PROCEEDINGS

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Balancing Human Security and Ecological Security Interests in a Catchment – Towards Upstream/Downstream Hydrosolidarity

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HUMAN SECURITY VERSUS ECOLOGICAL SECURITY
- COMPATIBLE OR NON-COMPATIBLE GOALS?

Analytical Summary

by Malin Falkenmark

The Seminar

Three earlier SIWI Seminars have addressed issues related to the upstream/downstream dimensions of catchment management in seeking ways and means of moving towards hydrosolidarity. In 1999, the focus was on national catchments, in 2000 on multinational catchments, and in 2001 on how to address water security for cities, food security and environmental security in a catchment. A number of issues and obstacles were identified, including conceptual issues, human momentum and social momentum obstacles.

The 2002 Seminar continued along this track but put emphasis on the balancing component: how to balance human livelihood security and ecological security, paying attention to water-ecosystem interactions and to upstream/downstream dependencies and how these interactions are modified or altered by human interventions and manipulations. The overriding goal is to seek clarity on what should exactly be meant by 'land/water integration taking a catchment-based ecological approach' - an approach advertised by both Global Water Partnership and Global Environment Facility in the follow up of the 2nd World Water Forum in 2000. This paper summarises the outcome of the Seminar. Speakers have been acknowledged by italics.

Human versus ecological security

The overall predicament was illustrated by **Figure 1** *(Falkenmark*). The global *ecosystem* is basically a system of interacting organisms which produces life support for the social system in terms of ecosystem goods such as food and timber, and ecological services such as for example oxygen production, dentitrification and pollination. The *social system* is driven by human needs and aspirations to produce increasing welfare but, by mismanagement of the life support system, the latter is continusously being degraded by processes such as pollution, salinisation and depletion. Both the global ecosystem and the social system are genuinely water-dependent and water is the bloodstream of both the biosphere and the anthroposphere.

The conceptualisation of human and ecological security respectively tends to remain rather swampy at present, unfortunately. *Human water security* in its most restricted meaning refers to safe drinking water (and sanitation to keep the water safe from the tap and beyond). This was the meaning the concept given at the Second World Water Forum in the Hague. Human livelihood security has however several water-dependent components, the most essential one being food security on the family level. Providing water-dependent security is therefore a key aspect, including water for agricultural production and for generation of employment and income. Agriculture is the key engine to reduce poverty. In the poor countries, the rationale for water resources management is to contribute to sustainable economic growth and poverty alleviation, seeing as growth-generating activities for instance irrigated agriculture, hydropower development and industrial development (*Sendama & Granit*). Therefore, human security includes also other dimensions such as economic security and employment.

But it is also clear from Figure 1 that human livelihood security must include the ecological goods (such as crops, timber, fish), and services (such as pollination, biodegradation, denitrification), on which the life support system critically depends. This leads to the conclusion that there can be no long-term human security without a large-scale *ecological security*. Focus is therefore needed on the risks of loss of ecological services or unwanted change into undesirable ecosystems, and how to minimize those risks. **Folke** stressed that a perspective change is now taking place in ecological circles: An international study of multimillennial human history has lead to the conclusion that humanity has always lived with change and that the relation between human habitations and the natural environment around those habitations has been one of resonance rather than one of cause-effect relations. By this shift in focus, attention is drawn away from ideas of ecological balance towards phenomena such as risk and resilience.

Looking ahead, this means that humanity has to prepare itself for living with unavoidable change and develop methods for adaptive management of the life support systems in such a way that these systems do not lose their integrity but continue to provide essential support for human wellbeing and economic activities. Adaptive management basically means a science-based management, able to respond quickly to signs of undesirable ecohydrological changes. It has to build on careful monitoring of essential determinants of key ecosystems, the building of knowledge and understanding in society. and be supported by flexible organisations able to respond by necessary policy changes.

Catchment configurations

The fact that water is a common denominator of the ecosystem and the human system. makes water's integrating function in the catchment an opportunity for overarching management and integrated approach (**Figure 2,** *Falkenmark***)**. The basic water resource is the precipitation, caught within the basin. It provides the water involved in terrestrial ecosystem production, crop production, societal water supply and aquatic ecosystems. The water moving down the catchment links land use and water; humans and ecosystems; blue water flow and quality; and upstream and downstream phenomena.

The catchment may be seen as a *mosaic of partly incompatible water uses and ecosystems*. (*Falkenmark*) The terrestrial ecosystems are green-water related, water-consumptive and influence runoff production, while the aquatic ecosystems are blue-water related, water-dependent and the river water constitutes their habitat. The three security dimensions water security, food security and ecological security are internally linked by water flows from the hilltops to the mouth and therefore closely interwoven. The human activities in the catchment can be structured into three different categories: water diversions with the water after use either being literally consumed, in the sense of returning to the atmosphere not available for reuse, or forming return flows; in stream use in the water courses; and land use involving consumptive water use and therefore influencing the runoff generation.

In terms of water use intensity and management strategies, three phases may be distinguished (*Molden*): the *development phase* when attention goes to how to obtain access to more water to meet growing water needs (situation in parts of Subsaharan Africa), the *utilization phase* when institutions are active in limiting access and upstream/downstream problems start to show up (situation in SE Asia and S Asia), and the *allocation phase* when physical resources constrain further water resources development and reallocation starts with priority to higher value uses (situation in Australia). Also the ecological security problems tend to change with these phase shifts: pollution damage is typical for the utilization phase, while reallocation and ecosystem restoration is typical for the third phase.

The water-related activities and phenomena are only partly compatible in the sense that the water use does not impinge on the ecosystem functions. The fact that they are at the same time *partly incompatible* means that a balancing has to be carried out, based on some priority rules. The challenge is in other words to find ways to orchestrate the catchment system for compatibility, i e satisfying societal needs, meeting certain ecological bottomlines (ecological minimum criteria) and securing hydrosolidarity (*Falkenmark*).

Cases

Real world problems were examplified from Sri Lanka (*Molden*, upstream setllement, downstream Ramsar site), India (*Rajagopal*, aquaculture, shrimp farms, deforestation, salinity intrusion, effluents), Equatorial Lakes (*Sendama*, water hyacint abatemen, how to sustain fisheries), Thukela basin in SAfrica (*Schultze*, not included in this report, impacts from uphill and downhill vegetation changes, water reallocation), and Murray basin in Australia (*Scanlon*, water diversion moratorium, restoration of environmental flow, salinity).

One set of elements of principal interest in these examples were *streamflow influencing activities* linking human activities with ecosystems in terms of:
* on the one hand consumptive water use in large-scale irrigation, giving rise to a moratorium to further diversions, in order to safeguard an uncommitted environmental flow in the river for the benefit of aquatic ecosystem;
* on the other hand land-based activities in terrestrial ecosystems, influencing runoff generation and therefore streamflow (upstream deforestation in the Indian and Murray cases, upstream reforestation and downstream clearing in the Thukela case).

Another set of elements related to *pollution load with effects on aquatic ecosystems* (agricultural runoff generating water hyacint expansion in Lake Victoria, aquaculture effluents influencinglocalwater supply and irrigation in the Indian case), but also salinity generated by on the one hand land use change (dryland induced salinity in Australia), and on the other water use (irrigation induced salinity in Murray basin, seawater storage for shrimp production in the Indian case).

Also *coastal complexity* was highlighted in several of the cases. An interesting situation was that valuable coastal ecosystems may have developed during the development phase of a catchment, generating a highly valued brackish water ecosystems. By upstream water resources development, reservoirs and flow control, additional freshwater has drained into the area and the wetlands tended to change. Another case was the Indian one, where the coastal region, by being at the downstream end of the river system, is highly vulnerable to upstream activities. It is influenced by upstream water use and land use change that influences the streamflow, and by downstream activities, such as local deforestation introducing vulnerability to flooding and cyclones; salinity change in the shrimp farm, groundwater pumping to maintain that salinity level, generating salinity intrusion and local water supply problems; and effluents from the aquaculture influencing nearby water supply and irrigated agriculture.

A further element highlighted was *environmental flows* and the related need to limit the amount of water withdrawn from the river system for the benefit of downstream aquatic ecosystems. In highly developed river systems, the river flow may have been overcommitted. Environmental flows will have to be secured in order to restore a healthy river system. This may incorporate the need for substantial changes of both the quantity of water remaining in the river, and the management of flows for enhanced environmental benefit. Reaching this goal may call for returning already committed water to the river to secure an environmental flow and restore key habitats along the river. It may also involve improving the river quality in tems of i.a. salinity and nutrient levels. Realization will involve establishment of water trading arrangements where water already in consumptive use upstream is bought back from irrigated farms, to be left in the river to increase the downstream uncommitted flow.

Orchestrating for compatibility - how?

A set of interesting conceptual renewals appeared in the presentations. The 'ecological bottomlines' called for by *Falkenmark* were examplified by the 'environmental flow' concept included in the new S African National Water Law, where it comes second in priority only to drinking water supply (*Schulze*). Environmental flows tend to be a broad concept thatmay refer to both flood episodes and a certain part of the natural flow for the benefit of aquatic ecosystems, and to the flow needed to keep the mouth open to maintain navigation and fish passage, to enhance estuarine conditions and to improve connectivity between and within riverine, wetland, floodplain and estuarine environments. Another overarching concept was '*healthy rivers*', describing rivers where a balance had been found between human activities and ecosystem security (*Scanlon*).

The distinction between groundwater recharge in uphill locations and groundwater discharge/seepage areas downhill had been made in S Africa in the Working for Water Project where alien downhill vegetation was being cleared away to increase groundwater seepage and therefore streamflow (*Schulze*). An interesting distinction was also made in regard to forest protection. The socalled 'watershed protection' - since several decades stressed as an important nature conservation measure - refers to uphill forests, also described as 'water producing ecosystems'. What they are producing is however not water as such but groundwater recharge and dry season flow. It moreover seems as if the way of looking at downhill riparian forests differs between ecologists who wants to protect them as a barrier against nutrient inflow to the river, whereas hydrologists in water scarce regions would denote them as 'streamflow consuming activities'. *Schulze* also stressed that legislation referring to afforestation has, as a consequence, to be more specific and rethought. His message "science before legislation" is equivalent to the adaptive management message of *Folke*: "science based adaptive management".

The road towards compatibility may be long and slow, since there are many barriers in view. First of all protection of *economic interests and employment* are of course essential and tend to generally be based on natural resource related activities. The linkages between economic security of the countries upstream of the Aral Sea and the survival of the Aral Sea's aquatic ecosystems is a clear example, the shrimp industry in India another.

A serious barrier to a successful balancing of economic versus ecologic interests is the rather old-fashioned *macro-eonomic worldview. Matthews* stressed that standard economic textbooks are water blind. He illustrated this by a standard 854 page textbook on macroeconomics from the 1990's where just 1/3 of a page was allocated to water resources. It is not understood that water is finite and that the life support system is physically limited. Moreover, freshwater is seen as value-less unless developed. One fundamental effort will be to get water mainstreamed into other peoples' thinking. That so has not already happened has however to be blamed on the water community itself.

It is interesting to note that the macroeconomic vision in that book is applicable where there is no ecosystem constraint on development, i.e. the economy is very small relative to the surrounding ecosystem that constitutes the supporting life support system. Most parts of the world are however now well beyond that stage and a situation where upstream economies are polluting downstream economies and their resource base is today frequent, even normal.

A third barrier to be overcome is the *politically 'sanctioned discourse'* , i e the dominating worldviews among national politicians (*Jägerskog*). Water management cannot be separated from politics, since politicians can only take decisions which are politically possible and can be accepted. This was illustrated with the Jordan basin case where the domestic discussions are clear boundaries to what is politically possible in terms of water sharing approaches. The Israelian ideology is based on preference of farming which makes farmers a strong political power and makes it a strategic risk to give up farming. The Palestinian ideology gives priority to water rights of the people.

There are also *governance barriers,* such as lack of tools to compensate for losses suffered after reallocation aimed at freeing water for environmental flows, for instance when water users have to give up irrigation on their lands. Tools needed to achieve water reallocation may include a long consultation process, water trading arrangements, water demand management, compensation mechanisms, compulsory taking of water in spite of property rights and trading markets in property rights.

Conceptual renewal essential

Conventional water management limited to the socalled 'water box' is evidently not enough for a successful balancing of human security and ecological security. The influences from land use changes, both intentional and unintentional, were particularly evident from several of the cases. The conclusion is that land/water/ecosystems have to be *managed in an integrated way.*

A second observation is the strong element of *hydroclimatic differences* related to the high evaporative demand in the tropics. These are land use effects on river flow not earlier paid much attention to in the temperate zone where the evaporative demand is low or moderate. *Schulze* referred to similar phenomena when highlighting essential differences between Afrocentric and Eurocentric approaches. Also, the extremely severe Australian salinity problems referred to by *Scanlon* belong to this category of unexpected side effects of Europe-inspired human behaviour.

The extreme *complexity* of the land/water/ecosystem management stands out very clearly also from the Indian case reported by *Rajagopalan* with focus on the explosive growth of a highly profitable shrimp aquaculture in the Indian economy with 12 Mp employed and representing 1.5% contribution to GDP. Both salinity problems with groundwater salinisation, conventional pollution problems complicating drinking water supply and irrigated agriculture, groundwater problems in terms of depletion and salinity intrusion, fuel supply problems for local people, and increased coastal exposure to cyclones were involved.

One step towards getting a better grip on catchment complexity is the *hydronomic area* concept (*Molden*). The internal relations within a catchment have been conceptualised from a return flow perspective by structuring the catchment into different zones based on the fate of the return flow after use and the opportunities for reuse downstream: does the drainage water spontaneously return to the system, or does it have to be pumped to get back to the system, does it go to the sea? Is the area a stagnation zone or is it an ecologically particularly sensitive location?

Conclusions and final remarks

The Seminar contributions made very clear that human security and ecological security are partly incompatible goals in a catchment. A central task for coming decades is therefore to develop methods and strategies for balancing human activities towards compatibility with "ecosystem bottomlines" defined by the need to protect ecosystem resilience to disturbances. It has also been made clear that *land/water/ecosystems will have to be managed in an integrated way.* Since water is a common nominator for all three, water links them internally by its movement through the catchment. Therefore integrated catchment management offers an opportunity for taking a holistic approach.

The high level of complexity in real world catchments makes conceptual development essential. In summary, a number of conceptual contributions were offered in the debate.

1. the concept of *hydronomic areas* aims at helping to untangle some of the upstream/downstream complexities in a catchment-wide water resources use: whether it can be recaptured for reuse or whether certain characteristics constrains reuse.

2. reference to land use as an *streamflow influencing activity*, which refers to the role of land cover in influencing runoff formation. In uphill locations, land use influences the partitioning of incoming precipitation between consumptive use, groundwater recharge and flood flow generation. In downhill locations land use influences the water pathway taken by seeping groundwater: whether it is taken up by riparian vegetation or whether it feeds the river with time stable flow.

3. in terms of "*ecological bottomlines* " needed as criteria for the balancing between human needs and ecosystem needs. Environmental flows needed to support aquatic ecosystems in and besides the river represents the present concept;

4. the strategy referred to under the concept *catchment-based ecosystem approach* continues to remain rather dizzy. What seems clear it that ecosystem protection must be seen on different scales. The less complicated one is *local ecosystems* that should be protected due to endemic species, natural park character, floristic biodiversity, Ramsar sites etc. The key here is to define the water determinants that have made possible the development of the particular characteristics, and to enter the protection of those determinants into the catchment management strategy by adaptive management. On the *catchment scale* it is more difficult to specify what the concept means. Basically it should refer to protection of the resilience of the catchment ecosystem as a whole. For the moment, the conclusion seems to be that this is where the research front lies today. Key components might be a set of "ecological bottomlines" referring to crucial water determinants, and a methodological approach with resilience protection through adaptive management as the core.

Another outcome of the Seminar was the stress goven to the *role of science* , referred to on several occasions:
* in developing a more science-based legislation for watershed protection
* in finding the modes of approach in adaptive management to secure resilience in the key ecosystems in the sense of ability to absorb change and surprises without loss of function
* the need to adapt the dominating macroeconomic worldview to the relevant phase of river basin management.

Since the seminar took place in the sequence of SIWI Seminars on *hydrosolidarity*, it is interesting also to see in what way conclusions can be drawn regarding this concept. Evidently, water-related solidarity may appear on many different scales. On the global and regional scales, transfer of water-related products such as grain (virtual water) as part of a global food security strategy can be seen as one type of hydrosolidarity. On the national scale intranational water transfers from a water abundant region to a water-short region is another type of hydrosolidarity, which can be examplified by the Spanish case of publically strongly opposed transfer of water from river Ebro to the SE coastal region. On the catchment scale the upstream/downstream water sharing is impossible to avoid and calls for development of a catchment hydrosolidarity, based on an ethically supported orchestrating of incompatible land, water and ecosystem related activities. On the crossnational scale the upstream/downstream water sharing in transnational river basins is a similar type of hydrosolidarity but which is superimposed by political aspects, i e where the sanctioned discourse perspective represents a strong component.

BALANCING ECOLOGICAL AND HUMAN LIVELIHOOD SECURITY IN A CATCHMENT: A HYDRONOMIC ZONES APPROACH

by David Molden

Introduction

Driven by goals of economic development and the elimination of persisting malnutrition, the development of water for irrigated and rain-fed lands has led to marked changes in landscapes. Changes in the way water and land are used in one part of a catchment, often affect the use of water somewhere else. Interventions that make sense from the point of view of an individual or community may inadvertently lead to adverse impacts on people or ecosystems. Hydro-solidarity, the reconciliation of upstream and downstream interests, is difficult to achieve because water-people-landscape interactions within a catchment[1] are inherently complex, especially in water-stressed areas. Water crises develop because of failures to find the balance between water for livelihoods and ecosystem security—salinized agricultural landscapes, degraded coastal ecosystems, desiccated and polluted rivers, and malnutrition in spite of intensive development of agricultural lands.

The concept of *hydronomic* zones (hydro-water, nomus-management) was conceived to help untangle some of the complexities of catchment-wide water resources use (Molden et al. 2001a). The zones were developed based on the recognition that there are certain key similarities between various hydrological, topographical, and hydro-geological conditions within catchments. The second key consideration for zoning is the fate of water flowing out of well-defined reaches within catchments. In some cases, outflow is recaptured and is of adequate quality for reuse, while in other cases, the quality, quantity or timing of drainage outflow constrains its effective reuse. Recognition of the physical conditions, plus consideration of the fate of water outflow allow for the definition of a unique set of hydronomic zones.

First this paper presents the concept of hydronomic zones, how they can be used to understand catchment water use patterns, and their use in conceptualizing water resources strategies. Second, it presents a discussion on changing water use patterns over time and the implications on ecological and human livelihood security. Last, it illustrates hydronomic zones with a case in Sri Lanka.

The Hydronomic Zones

Hydronomic zones can be illustrated with a simple example, washing hands. We turn on the tap, apply water and soap, and then rinse off the soap. Some people may use the water quite frugally, while others may enjoy the process and spend several minutes savoring the water running over their hands. Given that water is an increasingly scarce

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[1] *Catchment is used synonymously with river basin indicating the drainage area of a river basin up to the salt-freshwater interface at a sea.*

resource, the question of whether or not the person is conserving water should arise. The answer is found by considering what happens to the water *after* the hands are washed.

Some water remains on the hands, and is eventually evaporated, while the rest remains as a liquid, picks up some soapy material and passes into a drain. In many cases, the drainage water finds its way back to a river, is mixed with river water, and can be again diverted for another use. In other cases, the drainage water flows to the sea and cannot be reused, or the quality is so degraded that further reuse is not possible. In the first case, from the point of view of water savings, we are not so concerned about using a high quantity of water since it is readily available for reuse. Yet we may be concerned about the quality of water and the costs of delivery and treatment of water. In the second case, where water is not readily reused, we would be quite concerned about the amount of water applied to the hands.

Whether the water use is washing hands, industrial cleaning or irrigation, it is useful to consider where the drainage water flows, and this is the essence of the concept of hydronomic zones. Hydronomic zones are defined primarily on the destiny of drainage outflows from water uses. Two basic conditions are a) situations where outflows can be reused and b) situations where outflows cannot be reused because of location or quality of water. In essence, these are two basic hydronomic zones. Geographic location and topography play an important role as to which condition exists.

The concept of hydronomic zones evolved from a work originally performed in Egypt where the Nile was divided into Water Management Strategy Zones (WRSR 1996). Molden et al. (2001a) defined six generic zones and 3 conditions applicable across zones were defined (box and figure 1) and applied to four basins in various conditions. It is targeted to the conceptual gap pointed out by Lundqvist and Falkenmark (2000) who contend that there is little or no concern about what happens to water after use, compared to the attention given to water provision. This is an initial step, and there remains more scope for the development of the hydronomic zoning concept and its application.

