mostly agree	Strongly agree
Most community groups can collect valid catchment data	1	2	3	4	5
Relevant community-based research should be used for decision-making at a national scale	1	2	3	4	5
Community groups are only competent to conduct research at the sub-catchment level	1	2	3	4	5
Information from professional researchers is more reliable than that from community-based researchers	1	2	3	4	5
Community volunteers are unable to research severe catchment issues or problems (e.g. salination)	1	2	3	4	5
Community-based research data is not suited to *State of the Environment* reporting or other regional water quality strategies	1	2	3	4	5
Community groups are good at researching factors that demand long-term data collection (e.g. seasonality of water flows).	1	2	3	4	5
Data collected by community groups is seldom of sufficient quality to be used in catchment decision-making	1	2	3	4	5
Community-based research is of use only as background data	1	2	3	4	5
There needs to be more community involvement in catchment management	1	2	3	4	5
Only data produced by professional researchers should be used in catchment management	1	2	3	4	5
The local experience of many community group members qualifies them to conduct local catchment research	1	2	3	4	5

5. Next, we would like to ask your opinion on the various roles that may be played or undertaken by community groups in catchment management. Please CIRCLE the option closest to your view on the following statements.

	Strongly disagree	Mostly disagree	Neither agree nor disagree	Mostly agree	Strongly agree
As researchers, community groups play an important role in catchment management...........	1	2	3	4	5
Education and/or awareness raising are the only roles that community groups can play in catchment management	1	2	3	4	5
Community groups can play an important role in evaluating Government catchment management initiatives	1	2	3	4	5
Only professional researchers and managers are responsible for catchment management.......	1	2	3	4	5
Community groups are important for carrying out on ground remedial action (e.g. tree planting)..	1	2	3	4	5
Community groups can play an important role by 'ground-truthing' professional research data...	1	2	3	4	5
Community-based research is only relevant for decision-making at a local scale	1	2	3	4	5
By alerting the relevant authorities of any catchment problems, community groups play a vital 'watch dog' role in catchment management..	1	2	3	4	5
It is inappropriate that community groups be involved in all stages of catchment research	1	2	3	4	5
Community are vital to encouraging community involvement in catchment care	1	2	3	4	5
The entire community is responsible for catchment health	1	2	3	4	5
Community groups only provide a valuable contribution to the monitoring or data collection stage of research	1	2	3	4	5
Community-based research does not replace detailed scientific study......................................	1	2	3	4	5

6. The following statements concern the possible outcomes of community-based research. Please CIRCLE the answer closest to your opinion on the following statements.

	Strongly disagree	Mostly disagree	Neither agree nor disagree	Mostly agree	Strongly agree
The involvement of community members increases the local relevance of research	1	2	3	4	5
Community ownership of projects can only be increased by involving the community in the project research	1	2	3	4	5
Community-based research is an effective way to empower the community	1	2	3	4	5
Community-based research is unlikely to result in better environmental management	1	2	3	4	5
Professional researchers have little to learn from community-based research	1	2	3	4	5
It is the role of professional researchers to seek data only to answer specific questions or to test a specific hypothesis	1	2	3	4	5
Access to local knowledge is valuable in catchment research	1	2	3	4	5
Increased collaboration between professional scientists and community members is key to more sustainable catchment management	1	2	3	4	5
Most agencies and professional researchers are very effective at educating the wider community	1	2	3	4	5
Having support from community groups allows much more intensive sampling over a wider area	1	2	3	4	5
Community-based research is a cost-effective way to conduct research	1	2	3	4	5
Community-based research is a reliable way to get answers directly from the environment without having to access experts	1	2	3	4	5
Community-based research is a more socially aware form of inquiry than most catchment research	1	2	3	4	5
Detailed scientific knowledge is more important than community education in sustaining catchment health	1	2	3	4	5
The best way to access local catchment knowledge is through local community groups that conduct catchment research	1	2	3	4	5

7. Next, we would like to ask about the barriers to community-based research. Here are various opinions that we have heard people give on the topic. Please CIRCLE the answer closest to your opinion on the following statements.

	Strongly disagree	Mostly disagree	Neither agree nor disagree	Mostly agree	Strongly agree
The educational level of community group members has no effect on the group's ability to conduct community-based research	1	2	3	4	5
Community groups tend to see issues at a local rather than State or National level.	1	2	3	4	5
It is important that community group members have qualifications relevant to catchment research..	1	2	3	4	5
Most community groups are not sufficiently organised to undertake rigorous catchment research..	1	2	3	4	5
Limited access to technical equipment hinders community-based research	1	2	3	4	5
A designated coordinator is vital for community groups when assisting with catchment research	1	2	3	4	5
To assist with catchment research it is important that community groups have contact with professional researchers or agency staff	1	2	3	4	5
High turn-over rate of volunteers in community groups limits their ability to conduct catchment research..	1	2	3	4	5
Research conducted by community volunteers does not suit the purposes of professional research..	1	2	3	4	5
Volunteer burnout often results in research not being completed	1	2	3	4	5
Scientific staff are more concerned about State and National issues rather than local ones	1	2	3	4	5
The scientific goals of professional and community researchers often differ....................	1	2	3	4	5
Information from community groups lends support to that gathered by professional researchers...	1	2	3	4	5
Most people are capable of being trained to conduct catchment research..............................	1	2	3	4	5
Because community researchers are volunteers they are not as committed as paid researchers ..	1	2	3	4	5

