# THEORISING STRUCTURED DIVERSITY

## An approach to comparative research on water resources management

**Peter P. Mollinga and Daphne Gondhalekar**

**April 2012**

## ICCWaDS Working Paper No. 1

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"The 21st century will almost certainly be an era of increased global circulation of water issues, inquiry, expertise and action. During the late 20th century, international water organizations expanded in Europe, Scandinavia and South Asia. While they succeeded in creating new programs, the field of comparative international research has lagged behind these organizing and information dissemination efforts.

In light of the critical water problems faced in every region of the world, the next twenty years will require a major shift from largely implicit comparisons to rigorous comparative analyses that analyze and expand the range of water management adjustments that are designed to address these problems in different regions of the world. These comparative analyses will need to draw upon rich historical experience and geographical contexts that require new combinations of quantitative analyses, qualitative case study, and creative analogy. Research approaches that developed in limited interdisciplinary ways will need to be dramatically adapted, in ways analogous to river basin planning and water systems analysis in the 20th century, but that address issues that those earlier approaches overlooked or aggravated. It is a research vision that will require all of the comparative international insight that can be attained."

*(Wescoat, 2009:65)*

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# 1 INTRODUCTION

This working paper aims to be a methodological prologue to a comparative research programme on globalisation-localisation dynamics in water resources management. Narratives underpinning research endeavours can provide different types of justifications of their focus and approach. At least three narratives, and thereby three logics, underpin the present endeavour. The first narrative is related to the object of the research, the characteristics and challenges of contemporary water resources management; the second is related to the knowledge on that object, the characteristics and potentialities of (critical) water resources studies; and the third relates to the potential application or practical usefulness of comparative water research as a critique of 'mainstream' water policy and practice to support the development of more contextualised approaches to water policy formulation and implementation.

## 1.1 Characteristics and challenges of contemporary water resources management

One characteristic of water resources management is that its globalisation has intensified in recent decades, particularly since the early 1990s. This narrative starts from the observation that the 1990s has seen, with the end of the Cold War and the coming of age of environmental critiques in the 1992 Rio Earth Summit, the alignment of three 'big ideas' in a global discourse on water resources management.[1] These ideas are the idea of the market, the idea of democracy (often phrased as 'good governance')[2] and the idea of sustainability. These were assembled in the concept of IWRM, Integrated Water Resources Management, conceptual closure of which as a 'sanctioned discourse' happened around 2000. The 'new paradigm' that emerged at the global level is supported by a set of global organisations, notably the GWP (Global Water Partnership), several UN organisations, and (elements of the paradigm) actively propagated through international development funding agencies and, for instance, knowledge organisations involved in capacity building (e.g. CapNet).[3] The process has generated a variety of global civil society and professional networks responses through organisations like the International Rivers Network, the International Network of Basin Organizations and many others. The recent surge in attention for climate change, in which water resources management plays a central role, has added to the perceived global nature of the 'water question', most recently popularly framed as a 'water security' question.[4]

This process of the globalisation of water policy and water governance discourse is complex on several counts. The global discursive space is inhabited by many different actors, moving at and across different levels, deploying different strategies, triggering different mechanisms of change, with causalities running in multiple directions. For instance, local water controversies have sparked and shaped global rule making through

[1] With water resources management we refer to freshwater management, for agriculture, drinking water and sanitation, industry use, hydropower, navigation, and ecosystem services related to the ecological sustainability of wetlands, lakes, rivers and other waterscapes. We do not refer to the management of the seas. For detailed discussion of the argument summarised here, see Mollinga (2008).

[2] See Sending and Neumann (2006) on 'human rights as a normative master discourse' in the post 1990 period.

[3] For an account of this globalisation process see Conca (2006); on transnational corporations and water privatisation see Robbins (2003).

[4] On water security, see Zeitoun (2007) and Allouche et al. (2011).

mechanisms like the WCD (World Commission on Dams) whose principles and guidelines are now (partly) incorporated at regional and local levels[5]; global water governance frameworks can shape local policy and action through loan conditionalities, but such 'imposition' may also be appropriated by domestic interest groups for their own purposes; lateral relations of nation states in hydropolitical negotiations can be shaped by global mediation, law and policy paradigms, but often perhaps depend more on regional political and economic conjunctures; and so forth.

The global water discourse is full of contradictions – a second instance of complexity. The alignment of the three 'big ideas' in one concept or framework as mentioned above is problematic because the individual ideas as well as their connection are intensely contested. This is evident for instance in the competing overall framings of the 'water question': as a question of scarcity and (in)efficiency, as a question of governance, as a question of security, as a question of equity and justice, and/or as a question of imminent ecological disaster. In this sense global water discourse is a typical instance of the broader process of emerging global environmental governance frameworks, and the debates and controversies associated with these.[6] As such it is an entry point for interrogating the nature of contemporary development.

A third source of complexity is that the globalisation of water policy, governance and discourse is associated with other aspects of globalisation, notably economic globalisation, one dimension of which is the declining and/or changing role of the state in fostering, leading and regulating economic development.[7] Water resources management is an inherently localised practice. Concrete water use takes places within the physical context of basins, aquifers and landscape units, the scale of which is only limitedly extended by inter-basin transfers. Water is not a commodity that is traded or transported globally on a significant scale.[8] Economic globalisation of water use, management and governance is mostly associated with the commoditisation of water services of different kinds rather than with the water itself becoming an actively traded commodity.[9] Though the 'problemsheds' of water resources management usually extend well beyond the physical boundaries of water use, water resources management is a terrestrially and territorially grounded, but thus not bounded, practice. Historically, water resources management has played an important role in nation building[10], and the nation state remains the major institutional framework for water resources management.

This incomplete sketch of different aspects of the globalisation of water resources management suffices to suggest that there is a puzzle to unravel. It is not self-evident what the seemingly forceful process of globalisation means for water resources management, in different places, and at different levels, and what its attributes, modalities, effects and impacts are.

[5] See the special issue of *Water Alternatives* on the WCD 3(2) June 2010 www.water-alternatives.org.
[6] See Stone (2008) on the 'disjointed' and 'order and chaos' character of global environmental governance.
[7] See Newell (2008) on the institutional and statist 'fix' of a lot of analysis of the (politics of) global environmental governance, and an argument for explicit embedding institutional/policy/governance analysis in a political economy framework that takes global(ising) economic relations seriously.
[8] The trade in bottled mineral water is a miniscule part of global freshwater use. Virtual water trade is indeed virtual.
[9] On the complexities of the commoditisation of water, see for instance Molle and Berkoff (2007) on water pricing, Moore (1989) on irrigation, Bakker (2003) on water supply privatisation.
[10] A few examples are Blackbourn (2006) for Germany; Worster (1985) for the USA, and Whitcombe (1972) and Stone (1984) on the colonial experience of India. For grand theory see Wittfogel (1957).

## 1.2 Characteristics and potentialities of (critical) water resources studies

The second narrative that aims to justify the relevance of a comparative research programme on water resources management starts from the state of the art of water studies and the question of knowledge accumulation. The inherently localised nature of water resources management has produced a series of localised literatures on water. In the European languages sphere, the English, French and Spanish literatures are large and quite distinct bodies of water scholarship, reflecting their situatedness, notwithstanding increasing interaction between them, which itself is one aspect of globalisation. There are many other smaller literatures adding to the diversity. Other sources of the compartmentalisation of water studies are the different academic disciplines/disciplinary fields in which water is studied, the different scientific paradigms through which it is approached, and the different purposes of water studies (say the instrumental, intervention oriented purpose versus the reflexive, critique oriented purpose).[11] Despite the richness of this combined set of literatures, there is relatively little learning happening across the boundaries of the compartments, even in the tradition of comparative water studies.

The prospect of more cross-fertilisation of these different water literatures and related experiences may be found exciting enough by itself to aim at a comparative research programme. More profoundly, we will argue that it also addresses the question of knowledge accumulation and theory formation in water studies. In our assessment water studies are characterised by both over-generalisation and over-contextualisation. With the former we have in mind positivist approaches like prevalent in the economic and engineering sciences (but by no means limited to these) that look for 'Humean constant conjunctions' allowing generalised explanation. An example of the latter are ethnographic studies of local water management situations as prevalent in anthropology (but by no means limited to that field) that argue, explicitly or implicitly, for contextual uniqueness, against positivism. Like most dichotomies, this depiction caricaturises, but does serve to illustrate the puzzle of how, in research, to take contextuality and situatedness seriously, while maintaining the prospect of knowledge accumulation and theory development without succumbing to a-historical universalisation.

The two polar forms of research sketched are accompanied by quite a bit of 'loose comparison' undertaken to learn from the diversity of experiences. The most sophisticated and rigorous attempt at identifying 'Humean constellations' is probably Ostrom's work on farmer managed irrigation that led to identification of a set of 'design principles' for self-governing irrigation institutions (Ostrom, 1990, 1992), which critics would argue are a very useful mapping tool, but explain very little. Very common in water studies are collections of case studies in edited volumes with an introduction and/or conclusion aiming to derive general insights or set comprehensive agendas, usually without an explicit and rigorous methodological framework for comparison.[12] We conclude that there is, apparently, a strong desire for practical as well as conceptual learning, a lot of 'implicit comparison' (Wescoat, 2009b), but little in the way of explicit, rigorous comparative method to facilitate such learning.

[11] The analysis of 'compartmentalisation' can be further developed form philosophy of science and sociology of knowledge perspectives, but that is beyond the scope of this paper. On the logic of advocating *interdisciplinary* water studies, see Mollinga (2008, 2010a). The instrumental/reflexive distinction refers to Burawoy (2005).

[12] To make clear that this is as much self-criticism as a comment on others' work, one self-produced example of 'loose comparison' is Mollinga and Bolding (2004). Additional examples and a more refined argument are presented below.

The knowledge accumulation, theory development and learning puzzle just sketched is by no means unique to water studies, and neither is the suggestion that a comparative approach to research may help to resolve it an idea that originates from the water resources domain. We do want to suggest that the inherently localised nature of water resources management as now set in a context of intensifying globalisation provides excellent ground for growing a new branch of comparative analysis. We are tempted to claim that the nature of the object demands it, while the rapidly increasing volume and the diversity and richness of water studies allows for it. The framing of the puzzle of knowledge accumulation and theory development in this way, or the existence of such a puzzle in the first place, is, however, far from uncontroversial, as will be shown.

### 1.3 Standardisation and contextuality in water policy approaches

A third narrative to justify a comparative approach to water research addresses a recurrent dilemma and dichotomy in water policy theory and practice. Characteristic of water resources policy approaches is that they (implicitly or explicitly) adopt linear, rational planning conceptions of formulation, implementation and evaluation of policy interventions (for detailed argument, see Mollinga et al., 2007). The concrete consequence of this is standardisation in policy models and approaches. One of many examples is how the Government of Andhra Pradesh, India enacted the establishment of Water Users Associations (WUAs) in irrigation systems through the Andhra Pradesh Farmer Management of Irrigation Systems (APFMIS) Act, and about 10,000 WUAs were established with a single format. Linearity was further expressed through the top-down, centralised nature of the implementation of the irrigation reform policy.

An example in the policy sphere of generalising to learn form a diversity of experiences, is the 'IWRM toolbox' as a learning instrument for water resources decision makers (http://www.gwptoolbox.org/). This is basically a set of generalised descriptions of specific experiences deemed to be 'successful' and an effort to make that 'success' transferable to other places. Another example in the context of policy development is efforts to identify 'conditions for success', say for establishing effective Water Users Associations, by deriving such conditions from a comparison of a series of cases (Subramaniam et al., 1997).

On the other side of the policy/intervention/change spectrum we find the highly localised approaches of for example NGOs focusing on village development. One well known slogan in watershed development/water harvesting in India is 'catch the drop where it falls', implying a vision in which water problems are to be solved at local/village/community levels, each having their own specific circumstances. Critiques of standardised policy approaches are often cast in term of their neglect of 'contextual factors', calling for more local specificity and flexibility in implementation approaches.

Debates on what would be a 'right level' of specificity and contextuality in water policy, to the extent that it exists, is caught in a deadlock of polarised positions, notwithstanding convincing critiques of both standardisation and the glorification of 'community' (cf. Mosse 2003, 2005). The deadlock is consolidated by institutional, political and other interests in maintaining dichotomous positions (Mollinga et al., 2007; Mollinga, 2010b). What we propose is that comparative research may be an avenue for underpinning attempts at contextualising policy approaches and policy instruments in a way that avoids either extreme. Comparative research aims to identify significant differences (qualitative differences in structural configuration, as we phrase below) of different situations. Thereby comparative research can potentially help to define 'relevance

domains' for specific policy interventions, or, in reverse, help to design relevant policy approaches and instruments for given situations.

While the substantive and policy focus of a comparative research programme on water resources management as sketched above will be left for what it is, this paper focuses on the methodological dimension. This paper reviews the literature on comparative research in the social sciences and comparative water studies to identify a comparative method fitting the purpose and scope of the envisaged research programme, and (critical) water studies more generally. It aims to make a case for the usefulness of systematic, step-wise small-N/medium-N comparative analysis of water resources management.

### 1.4 Structure of the paper

This working paper is structured as follows. Having outlined the scope and aims of the paper in Section 1, Section 2 introduces the origins of the comparative method and its applications in the social sciences. Section 3 illustrates the water resources management research context and its use of the comparative method, listing a limited number of examples to highlight differences in methodological approach. Section 4 reflects on comparative water studies by looking at several issues including purpose, possibility and rigour of comparative analysis. Section 5 outlines the features of a stepwise small-N/medium-N approach to comparative water studies and 'fit' with critical realist ontology. For those particularly interested in the programmatic intentions of this paper, sections 1 and 5 are the main sections. Those interested in the literature review can find the main body of references in sections 2 and 3. Section 4 connects the two.