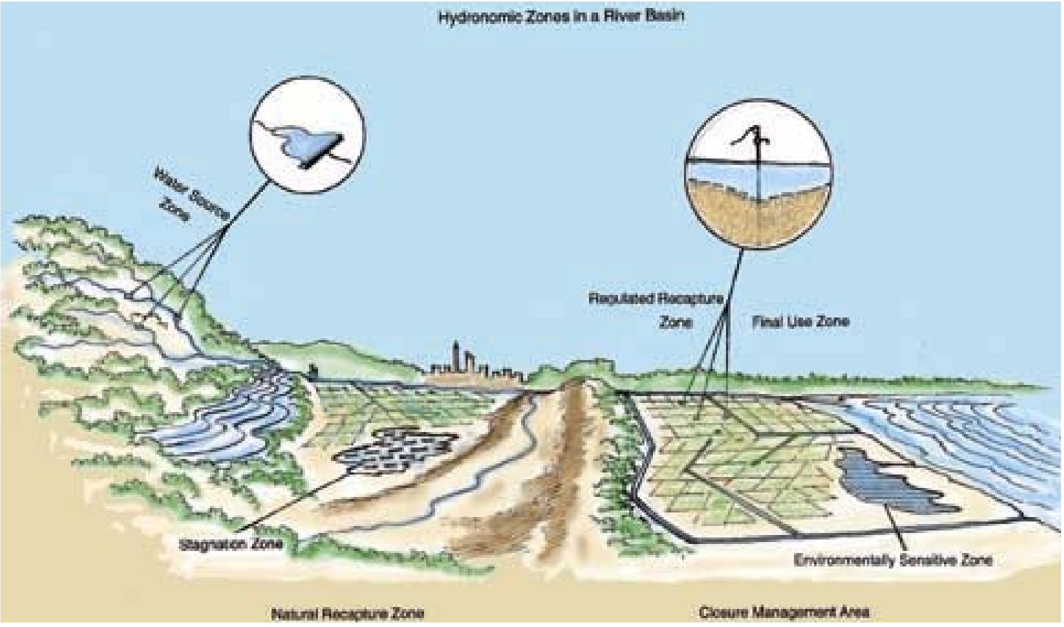


Figure 1. Illustration of hydronomic zones with a catchment.

All too often solutions are attempted that do not fit the circumstance. Efficiency improvements, water harvesting, pricing, groundwater exploitation while effective in certain situations, may not yield the results desired in all cases. Hydronomic zones provide an initial step in helping in the understanding and devising solutions. They have all the limitations of a first approximation tool, but they can be of aid in participatory methods to better understand catchment water dynamics, in helping people and organizations to conceptualize solutions, and they can be used in conjunction with more sophisticated modeling techniques.

Box. Hydronomic zones and conditions within zones

Water Source (WS) Zone. Water Source Zones are areas of the catchment where the blue water supply originates. Key concerns are land transformation and the resulting water and sediment yields.

Natural Recapture (NR) Zone. The Natural Recapture Zone is the reach or area of the basin where surface and subsurface drainage return flows are naturally captured by river systems or channel networks. In this zone, rivers act as a conveyance channel for water and also serve as the main drain.

Regulated Recapture (RR) Zone. A Regulated Recapture Zone is any reach or area of the basin where the reuse of surface runoff, spills, drainage, seepage or deep percolation water can be regulated. Return flows are captured by a drainage network that is physically separate from the distribution network and water does not naturally return to the river.

Final Use (FU) Zone. A Final Use Zone is any reach or area of the basin where there is no further opportunity for downstream reuse. Concerns in the Final Use Zone are centered on balancing the need to capture water for process uses and damage to the environment including salinization, seawater intrusion, pollution buildup and habitat destruction.

Stagnation (S) Zones. A Stagnation Zone is any isolated area where the drainage capacity is insufficient for the removal of leached salts and excess water caused by withdrawal of water for human purposes leading to ecological degradation.

Environmentally Sensitive (E) Zone. An Environmentally Sensitive Zone is any area where there is a requirement of water in terms of quantity, timing, and quality for ecological or other environmentally sensitive purposes.

Conditions within and across Zones

Water Quality: Pollution or Salinity Loading. An area loads the basin with pollution or salinity if an additional mass of pollution is added to the basin through the outflow from the area of interest.

Groundwater Storage or Utilization. The current or potential degree of dependence on and utilization of groundwater storage is an important consideration in formulating water management programs.

Open or Closed Basin. A basin is considered "*open*" if there are utilizable outflows from the basin in excess of environmental or other demands that could be tapped for additional supplies. A basin is "*closed*" for further development when all utilizable water has been developed and allocated across uses.

Developing Management Strategies

The primary reason for separating catchments into different hydronomic zones is because each zone requires its own set of water management strategies. A procedure for formulating water management strategies for each of the hydronomic zones involves first considering whether the basin is closing, closed or open (Seckler 1996; and Keller et al. 1996). Then for each zone, the statuses of pollution/salt loading and groundwater storage/utilization are considered. While this may appear to result in a large matrix of possibilities of water management strategies, it can be quickly narrowed down to a practical set of possibilities. First of all, determination of whether the basin is *open* or *closed* greatly reduces the number of possibilities. The stagnation zone stands alone because strategies for Stagnation Zones are generally quite site-specific.

Water interventions are basically aimed at redirecting flow paths of water. For example, a dam facility stores and then redirects water from the river to cities or irrigation. Water application to crops and practices of soil-water management for rain-fed agriculture are meant to convert blue water flows to productive green water vapor flows (Falkenmark 2000). A sample of water interventions is given below, with suggestions on how these interventions fit into various hydronomic zones.

Uses with high return flows. Domestic uses (such as the hand-washing example) require large inflows and generate large return flows. Low irrigation efficiency practices do the same. In natural and regulated recapture zones without appreciable pollution loading there is chance for reuse, whereas in the final use zone all water delivered to a use is effectively depleted as it is directed to a sink.

High classical efficiency. Practices are aimed at generating large evaporation and evpotranpsiration relative to rain and surface flows. This includes irrigation practices with high classical efficiency, such as drip irrigation, or precision basin irrigation. These practices are especially useful in zones with pollution loading, stagnation zones and final use zones.

Water harvesting and storage. These are practices such as local capture of rainfall, storage and conversion to productive green water flows for agriculture. This would include small water harvesting structures and reservoirs. The practice is useful in open basins to make more water available for human use. Care must be taken in closed or closing basins about reallocating use from one user to the next without due compensation measures.

Drainage and groundwater reuse. This includes local capture of drainage return flows for domestic, irrigation or industrial use. This would include small reservoirs to recapture water, pumping from drains, and pumping from groundwater where irrigation has increased recharge. These practices can be quite effective in the regulated recapture zone. They are not appropriate when they lead to excessive mixing of salts or pollution in pollution loading zones.

In-situ conservation. This practice aims to minimize nonproductive evaporation and direct water flows to crop transpiration. In rain-fed areas, this practice may have little effect on downstream blue water flows. Table 2 lists practices suitable to each zone where productive agriculture takes place.

Zone	Conservation Strategies
Final use	Increase classical efficiency, Reduce operational spills
Water source zone	Water harvesting in open basins In-field water conservation
Regulated recapture	Drainage reuse, groundwater pumping, managing quality and quantity of reuse
Natural recapture	Storage and water harvesting in open basins Control pollution loading
Stagnation	Improve drainage, Divert drainage flows to sea Control inflow of freshwater into area
Environmentally sensitive zone	Understand and meet environmental flow requirements in terms of quality, quantity and timing

Table 2. Practices suitable to each zone where productive agriculture takes place.

A Time Perspective on Changes in Catchment Water Use

The hydronomic zones present a useful snapshot of water use patterns, but we know that these can change rapidly over time, adding to the complexity of managing catchment water. Changing use patterns over time can be illustrated by conceptualizing phases of river basin development (For similar discussions, see Keller et al. 1998; Ohlsson and Turton 2000; and Molden et al. 2001). In its most basic form, water scarcity is a situation where people cannot access sufficient water for drinking or to grow crops. As a reaction to water scarcity, people tap into natural basin water resources including rainfall and river flows. Hydraulic structures, ranging from simple stone and wood diversion structures to complex dam, canal and drainage systems supply water from streamflow (blue water) for drinking and industrial supplies, and for agriculture. Rain-fed agriculture converts land use from its previous cover (forest, grassland) to cropland, redirecting green water flows with varying impacts on the previous hydrologic balance.

At a point in time, the available water supply for human use is a function of hydraulic infrastructure and the amount of land brought under rain-fed cultivation. When demand exceeds this available supply, one response is to provide more supply either by expanding hydraulic infrastructure or by expanding rain-fed agriculture. This supply approach is ultimately limited by the amount of land and water resources within a basin, the technical and economic limits we have in abstracting this supply (it would be difficult to divert the entire Amazon), ecological thresholds beyond which ecosystems cannot sustain land and water use practices, and societal desires about use of water which change over time in response to the state of a country's social development and economy.

Figure 2 represents a typical progression of river basin development over time with the original runoff and rainwater sources shown on the y-axis and time on the x-axis. Over time, more blue water is made available for human uses from streamflow or groundwater by building structures (dams, diversions, groundwater pumps) yielding a stair-step pattern. Larger dam or diversion structures would yield a sudden jump in the amount of water made available. After new infrastructure is developed, humans deplete available water by converting it to green water (evaporation) flows. Populations grow, wealth grows and demand and use increase, until depletion reaches the available supply, when possibly another structure is built. Similarly, conversion of land to rain-fed agriculture yields more water (directly from rain) for agriculture. Rain-fed expansion continues until a limit is reached.

The figure illustrates a possible trajectory of catchment water use. More water from blue and green water sources is depleted in this case past a utilizable limit. The stair-step pattern represents blue water interventions making more water available for human use and depletion.

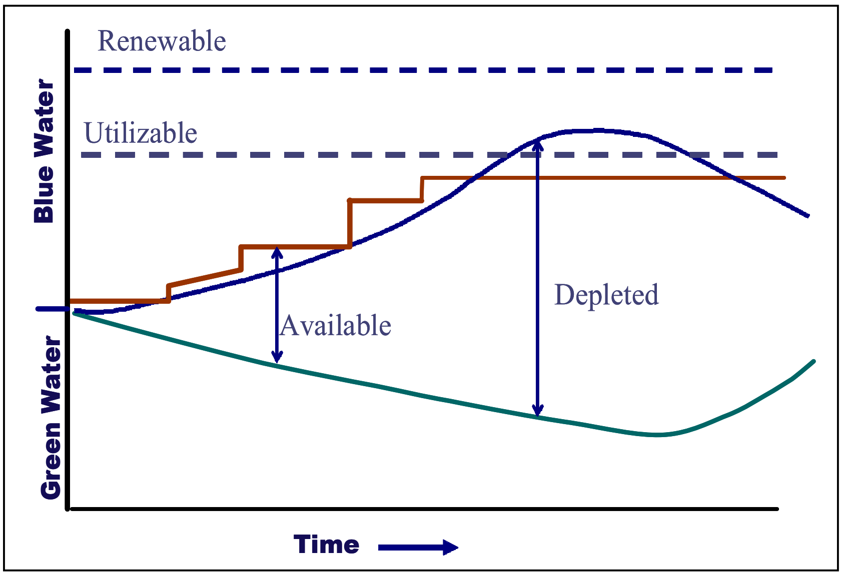


Figure 2. Phases of river basin development.

Initially, in a development phase, the amount of naturally occurring water is not a constraint. Rather, expansion in demand drives the construction of new infrastructure and expansion of agricultural land. Institutions are primarily engaged in expanding facilities for human use.

The middle portion of the graph represents a utilization phase where significant construction has taken place, and the goal now is to make the most out of these facilities. Water savings and improved management of water deliveries are important objectives. Institutions are typically concerned with sectoral issues such as managing irrigation water, or managing drinking water supplies because of fewer inter-sectoral conflicts.

When depletion for human uses approaches the potential available water there is limited scope for further development—a situation referred to as a "closed basin" (Seckler

1996). Efforts are placed on increasing the productivity or value of every drop of water. An important means of accomplishing this is to reallocate water from lower to "higher-value" uses. Balancing objectives of sustainability and equity in allocations among competing demands becomes a major issue.

Managing demand becomes increasingly critical. Infrastructure construction is limited to those that aid in regulation and control. Little scope remains for "real water savings." Institutions are primarily involved in allocation, conflict resolution and regulation. Several important management and regulatory functions gain prominence, including inter-sectoral allocation. National-level coping strategies include industrialization, and trade for food, thereby importing "virtual water" (Allan 2002).

When the catchment is closed, options are limited by the amount of water resources and the amount of water that can be brought in by trans-basin diversions. Mining of water resources can, and often does, lead to depletion levels over the utilizable limit. Groundwater mining in the North China plains is an example. Eventually though, human depletion must reduce to below sustainable limits.

Different issues tend to arise at different phases of development.[2]

Water scarcity. Construction of water facilities to provide access to water is often targeted at the relief of water scarcity. But even with facilities to provide access, scarcity can exist. Poor institutional functioning can drive scarcity when laws, traditions, or organizations restrict access or are inadequate to distribute water to all, leaving some people with water scarcity. Physical or absolute scarcity exists when the demand for water outstrips the facilities to tap into resources (IWMI 2000). For example, physical scarcity exists in the North China Plains where there is no more water left for the next user who may wish to develop a new supply. Economic-driven scarcity exists when water is ample in nature, but financial or human resources constraints impede the development of water resources for human use.

Water and human livelihood security. Water scarcity in each phase of development has important implications for poverty (van Koppen 2000). During the development phase, an important consideration is who benefits. Will access to additional water benefit the poor or will the wealthy capture the benefits? Different problems emerge during the utilization phase. Even though conveyance structures exist, management may not meet the needs of the poor. During the allocation phase, water is reallocated amongst sectors and people. When water moves away from agriculture to cities and industries, will the poor and less powerful be able to maintain their right or access to water, or will they find employment in other sectors? Will poor people be able to capture the economic gains when water moves to higher- valued uses?

Water and ecological security. Hydraulic infrastructure alters natural flow regimes and facilitates the change in landscape with growth in agricultural areas and cities. Large

[2] *Trajectories of basin development will vary from basin to basin, and these issues may arise at different times. The diagram is meant to provide an entry point in thinking about basin development.*

infrastructure or large development of agricultural land significantly alters natural ecosystems. During the utilization phase, water use and depletion intensifies, further removing water from nature and very often altering important ecological functions of water systems. A common "solution" to scarcity is to further exploit natural reserves of ecological significance for more water, resulting in damaged wetlands or loss of biodiversity in ecosystems generally. Ineffective use of water from agriculture or human uses often leads to intensified pollution, especially when less water is available for dilution. In the allocation phase, there is a danger of water being reallocated further from natural uses. Water tends to get reallocated to perceived higher- valued uses, such as industries and cities, leaving agriculture and ecosystem uses as residual users. It is between agriculture and ecosystems that the conflict over the last drops is to be found. Often though, ecosystem restoration to bring back important ecosystem functions and services is on the agenda during an allocation phase.

The Kirindi Oya Case

The zones are described with reference to figure 1, and using the case of the Kirindi Oya river basin in southern Sri Lanka (figure 2). This river basin flows from the medium-range hills of Sri Lanka to the Indian Ocean. The average annual rainfall is 1,000 mm with a dry season (yala season) from April to October. The minimum average temperatures vary from 26 ^{o}C in December to 28 ^{o}C in April. Values of reference evapotranspiration vary from 110 mm in November to 184 mm in August, with an average annual value of 1,765 mm.

Water resources in the area have supported vigorous agriculture since ancient times (Brohier 1934). The Yoda Wewa, Debera Wewa, Tissa Wewa, Weerawila, Pannagamuwa and Badagiriya tanks (serving the Old Area) and most recently the Luhungamvehera help utilize Kirindi Oya water for irrigation and other uses (Bakker et al. 1999) such as domestic, bathing, fishing (Renwick 2001), small-scale industrial uses and other important non-crop vegetation (Renault et al. 2000). Other agricultural activities in the Kirindi Oya catchment include livestock rearing, rain-fed agriculture and fishing, including shrimp fishing in the lagoons.

The Kirindi Oya Irrigation and Settlement Project provided irrigation upstream of this Old Area for new settlers with the addition of the Lunugamvehera reservoir, which began operation in 1985 (IIMI 1995). The additional lands irrigated by the project are referred to as the New Area. This reservoir gives the opportunity to tap into all Kirindi Oya water except for extreme flood events.

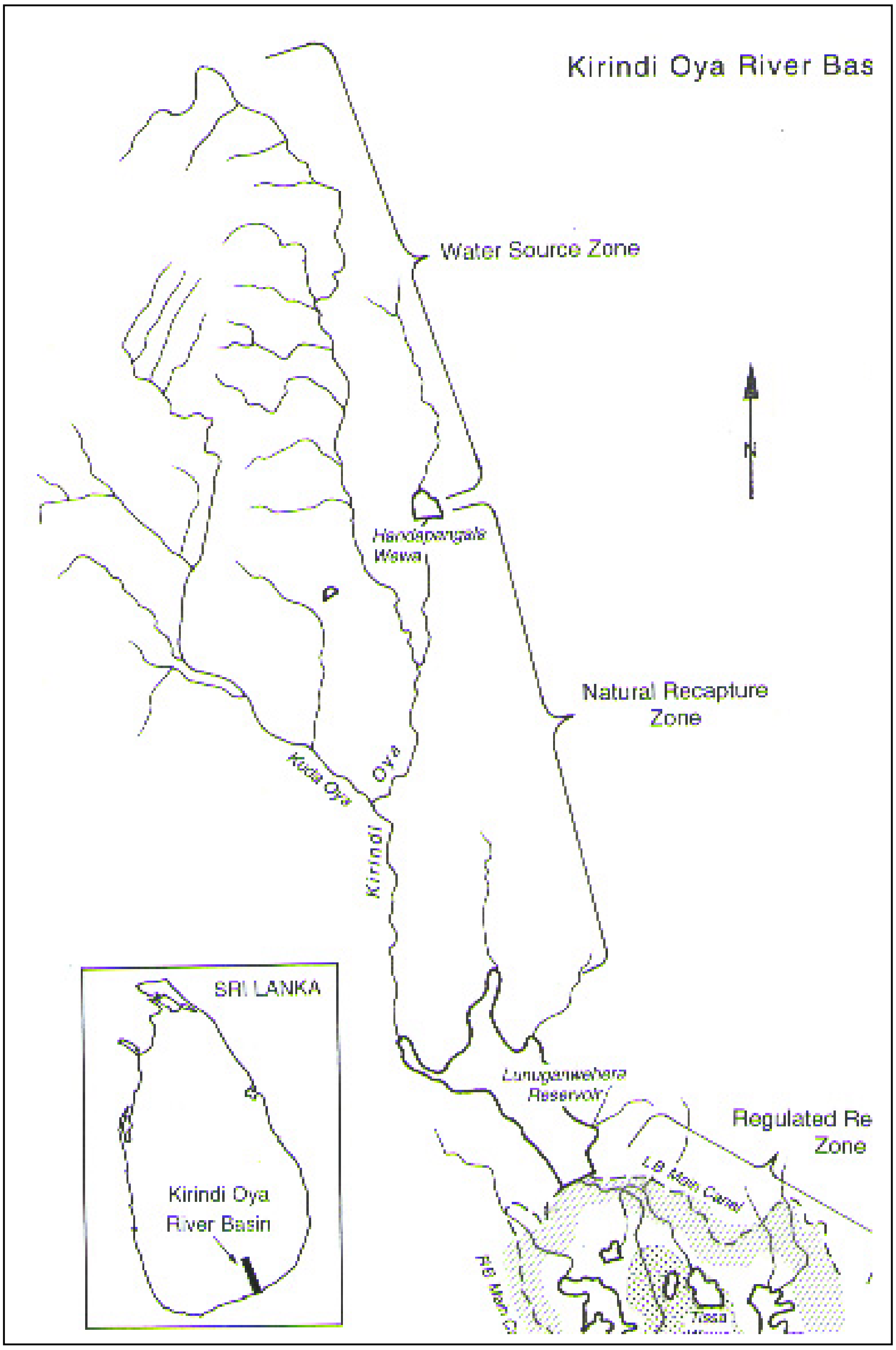
The Bundala lagoons, designated as a Ramsar wetland, are another dominant feature of the landscape. The lagoons support high biodiversity and provide an important nesting ground for migratory birds. The lagoons are of economic importance as they attract tourists and provide important fisheries. Since the construction of the Lunugamvehera reservoir, additional freshwater has drained into the lagoon, causing a change in ecosystems from one that served a brackish water ecosystem into a freshwater ecosystem.

Water source zone. At Kirindi Oya, the water supply zone lies in the upstream area, with up-country plantations, rain-fed (slash-and-burn agriculture), and forests occupying this area. Key concerns are a change in landscape from forests to agricultural land, which would change both water and sediment yield.

Natural recapture zone. There are several small tanks (reservoirs) serving irrigation farmers. Recently, many open wells and river lift pumps have been developed privately for vegetable growing. With increased population in the area, land use is rapidly changing. Any increase in evaporative depletion from a change in land use in this region results in a decrease in water availability downstream. Drainage outflows from various uses naturally find their way back to the Kirindi Oya river where there is opportunity for reuse downstream. Eventually, they flow into the Lunugamvehera reservoir where they will be again diverted.

Regulated recapture zone. The regulated recapture zone shown at Kirindi Oya lies between the Lunugamvehera reservoir and the area immediately downstream of the old tanks (reservoirs). Return flows are captured by drains and tanks separated from the river, and there are ample options for reuse. The old tanks serve as storage and regulating reservoirs, capturing upstream spills, storing them temporarily and providing a supply for downstream uses. Within the irrigated area are several trees, many of which are economically important, such as coconut trees, thriving on water indirectly supplied by irrigation via the shallow groundwater system (Renault et al. 2000). The area has been converted from a dry-zone ecosystem to a lush wet-zone ecosystem, because trees have ample supply of water made available by seeping reservoirs, canals and rice fields.