8. The following questions concern the ways in which professional researchers and community-based researchers may interact. Please CIRCLE the answer closest to your opinion on the following statements.

	Strongly disagree	Mostly disagree	Neither agree nor disagree	Mostly agree	Strongly agree
I am willing to assist training community groups in catchment research methods and techniques	1	2	3	4	5
Integrating community-based research into my research projects would complicate my job	1	2	3	4	5
If contacted by community groups I would willingly provide accessible advice e.g. on data analysis or application	1	2	3	4	5
I am prepared to integrate relevant community data into my research projects	1	2	3	4	5
I would not publicise or promote community-based research	1	2	3	4	5
I am keen to provide technical equipment for community-based research	1	2	3	4	5
I would like to develop a partnership approach to research and work community groups	1	2	3	4	5
I am willing to share data on a mutual basis with community groups	1	2	3	4	5
I am only prepared to use data collected by professional researchers to support any theories or recommendations	1	2	3	4	5
Community involvement is a good way to show the public good element of research required by most sources of funding	1	2	3	4	5
I would work more with community groups if I had more resources to do so	1	2	3	4	5
The involvement of community groups often makes an issue more complex	1	2	3	4	5
I welcome the involvement of community groups in catchment research	1	2	3	4	5
I would work more with community groups if I had more time.	1	2	3	4	5
I would find more interaction with community groups rewarding.	1	2	3	4	5

9. How often do you interact with community groups in the manner described by the following roles? (Please circle your answer).

	More than once a week	At least once a week	At least once a month	Between 2 & 4 times a year	Once a year	Never
As a paid consultant	1	2	3	4	5	6
As an informal (unpaid) advisor	1	2	3	4	5	6
As a co-researcher working in partnership with community group members	1	2	3	4	5	6
As a community member/local resident	1	2	3	4	5	6
As a researcher studying community groups	1	2	3	4	5	6
As the principal researcher working with and directing the research of community groups	1	2	3	4	5	6

Are you likely to commence or continue your interaction with community groups in the next twelve months? (Please circle your answer).

Very likely   Moderate likelihood   Minor likelihood   Not at all likely

If you have ever interacted with community-based researchers, could you please describe the nature of the project/activity?

____

____

____

____

____

Which best describes your experience working with a community group? (Please circle your answer).

Very positive   Mildly positive   Neither positive or negative   Mildly negative   Very negative

10. What is your occupation? (Please be specific, for example 'Senior lecturer in biology' rather than 'Lecturer'.

________________________ **Occupation**

11. What are the main duties in this position?

____

____

____

12. How long have you been in this occupation?

	Fewer than 1	1-2	2-5	5-10	10-20	Over 20
Number of years in occupation	1	2	3	4	5	6

13. In which Australian State or Territory do you reside? (Please tick.)

- ❑ Queensland
- ❑ New South Wales
- ❑ Tasmania
- ❑ Victoria
- ❑ Western Australia
- ❑ Australian Capital Territory
- ❑ Northern Territory
- ❑ South Australia

14. How long have you lived in your current community? (Please circle your answer.)

	Fewer than 1	1-2	2-5	5-10	10-20	Over 20
Number of years in current community	1	2	3	4	5	6

15. Which educational qualifications do you hold? (Please tick all that apply)

- ❑ Secondary school (to highest level)
- ❑ Any post-school educational qualifications
- ❑ Skilled or trade qualification (e.g. Hairdressing, Plumbing)
- ❑ Undergraduate or associate diploma (e.g. Dip.Ag)
- ❑ Bachelor degree (e.g. B.A, B.Sc.)
- ❑ Post-graduate degree (e.g. MA, M.Sc., Ph.D.)

16. Gender? (Please tick.)

- ❑ Male
- ❑ Female

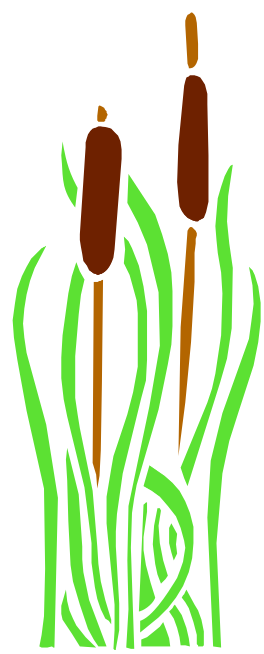
17. Which of the following age category describes you? (Please tick.)