## 2 THE COMPARATIVE METHOD IN THE SOCIAL SCIENCES

Comparative analysis as a method has a long history in the social sciences. Its proponents include John Dewey, who stated that "[a]ll intelligent political criticism is comparative. It deals not with all-or-none situations, but with practical alternatives" (1927, *The Public and Its Problems*).[13] Emile Durkheim argues in *The Rules of Sociological Method* (1982, orig.1895) that all sociological research is in fact comparative since social phenomena are always held to be typical, representative or unique, all of which imply some sort of comparison. Ragin (1987:1) states that virtually all empirical social research involves comparison of some sort, of real or hypothetical cases, or of cases' values to average values to assess covariation. He quotes Lieberson's (1985:44) statement that social science research "in one form or other, is *comparative* research". Bailey (1994, in Rihoux and Ragin, 2009:xvii) also states that any descriptive effort, any typology or classification involves comparison. In the *Penguin Dictionary of Sociology*, the comparative method is defined as neither a distinct methodology nor a particular theory, but rather a perspective (Abercrombie et al., 2006:74). The comparative method is thus not bound to any academic discipline in particular.

According to Mahoney and Rueschemeyer (2003:3) the comparative method was employed by the founding fathers of modern social sciences such as Adam Smith, Alexis de Tocqueville, and Karl Marx, at a time when

[13] Quote obtained from http://poli.haifa.ac.il/~levi/method.html

huge transformations necessitated finding new ways of understanding new large-scale phenomena. Capitalist commercialization and industrialization in Europe raised pressing issues and a search for explanation of large-scale processes. These were most appropriately studied through explicit comparison across national and regional boundaries (Mahoney and Rueschemeyer, 2003:7). Alexis de Tocqueville's *Democracy in America* (1945), Barrington Moore's *The Social Origins of Dictatorship and Democracy* (1966), and Theda Skocpol's *States and Social Revolutions* (1979) for example explicitly draw on the comparative method and specifically on cross-national analysis (Levi-Faur, 2004:180). The 1960s and 1970s saw a boom in writing on the comparative method (Collier, 1993). According to Oyen (1990:1), growing internationalization and the concomitant export and import of social, cultural and economic manifestations across national borders increased the call for comparative studies. Large amounts of data increasingly available from the late 1960s fed an increase in quantitative analyses (Mahoney and Rueschemeyer, 2003:16). These were employed to establish a positive statistical relationship between economic growth and democracy (Rueschemeyer, 1991:22) used to rank countries in the world. The exponential growth of quantitative comparisons between countries resulted in a number of world handbooks listing data although typological and quantitative approaches had many weaknesses (Teune, 1990:43). For example, data on similar topics is often not comparable as definitions of terms such as 'employment' or 'poverty' may vary considerably across countries.

The comparative method is used as a research methodology in various disciplines, for example in political science (see Mahoney and Terrie, 2008:737-755; Geddes, 1999 (an analysis using datasets including 163 authoritarian regimes to analyze democratization); Clark et al., 2009; Lijphart, 1971; Dogan and Pelassy's 1990 book *How to Compare Nations: Strategies in Comparative Politics*),[14] law (De Cruz, 1999), economics (Dabla-Norris, 2006), research on human rights (Church et al., 2007), urban planning (Davis and Tajbakhsh, 2005; Smith, 1991), cultural study of belief systems (Hayashi, 1992), and others, as well as in water management research, examples of which are described in detail in Section 3 of this paper. The comparative method has also been used to construct datasets (e.g. the three *Comparative Political Datasets* at the University of Bern).[15] There are also a number of university lecture courses and university chairs or disciplinary sub-fields especially in the political sciences in a variety of countries,[16] journals (e.g. *Comparative Political Studies*, *Comparative Politics*, *Comparative Social Research*, *Studies in Comparative International Development*, *Comparative Economic Studies, The Comparative and International Law Journal of Southern Africa*), and academic groups such as the *Research Committee on Comparative Sociology*[17] devoted to the comparative method, which point to its validity as a method in social science. The recurring importance of the comparative method is also

[14] For comprehensive lists of references see http://poli.haifa.ac.il/~levi/syllabusm.html and http://www2.bsz-bw.de/bibscout/MA-ML/MB/MB2300-MB2520/MB.2480

[15] I: 23 OECD countries, II: 28 Post Communist Countries; III: 35 OECD Countries and/or EU-member countries http://www.ipw.unibe.ch/content/team/klaus_armingeon/comparative_political_data_sets/index_ger.html

[16] To list a few: in USA: *Comparative Politics* at Colorado State University; *Comparative methods in sociology* at Ohio State University; *Social movements in comparative perspective* and *Comparative security and sustainability* at the political science department at MIT; *Comparative politics* at Princeton University; *Introduction to comparative political science* at Florida State University; *Comparative politics* as a disciplinary field at University of California, Los Angeles; *Comparative political economy* as a disciplinary field at UC Berkeley; Comparative Politics as a disciplinary field at University of Illinois at Urbana-Champaign; *Comparative welfare states* at University of North Carolina Chapel Hill; in Europe: *Comparative Political Economy* at Central European University, Budapest; *Comparative politics of Latin America, Africa and Asia* at University of Oxford; *Comparative Political Economy* at Humboldt University Berlin; Comparative Political Science chair at University of Regensburg; Comparative Politics chair at Zurich University; in other countries: *Comparative Social Welfare* at City University of Hong Kong; *Comparative methods in political and social research* at Haifa University

[17] http://www.isa-sociology.org/congress2010/rc/rc20.htm

evident in the trajectory of methodological discussions (Collier, 1998a). However, different academic disciplines, researchers and research projects employ the comparative method in very different ways, and a number of separate comparative methodological approaches can be identified.

This paper identifies five different types of comparative methodological approaches, namely the 'Qualitative', 'Quantitative', 'Small-N', 'Large-N', and 'Combined Methods' approaches. When international comparative research began in the 1950s, it was primarily preoccupied with data compilation (Scheuch, 1963:761, in Roberts, 1993:29), but later trends, especially in the social policy and engineering sciences, have emphasized the necessity for greater specialization in the classification and model construction schemes in order to meet the new requirements of specific fields of research and practical decision-making (Roberts, 1993:29). However, in the course of the development of the comparative methodology, several issues of contention between different comparative methodological approaches have developed. In the last decades, as a result of the debate concerning replicability of results, social scientists have long remained polarized over whether to employ qualitative or quantitative methods. Different methodological approaches seem to be conducted and advocated by quite different groups of researchers. According to Bernard (1994:15) in sociology, there is a growing minority tradition of interpretative research but the field is mostly dominated by the positivistic approach.[18] He continues that whilst in cultural anthropology, the debate between positivists and interpretivists is often tied to the issue of qualitative versus quantitative data, most anthropological research is based on qualitative data but is also in the positivist tradition. There is a journal published by Springer devoted to the discussion of instruments of methodology for more rigorous scientific results in the social sciences called *Quality and Quantity*. Further, scholars disagree on whether to use a small or a large number of cases (the so-called small-N/large-N debate). Several researchers also advocate a combination of these methodological approaches. Further issues of contention include the unit of comparison and the indicators chosen to compare them, as well as whether to focus on similarities or differences (Abercrombie et al., 2006:73). Usually cases are chosen as nation-states appropriate for macro-level research, but are also increasingly federal states or departments within a single country, supranational territories or organizations that encompass multiple nation-states, informal sub-national territories, social movements studied through socially constructed groups, or periods of time within one geographic unit, etc. depending on the subject matter (Mahoney and Rueschemeyer, 2003:14).[19]

## 2.1 Qualitative approaches

Researchers advocating the qualitative approach underline the importance of capturing in-depth aspects of the cases through the analysis which cannot be captured through quantitative data and statistical data analysis techniques. According to Ragin (1987:13), comparative social science tends to ask questions about empirically defined, historically concrete, large-scale social entities and processes, whereby historical outcomes often require complex, combinatorial explanations which are difficult to prove using quantitative social science methods. Ragin (1987:17) continues that comparative social sciences choose cases with a view to questions of

[18] See Steinmetz (2005) for discussion of 'positivism and its epistemological others' in a range of human science disciplines.
[19] Further, Kohn (1989; referred in Oyen, 1990:6) identifies four kinds of cross-national research based on the intent of study, whereby countries can be 1) the object of study, 2) the context of the study, 3) the unit of analysis, or studies can be 4) trans-national.

direct relevance to macrosocial units with meaningful social identities, which is often not considered in quantitative cross-national studies. Thus the implications also in terms of politics of methodological decisions are quite different (Ragin, 1987:17). Rubinson and Ragin (2007) build on Shalev's critique of multiple regression, found to be incongruent with case-oriented analysis in comparative research to argue that qualitative comparative analysis, fuzzy sets and related methods provide a strong foundation for systematic case-oriented comparative research. A sub-category of the qualitative comparative method is comparative historical analysis. Comparative historical analysis is conducted using specific sets of cases that exhibit sufficient similarity to be meaningfully compared with one another, and encompasses the analysis of causal relations and processes over time (Mahoney and Rueschemeyer, 2003:8,11). Ragin (1989, referred in Oyen, 1990:6) elaborates this classification by adding explanatory statements on the qualities and general features of the countries in a matrix. Tilly (1984:61) defines four historical levels at which the analyses of structures and processes operate, namely world-historical, world-systemic, macrohistorical, and microhistorical, and then placed his own studies at the edges of micro- and macro-historical analysis but within the macrohistorical level.

## 2.2 Quantitative approaches

The quantitative approach on the other hand advocates a common language of science whereby the data explains itself. *Designing Social Inquiry* by King et al. (1994) claims that the logic underlying quantitative research methods underlies or should underlie qualitative research (Tarrow, 2004:171). This sparked a long controversy, which was recently re-addressed by Brady and Collier in *Rethinking Social Inquiry*. They show how an emphasis on the goal of valid causal inference can lead to fundamental critiques of mainstream quantitative methods, and to a renewed focus on alternative tools that grow out of the qualitative tradition (2004:227). Ragin (1987:53) explains that the variable-oriented approach in comparative social science has been maintained since the 1960s and 1970s by renewed interest in macrosocial theory: a renaissance of ecological and evolutionary approaches, the convergence of various strains of modernization theory into a coherent macrosocial theory, and an explosion of interest amongst North American scientists in dependency theory and its theoretical descendant, world-systems theory. Proponents of the approach include Smelser (1976, in Ragin, 1987:12), who argues that the method of systematic comparative illustration is inferior to the statistical method as a comparative method. According to him, this is because the first must be used when the number of relevant cases is small thus reducing the possibility of establishing systematic control over the sources of variation in social phenomena. However, in addition to the weaknesses of the quantitative approach mentioned above, critics argue that the large number of cases necessary for statistical analysis reduces the level of detail of the analysis of individual cases. Further, Shalev criticises multiple regression as being an inappropriate method for comparative political economy because the amount of data available to do multiple regression properly is insufficient, and it is based on a linear and additive conception of causality that cannot appropriately address causal complexity (Pontusson, 2007). Teune (1990:3) adds that the aim of cross-national research is to reduce unexplained variance and find patterns and relationships, but the variance-reducing schemes presented in the studies do not often yield the relationships which are suitable as a foundation for building theoretical explanation.

## 2.3 Small-N approaches

Proponents of the Small-N or Case-Oriented Method claim that focusing on only a limited number of cases allows for in-depth analysis. According to Ragin (1997), comparative social science has always maintained a vigorous case-oriented side devoted to in-depth knowledge of particular times and places. Bradshaw and Wallace (1991:154) argue that case study comparative researches are useful when 1) researchers do not have sufficient knowledge of a case to place it in theoretical perspective (the case does not fit any extant theory), 2) a case partially supports (or deviates from) existing theories, 3) a case represents a special (perhaps unique) set of circumstances or phenomena that warrant special study. Lijphart (1971, in Collier, 1993:106) defines the comparative method as the analysis of a small number of cases, entailing at least two observations but too few to permit the application of conventional statistical analysis. He assesses this method in relation to the experimental, statistical, and case-study methods. Brady and Collier (2004:226) argue against a central argument of King et al. (1994) that the number of observations should be increased. Tilly also argues that comparative studies of big structures and large processes yield more intellectual return when investigators examine a relatively small number of instances, and suggests careful comparison of a small number of instances as a starting point and using large numbers of cases only when the objectives for doing so are clear (1984:77). Furthermore, investigators who use case-oriented methods often combine causal analysis, interpretive analysis, and concept formation (Ragin, 1987:51).[20] Ragin (1997) argues that case-oriented scholars use flexible analytic frames which can be modified in the course of the study as knowledge emerges, making case-oriented study especially well-suited for concept formation and theory development. Geertz advocates cultural, moral and scientific pluralism and distinctions rather than abstraction and reductionism as methods for social sciences research, believing that reality is a complex continuum of overlapping likenesses and differences that should not be placed in neat boxes and certainly not two boxes (Shweder, 2005:1-2). Thus, Geertz at one end of the spectrum advocates the smallest N possible, namely focusing on only one case.

## 2.4 Large-N approaches

Large-N scholars who are against using only a small number of cases include Goldthorpe (1997) and Hayashi et al. (1992:18), who argue that methods other than quantitative methods cut across social phenomena from fixed standpoints using convenient cases, while persuasively constructing theories which may hit upon the truth or which may be very misleading. However, critics use arguments against the large-N approach similar to the criticisms of the quantitative approach. Ragin (1997) for example points out the practical problems with large-N variable-oriented research as being 1) how to define and delineate the classes of cases relevant to a particular investigation, 2) how to study the causes of outcomes which are uniform across selected cases, 3) how to define and delineate negative cases to compare with positive cases, 4) how to study multiple paths to the same outcome (multiple conjectural causation), and 5) how to account for nonconforming cases.

[20] For an introduction to concept formation and modelling from both quantitative and qualitative perspective, and arguing against dichotomous understanding of these perspectives, see Britt (1997).