Final use zone. The final use zone at Kirindi Oya is situated downstream of the old tanks, and adjacent to the sea. There is no opportunity for reuse of drainage outflows downstream of this area. There are patches of salinity, especially in the newly developed area where salts in formation have not been leached out. There is significant drainage outflow from this area, especially during the wet season, and apparently scope for real water savings in this zone by reducing deliveries and storing water in the tanks, and at the same time either increasing application efficiency or water recycling.


Kirindi Oya River Bas
Water Source Zone
N
Handapangala Wewa
Natural Recapture Zone
Kuda Oya
Oya
Kirindi
SRI LANKA
Kirindi Oya River Basin
Lunugamwehera Reservoir
Regulated Re Zone
LB Main Canal

Environmentally sensitive zone. The lagoons incorporated in the Bundala National Park, downstream of the Badagiriya tank constitute an important ecological use of water and are sensitive to upstream, especially irrigation, water use. While some water is required to dilute the seawater for brackish water conditions, it is now thought that excess drainage flow induced by irrigation is artificially lowering salinity levels and adversely affecting the existing ecology (Matsuno et al. 1998). Several of the lagoons that supported brackish water ecosystems are now being converted into freshwater ecosystems.

Finding the Balance

How can ecological and human livelihood security be balanced at Kirindi Oya? The livelihoods of several communities are woven together within the Kirindi Oya catchment, from the very poor cultivators of the uplands who clear forestlands for agricultural crops, to the increasing number of vegetable growers in the natural recapture zone, to the newly settled irrigation farmers in the New Area, to the long-term inhabitants served by the Old Tanks to fishermen in the Bundala area, and to those dependent on tourism for a livelihood. Ecological security of the rivers, wetlands and water bodies that support biodiversity and agriculture, is also at stake. Poor rural cultivators look for new opportunities within the upland areas, thereby affecting quality and quantity of runoff in the water source zone. Pressures include the desire for more economic growth. Industrial development or transfers of water out of Kirindi Oya are possible. Can a balance be struck?

Agricultural uses clearly affect other ecological uses. The first problem to address seems to be the irrigated area where improvements could be made in production and water could be managed to better serve the needs of the Bundala area. Cropping intensities in the New Area are low at about 100 percent (1 crop year) while in the Old Area they are much higher reaching 200 percent (Renault et al. 2001). New area farmers complain of shortage in spite of water accounting studies showing drainage flows to the ocean. Strategies include classical efficiency improvements in the final use zone, which would reduce inflow requirements to the Old Area. Second, recapture and reuse of return flows could be more effectively employed in the regulated recapture zone. Presently, water is directly provided to the Old tanks from the new Luhungamvehera reservoir because the Old Area farmers claim a first right to water. From a water-savings perspective it would be better to deliver to New Area farmers first, then recapture return flows in the Old Area tanks, then use this as a supply to the Old Areas. A combination of these practices would reduce drainage outflows to the sea (with possible environmental consequences), allow for more storage in the Lunugamvehera reservoir, and a higher cropping intensity. The Bundala area would benefit from reduced return flows.

Second, water of the Lunugamvehera is managed primarily for irrigation but, in fact, the water serves fishers and domestic use, and the drainage outflow affects Bundala. Management structures are required that recognize crop needs but the needs of other sectors gain more value from the areas' water resources.

Should additional area be cultivated upstream through increased rain-fed agriculture, water harvesting or pumping from the river? This could potentially lead to decreased river flows in the dry season. With present irrigation practices, this would affect the New Area users who would receive less water. If however, the water conservation practices outlined above are practiced, enough water would be available for cultivation in both upstream and downstream areas.

Of course, it is much easier to conceptualize how this should work, but how can it be made to happen? It will require finding the right institutional mix of incentives to employ water-saving practices that would allow better irrigation for new area farmers. This may limit damaging drainage flows to the Bundala Park and would leave additional water for upstream cultivation.

Maintaining the balance over time will be at least equal in difficulty to the challenge of initially finding the balance for Kirindi Oya users. Changes in demands and values of society will continuously change how water is used and perceptions of how it should be used. The hydronomic zones are not a static landscape property, but will change depending on how humans manage water. It is unlikely that there will ever be a static. The key to maintaining the balance will be the adaptability of institutions.

Fortunately for Kirindi Oya dwellers, the situation at Kirindi Oya is not as severe as at other catchments. In the North China Plains, northwest India and Pakistan, for example, intensively developed surface water systems and groundwater irrigation support the livelihoods of millions of rural poor. Salinization, pollution and groundwater depletion threaten the water resource base on which the people depend. In much of sub-Saharan Africa, there appears to be opportunity for more water for agriculture, but sustainable practices have been elusive, and the cost of new water development is at the expense of important ecosystems and livelihoods dependent on those.

Conclusions

Hydronomic zones have been useful as a conceptualization tool at Kirindi Oya and other basins in understanding waterflow paths, quality considerations and opportunities for improvement. Potential uses are:

- providing a quick overall characterization of how water is used in a catchment, and providing an overview of special considerations
- dividing a river catchment into areas where there are distinctly different water management considerations
- conceptualization of strategies to improve water management within the zones
- development of solutions for specific hydronomic zones so that these solutions can be extended to similar hydronomic zones in other areas
- providing information for use in stakeholder discussions for people from diverse backgrounds

The zones present a snapshot of water use patterns within a catchment, but these patterns change over time with changing pressures on water resources. The implication is that institutional water management patterns have to adapt to often rapidly changing spatial and temporal water use patterns.

Hydronomic zoning and the Kirindi Oya case study helped to illustrate important problems and solutions in finding the balance between human and ecological security interests. The first is the impact of agricultural water use on other uses, and how a focus on agriculture is required to help balance competing needs. Improved water management in agricultural systems can be used to help find the balance. A second implication is the importance of drainage and return flows in water systems, and the importance of understanding opportunities and threats of reuse. Third is that because of changes in demand, human values, and supply, finding and maintaining a balance between conflicting interests is a continuous process.

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HUMAN LIVELIHOOD SECURITY VERSUS ECOLOGICAL SECURITY - AN ECOHYDROLOGICAL PERSPECTIVE

by Malin Falkenmark

Introduction

As water stress advances in catchments under influence of strong driving forces in terms of population growth, urbanization, industrialization etc, water management is getting increasingly complex. While human livelihood security has to be safeguarded (pure drinking water, household water, water-dependent food and income generation), also ecological security has to be achieved (healthy ecosystems, terrestrial as well as aquatic, and long-term resilience to unavoidable change).

The situation calls for conceptual renewals to facilitate the necessary tradeoffs involved and to develop the criteria and guidelines needed. This paper will analyse the integrated land/water/ecosystem management that will be needed and the need to master a growing complexity with implications both for the educational system and for efforts to secure societal acceptance.

Predicament

Humanity's basic goal is, principally, to come as close as possible to the dual but partly incompatible goals of human livelihood security and ecological security. Included in the former is water for survival and health, water for production of food on an acceptable nutritional level, and water for income generating activities to achieve poverty alleviation. The amount of water needed for health has been assessed at some 20-40 m3/p yr (Falkenmark et al 1989, Gleick 1996). The water needed for industrial production can - at least under conditions of water shortage - be limited to the same magnitude, while the water needed for production of food has been assessed to be of the order of 1300 m3/p yr (Rockström forthcoming), and is in other words the dominating one.

Ecological security on the other hand has basically two dimensions: to protect healthy ecosystems on the one hand, and to safeguard resilience, i.e. ecosystem capacity to absorb unavoidable change, on the other.

In the present situation, humanity's basic predicament can be characterised as follows:
* securing safe water for households has been the goal since the UN Water Conference in Mar del Plata in 1977, but has in spite of very large efforts it has not been possible to win the race against the proceeding population growth. Although the world has been running at a remarkable speed, it has not been moving;
* today some 800 million people remain undernourished due to insufficient food, mainly in the semiarid and subhumid tropics
* the efforts to stop contaminants from entering natural waters , especially from income-generating small and medium-scale industry have not been successful enough;

*In the developing world, expanding water pollution represents a serious threat to both human health and aquatic ecosystems. The latter are also suffering from consequences of river depletion. The conceptual grip of protecting ecosystems and what that practically implies still remains rather poor.

The overall predicament of balancing between ecosystem protection and human livelihood security and welfare is illustrated in **Figure 1.** The global *ecosystem* is basically a system of interacting organisms which produces life support for the social system in terms of ecosystem goods such as food and timber, and ecological services such as for example oxygen production, dentitrification and pollination. The *social system* is driven by human needs and aspirations to produce increasing welfare but, by mismanagement of the life support system, the latter is continusously being degraded by processes such as pollution, salinisation and depletion. Both the global ecosystem and the social system are genuinely water-dependent.

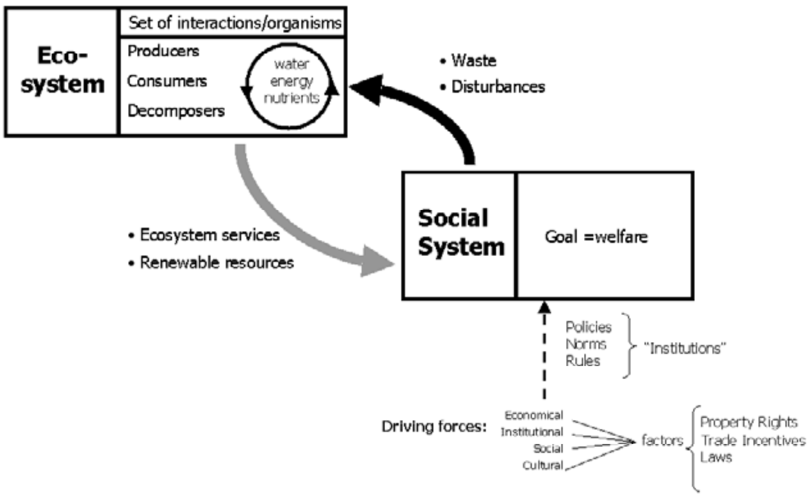

Figure 1. Humanity critically depends on the ecosystem offering renwable resources and producing ecological services. Human activities to improve welfare are driven by societal driving forces and influenced by the institutional system, but involve the production of waste and other disturbances that influence the functioning of the ecosystem.

Water is in fact the bloodstream of both the biosphere and the anthroposphere. The water cycle provides the *life support flows* of both systems. But, in addition, the processes going on in that cycle involves also a set of *consequence-producing processes*, that together act in producing the degradation consequences of human activities from introduced pollution loads, thereby disturbing water quality, and from manipulations of soil and vegetation, thereby disturbing water flows and pathways. What is being referred to are natural processes at work in the landscape:

* the partitioning of incoming rainfall between the evaporating part and the runoff producing part (blue/green partitioning)
* the socalled "lift-up-carry-away" function involving dissolution of water-soluble components along water pathways, carrying them away with the mobile water, and the erosion-sedimentation functions

* the water cycle-based transport continuity function producing long cascades of chain effects, whereby human influences on the atmosphere are transferred to the land and the terrestrial ecosystems, onwards to the water systems above and below the ground and to the ecosystems feeding on that water, and again onwards to the coastal waters and the coastal ecosystems.

Water as the common denominator

This central role of water in both systems in Figure 1 gives us a starting point in our efforts to cope with this complexity by realizing that *water is a common denominator of the ecosystem and the human system*. Water is essential for life support, for food production, for income generation, but also for the existance and functions of both terrestrial ecosystems and of aquatic ecosystems. This central role of water in both systems makes *water's integrating function in the catchment* an opportunity for overarching management and integrated approach, **Figure 2**. The basic water resource is the precipitation, caught within the basin. It provides the water involved in terrestrial ecosystem production, crop production, societal water supply and aquatic ecosystems. The water moving down the catchment links land use and water; humans and ecosystems; blue water quantity and quality; and upstream and downstream phenomena.

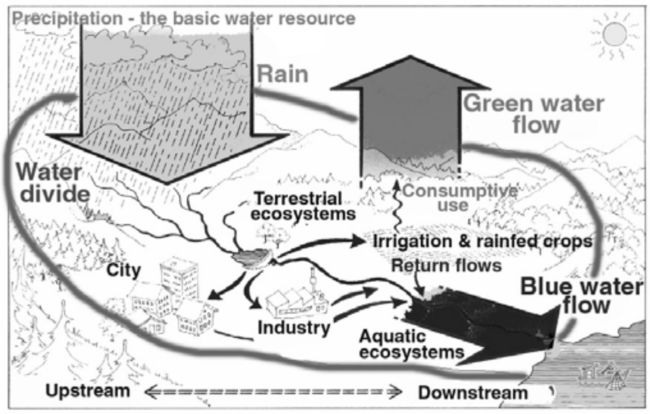

Figure 2. All the rainfall to a catchment is being partitioned between the visible blue water flow, supporting society with direct freshwater services, and the invisible green water flow, supporting plant production in terrestrial ecosystems including rainfed croplands. Water is withdrawn to supply cities and industries, returning the wastewater more or less loaded with pollutants. Water is also withdrawn to irrigated agriculture, from where the consumptive use part joins the green water flow whereas the return flow part returns to the river system loaded with salts and leached agrochemicals.

The catchment may be seen as a *mosaic of partly incompatible water uses and functions and ecosystems*. The terrestrial ecosystems are water-consumptive and influence runoff production. The aquatic ecosystems are water-dependent in that the river flow constitutes their habitat. The three security dimensions water security, food security and ecological security are linked by water flows from the hilltops to the mouth and therefore closely interwoven. The human activities in the catchment can be structured into three different categories: water diversions with the water after use either being literally consumed in the sense of returning to the atmosphere not available for reuse or forming return flows; in stream use in the water courses; or land use involving consumptive water use and therefore influencing the runoff generation. The ecosystems, on the other hand, are of two main categories: the green-water related terrestrial ecosystems where water is consumed in plant production; and the blue-water related aquatic ecosystems for which the river water provides the habitats.

These activities and phenomena are only partly compatible in the sense that the water use does not impinge on the ecosystem functions. The fact that they are at the same time partly incompatible means that a balancing has to be carried out, based on some priority setting rules. For instance, adding a pollution load into the water after use is not compatible with water as a habitat for aquatic ecosystem. The challenge is in other words to *find ways to orchestrate the catchment system for compatibility*, i e satisfying societal needs, meeting ecological minimum criteria, and securing hydrosolidarity. Components of this complex mosaic is withdrawal sites, sites for consumptive use/ return flow partitioning, sites for adding of pollution loads, stretches of instream use, runoff-modifying terrestrial ecosystems, and aquatic ecosystems dependent on uncommitted flow (McKinney et al 1999).

A crucial management tool to be developed is *land/water integration taking a catchment-based ecological approach*. Although land use and land cover are linked to green water flows, it seems preferable to develop this management around blue water integration as the core but incorporating land use influences, through their role in green/blue water partitioning and in influencing groundwater recharge. IWRM has therefore to be developed into ILWRM where L stands for land use (GEF 2002). Ecological criteria will have to be developed to find the water-relate "bottom lines" for ecosystem health, for local protection needs, for flood episode dependence, and for securing long-term resilience of the life support system in its totality. Hydrosolidarity guidelines will also have to be developed to arrive at principles of human rights, fairness, equity and equality principles (Falkenmark&Folke 2002).

The process has to incorporate *preparedness for change* and transient situations. This is due to the strong driving forces at work that will call for successive modification of land and water use. There are also response delays to be paid attention to: delays in societal response, in hydrological responses and in ecosystem responses (Meybeck 2001). There has moreover to be preparedness for hydroclimatic variability and disturbances in terms of fires, droughts, floods, pollution episodes etc.

Food production dilemma

As earlier indicated food production represents the dominating water need in the social system, needing 30-60 times more water than what is needed on the household level, depending on what source we are referring to. Moreover, it represents a consumptive water use, by which the water is turned into green water flow after use, i.e. water not available for reuse downstream. While the water consumed in production of the current diets in Subsaharan Africa and S Asia represents some 700-800 m3/p yr, an acceptable nutrition in line with FAO's recommended diet amounts to some 1300 m3/p yr (Rockström forthcoming). Taking both the current undernutrition and the population growth into account, this will by 2025 on the global level correspond to an overall additional need of consumptive use of 3800 km3/yr. *This additional water need is of the same order of magnitude as todays overall use of blue water.*

Looking at the regional perspectives, the food production needed to feed the growing populations in Subsaharan Africa and S Asia will increase the consumptive water need in the former regions by 3.1 times, in the latter region by 2.2 times. There are *four alternative sources* from where this extra green water needs may be found:
* by irrigation, relying on more blue water, transferring it into green water flow
* by reducing current water losses in applying a more-crop-per-drop strategy
* by horisontal expansion by turning the green water flows, currently used by terrestrial ecosystems in forests and grasslands, into water consumed for food production in stead
* by importing food, implying that the water consumed in the production of that food is green water used in some other region, socalled virtual water.

Orchestrating for compatibility

It follows from the above that the overall problematique boils down to finding ways for meeting at the same time both societal needs and ecosystem protection needs. The societal needs can only be met after manipulation of landscape components in terms of water pathways and land cover. Due to water's consequence-producing functions mentioned above, side effects of such manipulations will be unavoidable and involve disturbances of water-dependent ecosystems. At the same time, ecosystem functions in the water cycle have to be taken into account: terrestrial ecosystems are on the one hand water-consuming but on the other hand facilitating groundwater recharge, thereby securing dry season flow; aquatic ecosystems are on the one hand blue water dependent and therefore vulnerable to change when river flow, seasonality and/or water quality are altered, but are at the same time interacting with certain water contaminants, partially reducing water pollution problems.

The catchment can basically be seen as a mosaic of partly incompatible water phenomena, so that the overall challenge is to orchestrate this complex system for compatibility. This will involve three different types of balancing:
* to satisfy societal needs in spite of the pollution load added and the consumptive water use that is involved
* to meet ecological minimum criteria in terms of fundamental ecosystem determinants: environmental flow to be left uncommitted in the rivers, secured flood flow episodes, and acceptable river water quality
* to secure hydrosolidarity between upstream and downstream societal and ecosystem needs (SIWI Seminar 2001).

The catchment can be seen as a *socio-ecohydrological system* (Falkenmark& Folke 2002) in which trade offs have to be made. At the same time, social acceptance of the results of those trade offs has to be secured, implementation be made possible in terms of institutions, regulations and financing needed, and the implementation be realized by securing adequate incentives and education efforts. In these efforts, complications will however emerge, i.a. continuous change in terms of further land use and water use modifications, driven by ongoing population growth, urban migration and increasing expectations. Moreover, response delays will complicate the efforts and have to be accepted: delays in both societal response, hydrologic response and ecosystem reponse .

Finally, triggering events will have to be expected in terms of intervening drought events, flood events and pollution episodes.

As a result, three key directions have to characterise the emerging management system (secure-avoid-foresee): *securing* water-related services to the population, *avoiding* ecosystem degradation, and *foreseeing* changes and variabilitity. One particular dilemma involved in this process is to find ways to meet the huge green water needs to feed the hungry and the new born, and to manage the conflict of interest versus ecosystems' water needs. How can we proceed in minimising the conflicts involved? How large is the conflict? What are the real needs of the ecosystems and what are the "bottomlines" for ecosystems and their functions, terrestrial as well as aquatic? When balancing upstream against downstream interests, one has to identify downstream "bottomlines" in terms of uncommitted environmental flows and minimum water quality. The approach has then to move segment-wise upstream. A particular challenge here is to identify resilience determinants to avoid ecosystem collapses, cf Folke's paper.

In spite of the large attention needed to green water flows, blue water has to be used as the entry point. Green water influences on blue water flows, i.a. altered runoff generation, have to be incorporated. Attention has to be paid to runoff added along particular river stretches, to demand sites and the partitioning of the diverted water into consumtive use versus return flows, to pollution load added, and to instream uses. The basic water resource is the precipitation caught within the catchment's water divide, and the water routed through the catchment. In this routing, "bottomlines" have to be respected, upstream/downstream relations attended to, and resilience criteria respected. Guidance may be sought from the new *value flow concept* (Seyam et al 2002).

Learning to master complexity

Evidently, the overarching challenge is to master complexity. One overall task will thereefore be a *learning for mastering complexity*, a complexity that is the result of three superimposed sets of complexity: water's multiple functions (life support flows, the three consequence producing processes), ecosystem complexity, and societal complexities, and in addition strong driving forces at work that continuously alter needs and expectations.

The rapid complexification of water management will call for *rapid development of the educational system* in order to produce the new generation of water managers, hydrologists, ecologists, and economists needed.

The task involves considerable *conceptual challenges* as well. Focus has to be moved from withdrawals to what happens to water after use and from ecosystems as such to ecosystems' water determinants and to their hydrological functions (influencing groundwater recharge, water quality modifying functions). Finally, water-related determinants of resilience have to be identified as well as water's involvement in resilience erosion and the collapse of ecosystems, such as salinization of fertile soils, collapse of cloud forests, scrub development of savannahs etc, eutrophication of lakes.

Conclusions

To conclude, the challenge is to manage the water flowing down a catchment while orchestrating for compatibility between land use/water, humans/ecosystems, upstream/downstream, present generation/coming generations. The basic resource has to be seen as the precipitation caught within the water divide of the catchment, and partitioned between green water flows linked to consumptive water use by terrestrial ecosystems and by non-productive water losses, and the blue water flow available for societal use and forming habitats for aquatic ecosystems.

