3. Systems Praxis

In this chapter, system dynamics is explored with view to identifying how this applied field can contribute to the articulation of a transdisciplinary methodology in support of the management of complex environmental problems. Following this, and leading from it, a recent advance in the field of organisational management will be discussed. Called *learning organisation theory*, it provides some insights on how management systems can be enhanced so that the combined natural-human system under management might more closely resemble the complex adaptive system identified by Gell-Mann.

System dynamics is a field of study that provides a ready made set of tools and techniques for the implementation of a systems approach within environmental management. Moreover, it offers a systematic framework that can be adopted for use within a participative, transdisciplinary ecological economics. System dynamics has a long heritage, and its system simulation techniques and methodological underpinnings date back around 40 years to just after the invention of computers. It thus provides a substantial platform on which to build the methodology that is required to fulfil the research objectives of the present work.

3.1 System Dynamics

> *System dynamics deals with how things change through time, which includes most of what most people find important. It uses computer simulation to take the knowledge we already have about details in the world around us and to show why our social and physical systems behave the way they do. System dynamics demonstrates how most of our own decision-making policies are the cause of the problems that we usually blame on others, and how to identify policies we can follow to improve our situation.*
>
> *Jay W. Forrester*

System dynamics, has its roots in the study of industrial dynamics (Forrester and Cameron 1957, Forrester 1958), a field devoted to moving beyond deterministic and linear theories of management and economics. Further, there was an emphasis on the processes and structures that led to decisions in a complex management environment, and not just on the decisions themselves (Forrester 1987). Following a concentration of interest in industrial dynamics by various authors (e.g. Fey 1961, Forrester 1961, Edwin 1963, and Sprague 1963), Forrester (1969) expanded the horizons of the field by exploring the dynamics of urban development and

planning. Like industrial dynamics, urban dynamics has generated a significant literature (e.g. Babcock 1972, Jaeckel 1972, Alfeld 1974, Mass 1974). From these beginnings, the practitioners and theorists soon expanded their thinking to encompass broader concepts of applied systems work, and the label *system dynamics* started to be applied from around 1970 onwards. Since that time, work that is explicitly about *industrial dynamics* has petered out, with one of the final papers being Morecroft (1979), while the more generic label of *system dynamics* is now used in the majority of cases.

This heritage of system dynamics is acknowledged by the international System Dynamics Society to be an important part of the discipline. They describe the field of system dynamics as follows:

> System dynamics is a computer-aided approach to policy analysis and design. With origins in servomechanisms engineering and management, the approach uses a perspective based on information feedback and mutual or recursive causality to understand the dynamics of complex physical, biological, and social systems.
>
> The field developed initially from the work of Jay W. Forrester. His seminal book Industrial Dynamics (Forrester 1961) is still a significant statement of philosophy and methodology in the field. Since its publication, the span of applications has grown extensively and now encompasses work in
> - corporate planning and policy design
> - public management and policy
> - biological and medical modeling
> - energy and the environment
> - theory development in the natural and social sciences
> - dynamic decision making
> - complex nonlinear dynamics
>
> (System Dynamics Society 1998)

From the above, it can be seen that system dynamics incorporates the system principles of feedback and system element interdependence, and applies these in the context of the dynamics of a variety of complex systems. However, and notwithstanding this similarity, system dynamics has *not* arisen from the general systems literature reviewed in the previous chapter. Forrester's and others' early work arose from the field of servomechanism engineering (Richardson 1991).

System dynamics is essentially a computer simulation approach that makes use of the ability of a computer to deal with many complex relationships. The computer modelling is intended to aid decision makers and policy analysts who work with complex systems. Simulation is a key aspect of system dynamics. A researcher can construct a model of a real system using

computer software tools, and then use this model to simulate the outcomes of various options and policy settings. Simulation can be carried out using any computer model of a real system. In system dynamics, simulation is generally understood to be

> ... a numerical technique for conducting experiments with mathematical and logical models that describe the behavior of a system on a computer over extended periods of time with the aim of long-term prediction, planning, or decision-making in systems studies. The most convenient form of description is based on the use of the finite-difference form of equations.
>
> (Madala and Ivakhnenko 1994 p.4)

Following Richardson (1991), a system dynamics model can be specified as a system of coupled, nonlinear, first-order differential equations of the form:

$$\frac{d}{dx}\mathbf{x}(t) = \mathbf{f}(\mathbf{x}, \mathbf{p})$$

where **x** is a vector of levels (stocks or state variables), **p** is a set of parameters, and **f** is a non-linear vector-valued function. This is a recursive formulation (i.e. there is feedback) because the vector **x** is, among other things, a function of previous values of itself.

However, it would be misleading to suggest that system dynamics is simply a simulation technique based on the above algebraic formulation, although this is certainly a fundamental aspect of the approach. Indeed, Richardson (1991) provides an articulation of the field as an approach that involves:

- defining problems dynamically, in terms of graphs over time;
- striving for an endogenous, behavioral view of the significant dynamics of a system, a focus inward on the characteristics of a system that themselves generate or exacerbate the perceived problem;
- thinking of all concepts in the real system as continuous quantities inter-connected in loops of information feedback and circular causality;
- identifying independent stocks or accumulations (levels) in the system and their inflows and outflows (rates);
- formulating a behavioral model capable of reproducing, by itself, the dynamic problem of concern - the model is usually a computer simulation model expressed in nonlinear equations, but is occasionally left unquantified as a diagram capturing the stock-and-flow/causal feedback structure of the system;
- deriving understandings and applicable policy insights from the resulting model;
- implementing changes resulting from model-based understandings and insights.

(Richardson 1991, p.145)

System dynamics, then, is more methodology than technique. It is comprehensive in its perspective on problem solving, including both theoretical perspectives as well as modelling techniques and tools. Indeed, the system dynamics field provides an extensive body of literature devoted to building the methodology and advancing its application. This field therefore provides a substantive basis from which to construct a systemic methodology for application to environmental problems, such as is here proposed within the context of ecological economics.

During the four decades since the principles of system dynamics were first articulated, there have been numerous articles written that report practical applications of system dynamics. These applications typically involve computer simulations and cover the range of fields identified by System Dynamics Society (1998) above. Publications such as the journal *System Dynamics Review*, and Richardson (1996) provide many examples of these applications.

In the realms of environmental management, system dynamics practitioners have been active, although this particular focus only occupies a small proportion of the literature. Since *Limits to Growth* (Meadows *et al.* 1972), there have been a number of articles that reflect a research interest in the environment (e.g. Ford 1990, Ford 1996, Ford 1997, Ford and Bull 1989, Gill 1996, Mashayekhi 1990, Ruth and Pieper 1994 and Sudhir, Srinivasan and Muraleedharan 1997). Outside of the mainstream system dynamics literature, some ecological economists have made use of system dynamics modelling techniques in the context of studying integrated economic/ecological systems (e.g. Baker *et al.* 1991, Bockstael *et al.* 1995, Costanza *et al.* 1990, and van den Bergh 1995).

The introduction given above is intended to show that system dynamics fits generally within the framework of systems theoretic approaches, but is not directly related to such approaches. Moreover, the fact that system dynamics methods are being adopted by some ecological economists has been identified. The methodology that is to be described in Chapter Five draws heavily from the field of system dynamics. As the basis for that methodology, various aspects of system dynamics methodology will now be discussed in greater detail.

3.1.1 Qualitative and Quantitative System Dynamics

There are two main and interrelated parts to system dynamics methodology; and these can be characterised as qualitative system dynamics and quantitative system dynamics (Wolstenholme 1990). Qualitative approaches use "... diagrammatic modelling as a means of describing and

analysing complex systems", while the quantitative approach "...is based on converting these diagrams into formal simulation models" (Wolstenholme 1990, p. *xv*). There are a number of versions of qualitative approaches to system dynamics, and these have been identified as either *influence diagrams* or *system flow diagrams* (Hall *et al.* 1994).

3.1.1.1 Influence Diagrams

Influence diagrams are drawn using arrows to link related concepts, with the arrow head showing the direction of the influence. These diagrams are usually drawn by a facilitator in conjunction with system stakeholders (with these approaches mainly used in the business environment, system stakeholders are usually managers and other organisational employees). The purpose of influence diagrams is to elicit and depict "... the raw concepts supplied by managers" (Hall *et al.* p.343), and to provide a mechanism for the scoping and structuring of complex problems within a team environment (Ackermann *et al.* 1990, and Eden 1994). Coyle (1998) identifies influence diagrams as the starting point for consultancies where they are used to "... work with the client to capture *his* concerns about the system and to elucidate *his* mental models about how the system works" (Coyle 1998, p.345, italics in original). Eden (1988) has used a version of the influence diagram, the cognitive map, as a first step in working with teams on "messy problems" (Eden 1988, p.6). The construction of influence diagrams (and/or cognitive maps) has been proposed to help "... identify key issues within the problem and their relationship one to another, and establish the nature of the goal system within which the issues are defined" (Eden 1988, p.8). This approach has been suggested as a way to reduce the risk "... of finding the right solution to the wrong problem" (Eden 1994, p.257), a risk of dealing with complex systems also identified by Ackoff (1974) and Dillon (1976).

Another person to make use of influence diagrams is Chambers (1997). Although not from the system dynamics tradition, he makes use of causal flow diagrams as part of his Participative Rural Appraisal, an approach to community development that has been developed from a variety of sources distinct from system dynamics.

Influence diagrams are conceptually similar to directed graphs, a link made by Eden (1994). Directed graphs, or digraphs, have been employed by institutional economists as a way to analyse interactions among institutional agents (Bush 1983). They too use arrows to connect related concepts, with the arrow head indicating direction of influence. They are particularly well suited to exploring feedback relationships within a system, and have been used in this way by Gill (1996).

Digraphs are mentioned here because the influence diagram approach adopted in the methodology described in this thesis extends from the use of digraphs by Gill (1993 and 1996). He used them in the tradition of institutional economics, a discipline which for many years has been directly concerned with developing holistic understanding about complex social systems using pattern modelling and storytelling (Wilber and Harrison 1978). It is this holistic tradition of institutional economics which provides part of the heritage of the present work.

3.1.1.2 System Flow Diagrams

System flow diagrams are generally attributed to Forrester and are thought to predate other formal diagramming methods (Hall *et al.* 1994). They use control engineering symbology, and distinguish flows of resources from the mechanisms that regulate them. Morecroft's (1984) work provides further refinement, and shows how policy variables can be included in such diagrams. Causal-loop diagrams are also a form of system flow diagram, and are drawn to highlight the various feedback relationships in the system (Hall *et al.* 1994). They are the approach preferred by many system dynamics practitioners, and for this reason now are discussed in greater detail. Causal loop diagrams are constructed as in Figure 3.1.

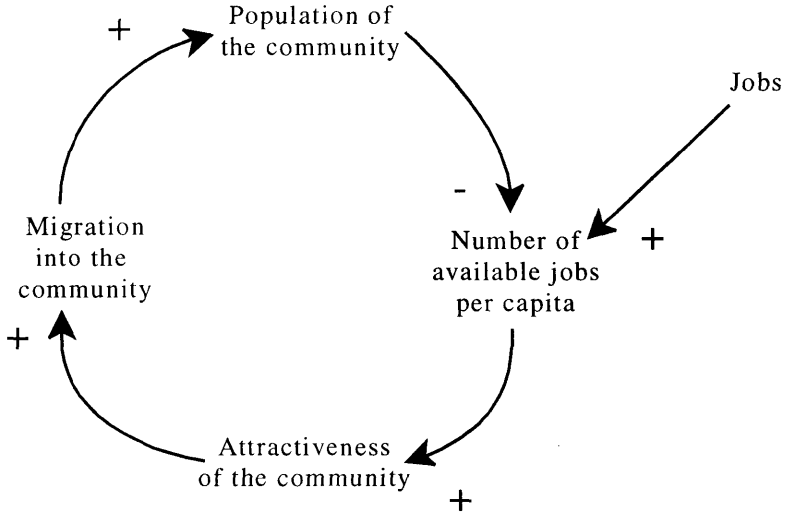


Figure 3.1 A Causal Loop Diagram (source Richardson 1986, p.159)

This particular causal loop diagram can be interpreted as follows. The existence of job opportunities in an area contributes to the attractiveness of that area, leading to a migration into the area, which in turn causes an increase in population of the area. An increase in each of these factors mentioned, leads to an increase in each subsequent factor, and this relationship is shown by including a plus sign next to each arrow head. (The plus sign means that a change in

the first variable will result in a change in the other variable in the same direction. Thus, a fall in the first would mean a fall in the second.) The closing relationship in the loop is that an increase in population has a negative impact on job opportunities, and thus a minus sign is drawn next to the relevant arrow head. (A minus sign means that a change in direction of the element at the tail of the arrow will result in a change in the opposite direction of the element at the head of the arrow). This is a goal-seeking (or negative feedback) loop in which in-migration will continue until there are no job opportunities, at which point the cycle will stop. An external stimulus could be applied that would create more jobs (represented by the positive-headed arrow joining the loop at available jobs); this would lead to an initial adjustment until a new equilibrium is reached.