## 2.5 Combined methods

Despite these methodological differences, many scholars advocate using a combination of different comparative approaches, as each approach has its advantages. Ragin (1987:69) argues that the case-oriented strategy is best suited for identifying invariant patterns common to relatively small sets of cases. On the other hand, he continues, the variable-oriented strategy is best suited for assessing probabilistic relationships between features of social structures, conceived as variables, over the widest possible population of observations. The first has a tendency to particularize and the second strategy has a tendency to generalize (Ragin, 1987:69). Thus, combining these can benefit different types of studies. Rueschemeyer attempts to combine so far polarized methods of quantitative and qualitative research in the study of macro-social phenomena, which yield differing results (1991:9). However, Crowly et al. (1998) found that seemingly contradictory results of cross-national quantitative studies conducted by economists and sociologists using largely the same methods and data, in parallel but in mutual ignorance, actually concord when the same variables are used. As many social scientists employ methods which are not necessarily only qualitative but are also quantitative (such as participant-observation, interviews, life-histories, genealogies, censuses, questionnaires, network analysis, archival transcription), the distinction may be not so much between the quantitative- and qualitative-ness of methods but rather in overall orientation and intention (Rapport and Overing, 2000:303). Nevertheless, the polarization between scientists over use of method hinders an effective pooling of existing research results.

Although scholars argue for the integration of the qualitative and quantitative (see Galtung, 1990:111), as well as the small-N and large-N approaches, this integration seems not so easy to effect. Combined strategies exist but according to Ragin (1987:17), close examination usually reveals that such studies are either quantitative or qualitative, and are an amalgamation of the two but not a distinctive strategy. For example quantitative cross-sectional and time-series analyses are used to support primarily interpretive, case-oriented investigation, and interpretive case studies are used to support the findings of cross-national investigations (Ragin, 1987:71). Comparative historical analysis is well situated to draw on diverse methods and analytic tools, as well as mediate between cultural analysis, which risks moving too far in direction of speculative understanding, and rational choice theory which risks ignoring the subjective dimension of actors' behaviour (Mahoney and Rueschemeyer, 2003:25). Several examples of comparative historical analysis combine the quantitative and qualitative approaches (for example Goldstone 1991, Huber and Stephens 2001, Paige 1975, Tilly 1967; in Mahoney and Rueschemeyer, 2003:17) or take results of cross-national statistical research as point of departure for qualitative comparisons (Rueschemeyer 1991, in Mahoney and Rueschemeyer, 2003:17) as is also suggested by Allardt (1990). Collier (2005) advocates using statistical theory to refine qualitative methods. Mahoney and Goertz (2006) propose that quantitative and qualitative research traditions can be thought of as distinct 'cultures', and that an appreciation of differences may benefit cross-'cultural' learning. Burawoy (1998) in advocating an extended case method differentiates reflexive science (which valorizes intervention, process, structuration, and theory reconstruction, and embraces engagement rather than detachment), and positive science (which is exemplified by survey research and works on the principle of the separation between scientists and the subject they examine), to extract the general from the unique. He further distinguishes between 1) research method (e.g. survey research and the extended case method), 2) techniques of empirical investigation (e.g. interviewing and participant observation), and 3) scientific model (positive or reflexive) (Burawoy, 1998).

Tarrow (2004:173-9) summarizes the tools for bridging the gap between quantitative and qualitative approaches (in the field of organizational decision making) as 1) tracing processes to interpret decisions as developed by George and McKeown in 1985, 2) systematic and non-systematic variable discrimination whereby qualitative research may identify non-systematic variables indicating 'tipping points' in history around which quantitative researches can then be reorganized, 3) framing qualitative research within quantitative profiles, 4) enriching quantitative data with qualitative data, 5) sequencing quantitative and qualitative research, and 6) triangulation, which he describes as particularly appropriate in cases where quantitative data is partial and qualitative data collection is obstructed for example by political conditions. Janoski (1991) concludes that studies combining time series with history seem most likely to achieve synthesis between internal analysis (within country inference) and external analysis (between country inference), especially when quantitative studies include some variables specific to each country rather than repeating the same rigid models for all countries, whereby synthetic studies with large Ns are much less likely to be done. Collier (1998b) underlines the ongoing need for synthetic study, as well as the need to devote more attention to the theoretical underpinnings of the approach, for example through the further development along the lines of the work of Pierson on the idea of 'path dependence' as applied to political analysis. Rihoux et al. (2009:170) show that Configurational Comparative Methods, and Qualitative Comparative Analysis QCA techniques in particular, display some features (and strengths) of both 'case-oriented' and 'variable-oriented' approaches, making these techniques holistic case-oriented, but at the same time analytic in nature as it is necessary to break down cases into variables. Because of the dual nature of QCA techniques, they can be fruitfully connected to many other including 'qualitative' and 'quantitative' techniques. On the ongoing controversy between qualitative small-N and large-N statistical generalizing analysis, Rihoux et al. (2009:171) state that a 'probably useful way to combine them is to consider them sequentially'. Tilly (1997) proposes a relational ontology in the tradition of classical economists, many 19th century analysts, American pragmatists, or the richer recent versions of network and institutional analysis to bridge the gap.

This section has identified and briefly described five comparative methodological approaches: 'Qualitative', 'Quantitative', 'Small N', 'Large N', and 'Combined Methods'. In their theoretical backgrounds, these approaches are quite separate and are conducted and advocated by different groups of researchers. The following section describes how these types of comparative analysis have been used in water resources management research.

## 3 THE COMPARATIVE METHOD IN WATER RESEARCH

Within the sphere of the natural and the engineering sciences there is a range of (sub-)disciplines dedicated to the study of water, notably hydrology, the water focused parts of civil engineering, and agricultural water use related (sub-)disciplines.[21] Apart from a long-standing connection with (neoclassical) economics, which was functional for calculating costs and benefits of the infrastructural works that water resources engineers were assigned to design and build by state governments and the corporate sector, the natural and engineering sciences had little connection with the social sciences and humanities till relatively recently. Though there are,

[21] In the *Appendix* we have included a note on comparative water and health research by Prof. David Bradley, who participated in the first Comparative Water Studies workshop at SOAS, London (October 2011).

to our knowledge, no long standing (sub-)disciplines in the humanities and social sciences specifically dedicated to water, water resources have been central to the work of some influential social theorists. Notable examples are Clifford Geertz's work on the irrigation society of Bali, and Karl Wittfogel's theory of hydraulic societies and oriental despotism. History as a field has a long standing interest in the study of water in societal development. It may be the only social science and humanities subject field that has an organised international network focused on water resources (the International Water History Association, www.iwha.ewu.org, founded in 2001).[22]

These two broad areas of water scholarship remained quite unconnected till roughly the 1970s, exerting very little influence on each other. From approximately the 1970s connection was sought explicitly through the combined mobilisation of technical and social sciences in international development programmes. The post-1945 'modernisation' development paradigm was a technical (infrastructural), and economic, as well as a cultural, institutional, and political project. The notion of 'water resources development' as meaning the building of new (large-scale) infrastructure started to be questioned when 'planned development' produced manifest contradictions, in relation to its equity/distributional justice, ecological sustainability and other aspects. Notions like community development, participation, and later rights and governance became important dimensions of water resources development thinking and policy intervention (see section 1.)

What this has meant for water studies is that since the 1970s a large body of water research has been funded in close connection with national, regional (notably the European Union) and international development aid/assistance/cooperation programmes[23], while quite a bit of the independent social science academic research on water resources takes these development efforts as its subject matter. Our review of comparative water studies thus also mainly has reference to research directly and indirectly related to the (international) development efforts of the last half century. Some of the implications of this particular contextuality of water studies will be commented upon in Sections 4 and 5; we first review the comparative dimension of water studies.

This section presents a limited number of examples of comparative analysis of the last decades pertaining to water resources management issues. These examples are grouped according to the five methodological approaches to comparative analysis identified in the previous section. The aim of the section is to illustrate the differences in the comparative methodology the different approaches (implicitly) employ. The main message of this review can be formulated as comparison having a long tradition in water resources management research, but without much rigorous and explicit articulation of comparative method.

[22] Members are historians, but also many others, not unlike the water grouping in the domain of geography, another contemporary concentration point of innovative water studies, which has geographers and many others as active participants in research and debate.

[23] To illustrate, Coward (1980:17) states that there is an increasing awareness of the critical role that institutions and organizations play in the process of irrigation development. The work of the 1970s and 80s was translated into practical management programs (Ostrom, 1992). Wescoat writes (2002:322) that a generation of scholar-practitioners working for development organizations like the Ford Foundation and the US Agency for International Development (USAID 1992), such as Coward (1980), Freeman (1989), Lansing (1991), and Uphoff (1992), advocated complete reform of water sector investment programs in Asia.

## 3.1 Comparative analysis in water resources management research

The examples used to illustrate different types of comparative methodology presented here are grouped according to the five comparative methodological approaches identified in Section 2, namely 'Qualitative', 'Quantitative', 'Small-N', 'Large-N', and 'Combined Methods'. The review and analysis offered in this chapter is on research methodology only, and not on research content or results of the studies referred to. The objective of the analysis is to identify how methodologically 'rigorous' the various examples of comparative water research are.

We hesitate to use the term 'rigor(ous)'. Paradigmatic differences in scientific approaches imply different understandings of 'rigour' and the term is therefore highly contested, and 'lack of rigour' regularly used as a pejorative disqualifier of the 'other'. When we use it in this paper, rigour of a comparative research exercise does not mean more than that a) there is a stated objective of comparison, b) there is an explicit comparative research question, and c) the method of comparison is clearly described and applied (preferably for both case selection and the comparative analysis proper). As we will attempt to show below, much water research employing comparison falls short on c), a practice that we have labelled 'loose comparison' above, and which Wescoat (2009b) refers to as 'implicit comparison'. As a result, more detailed aspects of rigour related to exactly what method is used how, leave alone the politics of method, do, and can, not come in sight. More important than observing (and emphasising) the 'lack of rigour' in comparative water studies, is, in our view, answering the question why so little explicit comparative method development and discussion exists in the field.

### *3.1.1 Qualitative*

There are several pitfalls in qualitative approaches as regards comparative rigour related to different methods of case selection. Much qualitative research is based on the idea of 'comparison by contrast' where cases are chosen by researchers specifically for the purpose of illustrating a particular issue. In terms of our 'light' definition of 'rigour' given above, this may be considered a rigorous form of qualitative comparison, as the purpose of comparison is clear and explicit, and attributes of cases to be compared defined (forming the basis of their selection, as well as informing the mode of analysis). On the other hand, the choice of cases in qualitative approaches is often also relatively arbitrary depending on data availability, feasibility of fieldwork, or the experience and preference of the researchers rather than clearly explicated selection frameworks. Data availability may be constrained by the limited coverage of existing databases, or the sample of cases defined by the availability of contributions to a collected volume or special journal issue. If, in addition, the research objective is not clearly stated, comparison is based on a weak analytical framework. Furthermore, whilst individual qualitative comparative studies with either small or a large numbers of cases generally have only one or few authors, article compilations tend to have many authors, which can derogate a weak analytical framework further. Varying degrees of analytical rigour of these different methods of case selection are illustrated below.

In the 'comparison by contrast' approach, one method of illustrating a particular topic is by selecting cases in a particular geographical region.[24] [25] [26] For example Hannam (2003) compares legal and institutional arrangements for water- and land management in Southeast Asia (Lao PDR, Bangladesh and the Philippines) and China, in order to gain a comprehensive overview of issues in the region. In order to compare these cases, selected environmental laws are examined, analyzed and interpreted against a legal and institutional standard, which in this case is the basic legal and institutional elements considered as essential by the author within an individual law or instrument to enable its effective implementation within the geographic and institutional jurisdiction to achieve the sustainable use of water and land (Hannam, 2003:6). Except for the regional proximity of the case studies, the author does not specify the reason for comparing these cases, such as historical aspects. Nevertheless, this study forms a starting point for a focused exchange on environmental law between neighbouring countries with similar issues for example in terms of climate.

On a different spatial scale, Jacobs and Wescoat (1994) choose cases at the river basin level in order to discuss a specific sub-topic. They analyze issues and accomplishments of international flood hazard reduction programmes in Asia's five largest river basins (the Changjiang and Huang Ho of China, the Ganges-Brahmaputra, the Indus and the Mekong basins) looking at five types of international flood programmes: United Nations, International Lending Organizations, Regional Intergovernmental Organizations, and International Non-Governmental Organizations. The research is based on the question of whether there are similarities among flood problems and approaches in Asia's large or highly regulated river systems, and is addressed through analysis of social and economic data which affect the ability of people and institutions to address flood hazard problems, as well as examining trends in flood damage, to determine increasing or decreasing vulnerability. The authors suggest identifying general principles as a key goal of future research, as well as showing how differences among the basins and flood management efforts lead to different vulnerabilities and protection. They recommend that flood problems and trends need to be more closely analyzed and compared, also in terms of people's responses to flood hazards historically, to create consistent 'flood hazard profiles' and more detailed databases, as well as including the flow of ideas through persons and agencies into the analysis due to heavy involvement of multi-lateral and bi-lateral organizations. Currently, the authors continue, there is very little evidence of whether and how information is shared between regions, and translations of e.g. Chinese publications and research on Chinese flood-hazard programmes should be a priority in enabling more comprehensive comparative analysis.[27] Although the study collects a large amount of data, as the authors concede, it only forms a starting point in terms of developing a methodology for comparing such cases more

[24] Wescoat cites a number of examples of comparative water resources management research with a specific regional focus, including Allan's study (1986) documenting community water management in the upper Indus, Rahman's study (1993) on irrigation development in the lower Indus basin of Pakistan involving the organization of comparative studies, Brooks and Emel's (1995) regional approach to Great Plain water management as part of a comparative international study of critical regional environmental problems, Cosgrove and Petts. (1990), who conduct comparative study critiquing modern water engineering and landscaping change in Europe and the Mediterranean (Wescoat, 2003).

