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# Working Paper Series

# The Cathedral and the Bazaar; (de)centralising certitude in river basin management

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The School of Development Studies, University of East Anglia
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# DEV Working Paper 02

# The Cathedral and the Bazaar; (de)centralising certitude in river basin management

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# Abstract

Two conceptual theories of river basin management are discussed. One is integrated river basin management with an apex regulatory authority that seeks hydrometric data collection and analysis to use in decisions over water allocation. This model of IRBM can be identified in training curricula and many derivatives of basin management programmes. The other, termed 'polycentric river basin management' is institutionally, organisationally and geographically more decentralised, constructed from four ideas of scale/form, a risk-based approach, hydrograph regime dissection and work scheduling. This model emphases conflict resolution, problem-solving, informality and step-wise adjustments of flows to different sectors. The polycentric model answers the question of how to make tangible progress in basins where data monitoring is limited, basin office resources are constrained and integrated planning has stalled. To explore these issues, we employ the 'The Cathedral and The Bazaar' metaphor of Eric Raymond who depicted two ways of writing computer code, one 'in house' drawn up by company employees, the other 'open-source', written by many contributors. Aware of inaccuracies, we feel compelled to so package our argument to bring new thinking to river basin management and governance theory. The discussion is informed by observations from Tanzania, Nigeria and the UK.


**Keywords**: *Adaptive, integrated, conflict resolution, data, governance, monitoring, regulatory management, river basin management, Sub-Saharan Africa.*

## Introduction

In attempting to achieve pressing priorities of more equitable, efficient and sustainable water management, countries across sub-Saharan Africa are instituting reforms with the support of the international donor community. Under the banner of Integrated Water Resource Management (IWRM) these reforms applied to the river basin emphasise the role of statutory laws and formal institutional frameworks to regulate the use of water resources (IWMI et al 2004, Jones and van der Walt 2004, Kabudi 2005, Sokile et al 2005; Pitman 2004). The reforms translate into an operational reality of resource ownership vested in the state with varying levels of stakeholder participation and subsidiarity in water use decisions, and the issuing of permits and charges, enforced by legal sanctions, to prevent conflict and resource deterioration. Although academics are mixed in their views of IWRM and 'Integrated River Basin Management' (IRBM), both feature as guiding philosophies of the international donor community's approach to water (EU 2005, Bonn Secretariat 2001, World Bank 2004). The Global Water Partnership (GWP, 2000) provides a generally accepted definition of IWRM as being a process that "*…maximises the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems*". The concept is underpinned by 'the Dublin Principles' which propose that water should be considered as a finite and vulnerable resource; be managed on a participatory basis; place women in a central role;

and be recognised as an economic good. IRBM is a response to the interconnectedness of the water cycle at the catchment and aquifer scale, requiring that the full range of water users, their needs and impacts should be considered together at both a policy and practical level, in order to achieve equitable, efficient and sustainable water use.

Although IRBM is being rolled out to many developing countries its application in the field is coming under increasing review. This concern was part of the recent World Water Forum (GWP 2006), and has been discussed by various authors (e.g. Biswas, 2004). 'Adaptive water management' is one emerging response, as evidenced by current literature and meetings (CAIWA 2007). Although the adaptive literature might explain how IWRM is interpreted, it does not to fundamentally question the basin approach, instead: "adaptive management is an approach to managing natural resources that encourages learning from the implementation of policies and strategies" (Allan and Curtis, 2005; 414; see also Kashyap, 2004; and Lankford, et al, 2007).

This paper is guided by a key question[1]; do conditions in Sub-Saharan Africa (SSA) undo the rationale for a regulatory integrated river basin approach? Conditions such as large distances, high evaporation losses, an institutionally challenging environment (Cleaver and Franks, 2005), lack of data monitoring and little recycling or reticulation of water suggest, in total, a challenging environment. In other words, basin-wide integrated responses may be too cumbersome to meaningfully cope with local variety and dynamics.

By asking this question, we believe that a flaw in integrated river basin management is revealed when it is applied to certain African river basins. The flaw appears to be that the 'theory-practice' dichotomy of IRBM has not overcome (or perhaps has even lead to) inertia and ineffective progress with basin management. This 'ontological' nature of IRBM is as a theory of *intending* to plan for the integration of supply and demand over a large basin achieved by integrated regulatory approaches which is then interpreted at the practice level as basin operations of the same. The consequences of highly comprehensive integrated planning are operations that are too comprehensive to be easily implemented.

However, given that adaptation management defines and refines the practice/operational level but not the theory, adaptation of IRBM cannot generate a categorically different and perhaps more relevant approach. In this paper, we explore whether a genuinely different approach to water resources management exists at the higher strategic level, which in turn might spawn an alternative operational model. Thus, we question the theory rather than practice of IRBM. We will argue, that by 'disintegrating' the basin management challenge into parts rather than integrating it into

[1] The paper explores other topical issues; the relationship between conflict resolution and river basin management; connections between data, decision aids and river basin management paradigms; and relationships between irrigation infrastructure and basin management.

a whole, programmes can focus on pursuing immediate solutions to problems that river basin societies face, encapsulating cost-effectiveness, local knowledge and appropriate water technology. In keeping with emerging work in this area (Molle, 2006; Molle et al, 2007) this alternative is termed 'polycentric river basin management' (PRBM) because of its emphasis on a completely different set of principles built around decentralised, nested solutions that tackle local-scale issues.

To some extent the two comparisons are captured by the 'Cathedral and the Bazaar' allegory of Eric Raymond who in 1997 contrasted proprietary computer code written by in-house developers and protected by copyright law (the Cathedral) with decentralized, open-source coding written by many unrelated individuals (the Bazaar). We hesitate to suggest that open source coding enabled by instant access via an intra/internet equates to the resource water which by its very nature is not immediately and simultaneously accessible or knowable by all. Yet, the comparison applies not to the resource/source but to the construction of knowledge and human interaction around it – the terms are powerful abstractions of two different paradigms of organisational management (see also 'rhizomes and trees' metaphor of Deleuze and Guattari, 1988). In the paper here, we attach the 'cathedral' term to integrated water resources management expressed at the basin-wide level, and 'bazaar' to a polycentric model of water management that focuses on nested zones or catchments within basins. The paper is structured so that we first explore the characteristics of the 'cathedral' before moving to a critique of its weaknesses which in turn precedes the exposition of an alternative 'bazaar' model leading to final discussion and conclusions on certitude regarding basin management.