- ❑ Under 20 years
- ❑ 20 - 29 years
- ❑ 30 - 39 years
- ❑ 40 - 49 years
- ❑ 50 - 59 years
- ❑ 60 - 69 years
- ❑ 70 - 79 years
- ❑ 0ver 80 years

18. Thank you. If there are other comments you would like to make about community-based research related to catchment management, please do so in the space provided below.

If you have any thoughts or experiences relating to community-based research in catchment management that you would like to share with me, I am keen to talk with you.

For further communication on this topic please tick here: ☐



[The following questions were re-worded as follows for the questionnaire sent to community groups]

8. ***The following questions concern the ways in which professional researchers and community-based researchers may interact. Please CIRCLE the answer closest to your opinion on the following statements.***

	Strongly disagree	Mostly disagree	Neither agree nor disagree	Mostly agree	Strongly agree
	▼	▼	▼	▼	▼
Most water management agencies are unreceptive to community concerns	1	2	3	4	5
Scientists and agencies are reluctant to use our data..	1	2	3	4	5
I welcome the involvement of scientists and agency professionals in our in catchment research..	1	2	3	4	5
I would willingly share our research data with scientists and agencies......................................	1	2	3	4	5
Scientists and agencies are reluctant to give us any assistance.	1	2	3	4	5
Recognition is more important to community groups than money	1	2	3	4	5
I would like to develop a partnership approach to research with scientists and agencies	1	2	3	4	5
I would appreciate some recognition for the research that we conduct from professional scientists and agencies......................................	1	2	3	4	5
Scientists and agencies do not know how to interpret our data.	1	2	3	4	5
Rigorous data collection to increase data quality takes the enjoyment out of monitoring.....	1	2	3	4	5
I would like to be more involved in more stages of research other than monitoring	1	2	3	4	5
I would like to have more of a say in catchment management...	1	2	3	4	5
My involvement in water quality research has increased my sense of responsibility towards the environment..	1	2	3	4	5
It is hard to convince scientists and local authorities of the value of our work	1	2	3	4	5
I would appreciate more direction from professional researchers and agencies to ensure that our research is useful	1	2	3	4	5
Our group's greatest success has been in providing an enjoyable social interaction	1	2	3	4	5
Involvement in community-based research has Increased my sense of community belonging.....	1	2	3	4	5

9. Practice

How often does your community group interact with scientists or agency professionals from universities or government departments in the following ways? (Please circle your answer).

	More than once a week	At least once a week	At least once a month	Between 2 & 4 times a year	Once a year	Never
Paying for information or expert assistance........	1	2	3	4	5	6
Requesting informal advice	1	2	3	4	5	6
As co-researchers working in partnership with scientists or agency professionals	1	2	3	4	5	6
As fellow community members/local residents ...	1	2	3	4	5	6
As the subject of external research.....................	1	2	3	4	5	6
Working with and having the research directed by a scientist or professional from a university or Government department.................................	1	2	3	4	5	6
Providing your research data on a one-way basis	1	2	3	4	5	6
Sharing research data on a mutual basis	1	2	3	4	5	6

Are you likely to commence or continue your interaction with such researchers in the next twelve months? (Please circle your answer).

Very likely	Moderate likelihood	Minor likelihood	Not at all likely

If you have ever interacted with researchers from universities or Government departments, could you please describe the nature of the project/activity?

Which best describes your experience working with a professional researcher? (Please circle your answer).

Very positive	Mildly positive	Neither positive or negative	Mildly negative	Very negative

APPENDIX B

Case record(s)

The data produced through the case study techniques of participant observation, focused interviews and document analysis were collated into a case record for each case study site. To ensure the anonymity and confidentiality promised to all participants, it is not possible to include such comprehensive records here (these will be made available to examiners on a confidential basis upon request). However, it is possible to compile a representative case record and to provide edited examples from each case record. The following pages present this public record of the case study data.

CASE RECORD CONTENTS

- Information sheet
- Consent form
- Participant observation
    - Researcher notes and personal reflection
        - Community monitoring weeks 1-12
- Interviews
    - Interview guide
    - Summary letter of interview and partial transcript
        - Round one (all agency participants, coordinators and core volunteers)
        - Round two (core agency participants)
        - Round three (reflective interviews with core agency participants, coordinators and core volunteers)
- Email communications
- Group/organisation newsletters
- Educational brochures and materials produced by the group
- Presentations, papers, books and articles written by participants *(confidential)*
- Newspaper articles *(appearing in local papers during the study)*
- Group archives *(a copied selection - confidential)*
- Photographs taken by the researcher at community monitoring sites *(confidential)*

- Codes utilised for data analysis

INFORMATION SHEET

COMMUNITY- BASED RESEARCH

Community-based research involves people as citizen scientists. This may involve active participation by non-professional researchers at any stage in research - from formulating the questions to evaluating the answers.