[25] Kuks (2005) offers a comparative analysis of the evolution of national water regimes in terms of transitions in water rights and water policies in six countries in Europe: The Netherlands, Belgium, France, Spain, Italy, and Switzerland.

[26] Zhovtonog et al. (2005) compare Bulgaria, the Czech Republic, Germany, Hungary, Macedonia, Poland, Russia, Romania, Slovenia, and the Ukraine in discussing irrigation sector reforms in Central and Eastern European Countries of Transition.

[27] Wescoat cites Elhance's comparison (2000) of patterns of conflict and cooperation in six international river basins concluding that institutional apparatus, precedents, and prospects are emerging for increased cooperation and conflict management (Wescoat, 2003:286-293), a further example of this type of study.

concretely. Nevertheless, as in the last example, this study also has a clear research objective and uses an explicit framework for the comparison.

**Sub-topics of investigation highlighted by Salman and Bradlow (2006)**

- Statutory framework
- Underlying principles and priorities
- Regulation of water uses
- Protection of water
- Regulation of water infrastructure
- Institutional arrangements
- Financial arrangements
- Enforcement of regulations and dispute resolution

An example of a study where selection of cases is based on existing databases or data availability[28] [29] but where the analytical framework seems less rigorous is that of Salman and Bradlow (2006). The authors select 16 different jurisdictions for comparison (Armenia, Brazil, Cameroon, China, Costa Rica, the European Union, France, Germany, Republic of Kazakhstan, Mexico, Morocco, Kingdom of Nepal, Senegal, South Africa, Vietnam, and Yemen) on the basis of availability and accessibility of water law, as well as on the need to represent different regions and legal systems in the world. They analyze the main similarities and differences in the approaches adopted concerning regulatory frameworks for water resources management by comparing a number of sub-topics (see box). Following the introduction, about half of the book (total: 198 pages) is dedicated to a very comprehensive overview of each of the jurisdictions' regulatory framework for water resources management, with information organized by the sub-topics of analysis. In the following analytical chapter (12 p, ca. 6%), the main similarities and differences between jurisdictions are pointed out under each of the sub-topics. Next, the authors highlight the essential elements that need to be addressed in any regulatory framework for water resources management and identify trends in water legislation, with references made to the Mar del Plata Conference and the Dublin Principles, and make recommendations for each of the sub-topics, with a few sub-topics added, such as process for preparing water legislation, ownership of water resources, private sector participation, and the right to water (19 p, ca. 9%, ca. 1 page per sub-topic). The concluding chapter (5 p, ca. 2%) underscores the relevance and importance of the regulatory framework and specifies conditions supporting its utility and efficacy. Although this is a very detailed analysis, little explanation is offered on why these groups occur, for example through a historical analysis, so that the analytical chapter is essentially descriptive. Further, the following chapter of recommendations is quite general, and thus it is not clear how the conclusions were reached as a result of the comparative analysis. Inside of the comparative analysis chapter, a summarizing table might have helped to identify broader patterns in the groupings of jurisdictions of similarities or differences based on other underlying factors, e.g. historical ones. The question arises whether 'availability of information' and 'need to represent diversity' are valid reasons for contrasting these specific cases (this less rigorous method of selection of cases may be why rigorous deriving of recommendations out of the comparison analysis was not expounded) and in how far these are general recommendations based on the authors' experiences and views. Nevertheless, although the comparison lacks

[28] Salman (1997:3-4) compares the legal framework for Water Users' Associations (WUA) in 6 countries, namely Colombia, India, Mexico, Nepal, the Philippines, and Turkey, the choice of case studies being based largely on the availability in the English language of copies of legal instruments on WUAs inside the World Bank, but also in consideration of the fact that participatory irrigation management in these countries is in different stages of development, in terms of enabling law, the bylaws of the WUA, and the transfer agreement between the irrigation agency and the WUA.

[29] Bottrall's (1981) study is based on already collected information pertaining to management, organization and operation of irrigation projects and the analysis and evaluation of the effectiveness of management and organizations collected for Taiwan, Pakistan, India and Indonesia and focuses on the development of a framework for monitoring and evaluating the efficient use of resources in the management and operation of projects, based on the existing case studies but also referring to a range of other cases.

rigour in terms of systematic application of a framework for comparison, the approach is very detailed in that a large amount of existing data is collected on each jurisdiction's regulatory framework, grouped according to common characteristics and visualized under a common format.

There are a number of edited volumes which have collected a range of case studies under a common topic of investigation such as irrigation reform.[30] [31] [32] [33] [34] [35] This type of study is frequently conducted and uses a number of cases, usually taking countries as the unit of analysis. Such edited volumes also use different methods of case selection. Cases may be chosen in a similar geographical region to illustrate a particular issue, whereby the cases are juxtaposed. Cases can also be chosen specifically to be grouped under contrasting sub-topics. Or, cases can be compiled under an over-arching topic. Wescoat's (2002) uses the term 'taxonomic survey' as a descriptor of some types of comparative research, a category that fits this type of studies well: they are basically compendiums framed by a relatively lightly theorised comparative perspective. The juxtapositions that characterise this type of studies are executed with varying degrees of analytical rigour, as is described using the examples below.

Kissling-Naef and Kuks (2004), in discussing the evolution of national water regimes in Europe, collect a number of cases, including the Netherlands, Belgium, France, Spain, Italy and Switzerland. A description of the evolution of the water regime in each of these cases is followed by a concluding chapter, a general comparison of countries in terms of regime development. Next, the regime transitions and change triggers are discussed for each case study country individually. The conclusions drawn include that only France and the Netherlands developed towards integrated regimes around 1990. The other cases described, according to the authors, still have complex regimes in which integration attempts are not sufficiently coherent and are struggling with regime fragmentation. The individual cases are then discussed in terms of assessment of regime integration, triggers for regime change, and restraints on regime change. In the final section, all cases are compared in terms of highly complex institutional regimes struggling with fragmentation. This study is set in a rigorous analytical framework and is thus able to derive detailed conclusions from the comparison.

[30] Dellapenna and Gupta (2009) collect a range of papers on the evolution of law and politics of water, with an introductory part (Mesopotamia: a history of water and law, Islamic law and politics of water, water in the Jewish legal tradition), a range of case studies on evolving national law and politics (including Brazil, South Africa, East Africa, Israel, Russia, India, Australia, United States), evolving supranational and regional water law and politics (including the European Community, South Africa, the Jordan Basin, North American Great Lakes, the Rio del Plata Basin), and current trends in international cooperation on water resources.

[31] Abernethy (2001) collects of examples from South Africa, Germany, Mexico, Turkey, Indonesia, and the United States, to discuss intersectoral management of river basins.

[32] Abernethy and Heim (1999) collect examples from the Philippines, Malaysia, Thailand, Indonesia, Vietnam, Lao PDR, Burkina Faso, and Niger, to discuss intersectoral river basin management.

[33] Hlavinek et al. (2006) collect cases from the Slovak Republic, Jordan, the Ukraine, the Orava Region, Bucharest, Obninsk, the Oka and Desna Basins, Canada, the Czech Republic, Egypt, and others to illustrate urban water resources management issues.

[34] Scheumann and Neubert (2006) juxtapose various examples of transboundary water management issues in rivers and lakes in Africa, including the Orange-Senqu, Zambezi, Limpopo, Lake Victoria, and Lake Chad basins: Each basin is characterized, followed by description and analysis of basin institutions, and listing of destabilization risks, cooperation potentials, and options for German Development Cooperation. Further, information transmission in the practice of cooperation in transboundary African basins is discussed in terms of Senegal, Nile, Orange-Senqu, Incomati and Maputo, Nubian Aquifer, Niger, Okavango, and Zambezi (Grossmann, 2006).

[35] Several studies of comparative water law were conducted in Europe, e.g. Seidmann and Seidmann 1996, Tarlock 1997, and Wouters 1997 (referred in Wescoat, 2005).

Coward (1980) uses a different method of case selection to highlight that successful irrigation management is not dependent on bureaucracy, with the aim of improving bureaucracies of water management. He collects a number of studies in two contrasting types of irrigation management and illustrates these using six regions: Community Irrigation Systems are illustrated through studies of Bali, Sri Lanka, Japan, the Northern Philippines, mountain regions in the Philippines, and Bureaucratically Operated Irrigation Systems are described using cases from Taiwan, India, China and Lao. There is no concluding analytical chapter and the analytical framework of the volume is not clearly articulated. However, the comparison does serve to illustrate an idea which was novel at the time the study was conducted, while the lack of systematic comparison did not prevent the volume to become influential, as already noted above.

Mollinga and Bolding (2004) collect a number of national cases of irrigation reform to illustrate contestation in the politics of water. They take reform to refer to any process of purposive transformation of the institutional features of irrigation agencies, the laws and regulations that constitute them and irrigation water use, and the relationships of these agencies with the water users and other relevant actors. In trying to deduce common processes and questions, the authors collect contributions in the form of case studies from South Africa, the Philippines, Indonesia, Zimbabwe, Pakistan, and one Indian State, which, according to the authors, form a reasonable cross-section of irrigation reform processes, but is a selection that is clearly constrained by available case analyses and 'willingness to write'.[36] The authors conclude that research on the politics of irrigation/water sector reform needs to be expanded and strengthened (Mollinga and Bolding, 2004:2,8). Despite contestation (of irrigation reform policy) being demonstrated in all the collected cases, this type of study constitutes a simple juxtaposition of cases. Although cases are collected under a common aspect, such as irrigation reform, this is a broad topic rather than a specific research question.

Little attempt is usually made in such juxtapositions to set up a rigorous analytical framework to guide the collection of cases. Rather, cases are chosen on the basis of conference attendances and researchers' personal networks. As a result, authors of contributions highlight aspects inside the broader topic according to their own preference, and using their own definitions, frameworks and formats. Also, there is rarely a concluding chapter in which a systematic comparative analysis is attempted. Thus, although such juxtapositions are very interesting and informative, they do not constitute rigorous comparison. Due to lack of data conformity the cases collected are difficult to compare, and therefore such studies can contribute only little to theory formation. In this sense, comparison by compilation may be the weakest form of qualitative comparative research.

### *3.1.2 Quantitative*

Quantitative studies in the water sector tend to take an empirical, statistical analysis and econometrics oriented approach, often based on numerical data or questionnaire survey used to capture socio-economic data. However, the quantitative approach may use a small or a large number of cases. The quantitative approach usually uses more than two cases, but although quantitative analysis is often portrayed as

[36] One implication of the strong funding and policy connection of irrigation/water resources studies with (inter)national development p[programmes is that the investigation of the practices of states and governments as well as international development agencies is a sensitive topic. The authors briefly discuss how this shaped the volume.

synonymous with large-N studies, this is not always the case. Comparative hydrology lends itself well to the use of the quantitative approach as it traditionally focuses on geophysical and technological characteristics and does not consider it difficult to quantify socio-economic aspects.[37] This may be considered an example of rigorous comparative methodology. However, it does not address the socio-economic context and does little to contribute to the type of theory formation advocated in this paper. In the quantitative comparative approach, there are also various ways of case study selection, with varying degrees of rigour of the analytical framework. As in the qualitative approach, in the quantitative approach cases may be chosen on the basis of illustrating contrast, for example using a limited number of cases, but with a large number of samples within this limited number of cases in order to warrant a quantitative approach.[38] Another method is to collect a large number of similar cases and compare all of these to each other.[39] [40] Finally, the quantitative approach may also be used to illustrate how it can be supplemented by qualitative methods.

An example of a quantitative study where a large sample is taken to compare two countries is the study of Hussain et al. (2003). They compare two distributaries (secondary irrigation canals), one in India and one in Pakistan, to analyze the factors underlying differences in wheat yield between the two countries. The premise they use is that yields can be increased through improved water management practices at the farm- and irrigation-system levels. The two distributaries were selected due to similarities in terms of inadequacy of canal-water environments, practicing of conjunctive use of canal-water and groundwater of differing quality, and large variations in farm-level wheat yields. In each distributary, three watercourses were selected, and a complete census of all farms along these watercourses conducted using a 'mini-questionnaire' for 1999-2000 and through interviews with farmers. Then a statistical and econometric analysis was conducted covering a sample of 36 farms along each watercourse (12 each on head, middle, and tail ends of each watercourse), giving a total sample size of 216 farms for India and 218 farms for Pakistan. Two types of questionnaire were used to collect the data: 1) a general questionnaire: to collect basic information including farm location, size, tenurial status, crop areas and production during the season; 2) a process questionnaire: to record daily observations from the beginning of the crop season till crop harvesting, on farmers' production activities on each of the selected plots, including water measurements at the plot level. In addition, data on farmers' *warabandi* (time-wise rotational water distribution) schedule, water measurements at the watercourse level, water table depth fluctuations, water salinity, soil salinity and rainfall were collected on a regular basis. The study illustrates four different scenarios based on canal-water reallocation, and showing potential difference in wheat yields, and concludes with the policy implication that under conditions of canal-water scarcity and

[37] Falkenmark and Chapman (1989:4) collect a number of contributions on the theory and methodology of comparative hydrology, as well as examples of areas with catchment response and of flatlands, which are compared using a number of characteristics of hydrological processes, described mainly quantitatively but also qualitatively. The authors' premise is that due to data scarcity, it is necessary to predict catchment flood and yield characteristics using available data on 'similar' catchments suggesting an underlying positivist approach. However, in this approach, socio-economic processes, which often directly influence water availability issues in catchments, are not captured.

[38] Kloezen and Garcés-Restrepo (1998) compare two sub-districts of the Alto Rio Lerma Irrigation District in Mexico at different system levels, to assess hydrological, agronomic, economic, financial, and environmental performances of irrigation systems, using comparative rather than only process indicators.

