

## Catchment Management Frameworks and Issues of Scale

*This paper addresses an important and topical issue in water management: that of organisational arrangements for catchment management and the impact of scale on bioregional water regulation regimes. Context is shown to be all-important in the process of establishing river basin organisations and other frameworks for managing water in its catchment setting. Taking a case-study approach, the paper identifies issues in catchment management surrounding tensions between top-down and bottom-up approaches, integrated management and subsidiarity, science and community based knowledge systems, and allocation and development priorities. The impact of these tensions on development assistance programs are discussed, as are implications of the field-based study for improved program design.*

### 1. Introduction

Water has conventionally been managed within administrative rather than natural boundaries, in a fragmented rather than holistic manner, and in a technocratic rather than participatory way. Using principles of integrated water resource management (IWRM), integrated river basin management (IRBM) or integrated catchment management (ICM), catchment management initiatives often involve moves toward governance within natural boundaries to manage water more holistically, equitably, efficiently and sustainably.

A basic tenet of catchment management is that what happens in one part of a catchment, as an interconnected system, affects people and environments in other parts. The greater the degree of diversion, impoundment, consumption, pollution and commitment of a basin's water resources, the greater is the degree of interdependence between users and potential tradeoffs between uses. Hence there is a need for collective governance of catchments as multiple user, multiple stakeholder and multiple value systems in the process of development.

On the above basic principles, there is broad agreement. Many countries are responding to these understandings with innovations in catchment governance, and overseas development assistance (ODA) in the water sector has provided support for policy reform and catchment-specific initiatives. In Australia, experience and lessons learned from our own catchment governance reforms have been brought to bear in ODA program design.

Despite an emerging orthodoxy on IWRM and IRBM/ICM, there are significant tensions in catchment management between:

- top-down and bottom-up approaches;
- the holistic philosophy that lies behind integrated river basin management and the participatory ideal of decentred decision making;
- the science-based approach that takes advantage of complex ecological knowledge, hydrological and water allocation models, and tools such as GIS, on the one hand, and community-based initiatives oriented to local knowledge on the other;
- catchment management institutions' role to allocate an increasingly scarce and finite resource (water) versus a catchment management institutional role to mobilise developmental resources and funds for new infrastructure to take yet more water off the river;

While these tensions are generic, their manifestation and means to deal with them are quite context-specific. In this paper, we consider catchment management as governance of water in

its river basin context through studies of reforms in Australia, Thailand, Vietnam, Vanuatu and the Mekong River Basin. We pay particular attention to the tensions that arise around issues of scale in catchment management. The lessons we draw for development assistance point to the need to work with endogenous development of appropriate institutional arrangements and the need for a diagnostic approach that will allow external interventions to be well tailored to context.

## 2. Issues and experience in catchment management

There is a large and diverse body of literature dealing with catchment management, integrated river basin management and transboundary basin management. Much of this work is multi-disciplinary and pairs hydrological assessment with the consideration of catchment management as a governance issue central to water management reform and innovation. The material reviewed here focuses on case studies and themes that are most directly relevant to issues of scale and contextual considerations in catchment management frameworks within diverse development situations.

There is a divide in approach between catchment management studies dealing with developed nations and those focused on developing nation case studies. Literature that deals with Australia, North America and Europe tends to review and be critical of existing catchment management regimes (Blackmore 1995; Connell 1997; Gomez-Fort, Macpherson et al. 1997; Cullen 1998; Farrier and et al. 1998; Irons 1999; Curtis and Lockwood 2000; Greiner and Cacho 2001; Gardner 2003; Kingsford 2003), while literature focused on developing nations is more normative and concerned with recommendations for reform (Brunns and Meinzen-Dick 1997; Falkenmark and Folke 2000; GWP, 2000; Booth, Warianti et al. 2001; Duda 2003; Jaspers 2003; Falkenmark 2004; Falkenmark, Gottschalk et al. 2004). The logic underlying this division has premised an approach in the catchment literature which justifies the transfer of institutional models and policy directives from one context to another.

Miller and Hirsch (Miller and Hirsch 2002) have critiqued the prescriptive approach, asserting that river management is a product of negotiation between civil society and the state rather than a set of policies, laws, or institutional models that can be transferred readily from one river basin to another. Although the authors acknowledge the benefits of cross-institutional learning in the form of processes and principles, they assert that packages and models are less suited for international transfer (Miller and Hirsch 2002). Furthermore, they identify a tendency for development assistance programming in the catchment management area to be negotiated by ‘experts’ in water management or policy at the expense of input from civil society and national government actors (Miller and Hirsch 2002). The risk in excluding rural community actors from catchment management design is that macro-level institutional arrangements can be disconnected from the local experiential level, and the knowledge, concerns and priorities held at this level. This can have the effect of de-legitimising catchment management organisations and inhibiting their effectiveness as coordinators and implementers of natural resource policy.

In articulating the tension between generic principles for catchment management and the need to address the specifics of each context, the international experience in catchment management has been discussed in the literature with reference to four key themes: the adoption of the catchment as the most ecologically appropriate management unit; the espousal of ‘integrated catchment management’ and ‘integrated water resources management’ as a means to draw together previously fragmented water policies; the acknowledgement that inclusive and participatory reform processes will be more effective than centralised decision-making; and the focus on sustainability as the driving force behind catchment approaches to water management.

The adoption of the **catchment** as a framework for managing water and other resources has dominated water management discourses for close to two decades. The shift to catchment

based management reflects a move towards more holistic management of water within its ecological context and an acknowledgement that politically determined administrative boundaries often bear no relation to natural ecosystem processes (Blackmore 1995; Heathcote, 1998; MDBC 1999).

The acknowledgement that water resource management must consider the **integrated** nature of water with other ecosystem processes at the catchment scale has directed policy reform and institutional restructuring in recent years. IWRM has become a popular concept with reference to water management initiatives (Jewitt 2002; Matondo 2002; Moriarty, Butterworth et al. 2004) and the implementation of IWRM policies is seen as a way to overcome fragmentation of existing water and other natural resource initiatives (Arcioni 2001). The extent to which integrated management is actually implemented remains to be seen. Similar to the concept of 'sustainable development', increasing concern has been shown by seasoned practitioners that IWRM has been either diluted to mean just about anything to anyone and revert to business as usual, or it has been used to legitimise practices that promote particular bureaucratic or developmental agendas (eg Biswas 2004).

A third feature of catchment management debates is the recognition that **inclusive and participatory** catchment management programs will be more effective than those based around centralised decision-making. It is commonly asserted in institutional and academic literature that implementing participatory management processes will engage stakeholders with water management and foster resource stewardship (Maaren and Dent 1995; Bruns and Meinzen-Dick 1997; van der Lee 2002). Mechanisms for participation are seen as a means for overcoming bureaucratic, centralised decision making and are tied to issues of organisational legitimacy (Duda and El-Ashry 2000). Greater ownership (or 'buy in') of decisions, and opportunities for groups with disparate interests to be exposed to diverse perspectives can also help avoid potential resource based conflicts by building trust and relationships. However, the extent to which participation has been effectively implemented at the local level has been challenged, with many academic critiques asserting that the adoption of 'participation' in catchment management regimes more often constitutes a linguistic than a practical change (Maaren and Dent 1995; Dube and Swatuk 2002; van der Lee 2002). There are some cases where consultation and participation have been integrated into organisational make-up, for example the establishment of a Community Advisory Committee within the central framework of the Murray-Darling Basin management structures (Blackmore 1995). However in other cases, catchment based participation programs are often somewhat of an afterthought in that they exclude stakeholders from early phase input in the overall direction of management initiatives, are often based around short-term consultation, and commonly lack mechanisms for ongoing engagement in water management processes.