Three things have to be developed: ability to strike tradeoffs, ecological "bottom lines" and criteria so that they can be respected, and sustainability principles based on an understanding of what resilience will demand (see Folke 2002). The management has to incorporate four basic perspectives: the social, the ecological, the economic, and the resource perspectives respectively. **Figure 3.**

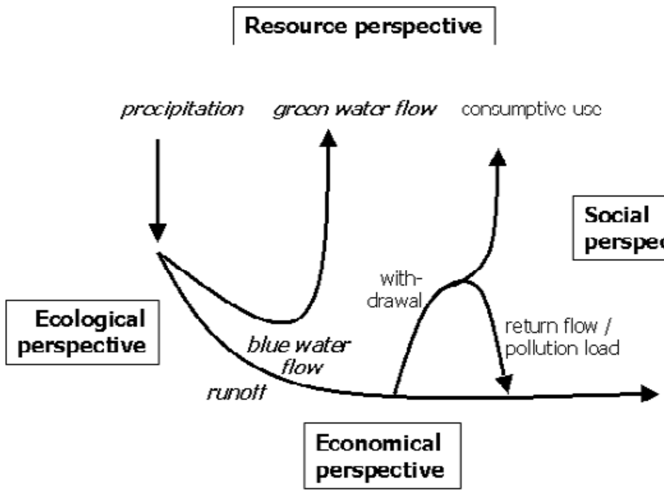

Figure 3. The catchment management has to incorporate four basic perspectives: the social, the ecological, the economic and the resource perspectives respectively.

The *ecological perspective* involves attention to terrestrial ecosystems and their involvement in local runoff generation, aquatic ecosystems and their dependence on flood episodes, uncommitted environmental flows, local ecosystems that have to be protected and their particular water determinants, and the long-term resilience of the overall system for the benefit of coming generations.

The *economic perspective* involves attention to benefit-costs relations, financing challenges, cost coverage to secure operation and maintenance of water in infrastructures, incentives to encourage implementation, and guidance from the values of water in different functions.

The *social perspective* involves meeting human needs in terms of safe household water, water-dependent food production, and - with present techniques - water-polluting income generation activities; securing societal acceptance by effective ways of stakeholder participation in planning and decision making.

The *resource perspective ,* finally*,* implies that the precipitation has to be seen as the ultimate water resource which will be partitioned between green water flows linked to plant production and consumptive water use and terrestrial ecosystems, and blue water linked to societal use and aquatic ecosystems. Attention has to be paid to blue water accessibility: how much blue water is there that can be mobilised and put to societal use when the need for uncommitted environmental flow that has to remain in the river is respected? The management efforts will have to include preparedness for a policy switch when a basin goes from being open to being closed (Molden 2002), i e when there remains no blue water surplus available for beneficial consumptive use.

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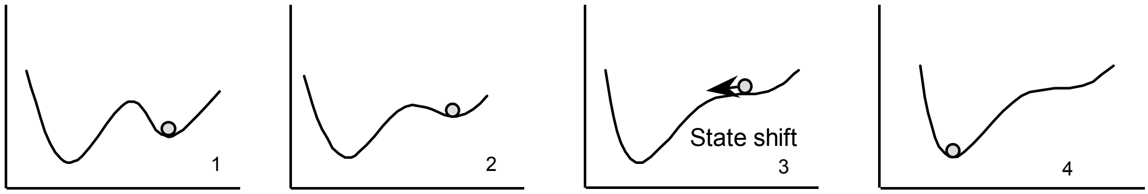
ENTERING ADAPTIVE MANAGEMENT AND RESILIENCE INTO THE CATCHMENT APPROACH

by Carl Folke

Emerging recognition of a two-fold, fundamental error underpinning past polices for natural resource management heralds awareness of the need for a correspondingly, world-wide fundamental change in thinking, and in practice. The first part of the error has been an implicit assumption that responses of ecosystems to human use are linear and predictable and can be controlled. The second has been an assumption, largely subconscious, that the human and natural systems are separate and can be treated independently. The evidence, however, accumulating in diverse regions all over the world, suggests that natural and social systems behave in non-linear ways, exhibit marked thresholds in their dynamics, and that social-ecological systems act as strongly coupled, integrated systems (Gunderson and Holling 2002, Folke et al. 2002). Social-ecological systems are both complex and evolving and their management is faced with uncertainty and surprise. People are strongly dependent on ecological systems for support, and societal development interrelates with nature in reflexive and dynamic ways. Freshwater plays a fundamental role in this context, not only as resource input for social and economic development but as the bloodstream of the biosphere from local to global scales thereby sustaining the ecological preconditions on which social and economic development depends (Rockström et al. 1999).

Natural-resource systems can be transformed by human action into less productive or otherwise less desirable states with consequences for human livelihoods, vulnerability, security and conflicts (see Figure 1). Such shifts reflect loss of resilience (Holling 1996). Resilience provides the capacity to absorb shocks while maintaining function. When change occurs, resilience provides the components for renewal and reorganisation. Vulnerability is the flip side of resilience. When a social or ecological system loses resilience it becomes vulnerable to change that previously could be absorbed (Kasperson and Kasperson 2001). In a resilient system, change has the potential to create opportunity for development, novelty and innovation. In a vulnerable system even small changes may be devastating.

Multi-equilibrium view



coral dominance	overfishing, coastal eutrophic-ation	disease, hurricane	algal dominance
clear water	phosphorous accum-ulation in soil and mud	flooding, warming, overexploitation of predators	turbid water
grassland	fire prevention	high rainfall and intense grazing	shrub-bushland

Valuable ecosystem services
Desirable state

Loss of ecosystem services
Undesirable states

Figure 1. Shifts from one stable state to another in coral reefs, lakes and rangelands as a consequence of human activities (Scheffer et al. 2001).

Resilience for social-ecological systems is related to (a) the magnitude of shock that the system can absorb and remain within a desirable state, (b) the degree to which the system is capable of self-organization, and (c) the degree to which the system can build capacity for learning and adaptation (Carpenter et al. 2001). Management can destroy or build resilience, depending on how the social-ecological system organizes itself in response to management actions (Berkes et al. 2003). Managing for resilience enhances the likelihood of sustaining development in a world of transformations where the future is unpredictable and surprise is likely.

Hence, resilient social-ecological systems are forgiving of shocks and surprises. They have the capacity to buffer perturbations, to renew and reorganize after change and to learn and adapt in a dynamic world. Freshwater plays a significant role in social-ecological resilience, a role that has up till now been given limited attention in freshwater management. The less resilient the system, the lower is the capacity of institutions and societies to adapt to and shape change. Misdirected management of the freshwater-resilience link may have been a major cause behind current freshwater crises and associated food scarcity and poverty. Managing freshwater for resilience is therefore not only an issue of sustaining capacity and options for development, but also an issue of environmental, social and economic security (Falkenmark et al. in review).

Partial perspectives and perceptions often cause erosion of resilience and subsequent vulnerability. For example, in the Argolid valley of Greece, people speak of an environmental crisis because there is not enough water to irrigate the citrus crops that were planted in the valley about 40 years ago. The water table in some parts of the valley has dropped up to seven meters a year, and now water is pumped at the valley's edge from depths as great as 400 meters. Hence, the environmental crisis is caused by the intensive citrus cultivation system itself, driven by an industrial perspective to agriculture. The people who brought this agroindustrial perspective to bear on the exploitation of the fertile lands of the valley came from outside the local farming communities. They were not familiar with the local ecohydrological context. These people could claim large economic subsidies derived from policies of the Greek government and the European Union, by declaring themselves as farmers for more than 50% of their time. This enabled them to make the investment in the cash crops citrus cultivation system at the expense of a diverse agriculture production system, and drove the whole region towards vulnerability (van der Leeuw 2000).

Another major problem in a similar context is the large-scale salinization of land and rivers in Australia. Extensive land clearing during the last two hundred years has changed ecosystem structure and processes and altered the ecohydrological dynamics of the Australian continent. About 5.7 million hectares are currently at risk of dryland salinity and this could rise to over 17 million hectares by 2050 (NLWRA 2001). The costs of salinization manifest itself as production loss due to saline river water, health hazards, production loss in agricultural lands and destruction of infrastructure in rural and urban areas. Added are the less well-known costs due to loss of biodiversity and ecosystem services in both terrestrial and aquatic environments. Hence, the terrestrial support capacity for societal development in Australia has been reduced through unexpected changes in ecohydrological processes, as a consequence of misdirected management. Successful restoration requires ecological as well as hydrological knowledge and understanding that actively manages the interplay of freshwater flows and ecosystem processes in a catchment perspective. It also requires proper incentives and institutions with the capacity to respond to change in complex and linked social-ecological systems.

Management that seeks optimal production in systems assumed to be stable and controllable can erode resilience and lead to resource degradation and socio-economic vulnerability. The scale of these breakdowns seems to increase with increasing technological and financial capacity based on such assumptions (Holling and Meffe 1996, Folke et al. 2002). In contrast to such an efficiency-driven, command-and-control approach, management that accepts uncertainty and seeks to build resilience can sustain social-ecological systems, especially during periods of transformation following disturbance (see Table 1).

From	To
Assume stability, control change	Accept change, manage for resilience
Predictability, optimal control	Uncertainty, risk spreading, insurance
Managing resources for increased yield	Managing diversity for coping with change
Technological change solves resource scarcities	Adaptive co-management builds resilience
Society and nature separated	Social-ecological co-evolution

Table 1. Change in perception

These statements will be exemplified by contrasting the recent development of modern aquaculture for increased food production in systems assumed to be stable and under human control (Naylor et al. 2000) with catchment based management in western Sweden where adaptive cooperative management, or adaptive co-management, is applied (Olsson and Folke 2001). A social context to freshwater management with flexible and open institutions and organizations that learn, create and adapt without foreclosing future development options seems to be required for building and sustaining social-ecological resilience.

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HYDROSOLIDARITY
– HOW TO LINK TO THE ECONOMIC DEVELOPMENT PERSPECTIVE

by Geoffrey J. Matthews

Introduction

To link hydrosolidarity, the interdisciplinary partnership for sharing water for sustaining the services of the ecosystem and the economy, to the economic development process, the community of water professionals must clearly demonstrate its value to the economic development decision makers, in particular politicians, financiers and their principle economic advisors, the macroeconomists. This paper addresses this challenge by first identifying the weaknesses of the standard macroeconomic vision for development from the water and natural resources perspective, and then proposing that this vision be substituted by an ecological macroeconomic vision linked to river basin hydrology. This ecological/hydrological macroeconomic vision is then used to illustrate the effects of changing water quantity and water quality, on the ecosystem services and the corresponding adjustments which must be made to ensure ecosystem and economic security. The various scenarios generated are then used to illustrate an example of the need and value of hydrosolidarity in the case of an upstream economy polluting a downstream economy.

Water, natural resources and the macroeconomy

Decades ago the size of the global economy and population were small relative to the finite amount of water and natural resources on this planet. This gave a sense of natural resource abundance. Today, due to the increase in the physical size of the global economy and present day demographic growth, the relative abundance of yesteryear is being replaced by a growing water and natural resources deficit. The standard macroeconomist has neither recognised this fact nor attempted to incorporate the role of water and natural resources into the economic development decision making process. The standard macroeconomic vision for water and the ecosystem which is used to guide the major decision makers, such as politicians and financiers can be found in standard macroeconomics text books such as “Macroeconomics” by Ekelund and Tollison 1994. Of its 859 pages only 1/3 of page 777 is devoted to water and natural resources. This section entitled “Natural Resources” states that:

"Every society is endowed with some quantity of land and natural resources such as fresh water, forests, and minerals. The US, Russia and China, for example, have large quantities of both. Possesion of land and natural resources may make growth easier, but it will not guarantee growth; nor will the lack of natural resources prevent growth. Japan has a small quantity of land and natural resources, yet Japan's post-WWII growth rate has been greater than of most other countries. By themselves, natural resources are valueless. They must be developed by labor and capital. Improvements in technology, moreover, may make resources more productive - as in fertilizing land - or even contribute to the development and invention of new resources. Aluminum, for example, is an invented alloy. It is a common misconception that the quantity of certain natural resources is absolutely fixed in supply. For example, as technology develops, it becomes possible to tap oil reserves at previously unreachable depths. New technology also may create opportunities to profitably extract oil from shale. Should the supply of oil ever begin to run short, new technology would likely bring alternatve fuel sources to the market. Technological change continuously alters the relative scarcity of natural resources."

This vision illustrates that there is no understanding that:
(a) the planet is finite and its land area is the sum total of its river and aquifer basins;
(b) water resources are finite i.e. fixed in supply;
(c) water is non-substitutable i.e. there is no alternative;
(d) climate instability governs the distribution of water resources not technology;
(e) the ecosystem is not a sector but a containing, provisioning, biophysical envelope that sustains the entire macroeconomy i.e. the ecosystem is a life support system dependent on water;
(f) there are limits to physical economic growth i.e. economies within river and aquifer basins must not fill the basin to the point that there will be insufficient ecosystem services to sustain it. From the water perspective, this means that there is an optimal scale of physical growth, which is dependent on the amount of water in quantity and quality which is available for the economy after the ecosystem service demands have been satisfied;
(g) water pollution, natural pollution absorbing sinks and drought must be managed if economies are to be sustainable.
(h) the relative abundance of water and natural resources of yesteryear is being replaced by a growing water and natural resources deficit.
(i) water sustains the services of the ecosystem and the economy.

Furthermore the book states that, freshwater is valueless unless developed by labour and capital and that, if a country has no natural resources it can continue growing.

In sum, this means that the present economic development process is not addressing the present water resources issues, because it is still assumed that there will always be plenty of everything to solve all development problems. Consequently there is no incentive to share water, to manage knowledge, to change human behaviour, to manage natural capital and to be concerned with human security and ecological security. Therefore, water resources management concepts, including integrated water resources management and hydrosolidarity, which the water community has been formulating and promoting since Mar del Plata in 1977, are still not being given serious consideration within the process of economic development. The challenge therefore, is to develop a macroeconomic vision which shows that water and the services of the ecosystem and the economy are everyone's business in all water resources and land use contexts.

Ecological economic development vision

As identified in "Water, a reflection of land use", page 16, the discipline of ecological economics offers a breakthrough in the quest to address the aforementioned challenge. A brief definition of this new interdisciplinary branch of knowledge and understanding from "Ecological Economics, concepts and methods" by Faber, Manstetten Proops, 1996, states that, "Ecological economics studies how ecosystems and economic activity interrelate." Essentially it closes the gap between ecology and economy by recognising that ecosystems are suppliers of services to the economy, and that these services represent a cost that has to be factored into economic development analysis before a decision is taken.

To measure these services and value them ecological economists have developed an ecological macroeconomic vision, illustrated by Figure 1, (Daly 1998). This vision, which is scalable, i.e. it can represent the sum total of all river basins or just one river basin, recognises that:

(a) the planet is finite;
(b) there is a need to preserve the ecosystem and the natural capital required to service the artificial economy i. e. there is an optimal scale to physical economic growth; and
(c) there will come a point when physical growth will have to be replaced by qualitative growth if the ecosystem and the artificial economy are to survive over the long term i.e. human and ecological security are considered to be vital issues of the economic development process.

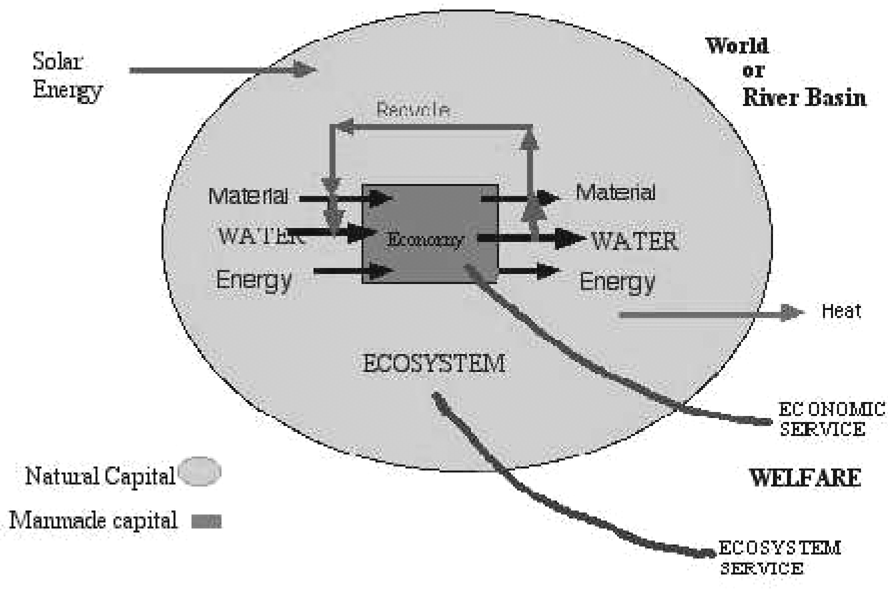

Figure 1. The ecological macro view of the macro economy

This latter point provides the opportunity for incorporating hydrosolidarity into the economic development process. To do this the author proposes that this ecological macroeconomic vision be linked to river basin hydrology. This linkage will create an ecological/hydrological macroeconomic vision able to illustrate the effects of changing water quantity and water quality on the ecosystem services and the corresponding adjustments which must be made to ensure ecosystem and economic security. Interdisciplinary research on the causes and effects of changing water quantity and water quality on, the services of the ecosystem and the economy, and the corresponding changes in macroeconomic security will provide data, information and knowledge for the practice of hydrosolidarity.

Ecosystem/economic security, hydrology and hydrosolidarity

The relationship between ecosystem security, economic security, hydrology and hydrosolidarity can be illustrated by the following figures which represent a generic river basin in, the initial stage of development, the optimal scale stage, suffering pollution and suffering drought (Matthews 1996). The figures comprise essentially of two elements. The first is a hydrological and the second a corresponding ecological macroeconomic vision. In the first element the upper curve represents the river basin's total water resource availability in terms of quantity (Q) against time (T). This curve is the boundary of the hydrological envelope within which the ecosystem and the economy survive. Knowledge about its behaviour is vital for the decision makers who have the authority for allocating this water to the ecosystem and the economy. The allocation is represented by the middle curve. This curve is the allocation boundary between the amount of water required to sustain the services of the ecosystem to the economy, i.e. the ecosystem services security demand, and the amount which remains for the purposes of economic development. The lowest curve represents the water demand of the economy i.e. the economic services security demand.

Figure 2 illustrates a river basin in the initial stages of development. In this case the demand from the economy is well below the ecosystem demand. This indicates that from the water resources perspective, there is potential for further physical economic development growth and hydrosolidarity is not critical. This is the scenario in which the standard macroeconomic vision can be applied i.e. from the water perspective there is no ecosystem constraint to development. The ecological macroeconomic element illustrates this i.e. the economy is shown to be very small relative to its surrounding ecosystem.

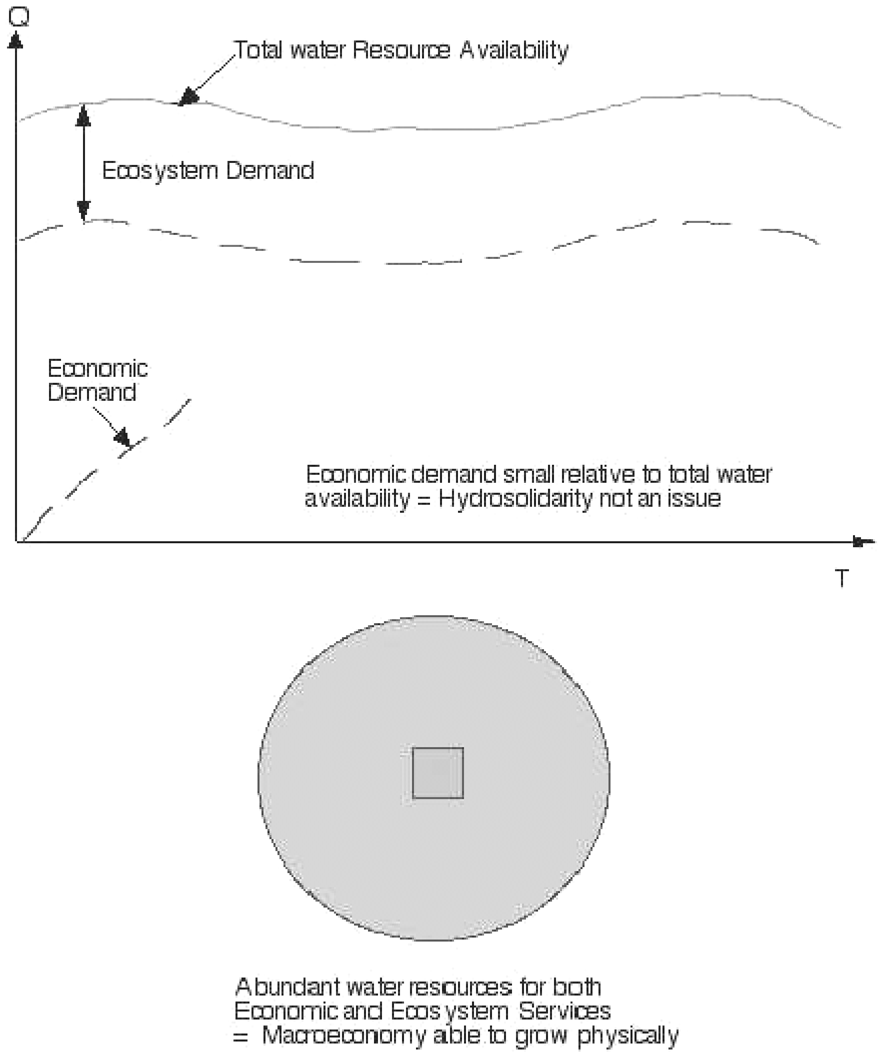

Figure 2. River basin in initial stage of development

Figure 3 illustrates a river basin which from the water resources perspective, has reached the limits of physical economic growth i.e. it has reached its optimal scale.