## The basin-wide regulatory approach ('Cathedral')

Characterised here as Integrated River Basin Management (IRBM), this governance model uses statutory control (permits, prohibitions and charges enforced by legal sanctions) of water abstractions and discharges (water transactions) following due consideration of other water users' needs. Although there are elements of stakeholder participation, IRBM predominantly uses a 'command and control' regulatory regime to manage demand and maintain quality and quantity of supply across a river basin. IRBM requires regulatory organisations to acquire a decision-making process to resolve whether a water transaction can take place, drafting and issuing a legal 'permit' of water use specifying the conditions and 'policing' compliance through monitoring and enforcement. Key features of the IWRM model are a reliance on surveys (see for example, Ramsar utilising Dickens et al 2004), data, science-based decision support systems and the charging of water users to recover the operational costs of water resource regulation.

Because the aim is to cover quite large river basins as single units (e.g. the Pangani Basin in Northern Tanzania) the normative model of basin management tends towards a hierarchical design. Lower level user groups are represented in higher groups who in turn can be represented at the apex authority. The hierarchy is seen as sensible because

water supply and demand in a river basin manifests itself as an additive common resource. The total supply needs to be quantified and added up to be balanced against the total demand, so that excessive demand can be regulated. Similarly, water quality objectives are targeted via monitoring and imposition of wastewater discharge standards. A central viewpoint is deemed necessary to explore trade-offs between users and supplies that may be very distant from each other.

An example of these reforms can be found in Tanzania (World Bank 1996, 2004). The government of Tanzania and the World Bank saw IWRM implementation as a fundamental pre-requisite to achieving the country's development goals. Institutional reform is based around new water resource law that is almost a facsimile of that in the UK. Countries in Sub-Saharan Africa are also exploring IWRM reform in river basin applications; e.g. Zambezi River Authority; Rufiji River Basin Office in Tanzania; Catchment Management Agencies in South Africa; Volta River Authority; and the Mara River Basin Management Initiative in Kenya.

Hofwegan and Jaspers (1999) and Jaspers (2003) outline the Cathedral IRBM model, listing constitutional changes and providing a formidable list of organisational and operational functionalities that must be in place for water management to be successful. A small sample of these include: a decision-making capacity which reflects the interests of different uses and users; a clear regulatory framework with norms and standards; a system that provides reliable information on the availability, use and quality of surface and ground water in the basin; a system that allows analysis of several scenarios for interventions in use of water at basin level; an effective and transparent accountability mechanism; sufficient capable people to meet the IWRM demands on planning and management, water resources assessment (quality and quantity); problem analysis; activity analysis; demand analysis and demand forecasting; formulation of objectives and constraints; design of alternative water resource systems; system analysis; system simulation and optimisation; sensitivity analysis; multi criteria and multi constraint trade-off analysis; involvement of stakeholders; allocation of water resources; demand management; administration of service provision to water institutions; operation and maintenance; monitoring and evaluation; financial management and performance auditing; and communication, negotiation and conflict resolution. Whilst admirable in ambition and comprehensiveness we ask how realistic such a comprehensive approach given the realities and contextual constraints facing developing countries?

Normative integrated water resources management is perhaps best recognised via its manifestation in training programmes, which are widespread (with training provided by Ramboll Natura, SwissRE, Stirling University, University of Wales, Global Water Partnership (GWP), CDA Consulting, Bern University of Applied Sciences to name a few). Curricula content includes many of the items listed in the previous paragraph. Furthermore, policy documents are also places where normative regulatory IWRM can be found. A web search of GWP, World Water Council, UNESCO, Ramsar, IWMI and

UNEP provide policy thinking that mirrors the kinds of approaches found in training courses. IWRM is also evident in practitioner-to-practitioner capacity building initiatives in 2005-2007 between environmental institutions in East and South Africa and the United Kingdom's Environmental Agency. Here, predominantly hierarchical models of regulation and enforcement were mapped from the UK to the very different contexts found in sub-Saharan Africa, although refinements followed when constraints in Kenya demanded a rethink.

Examining the training and policy tools of IWRM is not simply a device for listing the components of IWRM. It is germane to the argument that 'cathedral style' IWRM is given significant credibility when and where training and policy on water resources management is formulated. The mode of training and subject material are inter-linked. During training, a self-referencing edifice of IWRM is provided, reverting to core principles, planning modes, structures, linkages, objectives that need to be put in place. Such training and policy resources appear authoritative and knowledge-based, providing participants with the viewpoint that large river basins should be addressed via a large range of inter-linked 'integrated' activities.

Furthermore, endorsement of this normative approach receives significant levels of financial support through donor programmes with workshops constituting the strategic location for its promotion. Does this result in the requisite reflective learning? With 'numbers of delegates trained' often used as an indicator of success, a workshop culture is perversely fostered by receipt of an equivalent week's salary for one day's attendance. Yet, at one recent World Bank-funded workshop[2] in Tanzania, a senior World Bank water resources specialist insisted and was later repeated by the Ministry of Water's Director of Water Resources, that "water resource management is impossible without data". Notwithstanding the skewed incentives this provides to staff, with such persuasive backing there seems little room for dissention from this kind of IWRM message.

## Questioning the regulatory IWRM template

Two related questions follow: first we must ask whether basin officers, workshop participants and trainees are able to distinguish between detail given regarding the principles and planning of basin management and detail given for implementing basin management, particularly when the trainers and policy documents do not provide this distinction. Secondly, we must especially ask whether the regulatory model should *necessarily* be the dominant planning version; in other words whether it functions well in all river basins, particularly some that are located in Sub-Saharan Africa (SSA). Questionable basins are generally large, between 15 to 150 thousand square kilometres and comprising disparate communities, institutions and environments. Evaporation

[2] The workshop was estimated to cost the same as the government's entire annual operational allocation to its largest river basin office.

rates of 6-9 millimetres in Sub-Saharan basins and irrigation systems as compared to rates of 2-5 millimetres northern Europe frame a markedly different and less forgiving 'demand-side' dynamic. Agro-meteorology and geologies combine to create higher degrees of seasonality of surface waters in the savannah plains and watersheds of SSA. In addition, the basins' regulatory organisations, logistics and infrastructure for monitoring both demand and supply are generally under-resourced. Such basins are very different from those found in Western Europe that experience temperate/oceanic climates and where authorities have access to considerable financial, human, transport and technological capabilities which allow them to fulfil their duties according to accepted standards and protocols associated with IWRM (while the UK's Environment Agency has approximately 11,000 staff, Kenya's equivalent has less than 50). Yet it is from these well-resourced situations that policy templates and curricula for IWRM in poorly financed and resourced river basins are exported. The appropriateness of the regulatory model to the latter is a question that should be posed more deeply (Carter, 1998); given that implementation of IWRM will be extremely challenging due to a capacity and information vacuum (World Bank 2005).