Participation has been used to mean many things, from manipulation to full community empowerment (Arnstein 1969). Cooke and Kothari's (2001) work on the "new tyranny" of participation presents a recent challenge to participatory development initiatives and discourses, exposing its abuse and distortion. This analysis has yet to be applied specifically to participation as a buzzword that lends legitimacy to catchment initiatives.

The fourth theme in catchment management literature is the focus on **sustainability** as a driving force for regulatory change. It is widely accepted that continued water resource exploitation based on a command and control approach to natural resources cannot continue indefinitely for reasons of scarcity and inequity (McCully 1996; WCD 2000). This is commonly framed as the 'world water crisis' and the solution is constructed as a shift to more sustainable management practices focused on redressing the over-commitment of water beyond a level at which certain ecosystem functions can continue to operate. The sustainability debate has been marked by the application of increasingly sophisticated science to catchment management. Advances in hydrological modeling and improved understandings

of the complex relationships between different ecosystem functions underpin the confidence with which IWRM approaches are promoted.

Some authors have pointed to a significant weakness in institutional and governance reform according to these principles, which arises from over-attention to form and lack of attention to practice and process (eg Ewing et al). Adaptive management is a response to this and is also articulated by others as a negotiated (Miller and Hirsch 2002) or people oriented approach (Both ENDS 2002) to water resources management. The basic idea here is that water resource management policies, institutions and activities are the product of a participatory and iterative process which changes in response to shifting social, economic and ecological needs.

Environmental stresses and historical circumstances have often brought community interests and demand for action on water issues to a political level, for example the Sydney cryptosporidium and Giardia crisis in 1998 (Gardner 2003), and the Murray-Darling Basin blue-green algae outbreak in 1991 (MDBC). Public interest and the pressure for change is strongly influenced by environmental factors, as in the drought cycles in Thailand, which tends to bring interest in water management higher onto the agenda, with public interest declining in wetter years.

Whilst there is a significant body of literature in the social sciences, notably history, anthropology and human geography, which documents local and culturally-specific water resources management practices, less well covered is the significance of context to catchment management, and the embedded nature of governance in specific ecological, economic, cultural, social, historical and political conditions within catchments. Lovelace and Rambo note that “the inherent logic of the watershed as a natural, a functional, and an analytical unit and the watershed’s suitability and utility as a planning and management unit are supported only in part by the pattern of human activity across the landscape” (1991:81). While the number of river basins which have governance frameworks in the shape of formal river basin organisations is rapidly growing, water continues to be governed at other levels according to existing societal means of allocating and governing access to resources.

The ‘what is’ versus ‘what should be’ approach to catchment management has obscured thorough investigation of existing and historical catchment management models in developing nations and implies that catchment management regimes are linear in their evolution, with developed nations offering more ‘advanced’ water governance models. The following case study based discussion questions this assumption.

### **3. Catchment Management in Asia and the Pacific: A Case Study Approach**

In this study, we examine issues of catchment management through five case studies: Australia, Thailand, Vietnam, Vanuatu and the Mekong River Basin.<sup>1</sup> The case study approach allows us to examine ways in which catchment management is shaped by context and to draw implications for how development assistance needs to take account of specific ecological, social, economic, cultural and political conditions.

A number of reforms have supported catchment management in each case (Table 1). In Australia, the key reforms in catchment management have been a regionalisation of natural resource administration, whether it be forest management or catchment management. More recently, the Wentworth Group has supported the idea that market-based reforms should be part and parcel of the reform process and this involves standardisation across jurisdictional boundaries, through the National Water Initiative and CoAG activities. Water trading within

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<sup>1</sup> Indonesia was a sixth case study for the wider project of which this catchment theme paper is a part, but the emphasis in the Indonesia case study was on urban water service provision.

river basins is part of the reforms, and is predicated on a clarification of licensing arrangements and property rights in water.

In Thailand, Vietnam and Vanuatu, the reforms are much less extensive. In Thailand, the key reform has been in the territorial basis for natural resource administration toward natural catchment boundaries, through establishment of River Basin Committees. However, provincial and district boundaries continue to be the primary basis for territorial administration. Vietnam's Water Law provides for establishment of river basin organisations (RBOs), but these are only now really being put into operation. The centralised decision making framework and very limited opportunity for civil society involvement in governmental structures constrains the operation of catchment institutions in a participatory manner, and even provincial authorities are involved only to a limited extent in centrally planned initiatives (see Text Box 1). Basic inter-departmental involvement in river basin organisations is curtailed by the strong ownership of RBOs by the lead government agency, the Ministry of Agriculture and Rural Development (MARD). This strong ownership is partly a reaction to the progressive decline in water resources management functions undertaken by MARD (and the former Ministry of Water Resources it subsumed) with the gradual migration of water resource management functions to MONRE (Ministry of Natural Resources and Environment). This institutional reform is partly premised on the need to reduce the strong agricultural-bias in water resources development that occurred under MARD, in order to promote IWRM. In Vanuatu, the small Tagabe catchment management initiative is the only significant and experimental project to date. In the Mekong River Basin, the Mekong River Commission and other regional actors are engaged in transboundary governance initiatives that are only partly functional. The Basin Development Plan (BDP) is the MRC's most ambitious effort at integrated planning on a catchment-wide basis to date. Whilst efforts have been pursued to engage in some level of 'public participation' within the 10 BDP sub-catchments, participation has in practice been interpreted in a very limited sense. The strong consultative process within the programme between BDP coordinators in each riparian country has, however, facilitated regional learning at this level. The next phase of the BDP is likely to give greater emphasis to projects rather than process

**Table 1: Key Catchment Management Directions in Case Study Areas**

Case	Key Catchment Management Directions
Australia	<ul style="list-style-type: none"> <li data-bbox="448 1330 1361 1581">• The Murray-Darling Basin Commission governs Australia's largest transboundary river basin (occupying about one seventh of Australia's land mass and containing an agricultural area in which about 70% of Australia's irrigation occurs). The Murray-Darling has been a concern of the federal and state governments since federation and has inspired intergovernmental cooperation in water management since the signing of the Murray Waters Agreement in 1914. The Commission (established in 1992 by the <i>Murray-Darling Basin Agreement</i>) is often cited as an example of effective transboundary water governance and integrated catchment management as it represents cooperation in natural resource management between five States and Territories and the Commonwealth Government.</li> <li data-bbox="448 1592 1361 1868">• However intergovernmental cooperation has not resulted in sustainable management of the Murray-Darling Basin ecosystem and governments are now attempting to address problems associated with over-extraction and salinity. Environmental degradation has inspired a reappraisal of Basin Management with the placing of a 'cap' on levels of water extraction. Following the establishment of the 'cap' in 1997, the Murray-Darling Basin became Australia's first pilot scheme for cross-border trading in water licences. Under this scheme, water extraction licences are tradeable commodities and current licence holders who do not use their full allocation ("sleepers" and "dozers") are able to sell excess water entitlements for economic benefit. To address environmental problems in the Murray-Darling Basin, the Council of Australian Governments (COAG) has entered the water market and allocated \$500 million to purchase water for environmental flows.</li> <li data-bbox="448 1879 1361 2029">• At the state level in New South Wales, catchment management has been marked by successive reforms. In the last fifteen years there have been three models of catchment management: Catchment Management Committees, Catchment Management Boards and Catchment Management Authorities. These organisations have been governed by the <i>Catchment Management Act 1989</i> and the <i>Catchment Management Authorities Act 2003</i>. Changes in organisational structure have instituted a consolidation of catchment</li> </ul>