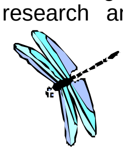
RESEARCH GOALS

The development of community-based research in the form of citizen science towards the solution of environmental and social degradation

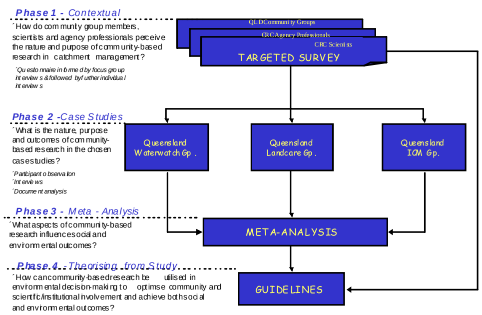
An understanding of how community-based research can facilitate partnerships between the community and professional researchers.

Inform strategies that enhance vertical aspects of social capital.

The development of appropriate and effective strategies for citizen participation in catchment research and decision-making



RESEARCH PLAN & QUESTIONS



APPLICATION

The challenges for those in natural resource management are increasing as environmental degradation accelerates and a more holistic view of the environment demands input from a wider cross section of the community. To meet these new challenges this research explores how professional researchers and communities can recognise their different skills and learn to meet as equals in order to foster partnerships for collaborative catchment management.

CONSENT FORM

COMMUNITY-BASED RESEARCH

Dana Thomsen, Australian School of Environmental Studies, Griffith University, Queensland.

CRC for Catchment Hydrology

1. Research objectives

The aim of this research is to investigate community-based research as a strategy for improving environmental quality in the short-term and increasing social capital/community capacity in the longer-term. Many Australian community groups undertake environmental research, but mostly the results are not used to inform policy or change practice. To increase the value of community research and influence of the community voice, I wish to explain how community-based research can inform decision-making and result in beneficial outcomes for all stakeholders involved (both community and agency). I am interested in research that facilitates mutual learning on behalf of the community and established research organisation by enabling a greater range of information and knowledge to be accessed and analysed. The purpose of this study is to illustrate the benefits and barriers of community-based research and to develop a matrix of community involvement that illustrates the optimum trade-off between community and scientific/institutional involvement in research and decision-making.

2. Your role

If you agree to participate in my study, I would like to meet with you several times over the course of your involvement in the Coast and Clean Seas Community Monitoring Project for interviews of about thirty minutes. The interviews will question you about your involvement and your perceptions of the process. These interviews will be tape recorded and confidential. Following each interview I will send you the interview transcript and/or a letter summarising the main points. This will enable you to verify any points and to make corrections.

3. Your rights as a participant

(a) To provide information on the understanding that it is confidential to the researcher, and that you will not be identified in any reports arising from this research.

(b) To ask any questions throughout the interview.

(c) To amend the interview transcript and to determine sections that you would not like used.

(d) To refuse to answer any question and to withdraw at any stage.

(e) To have access to the completed thesis.

4. Consent statement

I, ………………………………consent to participate in this research project 'Community--based research'. I understand and accept the assurances and I give permission for Dana Thomsen to use the information gained in any publication or thesis she may write.

Signed:

Date:

PARTICIPANT OBSERVATION

The following are excerpts from the participant observation notes made at each site. All names are pseudonyms and references to actual places have been omitted.

Day, 3, Site 1
…we went down into the Mangroves where Ellen and Phillip had chosen a site a week earlier. Everyone was very timid about standing on the pneumatophores and one member commented that we had turned into a 'bunch of ballerinas'.

Phillip began by explaining the different types of mangroves – noting that in far North Queensland there are over 30 types, but in SEQ there are only around 6. In this particular site there were 4 types of mangroves: Avicennia marina (Grey Mangrove), Rhizophora stylosa (Red Mangrove), Bruguiera gymnorrhiza (Large-leafed Orange Mangrove) and Aegiceras corniculatum (River Mangrove). For ease of identification Phillip explained that Avicennia produced all the pneumatophores, Rhizophora had the supporting roots, Bruguiera have knee roots and Aegiceras have salt secretions on the leaves. He stressed that since we were 'scientists' today that it was important to use the scientific rather than common names.

…Once the quadrat was run Phillip decided on the best place for a quadrat, the volunteers seemed to agree on the site and did not put forward any suggestions. Phillip then showed the volunteers how to construct a square quadrat using a compass. Wooden pegs were then hammered in as markers. A car accident on the road across the river caught everyone's attention for a while. Each member then volunteered himself or herself to conduct a research task each: girth measurement (Mary), height (Kim), recorder (Me), and tagger (Sasha).