However, such is the prevalence and multi-component nature of the regulatory model that basin stakeholders are not asking whether alternative basin approaches might exist, but how to assemble the provisions necessary to implement the regulatory model. At a river basin workshop in Nigeria (Lankford 2005), participants were asked to consider what they could do in the short term to allocate water between urban, agricultural and wetland sectors. Respondents drew up long lists of actions that constituted 'regulatory river basin management' rather than immediate 'make-do' steps to resolve pressing conflicts. When asked at a recent seminar in London how the Environment Agency would manage a river basin in East Africa that had no monitoring network, the answer given was to set up a monitoring network (Hepworth, 2007). This is sensible provided the cost, sustainability and usefulness of such a network are assured. However, networks for river data collection in Africa are in a poor state (ECA, 2000), rehabilitation efforts are short-lived, and data often goes uncollected or un-analysed. So the question remains, how can a river basin be managed if very little or no data remains the *de facto* situation?

The lack of data collection and analysis is not the only reason why a regulatory model should be thoroughly questioned. As well as practical limitations, five substantive issues can be identified regarding the fit of the regulatory model to certain basin environments. The first relates to degree of dynamism found. The applicability of a model built upon relatively fixed regulations in an environment where water supply and demand fluctuates both intra-seasonally and inter-annually, and where the demand curve is often increasing is questionable (Lankford and Beale 2006). In some African basins, the pace of change is very quick – for example incomers to irrigation systems and urban growth – lead to rapidly changing demand for water. Thus regulatory formality may date quickly which partly explains its mixed record in Tanzania - on various

functional levels, water rights have not performed according to expectations (van Koppen et al 2003). We believe these differences between assumptions and reality are not simply down to the administration of water rights issuance, but testify to greater theoretical challenges regarding how river basins should be managed. This challenge will magnify as basins experience increased variability stemming from climate change.

Secondly, efforts to replicate a working regulatory regime optimistically assume that the contextual pre-requisites of a functional and fair judicial system and associated procedural capabilities that provide legal authority to the regulators are already in place. For those with experience of the realities of legal machinations in many developing countries in SSA this is clearly not the case. Petty and institutional corruption, the practical impossibility of intra-government litigation, prejudicial prosecution of the poor who have restricted opportunities for compliance, fear of community revolt and political backlashes against enforcement together with procedural defects all conspire to emasculate the incentives associated with regulatory compliance. As the Managing Director of an openly polluting industry in Tanzania puts it "the biggest problem with water management here is corruption. There is a system but nobody follows it. It is possible to pay off anybody for anything" (Hepworth, 2007). Or to take the view from the regulators hamstrung by political patronage of polluting businesses, as one senior official puts it; "There are many powerful men twisting our arms.- we cannot do anything on enforcement". The failure of the regulatory route is evidenced by the track record of Tanzanian water pollution control legislation over its 32 year history, which was exercised once resulting in a 30 dollar fine. Whilst tackling corruption forms an ongoing development objective (Blundo and Olivier de Sardan 2006), we argue that its role in undermining regulatory water management is likely to persist at least in the medium term. Therefore what management modalities, which acknowledge the existence of corruption and perhaps draws in community-based reflexive law[3], best serve pressing water problems?

Thirdly, the deployment of non-regulatory solutions resonates with the reality of pragmatic water management in the UK. In a largely regulatory environment, basin officers made real improvements by omitting the strict regulatory pathway, reverting instead to dialogue and discussion. Similar examples were found in the Rufiji Basin Water Office in Tanzania, where officers opted to engage users in dialogue rather then via the courts. We describe this interpretative action 'personality authority', denoting a personal engagement with problems, and drawing from authority that arises from a person's character rather than their office. This illustrates Weber's contrasting of

[3] Reflexive law describes an array of agreements constituted from within organisation and communities rather than imposed from outside. Reflexive law therefore covers informal customary law, and newly instituted bye-laws.

legitimacy and authority (1947, 1958)[4]. The law exists as a bargaining chip and ultimate sanction but the main objective is not the application of the law per se but to help water users become more efficient and environmentally-cognisant by providing practical advice recognising their logistical, economic and capacity constraints. Prevention of conflict or environmental damage is seen as more preferable to initiating prosecution, being less costly for the regulator and water with legal enforcement action only used as a last resort (c.f. the motto of experienced Basin Water Officers "you can get a lot more done by not upsetting anybody"). Progress in solving major water use issues is commonly made incrementally rather than in leaps, often negotiated on non-confrontational terms. Such an approach has benefited the UK's Environment Agency. What exists is not *carteblanche* for regulators to apply the law or not as they see fit, but within certain constraints (to ensure consistency and credibility of the authority) there is room for the regulatory officers to build relationships and dialogues with and between water users, interpreting their needs and that of the environment in a dynamic way based on a first hand knowledge of the natural resource. Clearly, experienced basin officers know when to shift between 'cathedral' and 'bazaar' modes, but what are these same officers in Sub-Saharan Africa to make of new IRBM projects funded by donors and constructed by consultants whose reports (e.g. World Bank, 1996) outline procedures that are mostly regulatory upon which monitoring is conducted and further funding contingent?