[39] Bardhan (2000) conducts quantitative analysis of the physical, institutional, and socioeconomic determinants of cooperation in irrigation communities in South India and states that more satisfactory theoretical models and policy action are needed to capture features of real-world cooperation for which the comparative-static questions of game-theory models are too restrictive. According to Bardhan, issues like cooperation involve the quality of social and economic relations, for which data are also more qualitative.

[40] Ostrom (2001) conducts empirical study of collective action in 150 Nepali Farmer Managed Irrigation Systems.

locational variations in quality of groundwater, conjunctive use and joint management of surface water and groundwater is essential to increase overall gains from crop production, and states that the findings of the study could be strengthened by incorporating quantitative relationships between surface water and groundwater of differing qualities existing in various locations of the Indo-Gangetic plains, and by extending the study over a larger geographical area using Remote Sensing and GIS combined with some additional field-level data (Hussain et al., 2003:37). The study focuses on the quantifiable socio-economic and technical aspects of wheat production and a large amount of data is collected using a large sample of 434 farms in total. However, there is little focus on data interpretation, and although the study makes policy recommendations, the policy context is not addressed in depth. Nevertheless, the analysis is made rigorous by making the problem and the number of cases very small, by comparing two neighbouring and relatively similar case study countries, in what is actually a small-N approach.

Although the previous study successfully collected a large amount of data to warrant the use of the quantitative approach, the availability of a large enough amount of data to undertake quantitative analysis is often a problem in developing country contexts. In such contexts therefore, quantitative approaches are often supplemented by qualitative data. Samad and Vermillion (1999) for example analyze the impact of partial management reforms (irrigation management transfer to farmer organizations) on the performance of irrigation management based on a sample of 50 large- and medium-sized irrigation schemes in Sri Lanka. Impacts of reforms at the farm level are analyzed with information collected from a sample of farmers in two major schemes. Piecewise linear regression models are used to analyze trends in selected performance indicators five years before and after transfer, in four types of categories of schemes: those rehabilitated and transferred, those turned over but not rehabilitated, those rehabilitated but not transferred, and those without these interventions. The authors write that the method can yield a comprehensive picture of the impacts of management transfer (the selected performance measures cover financial, hydrological, agricultural, and economic aspects) where data is available. However, obtaining data from farmers more than 5-6 years back was difficult, and the authors contend that data collection and availability in many developing country contexts is problematic, limiting the possibility of quantitatively assessing change in performance over time. However, first obtaining quantitative estimates from farmers and then asking qualitative questions proved effective, and comparison of schemes which have and have not yet been transferred as well as using additional methods such as remote sensing, qualitative historical assessments by key informants and participatory rural appraisal techniques is deemed a methodological improvement (Samad and Vermillion, 1999:26). In this way, quantitative data are supplemented by addressing socio-economic issues in qualitative terms. This study shows that whilst there is much theoretical debate concerning the use of qualitative or quantitative approaches, in practice such issues are debated less and the qualitative and quantitative approaches are often combined out of necessity (on Indonesia, see Vermillion et al., 2000).

Hunt (1988) takes a quantitative approach, but uses it to illustrate that a combination of the quantitative with the qualitative approach can enhance quantitative results. He conducts systematic comparative analysis by defining variables which describe the concepts of ‘irrigation system’, ‘irrigation system size’, and ‘authority structure of irrigation system’, to study the relationship between size and structure of authority, in systems ranging from 700 to 458,000 ha. The study is conducted using a small purposive sample of 15 case studies ranging geographically from Mexico, Java, the Philippines, Japan, Spain, the US, Taiwan, Iraq and Sudan. Hunt starts with a definition of what is meant by ‘irrigation system’ or sampling unit of the comparative analysis, then focuses on a definition of what is meant by ‘centralized authority’, and then discusses the three means by

which the 'size of an irrigation system' have been measured previously: by population size, length of the main canal and other canals in the system, and overall extent or the area of the fields irrigated by the system. The study finds that size of the irrigation system is not directly related to power structure: 1) very small canal irrigation systems can be operated with no constituted authority; 2) canal irrigation systems of considerable size (458,000 ha) can be, and are, operated by local irrigation communities; and 3) canal irrigation systems of small size (700 ha) can be, and are, run by national governments, thus challenging the standard propositions about the relationship between canal irrigation and the structure of authority. Hunt concludes that in-depth field work is needed to understand irrigation organization in systems without a constituted authority. Further, he argues that the distribution of state-controlled and farmer-managed irrigation systems needs more detailed explanation, and that exploration on whether the *kind* of state has an effect on the size of irrigation systems and their type of management is a promising line of inquiry. He also lists communication technologies and water storage facilities as potential influences on irrigation system management. This study uses quantitative analysis to confirm a relatively simple thesis. However, although the study is based in a quantitative analysis, it uses the results to formulate an extended method whereby quantitative as well as qualitative methods would be applied. Thus the study acts as a preliminary inquiry to point out the gaps in quantitative analysis and the advantages of adding qualitative data, rather than as a completed study.[41]

### *3.1.3 Small-N*

Small-N analyses tend to be qualitative in nature as comparative quantitative or statistical analysis is not viable without a large number of cases or samples. In the early period of policy related research of the 1970s and 1980s, the first comparative works that emerged in water resources management research tended to be small-N, in order to seek out similarities and difference between specific cases to enable the deduction of policy implications. In the small-N examples cited here, authors tend to compare only a very small number of cases chosen for specific reasons and on the basis of concrete hypotheses. Different methods are used to choose a small purposive number of cases. Cases can be selected on the basis of comparison by contrast in socio-economic context, as in the previous approaches. Another method is to use an 'either/or' argument. Other methods to narrow down the comparison include selecting a very specific sub-topic of analysis, selecting cases on the basis of certain similarities, or choosing cases which are essentially the same and changing a variable to create contrast. All of these methods are, in our definition, relatively rigorous in terms of analytical framework, as the research question is clearly defined and specific outcomes and theory formation are often aimed at.

[41] Hunt's study can be used well to illustrate, for water studies, the limitations as well as contributions of variable-oriented research as against case-oriented research. Who can be surprised that there is no simple correlation between system size and authority structure? From the standpoint of critical realist ontology (as discussed below) it would be somewhat of a miracle when empirical regularity of this nature would be found, and if it was found, it would be the exception to be explained. However, the study also shows that variable-oriented research can identify new and interesting research questions, which is one reason for not being dogmatic on methodological choices. Moreover, the positivist framing of Hunt's study may more easily convince those working within the positivist paradigm (self-consciously or not) than a general argument about competing ontological perspectives, which is a consideration perhaps not irrelevant in a domain where positivist perspectives are so prevalent.

Comparative analysis on the basis of contrast in socio-economic context may illustrate socio-cultural,[42] East-West,[43] geographical,[44] or other contrasts.[45] Geertz (1972) for example chooses two country cases for comparative analysis based on maximum difference. He discusses 'traditional' irrigation by contrasting wet and dry irrigation in Bali and Morocco using a description of the internal organization of the two regimes and tracing their connection to more general cultural and ecological factors. The differences between the two cases are: Bali, which has a tropical climate and a plentiful water supply, displays a highly collective approach to the organization of irrigation facilities. Morocco, which is essentially an arid country, displays, on the contrary, a much more individual, property-based approach to water regulation. Geertz describes Balinese irrigation as a huge, homogeneous, very precisely calibrated, multi-leveled, extraordinarily effective system. Moroccan irrigation by contrast he describes as a "small-scale, quite heterogeneous, broadly at best, calibrated, single-level, but, at best, moderately effective system." He argues that these general differences in long-established irrigation regimes are determinately related to similar differences in technological, sociological, and cultural patterns in such a way that two quite contrasting ecosystems with quite different properties are created. Geertz concludes that the two cases contrast in almost every way possible, and discusses both socio-cultural contexts in detail. The study reads as very descriptive – Geertz' centre-pieced the term 'thick description' as a way to conduct ethnographic analysis (see chapter 1 in Geertz, 1973).

Studies based on very different cases may make quite wide-sweeping comparisons and try to derive generalizations, making it hard to derive concrete policy implications. However, often, such studies are based on very detailed qualitative knowledge of the researchers, who by knowingly contrasting such differing cases in detail invite further research on the topics highlighted.

An example of a study on the basis of contrast in socio-economic context where several cases are contrasted is Goldensohn (1994). He compares Water Users' Associations (WUAs) in six countries in Asia (namely the Philippines, Indonesia, Pakistan, Nepal, Sri Lanka and India) and in Egypt. The study tries to answer three research questions: 1) Have WUAs improved irrigation system performance, 2) What contribution have they made or are they likely to make to facilitate system turnover and enhance political participation? Are policy changes required to make these objectives attainable, and 3) Are there other participatory approaches donors might support if the WUA approach seems irreparably flawed? The study looks at WUAs in as many contexts as

[42] Radosevich and Kirkwood (1975, in Wescoat, 2002:323) explore organizational alternatives for on-farm water management by compiling examples from the United States, Spain, Argentina, Turkey, and Taiwan.

[43] Wescoat elaborates several East-West comparisons: He assesses the relevance of Islamic water law in Pakistan and in the American West by describing the legal system as pertaining to water law and animal rights in each setting, using the comparative method for generating alternatives in the two regions, and finding that analogy and extension play an important role in both cases (1995), draws a 'Muslim-West' comparison to show the Muslim contribution to geographic and environmental ethics research (1997), compares water rights in South Asia and the United States because of profound differences between the two regions, but also because the development of each region's property rights institutions have been influenced by those of the other region (2002:299), contrasts public trust in urban environmental design in Chicago and Karachi in terms of rights of water access and use (2009a), and changing perspectives on water development in South Asia and the United States in 1670-2000 (2000).

[44] Maass and Anderson, in *… and the Desert Shall Rejoice* (1978), seek to draw generalization from a comparison of case studies of irrigation systems in Spain and the United States (Wescoat, 2005). The authors caution against making inferences about water use derived from water rights analysis, but do not explain the discrepancies between legal and actual patterns of water management (Wescoat, 1984:89).

[45] Wescoat cites Jacobs' comparison (1999) of modern development of the Mekong and Mississippi rivers, both of which had strong involvement of the US Army Corps of Engineers (Wescoat, 2003:286-293).

possible: in small and large systems, in pump and gravity-fed systems, in systems with participatory management or wholly government management, etc. Goldensohn uses a comparative WUA matrix to illustrate the differences between the WUAs in terms of 15 critical issues or variables (see box). The study uses three simple indicators to measure the success of a WUA in achieving improved performance, participation and sustainability,[46] and identifies three groups of factors that influence the success of WUA programs.[47] This study is, using our minimum definition, very rigorous in that an analytical framework and research objectives are set out very clearly, and is able to achieve detailed results. Further, Goldensohn uses a simple tool, the matrix, to organize qualitative data in a comprehensive manner.

**Fifteen critical issues or variables identified by Goldensohn (1994) to assess WUAs**

1. The official typology of systems (e.g. canal or communal pump)
2. Inventory of irrigation **systems**
3. **Government institutions overseeing WUAs**
4. **Official name for WUAs**
5. Formal role of WUAs, legal status of WUAs
6. Levels of organization of WUAs (nesting)
7. Relationship to traditional organizations and leaders
8. Nature of organizing efforts (concept and reality)
9. Standard organization or local option
10. Source of funding, cost recovery, and level of investment
11. Major crops and intensities, and returns to investments in agriculture
12. Degree of democratization and relative power/independence
13. Government policies that affect WUAs (macro and sectoral)
14. Source and nature of support services
15. Official performance indicators

An example of a study using an 'either/or' argument to identify different case studies in the same socio-economic context or cultural region[48] [49] is Wade's (1989) *Village Republics*. He contrasts the success and failure to collectively manage natural resources depending on the internal organization of wet and dry irrigation villages in Southern India, using a sample of 31 irrigated and ten dry villages. Wade looks at the social response to open-field husbandry, the social response to irrigation, the range of council activities, and the mode of public choice, and demonstrates the variation between the villages in terms of social structure and ecology and risk. Wade and his assistants lived in the case study village for a period of 15 months overall (Wade, 1989:xii), and thus were able to collect very detailed qualitative information. However, detailed quantitative information is also collected for example in terms of numbers of village inhabitants, members in the village council, amount of village's standing fund, number of common irrigators, length of periods of their employment, irrigated area, numbers of men employed for crop protection, etc. (Wade, 1989:6). The book is a clear case of comparison being successfully employed for theory development, in this case theory on collective action in natural resources management.

Hill (1982) focuses on one particular sub-type of irrigation system in different settings in order to make the comparative analysis more specific. She compares dry grain farming families in Nigeria and India, based on very detailed fieldwork in both locations conducted by the author. Hill's book commences with the statement "I have suffered much condescension […] owing both to my unfashionable methods of field enquiry and to my

[46] 1) The area maintained under an irrigation system, 2) The assets of the WUA, and 3) The range of activities of the WUA.
[47] 1) Resource control issues, 2) Social structure issues, and 3) Administrative issues.
[48] Pradhan (1996) discusses gated or ungated water control in government-built irrigation systems comparatively in three sites in a specific region of Nepal called the *Tarai* which encompasses the southern plains of the country.
[49] Epstein (1973) compares a wet and a dry, an irrigated and a non-irrigated village in the same region of Mysore in India by taking an interdisciplinary approach to the study of development at the micro-level to examine the interaction between economic and other variables within a social system, as well as revisiting the case studies after 15 years for analysis of trends of development.

inability to formulate logically coherent conceptual systems of any general appeal. […] I have ventured to write this book as a practical demonstration of the possibilities of formulating, on the basis of detailed fieldwork, a set of coherent hypotheses relating to a specific type of rural under-development which has recently come into existence in certain very densely populated dry grain zones in both West Africa and south India – as doubtless in other regions of these and other continents. There is a *crying need for systematic categorisation of types of rural under-development in the tropical third world*, and I hope that in identifying and analysing this particular 'dry grain mode' I shall have done something to encourage other fieldworkers to identify other modes" (1982:1; author's emphasis). The author aims to justify the use of detailed field inquiries in the tropical developing world for the formulation of certain general principles, not as an end in itself, but as "a necessary preliminary to socio-economic analysis and the pursuit of theory." Many of the chapters of the book are historical. Hill also lists various world establishments which are apt to disdain inductive field methods in studying socio-economic issues: 1) The Western academic economists' ideological outlook as being reflected in the fact that it seldom encourages its students to undertake detailed fieldwork – in contrast to Western historians; 2) Official grant-awarding authorities which are apt to require the applicants to forecast their conclusions when outlining their research projects and to demand that the work should be 'useful'; and 3) Specialized agencies of the United Nations, such as the FAO, "which seldom support *intensive* socio-economic studies affecting agrarian systems and never integrate them with projects such as vast irrigation schemes, until it is far too late" (1982:4-5; author's emphasis). This study therefore uses comparative and very detailed field-based qualitative analysis to advance social sciences research methodology as such. Further, although Hill's study was written several decades ago, its central arguments still remain very relevant to today's social sciences and developing country research context, in terms of the research content as well as the difficulties in procuring funding for such research.