…At lunch Kim had to leave but Rachel and Terri had turned up. So now we had three volunteers, two of which needed training. A fire in the Melaleuca stands across the river provided excitement for the afternoon. We finished measuring the girth of the quadrat trees – some at basal height and some at breast height as this method did not seem to allow for small, but mature trees. Because of this difficulty Phillip considered leaving it out next time. Terri did the FPC (Foliage Protective Cover) measurement and apart from the dizzying experience, commented whether this method was 'real' science?

…At the end of the day (2.30 pm) Mary felt that they would need to go out at least once more with an expert to feel confident about doing these methods. Terri (who had recently completed a science and arts degree) disagreed and felt that once they had had a good read through Phillip's handout that they would be able to do it on their own – given the equipment (Callipers, height poles, compass, dress-maker's tape, FPC or light meter). However, they all agreed that it would be good to have a leader amongst the group to focus their efforts…

Day 1, Site 2
Drove there at 9am. There would have been around 15 volunteers most of which went off tree planting as organised by Charlotte. Jess, Anna, Tony and myself went water quality testing. I explained to

them what I was doing - "Oh, we have a doctor in the house!" joked Tony. "Not yet" I replied. Anna spoke of their previous efforts and was critical of the tree planting and mulching due to lack of rainfall and the proximity to the creek, which she believed could easily wash all the mulch away.

First stop, the head of XXXXX Creek (they monitor around thirty sites all chosen by themselves and DNRM). They proudly pointed out their revegetation site that had been very successful despite an arson attempt. We monitored right under the bridge - everyone seemed to have set tasks - Tony (Phosphates), Anna (air temp. & site assessment), Jess (pH, DO, Conductivity and water temp.). They monitor once a week and cover about 6 sites each time. Where a reading seemed unusual they measured it again using another method (eg. litmus paper from the Waterwatch kit). I asked if they were the usual water-quality monitoring crew - they said they were but often had international students from Norway & Holland etc. Tony commented that Anna liked to have control over the water quality monitoring…
…We looked at another revegetation site that had also suffered from two arson attacks - the volunteers were very disappointed because it had been very hard digging and now all their work was wasted. There were houses across the stream that could have acted as watchdogs, but John noted that they probably weren't home all day…

Day 10, Site 3
I began by helping Daniel test the stored water samples for nitrates and phosphates using a spectrophotometer. Daniel carefully followed the procedure letting the timer on the spectrophotometer guide him. He mentioned that an expert had shown him how to mix the samples without contaminating them and he took the time to wipe each phial so that the glass was clean and didn't interfere with the reading. Unfortunately there seemed to be an electrical fault with the meter so we had to stop testing and refreeze the samples. While waiting for the reagents to react we looked up the ANZEC guidelines on what the acceptable limits for each were. Many of the levels were in the unacceptable range and Daniel had watched the levels get worse over time with the lack of rainfall. He mentioned that the levels in XXXXX Creek were high at the headwaters and lessened towards to the mouth of the river, but that in XXXXX Creek the pattern was reversed.

On the way out Ellen commented on how her and the group's language had changed…She explained that in volunteer organisations that the relationship was and must be very different. People are no-longer working for monetary rewards, but rather the rewards are found in the experiences and the relationships that occur. She said that they were all very good friends and that there had never been a harsh word - this had not been the case before the shop…Not having a mutual meeting place meet that a lot of mis-communication went on. The shop had allowed for greater transparency and increased communication among all members. Ellen later said that one of the most important features she had to possess was total honesty with everyone - as soon as someone heard a different story then tensions flared and the whole thing feel apart.

…Ellen said that her job was always very fulfilling - it didn't matter what got done in the day the quality of the social interactions and the conversations made it all worthwhile…in every conversation there was something that someone was passionate about…

INTERVIEW GUIDE

The following is a generalised interview guide utilised for the first round of interviews. Subsequent interviews were tailored to each participant and based upon the participant observation notes.

- What motivated you to join Waterwatch/Landcare/participate in community monitoring?
- What do you and your organisation hope to achieve through participation?
- What benefits do you expect the community to gain from participation?
- Can you describe current community involvement in ecosystem management? How would you rate the current level of involvement by the community?
- With reference to both agency and community limitations, what are the major barriers to community participation in monitoring?
- Where do you believe the responsibility for ecosystem health lies?
- What do you see as the major pressures on ecosystem quality?
- What do you see as the most important indicators of ecosystem quality?
- Do you believe existing community knowledge and skill level is sufficient to produce useful and reliable data? Why?
- Are communities sufficiently mobilised to collect and analyse data?
- Do you see public participation as more than baseline data collection? If yes, what further participation can you envisage and why?
- At what stages in research can you identify public participation as being useful?