Fourthly, risk-based approaches have achieved real improvements in water management. Here, a few key issues that unlock success are pursued. The UK's Environment Agency (see EA 2006) teaches risk-based ideas in its training in Kenya and Tanzania. While this denotes a pragmatic identification of cost-effective tasks, this illuminates the fact that the regulatory framework is the underlying template for water management. However, discerning observers might note that the risk-based approach might be interpreted as the antithesis of an integrated approach working on many fronts. Clemett *et al* (2000) via their major review of water sector programmes provide evidence of the dangers of 'institutional procrastination' where a focus on long term structural change or development of comprehensive networks means that urgent operational activities such as the provision of clean water are, or are perceived to be neglected. Could it be that the more integrated we make IWRM, the more we impede its deployment? Perhaps 'comprehensiveness' is the factor that slows down progress, and that an alternative model should be 'slim'? As one Ministry of Water technician in Tanzania puts it "We always try to do big, big things when what we really need is small small" (Hepworth, 2007).

On a fifth count we ask whether the way that regulatory basin management is packaged demotivates those responsible for its delivery. A rich vein of psychology literature, in

[4] With respect to personality and regulatory authority, a body of work on 'cultural theory' and its application to water resource management may provide new insights for approaches in the field (see Jordan and O'Riordan 1997; Langford et al, 1998; van Ogtrop et al, 2005).

particular the work of Deci and Ryan (1985) on self-determination, supports this view, potentially having far-reaching implications for the way that donor intervention and capacity building is practiced. As they explain, events perceived as having an external locus of causality, experienced as pressure towards certain outcomes – thus co-opting choice – tends to undermine intrinsic motivation, restrict creativity and impair cognitive flexibility. Also, when events convey the experience that the person cannot master an activity, this promotes perceptions of incompetence - again, undermining intrinsic motivation. Is the way that IRBM is being externally framed solving water management problems; setting sights too high for current capabilities and restricting creativity and action amongst developing country water resource practitioners?

Before the next section discusses answers to the above via an alternative model, we need first to return to the relationship between theory and practice which broadly says that IWRM or IRBM theory is a package of sensible principles and regulatory frameworks (at a strategic level), but that in its *practice* (the operational level) there is considerable scope for interpretation. While this ontological flexibility appears useful and correct, the divide between theory and practice may cloud deeper questions about how operation is able to transcend it's higher 'strategic planning' parent. It is the certitude with which the IWRM model is held by resorting to and invoking its flexible theory-practice framework that this paper takes issue with, precisely because this theory-practice framework is not addressing the five points above nor delivering utility in many of the Sub-Saharan circumstances the authors have witnessed. It is not leading to rapid and effective progress. Transcending this inertia requires a theory-practice division but constructed around a theory model that generates planning and principles that lend themselves to expediency and more rapid implementation. If more utilitarian models of theory and practice exist, implications for basin managers, capacity building and donor support strategies will be significant.

## A polycentric model of river basin management ('Bazaar')

By comparing with cathedral IRBM in Tables 1 and 2, and Figure 1, we formulate some preliminary ideas of an alternative 'bazaar' model that captures polycentricism, personality, pragmatism and problem-solving at the theoretical level. The paper does not describe a working polycentric model – instead we infer from field observations that a decentralised configuration might assist planning and implementation in certain types of river basins.

Our viewpoint that a polycentric model is theoretically and practically appropriate rests on the de-merging of the properties of a river basin and of the process to manage it. Interpretations of either integration or dissection, and therefore the two models, are informed by four ideas of scale (or form and size), a risk-based approach, hydrographical regime dissection and time-scheduling (Figure 2).

Table 1. Comparison of two river basin management approaches

| **Aspect** | **Type** | Regulatory legal authority integrated water resources mgt. **'Cathedral'** | Personality authority, polycentric, pragmatic, problem-solving water resources mgt. '**Bazaar'** |
|---|---|---|---|
| Conditions best suited for model | Complex systems, mixed multi-sectoral demands, closed basins, mixed quality and quantity issues, high degree of urban, industrial and power needs. Requirement for transfer of water between sectors. Efficiency gains not readily available. | Basins that can be modularised or nested. Basins that can be monitored with few monitoring points. Basins that can be solved by addressing local water redistribution. Efficiency gains achievable. | |
| River basin manage-ment dissect-tion | Form/Scale | Hierarchical, vertical, centralised, basin-wide | Distributed, horizontal, decentralised, polycentric, nested. |
| | Risk approach | Large number or network of features, acts or points | Small number of features, acts or points to lever outcomes. |
| | Regime phase | Tends not to differentiate between supply phases | Employs phases of supply to discern management objectives |
| | Work scheduling | Pre-planning, base line surveys, composite, on many fronts. | Immediate, incremental, directly starts to adjust today's practices; deadlines |
| Legislative framework | Water rights and legislation. | Formalised, denominated, often fixed. Statutory and nationally ratified. | Customary law and reflexive law. Frequently negotiated & adjusted, emphasising transparency and proportionality, emphasising role of informal legal agreements |
| | Water rights [& obligations] | A right to a volume [To measure water] | A right to negotiate [To agree divisions in water] |
| | Enforcement | To legal standards | Informally, to local agreements |
| | Pollution control | Monitored, standards, regulated. | Nested local solutions |
| Water allocation | River basin visions | Target-led, scenario based 'A healthy catchment' | Improvement on today. Conflict resolution. 'A healthier catchment' |
| | Water allocation | Via regulatory practice, claim and counter claim | Via dialogue and experimental adjustments; incremental |
| | Dublin Principles | Widespread acceptance. Seeks equitable water distribution. | Locally-set priorities, conflict resolution. Seeks a *more* equitable distribution of water. |
| | Negotiation, decisions, trades | Regulator-to-user, Centre to user, user to centre. | User-to-user facilitated by key individuals/personalities |
| Science | Monitoring of water supply | Formal hydrometric networks, hydraulic formality in gauging | Informal, ad hoc, local knowledge – hydraulic informality in gauging |
| | Data needs | Substantial & formal | Light & informal |
| | Decision tools | Computer decision support system | Informal participatory methods, e.g. River basin game |
| | Science | Reasoned, central to the model | Reflective, in support, secondary. |
| | Allocation methodology and scale | Demand-derived reconciled at the basin level | Supply-set & cascaded reconciled at the locally nested (sub-catchment) level, experimental |
| | Demand calcs. | Formulae, building blocks | Incremental adjustment |
| | Quanta and metrics | Quantified, modelled, discharge in litres/second | Verbal, look-and-see, percentages |
| Instit-utional strength-ening and design | Subsidiarity | Village & irrigation system WUA's | Multi-layered & catchment WUA's |
| | Participation | Consultative | Substantial (via conflict mediation) |
| | River basin office | Multi-office in foreground of basin mgt. | Mini-Office, few people, in background of basin mgt. |
| | Entry points | Positions | Interests |
| | Capacity building | Training & workshops | Mentoring while working |
| | Role of experts | Experts central & leading | Experts in support, requested |
| Infra-structure | Water supply provision | Opts for reticulated supply network, large-scale solutions | Aiming for nested solutions, local recycling and storage. |
| | Distribution infrastructure | Centrally planned, volumetric, formally engineered/constructed. | Locally planned, enhancing access, transparency, flexibility and proportionality |