An alternative causal loop structure is the self-reinforcing (or positive feedback) one. An example is given in Figure 3.2

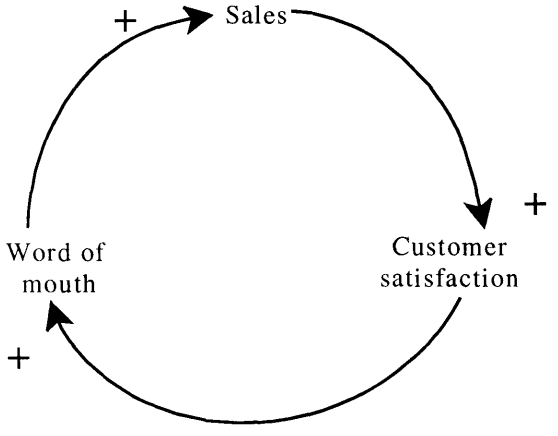


Figure 3.2 Example of a Positive Feedback Causal Loop (Source Senge 1992, p.82)

This diagram can be interpreted as follows. Customer satisfaction increases as people buy products they are happy with. This increasing satisfaction leads to positive word of mouth recommendations which in turn lead to further sales, increased customer satisfaction and so on. From the perspective of the firm, this type of self-reinforcing loop is referred to as a virtuous cycle. However, if the firm starts to sell inferior quality goods, customer satisfaction will fall leading to a fall in positive word of mouth (and, most likely, an increase in negative word of mouth). This will lead to a decrease in sales, but those sales that still happen will add to the pool of unsatisfied customers who will, in their turn, add their voices to the negative word of mouth recommendations. Such a reinforcing cycle would be identified as a vicious cycle.

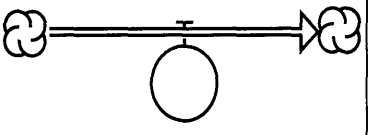
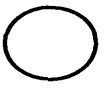
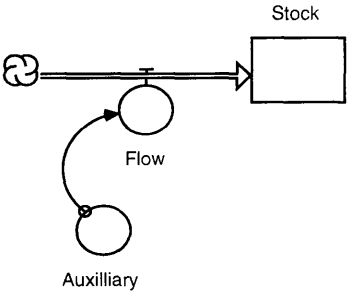
More complex causal loop diagrams can be constructed through the combination of positive and negative feedback causal loop diagram fragments. In this way, it is possible to represent nonlinear system dynamics which result from the varying interactions of self-reinforcing loops and goal-seeking loops.

The above serves to describe the nature of causal loop diagrams, and how they can be used to explore the feedback relationships in systems. They can be a useful tool in developing an understanding of systems, and are employed by some practitioners either as the first step in system exploration (e.g. Senge 1992, Randers 1980, Coyle 1998), or as a way of describing important relationships in systems after computer modelling has been undertaken (Senge and Sterman 1994, Coyle 1998).

3.1.1.3 Computer-based System Dynamics

As mentioned above, influence diagrams and system flow diagrams (including causal loop diagrams) can be construed as examples of Wolstenholme's (1990) qualitative system dynamics. A further example of this is the qualitative system dynamics that can be implemented with purpose built software such as *Vensim* (Ventana Corporation), *Powersim* (Powersim Corporation) and *ithink* (High Performance Systems). Following is a description of the *ithink* software package and an example of a qualitative system dynamics model that has been constructed using that software.

Table 3.4 The basic modelling elements of the *ithink* software.

 Stock	A stock is an accumulation, collecting whatever flows into it (High Performance Systems 1994, p. 4-9).
 flow	The purpose of a flow is to fill and drain an accumulation. The unfilled arrow head on the flow pipe indicates direction of flow (High Performance Systems 1994, p. 4-12). The cloud symbol represents a system boundary (see note below).
 Auxiliary	Serves a variety of purposes - holds values for constants, defines external inputs to the model, calculates algebraic relationships, and serves as a repository for graphical functions (High Performance Systems 1994, p. 4-16)
	The arrow between the auxiliary and the flow is called a connector. It represents a flow of information between the two (High Performance Systems 1994, p. 4-21). Note that the flow comes from a cloud symbol and flows into a stock. The cloud symbol is used to represent a system boundary. That is, it is not important to the modelling process where the flow comes from, just that it flows into the identified stock at some specified rate.

These basic building blocks of the *ithink* software (or similar ones in the other packages) can be used to create system diagrams. An example of this is given in the simple model shown at Figure 3.6, where pollution in a stream is shown as coming from land based pollution via the transport mechanism of storm runoff. This is clearly a simplification, and is given here merely as an example of a qualitative system dynamics model. A much more comprehensive version of this model will be reported in subsequent chapters.

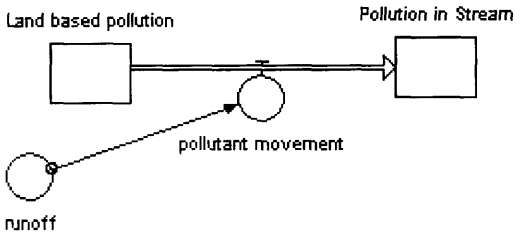


Figure 3.3 A qualitative system dynamics model constructed with the *ithink* software package.

Diagrams such as the one above "... create a forum for translating barely perceived thoughts and assumptions about the system by individual actors into usable [sic] ideas which can be communicated to others" (Wolstenholme 1990, p.5). This is a function that they share with the other methods (influence diagrams and system diagrams) described above. However, these computer constructed qualitative models provide an extra benefit to the hand-drawn versions, and that is that they can be readily converted into quantitative models. These models can then be used to simulate various scenarios, and thus to test alternative policy and management options.

The use of a system dynamics computer model to support learning and to explore various scenarios is well established within the system dynamics community. Variously referred to as "management flight simulators" (e.g. Ford 1997, High Performance Systems 1999, Radzicki 1999), "learning environments" (High Performance Systems 1997b) or "microworlds" (Morecroft 1988, Radzicki 1999), the use of a system dynamics to support learning through interaction with a computer-based representation of the real-world system is well documented in the literature. A description of a management flight simulator implementation of system dynamics software will be provided in Chapter Five as part of the description of the case study.

3.1.2 In Pursuit of Leverage

> *The bottom line of systems thinking is leverage – seeing where actions and changes in structures can lead to significant enduring improvements.*
>
> *Peter Senge*

Leverage is a simple principle – apply a small force to get a large result, an idea captured in Archimedes' famous words "Give me a lever long enough, ... and single-handed I can move the world" (cited in Senge 1990, p.13). The search for potential policy leverage points is a major consideration for system dynamics practitioners (e.g. Ritchie-Dunham 1998, Vennix 1996, Young and Chen 1998). Leverage points "... are places within a complex system (a

corporation, an economy, a living body, a city, an ecosystem) where a small shift in one thing can produce big changes in everything" (Meadows 1996, p.78, brackets in original).

Leverage is possible in systems because of the effects of positive and negative feedback. In a positive feedback system, a vicious (or virtuous) cycle can be generated by a small initial stimulus (cf. the 'butterfly effect' of chaos theory). This type of system can be influenced very easily by an external stimulus, since only a small action can lead to significant system change as the self-reinforcing dynamics are stimulated. On the other hand, a negative (or goal-seeking) feedback loop will always tend to its goal level or outcome, and will resist attempts to change it from this dynamic tendency. In the latter case, attempts to change a system outcome against the impact of a negative feedback loop will be a complete waste of effort, because once external stimulus is stopped, the system will revert to its inbuilt goal. To continue the leverage metaphor, this situation could be labelled 'anti-leverage'. (The leverage-cognisant policy prescription for change in the presence of a dominant negative feedback loop, is to change the goal of the loop, and then let the inbuilt system dynamics manifest the desired change). A system that exhibits dominant goal-seeking behaviour is thus very resistant to influence from its environment.

The principle of leverage (and anti-leverage) has important implications for system policy. Clearly, if a policy instrument can be devised that exploits real system leverage points, then substantial outcomes can be generated with relatively small expenditures of money, time and effort. Moreover, leverage exists whether it is explicitly recognised in policy or not, and it can create unintended outcomes just as readily as intended ones. Thus, system intervention that is naïve with respect to real system feedback loops could result in counter-intuitive unintended outcomes (Senge 1990).

The purpose of this section has been to explore the praxis of systems dynamics as an implementation of systems thinking. Over the years, study in the dynamics of systems in organisations has led to the observation that *learning* about the nature of the system by system agents is an important precursor to effective change within those organisations. In recent years, investigations about learning in organisations have been developed in the emergent field of learning organisation theory. This has largely co-evolved with the field of system dynamics, with many practitioners and researchers being active in both fields. As such, it provides an important extension of the basic ideas of system dynamics, and is thus reviewed in the following section.

3.2 Learning organisations

> *Human beings are unique among all living organisms in that their primary adaptive specialization lies not in some particular physical form or skill or fits in an ecological niche, but rather in identification with the process of adaptation itself – in the process of learning.*
>
> *David Kolb*

Kolb points to humans as having a propensity to learn, as being the "learning species" (Kolb 1984, p.1), and as using this learning skill to create and shape the social and physical worlds. The notion of a human as a learning entity, and the need to adopt a learning stance when dealing with environmental problems has already been alluded to in this thesis, and this will now be developed more fully.

A number of ecological economists including Gill (1997), Meppem and Gill (1998) and Perrings *et al.* (1995) have recognised that learning should be an integral part of dealing with environmental problems. Within the context of ICM/IRM, Cameron *et al.* (1996) and Cullen (1997) have argued for an adaptive learning approach to the integrated management of catchments. From another perspective, Parker and Stacey (1995) identify the need for systemic learning to be an intentional and explicit part of the management of chaotic systems. The purpose of this section is to explore the nature of learning as it might be applied to the management of environmental problems, to investigate some of the reasons why learning about complex systems does not happen easily or effectively, and to articulate some principles that can be adopted for use in the context of integrated environment management.

It is argued in this thesis that learning ought to be an integral part of the transdisciplinary methodology of ecological economics, since "... complex ecological economic problems are best handled by coming to terms with the issues at hand or learning and sharing insights, and on that basis, developing management options from improved understandings" (Gill 1997, p.8). Learning, as advocated in this thesis (and following Meppem and Gill 1998), is understood to be a feedback driven process resulting in:

> ... the accumulation of insights into system cause and effect by all those with interests in a decision or issue. Learning is regarded as a never-ending process and is always transdisciplinary in focus.
>
> (Meppem and Gill 1998, p.129)

The focus in this thesis is on group learning as distinct from individual learning. In the context of stakeholder driven management within IRM, there is a need for members of the group to

develop shared understanding and knowledge as a basis for developing and implementing management plans and actions. Without such shared understanding, there can be no common basis for deciding which particular course of action to take for the common good, and thus conflict is likely to arise.

Such a learning community approach is analogous to the learning organisation of the business management literature. The concept of the *learning organisation* is one in which members of an organisation develop shared understanding and knowledge and apply this collectively towards some common goal or purpose. The notion of group learning to support stakeholder driven management will be explored in the remainder of this section. Theories and insights from the study of learning organisations will be drawn upon to underpin the discussion.

Cullen (1997) is supportive of a learning community approach for use in the Australian community-based programs of Landcare and TCM. His idea of a learning community is one that garners information from a variety of sources, uses this as the basis for decisions, and then monitors to see if the outcomes are the expected ones. Such a community will generally be sceptical of "... experts and the solutions they propose, and they will learn to identify and challenge the assumptions underlying proposed solutions" (Cullen 1997, p.5).

Cullen's outline of how a learning community might interact with its environment is certainly plausible. However, for reasons articulated below, a group of people would be unlikely to come together in a committee and function as an effective learning community.

There are a number of factors that can interfere with successful team learning, and one of the most important is the paradigms (or mind sets) that people have. For example, those who maintain a firm commitment to their disciplinary foundations, and who are unwilling or unable to work outside of such disciplinary boundaries, effectively display mindsets which make it nearly impossible for them to work within a transdisciplinary framework.

The commitment to a particular paradigm leading to a reluctance to change has been addressed by Kuhn (1970) in his essay on the way that the acquisition of new scientific knowledge tends to lead to quantum changes in belief sets rather than gradual ones. He defines a paradigm as "... the entire constellation of beliefs, values, techniques, and so on shared by the members of a given community" (Kuhn 1970, p.175). He argues that those who are members of a particular disciplinary community will protect the central tenets and assumptions of that discipline, to the

extent that they will reject perspectives that threaten them. Kuhn characterises this behaviour as what might be called 'paradigmatic protectionism'.

