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# Integrating Research for Water Management: Synergy or Dystopia?

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**Abstract** In the hope of speeding translation from research to policy, the EU, and other funding bodies, advocate interdisciplinary research whilst underplaying real obstacles to achieving common aims and methodologies for the natural and social sciences. From inside observation of an antagonistic interdisciplinary research project, some suggestions are made on the preconditions necessary for successful collaborations.

**Keywords** Consilience · Interdisciplinary research · Social science · Systems analysis · Political ecology · Research funding

## 1 Introduction

For much of my career, I have been grappling with the problem of interdisciplinarity and sometimes hostility between the disciplines, both in theory and in practice. I was trained as a geographer and geologist and lectured in geomorphology for some years in the University of London, whilst researching the exchange of ideas between engineers, geologists and geographers on the concept of dynamic equilibrium in rivers. Then, I joined the newly-formed Research Councils as a manager of research funding. At first, I worked for the Natural Environment Research Council dealing with research in hydrology, meteorology, land use and geomorphology. Later, after a career break, I worked for the Economic and Social Research Council dealing with political science, economics and geography before I began political ecology research for my Doctorate at the University of Oxford on decision-making over dam construction. Since then, I have been working on an EU-funded interdisciplinary project on water resources in the Dead Sea region. This experience has stimulated my curiosity about the dissonance between acclaim for the virtues of

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interdisciplinarity and fundamental differences between disciplines in intent, methodology, interpretation and application of research results.

I have been privileged to hear many highly knowledgeable and intelligent people speaking from their own viewpoints and disciplines, often with scorn for alternative approaches, whilst I have actively promoted interdisciplinarity in devising research programmes and centres without close examination of the feasibility of synergistic results. One vision of the Research Councils is to stimulate new, integrated approaches so that the output from the research may be more accessible for policy-makers, who, otherwise, would themselves have to digest messages from different, discipline-bound studies.

The field of water resource management is chosen as an exemplar of some of the tensions inherent in extending the results of hydrological scientific analyses into the realm of policy. Hydrology attempts to study idealised relationships, often gathering data where direct influence of humanity is small, such as upland catchments, to characterise systems and process response to land cover change. Focus on the physical aspects of water flows studied as an earth science can lead to a difficult progression towards the ultimate goal of improving the interrelationships between people and their environment. This paper explores one aspect of endeavours to widen the hydrological grasp; that is attempts at integration which involve domination of positivistic scientific methodology over critical social science.

## 2 Integration of Social and Natural Sciences

Viewing social science as an add-on to the physical sciences may seem easy to handle; sometimes, historical studies can readily be added once the need is recognised or some social aspects of the results of the technical analysis may be tacked on at the end but true interdisciplinarity which involves sharing of methodologies between social and natural sciences is far more problematic. Even though ecological history, political science, anthropology and sociology have much to offer they are often ignored in interdisciplinary projects, along with local knowledge, which is belatedly now being recognised as crucial for successful hydrological management (Forsyth 2003; Leach et al. 2005).

In the literature, a technical mindset has been depicted which:

> puts its faith in empirical evidence and the scientific method; it relies on expert judgements in making policy decisions. Emphasizing logical consistency and universality of findings, it focuses attention in public decision-making on quantifiable impacts (Plough and Krimsky 1987).

Such an emphasis on quantifiable information has had a major impact. Attention of hydrologists has been concentrated mainly on the incorporation of social sciences such as economics, which shares some epistemic characteristics with hydrology in its reduction of problems to simplified and quantifiable relationships (e.g. O'Callaghan 1996; Barbier et al. 1997). True integration is more elusive.

Integrating social science into hydrological projects should not mean subjugation of the political, historical or sociological project to the scientific methodology. Too often have I heard statements such as:

> What is urgently needed is a total systems approach to modern civilisation through which the pooled talents of scientists and engineers, in cooperation with social scientists and the medical profession, can be focussed on the development of order

> and equilibrium in the presently disparate segments of the human environment. We surely have a right to hope that a technology that has created such manifold environmental problems is also capable of solving them (Mitsch and Jorgensen 1989, vii).