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	<p>management (there are thirteen Catchment Management Authorities compared to twenty-one Catchment Management Boards) and an apparent reduction in community participation.</p>
	<ul style="list-style-type: none"> <li>• Catchment management models in other Australian states are variable in terms of institutional make-up and level of stakeholder participation. Victoria has an established Catchment Management Authorities system (originating from 1994 legislation) and emphasises integrated management and sustainability. The Victorian system can be considered similar to, but more established than, the current New South Wales model. The South Australian model promotes community participation in catchment management and is coordinated by eight Catchment Boards. The Australian Capital Territory relies on the <i>Environment Protection Act 1997</i> (emphasising integration of environmental, economic and social considerations) and the <i>Water Resources Act 1998</i> (focused on sustainability) to direct catchment management policies but no dedicated catchment organisations exist. The same is true of Tasmania, the Northern Territory and Western Australia, where catchment management directives are typically incorporated into broader natural resource plans.</li> </ul>
Thailand	<ul style="list-style-type: none"> <li>• Bureaucratic administration of water has moved from a highly fragmented system of at least 31 government agencies dealing with water to a new Department of Water Resources under the new Ministry of Environment and Natural Resources, and a territorial demarcation of 25 river basins. However, the Royal Irrigation Department remains in a different ministry (Agriculture) and secures the largest budgetary allocation.</li> <li>• River Basin Committees have been established in each of the 25 basins (four of which have two RBCs to cover the upper and lower sections).</li> <li>• The proposed Water Law is still at the drafting stage, the latest version of a bill that has been in formulation since 1992 and that has been subject to civil society challenge and public hearings. Without the Bill, the RBCs do not have a clear legal underpinning and exist under Ministry Regulations.</li> <li>• Private sector consultants have taken on an increasing role in catchment management, the latest of which is to come up with investment plans for a number of river basins.</li> <li>• The history of conflict over infrastructure projects, dams in particular, affects relations within river basins. There is concern among NGOs, civic assemblies and others that RBCs will be used in part as a pretext to mobilize support for controversial projects, taking advantage of rainfall variability to press for large diversions and storage dams during times of drought (eg Salween in the north west, Kok-Ing-Nan in the north) and flood.</li> <li>• A key water initiative in Thailand is the proposed Water Grid, which uses a river basin framework to link water “surplus” basins with water “deficit” basins. This includes a transboundary component that would import water from Laos, Cambodia and Myanmar. Negotiations for sale of water from Laos, from southern Mekong tributaries, to Thailand are the most advanced transboundary water trades under consideration.</li> </ul>
Vietnam	<ul style="list-style-type: none"> <li>• Since the mid-1990s the national government has embarked on a process of reform of the water sector. This is part of the more wide-ranging process of restructuring state-society responsibilities and property rights in natural resources management accompanying <i>doi moi</i> (renovation).</li> <li>• Key water policy, institutional and legal changes accompanying this process of relevance to catchment management include the following: <ul style="list-style-type: none"> <li>○ the Water Resources Sector Review (1996) began the process of consolidating available data (at a macro level) on physical aspects of water resources; preliminary analysis was undertaken on priority concerns and projects for key basins;</li> <li>○ the merging of the Ministry of Water Resources (MWR) with other natural resources and agricultural agencies to form MARD in 1996 was an attempt to move away from the strong irrigation bias previously present in water resources development towards a more integrated approach to rural development; the restructuring of water management responsibilities under the Ministry of Natural Resources and Environment (overall water management) and MARD (river basin organisations and public water management) and in 2002 is a continuation of the reforms of 1996 and a further attempt to raise the profile of environmental aspects of water resources management.</li> <li>○ the National Water Law was passed in 1998, following considerable debate and revisions of the bill by the National Assembly; Articles 5, 20 and 64 (in particular) recognise the importance of protection and exploitation of water according to basin boundaries.</li> <li>○ pursuant to the Water Law, the National Water Council was established in 2000; it is considered the apex water policy body composed of the deputy</li> </ul> </li> </ul>

- Prime Minister and key natural resources management agency, regional, scientific and mass organisation representatives;
    - the establishment of 4 river basin organisations under the jurisdiction of MARD, with plans for organisations to be established in the remaining 17 river basins.
  - In each of the above reforms ODA has played a crucial role through provision of finance and expertise through international consultants.
- Vanuatu
- Catchment management is something new, described as “scary” even for government resource agencies, as it demands a degree of communication and application of science that officials are not used to.
  - Water management continues to be fragmented, notably between urban (Public Works Department – UNELCO) and rural (Department of Geology, Mines and Rural Water Supply) water service provision.
  - A Water Resources Management Act was passed in 2002 with provisions for customary tenure.
  - There are few catchment management initiatives in Vanuatu. They include:
    - Tagabe: Environment Unit: Port Vila water supply
    - Water quality monitoring in rural catchments (UNESCO – a project diverted from the Solomon Islands)
  - Catchment issues in Vanuatu are mainly framed in terms of urban water supply; logging; shifting cultivation pressures and erosion.
- Mekong
- The Mekong is often held up as an example of good governance in transboundary management, in securing *nearly* 50 continuous years of cooperation over water within a region marked by conflict and war.
  - The Mekong River Commission, and the Mekong Committee that preceded it, suffer from the absence of the basin’s two upstream countries, notably China.
  - There is a disconnection between the technical arm of the MRC (the Secretariat) and the political entity constituted through the Ministerial Council and Joint Committee. The Secretariat is a largely donor-funded and donor-driven agency whose primary role is the use of data and scientific assessments to underpin water sharing and basin planning under three core programs: the Basin Development Plan, the Water Utilisation Program and the Environment Program.
  - The Basin Development Plan divides the Basin into 10 key sub-areas. The first phase of BDP has largely been process-oriented, to establish mechanisms for stakeholders within each sub-area to have input into planning. There is now strong pressure for the BDP to become more project-focused and to serve as a mechanism for direct investment into infrastructure development. This is one of a number of tensions manifested in this and other river basin organisations, whereby they are perceived as another mechanism for development investment rather than coordination of activities and participation in decision making.
  - The Water Utilisation Program is designed to provide the data necessary to establish rules for water utilisation and sharing, which would provide much more detailed guidelines than the 1995 Agreement on the rights, responsibilities and procedures underlying development of water projects within the basin with transboundary impacts. Sophisticated hydrological modelling and other decision support tools underpin the WUP.