SUMMARY LETTER OF INTERVIEW

Dear XXXXX,

1. Thank you for taking the time to meet with me earlier in the month and agreeing to have your responses recorded. I enjoyed talking to you and I learned a lot. You have a great wealth of environmental knowledge, much life experience, and as always I found it fascinating listening to you.

2. As promised, I am sending you this letter as one form of feedback arising from my research. It summarises the interview we had on October 16 and highlights the points I thought were important. To ensure that I have understood you correctly and placed emphasis appropriately, I have left the margin wide for your comments. Please feel free to make any changes - deletions or additions - as you wish.

3. **Roles of xxxx xxxx**
4. Awareness raising, environmental advocacy and challenging ideas (for example, trying to reviews of city plans) are some of the most important roles that xxxx xxxx plays. You feel that it is also important to draw up a strategic plan for xxxx Creek and to foster networks with other people. The revegetation and on-ground works are 'really good things, but not the most important' they are really more about 'credibility'. However you do get a buzz from working with the volunteer core and watching the riparian vegetation grow. In sum, your mission is to look after water quality.

5. In the instance of Waterwatch, you make sure that they have all the necessary equipment and training and are there 'to help them out' when they need it. This enables the volunteers to feel confident when conducting the water tests or any other associated activities (eg. teaching school children).

6. You also assist them in contacting the EPA or [local council] when abnormal monitoring results are recorded. Indeed, 'the whole point of the monitoring program is to be the eyes and the ears of the catchment'.

7. Currently, your major problem is finding someone who will take your results and that you can report to….

8. You are also developing a strategic plan that will help identify areas that are important or threatened and indicate what kind of action needs to be undertaken. The strategic plan is also a way to see what others are doing and supporting them where necessary rather than starting new ones. Indeed, you are interested in supporting the existing networks and letting them grow sustainably. You note that xxxx is unusual in taking action first, because most coordinators start with their strategic plan and then work from there.

9. You contend that the volunteering aspect works well, 'but you've got to realise that everyone is here because they want something and you've got to figure out exactly what they want to do and then they'll be keen to do it'.

10. **Tasks undertaken by volunteers for xxxx xxxx**
11. The office generates letters, brochures, pamphlets, displays, and talks for other community organisations, schools, TAFE - 'you name it we've done it'.

12. The field crew targets natural areas and goes to many different sites throughout the catchment during the week. They carry out regeneration and their primary role is to provide a supporting role for weekend Bushcare groups and in this way they are able to learn new things whilst helping others. Since the NHT project expanded three years ago this has 'all just expanded' and now the crew is going to more strategic sites and not just xxxx Habitat ones that have a Bushcare group associated with them….

13. The Waterwatch crew looks at the health of xxxx Creek catchment towards assisting the health of the catchment.

14. **Barriers to the work of xxxx xxxx**

15. Currently, the biggest barrier is lack of funding. You really need someone to go out with the field crew each time 'to make sure that the job is getting done properly and to train the new people'. At the moment the older volunteers have been training the newer ones, but you feel that some of the younger ones need a bit more encouragement.

16. Another hindrance is lack of a permanent base. Unfortunately, the current premises are rented and the owner wants to sell. You believe that 'all catchment groups really need to have a shopfront' and their own space. They need somewhere that is secure, recognisable and where volunteers can come to them; 'a depot where people arrive, congregate and discuss what they are going to do, go and do it the come back'…

17. **Motivation**

18. You acknowledge that you are not policy makers or 'up there deciding what is going to happen', but rather that you are 'actually out there doing it' and this keeps you motivated because you feel that in the end xxxx xxxx is making a difference. You are 'actually implementing their policies and trying to wind your way through the legalities of getting integrated catchment management'. This means getting all the stakeholders within the catchment to talk to each other and to work together so that you can all see where you're going.

19. **Social aspects of volunteering for xxxx xxxx**

20. The field volunteers especially have a lot of social interaction - 'they go out there and do their work and have tea and coffee and have a chat'. Furthermore, the volunteer dinner is chance to thank them and also an opportunity for volunteers who may not have seen each other for a while to have a chat. Indeed, some of the volunteers who have retired or have quit due to health problems are still in touch with the friends they have made at xxxx xxxx.

21. **Agency interaction**

22. …You contend that you would be better off if you had the support of the paid agencies out there doing the work….'All the research that we do here is done by volunteers. A lot of them are amateurs so it can be a bit difficult to be taken seriously in the scheme of things. A lot them are qualified by their sheer experience- they know what they are talking about but they don't have that piece of paper - so that means that they are not acknowledged as well as someone who has been to university… It's just something that you have to fight against - you've got to get the professionals to realise that community is doing something worthwhile and that we are making a contribution and a difference'.

23. Thank you for taking the time to respond to my summary. Please feel free to make comments, corrections, to include questions for me, or to clarify your position where I may have misunderstood you. I enjoyed talking to you very much.