Figure 1. Schematic framework of the two approaches to river basin management

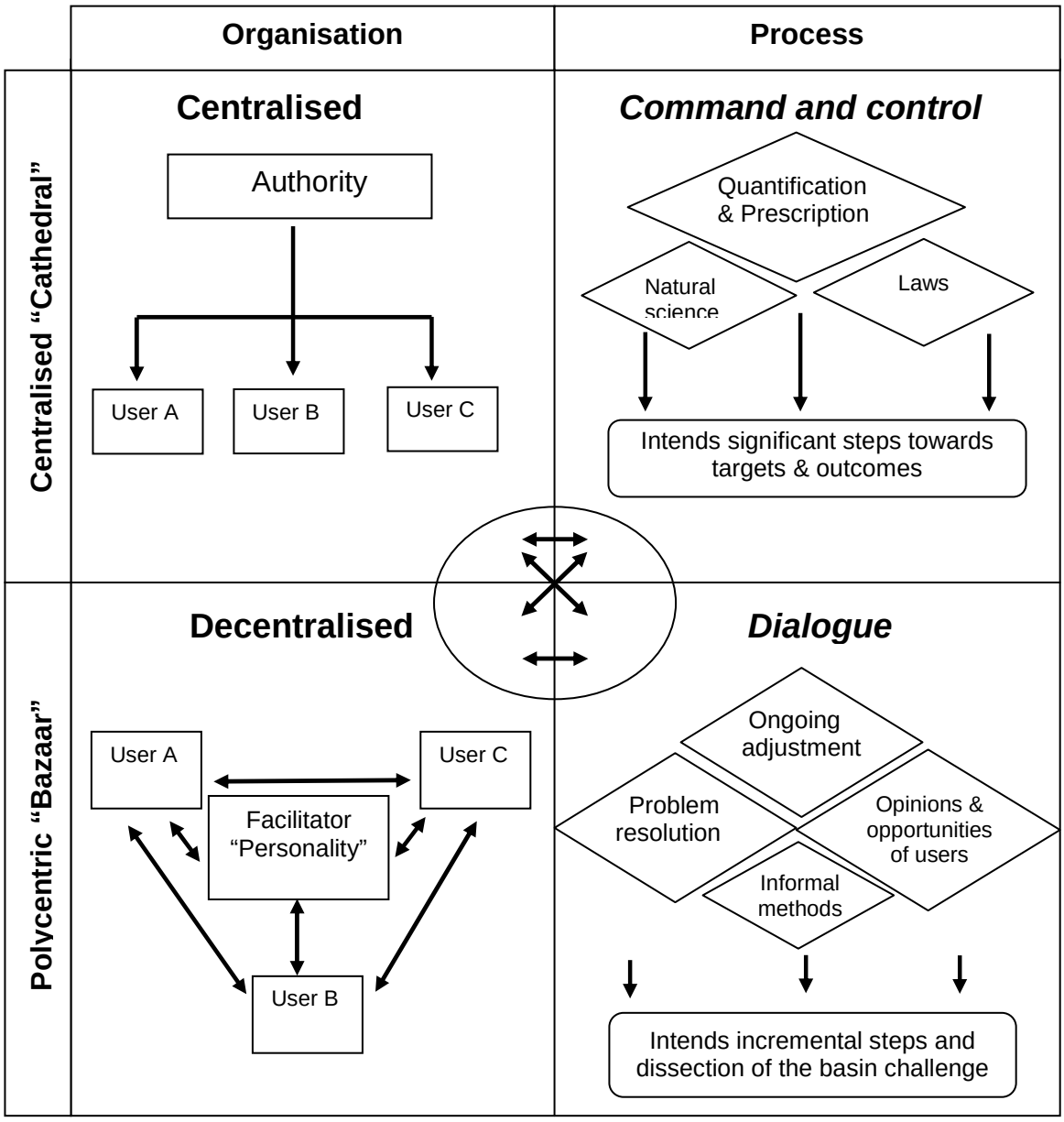
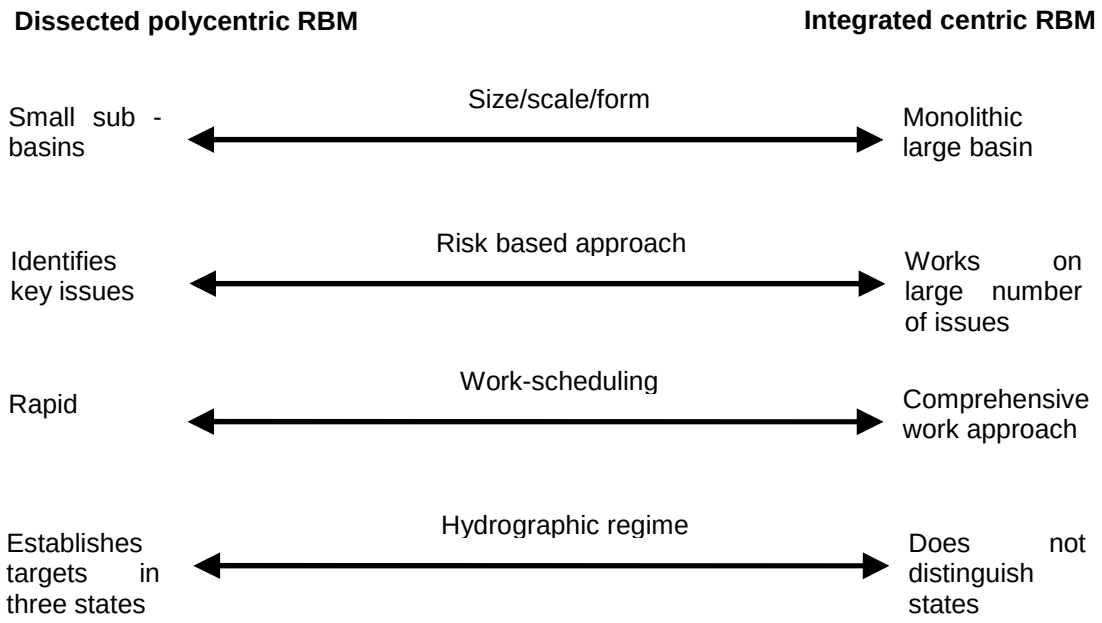