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Catchment management has been incorporated into international development assistance through the promotion of integrated water resource management and, more specifically, integrated river basin management. At a policy level the Global Water Partnership has worked with national governments to promote an integrated and multi-stakeholder approach to water resources management, however, they have been less successful in bringing stakeholders other than national governments into this dialogue. At an institutional level, the Asian Development Bank has promoted the establishment of river basin organisations and has established a Network of Asian River Basin Organisations (see <http://www.adb.org/Water/NARBO/default.asp>).

**Text Box 1: Cuu Long River Basin Organisation**

The establishment of the Cuu Long River Basin Organisation in Vietnam provides an example of some of the challenges associated with institutional strengthening for catchment management in the absence of effective mechanisms for stakeholder engagement. Following the establishment of the broad policy and legislative framework for RBOs the formation of an RBO for the Cuu Long (Mekong) Delta began in 2001, with AusAID support. The involvement of communities in water resources management and appropriate links with pre-existing resource management institutions are basic tenets of integrated river basin management. Whilst efforts have been made within the project to strengthen the capacity of the RBO secretariat (at SIWRP under MARD) to engage in community consultations, in practice this body remains an agency strongly disconnected from provincial and community involvement. These weaknesses became apparent at an RBO management workshop in late 2004 where provincial representatives were critical of the lack of information received from the RBO and the limited opportunity for input into RBO activities and planning.

RBO staff by their own admission recognise that they lack the capacity to properly engage in public participation, yet basin management continues to be seen as the purvey of experts and educated, rather than direct water users. Despite the greater attention given to issues of integration and ecological sustainability, in many respects the RBO in its current form represents a continuation of the command and control orthodoxy of the past, with a strong emphasis on technical capacity, data collection and hydrological modelling with stakeholder input occurring on a very limited basis.

RBOs are responsible for the resolution of water resource-based conflict. One of the major water-related conflicts to emerge in the delta in recent years occurred between rice and shrimp farmers in the brackish zone. The expansion of the freshwater zone, through the extension of the irrigation system and coastal dyke and sluice gate system was premised on the objective of the intensification of rice. However, the construction of the infrastructure was met with some resistance by local shrimp farmers, who saw brackish water as a resource underpinning their profitable farming system. Parts of the dyke system were destroyed by shrimp farmers to let in salt water and high-level political attention was given to solving the problem. Eventually after considerable consultation a technical solution was found to partially alleviate the conflict between fresh and brackish water users. In discussing this problem, RBO staff were of the view that better data and hydrological models could assist in resolving such conflicts in the future. Whilst they felt greater farmer input earlier on in the design of water resources infrastructure is important to avoid such conflicts, they also felt such input would have limited value because farmers have short-term views and a lack of knowledge to properly input into planning.

**4. Water Governance, Catchment Management and Issues of Scale**

Scale is not an objective construct but is rather subject to social processes which determine its influence and purpose. As such scale is dynamic, changing according to social and economic priorities and concerns. The influence of IWRM has resulted in greater social importance being given to the ecological scale of the catchment. This not only introduces a new scale for planning and decision making, but also raises several challenges in regards to how decision making at this scale relates to pre-existing scales of decision making, such as the nation, the province/state, district, and community.

Scale issues are important in catchment management for a number of reasons. Fundamental questions include what size of catchment is most appropriate for what type of management? Is a nested approach the best way to manage sub-catchments within larger catchments? What sort of participatory frameworks are feasible and work best at a wider river basin level? What are the relations (in terms of flow of information, resources, power) between the different scales of management? These questions address frameworks for catchment management within ecosystems and ecological boundaries, raising issues of relations between different scales of management. They require that we look at linkages – or lack thereof – between local level management of small catchments and wider river basin management frameworks.

An important question is the extent to which scale matters in catchment management. In other words, are the same principles applicable in managing upstream and downstream uses of water, terrestrial-riverine interactions and other relations within a small sub-catchment as they are in a large river basin? If so, what are these key principles? If not, what is it about scale that does make a difference? Also, to what extent is sub-catchment management nested within and part of an overall framework of large river basin governance, and to what extent is there a necessary but potentially creative tension between scales?

The choices in appropriate design of catchment management frameworks are contextually bound, but are shaped by some common areas of tension. Of course, “design” of catchment management is not a linear, tailored process. As with other areas of governance, outcomes, structures and processes evolve in an organic way through adaptive management that is shaped by struggles around some of the tensions dealt with here. The tensions are considered in turn, with reference to the case studies.

#### *Top-down and Bottom-up Approaches*

Catchments exist at multiple scales, and institutional means for managing catchments are similarly multi-scalar. Catchment management initiatives vary from transboundary river basin levels (Murray-Darling; Mekong) to micro-watershed programs based either on traditional management (*muang-faai* in northern Thailand) or participatory initiatives such as Landcare in Australia. There is no one right scale for catchment management, but scale is nevertheless all-important. A significant challenge by NGOs in Thailand to the river basin committee approach is that the RBCs are too large to serve as a responsive primary unit for management. Rather than start at this level and subdivide downward, some civil society voices are calling for building up networks or “federations” of small-scale initiatives to form bodies that are accountable downward rather than upward. On the other hand, recent New South Wales experience has seen an upscaling of the primary unit for catchment management administration, with the state initially being divided into 43 Catchment Management Committees, which were amalgamated to form 18 Catchment Management Boards, and these have now been restructured into 13 Catchment Management Agencies. The rationale is that the larger units have the economies of scale to professionalise, employ their own staff and have statutory powers that the old Committees and Boards lacked. In Vietnam several river basins have been identified for the establishment of River Basin Organisations. A fundamental challenge remains for how these new bodies are to link with provinces (see Text Box 1), let alone communities.

One of the more difficult challenges within catchment management is how to combine more socially embedded, local scale management with decision making at greater scales in a way that addresses catchment-wide social and ecological interconnections in a way that does not become separated from these local mechanisms for accountability and participation. Recognition of this need has led to great interest in and creative organisational efforts to scale-up local scale mechanisms, for instance for water allocation and conflict resolution.

#### **Text Box 2: Scale Issues in Muang Faai and RBCs in Thailand**

Water governance in northern Thailand has traditionally operated through village-based water user systems known as *muang-faai*, or channel-weir systems. These systems addressed complex land, water and forest interactions long before modern water resources management promoted integrated approaches. The physical basis of a *muang-faai* is normally a single diversion weir on a stream in a sub-catchment whose primary role was traditionally to divert water during the wet season into rice fields in such a way that all irrigators had an assured supply of water throughout the main growing season (typically June to December). More recently, dry season cropping has seen *muang-faai* serving smaller areas for which there is sufficient water and, in some cases, being fed by upstream storages that have been constructed for dry season cropping. The social basis for *muang-faai* is an elected leadership and committee whose functions were both system maintenance and fair allocation among upstream and downstream users. Irrigators paid an agreed amount of rice to the committee for their services and also provided labour and materials for annual repairs to the weir and removal of sediment from the channels. Local belief systems involving spirits of the weirs but also of the headwater forests added a cultural element to the solidarity behind these systems. Change in recent years has resulted from commodification of the rural economy, building of permanent structures by the Royal Irrigation Department that has also partly bureaucratized management, and difficulties in mobilising dry season labour for system maintenance. Nevertheless, *muang-faai* remain an important though modified water governance institution in small catchments, and importantly they also have symbolic value as autonomous governance systems that NGOs and groups of farmers allude to in response to heavy-handed bureaucratic control or interventions.