Best wishes,
Dana Thomsen

EMAIL COMMUNICATIONS

The following are examples of email communications from all three case study sites.

NATIONAL TREE PLANTING DAY

Pull on your work boots

Put on your hat and Sunscreen

Grab gardening gloves

Bring family and friends together

Make a real difference to your wetlands.

Where: XXXX Rd. Wetlands

Date: Sunday 29th July

Time: From 9.00 am

Some meetings coming up you may be interested in.

Impacts of Native Vegetation and Biodiversity Regulations:

Proposed Date:

Monday, 28 July

Contact XXXX XXXX

Agenda

10:00am – Introduction to the project

10:10am – Objectives of the day and why are we monitoring xxxx xxxx

10:20am – Mangrove identification

10:30am – Set up mangrove transects

11:30am – Set up 10m x 10m quadrats - Mangrove counts and measurements.

12:30pm – Lunch

1:00pm – Mangrove counts and measurements (continued).

1:45pm – Discussion and feedback – where to next?

2:00pm – Finish

EDUCATIONAL BROCHURES AND MATERIALS

The groups at Sites 2 and 3 produced a variety of educational materials and ran various educational events. These materials and activities were aimed at all levels in society. For example:

Photocopied material - not permissible for digital reproduction.

NEWSPAPER ARTICLES

The following articles illustrate those that were utilised in this study.

Photocopied material - not permissible for digital reproduction.

CODES UTILISED FOR DATA ANALYSIS

CATCHMENT COMMUNITY GROUP/PROJECT	*CCG*
Initiation	CCG-I
Objectives	CCG-OB
Organisation	CCG-ORG
Support	CCG-SUP
Evaluation	CCG-EVAL
19. Strengths	CCG-EVAL/S
20. Weaknesses	CCG-EVAL/W
Research activities	CCG-RA
• Issue identification	CCG-RA/ID
• Planning research	CCG-RA/PR
• Design methodology	CCG-RA/DM
• Data collection	CCG-RA/DC
• Data analysis	CCG-RA/DA
• Draw conclusions	CCG-RA/DC
• Take action	CCG-RA/TA
• Evaluation	CCG-RA/EVAL
• Quality assurance	CCG-RA/QA
• Data value	CCG-RA/DV
Training activities	CCG-TA
Community outreach activities	CCG-COA
Social activities	CCG-SA
Barriers	CCG-B
• Internal	CCG-B/I
• External	CCG-B/E
Opportunities	CCG-OPP
Outcomes	CCG-OUT
• Social (positive and negative)	CCG-OUT/S, +/-
• Social (anticipated and unanticipated)	CCG-OUT/S, A/U
• Environmental (positive and negative)	CCG-OUT/E, +/-
• Environmental (anticipated and unanticipated)	CCG-OUT/E, A/U
CITIZEN PARTICIPANT	*CP*
Demographics	CP-D
Motivation	CP-M
Perception of responsibility	CP-PR
Skills	CP-SK
Source of knowledge	CP-SKNOW
Local knowledge	CP-LK
Learning	CP-LEARN
Sense of place	CP-SOP
Barriers	CP-B
Opportunities	CP-O
Outcomes	CP-OUT
• social (positive and negative)	CP-OUT/S, +/-
21. social (anticipated and unanticipated)	CP-OUT/S, A/U
22. personal (positive and negative)	CP-OUT/P, +/-

EXPERT PARTICIPANT	*EP*
Organisation	EP-ORG
Demographics	EP-D
Motivation	EP-M
Perception of responsibility	EP-PR
Reflective practice	EP-RP
Source of knowledge	EP-SKNOW
Skills	EP-SK
Barriers	EP-B
Opportunities	EP-O
Outcomes	EP-OUT
• Social (positive and negative)	EP-OUT/S, +/-
23. Social (anticipated and unanticipated)	EP-OUT/S, A/U
24. Personal (positive and negative)	EP-OUT/P, +/-
CITIZEN/EXPERT INTERACTION	*CEI*
Citizen/expert linkages	CEI-L
Citizen/expert division	CEI-D
Citizen perception of experts	CEI-CP
Expert perception of citizens	CEI-EP
COMMUNITY-WIDE OUTCOMES	*CW-OUT*
• Social (positive and negative)	CW-OUT/S, +/-
• Social (anticipated and unanticipated)	CW-OUT/S, A/U
• Environmental (positive and negative)	CW-OUT/E, +/-
• Environmental (anticipated and unanticipated)	CW-OUT/E, A/U
PERSONAL OUTCOMES	*PER-OUT*
Learning/skills	PER-OUT/L
Transformation	PER/OUT/TR
Surprises	PER.OUT/SURP

APPENDIX C

Statistical significance tests

Index items utilised for attitudinal indexes

Quality and Utility of Community-based Research

COMPUTE Quality =
Valid data collection
National decision-making utility
Competent above sub-catchment level
Professionals produce more reliable information
Can research severe issues
Suitable for SOE reporting
Competent at long-term data collection
Utility above background data
Not only professional data should be used in catchment management
Community group members are qualified by experience to conduct
VARIABLE LABELS Quality 'Quality and utility scale'.
EXECUTE.