A number of studies, in contrast to identifying differences, base the selection of case studies on the existence of certain similarities.[50] [51] [52] [53] [54] Conca (2006) compares Brazil and South Africa in terms of hydrogeography, water law (which was crafted with specific use in mind in each country: hydroelectricity in Brazil, irrigated agriculture in South Africa), whereby water is seen as an important instrument of social control in both countries, both countries having undergone recent episodes of dramatic, democratizing political change that created windows of opportunity for non-incremental reform in water-related law, policy and practice, as well as modernizing political-economic changes earlier in the 20th century, and both countries provide a useful test of the influence of global protonorms (Conca, 2006:311-12). Thus, the study specifies very concrete reasons for undertaking the comparison, and derives detailed analysis and conclusions.

[50] Kramer (2006) compares three states in the Andean region of South America, namely Bolivia, Ecuador and Peru, in terms of decentralization of drinking water supply and waste water management. These case studies are selected because they have certain geographical common features, as well as similarities in their legal systems due to their Spanish colonial histories, and each of the countries has undergone a broad process of reforms in water supply in recent years.

[51] Roberts (1993) compares water management in Urumqi in China and Phoenix in Arizona, United States, on the basis of certain geographical and climatological similarities.

[52] In comparing two geographically close regions, Chambers (1980:28-50) provides a detailed study of several irrigation systems in Tamil Nadu in South India and in Sri Lanka.

[53] Bhat (2008) analyses river basin management in the Murray-Darling basin of Australia and the Brantas basin of Indonesia, two highly developed basins whose basin governance arrangements are currently undergoing transition.

[54] Molle (2005) discussed irrigation and water policies in the context of the countries in the Mekong Region.

In a more applied approach, comparative analysis can also be conducted on a small number of cases which are not just similar but essentially the same, by adding other variables to show differences in their effect. De Nys (2004:31,176) for example chooses two case studies in the same socio-economic setting for comparative analysis. In supporting stakeholders in evaluating prospective scenarios of water demand and alternative plans of water supply, juxtaposes two irrigation schemes in North-east Brazil and takes a modelling approach in order to test different research interventions: in one irrigation scheme, the possible organization of water supply to small producers at night, and in the other irrigation scheme, the feasibility of reducing the duration of pumping and canal operation through higher conveyance efficiency of the supply network were considered and discussed. The study includes a detailed analysis of the two irrigation schemes in terms of demand and supply of water, using a number of quantitative indicators (see box). Farmers' water demand is assessed using a quantitative model incorporating a producer's decision model and a model to assess the potential water supply. However, the existent datasets are often incomplete, difficult to access or unreliable in this context, and district information management and monitoring are advocated (De Nys, 2004:178-80). As the author concedes, the modelling approach described here illustrates the inherent difficulties of data availability in research in water resources management described also in the quantitative approach. However, the research approach is rigorous on our definition and can be expanded, for example by supplementing it with qualitative data.

**Quantitative indicators used by De Nys (2004)**
- Irrigable area
- Irrigation potential of soils including capacity of pumps
- Water supply network and operation in terms of cropping patterns
- Farm evolution patterns in terms of crop type per irrigation type and area
- The management structure
- Irrigation water consumption

### *3.1.4 Large-N*

In the use of comparative analysis to derive grand conclusions, in water studies Karl Wittfogel's *Oriental Despotism* (1981/1957) aiming at a large-scale cross-cultural generalization definitely stands out. Since Wittfogel's seminal work on the relationship between autocratic power and hydraulic systems, it has become clear that social power becomes articulated through socio-technical systems (Wittfogel, 1957, in Swyngedouw, 2009). Although Wittfogel erred in many of his comparisons, he did correctly recognize their importance (Wescoat, 2005:9), and the study did inspire analyses across a large number of cases to arrive at results with wide-sweeping implications. This type of approach gained momentum in the 1960s and 70s with the increases in computer calculation capacity, but not always to the benefit of depth of information. Whilst large-N studies do not necessarily always address a *very* large number of cases, they do tend to use a form of quantification in order to capture the significant features of the similarities and difference between the selected cases and tend to search for over-arching patterns. A number of large-N studies try to capture as comprehensive a picture as possible by using the maximum available number of cases and amount of data, often by utilizing or expanding large existing datasets.

An example of a study that deduces results using a very large existing datasets[55] is Hodgson (2003). He offers a comparative analysis of legislation on Water Users' Organizations (WUO), using legislative profiles prepared by FAO covering a range of countries including Argentina, Bolivia, Bulgaria, Chile, Colombia, Costa Rica, El Salvador,

[55] Such studies include statistical analyses of a large number of cases such as water data tables published in UN documents or the World's Water biennial series (Gleick, 2000, referred in Wescoat, 2005:2).

Indonesia, India (State of Andhra Pradesh), Italy, Mexico, Morocco, Nepal, The Netherlands, Pakistan, Peru, The Philippines, Romania, South Africa, Sri Lanka, and Tunisia,[56] with legislative reference to Albania, Armenia, Canada, Estonia, France, Germany, Kyrgyz Republic, Spain, Uganda, the United Kingdom and the United States. The aim of the study is to cover as large a geographic area as possible in order to present a preliminary comparative analysis of legislation (codes, laws, decrees and regulations). The study outlines each country's legislation and the ways in which such legislation approaches similar issues (different names conferred on WUOs in legislation, purposes for which WUOs may be established, legal status of WUOs, WUOs 'governing document' and 'internal rules', identifying actual or potential participants, variety of procedures for WUO establishment, institutional arrangements within WUOs, provisions conferring substantive rights and duties on WUO participants, legislative provisions on the sources of WUO income and financing, financial management of income, substantive rights typically conferred by legislation on WUOs, legislative approaches to WUO dissolution and re-organization, WUO 'federations'). The aim, rather than to purely describe is to see whether and how all of the WUOs considered in this study operate on a democratic and participatory basis. (Hodgson, 2003:4). The study concludes that in the range of countries considered, WUOs are democratically controlled, funded by their participants through very similar internal structures, operate on a non-profit basis, and are required to focus on specific water management tasks: these fundamental similarities transcend geographical, economic and cultural divides, as well as the wide range of tasks undertaken by WUOs across the world. Thus, although colonial legacy must be considered, examples pre-dating European legislation as well as informal WUOs also tend to operate in much the same participatory manner as those foreseen in specific WUO legislation. Thus, it is argued that "whilst the form of WUO legislation will greatly depend on a country's history, the basic content and approach is of general universal application" (Hodgson, 2003:102). An area for further research identified is an evaluation of the effectiveness of the WUO legislation described in the study, for which a multi-disciplinary research, combining rigorous analysis of the legislation with a review of the economic, technical and institutional performance of WUOs in each selected country is deemed necessary (Hodgson, 2003:104). As the research objective is to analyze WUO legislation in democratic and participatory contexts, the statement that "the basic content and approach is of general universal application", without more in-depth discussion of the implementation context of countries with less democratic state forms, seems a bit of a stretch.

An example of a study using large existing datasets and extending them for the purposes of the study is Gleditsch et al.'s work (2004) on water wars/conflicts uses a database covering data on 251 river basins in the Middle East/North Africa and Sub-Saharan Africa.[57] The dataset covers the time span from 1880-2001, is supported by Geographic Information Systems, and is based on basin rather than river variables as well as measures of water scarcity, to test for the probability of resource scarcity-related conflict scenarios in shared river situations. Variables on each dyad include identification of the upstream state, the percentage and size of basin in both and each countries, length in kilometres of the boundary between contiguous dyads demarcated

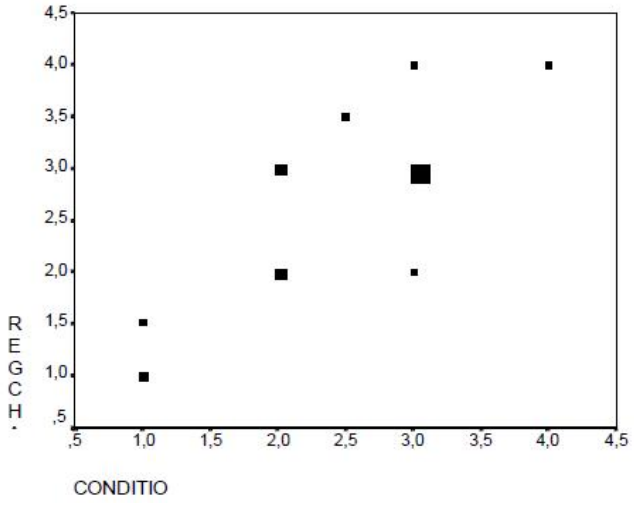
[56] Water User Organization legislative profiles on these countries prepared by FAO can be found at www.fao.org/landandwater/aglw/waterinstitutions/toconf.htm (Hodgson, 2003:106).

[57] Regional definitions include: Middle East and North Africa: Algeria, Bahrain, Egypt, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Qatar, Saudi Arabia, Sudan, Syria, Tunisia, Turkey, United Arab Emirates, Yemen (Arab Republic), Yemen (Peoples Republic). Sub–Saharan Africa: Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Congo, Democratic Republic of Congo (Zaire), Cote d'Ivoire, Djibouti, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea–Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, Somalia, South Africa, Swaziland, Tanzania, Togo, Uganda, Zambia, Zanzibar, Zimbabwe.

by a river, the number of river crossings of a border between two countries, the total size in square kilometres of the river basins shared by the dyad, the size of the shared basins in the upstream state, the percentage of the total basin area lying in the upstream state, water scarcity (e.g. drought) and water resources (e.g. rainfall) measures, economic development variables, geographic location, conflict variable, etc. The data is analyzed using regression analysis (with bivariate and multivariate logit models) and shared river situations are tested against a number of hypotheses (see box). Using this model of interstate conflict, the study finds that the result that shared basins proved significant while the more detailed data on number of rivers and river boundary did not, suggests that conflict is not dependent on the number of rivers, but rather on the overall importance of a basin. Further, that the expectation that the risk of water-related conflict will be influenced by income level and geographic region was born out: i.e. poorer states and states in the water-scarce regions of the Middle East/North Africa and Sub-Saharan Africa experience more conflict than comparable basin-sharing dyads. The study further concludes that, using the new basin based river data, earlier studies of neomalthusian conflict over water are upheld in that shared water resources can stimulate low-level interstate conflict. Given this comprehensive analysis using detailed and ample data, the results of the study seem quite general. Although the study assumes certain socio-political similarities between the case studies, the scope is limited in this study in that, despite being 'historical', a more in-depth analysis of the individual socio-political histories of the contexts of the river basins for a better differentiation of the perceived phenomena is not detailed (also see our comments on Hunt's study above).

**Hypotheses posited by Gleditsch et al. (2004)**

1. Dyads that share a river basin experience more conflict between them
2. Dyads that have a boundary in a river experience more conflict between them
3. Pairs of countries that have a greater number of places where a river crosses their border experience more conflict behaviour between them
4. The greater the amount of water resources two countries share, the higher the probability of dyadic conflict
5. Where distribution of water resources is particularly unequal between two countries, there will be a higher the probability of dyadic conflict
6. When two countries share a river basin and one or both has little rainfall, they will display greater risk of conflict
7. When two countries that share a river basin and one or both has recently experienced drought, they will display greater risk of conflict
8. When a pair of countries shares a river and one or both of them lies in the Middle East/North Africa, they experience an increased risk of conflict
9. When a pair of countries shares a river and one or both of them lies in the Sub-Saharan Africa, they experience an increased risk of conflict
10. Among pairs of countries that share a river basin, those with higher levels of development will display lesser risk of conflict
11. Stress on resources, and resource conflict, is least severe for states at the lowest and highest levels of development




**The relation between favourable conditions and regime changes towards more integrated water management regimes, made visual in this scatterplot and the size of the dots**
(Source: Bressers and Kuks (2005)).

### *3.1.5 Combined Methods*

Studies that aim to combine qualitative and quantitative methods seem to depart from either one or the other of the two approaches. Some of these studies take a qualitative approach and apply quantitative methods, and

others take a quantitative approach and apply qualitative methods, as described below.