Table 2. Application of two approaches (adapted from observations in Tanzania[5])

| Regulatory basin wide and national approach (Cathedral) | Polycentric approach (Bazaar) |
|---|---|
| ➢ Expect large river basins to be complex; maintain sense of scale, capturing many stakeholders and sectors.<br>➢ Adopt statutory WRM at national level.<br>➢ Formulate 'water rights' IWRM strategy.<br>➢ Sell rights (wet season) to individuals & water user associations.<br>➢ Vest power and authority in government institutions to manage water.<br>➢ Observe non-functioning of IWRM system.<br>➢ Begin to employ personal dialogue and other solutions to ensure water passes downstream. | ➢ Interpret these basins as being more simple than expected, comprising small key sub-catchments as manageable 'modules'.<br>➢ Hold problem-focussed conflict resolution workshop as the means to move forward.<br>➢ Scope local & external understanding & solutions of water management. Develop local and community authority to manage water.<br>➢ Replicate solutions & bye-laws where possible.<br>➢ Support with additional services and solutions.<br>➢ Observe local and downstream impacts and recursively adjust agreements and solutions. |

Figure 2. Integrated and dissected approaches to water resources management




With respect to scale, the hydrological underpinning of a polycentric approach applies to basins amenable to nested, modularised (compartmentalised) solutions. This effectively means that sub-zones or sub-catchments in the basin are identified wherein water balances and institutional logics are resolved internally in order to minimise the transaction costs and losses with allocating water across the basin[6]. This physically

[5] See Franks et al (2004) for a description of the case study.

[6] Without being prescriptive, if river basin management covers basins from 1500 to 150 000 square kilometres (or more), then a polycentric approach envisages covering parts of these, possibly from 250 to 20 000 km$^2$ depending on the size and complexity of the basin and component parts. In addition, sub-basins can be further divided into sub-catchments.

establishes a more decentralised approach but requires sub-zone or sub-catchment-based water user associations (WUA's) to distribute water shares that meet internal and downstream needs. Thus, stakeholders have to discern whether the basin can be divided into nested manageable catchment units to promote meaningful subsidiarity so that rapid intra-unit user-to-user negotiation is made more possible. This is in contrast to the cathedral model with a basin-wide scope that then merits additional vertical authority and formality and a reliance on data collection and analysis for it to function.

Risk-based approaches and quicker work scheduling function together. As discussed above, risk-based approaches identify tailored key solutions that generate the most effective or rapid outcomes and reward[7]. Scheduling defines the pace with which basin management is pursued. Watkins (1998) and Moore (2004) identify the setting of deadlines to force action in this respect. Thus, a decentralised approach is validated by, and insists on 'quick progress' in basin management befitting the lack of a more comprehensive programme, office and infrastructure. This may be possible because of a relatively straightforward challenge of quantitative allocation perhaps underpinned by a relatively small number of critical monitoring and flow adjusting points in the basin – which in turn need not be formally engineered – and by devolving action to water user groups.

Hydrological regime dissection allows the categorisation of key objectives, and is effected by dividing a river flow regime into three phases or states of water supply. These are 'critical water' denoting very small amounts of water availability during droughts and dry season; 'medial water' for scarce to average flow conditions, and 'bulk water' for wet to flood conditions (see Lankford and Beale, 2006; Lankford et al, 2007). For each state we can consider priorities of allocation and which allocation device (markets, command and control, local community responses and other interventions) are appropriate for each state. A look at the Tanzania case study indicates that critical and medial water require special attention by the basin office, but that each can be addressed by relatively simple, practical and localised solutions rather than by more cumbersome formal rights based interventions.

Table 2 demonstrates the differences in interpretation of IRBM theory from the case study in Tanzania; the left hand side begins with an assumption of complexity to draw up an appropriate regulatory IWRM response, and the right hand side rests on the notion that a large river basin might not be that complex (or that at least its complexity is understood), and that water allocation between sectors could be effected by relatively simple means operating at a local scale. In the case study in Tanzania, this simplicity is born of the local observation that the irrigation sector is upstream of environmental and hydropower needs and that in many places only a few irrigation intakes significantly influence water apportionment for a particular sub-catchment. Regarding risk based approaches, while scientists at a workshop in Northern Nigeria argued for a network of

[7] The Pareto principle is an example, where 80% of consequences come from 20% of the causes.

standard gauging stations (that would then require formal data collection and use), it was possible to identify a few existing points in the basin that could be gauged using informal methods, including a landmark large tree and a bridge culvert. The choice here is pragmatically informed by work scheduling, scale and risk; how to make progress in water management *tomorrow* – not an abstract 'tomorrow' – by using local and existing knowledge and infrastructure that meets both local and wider needs.

The regulatory model derives further legitimacy from its use of science – for example 'building block computations' to derive demand quotas which are then used to balance available supply. One example is the derivation of crop water requirements and irrigation demand that now looks to be outmoded in this respect (Lankford, 2004). Scientific methods to determine environmental flow assessment (King and Louw, 1998; Pyrce, 2004) appropriate for computational claims on water have to be similarly questioned because it is possible, more pragmatically, to ascertain tomorrow's supply quotas by a simple percentage adjustment of today's supply or by experimentation. Continuous adjustments can be made over time to arrive at divisions of water that might cascade new practices and efficiencies[8].