Barriers to Community-based research

COMPUTE Barriers =
Educational level
Group organisational skills
Limited access to technical equipment
High turn-over rate of volunteers
Not suited to the purposes of professional research
Volunteer burnout
Different research goals
Training capability
Commitment
Inability to see issues beyond local level
VARIABLE LABELS Barriers 'Barriers scale' .
EXECUTE .

Advantages of Community-based research

COMPUTE Advantages =
Reliable way to get answers directly from the environment
Community ownership
Community empowerment
Improved management
Social learning
Support for professional research
Access to local knowledge
Cost-effective
Collaboration
Allows more intensive sampling over a wider area
VARIABLE LABELS Advantages 'Advantages scale' .
EXECUTE.

Test Statistics [a]

	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
The entire community is responsible for catchment health	2750.500	18150.500	-2.066	.039
Only professional researchers and managers are responsible for catchment management	2857.500	3598.500	-1.498	.134
There needs to be more community involvement in catchment management	2176.000	17576.000	-3.652	.000
Community are vital to encouraging community involvement in catchment care	2175.000	17575.000	-3.858	.000
Education and/or awareness raising are the only roles that community groups can play in catchment management	1696.000	2437.000	-5.236	.000
Community groups can play an important role in evaluating Government catchment management initiatives	2636.000	18036.000	-2.324	.020
Community groups are important for carrying out on ground remedial action	2501.000	17901.000	-2.685	.007
Community groups can play an important role by 'ground-truthing' professional research data	2730.000	18130.000	-1.898	.058
Community groups play a vital 'watch dog' role in catchment management	2250.000	17650.000	-3.495	.000
As reseachers, community groups play an important role in catchment management	2074.000	17474.000	-3.852	.000
Community groups only provide a valuable contribution to the monitoring or data collection stage of research	2327.500	3068.500	-3.077	.002
It is inappropriate that community groups be involved in all stages of catchment research	2553.500	3294.500	-2.305	.021
Community-based research does not replace detailed scientific study	2355.000	3096.000	-3.129	.002

a. Grouping Variable: GROUPS

Test Statistics [a]

	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
C identifying issues	2924.000	18149.000	-1.444	.149
C planning research	3183.500	3924.500	-.341	.733
C designing methodology	3071.000	18122.000	-.678	.498
C collecting data	3042.500	18093.500	-.920	.358
C analysing data	3261.000	18486.000	-.138	.891
C drawing conclusions	3200.500	3941.500	-.327	.743
C recommending actions	3115.000	18166.000	-.586	.558
C taking action	3117.000	3858.000	-.652	.514
C evaluating initiatives	2871.000	3612.000	-1.462	.144
S identifying issues	3138.500	18363.500	-.845	.398
S planning research	2856.500	3559.500	-1.799	.072
S designing methodology	2881.000	3622.000	-1.424	.154
S collecting data	3253.500	3994.500	-.240	.810
S analysing data	3062.500	3803.500	-.752	.452
S drawing conclusions	3212.000	3953.000	-.274	.784
S recommending actions	3133.000	3874.000	-.662	.508
S taking action	3022.500	18247.500	-1.001	.317
S evaluating initiatives	3051.000	18276.000	-.715	.474

a. Grouping Variable: Group

Mann-Whitney Test

Test Statistics - Professional vs Community Knowledge[a]

	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
Quality control	2006.500	15372.500	-4.173	.000
National standards	2811.000	16839.000	-1.322	.186
Communication protocols	3089.000	3830.000	-.100	.920
Funding	2571.000	16599.000	-2.736	.006
Participants	3061.500	17257.500	-1.638	.101
SOE reporting	2747.500	3308.500	-.036	.972
Collaboration	3042.000	17407.000	-1.785	.074
Trend in numbers	2602.000	15482.000	-1.841	.066
International connections	1861.500	15064.500	-3.420	.001
National network	1615.500	14335.500	-4.303	.000
Number of groups	1899.000	15429.000	-5.677	.000

a. Grouping Variable: GROUP

Ranks

	GROUP	N	Mean Rank	Sum of Ranks
Knowledge score	Community	39	146.17	5700.50
	Professionals	170	95.56	16244.50
	Total	209		

Test Statistics[a]

	Knowledge score
Mann-Whitney U	1709.500
Wilcoxon W	16244.500
Z	-4.764
Asymp. Sig. (2-tailed)	.000

a. Grouping Variable: GROUP

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