An example of a study which starts from a qualitative perspective and adds quantification, is the study of Bressers and Kuks (2005). They conduct comparative analysis of the case studies in the Euwareness project, which was a European Union funded study. Two cases are chosen in each of the six participating countries, to discuss the development of integral water management in the context of the European Water Framework Directive. Cases were selected on the basis of water basins at a regional scale or with a tributary character, on the basis of rivalry between heterogeneous/homogenous uses/users of the same water resource, with public as well as private ownership of water resources, and the presence of attempts at transition towards more coherence in the last two decades, and a combination of other similarities and differences. The research question is whether the regime for the management of a water system provides sufficient guarantees for its sustainable use, by diminishing or preventing rivalries between users and use functions. To test this, the researchers use three hypotheses (Bressers and Kuks, 2002 and 2005),[58] and focus on institutional regimes for natural resources as comprised of a public governance and of a private property rights component, the integration of which influences the sustainability of the use of the given natural resource. Further, the public governance and private property rights components are influenced by external change agents, categorized into four fundamental ones, which lead to regime change.[59] The case studies had two stages: a first descriptive stage in which the emphasis is on the story/stories to be told, and a second analytical stage in which the values of the variables are assessed. The quantitative data was collected using questionnaire survey for the case study researchers to fill in, the purpose of using numerical data being to summarize the case information in a uniform format to make cases comparable along the lines of the theoretical variables and hypotheses, using a five-point scale. Such judgement was deemed applicable as the researchers filling out the assessment have extensive and intensive knowledge about the individual case studies. The conclusions of the 24 cases and 13 variables per case resulting are portrayed using descriptive and analytical statistics (see illustration). This study draws on qualitative and quantitative methodologies in an. On our definition, analytically rigorous framework with a clearly defined research question. Further, qualitative data are quantified and additionally visualized, making the study more readable and adding a further degree of rigour.

Studies which start from a quantitative perspective and add qualitative data include Van Koppen et al. (2002:3-4). They compare the effects of Irrigation Management Transfer (IMT) in Andhra Pradesh and Gujarat, because

[58] 1) The observed change agents (in the period and context of our cases) will lead to more differentiation in the regime (resulting in more complex regimes) but not without additional prerequisites to more coherent regimes, 2) Attempts to change regimes into a more coherent status will have relatively more success when: i) there is already a longer tradition of co-operation in the water management sector; ii) there is a common understanding that the counteracting (side) effects of non-integrated water management harm sustainability and that this sooner or later will have to be stopped anyhow (joint problem); iii) there is a notion of possible joint gains from coherence, so-called 'win-win situations' (joint opportunities); iv) there is a credible threat of a dominant actor accumulating power and altering the public governance pattern in his interest when no solution is reached (credible alternative threat); v) there are well functioning institutions that provide fertile ground for coherence attempts (institutional interfaces), 3) a) Regimes with a deficient extent will be more likely lead to degradation of water resources or inability to protect the ecological functions of the water resource, than regimes with a larger extent, b) Regimes with a large 'extent', but with low coherence will more likely lead to degradation of water resources or inability to protect the ecological functions of the water resource, than regimes with a similar extent but a higher degree of coherence.

[59] 1) European Union originated policy pressures, 2) National regime developments, 3) Problem pressures, and 4) Various other pressures, e.g. rise of environmental NGOs.

in the two Indian states the programme was implemented with significant differences, but the implementation is still relatively young in both cases so that effects have not yet crystallised, and thus the findings can serve as a baseline for continued impact monitoring. The sample of the analysis, which reflects a one year period in 1998-1999, covers seven newly established Water Users' Associations (WUA) (three in Andra Pradesh and four in Gujarat), 700 farm households (classified according to four size classes of operational land holdings, which allows identifying farm-size related patterns: results are regrouped into 'small farmers' (totalling 490) and 'larger farmers' (totalling 210), and 67 WUA committee members. The study looks at poverty and farm size (in terms of plot location (tail end or upper reaches), crop choice, and other income sources), access to water (in terms of alternative irrigation sources, differential access to water, and land tenure), impact of IMT on access to water (in terms of access to water, cropping patterns, yields, incomes, extension of irrigated area, higher-tier negotiations in Andhra Pradesh, and cost recovery and water distribution in Gujarat), participation in WUAs (in terms of awareness, member participation in WUA activities, committees), and concludes by making recommendations for pro-poor IMT (Van Koppen et al., 2002). This study is quantitative in its setup, but through the interviews conducted with 67 WUA committee members, also has a strong qualitative component, as is apparent in the information given in the text.[60]

Another study that starts from a quantitative perspective is Ostrom (1990:14), who collects empirical data on a range of irrigation systems, to argue that the capacity of individuals to extricate themselves from various dilemma situations varies from situation to situation and illustrating through the cases both successful and unsuccessful efforts to escape tragic outcomes. Ostrom focuses on small-scale common-pool resources situations where the common-pool resource itself is located within one country and the number of individuals affected varies from 50 to 15,000 persons who are heavily dependent on the common-pool resource for economic returns: primarily inshore fisheries, smaller grazing areas, groundwater basins, irrigation systems, and communal forests. Ostrom provides in-depth study of a broad range of cases including high mountain meadows in Japan and Switzerland, water projects in the Philippines and California, and fisheries in Canada and Turkey. The cases were also chosen according to three further criteria: 1) Renewable rather than non-renewable resources, 2) Situations where substantial scarcity exists, rather than abundance, and 3) Situations in which the users can substantially harm one another, but not situations in which participants can produce major external harm for others. After definition of what is meant by a common-pool resources situation and individual choice in a common-pool resources situation, Ostrom's work is organized into three empirical parts, in which specific cases of long-enduring common-pool resources situations, the origin and development of common-pool resources institutions, and common-pool resources failures and fragilities are examined. In concluding, the theoretical reflections of each of these parts are pulled together in addressing implications of the results of the study for the design of self-organizing and self-governing institutions (Ostrom, 1990:26-28). In this study, a quantitative analysis, where data are translated into indicators, is coupled with a clear theory formation and policy significance objective. Based on this and other work Ostrom developed her Institutional Analysis and Development (IAD) framework (Ostrom, 2005).

[60] Wescoat lists a number of detailed field-based research projects on irrigation efficiency and equity in Pakistan, India, and Sri Lanka conducted by geographers associated with IWMI, including Vander Velde and Svendsen (1994), and Vander Velde and Johnson (1992) (2003:286-293) that have similar combination of quantitative and qualitative analysis.

Ostrom's work is clearly set in the positivist tradition, as illustrated by the search for universal (for a certain class of situations) design principles. It uses the richness of case analysis and in-depth understanding of the context of these cases as a tool and route for coming to general theory. While the theory thus generated provides an excellent template for asking relevant questions for particular situations, it does not help to explain certain aspects of such particular situations. For instance, it may be argued that a certain common pool resource management situation is not robust (on a certain set of criteria) because several of the design principles are not present/followed. This may very well be true, but the theory is unable to help answer questions about the 'why' of this, and about what might be done to change it (other than saying: the missing principles should be implemented) – for that other theory needs to be mobilised. It also raises basic questions on ontology and explanation as understood in different scientific paradigms. Method, including comparative method, has a complex relationship with such foundational questions, and an equally complex relation with the politics of (comparative) methodological choices. Notwithstanding the universalising nature of Ostrom's theory development, her agenda is clearly political. In Ostrom (1990) she concludes "if this study does nothing more than shatter the convictions of many policy analysts that the only way to solve common pool resource problems is for external authorities to impose full private property rights or centralized regulation, it will have accomplished one major purpose."

**'Design principles' found in robust common pool resource institutions (summarised from Ostrom, 1990)**

1. *Clearly-defined boundaries: individuals or households who have rights to withdraw resource units from the CPR must be clearly defined, as must the boundaries of the CPR itself.*
2. *Congruence between appropriation and provision rules and local conditions: Appropriation rules restricting time, place, technology and/or quantity of resource units are related to local conditions and to provision rules requiring labour, material and/or money.*
3. *Collective-choice arrangements: Most individuals affected by the operational rules can participate in modifying the operational rules.*
4. *Monitoring: Monitors, who actively audit CPR conditions and appropriate behaviour, are accountable to the appropriators or are the appropriators.*
5. *Graduated Sanctions: Appropriators who violate operational rules are likely to be assessed graduated sanctions (depending on the seriousness/context of the offense) by other appropriators, by officials accountable to the appropriators, or both.*
6. *Conflict-resolution mechanisms: Appropriators and their officials have rapid access to low-cost local arenas to resolve conflicts among appropriators or between appropriators and officials.*
7. *Minimal recognition of rights to organize: The rights of appropriators to devise their own institutions are not challenged by external government authorities.*

For CPRs that are part of larger systems:

8. *Nested enterprises: Appropriation, provision, monitoring, enforcement, conflict resolution and governance activities are organized in multiple layers of nested enterprises.*

## 3.2 Some conclusions on the use of comparative method in water studies

The examples discussed in this section have illustrated that comparative analysis methodology is used in a number of different types of studies in water resources management research. It is applied to a number of academic disciplines within the water resource management topic area, for example analysis of irrigation

management, water law and policy[61], and others. Further, studies conducted using comparative analysis range very broadly in scale and methodology, from very small-scale studies comparing two villages to very large-scale studies comparing a large number of countries, using empirical or statistical data or the authors' impressions. However, the phrasing that water studies 'use comparative analysis' is often a bit of an over-statement. We have demonstrated that there is a plethora of comparative water resources management studies using comparison as part of their analytical approach, but it has also been shown that even with a minimum definition of comparative methodological rigour as we have used, many studies using comparison do not employ clearly articulated and operationalised comparative analytical frameworks, neither for case selection, nor for analysis proper. Only in very few studies there is clear evidence that the rigour of the comparison has been a major factor in theory development.[62] Wescoat's conclusion that most comparative water research uses 'implicit comparison' rather than 'explicit comparison' seems warranted.[63] A sign of this is perhaps that there seems to be no self-standing discussion, that is, collective and explicit reflection, on the use of comparison and comparative method in water studies. It seems to us that a lot of analytical potential thus remains underused.

Although the examples presented in this section have been grouped according to the five types of comparative research identified in Section 2, in-depth reading of individual comparative studies in water resources management research in this section has revealed that there are very few studies which use 'Qualitative', 'Quantitative', 'Small-N' or 'Large-N' methods exclusively. The examples presented in this section show that the different types of comparative analysis often overlap. Although 'Large-N' is often associated with 'Quantitative', and 'Small-N' with 'Qualitative' in theoretical discussion, and this association is found in several of the examples illustrated in this section, it is not necessarily always the case, as many of the other examples in this section show. This section demonstrates that most studies use qualitative as well as quantitative methods in some form of combination.

The reasons for the combination of methods may have quite practical origins. Data collection in developing economy research contexts often presents various difficulties, limiting the scope of purely quantitative approaches. Although large amounts of statistical data have become available in recent decades, these data are often not detailed or reliable enough to be able to infer structural change patterns from analysis results. Further, in difficult research environments, the availability of detailed records over a longer period of time is often problematic, as many authors of the studies presented also concede, making it difficult to trace past developments and to inform mathematical predictive models. This also means that the historical comparative analyses advocated by theorists in Section 1 seem to be quite rare in water resources management research.[64] Thus, as a result of lack of data, questions of *why* changes occur the way they do are often left open. On the

[61] Wescoat cites Wolf (1997) and Wescoat (1996) as studies comparing water laws and treaties in different regions and basins, and cites Mitchell (1998) as offering one of the few comparative frameworks for analysis of national water policies (2003:286-293).

[62] We are not suggesting that good theoretical ideas can only come from rigorous application of rigorous method. However, its absence can lead to underutilisation of data, while its application (and explication) also makes studies and their evidence base more accessible to others' critical scrutiny.

[63] He argues that international water management comparisons often entail simple juxtapositions, selected unsystematically (Wescoat, 2005:11), so that geographic comparison remains largely subjective and unscientific (Wescoat, 2000: 125). In international comparisons, more systematic sampling and coverage is needed in comparative water rights research, as well as more balance rather than an 'export or import mode' of comparison (Wescoat, 2002:326)..

[64] Most social science historical work on water seems to be case-oriented. Maybe the criticisms levelled at Wittfogel's grand effort have scared scholars off from such enterprises.

other hand, the collection of qualitative data helps to bridge some of the data gaps in more quantitative approaches. Qualitative analyses are often very detailed, and seem capable of capturing quite complete pictures of situations – 'the whole story' so to speak. Our reading of comparative water studies (water studies using comparison) supports the position that rigorous comparative research cannot do without in-depth case studies (see Section 2).

As for the 'Small-N/Large-N' debate, there appears to be little consensus on which quantity of cases constitutes 'Small-N' or 'Large-N'. Whilst obviously two cases are 'Small-N' and hundreds or more are 'Large-N', many studies exist in a relatively wide 'Medium-N' range of more than two and less than one hundred cases. Many studies combine the 'Small-' and 'Large-N' approaches by setting out to compare two countries or regions, and then selecting many cases within these. Thus the 'Small-N/Large-N' debate may be associated more with whether studies employ qualitative or quantitative methods. Also, whilst debate and polarisation seem to persist between different camps of social and natural scientists in the theoretical realm of comparative methodology (such as the economists' positivist versus anthropological interpretative outlook), in the practice of research in water resources management issues, the best studies seem to use a mixture of methods, again illustrating a point made in Section 2. Though there is little explicit debate on comparative method in water studies, and very little explication of ontological and epistemological premises, there seem to be significant paradigmatic differences, both within and across disciplines, reflecting the overall situation in the sciences (cf. Geertz's and Ostrom's work for instance). The consequent absence of explicit polarisation on questions of method perhaps provides an opportunity for enhancing comparative research in water studies without immediate stepping into dichotomous traps (or comfort zones).

To conclude, this section has aimed to assess examples of comparative water studies in terms of their methodological rigour. We find that generally, although many studies set out with the aim of conducting comparative analysis, rigour, defined at the start of this section as research that has a stated comparative research objective and research question, uses a clear and explicit comparative framework for case selection and analysis proper, and is therefore able to yield detailed outcomes and make a contribution to theory formation, is not always achieved. Further, the issues related to conducting comparative analysis have found very little explicit reflection in the field of water studies, one implication of which is that while the use of a mixture of methods is common, there is little systematic deliberation on this.