Presently, 29 River Basin Committees (RBCs) have been established in the 25 main river basins in Thailand, initially under the Office of the National Water Resources Commission, and more recently under the newly established Department of Water Resources. The RBCs are much larger than *muang-faai* systems, typically covering several provinces. In principle they also serve allocation functions and exist to mobilise resources. However, their size, but also their establishment through a bureaucratic process, means that they have little connection with grassroots, village level processes. Representation on the RBCs is half government, half non-government, but even the non-government representation includes Chambers of Commerce and senior persons who have weak connections with

farmer leaders. To date, there has been little connection between RBCs and *muang-faai* or other more organic, locally and culturally embedded governance. Some NGOs in Thailand see RBCs as a means for government to establish a kind of spurious constituency to build large projects including dams, which in recent years have been the object of protest by affected communities. Thailand's proposed Water Grid also envisages employing RBCs as a vehicle to secure agreement for transfer of water from "surplus" to "deficit" river basins, with attendant social and ecological consequences.

It is sometimes assumed that consolidated water law will be able to establish a clear, permanent framework for catchment management from the top. However, the legal underpinning of catchment management is often tentative and shaky, and institutional approaches are still at quite an experimental stage even where they have been implemented the longest. Australia has seen itself as pioneering in integrated river basin management through the Murray-Darling Initiative, and Australian experience is being applied through development assistance and consultancy in multilateral and bilateral aid programs (see Text Box 3) (Linn and Bailey, 2002; Miller and Hirsch, 2003). However, even in Australia, the legal and applied basis for catchment management remains fluid. The Murray-Darling Initiative is less than two decades old. New South Wales has gone through three institutional reformulations for catchment management in 15 years. The National Water Initiative, based primarily on the challenges of the Murray-Darling system, is very new. Elsewhere, catchment management is operating in a kind of legal flux. In Thailand, river basin committees have been established ahead of the Water Law that is supposed to underpin them. In Vanuatu, holistic catchment management is understood by very few in the government system, although the recently implemented water law contains many aspects that back it up. In Vietnam the basin authorities remain largely disconnected from other institutions. In the Mekong Basin context there are very complex issues associated with how to re-orient national planning according to the 10 sub-basin areas and link these with pre-existing institutions. The overall message is that catchment management needs to be seen as an adaptive process based on what works in a particular context and should not be imposed in a formulaic way. Another issue for the legal underpinning of catchment management institutions is the question of whether they have statutory powers in zoning, revenue-raising and so on.

### **Text Box 3: Sharing Lessons and Experiences between Basins**

It is difficult to identify a basin anywhere in the world that is comparable, even on the most basic level, to the Mekong Basin. The large basin area, the mix of bioregions and diverse natural features, the particular historical circumstances of cooperation, and the varied socio-economic characteristics and stakeholders of the six riparian countries present unique development challenges for transboundary water resources management. Throughout the MRC's 10 year history there have been numerous programmes whereby models of river basin management have been used to inform and guide its activities. The Tennessee Valley Authority formed a model for early activities of the Mekong Committee in the 1960-70s (Nguyen Thi Dieu 1999; Miller and Hirsch, 2002). Yet it has been the experience of the Murray Darling Basin that has proven influential in more recent years.

The MDBC and the 1992 Agreement were influential in the formulation of the MRC and its 1995 Agreement (Chenoweth, 2000:101). Following on from this, AusAID funded a strategic liaison program from 1996 between the MDBC and MRC to facilitate the sharing of lessons. The second phase of this program focused more on MRC-identified needs and addressed capacity building in organizational and technical areas, as well as community engagement. As the MDBC-MRC program evolved over time greater emphasis appeared to be given to the need to adapt the Australian river basin management experience to the very particular social and ecological context of the Mekong Basin.

The relevance of the Australian river basin management experience has received some academic interest (Bui Kim Chi, 1996; Bui Kim; Chi, 1997; Chenoweth, 1999; Gillbank, 1999; Birch and Taylor, 1999; Malano and others, 1999; henoweth, 2000), with some writers taking a more cautionary note highlighting the need to adapt the Australian experience to the context in which it is applied (Pigram 2000; Linn and Bailey, 2002; Miller and Hirsch 2002). The Australian Mekong Resource Centre facilitated a dialogue amongst key water actors in the Mekong and Murray-Darling Basins in 2002 through a series of workshops and on-line media which generated some debate and analysis on the issue of transferring lessons between basins (see [http://www.mekong.es.usyd.edu.au/case\\_studies/rbm.htm](http://www.mekong.es.usyd.edu.au/case_studies/rbm.htm)). A key lesson drawn from this dialogue was the need for basin planners to look more strongly to endemic experiences in water resources management which exist at sub-catchment or more local scales, rather than relying so strongly on importing international experience. Such an approach is more in keeping with the concept of river basin management as a negotiated approach rather than something that can be prescribed or modeled.

Many local scale catchment management initiatives emerge organically from a variety of circumstances and antagonisms, and environmental stresses. In some cases, catchment management initiatives have started from the premise that forest-land-water interactions at a local level are rooted in culture and indigenous knowledge systems. In Thailand, NGOs have emphasised the interconnected nature of forest, land and water for many years. Traditional belief and knowledge systems in northern Thailand have served as the basis for community forest programs that have a strong connection with small river catchments, often connected with traditional irrigation systems. The “*loum nam*” (small catchment) approach was largely associated with alternative, critical NGO discourse until the late 1980s, emphasising the integrity and holistic nature of local knowledge in opposition to the segmented nature of bureaucratic resource management knowledge and practice. The Royal Forest Department ran a high-profile catchment initiative at Sam Mun through its Watershed Division from the 1980s, supported by UNDP, and this helped establish the Watershed Division that acknowledged the place of rural villagers in managing local resources. This contrasts with a more conventional watershed management approach in Thailand, based around zoning upper catchments into classes and entirely excluding villagers – especially ethnic minorities – from certain zones. In Australia, the principle of Landcare groups has been to serve as the core of rural local initiatives to manage land, water and vegetation in an integrated and participatory manner (Curtis and Lockwood, 2000). It is important to note that Landcare grew out of the 1990 mending of a historical antagonism between farmers and environmentalists, as the leaders of the National Farmers’ Federation (Ric Farley) and the Australian Conservation Foundation (Phillip Toyne) put past differences aside to initiate the program. In Vietnam, there are some small-scale initiatives in participatory catchment management supported by bilateral and NGO donors. The origins and financing of such initiatives has a considerable bearing on their institutional sustainability. In some mountainous areas community based irrigation systems have long been designed and operated according to naturally-defined boundaries. However, the challenges in Vietnam in regards to linkages between catchment and local initiatives are characteristic of the more general limitations associated with bureaucratic, top-down planning.