Or as the UK's Chief Scientific Adviser and Head of the Office of Science and Technology, the numerical biologist Sir Robert May used to proclaim, "The trouble with social science is the social scientists! If only it were done by physicists how much better it would be!." In this taunt, he was echoing Edward O Wilson's famous book *Consilience* which tells the social scientists how they should adopt the scientific method in order to be admitted into the grand design of consilience, bringing all knowledge together under one heading. Wilson writes,

> the central idea of the consilience world view is that all tangible phenomena, from the birth of stars to the workings of social institutions, are based on material processes that are ultimately reducible, however long and tortuous the sequences, to the laws of physics (Wilson 1998, 297).

You do not need to be an expert in Foucauldian analysis to read the assertion of power in such statements. The scientist is saying that scientific methods of reducing problems to their bare essentials, to things which may be measured and linked causally can, and should, be applied to explain and control civilisation. The power of the scientist and the engineer to coerce others should be equal to the power of their analysis, albeit with a concession "in cooperation with social scientists and the medical profession" (ibid. Mitsch and Jorgensen). Their idea of rationality is being used as an instrument of naked power and control. Although we are asked to believe that the motives of such technocrats are for the common good, the spectre of dictatorship lurks in such statements.

## 3 Problems of Introducing Social Complexities into Systems Models

At first sight, systems analysis appears to present a blueprint for solving environmental problems, such as water resource management, with its promise that the mechanisms within the system may be sufficiently well-understood that the effects of perturbations become predictable. However, translation of the results from the model into real, complex situations is problematic.

Systems analysis is not simply recognition of many elements interacting but implies coherent causal relationships (Taylor 2005). Modelling, by definition, is a simplification of reality to enable reasoning within an idealized logical framework. Adherents hope that systems analysis will clarify thinking about the complex dynamics of water/environment in the region, suggest hypotheses for testing and give a clearer picture of the quantities of water which would be affected by future changes in land use and water supply. Engineers and development experts often limit their analyses to economic and demographic measurements, such as age, income and education, which can be included in modelling tools. The model is abstract, lacking information on those spatial relationships and physical constranits, which are so important in water resource management.

Causal loop-based systems models lack the ability to offer multi-dimensional links to represent the heterogeneity within a single society. In reality, even small societies are heterogeneous and different individuals within those societies have multiple forms of identity within changing relational networks. These include ethnicity, religion, caste, tribal relations as well as informal everyday life practices. Individuals might identify themselves

by a certain facet of identity in one context and by a radically different facet in another. People respond to the actions of other people in ways which often are not consistent over time. Furthermore, the model is unable to represent one extremely important dimension within environmental management: that is conflict, let alone latent conflict which may emerge in response to change. And how are various forms of power, influence and manipulation represented or taken into account within such a model?

A natural scientist might defend reductionism as a means of identifying fundamental processes from confusing complexity and cite its success in science but there are significant dangers inherent in using this method in understanding society. Whilst the systems approach tends to accept the current situation as the framework for action, critical political analysis asks how the institutions and power relations came about and whether they are changing. The distribution of water in any place is rarely solely a physical problem but a result of interaction of people with their environment in changing land use, in manipulating rivers, in draining wetlands and in controlling the quality of water and its allocation. Examination of historical hydrological measurements for extrapolation needs supplementation by contextual historical study and analysis of current power relationships before serious thought is given to changing future directions. With the addition of social and political analysis, there should be no more talk of "society" as if it were homogenous, no more assumptions that water in all its forms is commensurable (Espeland 1998), no more neglect of gender relations, no more untested assertions of the power of the state to control changes to the environment.

Once the motives and purposes and struggles which brought about the current, problematic distribution of water have been understood, however dimly, questions of values have already been introduced. The scientists' or engineers' claim to be apolitical cannot hold. Even the term "water resources" includes a framing of water as at the command of humans for utilisation rather than for appreciation for its beauty or contribution to other living things. Choices involve values and the positions adopted by the authors need to be made explicit (Lélé and Norgaard 2005). Major issues are raised: Should new policies have concern for the weakest members of society or should they give increased power to the strong? Who bears the risks? How is coercion to be exercised?

Systems analysis leads to analytical subdivision and limitation of the issue to be addressed whilst the critical approach looks at a larger picture in which the selected component is just part. Whereas a systems approach attempts to make predictions of a range of outcomes, a critical approach will recognise that many outcomes are indeterminate (Cox 1986). Systems analysis is feared by critical social scientists for use as a basis for policy-making because of the "false negative" given to the information which has been discarded as irrelevant. In real life, the prevalence of unintended consequences following policy changes must cast doubts on any simplistic assumptions about social dynamics. For example, the superficially rational assumption that problems concerning the allocation and use of scarce water will be solved by the market implies that if you increase the price of water, it will be used efficiently. Yet an increase in price may provoke unhealthy avoidance, or under-use, of metered water supplies and outbreaks of cholera as recently experienced in South Africa; violent resistance as in Cochabamba, Bolivia; water theft by the poor and no reduction in use by the rich. Implementation of the pricing policy and its enforcement by the state will not be free of politics (Ferguson 1994; Scott 1990) and powerful social groups may be favoured. Some of the information discarded in building a systems model may assume dominance in reality.