Following Kuhn, another author who has commented on the problems inherent in fixed mindsets (i.e. paradigmatic protectionism) is Brevik (1996), who argues that problems of fixed mindsets will make it impossible to achieve sustainability. In order to overcome this problem, he advocates that the problem of sustainability must be "... approached as a learning enterprise" (Brevik 1996, p.1), where decision makers are encouraged to "... cultivate a new mindset – with the goal of incorporating the imperatives of sustainable development into all decision-making processes" (Brevik 1996, p.1).

Whereas Brevik advocates a learning approach to assist the cultivation of a new mindset, he does not make explicit just how the learning is to proceed so that this can happen. Indeed, as people have a tendency to hold fast to what *they* believe to be important and true, often irrespective of the views of others or evidence to the contrary, it is likely that this will present barriers to effective dialogue and joint learning. Vennix (1996, p.2) observes:

> When individual team members are convinced that they are right, this gives rise to a climate in which team members primarily argue for their own opinions rather than listen to each other. The resulting sphere is one of trying to win the discussion rather than trying to learn from the perspectives of other team members.

This particular aspect of human nature has been important in the development of the integrative decision making methodology to be described herein. The propensity of people to hold fast to their views and beliefs must be explicitly addressed before those people are able to even consider that there might be other perspectives on the truth. The learning mechanism that is employed in the new methodology is described in Chapter Five.

Moreover, not only is group learning difficult because of human nature, it has also been observed that effective learning about complex dynamic systems (such as joint human-environmental systems) is "... difficult and rare because a variety of structural impediments thwart the feedback processes required for learning to occur" (Sterman 1994, p.292).

The system dynamics literature in general, and the learning organisation literature in particular, provide useful insights about the nature of the mental models that people hold (i.e. their

mindsets or paradigms[3]), the way they think about problems, and useful methods for making the group learning approach more effective. This is addressed in the following.

3.2.1 Mental models and learning

There is nothing mysterious about mental models. They are used every day by all people as they interpret their environment, make decisions and take actions. "Our decisions and actions are based not on the real world, but on our mental images of that world, of the relationships among its parts, and of the influence our actions have on it" (Sterman 1988, p.210). In a similar vein, Senge (1990, p.175) notes that the mental models which people hold "... determine not only how (they) make sense of the world, but how (they) take action". Stacey (1993, p.208), commenting on the way managers make decisions, writes that "... everything managers do depends at the most fundamental level on the mental models through which those managers understand their world ...".

A mental model, then, is a cognitive mechanism that is used by individuals to provide a framework for understanding the things they experience, and as a basis for heuristic decision making. The type of learning that occurs when an *unchanging* mental model is used to help understand an experience is called *single-loop learning* (after Argyris 1985). This can be diagrammatically represented as in Figure 3.4.

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[3] A mental model is analogous to Kuhn's *paradigm*. For consistency with the system dynamics literature, the former term is preferred here.

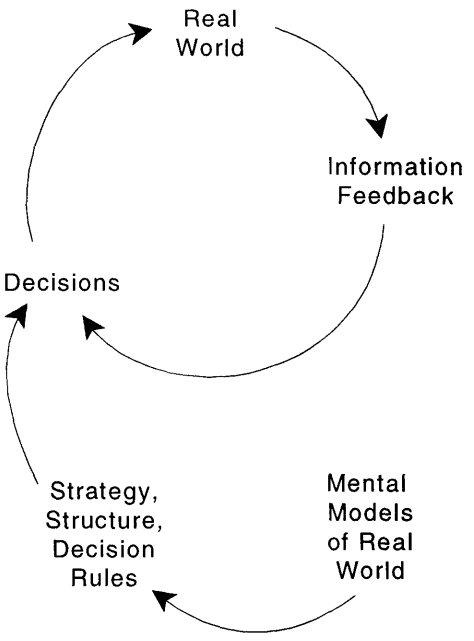

Figure 3.4 Single-loop learning (Sterman 1994)

In single-loop learning there is no questioning of the underlying mental models that managers and policy makers base their decisions upon (Parker and Stacey 1995). Thus, single-loop learning does not result in a change in fundamental beliefs about how a system is structured, the boundaries and time horizons that are considered relevant, nor about goals and values (Sterman 1994). Rather, the unchanging mental model provides a fixed reference point from which to interpret and judge events, and from which to set overall strategies. Information feedback from the real world provides the basis for decision making *within the framework provided by the prevailing mental model(s).*

This single-loop learning approach is satisfactory so long as the prevailing mental model(s) (or subjective reality) is/are roughly congruent with the underlying realities (objective reality). In this case, decisions will be made based on a perception of reality that is approximately correct, and it is thus likely that the outcomes of that decision will be approximately consistent with expectations. Another way to describe this is that if the subjective reality of the decision maker is approximately aligned with the related objective reality, then reasonable congruence between the expected result of a decision and the actual result of a decision is possible (although, as a result of chaotic unpredictability, not guaranteed). Conversely, if the subjective reality of the decision maker and the related objective reality are very different, then this person will make decisions based on a perceived reality that only vaguely resembles objective reality. In this case, expected outcomes can only occur by pure chance.

However, using such an approach for learning about a dynamic and complex system can lead to problems if the objective realities change (which they will because it is a *dynamic* system) without a corresponding change in the mental model to reflect this change (Parker and Stacey 1995). Where there is incongruence between objective reality and the mental model, decisions based upon such a mental model may lead to unexpected outcomes because the behaviour of the real system is significantly different from that upon which the mental model has been based. Where such a problem exists, it is necessary to employ *double-loop learning* (after Argyris 1985).

Double-loop learning occurs when feedback from the real world causes changes in mental models, as well as directly influencing decisions. Extending Figure 3.4, it involves the addition of a feedback link direct to the mental models. This is represented in Figure 3.5.

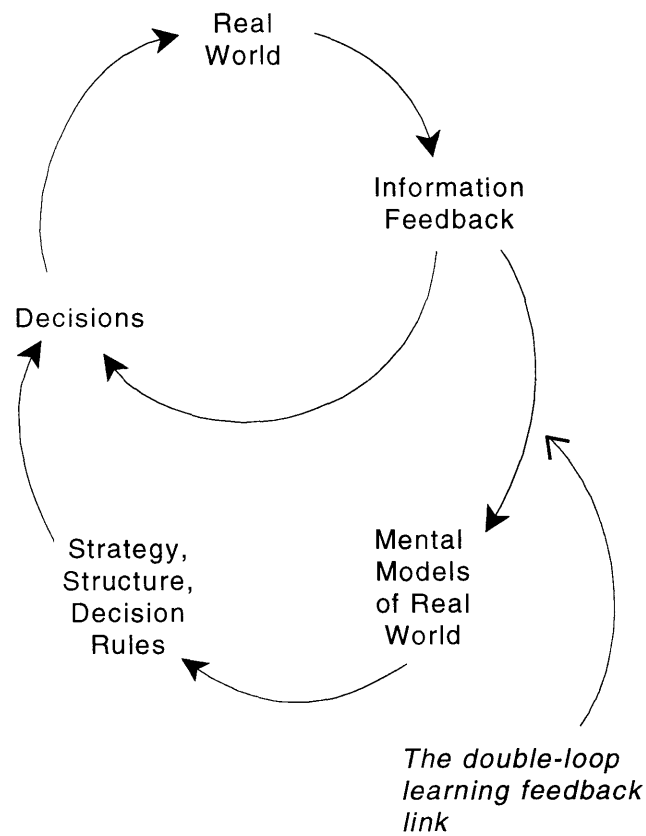

Figure 3.5 Double-loop learning (adapted from Sterman 1994)

Double-loop learning is conceptual shorthand for an approach to learning in which "... feedback about the real world not only alters our decisions within the context of existing frames and decision rules but feeds back to alter our mental models" (Sterman 1994, p.296). It attends to "... the contradictions and conflicts between what is actually happening and the

expectations to which an outdated mental model leads" (Parker and Stacey 1995, p.16). Double-loop learning is also a destabilising influence, since it results in challenges to the status quo (Parker and Stacey 1995).

Of particular relevance to the present study, double-loop learning has been identified by Sterman (1994) as part of a systems approach. He observes that the "...development of systems thinking is a double-loop learning process in which we replace a reductionist, partial, narrow, short-term view of the world with an holistic, broad, long-term, dynamic view and then redesign our policies and institutions accordingly" (Sterman 1994, p.297). He emphasises that such learning "...leads to new goals and new decision rules, not just new decisions" (Sterman 1994, p.297).

In this context of the relationships between effective learning and holism, Daniels and Walker (1996) have firmly connected these ideas to public participation in environmental management. They write:

> Systems thinking is at the heart of (ecosystem based modelling) ESBM. "Ecosystem" conceptually integrates key features of "ecology" with central properties of a "system". Thinking about ecosystems, then, includes thinking about interrelated parts, holism, and emergent properties. In other words, understanding ecosystems requires systems thinking, and *systems thinking is embedded in effective learning*. Thus, learning-centred public participation lends itself particularly well to natural resource conflict situations, because it shares a systems foundation with ESBM.
>
> (Daniels and Walker 1996, p.77)

3.2.2 Team learning – not just aggregated individual learning

The above addresses learning as it might be undertaken by an individual, however the concepts of *learning community* and *public participation* each suggest that group or team learning needs to be encouraged. That is, learning by individuals as individuals does not necessarily imply that an aggregation of these same individuals' learning will result in team or group learning. This is because this latter concept embodies the principle of synergy, whereby learning of and by the group is in some sense greater than the simple sum of learning by the individuals. Moreover, "Team learning presupposes that people are willing to question their opinions" (Vennix 1996, p.2), and if participants adopt the argumentative approach described earlier, it is unlikely that they will be prepared to do this.

Due to the difficulties outlined above, special effort needs to be invested so that effective team learning might result. In order to facilitate this, it is important to create an atmosphere where "... team participants start to doubt their ideas rather than stubbornly clinging to their own opinions" (Vennix 1996, p.2) and in which "... team members attempt to learn from each other rather than trying to 'win' the discussion by conspicuously demonstrating their (by definition limited) knowledge" (Vennix 1996, p.2, brackets in original).

Senge (1990, p.236) identifies team learning as "... the process of aligning and developing the capacity of a team to create the results its members truly desire". The notion of alignment is an important one, and deserves expansion. Essentially, it is about getting a group of people to coordinate their efforts, and to minimise the amount of resources that is wasted on efforts at cross purposes. This can be represented diagrammatically. Figure 3.6 is the case in which a group of people are not in alignment either with each other or the overall goal. Conceptually, it is not difficult to realise that in this case much wasted effort and nervous energy may be expended with no contribution to the overall goal.

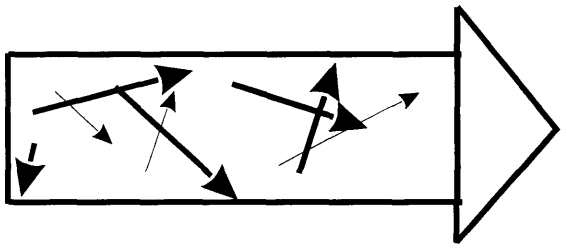

Figure 3.6 Representation of a non-aligned group (after Senge 1992)

The alternative situation, depicted in Figure 3.7, would occur once the group have developed a sense of common purpose (which is represented as the small arrows pointing in the same direction as the large enfolding arrow), and have decided to apply their individual efforts to support and enhance the efforts of others (the near alignment of the small arrows). This situation can be typified as one in which

> There is a commonality of purpose, a shared vision and understanding of how to complement one another's efforts. Individuals do not sacrifice their personal interests to the larger team vision; rather, the shared vision becomes an extension of their personal visions.
>
> (Senge 1992, pp.234-235)

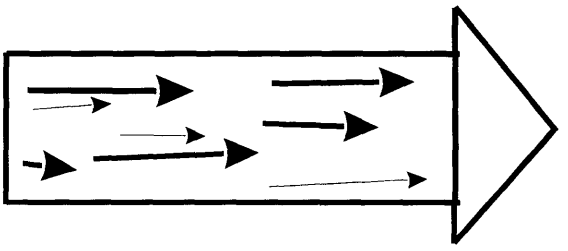

Figure 3.7 Representation of an aligned group (note that some difference in direction still exists, but the substantive thrust is in same direction as the overall goal). (After Senge 1992)

Alignment is more than agreement, in that it explicitly includes the notion of 'functioning as a whole' (Senge *et al.* 1994). The process of building alignment (an ongoing activity since perfect alignment will never be achieved) involves "... enhancing a team's capacity to think and act in new synergistic ways, with full coordination and a sense of unity, because team members know each other's hearts and minds" (Senge *et al.* 1994, sect. 52).

Implicit in the above is that alignment involves a group of people working together towards some *shared vision* or common understanding (i.e. the focus of their aligned activity) of group purpose. *Alignment* can thus be seen to incorporate the ideas of consensus and teamwork, and implies a diminution of conflict and unproductive efforts. It implies that *shared vision* is an important aspect of groups working together in a learning mode, since alignment requires the development of a vision shared by the group. Indeed, Senge's (1992) conceptualisation of the *learning organisation* is based on five key principles of which shared vision is one (the others are systems thinking, mental models, team learning and the discipline of personal growth and learning).