While initiatives exist at multiple levels, there are very few well thought out linkages between basin-wide and small-scale management. An exception might be the Community Advisory Committee of the Murray-Darling Basin, but even here the “community” in question refers more to the “basin community”, in a representational mode, than to local issues. This – stakeholder representation - is perhaps one of the most pressing areas for innovative governance initiatives. The closest initiative in the Mekong region is a recent proposal, put forward at a November 2004 international NGO-Government meeting held at the UN building in Bangkok, for a “Mekong People’s Council” to be established as a form of civil society counterweight to the formal, state-centric institutional cooperation structures in the region. NGOs and civil society groups in the Mekong Region have long been critical of the failure of the MRC to link with local resources management initiatives. There remains a strong disconnection between planning at the basin scale and local initiatives. In the Mekong River Basin, the National Mekong Committees are important vehicles for linking domestic processes to the international governance framework of the MRC, yet there are important differences within the region in terms of the profile and status of NMCs, and their relationship with key line agencies. There are also poor links between NMCs and civil society structures and processes within each country.

#### *Integration and participation*

Three basic governance challenges underlie the promotion of integration and participation, which are both fundamental principles of good catchment management. The first is to understand a catchment, its resources and environmental processes, and the people who live in it as an integrated system. Integration means breaking down functional and territorial barriers, and a way of thinking that focuses on connections, recognising that an action in one part of a system has flow-on effects elsewhere. The governance challenge here, therefore, is

holistic management. The second is to understand that management is done by managers, and that managers are not just a professional elite but also all those who depend on and act on a catchment, including direct water users. In other words, participation of basin users in management is crucial, and this can include participation in designing appropriate institutional mechanisms for management. The third governance challenge is that of managing the inherent tension between holistic approaches, which have centralist tendencies such as whole-of-government initiatives whose emphasis is on high-level committees, and inclusive approaches that can immediately require a more decentred set of processes.

While holistic thinking is part and parcel of the rhetoric behind recent river basin management initiatives, and despite the basic holistic principle behind catchment management and integrated river basin management, the “silo effect” continues to operate and institutional constraints continue to limit whole-of-government thinking and practice. Nevertheless, catchment management in all cases signals a need to break down the functional demarcation between different parts of the bureaucracy. The Catchment Management Agencies of New South Wales now have statutory powers and hence more clout in dealing across the range of government agencies. In Thailand, River Basin Committees are largely associated with one Department (Water Resources) and this remains in competition, at a political level, with the Royal Irrigation Department whose ministry location is separate from DWR. The potentials and constraints are in part attitudinal and in part institutional.

Are informal institutions (organisations) recognised within the current framework for water resources management? What role do informal institutions play in water resources management? In most cases, these remain open questions. In principle, Thailand’s River Basin Committees are not incompatible with smaller-scale, community-based and informal organisations. In practice, there has been little thought or experimentation to accommodate the two scales and forms of management. More participatory approaches can in part be based on traditional management practices that can be documented within local catchment contexts. Rarely, however, have such practices been incorporated into formalized catchment management structures and processes. In general, there is not a close fit between traditional practices and new catchment management initiatives. Many such initiatives are established expressly to deal with what are seen as harmful traditional practices. Exceptions are found in the case of small-scale initiatives in northern Thailand based around *muang-faai* systems, and there are other aspects of traditional management that are incorporated into catchment management, for example the writing in of customary rights into Vanuatu’s Water Resources Management Act. In Vietnam the emergence of so-called ‘new style’ cooperatives in recent years has provided an opportunity for community based knowledge and experience in water resources management to inform decision making at greater scales. In practice, this has not as yet been realised.

In Australia, there are some cases of parallel formal and informal institutions. For example, the Hawkesbury-Nepean Catchment Foundation, which is the residual community component of the disbanded Hawkesbury-Nepean Catchment Trust, now operates in parallel with the newly established board of the Hawkesbury-Nepean Catchment Management Authority as a kind of citizens’ watchdog.

Whilst there have been moves towards more holistic river basin management in Vietnam, this has not necessarily resulted in greater inter-departmental cooperation, or even, in the case of the Vietnamese Mekong Basin, thorough consideration of upstream and downstream linkages. The Central Highlands and the Mekong Delta form part of the Mekong Basin, yet remain treated as largely separate planning units and natural regions. The establishment of a river basin authority for the Mekong Delta, presented an opportunity for the two regions to be brought under a single planning and managerial body to be considered in an integrated way. However, due to tensions between different ministries, rather than this body being placed under the VNMC (which already dealt with the two regions as part of MRC activities) the

RBO came to be situated under the MARD's southern-water institute, whose mandate does not extend to the Central Highlands. The Central Highlands is the site of continued hydro-power development and irrigation expansion which have downstream impacts on water availability in Cambodia and the Mekong Delta (Vietnam's 'rice bowl'). This means potential linkages between the two regions, in terms of upstream-downstream interactions, remain poorly considered.

Catchment management is situated within specific approaches to public administration, resource allocation, division of roles and responsibilities between levels and departments, and these vary from one country to another. In order to be both holistic and participatory, catchment management requires good horizontal (between sectors and interest groups) and vertical (between levels) flows of information. Policy needs to be sufficiently flexible to adapt to place and context, and yet sufficiently clear to give the multiple users and stakeholders clear role definition in new institutional arrangements. An open question is the role of overarching water law. Should it be generic and open-ended, providing basic principles within which specific arrangements and institutional forms can be negotiated and adapted, or should it be specific and prescriptive? Finally, the level at which the financial side of catchment management operates will to some extent determine the degree of accountability and independence of decision making.

#### *Science and community*

Science-based management of catchments is crucial to sustainable outcomes and to living within the means of already stressed natural systems to support people, economy and nature. The integrated nature of catchments as complex ecosystems requires a multidisciplinary understanding and ability to deal with multiple levels of uncertainty. At the same time, the commonly accepted role for catchment communities at different levels to participate in catchment management means that managers are coming at the challenges with quite different sorts of knowledge and levels of scientific understanding. It is useful, here, to distinguish between science and scientism, where the latter is an approach that arrogates all knowledge to the realm of a privileged few, and rejects expertise and understandings derived from non-science means and paradigms. Catchment management frequently comes up against science/community tensions, both in the everyday working arrangement of catchment management institutions and in their design and approaches to knowledge.

#### **Text Box 4: Local Knowledge, Mekong Fisheries and Scales of Management**

River basin management does not concern water governance alone, as changes in water quality, quantity and timing has implications for other resources, such as fish, wetlands, forests and agro-ecosystems. Traditionally there has been a classic trade-off made between increased water resources development and decline in aquatic diversity. Such a strategy was often pursued in the absence of scientific certainty on the true economic, livelihood or ecological value of such resources. One of the greatest concerns over water resource development in the Mekong River Basin is the potential impact on fisheries, given the significance of fish as 40 – 80% of the animal protein diet of the Basin's 70 million inhabitants. While there has been a great deal of scientific research, the complexity of the fishery in terms of species diversity (the Mekong is the second most fish biodiverse river basin in the world), ecology and migration patterns means that there is a great deal of work to be done to understand the implications of changes in the hydrological regime and the effects of barriers and diversions.