Such technical methods, despite their many limitations, attempt to set engineers and technical experts at a superior level that marginalises lay-people who are directly affected

by the decisions made about their environments. The solutions proposed by the scientist appear to assume a small elite in control of a larger population. The critical social scientist makes no such assumptions and questions the use of science to legitimate power. They are interested in the relatively powerless and the less articulate as well as the dominant social groups. The knowledge of the people at whom 'development' would be targeted would be ignored if such models were accepted as driving forces for policy-making. Recent advocacy of IWRM attempts to counteract such tendencies by inclusion of the public and aims towards equity. This realisation of problems caused by neglecting study of people, institutions and politics is not confined to social scientists: Biswas (2004) in his critique of Integrated Water Resource Management raises many issues, social, institutional and political, which intervene between any idealised model of management and reality.

A systems model may be fed with data extrapolated from sparse measurements and measurements taken at a distance, such as by remote sensing. Without careful study of human activities on the ground, it is easy to leap to false conclusions. The most notorious of these has been the concept of desertification, a generalisation enamoured by global environmental organisations but shown to be based on many hydrological and social fallacies (Mace 1991; Turner 1993). Turner demonstrates that,

> Environmental analyses that focus solely on stocking rates, no matter what their spatial scale, oversimplify the biophysical aspects of vegetative response to grazing and exclude a whole realm of social causality within which grazing management is embedded... with tragic consequences for those livestock-rearing peoples chosen as development subjects (Turner 1993, 406).

Neglect by hydrologists of the social effects of their results may allow them to be used to support repressive policies (Leach and Mearns 1996; Stocking 1996), and to feed a more general cynicism about "experts" in a post-modern world. To extend hydrology into the policy arena, the social sciences are needed both to define priority problems and to illuminate the social and political context of changing regimes. Yet the process of interdisciplinarity is far from easy.

## 4 Interdisciplinarity in Practice in a Large, International Team Studying Sustainable Water Resource Management

My own experience of joining an EU-sponsored research programme on options for a more sustainable water management for the Dead Sea basin has been illuminating. From my optimistic enthusiasm for interdisciplinarity as a research administrator, I was plunged into interdisciplinarity in practice. The project was based on the objective:

> to establish the scientific basis for a 'more sustainable than today' water management and water-related management in the Dead Sea basin, and from this, to develop practical recommendations that can be used for strategic decision making.

At once, you will see the technocratic slant in the objective: the claim that science rather than politics or economics is the basis for better water management; the claim that from science "practical recommendations" can be drawn for strategic planning. The intervention of value-free and depersonalised "science" is seen as the answer to struggles over water in a semi-arid to arid area. An unsupported assertion is made implicitly that top-down "strategic" planning should be effective even in an area engaged in active political conflict.

The specification of the project implied that the fate of the Dead Sea was an environmental problem of international importance and that EU intervention was desirable.

To the EU, the project must have seemed like an extension of aid funding to the troubled Middle East and a welcome attempt to promote collaboration between scientists from Israel and its Arab neighbours. The EU was also under pressure to be seen to be contributing to research in support of the Millennium Development Goals to bring improved water supplies to the world's poorest. Addition of political science would be seen as a bonus towards the delivery of results with a claim to applicability. A political scientist was invited to join the project, having previously researched water conflicts in the West Bank, but took no part in drawing up the specification. The specification of the project had systems analysis and computer modelling at its core. Misunderstanding played a part in acceptance of systems analysis as a possible political science approach.[1] Yet careful perusal of the specification would have shown little critical political content and trouble might have been anticipated.