Following from the preceding review, it is appropriate to assert that *alignment* and *shared vision* are concepts that should be part of the transdisciplinary, learning approach for IRM that is being advocated herein. Moreover, the integrated approach to environmental management that is part of the IRM arena (see review in next chapter), is demanding of community participation and cross-disciplinary cooperation. An explicit emphasis on building shared vision and alignment of effort is surely at least a move in the right direction in terms of harnessing the maximum possible outcome from such an approach.

Shared vision is a concept that has been developed for use within a business organisation, and might not necessarily be directly applicable to the public sector in general, nor the

environmental sector in particular. This is a comment that can be generalised to the overall field of system dynamics, the theory and practice of which has in the main been focussed within the world of business organisations, with little work to date done in the context of public management of environmental resources. This point has been made by Meadows, a system dynamicist with an environmental focus (e.g. Meadows *et al.* 1971 and Richardson *et al.* 1987) who wondered whether the practice of system dynamics within organisations "... would translate directly into the public sector, (and if not), what would have to change to create significant systems insight and change there?" (Meadows 1998, p.1).

The comment by Meadows suggests that the shared vision approach may not be directly applicable to environmental problems. However, there appears to be no *a priori* reason why the activity of public management cannot be informed by the concept of shared vision developed in the business world. Although differences in organisational structure between a private business and a participative public management stakeholder group may cause difficulties in transferring the principles of learning organisations from the business world, these problems need not be insurmountable. In this context, Stewart (1996) makes the point that the very factors that appear as a hindrance, may actually be exploited as a positive force for learning and change, given appropriate facilitation and change management.

It seems reasonable to propose that within a systems theoretic framework, a participatively functioning group could develop a shared understanding of the particular problems they are facing. This would involve a joint investigation of the way that various strategic and tactical responses might impact on these problems, and the development of general consensus (alignments) about desirable system conditions towards which the groups activities can be directed. As an example of how this might be achieved in practice, the methodology articulated in this thesis includes an empirically-based method for facilitating such group actions within the context of learning approaches to environmental management, particularly in the area of IRM.

As a final contribution from the learning organisation literature, it is appropriate to note that that literature is replete with articles and books that describe a particular approach for supporting groups that seek to operate with a learning perspective. That particular approach is system modelling using the intuitively understandable system dynamics techniques and associated computer software. It is perhaps not surprising that theorists and practitioners of learning organisation approaches should suggest that these approaches ought to be assisted by

system dynamics modelling, since the idea of the learning organisation is one that largely developed from system dynamics practitioners! Books such as Morecroft and Sterman (1994) and Richardson (1996) contain many examples of the use of modelling in support of learning. There are, of course, other authors who would not be regarded as being directly involved with system dynamics, but who have addressed the idea of learning in organisations. A notable example is Ralph Stacey, who has explicitly addressed this issue (Stacey 1993 and Parker and Stacey 1995), but who does not invoke system dynamics modelling as part of his work. Moreover, he is not referenced in an extensive bibliography published by the System Dynamics Society. However, the fact remains that system dynamics modelling is widely applied in support of team learning within organisations. The methodology presented herein has been developed from that heritage, and adopts many of the insights and perspectives that are available from the literature and from discussions (written and verbal) with system dynamics practitioners.

3.3 Towards a New Methodology

In their pursuit of new strategies for sustainable development, de Graaf *et al.* (1996, p.213) identify the need for "... a method to locate all needs and wants relevant to the negotiations at hand". An outcome of the Rio Earth Summit was the unequivocal statement that "Environmental issues are best handled with the participation of all concerned citizens..." (UNCED 1992a, Principle 10). A participative systems approach has the potential to provide a methodology that incorporates these ideas. Mitchell (1987) points to the systems approach as being appropriate to the management of complex environmental problems. He observes that "... the integration of land and water through a comprehensive or holistic approach offers the potential to consider the dynamics of an entire system and thereby to ensure that critical relationships are identified and managed" (Mitchell 1987, p.3). Within the framework of a systems approach, O'Neill (1991) point out the benefits of using a computer model:

> The modeling format permits synthesization of an enormous amount of ecological data and insight into a manageable tool. Then, the tool will slavishly work out the logical consequences of this understanding. Most importantly, the model can deal with potential indirect effects that are largely inaccessible using other approaches.
>
> (O'Neill 1991, p.40)

These benefits of computer modelling are explicitly harnessed as part of the methodology articulated in this thesis – a methodology that draws heavily from the praxis of system dynamics.

Although computer models can be good adjuncts in the understanding of complex systems, one needs to be careful when interpreting the outputs of models, which are only as good as the embedded relationships and data. This caveat is explored by O'Neill (1991, p.40):

> If the understanding and data are inadequate to address assessment objectives, model predictions will not be correct. However, the lack of adequate understanding should be blamed, not the methodology. The model is simply (1) synthesizing and (2) drawing out the implications of current understanding. When interactions become very complex, modeling is about the only tool for augmenting mental faculties and examining implications. The model, correctly scaled and formulated, is at least a faithful servant of ignorance.

However, the fact that predictions of models will be incorrect need not be a problem, especially when one considers that complex systems under study are generally unpredictable anyway. This points to that fact that research should be about understanding and learning, and not about attempts at prediction.

> Given our arguments that many social phenomena are inherently chaotic and thus unpredictable, the research goal of understanding is the only viable objective when studying chaotic social phenomena. In short, systems exhibiting chaotic behaviors can only be understood, whereas, nonchaotic systems can be understood, predicted, and perhaps controlled.
>
> (Gregersen and Sailer 1993, p.798)

This idea of focusing on understanding and learning within a participative framework has been explored in detail at Section 3.2. Here, it was noted that a variety of authors have prescribed the learning approach as the only appropriate way to deal with complex human-environmental systems. Within such an approach, decisions are made as system behaviour unfolds and there is an emphasis on process rather than on outcomes, and on relationships rather than on component behaviour. This is consistent with system thinking approaches.

As part of a participative learning approach in the context of IRM, Mitchell has noted how common goals and objectives are important. He writes:

> In developing this bounded holistic perspective, definition by the various participating individuals and organizations of a set of common goals and objectives is important. With those established, individuals and organizations can determine how they might contribute to the realization of the common goals and objectives. Without an overriding sense of common purpose or direction, it is unlikely that co-ordination will be achieved.
>
> (Mitchell 1987, p.25)

Here, the author is highlighting an issue that is for practical purposes the same as the concept of shared vision that was discussed in Section 3.2. Note that in the context of the present

study, shared vision in the public management context should be interpreted as follows: a participatively functioning group could develop a shared understanding of the particular problems they are facing, the way that various strategic and tactical responses might impact on these problems, and general consensus about desirable system conditions towards which the groups activities can be directed.

Finally, since it is generally received wisdom that it is unwise to advocate extremes of anything, the same rule should be applied to advocates of participative processes (such as the present author). This warning is made by Coakes (1998), who, in reviewing Arnstein's ladder (Arnstein 1969), makes the following observation:

> In many respects, either extreme of Arnstein's ladder may not yield good sound decision-making. However, it is suggested that a more participatory model is required which reflects a partnership between stakeholders and authorities and where opportunities and constraints can be explored and tradeoffs negotiated.
>
> (Coakes 1998 p.48)

Following on from this, she identifies that "Trust is a key factor in building constructive partnerships and relationships, and in ensuring that shared learning is promoted between government authorities and communities" (Coakes 1998 p.49). Coakes' exhortations have been noted, and the present work is about the development of an approach which supports the "more participatory model" that she suggests.

In this chapter, the system dynamics and learning organisation fields have been presented as exemplary of systems praxis. A number of key methodological factors have been identified and discussed. The purpose of the chapter has been to provide a foundation for the pursuit of Research Objective One – to refine and develop the methodology. In Chapter Five, this new methodology will be described in detail, and it will be seen to embrace many of the concepts described in this and the previous chapter. However, before proceeding to the methodology, there is another area that needs detailed review – that of integrated resource management. This will be addressed in the next chapter.

4. Integrated Resource Management

This chapter provides a discussion of IRM/ICM, exploring something of its background and how it comes to be construed as an example of ESD in action. The study of Integrated Resource Management (IRM) is relevant to this study in two ways. It has been suggested by some authors that it is an *example of ESD in action*, and thus bears further investigation to identify how this occurs. Secondly, IRM provides the *context for the case study work.* Also called Integrated Catchment Management (ICM), the praxis of IRM is closely associated with Total Catchment Management (TCM), the version of ICM that is enacted in the State of New South Wales, Australia. The main case studies for this research were carried out in conjunction with TCM Committees, under the general guidance of the New South Wales *Catchment Management Act 1989* and other practice relevant to TCM.

Following a general review of IRM and ESD, the use of participative processes in IRM will be explored, followed by a discussion of the past and present uses of participative processes in decision making. The final section in the chapter includes an exploration of the way that IRM has been implemented in Australia. Overall, this chapter provides the context of the research case study work for this thesis. The general institutional framework is described, and the intention of IRM to integrate across the social, economic and ecological dimensions of environmental problems noted. This is particularly relevant to the research, especially in respect of the first research objective which identifies the intention to create a methodology that supports effective integration across these dimensions.

4.1 IRM as ESD in Action

The notion that integrated approaches should be used to manage environmental resources has been evident in the literature for more than a decade. In 1987, Mitchell published *A Comprehensive-Integrated Approach for Water and Land Management.* From the title and the opening sentence that reads "The idea of jointly considering land and water management has received increasing interest since the publication of *Water 2000* in which the co-ordinated management and use of water and land resources was identified as being one of eight major issues facing the Australian water industry" (Mitchell 1987, p.1), it is clear that the idea of integration was very much on the agenda at that time. Whereas Mitchell's work represents an early articulation of the principles of IRM (see also Burton 1985 and Cunningham 1986),

Cameron *et al.* (1996, p.4) have noted that "... many closely related ideas have been in currency since before the first world war". However, it was not until the middle of the 1980s that terms such as IRM, TCM and ICM first came to be used.

Historically, there appear to be three main threads within the IRM work. This was articulated as part of a forum entitled "Integrated Catchment Management Forum: Effective ICM in an Urbanising Catchment", in which one facilitator was led to comment:

> It is worth noting how the priorities of the participants reflect what might be termed the historical traditions of ICM. The research team (Cameron *et al.* 1996) has identified three main intellectual traditions which have come together in ICM - the land or conservation ethic, managerial accountability and public participation.
>
> (Anonymous 1996, p.10)

At the 1997 Australian conference entitled "2nd National Workshop on Integrated Catchment Management: Advancing Integrated Resource Management, Processes and Policies", a variety of papers representing these three strands was in evidence. The land or conservation ethic, or more generally, concern for and about the state of the natural environment, was addressed by a number of authors (e.g. Brierly 1997, and Hart 1997). Managerial accountability, was addressed in papers such as Fargher (1997) and Read (1997), while public participation attracted many contributions among which were McDonald (1997) and Scarsbrick (1997).

Whereas these three trends may be indicative of the historical basis of IRM, an emerging area of interest is that of institutional reform. Some papers dealt explicitly with the question of institutional and legal arrangements (Robinson and Humphries 1997 and Verhoeven 1997), while market structures and the freeing up of water trade were addressed by Ballard (1997).

A further issue that receives attention in the literature is the political and bureaucratic processes that are part of the implementation of ICM. Reflecting on the Australian scene in this way are Mitchell and Hollick (1993) and Cameron *et al.* (1996), while an international perspective is given by Gardiner (1997) and Mitchell (1997).

The above suggests that ICM has a number of facets. It is not a single well defined field of practice, nor does it have any particular methodology that can be uniquely identified with it. Moreover, "... there is no definition of ICM in the literature that is widely authoritative and that can be made operational in a quantitative sense" (Cameron *et al.* 1996). There is from this perspective a strong similarity between IRM and ecological economics – the precise nature of each is elusive and they are methodologically pluralistic. Furthermore, ecological economics is

explicitly about the study of sustainability issues, while IRM is also becoming increasingly influenced by the imperatives of ESD.

A trend that has emerged in recent years, has been to identify that IRM should, or does, involve principles and practices that are consistent with ESD. Heaton and Hollick, in proposing an ecosystem approach to catchment management observe that:

> The fundamental basis of ESD is the integration of ecology with development. While ecology is concerned with understanding the environment in which we live (in terms of natural and cultural characteristics and processes) development is concerned with manipulating the environment in which we live to achieve desired goals (e.g. managing resources for production to meet the demand, while maintaining stability).
>
> (Heaton and Hollick 1994, p.337)

Hooper (1996, p.2) contends that ESD "... has become *the* paradigm, *the* way of doing things and *the* accepted philosophy, by the present generation of resource management agencies, environmental organisations, farmer groups, industrial organisations and resource user groups such as water user groups, mining associations, forestry associations and the like" (emphasis added). He adopts the Brundtland Report definition of ESD, and interprets this in the context of the Dawson Valley in Queensland as meaning "... that land and water resources use in the Dawson Valley should be done in a way that does not impair resource use by future generations of Dawson Valley residents or other Australians" (Hooper 1996, p.2). Hooper is thus placing the whole praxis of ICM/IRM unambiguously within the context of ESD as defined in the general way of the Brundtland Report.