The Mekong River Commission has taken a novel approach in bringing local ecological knowledge to the fore as a means of understanding the ecology and livelihood importance of fish. The Assessment of Mekong Fisheries Program was initially designed around scientific sampling of the Mekong and its tributaries to establish an understanding of fish migrations, stock abundance and so on, but it soon became apparent that a much more cost effective and robust way to carry out the assessment was to tap fishers' own knowledge (Poulson). The result was a dramatic revision upward of the estimate of fish catches, easily making the Mekong the largest freshwater fishery in the world, largely based on artisanal practices.

While the tapping of local knowledge and application of GIS, extrapolation tools and other scientific techniques is an advance and an accommodation that bridges the all-too-great divide between knowledge systems in understanding catchment resources, it was carried out for the purposes of management by the MRC, a large scale institution. Further potential exists for support of local knowledge application to local resource management solutions in community fisheries and other community-based natural resource management at a more local level. Tubtim and Hirsch (2005) describe one such CBNRM process in community fisheries in southern Laos, and Hirsch, Phanvilay and Tubtim (1999) describe another in the context of community-based watershed management in central Laos.

Lines of tension between more technical and more participatory, more bureaucratic and more community-based approaches to catchment management are drawn somewhat differently in each case. In Australia, there is a quite widespread acceptance of, and enthusiasm for, the application of good science to catchment management. It is recognised that technically and ecologically informed catchment science is fundamental to getting better outcomes. This acceptance makes it easier to accommodate participatory management within professionalised agencies. Nevertheless, tensions remain where, for example, rural catchment bodies are dominated by primary producers with strong vested interests against withholding irrigation water in favour of ecologically driven environmental flows. There is also a political economy associated with the financing of the research underpinning decision making, with greater funds now available (from both public and private sources) to support strategic export industries (such as rice and cotton). In Thailand, there is a distrust of technically driven approaches since these have tended to be top-down in the past and have taken little heed of local and experiential knowledge of farmers and primary catchment users. Similarly, the River Basin Committees suffer a close association with the provincial and national bureaucracy, making them relatively inaccessible to community-based management and sense of accountability.

**Text Box 5: The Hawkesbury-Nepean**

The Hawkesbury-Nepean catchment is the source of most water supplies for the greater Sydney metropolitan region, it is the site of Sydney's urban expansion, and it contains significant World Heritage areas in the Blue Mountains. The catchment is therefore both a significant and stressed area. Reflecting its importance, catchment management models for the area have been controversial and contested, with divisions between upstream and downstream users and between advocates of differing levels of community participation.

The Hawkesbury-Nepean case study characterises common catchment management issues within NSW and highlights tensions between community and science based approaches. Since establishment of the Hawkesbury-Nepean Trust in 1993, water management has been marked by legislative change and shifting community engagement with management processes. Tensions between upstream and downstream interests and the pressures of development in Western Sydney have made management of the Hawkesbury-Nepean a contentious issue. There has been a general shift away from community-based management (most recently with the establishment of the Hawkesbury-Nepean Catchment Management Authority), however Hawkesbury-Nepean residents continue to be active in water management through the Hawkesbury-Nepean Catchment Foundation, an independent watchdog established by community members following dissolution of the Trust.

Within this context of change, science has played a role in directing catchment management in the Hawkesbury-Nepean and this has generally been supported by community stakeholders with an interest in long-term health of the river system. However at times scientific realities for achieving environmental sustainability do not accord with the interests of those for whom water extraction is considered essential for agricultural production or drinking supply. Most recently, the issue of environmental flows has illustrated these tensions with conservation and extraction imperatives dividing the community and placing pressure on the ability for participatory community-based management to achieve successful outcomes. This can be illustrated by the decision in June this year to reduce by half the volume of environmental flows in the Hawkesbury-Nepean pending a raise in levels at Warragamba dam.

Vietnam still has a long way to go in terms of diversifying the knowledge base for water resources management. Many of the decision makers and officials involved in water resources management are technically trained. Whilst the value of participation is growing in acceptance, capacity amongst these technically-dominated bodies to pursue more participatory and negotiated approaches to water resources management remains severely constrained. There is also a continued reluctance to acknowledge the value of traditional or 'non-expert' knowledge. There is a danger that the creation of these new institutional layers for river basin planning, which still remain largely disconnected from pre-existing institutions, could further entrench existing power and knowledge bases within catchment management.

*Allocation and development*

Are river basin institutions mainly concerned with allocation for sustainable and equitable use of water or are they mainly concerned with mobilizing resources for development? How does this play out in different developmental contexts? In developing countries, the

developmental impetus pervades most institutions. In the case of river basin organizations and institutions, there is a fundamental tension between the institution as a body to set rules, regulate and allocate, on the one hand, and the institution as a focus for investment in new basin infrastructure, on the other.

The Mekong River Commission has seen an oscillation and tension between these functions through its history. The MRC predecessor, the Mekong Committee, was closely associated with drawing up plans for submission to donors as a kind of menu or smörgasbord of projects in which to invest. Large dams dominated this investment portfolio. Few got built because of the geopolitical circumstances of the region during the 1960s and 1970s. The MRC has operated during an era where more caution has been displayed in large-scale infrastructure, but also where the institutional role of a river basin organization has been seen as more oriented to process and regulation than to direct investment and ownership in basin infrastructure. The influence of CEO Joern Kristensen served to reinforce the work of MRC as a science-based agency whose agenda was knowledge production in support of informed, equitable and sustainable decision-making. The new MRC regime led by the current CEO Olivier Cogels appears to be moving more in the direction of facilitating investment, but within the rhetoric of Integrated Water Resources Management.

A similar tension is displayed in the evolving role of river basin organizations in Thailand. In principle, RBCs exist to allocate water between multiple users and facilitate sustainable development of resources in what are already stressed catchments. In practice, the early experience of RBCs has been to serve as channels for requesting investment in weirs, reservoirs and other water resource development. RBCs have also been posited as a framework to facilitate water transfers between river basins under the Water Grid (see WPI).

Catchment agency resourcing is also an issue in Australia, where new catchment management framework in NSW has been restricted in the past by lack of regulatory authority and revenue raising power. The new legislation in NSW gives a greater degree of both to the Catchment Management Agencies, and the Native Vegetation and other legislation under which the CMAs operate help direct investment toward more sustainable use of water and catchment resources.

Perhaps due to the strong donor driven nature of river basin management reforms, (the ADB for example has established a Network of Asian RBOs and is taking the lead in technically supporting many RBOs) countries are viewing these as another window whereby finance for basin development schemes can be pursued. This has resulted in the preparation of ‘shopping lists’ of water resources development projects accompanying the establishment of RBOs.

## **5. Conclusion: Implications for Development Assistance**

The above discussion of trends and tensions in catchment management has important implications for the manner in which development assistance can support more integrated, inclusive and sustainable approaches to water governance. The paper points to the need to work with the endogenous development of appropriate institutional arrangements and the need for a diagnostic approach. A contextual understanding of scale issues in catchment management has several implications for development assistance.