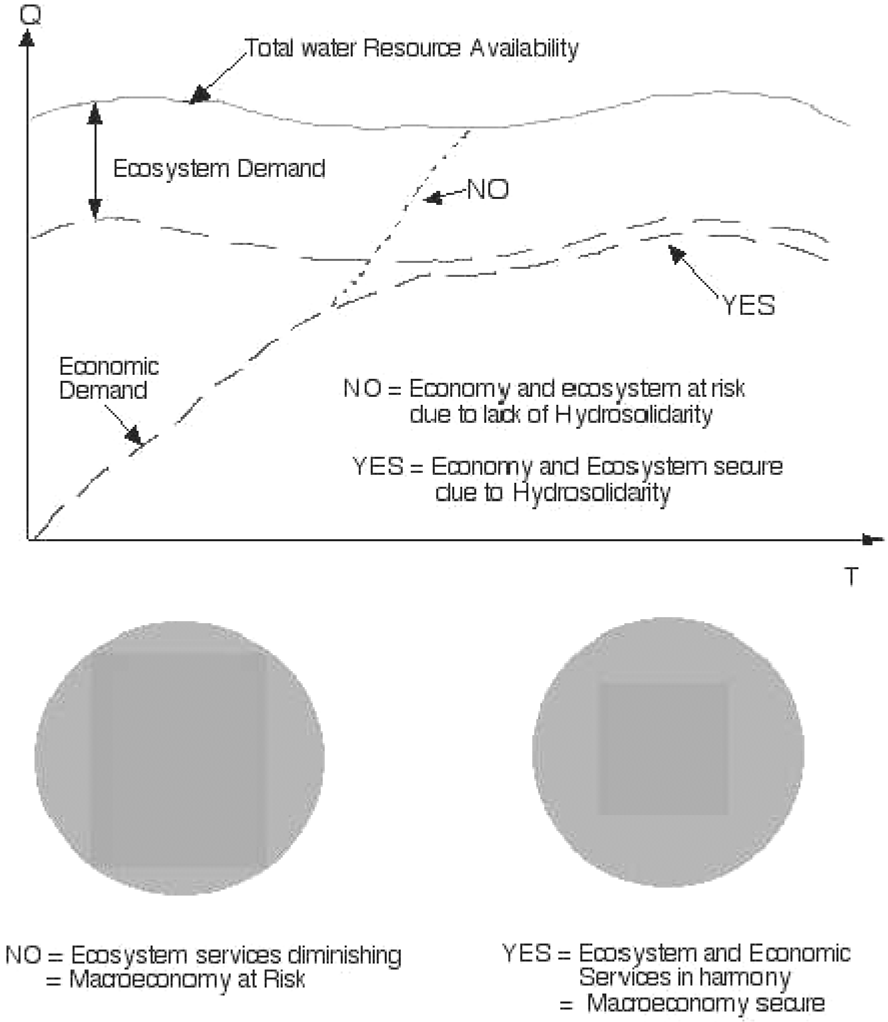

Figure 3. River basin in optimal stage of development

In this case the water demand from the economy follows the middle ecosystem allocation curve. To maintain ecosystem and economic security the lower curve must never transgress the middle curve i.e. economic demand is subservient to ecosystem demand. If physical growth is not restrained, the economic water demand will transgress the ecosystem allocation curve and eventually the ecosystem services to the economy will be lost and the economy will die. Hydrosolidarity is critical in this situation, as the allocation of water within the economy will be in a constant dynamic state. Furthermore from the water perspective, physical growth will have to give way to qualitative growth, after recycling and other water economizing devices have realized their full technological potential. The ecological macroeconomic views illustrate the importance of hydrosolidarity.

Figure 4 illustrates the effect of pollution on ecosystem and economic security. Pollution will force the ecosystem allocation curve down to leave sufficient water in the the river to dilute the pollution, in order to, maintain the natural pollution absorbing sinks, so that the ecosystem, farming and irrigated areas are not contaminated/poisoned, and to prevent the overloading of water treatment plants which supply industry and drinking water. Hydrosolidarity will be vital for the fare and equitable allocation of the remaining water throughout the economy, as shown by the corresponding ecological macroeconomic views.

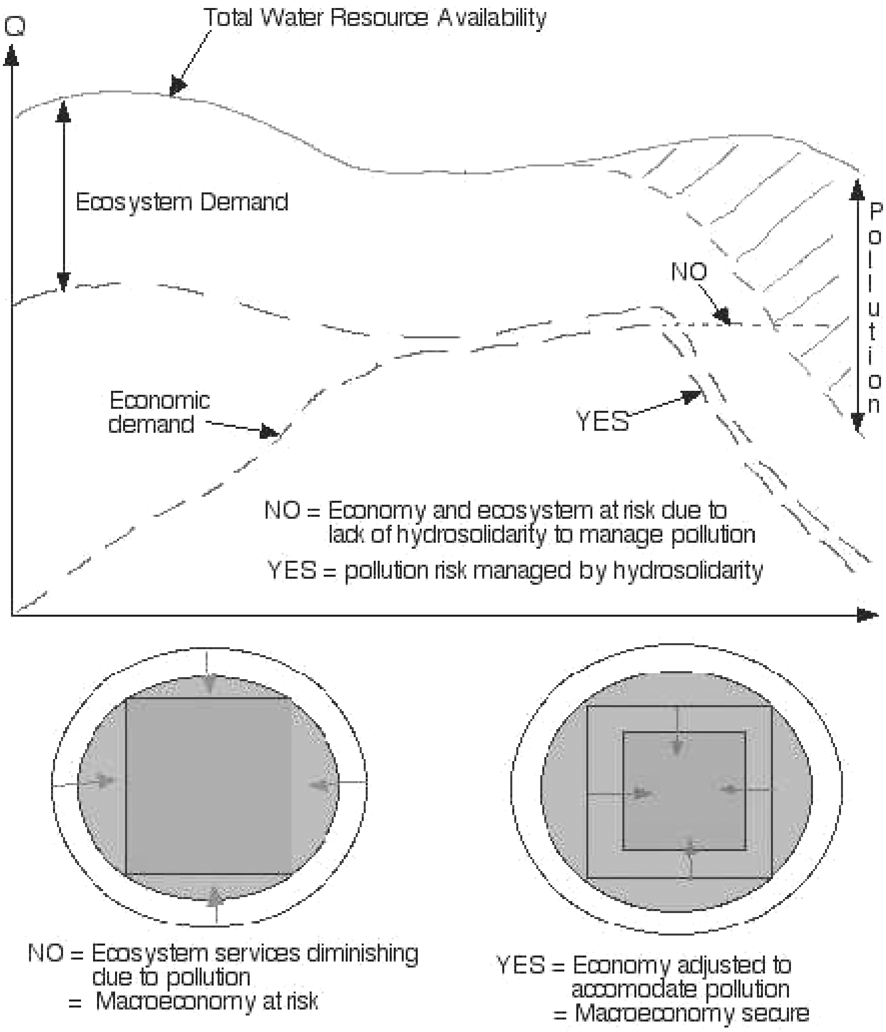

Figure 4. River basin suffering pollution

Figure 5 illustrates the effect of drought on the ecosystem and economic security. The first priority will be to ensure ecosystem security, so as not to exacerbate desertification and the eventual death of the economy. As in figure 4 hydrosolidarity is vital if the economy and the ecosystem are to survive the drought.

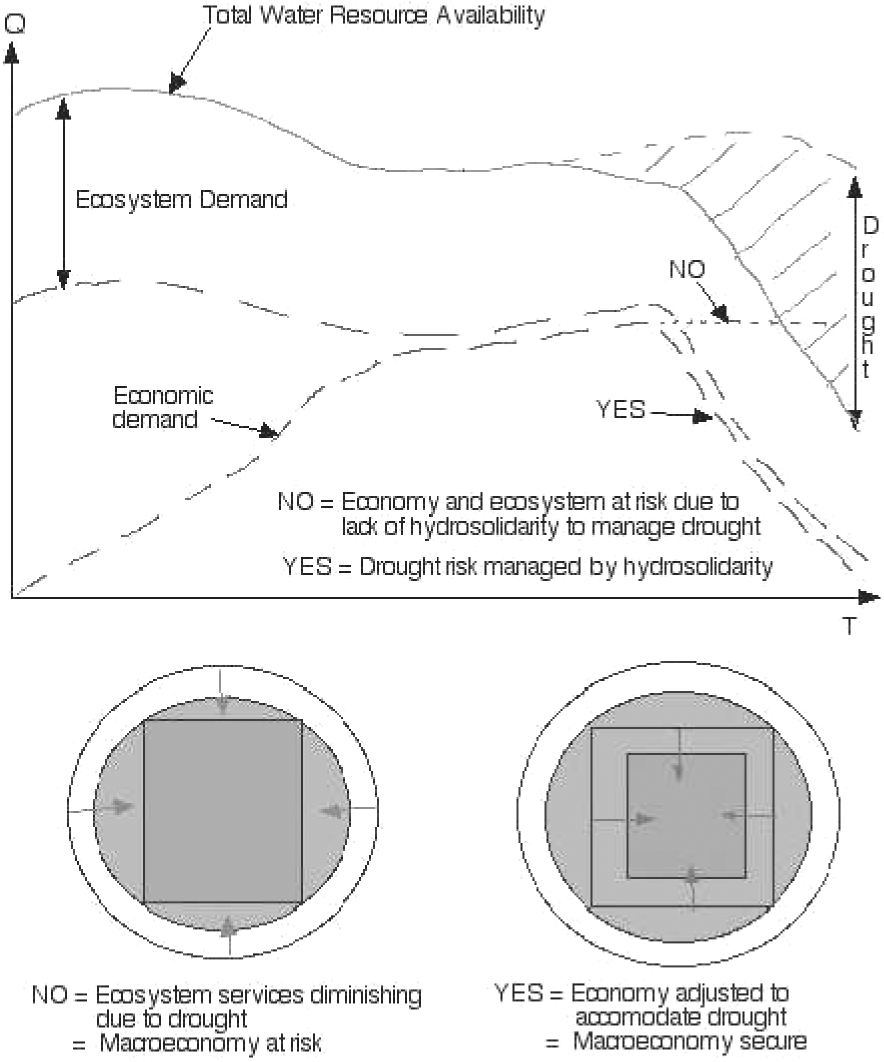

Figure 5. River basin suffering drought

Ecological economics and Upstream-Downstream Hydrosolidarity

Many important rivers have two or more well defined economies which depend on the one river flow. If the river basins are to be developed to their maximum potential from the water resources perspective, hydrosolidarity will be vital to the economic development process of the entire river basin, whether the river basin is national or transnational. Figure 6, a macro view of an upstream economy polluting a downstream economy illustrates this vital need.

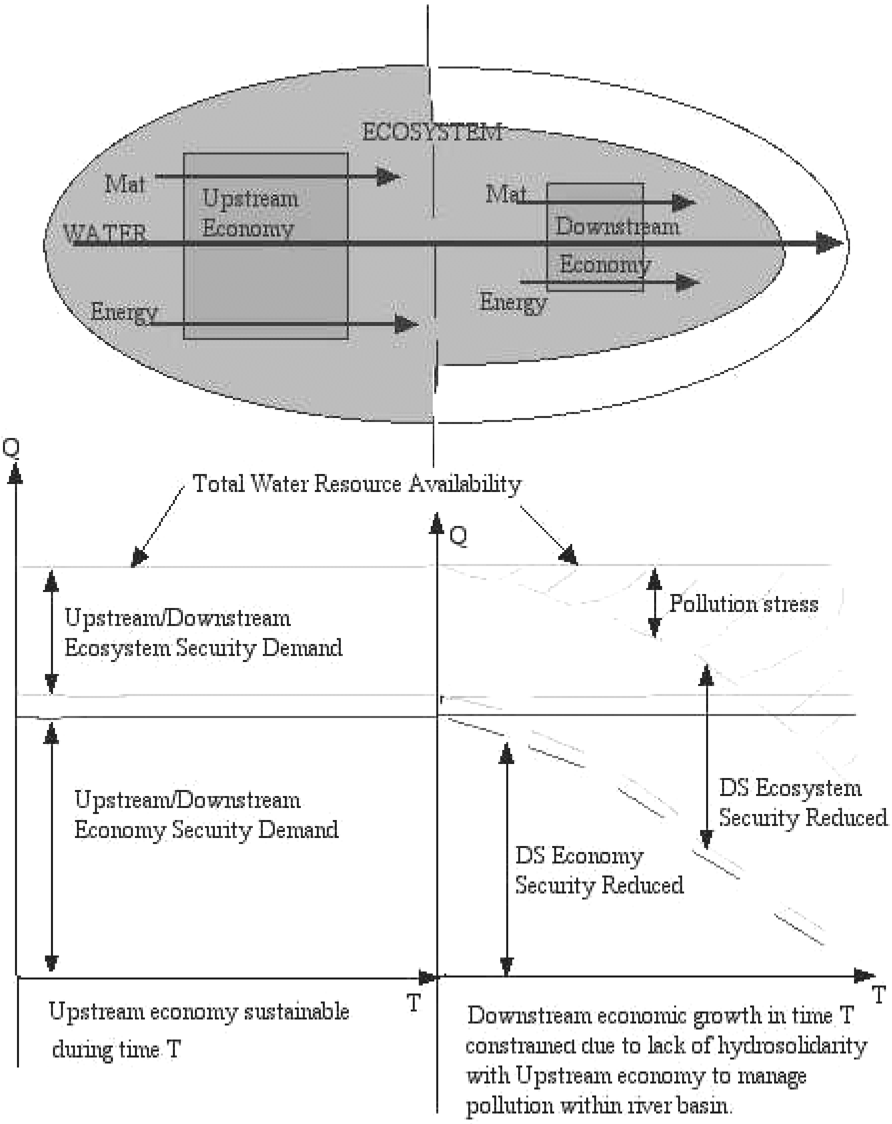

Figure 6. Macro view of an Upstream economy polluting a Downstream economy without Hydrosolidarity

This figure is derived from Figure 3 and Figure 4. Both economies need the same amount of water quantity Q for their ecosystem and economic security. The upstream economy is in the Figure 3 stage of optimal sustainable development during time T. However during this same time T it has been releasing pollution towards the downstream economy. Due to a lack of hydrosolidarity between the upstream and downstream economies about pollution management, the downstream economy is being forced to use part of the water flow Q to reduce the pollution stress; which consequently constrains its economic development growth and potential as illustrated by Figure 4.

In a drought situation a similar figure can be generated showing the same upstream economy deciding not to share the economic and ecosystem burden of the drought with the downstream economy. In this case the ecological macroeconomic view would show the upstream as per Figure 3 and the downstream by Figure 4 plus Figure 5. This is because the reduction in water quantity from upstream would diminish the ability of the downstream economy to dilute the pollution it is receiving from upstream, thereby exacerbating its economic and ecosystem insecurity. Only the application of hydrosolidarity will remedy this scenario.

Conclusion

At present, standard macroeconomics has no vision of the role of water in the economy, and the vital importance of water for ensuring the sustainability of the ecosystem services which support the economy. The rule is to grow forever and optimal scale and vulnerability are not considered. Consequently there is no incentive for appreciating and implementing hydrosolidarity. To address this situation it is proposed that a vision which links the ecological macroeconomic vision to river basin hydrology, be adopted. This ecological/hydrological vision has the ability to illustrate the value of hydrosolidarity for enhancing the economic development process of a river basin with one economy, or, multiple upstream and downstream economies sharing the same water resource. This vision will also provide a framework for interdisciplinary research on the effects of changing water quantity and water quality on the economy and ecosystem. The results of this research will provide data, information and knowledge for the practice of hydrosolidarity.

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HYDROSOLIDARITY AS SEEN FROM A POLITICAL PERSPECTIVE – OVERCOMING SANCTIONED DISCOURSE OBSTACLES

by Anders Jägerskog

Introduction and aim

Water relations between states in a river basin are often analysed on the international level treating the states as unproblematic singular units. It is argued that this represents a gross simplification. In order to understand why states choose the policies they pursue in an international river basin it is imperative to analyse the domestic structures of the parties since the policies pursued in the international arena are likely to be a reflection of the domestic structures.

The aim of this paper is to analyse how the sanctioned discourse[1], in which prevailing opinions and views have been legitimised by the discursive and political elite thus forming a dominant belief system or paradigm of the societies in states within a catchment, affects the water policies pursued in the basin thus effectively determining the degree of hydrosolidarity. In particular the dynamic of sanctioned discourses, i. e. the how the sanctioned discourse develops and changes over time, is analysed. The transboundary relations in the Jordan River Basin is used as a case study.

Earlier SIWI seminars have pointed out that it is of importance to develop a water ethic and an increased hydrosolidarity between upstream and downstream uses (Falkenmark, 2001). While this is certainly something worth striving for it seems still that there are various stumbling blocks in terms of analysis that needs to be addressed. It is argued that an understanding of the impact of the sanctioned discourse on the political processes in a society is imperative for water practitioners as well as water scientists. Scientific research results and policy advises, no matter how rational and well grounded they may seem, that does not display an understanding of the political context that they are concerned with inevitably run the risk of being inadequate and thus subsequently rejected. It is argued that an analysis of the sanctioned discourse within a river basin effectively tells us what is and indeed, what is not, *politically feasible.*

Theoretical framework[2]

"Many of the statements on water resource use and management by Middle Eastern leaders are determined by the national 'discourse' and not by the recommendations of government servants and certainly not by the advice of alien visitors" (Allan, 2001, p. 182)

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[1] *Sanctioned discourse is a term coined by Charles Tripp, School of Oriental and African Studies, University of London.*

[2] *Part of this section is based on Jägerskog, Anders. (2002) "The Sanctioned Discourse - A Crucial Factor for Understanding Water Policy in The Jordan River Basin" SOAS Occasional Paper, University of London, No. 41*

The observation of Allan on water use in the Middle East is not a feature exclusively applicable in that region. On the contrary, the role of discourse is important in any region.

Foucalt (1980) has usefully distinguished between coercive power (which usually rests with the state through the military forces) and 'discursive' power. While the former refers to the use of force the latter is a result of the interaction of interests, which form a consensus on an issue. The discursive power is not thought to be in the hands of only a few but rather represents a knowledge or opinion that is dispersed through networks in society. Discourse is thought to be covering all forms of spoken interaction - formal and informal - as well as written texts of all kinds. The language is seen as active and thus carries with it political implications and meanings (Potter and Wetherell, 1994). Thus the language helps to construct versions of the social world.

It is argued that the discourse sets limits within which policies have to be pursued, i.e. it indicates what avenues that may be politically feasible (Allan, 2001). It represents what may be said, who may say it and also how it shall be interpreted. The concept of sanctioned discourse seems to be related to Kuhn's (1962) description of a scientific paradigm in which certain methods and ways of viewing the world have become institutionalised and thus effectively work as "boundaries" for what is feasible or possible to study. In a vein inspired by the works of Kuhn a notion of a public policy paradigm has been developed (Capano, 2001). A public policy paradigm is defined as "the series of beliefs that the policy makers (those who formulate and implement policy) have with regard to:

a) those normative and ontological tenets, those fundamental values, based on a specific vision of the world, which underlie the individual and collective identities that, in turn, identify and govern the objectives to be pursued in a given public policy sector;
b) the casual theories underlying the construction of sectorial strategies for action;
c) the individual public policy instruments that are used daily within a given public policy sector." (Capano, 2001, p. 4)

Capano argues that within each public sector there exist a set of coherent beliefs about the "things" that have to be done as well as "how" they should be done. It includes principles that are not up for negotiation and consequently works as boundaries for action. Hence the concept of public policy paradigm seems to be linked to what is here labelled sanctioned discourse.

Turton has usefully described sanctioned discourse (when talking about water), as something that is best understood as a form of "hydropolitical ideology". This is a particularly useful term as it is associated with and draws from other ideologies in society such as nationalism (Turton, 2001). It is helpful in explaining why people that are confronted with same scenarios or events nevertheless describe their experience in quite different ways. The rationale for explaining events in one way or another are often a result of the surrounding social context and the particular discourse that has been sanctioned. In a related line of thinking the sociologist Bourdieu (1986) argues that the dominant knowledge or view in a society is dominant not because it represents a "higher level" of knowledge but because it is formulated from a social position that enjoys a strong power position in the social hierarchy. This position is depending on economic, social and cultural capital.

In the creation of the sanctioned discourse various "discursive actors" are active in the arena with special interests or stakes. However, the outcome of this "discursive battle" is bound to be determined by interests and power positions as elaborated by Bourdieu above. While politicians, both in democratic and non-democratic regimes, are in a position to influence the discourse they are not able to exercise full control over it. The discursive line of thinking is useful in explaining why they sometimes choose not to carry out water policies, which would seem to be the most rational. Allan (2001a) argues that the role of politicians is mainly to legitimise "that which is determined by the 'discourse'". While that is true one may add, arguing along the lines of Bourdieu, that politicians can be a strong actor in the discursive battle as they possess certain economic, social and cultural capital. A useful distinction when analysing how discourse affect policy is the one made by Hajer (1995) who argues that actors in a given area (such as the water sector) create coalitions that subscribe to the same narratives. He calls these 'discourse coalitions'. These coalitions can consist of government officials, water professionals, journalists etc.