Mitchell (1987) has also identified aspects of ICM that are consistent with ESD. Whereas he doesn't refer directly to ESD or sustainability principles (which is hardly surprising since the Brundtland Commission report had not been released when he was writing), he nevertheless identifies the need for an holistic systems approach in which public participation is a key component. These ideas appear again in Mitchell and Hollick (1993), and are consistent with ideas to be found in the ESD literature. A subsequent version of Mitchell (1987), reprinted in a modified form as Mitchell (1990) *is* explicit about the link between ICM and ESD. He suggests that integrated water management (or ICM) should be approached:

> ... with reference to the interrelationships between water and social and economic development. At this level, the approach is on the scale recommended by the Brundtland Commission, with its stress upon the relationship between environment and economy.
>
> (Mitchell 1990, p.1).

Heaton and Hollick (1994) assert that there is a variety of planning and management procedures, including ICM, that can be viewed as practical applications of ESD principles. They note this in the context of the frustration that people have with the broad and all encompassing concept of ESD because of the failure to transform it into an operational tool for environmental management and planning. "There are however, a number of existing planning and management procedures that are implicitly associated with ESD (such as conservation farming, land capability assessment, integrated catchment management etc.) which are of demonstrated practical values" (Heaton and Hollick 1994, p.337).

However, the practice of ICM has been criticised for its failure to take proper account of environmental concerns. Tim Fisher of the Australian Conservation Foundation admonished Catchment Management Committees (CMCs) for not addressing environmental issues "... to anything like the extent required" (Fisher 1997, p.1). He notes that many CMCs "... do pay a fair bit of attention to biodiversity conservation issues, but in our assessment most CMCs focus much more on issues closely related to farm productivity" (Fisher 1997, p.1). Cullen (1997, p.4) refers to this typical environmentalist view where he writes:

> The problem is that most environmentalists believe TCM groups are totally dominated by rural landholders and environmentalists are not given adequate representation. Other interests such as tourism and recreation groups are also probably under-represented or so swamped by the prevailing 'production' orientation of the forever 'struggling' farmers.

The above criticism suggests that despite the rhetoric about ecologically sustainable development and the intention to pursue sustainability within the context of Integrated Resource Management, it may be that the actual practitioners have other priorities (such as bottom-line profit) that capture the agenda. This is not to suggest that the profitability of individual producers is not important; it merely reflects that different stakeholders will have different priorities and that these have the potential to come into conflict.

Notwithstanding such criticism, it is clear that IRM praxis can be closely linked with aspects of ESD. Having established this link, it follows that IRM is an appropriate environment in which to explore the application of tools proposed in this thesis, as consistent with Research Objective One. The particular aspects of ESD that are to be addressed in this research are the need for a systems approach, the need for participative process and the need to take a learning approach to participative management. (This latter is only implied in the ESD literature. However, it will be argued in this thesis that the use of participative process and a systems approach necessarily require that learning be explicitly allowed for and included.)

4.2 The Use of Participative Processes in IRM

Arguments about the need for participative process as part of IRM, and reports of their use are to be found readily in the literature. One of the early advocates of the need for an integrated approach to environmental resource management was John Burton, who has been attributed with an influential role in the early stages of the formulation of government policy about ICM (Mitchell and Pigram 1988). Whereas Burton's emphasis was on the *integrated* aspect of catchment management, he was (and is) also committed to the belief that a fundamental part of ICM is the involvement of the community as participants in the integrated management process (Burton 1974, Burton 1985, Burton 1988 and Burton pers. comm. 1998).

Bruce Mitchell has been a consistent and prolific advocate of community participation in catchment management. He argues that participation is a necessary ingredient if integration is to be achieved, because "without the interest and support of the local community, it is likely that efforts to implement an integrated approach will experience difficulty" (Mitchell 1987, p.2). Later in the same document, he expands on this thought:

> If integration is truly sought, then provision should be made to ensure that the viewpoints of the general community and individual land owners are fed into planning and management exercises. In other words, some 'bottom up' elements are desirable as a counterpoint to much of the 'top down' orientation which (it has been suggested) characterizes the Australian approach to planning and management of resources.
>
> (Mitchell 1987, p.20)

Elsewhere, he observes that in the pursuit of a combined top down and bottom-up approach to IRM, countries such as the United States and Canada have used a variety of public participation procedures to involve the public in management decisions (Mitchell 1990, p.215). Along with Hollick, he has also argued that one of the building blocks of ICM should be a "... stakeholder approach, in which it is recognized that citizens and nongovernment groups should be able to participate in decisions about what ought to be, what can be, and what will be for an area (Mitchell and Hollick 1993, p.740).

Cullen (1997) attributes an important function to the participative process. He gives it a "missing link" status in that it "...provides the critical integration between districts, disciplines and issues which Government agencies with their territorial imperatives have largely failed to do" (Cullen 1997, p.3). This failure of government agencies to coordinate effectively is no doubt a significant factor behind his statement that "... the public and private partnership in land management up until the nineties has failed" (Cullen 1997, p.1).

Warriner *et al.* (1996) record the Canadian experience in which community participation has been an emerging trend since the late 1960s. They observe that "Public demand for participation, combined with the struggles between public and private interests, ... has made public input an integral component of sound watershed management" (Warriner *et al.* 1996, p.254)

Marshall *et al.* (1996, p.168) note that "ICM can be thought of as a way of obtaining increased collaboration within communities, among communities and between communities and the state in order to improve identification and implementation of solutions to environmental problems." Here, these authors are saying that ICM is *fundamentally* participative. Their observation points to a nexus of communication between all stakeholders (including the relevant government agencies) and a comprehensive level of participation by all concerned.

Participation is not only written about in the normative sense, it is also becoming an integral part of the resource management framework. Woodhill and Robins (1998) have written a guide for facilitators of Landcare and IRM community-based project management groups. In it they reflect on the pervasiveness of community involvement in IRM:

> Through landcare and catchment management, people have become very familiar with participating in the planning and implementation of group projects. It is also widely recognised that, for many reasons, natural resource management depends on the active involvement of local people. A *philosophy of participation* has become widely accepted and understood (italics in original).
>
> (Woodhill and Robins 1998, p.9)

There are many examples of community participation in IRM to be found throughout Australia. In 1995 a report on the effectiveness of ICM in Australia was prepared for the Commonwealth Department of Primary Industries and Energy. In this report (AACM and Centre for Water Policy Research 1995), the authors report on a selection of catchment management activities from around Australia. Each of these 15 examples involves the participation of stakeholders and the general community in the preparation of management plans and implementation of actions. However, the extent to which these groups are based on participative processes varies greatly. An example of a "bottom-up" group is the Liverpool Plains Land Management Committee which is a "... grass roots landholder driven organisation with representation from the Department of Conservation and Land Management, NSW Agriculture, Department of Natural Resources, Environmental Protection Authority, Local Government and most importantly the rural community" (AACM and Centre for Water Policy Research 1995, p.13). An example of a more "top-down" approach is also to be found in New South Wales. The

Hunter Catchment Management Trust is empowered in the *Catchment Management Act 1989*, and is responsible for "... coordinating the NSW Government's TCM policy to ensure the sustainable use and conservation of soil, water and vegetation and the mitigation of the effect of flooding" (AACM and Centre for Water Policy Research 1995, p.6). In contrast to the Liverpool Plains Land Management Committee which "... originated out of community concerns in regard to the threat of rising saline water tables" (AACM and Centre for Water Policy Research 1995, p.12), the Trust was created by government fiat - an indisputable "top-down" initiative! Nevertheless, public participation is still an integral part of the Trust's activities. Ten of the 19 trustees are landholder and/or land user representatives, so strategic planning and policy making are strongly influenced by community representatives (although it should be noted that these representatives are Ministerial appointments). Moreover, in coordinating the adoption of TCM within the Hunter catchment, the Trust is clearly required to encourage community participation because this is explicitly identified as part of TCM in the Act.

The Australian Landcare movement "... is a grass roots movement for achieving sustainable land management" (Scarsbrick 1997, p.1). Landcare groups are typically made up of local farmers who meet together to address common environmental problems. Many integrated catchment projects have been initiated by consortia of landcare groups, and at the end of 1997 there were 80 of these consortia in New South Wales and over 30 in Victoria (Scarsbrick 1997). These consortia are *fundamentally* participative, because they are built from the bottom up as groups of farmers form cooperative groups to deal with joint problems.

The above survey shows that participative processes are strongly associated with IRM, both from the perspective of what ought to be, and by the way that things are actually occurring. There is another perspective to ICM that is gaining currency, and that is that community participation should be undertaken within a learning culture. Cameron *et al.* (1996, p.200) argue that ICM should be converted "... explicitly into a learning system which tries continually to clarify its own nature at the same time as it tries to get things done", while Cullen (1997) has argued for a continuous learning approach within a whole systems framework. The idea of a systems approach to environmental problems and various aspects of learning approaches have each been addressed earlier in this thesis.

The need for a participative and integrative process has been articulated as one of the transdisciplinary indicators identified in Chapter Two. Building on this, the preceding

discussion has highlighted participative processes as an integral part of the environmental management landscape. In the context of the overall objectives of this thesis, the use of participative processes is seen as an important part of the methodology for transdisciplinary research that is being articulated. Participation provides an effective mechanism through which to proceed with transdisciplinary research, in that it provides a means through which to seek and consequently harness the synergies of transdisciplinary cooperation. Diagrammatically, it can be thought of as a means to facilitate movement up through the transdisciplinary vortex depicted in Figure 2.1.

The above discussion has focused on participation within the context of IRM. There are other literatures in which participation is addressed, and these are reviewed in the following subsection. Following this, the way that IRM has been actually implemented in Australia is explored, with the review of case study examples.

4.3 Perspectives on Community Participation

The notion that community participation is a beneficial thing is implicit in the literature surveyed above. However, this generally positive belief about participative processes is by no means common in all the literature on participation. Sandercock (1994, p.9) has cautioned that "It cannot be taken as self-evident that public participation is a 'Good Thing'". Moreover, one ought not make pronouncements about participation in general since "... participation can mean most things to most people, according to their preconceived values" (Sandercock 1994, p.9). It thus seems appropriate to explore some of the facets of public participation, and articulate some of the strengths and weaknesses that have been identified in the literature.

4.3.1 Empowering the powerless

Early writing about citizen participation in public decision making was focussed on participation as a path of empowerment for the politically disadvantaged. A regularly cited article in the participation literature is Arnstein (1969). In this article, Arnstein proposes "a ladder of citizen participation" (Figure 4.8) in which the rungs represent the various "... gradations of citizen participation" (Arnstein 1969, p.217). She observes that understanding these gradations "... makes it possible to cut through the hyperbole to understand the increasingly strident demands for participation from the have-nots as well as the gamut of confusing responses from the powerholders" (Arnstein 1969, p.217).

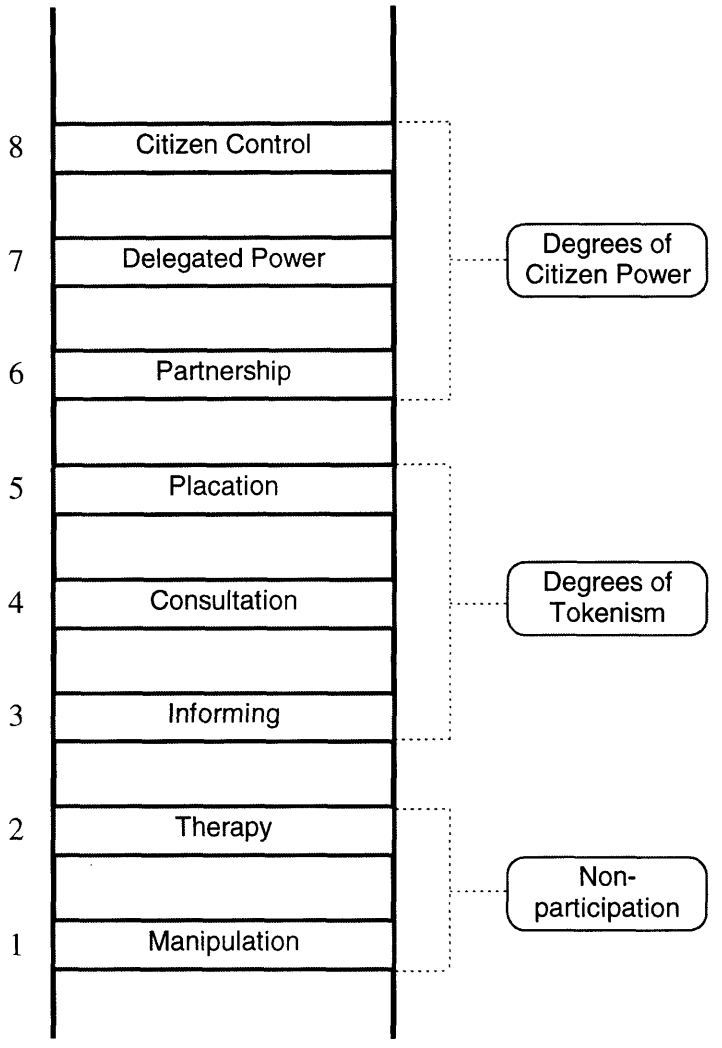

Figure 4.8 The Ladder of Citizen Participation (after Arnstein 1969).