Catchment management frameworks are everywhere evolving and in flux. In Australia, catchment management has evolved out of significant conflict and contested values and visions by key players. Externally designed or imposed initiatives have very limited scope for establishing a constituency for or sustainable commitment to institutions.

Adaptive management and broad societal involvement is integral to the design of catchment management frameworks if they are to be sustainable, equitable and acceptable to the wide range of players and interests inherent in an integrated approach.

Community participation can not be relegated to single or stand-alone consultations, for example in the design or priority setting phase of a RBO, but rather needs to be conceived as part of a longer-term commitment to inclusive decision making.

Different developmental contexts establish different types of agendas dominating not only the portfolio of catchment management activities, but also the understanding of the key function of catchment management institutions/river basin organisations.

There is a need for a more considered approach to the appropriate scale of intervention, from top-down to bottom up and from large-scale basin to small scale sub-catchment. There is considerable potential for experimental linking of scales, but each will need to be carefully designed to the socio-political context of the country in which the program is located.

Program design should consider elements of the “(dis)enabling environment” in which catchment governance is being promoted to identify appropriate points of assistance.

Institutional support at the central level should be pursued in parallel with efforts at building stakeholder engagement and participation at sub-national and local levels. Strengthening of macro level institutions in the absence of participation can not only delay such participation, it can prohibit it.

Innovative stakeholder organisation and locally led initiatives that seek to connect across social and ecological scales, offer great opportunities to build on more socially embedded management regimes.

To counter the negative trend of socially and institutionally-disconnected RBOs in the region, efforts by which to scale-up local initiatives in water sharing, decision making and conflict resolution offer a promising opportunity to support greater social ownership of catchment management.

## References

- Arciono, E. (2001). "Can catchment management deliver coordination of natural resource management in New South Wales?" Australasian Journal of Natural Resources Law and Policy 7(2): 169-195
- Birch, A and Taylor, P (1999) "International Mentoring: Application of Australian Experience for Sri Lankan Water Sector Reforms Under Technical Assistance of the Asian Development Bank". Water International, 24(4): 329-340
- Biswas, A., Varis, O, et al (2005) Integrated Water Resources Management in South and South-East Asia New Delhi, Oxford University Press.
- Blackmore, D. J. (1995). "Murray-Darling Basin Commission: a case study in integrated catchment management." Water Science and Technology 32(5-6): 15-25.
- Booth, C. A., A. Warianti, et al. (2001). "Establishing an Integrated Catchment Management (ICM) program in East Java, Indonesia." Water Science and Technology 43(9): 227-234.
- Bruns and Meinsen-Dick (1997) Renegotiating Water Rights: Directions for Improving Public Participation in South and Southeast Asia, Participation in Turbulent Times, Conference of the International Association for Public Participation, Toronto, Canada.
- Connell, D. and MDB Commission (1997). What have we achieved in water management? Landcare Changing Australia: National Conference, Adelaide, Primary Industries.
- Cullen, P. (1998). Water and Emerging Political Imperatives. A. N. University. Canberra, 20 October.
- Curtis, A. and M. Lockwood (2000). "Landcare and Catchment Management in Australia: Lessons for State-Sponsored Community Participation." Society and Natural Resources 13(1): 61.
- Dube, D. and Swatuk, L. (2002) "Stakeholder participation in the new water management approach: a case study of the Save catchment Zimbabwe" Physics and Chemistry of the Earth, Parts A/B/C 27(11-22): 867-874.
- Duda, A. and El-Ashry, M (2000) 'Addressing the Global Water and Environmental Crises through Integrated Approaches to the management of Land, Water and Ecological Resources". Water International 25(1): 115-126.
- Falkenmark, M. (2004). "Towards Integrated Catchment Management: Opening the Paradigm Locks between Hydrology, Ecology and Policy Making." Water Resources Development 20(3): 275-282.
- Falkenmark, M. (2004a). "Towards Integrated Catchment Management: Increasing the Dialogue between Scientists, Policy-makers and Stakeholders." Water Resources Development 20(3): 297-309.
- Falkenmark, M. and C. Folke (2000). "How to bring ecological services into integrated water resources management." Ambio 29(6): 351-352.
- Farrier, D. and et al. (1998). "Integrated lands and water management in New South Wales: plans, problems and possibilities." Australasian Journal Of Natural Resources Law And Policy 5(2): 153-185.
- Gardner, A. (2003). "Law and policy for sustainable water quality management: focus on the Sydney water catchments." Australasian Journal Of Natural Resources Law And Policy 8(2): 99-128.
- Gomez-Fort, R., D. Macpherson, et al. (1997). "Public participation in integrated catchment management: more than lip service?" Australasian Journal Of Natural Resources Law And Policy 4(2): 211-226.

- Greiner, R. and O. Cacho (2001). "On the efficient use of a catchment's land and water resources: dryland salinization in Australia." Ecological Economics **38**(3): 441.
- Hirsch, P. and Phanivlay, K (1999) Nam Ngum, Lao PDR: Community based natural resource management and conflicts over watershed resources. Cultivating Peace: Conflict and Collaboration in Natural Resource Management, D. Buckles. Ottawa and Washington DC, International Development Research Centre and World Bank.
- Irons, C. D. (1999). "Catchment management: assessing community values." Australian Journal of Environmental Management **6**(1): 10.
- Jaspers, F. G. W. (2003). "Institutional arrangements for integrated river basin management." Water Policy **5**(1): 77-90.
- Jewitt, G. W. (2002). "Can integrated water resources management sustain the provision of ecosystem goods and services?" Physics and Chemistry of the Earth, Parts A/B/C **27**(11-22): 887-895.
- Kingsford, R. T. (2003). "Ecological Impacts and Institutional and Economic Drivers for Water Resource Development--a Case Study of the Murrumbidgee River, Australia." Aquatic Ecosystem Health & Management **6**(1): 69-80.
- Lane, M. G. McDonald et al (2004), "Decentralisation and environmental management in Australia: a comment on the prescriptions of The Wentworth Group " Australian Geographical Studies **42**(1): 103-115
- Maaren, H. and Dent, M. (1995) "Broadening participation in integrated catchment management for sustainable water resources development " Water Science and Technology **35**(5): 161
- McCully, P. (1996). Silenced rivers: the ecology and politics of large dams. London, Zed Books.
- MDBC, M.-D. B. C. (1999). "The Murray-Darling Basin: an example of integrated catchment management." Issues(March): 25-30.
- Miller, F. and P. Hirsch (2002). Reflections on International Experience of Transferring River Basin Development Models. River Symposium, Brisbane.
- Moriarty, P., J. Butterworth, et al. (2004). "Integrated Water Resources Management and the domestic water and sanitation sub-sector." from Online, hard copy saved to disk.
- Tubtim, N. and P. Hirsch (2005). "Common Property as Enclosure: a case study of a backswamp in southern Laos." Society and Natural Resources **18**(1): 41-60.
- van der Lee, J. (2002). "An Integrated Learning Approach to River Basin Management." Resources Policy **8**(1): 11-13.
- World Commission on Dams (2000). Dams and development: a new framework for decision-making. London, Earthscan.