The dynamics of sanctioned discourse

One important feature in the discussion on discourse is the dynamic aspects of it. What are the factors that steers the development of the discourse and are there tangible ways to affect it? In general it is argued that it is extremely hard (if not impossible) to get ideas accepted that run contrary to the sanctioned discourse in a society, which is similar to how hard it is to challenge the ruling scientific paradigm. Kuhn (1962) argues that when new candidate to become a paradigm appears a “paradigm war” (p. 84) occurs in which either the ruling paradigm resist the challenges from the candidate or the candidate succeeds in “ousting” the ruling paradigm. However, paradigm shifts cannot occur until the old paradigm is deemed inadequate and then a total re-evaluation of earlier research is needed. Hence one can say that paradigmatic changes take place as a result of a crisis of the paradigm in currency.

A concept that is related to the scientific paradigm shift is the public policy paradigm shift. A public policy paradigm change can take various forms. Capano (2001) argues that a change in a policy paradigm by necessity also implies some degree of modification on the part of the elements on which the paradigm in use is based. It can either be a substantial change of the paradigm or a gradual adaptation towards a new paradigm. This will depend on the degree to which the basic underlying tenets of the paradigm are affected. As argued by Kuhn it is of importance, if a change is to occur, that an alternative paradigm exist because otherwise the existing paradigm stand a good chance of eliminating the anomalies by means of limited adaptation, which means an re-evaluation of some of its marginal components. In some societies or sectors the openness to advice from “outsiders” is very limited and in such cases the ruling paradigm can be seen to be “hegemonic” (Capano, p. 5-6).

The concept of a hegemonic paradigm is helpful when thinking about sanctioned discourses and how they are apt to change. Certain aspect of what has become the sanctioned discourse in societies are not likely to change (at least not swiftly) if the political elite and other actors that possess social, political and economic capital are in agreement on the content of the discourse. In that sense the sanctioned discourse has a hegemonic inclination. In other cases, when there is a challenge to the sanctioned discourse it can be described as dominant but not uncontested. However, a dominant discourse can still be very strong in terms of creating the boundaries within which policies have to be pursued. Thus an understanding of the sanctioned discourse is helpful for understanding what is politically feasible in a specific context. The importance of political feasibility is highlighted by Allan (2001) as well as by a recent study by the Swedish Ministry for Foreign Affairs (Nicol et al, 2001) both indicating the significance of an understanding of the political context for the application of relevant and acceptable water management proposals.

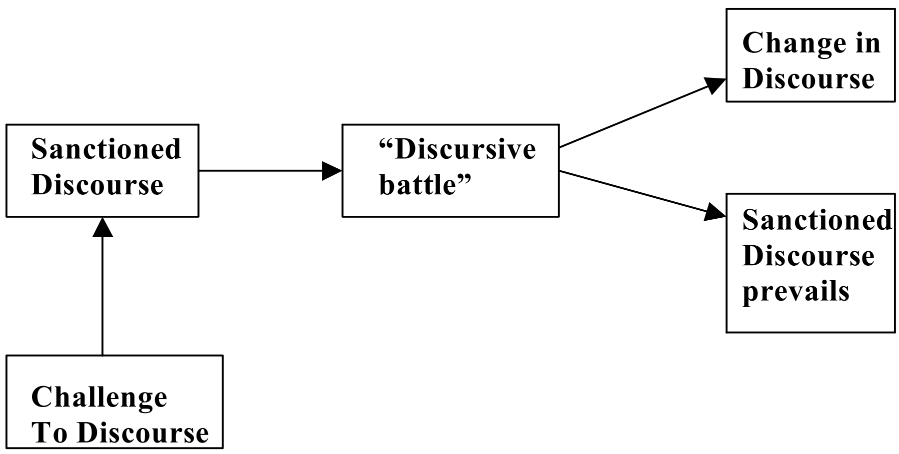

Figure 1. The dynamics of discourse

The figure is an effort to present a schematic picture of the dynamics of the sanctioned discourse.

A *challenge* to the discourse could occur when, for example, a new concept (that is at odds to a lesser or larger extent with the sanctioned discourse) or idea for managing water resources is introduced in a society or state. However, in order to be an *actual challenge* to the sanctioned discourse the challenge must be conveyed from a position that enjoys a certain amount of social, economic and political capital (see Bourdieu, 1986).

The discursive battle is another form of what Kuhn calls a "paradigm war". It can be either a low-intensity struggle or a very intense one. If the challenge to the discourse is put from a position that lacks the essential political and social capital needed to be an actual challenge the sanctioned discourse can effectively resist the challenge. However if the challenge stems from a group or formation with sufficient social and political capital it can be an intense battle. The challenge can be built on, for example, new information, which is a factor that Wegerich (2001) has pointed out as important for institutional change. Nevertheless it is important to remember that the process of change in the discourse is a slow process.

The *outcome* of this discursive battle is, as indicated above either a change in the discourse or the prevailing of the current one. However, one might also say that there is a middle way. Since there is no indication of time frame the discursive battle may last for a long time with a relatively low intensity although it might eventually result in the institutionalisation of a new discourse. Hence how one view the outcome depends on the time frame. Nevertheless, it is here argued that some factors are decisive for the outcome. These are:

1) social, political and economical capital
2) the role of political elites
3) the role of institutions (regimes etc. – however, long time frame)

The various forms of capital, which will not be elaborated upon here in great detail, are identified as being important factors in the development of the discourse in a society. Bourdieu (1986) maintains that dominant ideas and narratives become dominant because the positions from which they are conveyed are characterised by a high level of social, economic and political capital. While *economic capital* is a rather straightforward concept social and political capital needs further explanations. *Social capital*[3] is often broadly thought to be concerned with networks, i. e. the relationships within and between actors in networks and the norms that govern these relationships (Schuller, 2001). Political capital is linked to and can be seen as an extension of social capital. Baumann (2000) argues that 'political capital' deals with the political power relations in a society. Political capital is argued to be an asset that links an individual or a group to power structures.

If a change of a discourse is to happen it involves aspects of change within the networks and relations in a society. If an actor is to effectively influence a discourse he/she needs to possess a strong position in the web of relations that is decisive for the formation of norms in a society. Taking a political capital perspective it is essential with a position in the hierarchy of power in order to be influential and affect the discourse. Intimately tied to the issue of political capital is the role of political elites. In modern societies elites are defined as "creatures of institutions in which the have defined functions offices, or controlling interests." (Marcus, 1983, p. 16) thus connecting the issue of political elites to role of institutions. Jägerskog (2002) in the context of the Jordan Basin and Turton (2001) in the context of Southern Africa argue, from an institutional/regime perspective, that water regimes in a longer perspective can contribute to a change in a predominantly hostile discourse through the institutionalisation of co-operation in the movement from a zero-sum to positive-sum perspectives. The process of water regime creation does not,

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[3] *There is an ongoing debate on the issue of social capital in that there seems to be an emerging consensus that it should be included as a factor of production. See, for example: Woolcock, Michael (2001) "The Place of Social Capital in Understanding Social and Economic Outcomes" in Canadian Journal of Policy Research, Vol. 2, No. 1, Spring 2001. However, in this paper it is the importance of the social capital as a force in the dynamics of discourse that is explored.*

however, materialises by itself but is in general supported by outside actors such as donor organisations or other states. Thus in a long-term perspective it is argued that regime creation is something that can affect a discourse.

In the dynamics of discourse a central concept is Hajer's 'discourse coalitions', which is "a group of actors who share a social construct" (Hajer, 1993, p. 45). Depending on the degree of political, social and economic capital the actors in such a coalition bring in to it these alliances can be very effective both in bringing about a change in the discourse as well as in preventing a challenge to the discourse.

The very brief picture sketched above seems suggests that there are limited possibilities to affect and determine the direction in which a discourse develops. It is necessary to understand the very long-term aspects of the dynamics of discourse.

Case Study– the Middle East[4]

The Jordan River Basin, focusing on Israel and the Palestine Authority is analysed below since it represents a good example of how discourse is decisive for the outcome of the transnational water relations and thereby also river basin hydrosolidarity. In Israel the dominant discourse was determined by ideology from the 40s up until the 70s according to Feitelson (2002). This means a strong emphasis on water being allocated to agriculture since farming was a strong component in the building of the Zionist state. While Feitelson maintains that there has been a shift in the discourse in favour of more economic solutions it is here argued that there is still a strong ideological element in the Israeli discourse as a result of the disproportionate political capital that the agricultural enjoys. One might argue that within the Israeli water sector there was (and still is) a "discursive battle" between those that argue for more of economic reasoning in the water policy, and thus a change of the sanctioned discourse, and those that want to keep the status quo in terms of subsidised water allocations to the farming community. It is argued that the agricultural interests have linked up with the military or strategic interests in Israel, which argue that it is important to keep agricultural settlements in the remote parts of the country as a means of defence (Ben-Meir, 2001). Hence Israeli water policy can be seen as driven by a farming/military discourse coalition to borrow the term of Hajer (1995). The strong political and social capital that both the farmers and the military possess has, consequently, prevented a drastic change in the discourse towards more economic reasoning although, as the water situation deteriorates, the discourse is slowly adapting. The dynamics of the domestic Israeli discourse on water is important as it sets the boundaries for what can be pursued in the international arena.

The Palestinians does also have a strong sanctioned discourse on water which affects the international level. Two main features can be detected. First, Palestinians maintain that in a negotiation with Israel on water the most important thing is to establish Palestinian water rights. After these are established it is possible to discuss other areas (Jägerskog, 2002 and Attili, 2002). The history of conflict, in which the Palestinians have been subject to inequality and repression, and the strong history of farming among

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[4] Part of this section is based on Jägerskog, Anders. (2002) "The Sanctioned Discourse - A Crucial Factor for Understanding Water Policy in The Jordan River Basin" SOAS Occasional Paper, University of London, No. 41

the Palestinians is an integral part of the domestic structure in Palestine. Hence the idea that water rights ought to be the starting point in any negotiation is deeply rooted in the history of the conflict, thus setting the boundaries for what is politically feasible. The second feature is to do with the dominant view among Palestinians that it is almost exclusively because of Israel that Palestine have water problems (Trottier, 1999). This rhetoric is found among academics, water professionals, media as well as government officials. While this is to a certain extent true it is also a result of having been deprived of rights and self-rule by Israel.

The features of the Israeli and Palestinian discourses are effectively setting the boundaries for their respective foreign policy with regards to water issues in the Jordan River Basin. While the features described above, in which strong forces in Israel wants to keep up the volume for Israelis (on the expense of the Palestinians) and the Palestinians do not (in most cases) trust their Israeli counterparts the situation for transboundary co-operation is not particularly positive. Still, on a basin level there exists co-operation. Important aspect for this co-operation to take place are the initial help of economic capital which has come from internatonal donors. The fact that a water regime has become institutionalised, through the Joint Water Committee (JWC), in the basin has also served to draw the parties towards increased co-operation. If a co-operation is started on some level it is likely that this can transform norms and help the parties overcome prejudices over time and thus serve change the sanctioned discourse and to promote an increased hydrosolidarity. Again, this is a very long process that might face several setbacks at times as has happened during the latest intifada.

Conclusion

It is argued that hydrosolidarity in a river basin, to a large extent, is determined by the various sanctioned discourses that guide the water policy of the basin states. Advice and policy proposals that contradict the sanctioned disocurse run the risk of being rejected regardless of how rational and "good" they are. However, it shall be noted that there is also a dynamic aspect of the discourse.

In a transboundary setting, which might be characterised by a high level of conflicting interests by riparians, donors and international organisations can promote water regime creation, through the institutionalisation of co-operation in the form of, for example, a river basin organisation, which has the possibility to slowly transform a hostile discourse towards one in which co-operation becomes sanctioned. Furthermore, in order to promote good ideas and overcome sanctioned discourse obstacles it is possible to create what Hajer calls 'discourse coalitions' which can, if the coalition members possess enough economic, political and social capital, promote hydrosolidarity.

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BALANCING UPSTREAM AGRICULTURE SECURITY WITH DOWNSTREAM AQUACULTURE 'PROSPERITY' - SOME REFLECTIONS FROM INDIA.

by A. Rajagopal

Hydrosolidarity has become an essential requirement for not only water management but also peaceful coexistence of humans in India as there is increasing upstream and down stream conflicts over user of water in many river basins. These conflicts have assumed serious proportions in many cases causing social unrest and communal disharmony among riparian states. In the last decade, there have been reports of violence and deaths on account of conflicts over water rights between upstream and down stream areas in many river basins in India. *Narmadha, Cauvery, Krishna, Godavari* basins are some examples for such incidents. In the case of dispute over water use between Karnataka and Tamilnadu states over *Cauvery* River, there were communal disturbances between two nationalities viz. *Tamils* and *Kannadigas.* In fact several water tribunals were formed and judgments pronounced in many river basin's disputes but solutions are evading for a long time. In the case of *Cauvery*, the problem remains for more than a century. There are also many court cases pending at local levels as regards uses of water, which affect livelihoods of many. All these are clear indications of the hydro animosity among communities, states and nations. These conflicts are related to many aspects of water uses. In this paper we would concentrate on the issue of aquaculture and how is it affected and affects other water uses in a river basin or a catchment.

Aquaculture in India

Aquaculture may be defined simply as farming fish and other aquatic organisms. Fish is used here generally to include all farmed aquatic organisms. Land based systems are commonly integrated with agriculture by stocking fish in rice fields. Water based systems are for raising fish in water bodies such as rivers, lakes, reservoirs or bays. Asia accounts for about 90 % of global production with China dominating the scene. Aquaculture contributes to the livelihoods of the poor through food supply, employment and income. Though there are many aquatic organisms shrimp culture has received more publicity. However, it contributes to 10 % of global production and carried out by better off farmers.

India occupies second position in the world in aquaculture production and contributes to about 7 % of world production. Fishery sector in India provides employment to about 6 million fishers and another six million are employed in fishery related activities. That is about 1 % of the total population depends upon fishery sector in India.

Inland aquaculture has been the major fish producing system in India. Inland production includes catches from rivers, tanks, reservoirs and lakes. Major states, which are involved in inland aquaculture, are West Bengal, Andhra Pradesh, Orissa, Tamilnadu, Madhya Pradesh, Karnataka and Maharastra. Aquaculture is generally dominated by traditional species but there is a tendency for production of high value species like shrimp, which is also environmentally degrading and has come under increasing scrutiny and criticism. Pollution of water and land systems, destruction of coastal habitats and significant socio-economic costs are to be balanced against benefits of exports earnings and 'employment' from this sector. In this paper we deal more of these aquaculture problems and how to balance the human food security and ecological security and sustainability. This is especially important in the context of contradiction between agriculture and aquaculture in many states in India and also some other South East Asian countries.

Shrimp Culture

Shrimp culture in India has begun on a commercial scale only during last four or five years. About 1.2 million hectares of land has been identified as suitable for brackish water aquaculture, of which already about 0.10 million hectares under cultivation. Development of shrimp culture has taken place on a significant extent mainly in Andhra Pradesh, Tamilnadu, Karnataka, Kerala, Orissa, Maharastra, Goa, Pondicherry and West Bengal. Liberalisation of economy, high profitability and good international market are the factors, which have given impetus to shrimp culture boom in India. Shrimp culture has been listed as one of the priority sectors by the government for increasing export and thereby foreign exchange reserves. The government also has chalked out a policy of leasing out its vast land area along the coast on favourable terms to the industrialists. In addition, liberal credit from financial institutions and subsidies from government have encouraged the operations on a large scale. Also the Marine Products Export Development Authority (MPEDA), a government sponsored organization is involved in promotion of shrimp culture. It has set up its research and development units to cater to the needs of shrimp industries. Motivated by high profitability, not only individual companies but also corporate bodies are participating in a large number in shrimp production. Cultured shrimp production contributes to about 25 % of total shrimp supply of 200,000 tons in India. It is seen that while cultured shrimp production is increasing, the production through capture is stagnating. The shift from capture to culture is sign of depletion of national habitats as noted on global level by Csavas. In India, shrimp culture is 100 % export oriented. Of the total sea food export of Rs.25,040 million, shrimp exports constituted about 71 %. Japan is the largest importer of shrimp from India, the share of which is about 44 %. West Europe ranks as second largest market. United Kingdom, Spain, Italy are other countries importing shrimp from India.

Impact of Aquaculture on Local Economy

Fast developing aquaculture has already made its consequences on local economy and environment. Apart from wastelands, fertile agricultural lands are also bought. Not only private lands but also village commons have been encroached by them. These include pasture lands, canal and stream banks, burial grounds, common land used by fishers for drying of nets, foot path etc. Purchase of agricultural lands on a large scale has boosted artificially the value of lands several times in these regions. It is reported that one acre of land which was about Rs.2500 in 1991 has increased to about Rs.1,00,000 in 1994. Tempted by these spiraling prices, even small and marginal farmers have sold their lands thus losing their only source of livelihood. In some areas farmers were compelled to sell their lands as they found it difficult to carry on cultivation operations since aquaculture ponds surrounded it. In such cases, they were offered only less prices than the prevailing market price. Conversion of agriculture lands into prawn has affected the employment opportunities of thousands of agricultural labourers most of them belonged to depressed castes. Moreover paddy is the main crop cultivated in these areas which is more labour intensive compared to other crops. Hence conversion of paddy lands into prawn farms has affected the employment opportunities for agricultural labourers on a massive scale. The problem is particularly important for women agricultural labourers as they use to get employment in many operations of paddy cultivation such as transplantation, weeding and harvesting. Conversion of paddy lands into prawn farms has not only displaced agricultural labourers and poor peasants but also affected rice production in the area.

Ecological Impact of Shrimp Culture

Like that of many Southeast Asian countries, unregulated shrimp culture has resulted in ecological degradations in India. These problems are common both for agriculture and fishing communities. A major problem noted is pollution and salinisation of drinking water in many villages. Excessive pumping of ground water along the coast for the purpose of salinity control in the ponds has resulted in intrusion of sea water. Also storing of sea water in ponds continuously for many months has turned the ground water saline through seepage. Seepage of saline water from prawn farms has led to acidification of soil of nearby agricultural lands. Thus there is a danger that most of the fertile lands would become barren after few years. It is found that effluents which contain chemical fertilizers, antibiotics and toxic elements are discharged from prawn ponds polluting nearby estuaries, canals and tanks. Discharge of effluents also causes death of fish in estuaries reducing the availability of stock, especially shrimp seeds, for those who are depending upon them traditionally. Yet another ecological implication of shrimp culture is destruction of forests along the coast leading to deforestation. It is found that trees like coconut, palmyrah, tamarind and casurina are cut to make fish farms. Destruction of mangrove forests has also been reported to a significant extent. As a result the coastal area is now more prone to ravages of cyclone, which already affects the east coast often. Destruction of trees has also created fuel problem for local people who have depended upon them traditionally for their fuel requirements.

Thus the downstream aquaculture has created adversity in agriculture in the upstream in the guise of ‘prosperity’ in downstream. There were protest movements in many states and filing of court cases for remedies. The Supreme Court has ordered for regulation of these farms and Government of India has passed an Act for better management of these catchments. However the problem continues, as not adequate efforts taken by government for proper regulation of these farms. Most of these farms are run by big companies and they evade all the rules and regulations prescribed under this Act. Hardly there were any efforts for involving the stake holders-agriculturists, shrimp farmers, companies, fisher folk, trade unions, NGOs, and government – in the process of negotiations.

In the foregoing description we have seen the impact of shrimp aquaculture on local economy and environment especially how they affect water systems in lakes, tanks and under ground. It is also seen that the shrimp culture affects agriculture through conversion of paddy lands in to aqua-farms and degradation of agricultural lands after some time. In another situation it is seen that the water use for agriculture affecting aquaculture mainly fresh water aquaculture. In this case, the competition between irrigation and aquaculture affecting the later. This occurs through damming of rivers, which affects downstream flow affecting fishers who are depending upon it for their livelihood.

The best way for ensuring of hydro solidarity in a catchment is through the process of dialogue and negotiation of issues including water rights among different stakeholders. Multi Stakeholders Dialogue (MSD) is a well recognised concept in the river basin management and advocated by United Nations Organisations. In fact, FAO has already prescribed effective procedures under Article 8 of code of conduct for responsible aquaculture. There are already some basin level organization established in India, for addressing the upstream/downstream issues, however most of them were defunct mainly because of the inactive dialogue process involved. It is to be noted here that the National Water Policy framed by the Government of India in April 2002 also did not recognize explicitly the importance of dialogue process in balancing of different interests in a catchment. The problem is not peculiar to India but prevalent in many South East Asian countries.

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A NEW APPROACH TO THE JOINT MANAGEMENT OF RIVER BASINS IN THE LAKE VICTORIA BASIN

Nile Equatorial Lakes Subsidiary Action Program
NELSAP

by Antoine Sendama and Jacob Granit

Preamble

Thank you for inviting me to speak at the annual SIWI Seminar to try to capture what is an emerging multi-country river basin management process in the Lake Victoria Region within the framework of the Nile Basin Initiative. I understand my contribution today as an illustration of what is taking place on the ground between countries sharing a river basin. My contribution will hopefully add to the conceptual framework that have been discussed by previous speakers today and open up for a dialogue by providing some thoughts on these processes.