For Arnstein, participation as she perceived it at that time was unambiguously concerned with the "have-nots" being able to influence decisions that affected their lives. On writing about demands by the socially underprivileged to be involved in decision making, she notes that the "... underlying issues are essentially the same – 'nobodies' in several arenas are trying to become 'somebodies' with enough power to make the target institutions responsive to their views, aspirations, and needs" (Arnstein 1969, p.217). From Arnstein's observations, it can be inferred that the then contemporary understanding of participation was that it was a political process largely driven by the demands of the underprivileged.

4.3.2 Community development

In contrast to community participation being a bottom-up driven activity as characterised by Arnstein, the techniques of Rapid Rural Appraisal (RRA) and the related Participative Rural Appraisal (PRA) are implemented by aid agencies, universities, non-government organisations

(NGOs) and government field organisations. Each of these approaches is mainly used in the context of providing aid development projects to communities within lesser developed countries. They each involve direct interaction with the target communities, but with different purposes. RRA developed during the late 1970s and 1980s, and focussed on enabling researchers to elicit knowledge from communities more quickly than previous techniques. The process was driven by outsiders to the local community, with these outsiders subsequently developing and implementing plans and projects for the community. During the late 1980s and 1990s, the techniques of PRA have achieved widespread use. As the name suggests, PRA is explicitly about participation of (by implication) the target communities. There is a focus on harnessing the capabilities of the local people, and the role of the outsider is to facilitate and empower these people. (This discussion of RRA/PRA is based on a survey by Chambers (1997), particularly pp. 102-116).

Chambers (1997, p.115) provides a table (reproduced as Table 4.1) which depicts the RRA-PRA continuum, and this can be used as a basis for classifying the RRA/PRA approaches according to Arnstein's ladder. Under RRA, the outsider is an investigator who is seeking information from the target communities so that analysis and decision making can be carried out. Once members of the community have provided the information, they are no longer involved in the decision making; it is made in isolation from them. This type of approach is analogous to Arnstein's "consultation" step in which stakeholders are seen as "... statistical abstractions, and participation is measured by how many come to meetings, take brochures home, or answer a questionnaire" (Arnstein 1969, p.219). Arnstein observes that if this type of consultation is carried out as the main basis of involving the community, then it is a "... sham since it offers no assurance that citizen concerns and ideas will be taken into account" (Arnstein 1969, p.219). In contrast to RRA, PRA is much more involving of the local community on a continuing basis. PRA is about empowering the community by helping them to understand their particular issues more clearly. Knowledge that is generated by the process is applied directly by the stakeholders to dealing with their problems and needs. The outsider's role is chiefly to provide the process by which the efforts of the community can be harnessed most effectively. The PRA approach is thus 'higher up' Arnstein's ladder, displaying elements of "partnership", "delegated power" and "citizen control".

Table 4.1 The RRA-PRA Continuum (after Chambers 1997)

Nature of Process	**RRA**	<---------->	**PRA**
Mode	finding out-elicitive	<---------->	facilitating-empowering
Outsiders' role	investigator	<---------->	facilitator
Information owned, analysed and used by	outsiders	<---------->	local people

4.3.3 Local government planning

The local government development planning and approval process is another area that typically has included community participation and consultation. Within this area there is great diversity in the extent to which the public are included in the process. A diagrammatic representation of this was proposed by Department of the Environment, Sport and Territories (1995), and this is reproduced as Figure 4.9.

The 'steps' apparent in Figure 4.9 are reminiscent of the steps in Arnstein's ladder. The range of participation represented in this typology can be approximately overlaid on Arnstein's "informing", "consultation", "placation", and "partnership" levels. Both Arnstein and the Department of the Environment, Sport and Territories have contexted their work in the area of urban development. It seems that here the degree of participation is an important issue; with the aforementioned author discussing it in an attempt to clarify the then extant hyperbole in demands for participation, and the latter as a way of contrasting the different ways in which councils approach the consultation process.

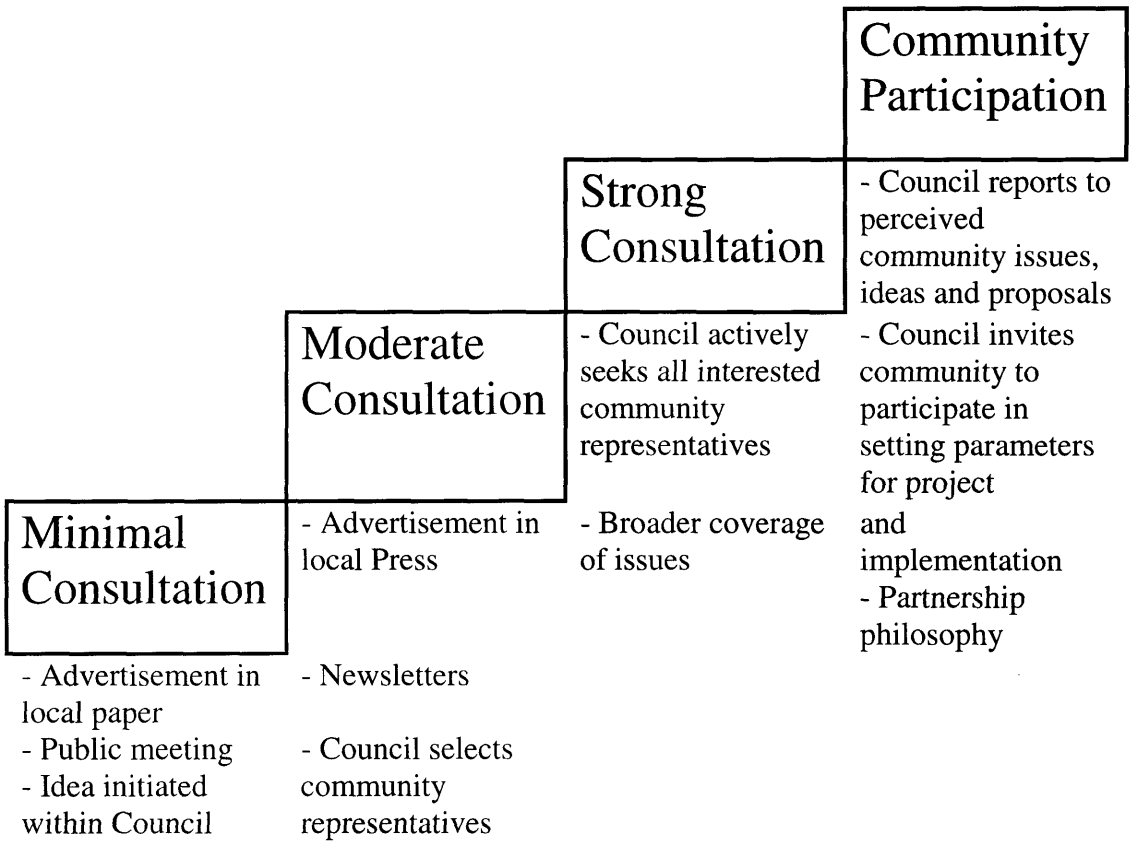

Figure 4.9 Degree of consultation in Local Government decision making

(Source: Department of the Environment, Sport and Territories 1995, sect. 6.1.3)

Another way that public consultation can be examined is by determining whether or not it is effective in facilitating change. As a general comment on this, it has recently been observed that in the contemporary literature "... there are two contradictory perspectives of public consultation that can be characterized as optimistic and pessimistic" (Warriner et al 1996, p.255). Under the optimistic view, it is generally asserted that "... public consultation over the last thirty years has improved policy making by creating a political system which is more open and accessible to the influence of ordinary citizens" (Warriner et al 1996, p.255). In contrast, those with a pessimistic viewpoint would claim that "... public consultation creates the illusion of authentic political participation, but is really a means of manipulating the public into acquiescing to decisions made by elites" (Warriner et al 1996, p.255).

The optimistic view can be identified quite readily in the IRM and ESD literature (see sections 4.1 and 4.2), where there seems to be an implicit understanding that public participation is a 'good thing'. On the other hand, the planning literature is not as sanguine about the benefits of participation, with much of it adopting a pessimistic perspective.

Some authors have been extremely critical of public participation in the context of development planning. Writing in the 1970s, Sandercock was scathing in her comments, describing public participation in planning as "... the great populist red herring of the seventies in Australia" (Sandercock 1994, p.7). However, the vehemence of these comments should be taken in the context of later statements, when she wrote the preface to the republication of her 1970s article in a book in 1994. In this she noted that "I am not suggesting that we give up on 'community participation', but that we acknowledge its limitations, and encourage community empowerment as a sometimes complementary and sometimes alternative strategy ..." (Sandercock 1994, p.7). The criticism of participation leading to middle class bias has also been made by Munro-Clark (1992), who comments on this bias in the Australian experience of participation. She refers to a study in which it is concluded that:

> ... the [typical] participant is a married, middle-aged, well-educated man who is active in voluntary organisations. His income is higher than average; he owns his own home and a car; he has resided in the area a long time and is active in local politics.

Within the planning environment, the participative approach may not always be indicated. Munro-Clark (1992, p.198) has noted that in some cases "...the ideological nature of a major planning dispute may make participative procedures inappropriate as a means of conflict resolution, (and that sometimes) negotiations will be undermined from the outset, because the most powerful party is not prepared to move at all".

Notwithstanding the above criticisms, there are positive indications that public participation in the planning process can be beneficial. In the context of public planning and design decisions, public participation with the working out of detail can be successful. Based on common practice and contributions to the book she edited, Munro-Clark (1992, pp.199-200) identifies the important factors in the success of such participation. These are:

- an open and responsive attitude in the bureacracy [sic] concerned;
- an adequate information-base for lay participants...;
- representation, if possible, of the full range of opinion among those who stand to be affected by the planning outcome;
- the provision of feedback incorporating a clear and considered response to every view that has been presented, whether or not this view is reflected in the final decision;
- the use of small-group meetings for the discussion of complex or contentious issues;
- facilitators who can highlight the need to trade off various costs and benefits and to put goals in some order of priority;

- openness from the outset about the limits on what can be achieved by the participatory process, so that a realistic atmosphere prevails and false hopes are not raised.

Another area in which participation has been successful is in citizen-initiated planning. In a case study reported from New Zealand, residents took the initiative in the development of the harbour-waterfront. This example included the use of a wide range of participatory methods, and was led by "... a well-established body, with a stable organisational structure and access to high levels of political finesse and technical expertise" (Munro-Clark 1992, p.201). This type of participative process has been identified as a "... potentially fruitful area in which to develop theory and method – which people could set about applying as a matter of course when things need doing ..." (Munro-Clark 1992, p.201).

Throughout this discussion on community participation in decision making, it is apparent that different degrees of community empowerment are involved in different situations. In Arnstein's Ladder of Participation, the top level represents a high degree of genuine empowerment, while the tokenistic and non-participatory levels would involve zero community empowerment. PRA was noted to involve intentional community empowerment, with attention being paid to supporting ongoing ownership by, and commitment from, the community. In the context of local government planning, most community involvement occurs as 'consultation' in which very little genuine empowerment is involved. The level entitled "Community Participation" in Figure 4.9 includes a 'partnership philosophy' and the involvement of the community in setting parameters for projects, although empowerment is still generally held onto by Council. The example of citizen-initiated planning in respect of a New Zealand harbour-waterfront is perhaps most indicative of genuine empowerment for the community.

The above suggests that community empowerment is an important aspect of public participation. It can vary in degree depending on the particular situation, but one might reasonably expect that higher levels of empowerment correspond to genuine attempts at community participation and ongoing involvement, whereas if no empowerment is in evidence it is likely that participatory processes are tokenistic at best.

So far, the content of this chapter has included a discourse on the similarities between ESD and IRM. In particular, the need for a systems approach, the need for participative process, the need to translate participation to empowerment, and the need to take a learning approach to participative management have been identified as consistent with both ESD and IRM. The

systems approach and learning issues have been addressed in Chapter Three, whereas various aspects of community participation as advocated within IRM and elsewhere have been addressed in this chapter.