Within the project, emphasis was given to analysis of satellite imagery, the development of a GIS database and a systems model and scenario building. Stock-flow diagrams based on an assumption of economic rationality were used in the project with insertion of causal loops to depict hypothetical water movements in an abstract system. The political scientist believed that the methodology was flawed and refused to provide data for insertion in any systems model and an emotional battle emerged as the engineers and scientists attempted to impose the original project specification. Instead of either side being persuaded to modify their views, or to accommodate each other, the project became dystopic with disagreements becoming personalised. An opportunity for production of new knowledge cutting across disciplinary boundaries was lost. The project had been in progress for 2 years before I joined for its last year to assist with the synthesis as a political ecologist. What I found was a project riven by discord between the political scientists and the natural scientists/engineers. Although there were significant achievements in parts of the project, the central aim of integration of political analysis proved too ambitious. The discords and a full discussion of methodological difficulties have been meticulously reported to the EU both as a significant research finding in itself and in the hope that improvements in the management of interdisciplinary research might be introduced.

## 5 Interdisciplinarity and Environmental Research

Such failure to achieve the high hopes of interdisciplinarity contained in the exhortations of the EU is not singular. A review of the EU' s Fifth Framework programme, which explicitly encouraged integrated approaches to research, found that there were "disappointingly few" projects which achieved interdisciplinary integration across the boundary of the natural and social sciences (Bruce et al. 2004). These reviewers advise on how interdisciplinarity might be encouraged in the future by overcoming personality and institutional barriers but, ironically, they suggest as a possible way forward adoption of "systems analysis," the very methodology which caused the most fundamental disagreement in the Dead Sea project.

Imposed integration in science-led projects is elusory because of the limited social observations included in computer models yet spontaneous interdisciplinarity can be creative and productive. Nissani celebrates the joys of freedom experienced by those choosing interdisciplinarity and its importance in crossing communication gaps thus

[1] Waltz (1979), used systems analysis to depict power relations between states but subsequent failure of this approach to predict the downfall of the USSR has now favoured more eclectic theorising.

mobilising "intellectual resources in the cause of greater social rationality and justice" (Nissani 1997: 201). Research on environmental science and politics, particularly the empowerment of disadvantaged social groups is growing (e.g. Zimmerer 2000; Forsyth 2003). Environmental management, especially ambitions for Integrated Water Resource Management, must be based on research which explores and illuminates complexity rather than relying on partial simplifications from either social or technical scientists working in isolation (Taylor 2005). The requirement is clear but facilitation of delivery needs improvement.

## 6 Conclusion

The rueful conclusion I have drawn as an ex-research manager (now researcher) is that promotion of interdisciplinarity and communication between natural and social scientists is far more complex and interesting than I had previously envisaged. Administrative encouragement to add one or two critical social scientists to any team adhering to a very different paradigm may prove dystopic by losing the benefits of parallel research whilst failing to achieve new interdisciplinary insights. Exploration of useful intersections between different knowledges needs strong motivation, critical examination of strongly-held convictions, freedom to innovate and time to allow interdisciplinary links to emerge, rather than being imposed. Whilst for accountability, the funder needs to have information about the research proposed and assurance that thought has gone into its planning, requirements for over-specification of research can have a negative effect on the creativity needed for interdisciplinarity. If the specification constrains growth and limits alterations, the results are less likely to produce new research findings.

Facilitation of the early planning stages, post-award, should be a priority with recognition that disagreement is an expected stage in the development of team work rather than a disruption to be avoided (Tuckman 1965, famously described the sequence in developing group work as "forming, storming, norming and performing"). "Storming" should lead to excavation of fundamentals lying below the conventions. Revisions and development of researchable issues should be expected and welcomed without unrealistic expectation of total integration. Rather than recruiting social scientists to translate, or make more acceptable, technical findings for policy makers at the end of a project, participation of policy-makers is needed from an early stage, if any project has ambitions to be policy-relevant.

Wilson's attempt to discipline social sciences and humanities into adopting scientific methods as 'consilience' will not succeed but valuable synergy is possible without domination by one method of analysis. As Stephen Jay Gould reflected:

> I want the sciences and the humanities to become the greatest of pals, to recognise a deep kinship and necessary connection in pursuit of human decency and achievement but to keep their ineluctably different aims and logics separate as they ply their joint projects and learn from each other. Let them be the two musketeers – both for one and one for both – but not the graded stages of a single and grand consilient unity (Gould 2004: 195).

By closer working with social scientists, hydrologists will access a much more conceptually-rich world of diverse explanations and will gain understanding of the power relationships inherent in water resource management. Social scientists also have a great deal

to learn from hydrologists. The need for better water management is so pressing that all opportunities for synergy (without domination) between natural and social scientists must be embraced. We can and should be pals.

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