By contrast, the experience of the authors in gaming as a form of conflict resolution is instructive. Lankford et al (2004) used the river basin game to identify and prioritise solutions to problems, and to initiate steps to bring those solutions about. The river basin game functions by allowing players to see that adjustments of existing shares is a feasible way of progressing in comparison to water demand claims based on computations, such as would be found in a water allocation decision support system. Conflict resolution could be seen as a defining feature of decentralised basin management because it strongly features *local* problem resolution via incremental steps rather than by initiating claims underpinned by a protocol for determining water demand; properly conducted, it should speed up solutions and employ risk-based approaches. Conditional agreements between parties, while not legally recognised, could refer to customary practices, or be instituted as local bye-laws and other forms of reflexive law.

On the basis of the previous two paragraphs we can contrast two methodologies for determining basin allocations. For the regulatory centralised model using decision aids, we can see that a new water supply allocation is a function of (St, FV, Dx, Bx, $x, Wx, Px), where St = today's supply pattern; FV = future vision; Dx = modelled demand of uses; Vx = benefit of different uses; $x = cost of different uses; Wx = waste in different

[8] Note that the UK government part decides an allocation of funds to Universities using 'annual efficiency gains' of 1-2% not computations of where and how that money is utilised in universities (Greenaway and Haynes, 2000). This is the difference between 'building block' calculations of demand and supply forcing of demand. At a recent workshop in South Africa, one author was told of commercial farmers in the Oliphants Basin recently agreeing to a decrease in allocation in order to provide water to smallholders breaking a deadlock in negotiations.

uses; Px = participation of users. For the polycentric, increment-based model, new water supply allocation is a function of (St + dS/dt) where St = today's supply pattern; dS/dt = small supply adjustments over time. While the former constructs a model useful for some river basins, the latter might usefully bring acceptable progress to others. One example of the incremental approach in Tanzania occurred in the Mkoji subcatchment where day schedules were applied and adjusted to provide water to different irrigation intakes.

Examples also come from water quality control. In the cholera outbreak in Dar es Salaam which claimed 117 lives in 2006, the city waste stabilisation ponds were overlooked despite pathogenic waste passing untreated to a heavily used urban river along which many of the cases were found. When asked the reason for this regulatory blind spot, various officials responded that they were waiting for a pond rehabilitation programme which has been on the table for ten years; that there was a lack of capacity for water quality monitoring; that they were waiting for the new water law and new institutional arrangements for regulation to take shape. It seems that the reliance on a regulatory model, with the delays in assembling the appropriate finances, infrastructure, institutional shape and capacity to get data in place diverted attention from pragmatic immediate solutions. The problem - a blocked pipe causing untreated waste to flow directly out via a storm overflow, could have been solved by a meeting with the site supervisor (who wasn't aware of the linkages to disease risk) to organise low cost maintenance to unblock the pipe (Hepworth, 2007).

The role of the advisory expert is very different in the two models. In the regulatory model, the advisory professional manages the regulation of water. As Raymond found, the 'cathedral' emphasises *products* generated by specialised experts who consequently take a leading role in formulating and owning river knowledge that is then via consultation or the market is handed over to or sold to users. Examples of products are water rights, computer decision-aids, highly engineered intake structures and legalised claims for water. In the 'bazaar', advisory professionals are working much more in *process* mode; allowing knowledge to be requested and framed by many more types of water users so that products are produced and owned by them. In the bazaar, resource users stipulate products and solutions that fit their particular locality and solve conflicts while recognising wider basin obligations. Examples are mapping services, conflict resolution workshops, irrigation infrastructure re-tuning and legal advice. The differences regarding advice, solutions and products between cathedral and bazaar may be subtle , but emanate from the manner in which problems are found, elicited and validated (considerably more field-tested in the bazaar), and then the manner in which solutions are generated (again emphasising local ownership). Here, communication from resource users to a much more responsive basin office is cultivated. The 'expert-in-support' does not work without recourse to scientific methods and protocols, but instead are used when necessary to enrich dialogue.

Another example of this difference can be seen in the often-used phrase in IWRM 'equitable water supply'. In cathedral mode, this only has meaning as planning or strategic workshop rhetoric and cannot be used to inform real changes. Rather the issue is how to provide a *more* equitable situation tomorrow that is an improvement on what exists today. One would not even use a phraseology that includes terms such as 'equitable', but to focus on what problems exist – these may be related to crops, or livestock conflict, or proportionality, or transparency.

Simplified and appropriate systems of data collection are also effective and in the hands of an experienced basin officer reduces the need for expensive monitoring networks and lab analysis. Low cost tools such as dipsticks and field testing kit for water quality are supplemented by visual and physical inspections (for benthic invertebrates, water colour/film, smell, mold, holding of foam, fish behaviour) which cost only time. The use of spot flow-metering equipment and buckets for measuring flows and the use of drain tracing dye also provide cheap and immediate field data. In diagnosing water problems such look-and-see approaches, whilst not always able to provide legal evidence, provide quick, effective and economic solutions.

The type, application and ownership of basin technology defines and facilitates the differences between the two models of basin management. In Tanzania, for example, formal donor programmes have utilised a high level of engineering formality in designing basin and irrigation infrastructure. In contrast to this, also in Tanzania and Nigeria, local users and projects have explored technical designs that employ materials such as stone gabions, log-stops and metal shutters that tend to result in proportional division rather than undershot orifice gates favoured by engineers. At a deeper level, these ideas create a platform for giving local users ownership, access and permission to constantly re-tune and adjust infrastructure to meet the pace of change in their sub-catchment, and to ensure acceptable levels of transparency in water division and allocation. The choice of technology – formal or informal – fits the degree of pragmatism required within the locality of that nested part of the wider basin. (Because space is limited here, the reader is referred to Lankford and Mwaruvanda (2007) for a discussion on appropriate proportional structures that support frequent and nested adjustments of water allocation improving knowledge of water distribution without recourse to flow measurements).

## Further discussion – decentralising certitude

We argue that the components of each side of Table 1 work in unison to define categorically different approaches – while current IRBM is constituted from an interlinking of formal and normative building blocks applicable to a hierarchical, centralised regulatory approach with basin wide jurisdiction, an alternative applicable to, and made possible by sub-basin differentiation, is composed from systems of polycentrism, subsidiarity, informality, pragmatism, incrementalism, appropriate technology, problem-solving and peer-to-peer dialogue facilitated by individuals or

'personalities' . It is this contrast that the 'Cathedral and Bazaar' organisational metaphor captures well.