I have the fortunate position to coordinate and facilitate the Nile Equatorial Lakes Subsidiary Action Program (in short NELSAP), which is a sub-program under the Nile Basin Initiative. In this position I have the opportunity to work closely with the riparian countries in supporting them in their endeavor to jointly manage their natural resources for sustainable economic growth. This is a unique position and I can only try to present to you the processes they have initiated.

I come from Rwanda myself, a small and mountainous country, lying in the extreme southwestern part of the Nile Basin and contributing flow to Lake Victoria. It is situated between the Congo and Nile Basins, with about 80% of the land area in the Nile Basin. Essentially agricultural, Rwanda is ranked amongst the poorest indebted countries, classified at the 164^{th} position over 174 poorest countries of the world. In this small country, water is regarded as common good but faces, as many other countries in the region, many problems, unequal distribution in time and space, lack of public awareness of the value of water and the link of health issues and sanitation, inefficient use of water in agriculture, lack of effective legal framework regulating industrial water use, insufficient investment in the sector, etc. This is to tell you that I am well aware about the need to better manage our shared water resources.

1. Introduction

In my presentation, I will, **first of all**, provide an overview of the Nile Basin Initiative, so as to highlight its characteristics, **secondly**, discuss the emerging cooperation at the sub-basin level in the Lake Victoria Basin. **Finally**, provide some early emerging conclusions on this growing cooperative framework. The presentation does not dwell on the general discussion on international river basins as most of you, are familiar with the need for such an approach. Instead, the focus is on the real actions on the ground.

Before I move into the core of my presentation I would like to say that the issues discussed in this seminar – human security and ecological security – perhaps have a different interpretation in the part of the region I represent. Why? you may ask considering that these aspects should have a global and more general meaning for all? Human security in the Great Lakes Region is strongly linked to poverty, which is fueling conflicts at local and sub-regional levels. These processes may relate to the management of water to some extent but there is a whole other set of causes that creates in-security in my region. However, let us limit the discussion to water resources.

The relevant question, in my opinion, would be how much water resources management at the local, national and regional level can contribute to reduce the level of poverty and create peace and stability?

Using Rwanda, as an example, we can not afford to undertake investments in areas that are regarded as not providing real value for the poor. The rationale for improved water resources management is for Rwanda, and I assume for the other countries in the Lake Victoria Basin as well, to contribute to sustainable economic growth and poverty alleviation. This can only happen if the river basin management processes (or catchment management processes) we support lead towards real investment in growth generating activities. This may include irrigated agriculture, hydropower development, water for industry and domestic use and the protection of ecological interests – in other words benefits that reach far beyond the catchment itself.

2. The Nile Basin Initiative – a regional framework for development

The NBI framework is critical to the development, on a catchment basis, in the Nile Equatorial Lakes Region. It provides a good example of the necessity to address regional and perhaps even global concerns in supporting sound catchment management since much of the water resources are in the Nile Basin.

The Nile is one of the world's greatest assets. Throughout history, the river has nourished livelihoods, a multitude of ecosystems, and a rich diversity of cultures. Ten countries share the Nile: Burundi, Democratic Republic of Congo, Egypt, Ethiopia, Eritrea, Kenya, Rwanda, Sudan, Tanzania, and Uganda. The Basin encompasses an area of 3 million square kilometers (one tenth of Africa's total land mass or about five times the size of Sweden) and the countries of the Nile serve as home to an estimated 300 million people. Today, the region is characterized by poverty, instability, rapid population growth, and environmental degradation. Four of the Nile Basin states are among the world's ten poorest countries. However, in spite of the current situation today, the Nile holds significant opportunities for cooperative management and development. Such cooperation might also serve as a catalyst for greater regional integration outside the Nile Basin itself, with benefits far exceeding those derived from the river only.

Recognizing that cooperative development holds the greatest prospect of bringing mutual benefits to the region, the Nile riparians took a historic step in the establishment of the Nile Basin Initiative in1999. The NBI is an initiative that includes all Nile countries and provides an agreed basin wide framework to fight poverty and promote socio-economic development in the region. The Initiative is guided by a Shared Vision "*to achieve sustainable socio-economic development through the equitable utilization of, and benefit from, the common Nile Basin water resources.*"

The Nile countries seek to realize their Shared Vision through a Strategic Action Program, comprising basin-wide projects, as well as joint investment projects at the sub-basin level. The basin-wide Shared Vision Program is a broad based program of collaborative action that seek to exchange experience, build capacity and trust and create and enabling environment for investments on the ground.

A set of seven basin wide projects are addressing issues common for all the riparians such as transboundary environmental concerns, regional power trade, agricultural production, water resources planning and management, communication, applied training, and socio-economic development and benefit-sharing. The seven projects have been endorsed by the Nile Council of Ministers of Water Affairs, which is the governing body of the Nile Basin Initiative. Several of the projects are now in the early implementation stage with funding from the international community on a grant basis.

At the same time, groups of countries - one in the Eastern Nile and another in the Nile Equatorial Lakes region - have identified joint, and mutually beneficial investment opportunities at the sub-basin level. They try to develop these investment opportunities by collaborating in two Subsidiary Action Programs.

The first program **- the Eastern Nile Subsidiary Action Program -** includes the three countries of Egypt, Ethiopia, and Sudan. The approach they have chosen to reach towards joint investments is to develop one regional and integrated multi-purpose program through a first set of sub-projects. The three countries have identified seven sub-projects again in the key areas for developments such as integrated water resources management, flood management, power generation and interconnection, and irrigation and drainage. All these projects are in a pre-preparatory stage.

The other program - **the Nile Equatorial Lakes Subsidiary Action Program (NELSAP)** - includes the six countries - Burundi, D.R. Congo, Kenya, Rwanda, Tanzania, and Uganda as well as the two downstream countries Egypt and Sudan who are directly affected by development up-streams. NELSAP has a small office, which is based at the larger NBI Secretariat in Entebbe, Uganda.

The NBI and the two Subsidiary Action Programs are in this early stage of development in need of external support and funding. Should the region develop economically and cooperation between the ten riparians materialize in earnest, the need for external assistance should gradually reduce. Today the NBI enjoy strong support from the international community. Initial partners supporting the Nile Basin Initiative include the World Bank, United Nations Development Program, and the Canadian International

Development Agency. A much larger list of donors has joined these initial 'cooperating partners' including the Swedish Development Cooperation Agency, Sida.

Sustaining the Nile cooperation requires a permanent institution, and an agreement on core legal principles including a strong development focus to maintain the cooperative spirit. To meet that objective the Nile riparians has established a forum for a process of legal and institutional dialogue. The forum has prepared a draft text of a new 'Cooperative Framework', which encompasses general principles, rights and obligations, and an institutional structure. This draft framework has moved the riparians a long way and important compromises have been reached on the future management of the common Nile waters. However, some key issues remain to be resolved, and the Council of Ministers had directed the legal experts to continue seeking further agreement on the outstanding issues.

The NBI provides a unique forum for the ten countries of the Nile to move forward a cooperative process to realize tangible benefits in the Basin and build a solid foundation of trust and confidence. The alternative would be unilateral actions, which could lead to increased tensions and even conflicts. The decision making process is strong with the Nile-Council of Ministers for Water Affairs serving as the highest decision-making body. The core costs of this structure is supported by the Nile Basin countries through payment of annual dues.

3. The Nile Equatorial Lakes Subsidiary Action Program – moving towards investments on the ground

The Nile Equatorial Lakes Subsidiary Action Program (NELSAP), is one of the two investment programs within the framework of the NBI. The program provides an example of how riparians are moving towards catchment planning and management in the Lake Victoria Region.

The Nile Equatorial Lakes Region, NEL, is a region whose water resources include one of the world's great complexes of lakes, wetlands, and rivers. The sub-basin includes the headwaters of the White Nile, which are located in the upland plateau, from which water flows northwards via lakes and rivers to landforms at lower altitude. There are strong hydrological and environmental interactions between the individual hydrological units comprising it. The water resources of the sub-basin are central to the sustenance of unique natural ecosystems, and to the support of its people.

Challenges

The region is characterized by economies dependent on rain-fed agriculture where subsistence farming prevail and where there is a low level of industrialization. At the same time there is high population growth and poverty.

As mentioned earlier, there is a provision to develop a Nile Equatorial Lakes Subsidiary Action Program (NELSAP) within the NBI framework to begin to tackle the issue of water resources management in a broader context. The NELSAP provides such an opportunity.. The first steps to develop the program was taken at a meeting of Ministers and other representatives of the concerned Nile riparian countries of the Nile Equatorial Lakes region in Arusha in 1999. The preparation and monitoring of the program follow the same format as the NBI with a Council of Ministers of Water Affairs, a Technical Advisory Committee and small Secretariat to support and facilitate the process.

The objective of NELSAP, as defined by NEL-COM, is *to contribute to the eradication of poverty, to promote economic growth, and to reverse environmental degradation.* The process of establishing NELSAP consists of five major sets of activities: (i) in-country level analysis and project identification; (ii) inter-country project conceptualization; (iii) preparation of joint Project Identification Documents (PIDs) for submission to the international community for funding (iv) preparation of detailed project proposals, and finally (v) implementation of these instrumental proposals.

The process to establish NELSAP has from the outset been based on the NBI Guidelines that stress the following aspects of project preparation and implementation:

- planning at the lowest appropriate level;
- involving all who are affected;
- building on principles of equitable utilization, no significant harm, and cooperation
- benefiting all involved;
- distributing benefits, costs and risks equitably and using available resources efficiently; and,
- protection of the environment.

During the course of this process there were three types of programs identified: First of all two on-the-ground investment programs addressing efficient water use in agriculture and power development and trade. Two natural resource management programs addressing sustainable fisheries management in Lake Albert and Lake Edward and water hyacinth abatement in the Kagera River Basin. The third an final program is a water resource management and development program consisting of three projects, dealing with serious existing problems in small to medium river basins within the NEL sub-region and shared by two or more riparians. At this stage we have moved into the detailed preparation phase of the three water resources management projects with support of Sida and NORAD and are beginning the detailed preparation of the power development program.

The development and implementation of the water resources management program followed the key principle of consultations, including consultations with all the regional institutions and programs as well as the donors supporting different initiatives and projects in the region. This to make sure that there is synergy and complementarity between all the regional activities. In the case of preparing NELSAP this has included, for example, the East African Community and the Lake Victoria Management Project (LVEMP).

The three shared river basin management projects will support the development of new and effective mechanisms of joint water resources management and planning, and the provision of the hydrological infrastructure necessary for management decision-making between countries. These activities will lay a common ground for future national and international investments in water resources development. The projects thus focus on the creation of an enabling environment for investments. The three projects are:

- **Development of a Framework for Cooperative Management of the Mara River Basin**. The objective is to prepare for sustainable investments on a national and international level. The basin is shared between Tanzania and Kenya and is the site of conflicting development, and of two of the world's great wildlife parks.

- **The Kagera River Basin Integrated Water Resources Management Project**. This river basin is shared between Burundi, Rwanda, Tanzania, and Uganda, and is the site of much land degradation, but also of important development opportunities such as the Rusumo Falls Hydropower project. A coordinated framework is needed to realize these shared development opportunities, and

- **The Sio-Malaba-Malakisi Water Resources Management Project**. The objective of this project is to establish a sustainable framework for joint management of the shared water resources of these three adjacent basins fed from the slopes of Mt. Elgon, and shared between Uganda and Kenya. A joint management framework is needed in order to deal effectively with the competition for water for grazing cattle that has been the cause of intermittent transboundary conflict between peoples in the Malakisi Basin. The project includes small-scale investments for domestic and livestock water supply.

As mentioned, we have now reached the stage of detailed preparation of these three projects and important steps have been taken in the right direction. During last month (July 2002) the five riparian countries sharing these river basins met in Entebbe, Uganda and established two Regional Project Steering Committees (RPSC) to oversee and guide project preparation and subsequent implementation. From each country concerned there are three senior government officials participating in the RPSC. The RPSCs are a prerequisite for successful planning of these projects. The countries are now ready to prepare the projects in detail which no doubt will lead to real project activities on the ground and then to the desperately needed investments.

4. Conclusion

The new approach to the joint management of river basins that have been presented has, as its starting point, the needs at the local level, but covers aspects of global, regional, national, and sub-national policy making processes. Reaching upstream/downstream hydro solidarity in a cathment involves all these aspects to some extent.

In the case of cooperation at the catchment level in the Nile Equatorial Lakes Region, it is recognized by the riparian states that they have to cooperate and discuss the overall use of the river systems with each other to reach win-win solutions and to avoid unilateral actions that may cause tensions and even conflicts.

The process is painstakingly long and we have not seen the final outputs yet. However, the will is there and the signs are promising but the process is fragile.

To summarize the NBI/NELSAP experience to illustrate the complex process of balancing human and ecological security in a catchment, I would like to stress the following aspects:

- The need to move towards a basin wide framework of cooperation with all the riparian countries participating,
- The need to focus on the politics of the basin and sustaining commitment,
- The need to focus on investments to promote sustainable economic growth early,

- The need to engage key stakeholders at all levels but at the right time in the process, and
- The need to maintain opportunities to meet frequently and engage each other in dialogue on joint development opportunities to share benefits in a larger context.
- The need to work at the global level and engage international financiers to support the processes.

This new approach to joint management of river basins is not easy since it tries to integrate and analyze societal forces and policy making from the global to the local scale. We will still have to see if it works in real life.

Thank you

FROM TAKING, TO CAPPING TO RETURNING : THE STORY OF RESTORINGENVIRONMENTAL FLOWS IN THE MURRAY DARLING BASIN IN AUSTRALIA

by John Scanlon

1. The Federation of Australia

In 1901 six separate colonies federated to become the Commonwealth of Australia.The process of federation was almost derailed by a dispute over how the new constitution should address the sharing of the waters of the River Murray between the (then) colonies of New South Wales, Victoria and South Australia. The Colony of South Australia, the downstream colony, had argued for the Commonwealth to be given the power to manage the waters of the River Murray, which was fiercely resisted by the upstream colonies. South Australia's principal interest at the time was navigation and while it was not successful in including a power for the Commonwealth over the River Murray, it was successful in ensuring the Commonwealth had power over navigation. The Commonwealth was not however given any specific head of power to deal with the River Murray, or with water resources or the environment more generally.[5]

The history of the creation of Australia and the constitutional sharing of powers between the States and the Commonwealth has had a significant influence on the measures that have been taken over the past 100 years to manage the shared resources of the Murray Darling Basin. This has resulted in a co-operative approach being adopted and the collective efforts of the Commonwealth, the States of South Australia, Victoria, New South Wales, Queensland, and the Australian Capital Territory, together with the community, is known as the Murray Darling Basin Initiative (the Initiative).[6] This cooperative approach continues today.

The Commonwealth's most effective tool in addressing environmental issues to date has been through the use of its financial strength, which it has used to bring about desired change.[7]

In a clear departure from taking a co-operative approach, the Commonwealth legislated in 1999 to create new Federal environmental legislation, the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act), through which the Commonwealth asserted the full extent of its Constitutional powers, to take a stronger leadership role in relation to environmental issues of 'national environmental

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[5] *Section 100 of the Constitution provides that the Commonwealth shall not "by any law or regulation of trade or commerce, abridge the right of a State or the residents therein to the reasonable use of the waters of rivers for conservation or irrigation", a provision that has never been fully tested. The Commonwealth has used many other heads of power to legislate on environmental issues, including legislating for the domestic implementation of international treaties under its 'external affairs' power.*

[6] *For more information see: www.mdbc.gov.au*

[7] *In particular through the implementation of the National Competition Policy and the Natural Heritage Trust.*

significance'.[8] The EPBC Act applies to the whole country, not just the Murray Darling Basin, and involves an assessment and approval process for actions that may have a significant impact on identified matters of national environmental significance, including Ramsar listed wetlands, nationally listed threatened species and threatened ecological communities and nationally listed migratory species.

2. The Murray Darling Basin – some basic facts

The Australian Aboriginals were the first to discover the bountiful resources of the Murray Darling Basin, more than 70,000 years ago. The Basin and its floodplains shaped, and is part of, their beliefs and lives. The Basin has also shaped important elements of modern Australian history, and as the nation's first great transport network, fostered the development of towns and agricultural industry.[9]

The Murray Darling Basin spans across much of five jurisdictions, is over 1,000,000 million square kilometers in area, or 14% of Australia, home to two million people and Australia's most productive region for irrigated agriculture (with over 70% of all of Australia's irrigated agriculture occurring within the Basin). The City of Adelaide, with a population of over one million, relies on the River Murray for up to 90% of its water supply in drought years. Today the Basin enriches Australia by an estimated $23 billion per year. Agriculture produce now exceeds $10 billion, mining $3 billion, tourism and leisure around $6.5 billion, electricity $0.3 billion and commercial fishing and other industries $2,5 billion.

The Murray River is approximately 2,500 kilometers in length, commencing in the Snowy Mountains of New South Wales, entering the sea at the Coorong on the southern coast of South Australia. The Darling River, Australia's longest, is approximately 2,740 kilometers in length, from its source in the south east of Queensland to its confluence with the River Murray at Wentworth.

Basin run off prior to regulation was approximately 24,000 GL, and today diversions account for about half of the annual runoff, with about a quarter reaching the sea. Flows to the sea from the mouth of the River Murray are today 27% of natural (pre development) flows.

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[8] *See Scanlon and Dyson, Will Practice Hinder Principle: Implementing the EPBC Act, EPLJ, Volume 18, February 2001 at page 14.*
[9] *See The Living Murray Discussion Paper, July 2002 at page 13. See www.thelivingmurray.mdbc.gov.au for the full text.*

THE BASIN IN EACH STATE AND TERRITORY[10]			
State	**Percentage of Basin**	**Percentage of State**	**Total Diversions**
Queensland	24.55	14.63	5.4 % or 611 GL
NSW	56.65	74.79	54.5 % or 6194 GL
Victoria	12.32	59.96	33.9 % or 3858 GL
South Australia	6.49	6.98	5.9 % or 667 GL
ACT	0.22	100	0.4 % or 44 GL

3. Interstate Agreements to Manage the Shared Resources of the Basin

The first agreement was between the States of New South Wales (NSW), Victoria, South Australia (SA) and the Federal (or Commonwealth) Government (ratified by legislation in each jurisdiction) in 1914, known as the River Murray Waters Agreement. This agreement, which took almost 15 years to negotiate,[11] dealt principally with the sharing of the waters of the stem of the River Murray between NSW, Victoria and SA.

The Agreement has evolved over the years, and in 1985 an agreement known as the Murray Darling Basin Agreement was signed, which:

- expanded the focus from the stem of the River Murray to the whole of the Basin;
- included natural resource management across the entire basin, with an increased focus upon water quality as well as quantity; and
- established a Ministerial Council as the peak policy body under the Agreement.

This current agreement is dated 1992[12] and in 1996 the upper most State, Queensland joined the Agreement, and the Australian Capital Territory agreed to participate in certain aspects of the Initiative through a memorandum of understanding in 1998 (with Canberra being the only capital city within the Basin itself).

The purpose of the current Agreement is to "promote and coordinate the effective planning and management for the equitable efficient and sustainable use of the water, land and other environmental resources of the Murray Darling Basin."[13] This broad focus on the sustainable use of all of the environmental resources of the Basin is reinforced throughout the Agreement.

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[10] *Sources: P Crabb, Murray Darling Resources, MDBC 1997 and MDBC, Murray Darling Cap on Diversions Water Year 1997/98.*
[11] *The River Murray Commission established under the Agreement did not meet until 1917.*
[12] *And was ratified by legislation in all participating jurisdictions in 1993.*
[13] *Clause 3(2) requires any provision of the Agreement to be interpreted in a manner that promotes the purpose or object underlying the Agreement.*

In its broadest sense the Initiative involves two separate but related issues, namely:

- The sharing and distribution of the waters of the River Murray between NSW, Victoria and SA in accordance with the Agreement; and
- The development of policies and programs to promote the integrated catchment management of the Basin.

The institutional arrangements for the Initiative are set out in the Agreement.

4. Institutional Arrangements for the Murray Darling Basin

The institutional arrangements are:

- The Ministerial Council – the peak policy making body under the Agreement;
- The Commission – the body responsible for administering the agreement and providing advice to the Council;
- The Community Advisory Committee – established by the Ministerial Council in 1986 to provide community views directly to the Council; and
- The Office of the Commission – the secretariat of the Commission, holding a wide array of delegated authority.

4.1 The Ministerial Council

The Ministerial Council was established in 1985 and is responsible for considering and determining major policy issues of common interest. It is the peak body under the Initiative.

The Council consists of up to three Ministers from each State and the Commonwealth and one from the ACT (who has observer status). Members are drawn from Ministers who have prime responsibility for matters relating to water, land and environment[14] and the Commonwealth Chairs the Council, traditionally through the Minister with responsibility for agriculture.[15]

The Initiative is in effect an inter jurisdictional compact between the Commonwealth and States that provides a means for dealing with matters of common interest. It requires high-level political engagement and the establishment of the Ministerial Council in 1985 represented a significant step forward in managing the Basin as it provided a regular forum for this to occur.