The integrative decision making process to be described in Chapter Five has been developed explicitly for application as an aid to facilitate learning and public participation within a systems framework for IRM. Prior to describing this methodology and in order to provide the context in which it is intended for application, it is appropriate to explore IRM as practised in Australia, with examples drawn from various states.

4.4 IRM in Australia

The comment was made a few years ago that in the Australian context "... few governments have successfully integrated the management of land and water resources" (AACM and Centre for Water Policy Research 1995b, p.3). When making this observation, the authors noted that the states of New South Wales and Queensland were making progress towards this end but that other states still required significant reforms. It may be that little has changed in the intervening years. Just recently, a catchment planner in New South Wales pointed to the "... shortcomings that have plagued catchment plans and strategic plans since they first started being developed 6-7 years ago" (Anderton 1998, p.1). He points to the problem that these plans have been "... written documents rather than action oriented processes, and consequently have consistently failed to make the implementation step ... (to achieve) actual outcomes" (Anderton 1998, p.1).

Whether it is appropriate to be so pessimistic about the current state of IRM in Australia is an interesting question. In the following review of some aspects of IRM in Australia, the institutional settings will be briefly documented, and then some examples of IRM will be described. Following this review, some comment will be made about the general trends evident in Australia at present, and whether criticisms such as those above are warranted.

4.4.1 Institutional Setting for IRM in Australia

IRM has been implemented within government programs at both the Federal and State level in Australia. At the national level, the National Landcare Program (NLP) has been identified as an implementation of IRM (AACM and Centre for Water Policy Research 1995a). Landcare is an approach to the sustainable use of natural resources and fixing environmental problems that

is based upon an explicit community-involvement approach. It aims at creating partnerships among community, industry and government to achieve "...integrated and sustainable natural resource management at the farm, catchment and regional level" (Department of Primary Industries and Energy 1998, web page). The administration of the program involves the Federal Government making money available ($92.2 million AUD in 1998-99) to community groups and landholders to encourage them to "...identify and solve the soil, water and vegetation management problems which they share at the local, catchment and regional level" (Department of Primary Industries and Energy 1998, web page).

AACM and Centre for Water Policy Research (1995a) provide a comprehensive review of the NLP as they found it at that time. It is outside the scope of the present work to present another comprehensive review of the program. However, there were a number of strengths of the NLP identified in that review and these remain current. In particular, it is now generally recognised that the NLP "... has had a significant impact on the Australian community by raising their awareness of natural resource management issues; raising the profile of rural land managers in urban communities; and in developing joint programs with communities and governments to address the issues" (AACM and Centre for Water Policy Research 1995a, p.3). This particular outcome of the NLP has proven to be of some value to the present research. The integrative decision making process to be described in the next chapter includes an explicit focus on building and harnessing partnerships among stakeholders. The pre-existent experience of the Landcare approach by many participants in the case studies for this research meant that they were generally amenable to such a partnership focus.

At the state level, IRM is instituted either through an Act of Parliament (e.g. New South Wales Catchment Management Act 1989), as a program that forms part of the general purview of a particular government department (e.g. in the State of Queensland, integrated resource management is pursued as a part of the Resource Management Program of the Department of Natural Resources), or under the auspices of a self-organising community-based group (e.g. the Liverpool Plains Land Management Committee in New South Wales was formed as an outcome of the local community's desire to achieve a more integrated approach to the management of natural resources in the catchment). Although there are a variety of funding mechanisms, institutional arrangements and implementation philosophies, all of the approaches to IRM have a point of fundamental agreement – they are an attempt at an *integrated* approach to the management of complex human-environmental systems with a view to achieving a more sustainable use of resources.

Community empowerment is an issue that has been referred to previously in this thesis. Throughout IRM, there are various degrees of empowerment in evidence. In the Landcare movement, self-organising landholder groups request funds from the government to carry out projects. Under this model, once the group receives the funds, it effectively has full financial empowerment to proceed with the work. Landcare groups are of the 'grass-roots' variety, and involve community members directly in the decision making processes. As such, the degree of effective empowerment is high, suggesting a genuinely participative model. However, it should be noted that their empowerment is at best a constrained one, because they remain bound by relevant state and local rules and regulations which may impact on their ability to effect the outcomes they desire. At the state level, the usual approach for IRM is to form a management board or committee consisting of members appointed by ministerial decree or other political process. Typically, members comprise community representatives, various government agency personnel and people selected for their previously demonstrated acumen in environmental or business management. However, members are not always appointed for these reasons. For example, in New South Wales concern has been expressed "... at the political pressure exerted by local and state government members of parliament interfering in the selection of catchment management committee members" (AACM and Centre for Water Policy Research 1995a, p.17). It is with these boards or committees that the power to select and fund projects rests. The wider community is asked to provide input into the decision making process through consultation processes, but the initiative and responsibility usually remains with the regional or state committees. The degree of community empowerment is less here than is apparent under the Landcare model, although the same sort of constraints will apply. Following Arnstein's Ladder typology, one might expect to find a more tokenistic approach to participation under the state based IRM approach.

The following review of some examples of IRM in action provides the opportunity to comment on the effectiveness of the integration that is important in the philosophy of IRM. Some observations will also be offered in respect of the degree of stakeholder empowerment evident in the examples.

4.4.2 Australian Examples of IRM Praxis

4.4.2.1 The Liverpool Plains – New South Wales

The organisation of integrated catchment management in the Liverpool Plains area has previously been noted in this thesis as an example of a "grass roots landholder driven organisation". The Liverpool Plains Land Management Committee (LPLMC) is not constituted under the *Catchment Management Act 1989* as are nearly all catchment management committees in the State of New South Wales. The LPLMC was established by the community of the Liverpool Plains in order to address the threat posed by saline water tables to cropping and other agriculture and the problems of floodplain management. As might be expected from a group with such a strong community-driven background, the LPLMC has a strong emphasis on the involvement of the wider community in their activities. This is made explicit in the core objectives of the Committee which include the following:

- to ensure that catchment benefits from informed community participation and progression towards the goal is supported by community understanding and action; and
- to confirm that the strategies and actions adopted continue to be effective, equitable, relevant and supported by the community.

(AACM and Centre for Water Policy 1995, p.13)

The LPLMC has recently commissioned a consultancy to produce a catchment action plan for the Liverpool Plains catchment. The brief for this work states that the consultant "... will be required to implement a process by which the community can take responsibility for their section of the catchment, understand its current condition and the role each individual plays in contribution to that" (LPLMC 1998, p.3).

Whereas the LPLMC makes explicit the need for a high degree of community involvement in the consultancy brief as well as having this embedded in their core objectives, it appears that the actual opportunity for the wider community to be involved in the decision making process is limited. Previously, the LPLMC has "... undertaken numerous consultations and information gathering processes which have provided information on problems, issues attitudes and desired directions" (LPLMC 1998, p.7) and this information now forms part of the knowledge base. The present consultancy is aimed at assembling available knowledge and from this to develop an action plan. During this process, it appears from the consultancy brief that no allowance has been made for a community-based learning approach to the development of the plan, other than the intended interaction between the Committee and the consultant. The

only phase in which the general public is consulted about the action plan is called a "negotiation phase". That is, it seems that the wider stakeholder community will only be involved once a number of proposed actions have been identified, and then only so that they can react to the proposals. This approach is the antithesis of an effective learning approach in which the relevant stakeholders ought to be involved throughout the entire process. Moreover, it seems to be out of character with the grass-roots nature of the LPLMC. Upon checking with the Committee, the author found that community consultation does form an ongoing part of the process that the consultants are expected to implement, and that they have developed a consultation strategy during the first part of their engagement.

The LPLMC is atypical in that it was formed at the instigation of local interests. The more usual scenario for implementing an IRM approach in New South Wales is through the Total Catchment Management (TCM) program supported by the Department of Land and Water Conservation. Under this scheme, there is a strong emphasis on the coordination of activities so that integration occurs. To support this, there is a State Catchment Management Coordinating Committee, Regional Catchment Management Committees and localised catchment-based Catchment Management Committees. The two case studies undertaken as part of the present research involved interactions with the Throsby Creek Catchment Management Committee and the Malpas Catchment Management Committee – each group being responsible for a sub-catchment of a major system (the Hunter and Macleay rivers respectively). The Regional Catchment Management Committees are supported by paid staff and provide a coordinating, strategic planning and support role for their constituent Catchment Management Committees (CMC).

Following is a brief review of the recent activities of two Regional Catchment Management Committees in New South Wales. They provide examples of the way that IRM is being implemented at the regional level, with particular emphasis on the degree and effectiveness of community participation, which has been identified as important in the context of this thesis.

4.4.2.2 The North West Region of New South Wales

The North West CMC is responsible for the Macintyre, Gwydir and Namoi River Catchments, all of which feed the Murray Darling system in the north of New South Wales. The North West Region includes the Liverpool Plains and the LPLMC. Even though the LPLMC was not constituted as part of the TCM program, there is nevertheless good cooperation between the two organisations (AACM and Centre for Water Policy 1995 and LPLMC 1998). A major

aspect of the work of the North West CMC (as for most CMCs) is the preparation of a strategic plan, the identification of important issues in the catchment, and the allocation of priorities for dealing with them.

To achieve these ends, the catchment coordinator organised a series of community workshops to which general invitations were issued via advertisements in the print media, flier distribution and the use of existing social networks (Michelle Holmes, North West Region CMC, pers. comm. Jan. 1999). The workshops were held at various locations in the catchment (the Namoi in this case) with around 30 people attending each workshop. The workshops were facilitated with personnel drawn from the CMC and the Department of Land and Water Conservation. Groups with thematic interests such as land use, water and vegetation were formed, and participants were invited to join the group that interested them. The groups were asked to work on the goals for their particular interest area, provide strategies for achieving those goals and prioritise their suggested strategies. The prioritising was based on a voting scheme where participants had a number of paper 'dots' and voted by allocating varying numbers of their dots to the different strategies. In this way, each group established priorities for its suggestions.

Once the various community workshops are finished, it is the role of the CMC to synthesise the suggestions of the various groups and thus to develop an integrated strategy plan. The approach they take to achieve this is to look at the various goals that have been identified at the workshops and consider how they link together. They do this by a form of qualitative scenario testing where they look at various options for action and ask of themselves the question "If we do 'this', what goals does it help us with". It was noted by Holmes that the overall approach is not really satisfactory, and she identified the need for a more systematic and consistent way to prioritise issues and actions.

Based on formal and informal discussions with catchment coordinators from around Australia, it seems that the approach taken in the North West Catchment Management Committee is typical of many CMCs. Most employ a similar form of community consultation with workshops, lists of suggested actions, collective prioritisation and subsequent attempts to synthesise an integrated plan with varying degrees of success. A somewhat different approach has been adopted by the Catchment Planner for the Macleay River Catchment.

4.4.2.3 The Macleay River Catchment of New South Wales

At time of writing, the Macleay Catchment Management Committee is midway through an 18 month project to prepare the Macleay Community Resource Management Plan. This is being developed with a very purposeful community focus in an attempt to avoid "... the shortcomings that have plagued catchment plans and strategic plans (in the past)" (Anderton 1998, p.1). Anderton (1999, pers. comm.) also observes that catchment planning has generally failed in the implementation stage – most CMCs have Mission/Vision/Strategy documents, but these don't get translated into action. Based on a recognition of these issues, David Anderton (the Macleay Catchment Planner) has approached the catchment planning process with the intention of creating a plan that leads to real outcomes. In order to achieve this, he has adopted an intentional learning approach based on the premise that "... individuals and communities only change behaviour after going through a self directed learning process, and that this process may happen more quickly if the people are able to go through it as a group" (Anderton 1998, p.3).

Anderton (1998) has identified a number of novel aspects of his approach. These include the attempt to link planning with implementation through involving various agencies at an early stage and getting their commitment; a move away from consultation to participation; and the intent to value community knowledge above scientific knowledge. The latter point has meant that there has been no specific attempt to gather general data about the catchment prior to consultation. The community engagement phase has included three major strategies; one of these has involved community meetings at the sub-catchment level; a random survey seeking comment from catchment residents; and the use of a freecall phone number so that people who might not want to participate in either a community meeting or a mail survey have an alternative. He has designed the public interaction phase in this way "... to facilitate local people to undertake their own analysis, that is, diagnose their own problems and the possible solutions to them" (Anderton 1998, p.2).

Anderton identifies the community development, adult learning and agricultural extension literatures as influential in forming his views on the reason to take a learning approach. The methodology to be articulated in the next chapter also includes a specific learning approach as its foundation. However, in contrast to the literary bases of Anderton's approach, the integrative decision making process has evolved from the following literatures: sustainability, ecological economics, system dynamics and learning organisation. The difference in background has resulted in a different set of methods, but the underlying philosophy is

nevertheless similar. The fact that, despite the difference in intellectual underpinnings, Anderton and the author of this thesis have come up with similar prescriptions for effective integrated catchment management, tends to reinforce the robustness and appropriateness of the participative, stakeholder-driven, learning approach being advocated.