Rather pessimistically concluding, for seven reasons we do not foresee that polycentric 'distributed' basin management will be forthcoming, even though ideas contained in this paper have been recognised and understood by academics and managers. Feedback at several workshops in England, Netherlands and South Africa where the concept has been presented indicates both interest and scepticism. Firstly, we believe such scepticism arises because water is seen as multi-functional and integrating, requiring an 'integrated' response at the basin level. The planning of IRBM, manifest in training sessions and workshops, exemplifies this. Few seem willing to interpret river basin management as an endeavour that can be simplified and *disintegrated* (though we argue that to discern simplified approaches requires high levels of skills and experience).

The second reason is that scale is invoked as a defence; that large river basins necessarily need centralised control and regulation, and that water user organisations have limited reach and cannot extend over a great area. Key here, is the need to conduct meaningful analyses of whether basins could be subdivided into modular units that can self regulate and be re-constituted into a federalised basin. Just as open source computing is overseen by a central administrating unit, we foresee that basin-wide perspectives are still needed for the bazaar to function. 'Foregrounding' or 'backgrounding' this overseeing unit would relate to the basin model being pursued, and consequently help define the location of managerial authority between this central unit and the polycentric subsidiary units. Modularisation would also lend itself to localised planning and implementation of supply systems for small amounts of water, beneficial to households and livestock, required during the 'critical' state (dry seasons and drought periods).

Thirdly, many water scientists may simply argue that the stakes are too high not to introduce a regulatory model – but that more time, finance and training are needed. Concerns particularly revolve around the question of how to deal with powerful vested interests that require legislative control. (Field research by the authors reveals that many such imbalances in Tanzania have never been taken to court, despite the country having a sophisticated water law for more than 20 years).

In a related fourth point, even if it could be shown that a pragmatic polycentric model complements an eventual move towards formal procedures, many scientists would probably argue that it is already captured in the participative dimension of regulatory water management. To answer both of these points, requires further exploration of how meaningful subsidiarity at the local level goes beyond current practices of 'participation' to solve power imbalances. The 'bazaar' does not envisage the absence of courts and laws, but does emphasise local informal and reflexive legal institutions and norms.

Fifth, the ontological 'get-out clause' can be invoked; the defence being that bazaar-type approaches are simply operational interpretations of IWRM cathedrals – the latter being appropriate for higher level, or national, IWRM planning. While this may be true, and we question this, the onus is on those who promulgate cathedral teaching to also provide bazaar methodologies and templates at the same training sessions; currently the emphasis appears too much on the former than the latter.

Sixth, the decentralised approach implies a radically different 'capacity building' cognition. Teaching process operable at a local scale is much more difficult and might not be addressed by adjustments to existing courses, i.e. by introducing more role-playing or specific exercises. The polycentric model would require the formulation of a training 'package' comparable to that which exists for IWRM – yet as one Environment Agency scientist said in 2006 at a meeting in which the Cathedral and Bazaar idea was proposed, 'how could this be done?' For polycentric water management, training[9] would be scaled back in favour of mentoring, implying a different aid model of long-term *in situ* technical assistance by scientists, NGO's and other support agencies.

Perhaps the more significant, seventh reason would be the political blocks on the process of adoption of different models of IWRM – a decentralised model greatly increases the independence of basin officers and the responsibility of local users in negotiating water and calling in services from providers – in contrast to the state sovereignty and command and control embedded in the regulatory model. Furthermore, the implication of dysfunctional state regulatory administration may force a level of introspection that is unacceptable.

## Conclusions

Should there be an IRBM theory shift, in reality, regarding 'practice interpretation', actual river basin operations in the future will be a balance between the two models. In some river basins there will be a clear case for a well-financed regulatory authority deploying centrally planned infrastructure, water measurement and legal safeguards against powerful sectoral interests, while in other basins, a basin-centred office would be downplayed against support for localised modular sub-units each determining particular priorities to meet internal and external objectives.

However, the explorations of the limits of regulatory water management in the UK[10], Kenya and Tanzania by the Environment Agency are illuminating; yet discussions with basin officers as a part of this research indicate that these explorations have not knocked the certitude that regulatory command and control are a necessary part of river basin management. While the authors hold an open mind regarding that, we take issue with

[9] A move away from the workshop culture, easily recognisable in the majority of development cooperation programmes in sub-Saharan Africa, may be unpalatable to various parties (Smith 2003).

[10] The application of the Environment Agency's Enforcement Policy is a working example of a bridge between the regulatory and dialogue based models.

the extent to which the principle of 'ex cathedra' regulation accrues a comprehensive monolithic basin-wide approach (for example see the seven points discussed just above) much of which are open to question and need not be automatically adopted in some types of river basins. In this regard, one could empirically argue for polycentric possibilities; in other words such is the wide range of institutional and infrastructural options available to fit the very large number of basin conditions and contexts found, it would be unusual if the basin-wide regulatory model was the only planning format going.

Concluding, we argue for much less certitude regarding the regulatory approach. Water managers need a pragmatic theory of water management that generates focussed and practical operations. By starting out at the planning level with principles of polycentric basin management, one would expect the operational level to adopt these, a process with much scope for the interpretation as the right hand sides of Tables 1 and 2 indicate. While further thinking is required, it is clear that we and others are legitimately able to question the theory and hegemony of 'integrated' river basin management given the contrasts between a global momentum to actualise it and our grounded observations of operational inertia. While adhering to the *sentiments* of integrated water resources management, we shall in some cases need to *disintegrate* IWRM and IRBM.

It is worth returning to the subject of knowledge frameworks that currently wrap around the policy and training of IWRM. We believe that a considerable self-referencing system of literature, training and consultancy heavily skews the balance towards an integrated regulatory model regardless of circumstances. Little about the use of informal field methods, the role of individual personalities, personal experience, step-wise progress and practical conflict resolution is taught in formal water training. This is indicative. This imbalance means planning and operational designs of IWRM are less open to the possibility that progress can be made in a decentralised, modular, informal mode, on to which 'more formality' and federalisation may be piggybacked in the future; 'start with the bazaar and move to the cathedral'. Curricula and training on the dissection and poly-centralisation of basin management built from ideas around scale/form, risk approaches, scheduling and regime states might be a way forward.

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