The achievements of the Ministerial Council over the last 15 years stand in stark contrast to the achievements made over the first 15 years of federation. They are testament to the strength of the Federation of Australia.

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[14] *See Clause 8(3) of the Agreement.*

[15] *The current Chair being Minister Warren Truss, Federal Minister for Agriculture, Fisheries and Forestry*

The major achievements of the Ministerial Council include[16]:

- ***The 1988 Salinity and Drainage Strategy.***

  From 1975-85 salinity levels when measured at Morgan exceeded 800 EC units 42% of the time. As a result of the implementation of the Salinity and Drainage Strategy, including groundwater management schemes costing $50 million, salinity levels currently exceed 800 EC units 8 % of the time, with average salinity being 520 EC units.[17]

- ***The 1995 Cap on water diversions.***

  This is the most significant decision ever taken by the Council, through which all jurisdictions voluntarily agreed to cap their own diversions form the Basin.[18]

- ***The 1997 Pilot Program for permanent interstate trade.***

  This has allowed water to move to more valuable uses and has meant that the cap on diversions has not been a cap on development.[19]

All major achievements, but quite clearly more needs to be done.

4.2 The Community Advisory Committee (CAC)

The Ministerial Council established the CAC as a Committee in 1986. It is responsible for providing direct advice to the Ministerial Council on matters referred to it by the Council and Commission, and to provide advice on the views of the Basin's communities.

The CAC is comprised of an independent chair and 26 members, 21 of who are chosen on a catchment or regional basis. Of the remaining five members, four are drawn from four peak non-government groups and there is an appointee to provide an individual Aboriginal perspective.

Under the leadership of current Chair,[20] the CAC has been an active, independent, and powerful community voice in providing an alternative source of advice to Council. Members also actively participate in Commission working groups and committees.

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[16] *Other more recent initiatives that could be referred to include: The MDBMC, 1999 Salinity Audit, MDBMC 2001 Basin Salinity Management Strategy and MBDMC 2001 Integrated Catchment Management Strategy.*

[17] *See 1999 Salinity Audit at pages 11-13.*

[18] *Queensland has agreed to a cap on diversions but is awaiting the finalisation of its water resources plans before it agrees on the level of diversions.*

[19] *See Dyson and Scanlon, Trading in Water Entitlements in the Murray Darling Basin – Realizing the Potential for Environmental Benefits, IUCN ELP Newsletter, Issue 1, 2002 at page 14 (available from www.iucn.org/themes/law).*

[20] *Leith Boully.*

4.3 The Murray Darling Basin Commission

One can trace the Commission back to 1917. Up until 1985, the Commission was the peak body under the various Agreements. Since then the Commission has answered to the Ministerial Council.

The current Commission was established under the 1992 Agreement and it requires each government to appoint two Commissioners who between them represent "water, land and environmental resource management."[21] Two Deputy Commissioners are also appointed by each government. The ACT has observer status.

Traditionally, State Commissioners have been the heads of relevant State government departments, and Commonwealth Commissioners have been deputy level secretaries of the relevant Commonwealth departments.[22] An independent President, appointed by unanimous vote of the Ministerial Council, chairs the Commission.

The Commission is responsible for:

- Providing policy advice to the Ministerial Council and giving effect to decisions of the Council.[23]
- Administering the Agreement, including the sharing and distribution of the waters of the River Murray, oversighting and directing the implementation of approved works and measures, and coordinating efforts at achieving integrated natural resource management across the Basin.[24]

The Agreement requires the Commission to examine the possible effects that the exercise of its powers or functions, or the implementation of works or measures, is having on the water, land, and other environmental resources of the Basin. In doing so it may have regard to the need to give directions that will improve water management and environmental objectives consistent with the overall framework established for the distribution of waters.

The Commission does not own any infrastructure or any land, which is all owned by the Contracting Governments, normally through the Constructing Authorities. The Constructing Authorities build, own, and operate the joint works and measures that have either been included in, or subsequently agreed through, the Agreement for and on behalf of the Commission. The Council or Commission therefore authorises the joint works and measures[25] but is not

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[21] *See Clause 20(2) of the Agreement.*

[22] *The author is not aware of any non public servant being appointed to the Commission, other than the head of corporatised bodies such as Goulburn-Murray Water and SA Water. This has been by tradition rather than being required by the Agreement.*

[23] *The Commission also supports a significant investigation, research, development, and education effort and seeks to maximise the return on public investment in natural resource management by coordinating the many different funding programs that operate in the Basin.*

[24] *It also has a role, inter alia, in considering and commenting on proposals that may "significantly affect the flow, use, control or quality of water" in the River Murray. See clause 46 of the Agreement.*

[25] *And the Commission subsequently declares them to be 'effective' and monitors their ongoing operation.*

responsible for their implementation, which is carried out by a nominated Contracting Government.[26]

4.4 The Office of the Commission

The Office is not specifically recognised in the Agreement, but the Commission has the power to employ staff, which it does through the Canberra based Office of the Commission.

This Office of around 70 highly skilled staff, has been a key driving force of the Initiative and has played a vital role in helping the Initiative get through some difficult challenges.[27] The Office also provides support to the Ministerial Council, the Commission and the CAC.

The work of the Office is separated into River Murray Water, an internal ring fenced business unit to manage the sharing and distribution of water in accordance with the Agreement, and Natural Resource Management. Since 2001, an Environmental Manager has been appointed to the Office to closely monitor the environmental aspects of water options for the River Murray and its tributaries, and to provide the Commission with advice on how any arrangements could be better coordinated.

5. Major Challenges Confronting the Basin

The management of the River Murray, and subsequently the Basin, has been a challenge since well before federation. The challenges have steadily increased as development pressures, and consequential environmental and social pressures have risen. Challenges being experienced today include:

- Irrigation induced salinity - an issue that was first seriously addressed through the Salinity and Drainage Strategy of 1988.
- Dryland salinity - a far more serious problem than irrigation induced salinity due to its Basin wide impacts, the scale of the threat and the limited options for its amelioration.[28] (The Federal Government has taken a national approach to tackling this Australia wide problem through the National Action Plan on Salinity and Water Quality).
- Operating in the context of increasingly sophisticated water markets - managing water trading to balance competing economic, social and environmental demands on the system.
- Managing environment flows for a healthy system - possibly the most important issue for the next decade, which will involve significant changes to both the quantity of water left in river and the management of flows for enhanced environmental benefit.

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[26] *This may become important in the context of the application of the Commonwealth Environment Protection and Biodiversity Conservation Act 1999.*

[27] *Much to the credit of Chief Executive, Don Blackmore.*

[28] *A Vegetation Bank has been proposed by the Ministerial Council to accelerate the development of plantations in highly effected priority areas. See 1999 Salinity Audit.*

- Higher community expectations and changing community values - including a call for greater transparency in the operation of the Commission.

6. Environment Flows – the Evolution

6.1 The Taking Years

The decades leading to Federation and up to the time of the Cap on diversions were decades of taking, with little comprehension in many areas of the limits to taking for consumptive uses.[29]

Governments and the Australian public actively supported irrigation for over 100 years, which has generated great prosperity for the nation and its communities. Diversions grew from the 1870's but the rate of growth grew sharply in the 1950's and 1960's. For example diversions tripled in the 50 years to 1994. Amongst other matters, irrigation was seen as a means of increasing the intensity of farming which allowed schemes for the settlement of returned soldiers from the First and Second World Wars.[30]

6.2 The Decision to Cap Diversions

During the mid to late 1980's and early 1990's there was a growing recognition that there needed to be a better balance achieved between taking for consumptive uses and providing for non consumptive use, resulting in the decision taken by the Ministerial Council in 1997 (following an interim decision in 1995) to cap diversions from the system at 1993/94 levels.

This decision was brought about by several factors, which are discussed below.

6.2.1 The Water Audit Report and the Independent Audit Group

In 1995 the Ministerial Council completed an audit on the level and rate of growth of water extractions from the Murray Darling Basin.[31] The results of the Audit demonstrated that the increasing levels of diversions from the system could not be sustained. This resulted in a decision by the Ministerial Council in 1995 that a balance needed to be struck between consumptive and in steam uses of the rivers of the Basin, and a decision to place an immediate moratorium on further diversions, while the precise details of a future cap could be determined. The decision was to place an interim cap on the volume of diversions associated with the 1993/94 levels of development.

The Council established an Independent Audit Group in 1996 to investigate and report on the progress in implementing the Cap, the effectiveness and consistency in approach between the States in implementing the Cap, equity issues that needed to be resolved

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[29] With some notable exceptions, such as the State of South Australia which capped diversions in 1960.

[30] See Hallows and Thomson, The History of Irrigation in Australia, Australian National Committee on Irrigation and Drainage, Mildura.

[31] This report was triggered by a paper presented in June 1993 by the (then) Lead Minister for South Australia, Minister Klunder, on The Changing Demands for Surface Water in the MDBC, to recognize that the over commitment of surface water represented a problem of high priority requiring urgent political direction.

and options for resolving inconsistencies and equity issues. The Report of the Audit Group formed the basis of the decision to implement a permanent cap in 1997, together with the final details of the Cap.

The decision to implement the Cap was seen as a vital step to ensuring security of supply to existing users and to establishing a cross border water trading regime.

The Cap on Diversions

The Cap on diversions was introduced in 1995 and limits the amount of water extracted from the Basin's rivers. In regulated rivers diversions are limited to what would have been diverted under 1993-94 levels of development. In unregulated rivers the Cap may be expressed as an end-of-valley flow regime.

The Cap has been applied in this way, with small variations, in NSW, Victoria and South Australia which combined account for 94 per cent of the Basin's diverted water. Queensland and the ACT take a total of 6 per cent, and their Cap and the way it is determined has not yet been finalised.

The Ministerial Council implemented the Cap as a way a first step towards striking an appropriate balance between the economic and social benefits obtained from the development of the Basin's water resources, and the environmental uses of water in the rivers.[32]

6.2.2 The Impact of National Competition Policy

The decision to cap diversions was given further support through the National Competition Policy, April 1995[33], an agreement between the Commonwealth and State and Territory Governments to progress a nationally coordinated approach to microeconomic reform in return for a series of national competition tranche payments, based upon the effective implementation of the reform agenda.

The reform agenda included so called 'related' reforms,[34] including the strategic framework for the reform of the Australian water industry, adopted by all Australian governments in 1994. Through including the 'related reforms', the National Competition Policy entrenched the following issues on the national agenda:

- Identifying and managing assets;[35]
- Efficient pricing;
- Trade in water rights;

[32] *Source: The Living Murray Discussion Paper at page 17.*
[33] *See National Competition Council, Compendium of National Policy Agreements – Second Edition, June 1998.*
[34] *See National Competition Council, Compendium of National Policy Agreements at page 99.*
[35] *With the Commission oversighting the management of over one billion dollars worth of ageing assets through the contracting governments.*

- Environment flows; and
- Community involvement.

More specifically, this strategic framework included provisions relating to urban and rural pricing, separating water allocations or entitlements from land title, institutional reform, water trading, third party access to infrastructure, environment flows and community consultation.

In the context of environmental flows the framework required all jurisdictions to, inter alia:

- Give priority to formally determining allocations or entitlements to water, including for the environment as a legitimate user of water;
- For stressed, or over allocated rivers, to provide a better balance in water resource use including appropriate allocations to the environment in order to restore/enhance the health of river systems; and
- Before undertaking significant new irrigation or dam construction, to ensure that the environmental requirements of the river system are first met.

All jurisdictions were also required to have regard to the work of the Agriculture and Resource Management Council of Australia and the Australia and New Zealand Environment and Conservation Council in the area, which produced a joint report, National Principles for the Provision of Water for Ecosystems in July 1996.

6.3 The Need to Return Water to the System

The National Competition Policy resulted in a lot of work being undertaken in all jurisdictions to reform institutions, legislation and to undertake greater scientific research and community consultation. As a result, the late 1990's and the early 2000's saw a growing recognition that in order to achieve a healthy, functioning and sustainable system, there was a need to start returning water to the river for non consumptive purposes: for environment flows.

6.3.1 The Salinity Audit

The need to return water to the system was given major political impetus in the Murray Darling Basin as a result of the findings of a Salinity Audit released by the Ministerial Council in 1999. This report included findings that showed that assuming no intervention measures were taken, over the next 20-50 years salinity levels at Morgan on the River Murray (the off take for water going to the City of Adelaide) would exceed World Heath Organization standards for drinking water. Further, many tributaries of the system would have salinity levels far exceeding these levels, including the tolerable levels for both irrigation and maintaining native habitat. This resulted in serious alarm from the community, in particular the 1.2 million residents of the City of Adelaide.

Political momentum gathered, and national and state based media outlets ran a constant flow of stories and articles dedicated to the health of the system. Community and political awareness reached an all time high, and it became generally accepted that too much water was being taken from the system. Something had to be done and governments and Parliaments needed to act.

This evolution represents a major shift in community values and attitudes, which has been reflected in the political response taken to the issue of environment flows in Australia.

7. Moving from Principle to Practice

The Cap was always seen as a means to an end, with the overall objective of creating a healthy system only being possible through identifying environmental water requirements and flow regimes and by establishing a supporting management and institutional framework, including trading water.[36]

Following much deliberation and political maneuvering between jurisdictions, in March 2001 the Ministerial Council took a major decision to adopt a vision for the Basin setting out 15 high level objectives for a healthy River Murray. The vision was originally put forward by the community through a community reference panel working with the MDBC Environment Flows Project Board.

This was a critical decision as it set the framework for future work.

The adopted vision was for…'a healthy River Murray system, sustaining communities and preserving unique values'. This was supported by the following 'high level (but none the less specific and aspirational) objectives':

River health objectives

1. Protect and restore key habitat features in the river, riparian zone, floodplain and estuary to enhance ecological processes
2. Protect and restore healthy riverine and estuarine environments and high value floodplain and wetlands of national and international importance
3. Prevent the extinction of native species from the riverine system.
4. Overcome barriers to the migration of native fish species

Environmental flow objectives

5. Reinstate ecologically significant elements of the natural flow regime
6. Keep the Murray mouth open to maintain navigation and fish passage and to enhance estuarine conditions in the Coorong
7. Significantly improve connectivity between and within riverine, wetland, floodplain and estuarine environments

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[36] *See for example Setting the Cap, Report of the Independent Audit Group, November 1996 at page viii.*

Water quality objectives

8. Substantially improve water quality in the Murray system to a level that sustains ecological processes, environmental values and productive capacity.
9. Manage salinity to minimise impacts on ecological processes and productivity levels.
10. Manage nutrient levels to reduce the occurrence of blue-green algal blooms.
11. Minimise the impact of potential pollutants such as sediment and pesticides within riverine environments.

Human dimension objectives

12. Implement an adaptive approach to the management of the River Murray consistent with the ICM Policy Statement, monitoring ecological outcomes and reviewing operations in the light of new information
13. Gather, evaluate and disseminate the community's living, scientific and intuitive knowledge to optimise environmental flow strategies
14. Ensure participation of the entire community by recognising the cultural and historical relationship to the river, its landscape and its people and acknowledging the past to effect the future
15. Recognise the importance of a healthy River Murray to the economic, social and cultural prosperity of communities along the length of the River

The vision and objectives served to provide direction to an expert panel of scientists from across Australia known as the Expert Reference Panel,[37] established to advise how much water is required for a healthy River Murray. Several scenarios were presented depending upon what values were being managed for and the results of subsequent research.

Based upon this advice, in April 2002 the Council decided to engage the entire community in an 18 month long consultation process addressing three different scenarios for achieving additional flows in the River Murray. The three scenarios revolve around how much water to return to the river annually, 350GL, 750GL or 1,500GL. They are not options but a reference point for a consideration of the costs, benefits and issues involved. The Council also took several other important decisions, including a recognition of:

- the need to spend $150 million on modifying dams, weirs, and locks and other measures to make the best use of all of the water that is currently available to the environment; and
- the importance of establishing water trading arrangements, the efficiency of which will depend upon a clear definition of access rights to water.

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[37] *See Jones G et al, Independent Report of the Expert Reference Panel on Environmental Flows and Water Quality Requirements for the River Murray System. CRC for Freshwater Ecology Report to the Murray Darling Basin Ministerial Council, February, 2002.*

The consultation is to be led by a three person body to be known as the Independent Community Engagement Panel. These citizens will help make sure the community is fully engaged and understand the issues involved. Interestingly, a recent survey of 321 stakeholders has found that 95% of those surveyed supported the principle of environment flows for the River Murray, but this dropped to less that 40% if the community was not actively engaged in the decision making process.[38]

The Ministerial Council will publish a future report after the work on the costs and benefits has been completed, to facilitate a discussion on the trade offs that will have to be made if additional environmental flows are to be provided. This is in the context of the clear intention of the Ministerial Council to ensure that any changes to existing arrangements are considered as a part of "an open, transparent, accountable and fair decision-making process."[39]

7.1 What is an 'environmental flow'?

The Living Murray Discussion Paper describes an 'environmental flow' as "any river flow pattern provided with the intention of maintaining or improving river health" and further describes it to include:

- making best use of water currently available to the environment;
- saving water lost in channels and other distribution systems and redirecting it to the environment; and
- reducing the amount of water removed from the river for human use.[40]

The Living Murray Discussion Paper also recognizes that a healthy river does not simply depend upon its flow pattern, but also on the condition of the entire catchment.

7.2 The Questions to be tackled

There are many difficult trade offs to be addressed through this process, and this is recognized by all involved. The desire of the Ministerial Council is to ensure that all is done to best determine the costs and benefits of the scenarios put forward and to fairly take account of all views and impacts, so that informed decisions can be taken. This is to ensure that the costs and benefits of any measures are fairly distributed.

Major issues to be tackled include:

- How much water to return to the river.

  This includes a determination of what values are being managed for.
- Where the water will come from.

  For example, from all users, predominantly upstream users, or to be diverted from other sources.

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[38] *The Living Murray* Discussion Paper, at page 32.
[39] *The Living Murray* Discussion Paper at page 9.
[40] See page 6, see also page 30 for a more complete definition.

- How the water will be recovered.

  Options include, reducing entitlements, investing water savings from the rehabilitation of existing schemes, and from the closing down of uneconomic irrigation areas, back into the river.

- How the water will be identified and managed.

  Options include establishing an independent 'bank' for environmental water, working through an environment manager, or through community groups to manage the water.

- Whether exiting users will be compensated where water is taken to return to the river.

  Compensation may or may not be legally payable, and the law in each jurisdiction varies. The legal obligation to pay and the political ramifications of a failure to compensate are separate issues. Issues of structural adjustment and compensation for deliberate flooding also arise.

- Who will pay.

  All or some exiting users, the governments, the community at large, or a mix of all of them.

- How the possible compulsory taking of water will be addressed where property rights and a trading market in water rights has been established.

  The implementation of National Competition Policy has created new rights and expectations, and a vibrant market in water trading, both intra and inter state. However, consistency in definitions of water access rights across jurisdictions remains unresolved.

- How additional volumes of water will be managed for maximum environmental benefit.

  More water alone is not the answer. The timing and extent of flows and the management of the water infrastructure is equally important.

- How progress will be monitored in improving river health.

  The public investment in returning water to the river will be in the order of hundreds of millions of dollars. The impact of such a major investment will need to be monitored and measured and an adaptive management approach applied to achieve the best return.

These issues and many more are addressed in the documentation produced to facilitate community engagement, namely The Living Murray Discussion Paper of July 2002.

8. Summary

The story of environment flows in the Murray Darling Basin, is one that involves satisfactorily resolving difficult issues of common interest in a federal system, political maneuvering, a drive for microeconomic reform, an improving knowledge base and changing community values.

No one factor has been decisive of itself, but a main driver has been clear evidence of a deteriorating natural resource base that has propelled a determination on the part of the community, and politicians, to reverse the decline in order to protect both productive capacity and environmental values.

The voluntary decision to cap diversions in 1995 was a momentous one, and the decision to adopt a vision for a healthy river system was a major milestone. The most difficult decisions are yet to come, but what is clear is that the community will be an integral part of whatever options are taken and nothing is going to stop the momentum to see more water returned to the system.

This reflects a dramatic shift in community values over a relatively short period of time.

Community Engagement

Environmental Flows and Water Quality Objectives for the River Murray Project

Opportunities for community input

Year	Month	STAGE	STEPS
2002	July August September October November December	**Stage 1: Inform & Engage**	- inform community of the work and knowledge that has led to the recognition of the need for the Australian community to consider what it wants for the future of the River Murray - inform Murray-Darling Basin Commission of the community's knowledge, values, aspirations, issues, information needs and concerns; -provide progress report on community engagement to Ministerial Council Meeting in November 2002 and set a framework for further discussions and investigations.
	January February March		*consolidation period to prepare the documentation necessary to inform Stage 2*
2003	April May June July August September	**Stage 2: Propose**	Community and government agencies will work together to: - provide a comprehensive analysis for the provision of water to the River Murray using three reference points (350 GL, 750 GL and 1 500 GL a year); - evaluate the benefits and impacts of the three reference points; - seek views on a preferred way forward to address local and system-wide issues; - establish what's needed to manage and keep track of the social, cultural, economic and environmental impacts of any decision; - inform the Ministerial Council meeting of October 2003.
2003	***October***		***Ministerial Council Meeting*** *- will consider the outcomes of the engagement process and the recommendations brought before it by the Murray-Darling Basin Commission*
November 2003 - Onwards		**Stage 3: Implement**	- negotiate details of and timeframes for the implementation of Council decisions.

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