4.4.2.4 The Johnstone River Catchment of Queensland

IRM (called integrated catchment management in Queensland) was established by the Queensland State Government in 1990 "... in response to community interest in a river catchment approach to dealing with resource degradation issues" (AACM and Centre for Water Policy Research 1995b, p.26). Five pilot study areas were selected, and the Johnstone River catchment was the first of these to be investigated.

The Johnstone River catchment is located in far north Queensland and the principal activities are dairy and beef cattle production, intensive horticulture, sugar cane farming, marine fisheries and tourism. There are also significant wilderness areas, with 45 per cent of the catchment declared as a World Heritage Area (AACM and Centre for Water Policy Research 1995b).

The Johnstone River study involved the establishment of a community based Catchment Coordinating Committee (CCC) to provide oversight of the study. The committee included members drawn from a wide cross-section of the community, including agricultural, industrial, tourism and community representatives. The main functions that the committee should fulfil during the pilot study as identified by its constituent members were: to address complex environmental problems that involved the government and community; to provide a forum for stakeholders to contribute their views; to allocate priorities to issues; and to develop and promote strategies to address the issues within an integrated catchment management framework.

The implementation of the pilot study involved significant community consultation which was based around "shed meetings" and one-on-one interviews. The "shed meetings" were convened in a local cane or banana grower's shed, with typically 10 to 20 local farmers in attendance. The CCC representative who convened these meetings was able to gain input from the farming community on its perceptions of the resource management issues, and suggestions for possible solutions. Based on the input from the (mainly) farming community, and other catchment stakeholders, a draft catchment management strategy was developed. This was then

made available for public comment; a copy was placed in the library, various people were approached directly for their feedback, and further shed meetings were held in which participants were asked for their further input (Peter Gleeson, Catchment Coordinator, pers. comm. 1999). Indeed, it might be suggested that the community consultation phase was carried to the extreme. The review by AACM and Centre for Water Policy Research (1995, p.37) observed that a weakness of the process was the "Emphasis on planning and consultation rather than action on the ground – (the) community is now ready for some activity".

The major outcome of the pilot study was the development of a management strategy which addressed natural resource issues within the catchment. The strategies were grouped under the headings of land management, water management, riverine management and habitat management. The government agencies which are responsible for implementing actions as part of the strategies were identified within each heading category. The review by AACM and Centre for Water Policy (1995, p.34) has identified the implementation process which the Johnstone River CCC have developed as "... one of the most advanced and well thought out in Australia", although at that stage it hadn't actually been implemented. The elements of this process as articulated by the CCC are:

- allocation of priorities as the first step for implementation of activities under each strategy;
- allocation of responsibilities for implementation; and
- negotiation of Memoranda of Understanding between different (agencies) with responsibility for contributing to the implementation of activities under priority strategies.

(AACM and Centre for Water Policy 1995, p.35).

The latter process is very similar to the approach adopted more recently by Anderton (reported above) where he sought early commitment from the various agencies so that they would have involvement with, and ownership of, the various activities that proved necessary for the successful implementation of the management plan.

The above description of the Johnstone River ICM experience is based on the report by AACM and Centre for Water Policy Research (1995) and discussions with the present catchment coordinator. Following the finalisation of the strategic planning phase, a number of activities have been undertaken in respect of implementing some of the identified strategies. The CCC have been able to develop good cooperative arrangements with the majority of agencies and various community groups, and a number of on-ground projects have been commenced. One

of the major strategies for achieving water quality improvement has been the pursuit of best management practice (BMP) standards for use within the various agricultural sectors. The CCC presently employs a BMP coordinator whose role it is to identify appropriate BMPs, provide relevant information and encourage landholders to modify their farming practices to incorporate BMP. According to Gleeson (1999, pers. comm.), the extension of BMPs is proving to be difficult. The extension programs include workshops and information evenings, but the farmers remain hard to convince. "Farmers must get something out of it – ownership of the solution is nine tenths of the battle" (Gleeson 1999, pers. comm.).

4.4.2.5 The Onkaparinga Catchment of South Australia – Leading the Way?

In the State of South Australia, IRM has been implemented under the rubric of Catchment Management. The enabling legislation is the Water Resources Act 1997 which, among other things, requires that those responsible for administering the act should "... encourage members of the community to take an active part in planning the management of water resources and in managing those resources" (South Australian Parliament 1997, Sect 6.2(b)(vi)). The Act also makes explicit the need for the management of water resources in a way that is fully consistent with the general principles of ESD. Whereas the focus in South Australia is explicitly on the use and management of water, Catchment Management explicitly recognises the need for an approach integrated with other resources since they "... are inextricably linked to one another by hydrological and biological cycles" (South Australian Department of Environment and Natural Resources, undated, unpaginated).

Under the Act, Catchment Management is to be implemented on a regional basis in South Australia through the creation of Catchment Water Management Boards (CWMB). Early in 1998, the Onkaparinga CWMB was announced by the relevant Minister. Appointment to the Board followed a public call for nominations of persons with the appropriate skills and experience as required under the Act. In order to pursue their role of developing a catchment water management plan in conjunction with the community, they have written a consultancy brief with a view to engaging a consultant to assist them in this process. This brief has a number of features which suggest a high level of commitment to genuine stakeholder engagement by the Board. These are described below.

One of the most obvious aspects of the consultancy brief is that it is very comprehensive. It addresses a multiplicity of background issues, and provides an intensive review of the CWBM's position on issues such as community involvement. Clearly, significant funds have

been invested in the brief, and this has resulted in a high quality set of documents in terms of information conveyed (the documents themselves are simply presented) which clearly establish a framework for the consultancy that is consistent with the principles of ESD and also demanding of effective and ongoing involvement of the stakeholder community.

A noteworthy aspect of the brief is that it makes explicit that the multiple communities are involved within the concept of *stakeholder*. It defines *stakeholder* as "... anyone who has a stake in the outcome" (Onkaparinga CWMB 1998a, p.22), and identifies the following as members (but not necessarily the only members) of the stakeholder group: community environmental groups, resident groups, local rural landholders, irrigators, agricultural interests, Soil Conservation Boards, Economic Development Boards, tourism and small business interests, cultural groups and regional, local, State and Federal government bodies, conservation groups and educational bodies. This is an unusual list in that it makes explicit mention of government agencies; many stakeholder identification processes exclude the government agencies because they are perceived to be external to the system under management. An important insight from the system framework that underpins the present research is that many government agencies are inextricably interconnected to any given anthropo-environmental system, and as such must be included within the umbrella of stakeholders – those with a stake in the system. The Onkaparinga approach can thus be seen to be consistent with this principle.

The Onkaparinga CWMB has a clearly articulated policy on how community consultation ought to be undertaken. This appears to be a novel feature and contrasts with the case studies reported above (with the exception of the Macleay catchment) where consultation seems to have been undertaken without a clearly articulated approach having been previously identified. The lack of an explicit policy on the process of community involvement was apparent when discussing this general idea with the people identified above, as they failed to identify such a policy when questioned explicitly about their approach. The exception was David Anderton of the Macleay Catchment who identified particular reasons for selecting the approach he adopted.

The Board's policy entitled "Community Consultation and Involvement" states that "To achieve change, the community must feel that they have an influence on decision making and this will lead to community ownership of problems and solutions" (Onkaparinga CWMB

1998b, p.6). It includes five key principles, which it asserts the management plan will be based upon. The principles are the following.

1. The purpose of the consultation process and the relationship between decision-making and consultation needs to be clearly understood by all participants.

2. Community involvement should start early in the planning process.

3. Recognise multiple communities and involve all stakeholders (as discussed above).

4. The techniques employed must be appropriate to the cultures of the various communities. There is a need to organise public meetings so that local people are attracted and provide feedback. Techniques should recognise the varying levels of time, interest and expertise of participants.

5. Sufficient time should be allocated to ensure that people get the opportunity to participate.

(Adapted from Onkaparinga CWMB 1998b)

In the context of the above, the Board requires that the consultant "Develop a process to consult with various sections of the community on how they want to be involved in the development, conduct and implementation of the OCWMP" (Onkaparinga CWMB 1998b, p.3).

The conclusion to be drawn from the Board's position on community involvement is that they appear to have a desire for genuine and ongoing involvement of the wider stakeholder community in the management of the catchment. They are explicit about the reason for the stakeholder involvement, and articulate a comprehensive basis on which to proceed. Moreover, the consultancy brief itself has been prepared as a result of extensive stakeholder consultation. This overall approach to stakeholder involvement is congruent with the principles embedded within the integrated decision making framework to be described in the next chapter.

As part of the catchment planning process and based on previous community consultative processes, the Onkaparinga CWMB has specified a number of tasks that must be undertaken. These include the preparation of a comprehensive status report that refers to social, economic and environmental factors, an implementation plan inclusive of priorities, a methodology to assess the effectiveness of the plan, and the identification of priorities for additional research to

fill knowledge gaps that are identified in the process (Onkaparinga Catchment Water Management Board 1998c). This type of referential study and implementation planning and assessment is typical of many catchment planning situations. It is highlighted here because it, along with the need for comprehensive community involvement, can be effectively addressed as part of the methodology to be described in Chapter Five.

4.4.3 Some Comments on IRM in Australia

The above provides a review of a number of different examples of IRM as it has been implemented in Australia. The examples from the Macleay and Onkaparinga catchments stand out because of the fact that the *process* of participation has been addressed as an issue. In the other examples, community participation/stakeholder involvement has clearly occurred, but there does not seem to have been the emphasis placed on selecting a mechanism of participation that is directly relevant to the characteristics of the catchment. Moreover, in the case of the Johnstone River catchment, it seems that the community consultation phase may well have been taken to extremes (as noted in the discussion above).

The criticism that IRM often fails to achieve effective integration across stakeholders was noted above. Whether or not effective integration has been achieved, depends on two things: what exactly is meant by *effective integration*, and whether it is this which has been achieved. Unfortunately, the idea of integration within IRM is mostly addressed as rhetoric. It is written and talked about as being a 'good thing' (much like the way that the notion of community participation is often presented), but it is generally not made explicit how management that is integrated ought to be done. The systems-theoretic framework proposed herein offers a basis on which to specify the key aspects of effective integration. The following pointers are suggested:

1. The systemic nature of the management problem should be explicitly recognised. Attention should be paid to the interactions among elements of the natural environment, between human and environmental systems and among the government agencies and other stakeholders. Action should be taken to create or strengthen links that are recognised as important elements in the overall system;
2. There should be a recognition of the potential for synergistic outcomes; and
3. The management culture for addressing the catchment management issues should be one of learning, adaptation and searching for solutions based on cooperative efforts.

In the review of various case studies presented above, it seems that these criteria are probably not met particularly well. Whereas many (if not most) involved in IRM will implicitly recognise that things are interconnected, it appears that this most fundamental system feature is rarely addressed explicitly. Certainly, there is no evidence of this being a priority in any of the above case studies, although it is recognised that such an issue may well have been addressed informally in workshops. The potential for synergistic solutions is also generally not addressed in IRM praxis, although this is a clear feature of the systems-theoretic framework. Moreover, it should be noted that the systems approach has been identified as an important part of IRM (Mitchell 1987, Cullen 1997), and yet this important aspect of the systems view is not central to present practice, nor has it been addressed explicitly in the literature.

Of the three criteria identified above, the third is the only one that seems to have been adopted explicitly. All the examples addressed incorporate the idea of learning about the problem, adapting solutions to the problem context and pursuing cooperative solutions to at least a small extent. The Macleay and Onkaparinga examples reveal an intentional focus on cooperative work due to their respective emphasis on comprehensive stakeholder involvement. The other cases reported each reveal evidence of cooperative activities among agencies and stakeholders. However, with the exception of the Macleay, learning and adaptation are only implicit in all the cases reported. In the Macleay, Anderton has been explicit about the adoption of a learning process in which ownership and adoption of solutions are facilitated. This contrasts with the experience in the Johnstone catchment, where present efforts are being thwarted to some extent because the farmers are being confronted with best management practices which they don't want to adopt. Clearly, they haven't been given the opportunity to learn about the problems, the solutions, why BMPs are important and why they might be worth adopting.

Nothing in the above is intended to suggest that those involved in IRM are not trying their best to come to terms with the notion of integrated management and to implement this to deal with local catchment-related problems. Moreover, in some cases, these efforts will have led to solutions that are synergistic in that they harness the cooperative efforts of various stakeholders in the identification and implementation of creative actions. However, it appears that in many cases integration (at least as defined by the indicators above) is poorly achieved, and this implies that more might be achieved than has been in the past if better degrees of integration can be facilitated.

Essentially, the purpose of the integrative decision making process which is the subject of this thesis has been developed to assist people working within IRM to achieve more effective integration in a way that is systematic and transferable. The integrative decision making process is described in detail in the next chapter.