## 4 COMPARATIVE WATER STUDIES: A REFLECTION

In this section we expand upon and qualify some of the immediate conclusions from the review in Section 3 while reflecting on some of the potential reasons for the absence of a more explicit and articulate practice and debate on comparative method in water studies, with the aim to think about ways in which comparative water research can be enhanced and strengthened. James Wescoat being the almost only scholar who has consistently written about and advocated comparative water research, this section is to a large extent an engagement with his writings.

## 4.1 The purpose of comparative water research

Wescoat states that the most effective comparative studies are those driven by immediate water problems (2002:326), and comparative analyses become more practical when they focus on water resources management 'successes' and 'failures' for their potential relevance beyond the places and times where they have been observed (2005:2). This reasoning resonates with the strong policy connection of water resources management studies that we have highlighted above (also see Wescoat's title-page quotation as an example of this type of justification). 'Practical relevance' is part of many statements on the need for (comparative) water research. In talking about the complexity of water resources management issues, Rajagopal (2009) states, "The topics of significant research import are the quality of questions that we pose, the ability to integrate diverse water-related data bases so as to provide answers to such questions, and the relationship of such questions and answers to societal decisions. The research agenda over the next two decades should be driven by the development of a variety of templates linking data to information to practical questions faced by water resource decision makers on the ground." Also for Tobin (2009), the challenge lies in connecting knowledge to action – action that is socially just, environmentally sustainable, and yet cost-effective.

While certainly not unjustified, 'utility' and 'urgency' forms of reasoning to underwrite enhanced effort as at comparative water research, are a specific, and not the only possible definition of purpose – it begs questions like whose utility, urgency and problem is implied, and which decision makers. We are cautious about such forms of reasoning because it is perhaps exactly the strong policy connection of water research that inhibits certain types of theory and method development, as we will argue in more detail below.[65]

More generally, in Burawoy's (2005) classification of different types of sociology (and by implication social science), 'utility' and 'urgency' reasoning would cover only some of the possible purposes and related characteristics of the social science enterprise, linking science very directly to concrete problem solving, of either 'mainstream' of 'progressive, transformative' variants (see the table below from Burawoy, 2005). The potential 'pathologies' related to this research are 'servility' (for the mainstream variant of instrumentalism) and 'faddishness' (for the progressive, transformative related variant). Burawoy's suggests that these types of research, together with independent academic research of the mainstream kind (with 'self-referentiality' as its pathology) and of the critical, reflexive kind (with 'dogmatism' as its pathology) should be standing in a relation of 'antagonistic interdependence' to correct each other's limitations and avoid each other's pitfalls. The upshot of this is that we would suggest that efforts at enhancing comparative water research should as much problematise the relationship with water policy and practice (funding), mainstream or progressive, as they should associate with it.[66]

[65] In this regard, Wescoat, in our view plausibly, suggests that the limited record and accomplishment of comparative water rights research to date may be explained by an ambivalent attitude towards legal issues and inquiry among water resources engineers and policy analysts (Wescoat, 2002:326). River basin development became the main object of international exchange and comparative research (Wescoat, 2002:315). Such comparisons however, despite going beyond simple juxtapositions, stopped short of detailed analysis of river basin institutions and their relations with water rights regimes (Wescoat, 2002:318).

[66] Funding problems are an issue in furthering comparative water research as in any other type of research. Smith (2009) states that although political ecology and political economy as well as historical approaches are just as vibrant in terms of research agenda, many institutions prefer to fund neutral and primarily quantitative water resources research. Layzer (2008) stresses that controversies over how to approach water resources management issues are rooted not in technical discrepancies but in value differences.

Wescoat goes on to suggest the outline of a research agenda in the subject-field of global water law and policy. The elements of this agenda are a periodisation [67], conceptual approaches to transferring water management lessons [68], opportunities for future research [69], and future research priorities[70]. To enhance comparative water research such efforts at agenda definition should also be undertaken for other subject-fields. The point for the present paper is that each of these elements can, and should, be framed and operationalised differently in relation to the different research purposes.

| | ACADEMIC AUDIENCE | EXTRA-ACADEMIC AUDIENCE |
|---|---|---|
| **INSTRUMENTAL KNOWLEDGE** | *Professional Sociology* | *Policy Sociology* |
| - **Knowledge** | Theoretical/empirical | Concrete |
| - **Truth** | Correspondence | Pragmatic |
| - **Legitimacy** | Scientific Norms | Effectiveness |
| - **Accountability** | Peers | Clients/Patrons |
| - **Pathology** | Self-Referentiality | Servility |
| - **Politics** | Professional Self-interest | Policy Intervention |
| **REFLEXIVE KNOWLEDGE** | *Critical Sociology* | *Public Sociology* |
| - **Knowledge** | Foundational | Communicative |
| - **Truth** | Normative | Consensus |
| - **Legitimacy** | Moral Vision | Relevance |
| - **Accountability** | Critical intellectuals | Designated Publics |
| - **Pathology** | Dogmatism | Faddishness |
| - **Politics** | Internal Debate | Public Dialogue |

## 4.2 The possibility of comparative water research

Several attempts have been made in academic settings to tackle the complexity of water resources management issues comprehensively by pooling research efforts to generate new knowledge. As early as 1955, a group of professors at Harvard University initiated the Harvard Water Program to investigate ways to improve the planning and design of complex water resource systems because adequate guidance for the design of water systems was deemed to be lacking (Reuss, 2003). The programme yielded the breakthrough *Design of Water Resource Systems: New Techniques for Relating Economic Objectives, Engineering Analysis, and Governmental Planning* by Maass et al. in 1962 (Wescoat, 2009b). However, this initiative ended in the early 1970s (Reuss, 2003), possibly because the approach itself was too complex, involving computer models aimed at capturing a range of water related issues.

[67] He defines six major historical-geographic situations or time periods, to be used as a conceptual framework for the analysis of multilateral water agreements: 1) Laws of nature and nations – in Europe: 1648-1792, 2) Conflict, commerce, and river commissions: 1804-1868, 3) Colonial water treaties in Africa and Asia: 1830-1901, 4) Codification and incremental advance: 1887-1921, 5) International non-governmental organizations: 1879-1948, and 6) Multilateralism on a hemispheric scale: the League of Nations and Pan American Union: 1910-1948 (Wescoat, 1996). This framework could be extended to include more recent decades.

[68] 1) Comparative theory and practice: to discriminate differences and make associations across similar cases, 2) Diffusion of innovation: on how legal precedents spread, 3) Social learning and social movement in water management: to focus on causal mechanisms and processes, and 4) Legal mirrors and legal transplants: using the review of water law literature as cultural archives (Wescoat, 2005:10-16).

[69] Being: demonstrating how the reanalysis of previous research and data is relevant to informing comparative water policy, a redesign of data collection strategies to enable meaningful comparison, determining the combinations of rigorous comparative methods that best apply to different water problems, developing effective communication among comparable yet different research approaches, and developing credible international peer review processes that draw upon comparative international cases.

[70] Future research priorities include: 1) Analysis of time scales of water policy change, that is, the conditions under which policies change on annual or decadal periods, 2) Assessing the long-term performance of incremental versus major, and procedural versus substantive, policies, and 3) Determining the measures and necessary conditions of long-term water policy effectiveness, with the aim to try to explain why international water policy precedents and innovations are adapted by some countries at certain moments in their histories (Wescoat, 2009b).

Wescoat writes that with the huge advances in water related research, the growth of internet resources on the topic and increase in access to scientific and policy information in the last decade alone, "there is no longer any excuse for ignoring the wealth of international water management experience", although the comparability of different international cases remains an ongoing challenge (2005:8). New technologies becoming available for integration into existing methods are improving data collection and monitoring. For example Han (2009) advocates using Geographic Information Techniques to analyze water resources. However, new technologies also bring inherent difficulties. Smith for example (2009) states that remotely sensed imagery needs to be complemented by on the ground experience and ongoing partnerships to enable long-term data and information collection and joint learning. Smith further refers to Rajagopal (2009) who points out the importance of rescuing old data and converting it systematically for current use, as well as finding ways to communicate data and information to positively influence policy. On-line instruction also holds various potentialities for water resources management education (Viessman, 2008). Further, and to turn a constraint into an opportunity, many data and studies exist in other languages, as noted in section 1.

Nevertheless, a very significant amount of comparative water related information has become available over the last decades in various databases and data repositories. Wescoat (2009b) compiles a comprehensive list of water research organizations and resources, including the U.S. Food and Agriculture Organization's Legislative Branch which has compiled and drafted water codes for decades. There is also a Centre for Comparative Water Policies and Laws at the University of South Australia,[71] the UNESCO Centre for Water Law, Policy and Science at the University of Dundee in Scotland,[72] a hub for future international water policy research and experimentation (Wescoat, 2009b) which acts as the Regional Coordinating Unit for the 20+ basins under the European UNESCO/World Meteorological Organisation's Hydrology for Environment, Life and Policy (HELP) programme, and very detailed work has also been conducted by the World Commission on Dams, which produced a wealth of case studies, surveys and country studies (Wescoat, 2005:6).

What this summary of Wescoat's argument about the advances in water resources science suggests to us that while there are always data problems, there is, indeed, no reason to evade comparative research on a lack of data argument. In addition to the availability of databases and repositories, we would emphasise the availability of a large number of in-depth case studies and other forms of intensive research that have been produced in the past decades, on water law and policy, as on many other subject-fields. These provide a rich basis for the small-N/medium-N comparative research that we envisage can be usefully undertaken to enhance knowledge accumulation and theory development in critical water studies.

### 4.3 Rigour in comparative water studies

Although, as noted above, Wittfogel erred in the causal relations among political, social, psychological, technological and environmental variables, he was the first to bring these together; yet, comparative geographic research on water-management systems remains today at a rudimentary level (Smith 1861, Wescoat 1994; referred in Wescoat, 2000:122). Disregard for methodological issues seems to be too frequent

[71] http://www.unisa.edu.au/waterpolicylaw/
[72] http://www.dundee.ac.uk/water/news/waterutilities.php

in comparative research (De Meur and Berg-Schlosser, 1994:193-4, referred in Levi-Faur, 2004:196). This is partially indicated by repeated references to methodological studies from the early 1970s in current comparative research, and can be partly attributed to the fact that methodological training in the political sciences and sociology is primarily oriented to statistical training (Levi-Faur, 2004:196). In order to draw lessons from some situations and ask if they are applicable to other situations, a type of cross-cultural comparative research is needed which is underdeveloped in water resources geography (e.g. Blomley 1989, Clark 1989, Emel et al. 1992, Matthews 1984, Wescoat 1994; referred in Wescoat 1995), and, we suggest, water studies more generally.

Nevertheless, attempts to bring more analytical rigour to the field have been ongoing for decades. In 1984, Ingram et al. published *Guidelines for Improved Institutional Analysis in Water Resources Planning*, motivated by a lack of rigour in policy/institutional analyses under-girding most water resources planning and evaluation efforts, in order to explain "how human beings are likely to behave, and not how we might hope they would behave" (in Blomquist et al., 2004). This was followed in 1999 by Saleth and Dinar, who state the "lamentable dearth of understanding on the issue of how to affect water institutional change" and advocate, similar to Ingram et al.'s framework, carefully identifying legal, policy, and administrative features common to most water settings, the relationships among these features, and how they affect the performance of water organizations (referred in Blomquist et al., 2004). Kenney and Lord (1999, referred in Blomquist et al., 2004) in their framework assume a capacity for rigorous institutional analysis, but identify the "growing desire […] to bring a greater level of scientific scrutiny to the description, analysis and, ultimately, the design of institutional arrangements." Thus, Blomquist et al. (2004) advocate that 21st century water resources management research needs to include studies comparing water laws and institutions, and improved understanding of user created organization. They propose using comparative study to isolate institutional effects from a myriad of other influences, and empirical study to develop applied knowledge for effective institutional analysis of water resources management, using a number of methodological criteria.[73]

However, the type of approach that Blomquist et al. (2004) promote remains caught in a positivist framework that can produce useful formal theory, but has limitations on the side of substantive theory, as we have argued above.

## 4.4 Explicit debate on comparative method in water studies

Exceptions to the lack of explicit debate on comparative method in social science water studies are situations where disciplines with a comparative tradition have taken water as their topic. The main examples are comparative law and comparative politics (for comparative studies on water and health, see the Appendix). For illustration we briefly look at comparative law.[74]

[73] 1) Selecting cases for comparison in ways that help isolate institutional factors, 2) Studying cases where water policy reforms are being or have recently been attempted, 3) Attending to the level of action, and 4) Minding the intergovernmental relations context, and further, as important institutional topics 'ripe' at this time for intensive comparative empirical research, identify 1) Property rights and water policy reforms, 2) Organizational fragmentation and coordination, 3) User created organizations in the watershed, and 4) Public participation, or water user participation.

[74] The examples discussed in Section 3 of comparative analysis of European water policy regimes, can be considered as falling in the domain of comparative politics and comparative policy analysis.

Kramer (2006:22) sees the value of comparative analysis as enabling a critical review of the legal design of water supply and to learn from the experiences of neighbouring countries such as Peru, Bolivia and Ecuador, which also have a number of other similarities. In terms of comparability of countries as case studies, she highlights several opinions in existing literature, and refers to Van Reenen (1995b:407) for a more extensive literature analysis on this topic: thus according to Kramer, Bernhardt (1963:437) for example posits that the law of countries can only be meaningfully compared if similar socio-economic circumstances and a fundamentally similar legal system exist; others posit comparability based on economic and political development stage, for example Mechlem (2000:314) and Mattei (1997) further defines three categories of legal systems by which he organizes various countries (referred in Kramer, 2006:50). However, Kramer writes that to determine the question of comparability on the basis of the object and aim of the research, as is advocated by De Cruz (1999:222) seems more interesting than to establish generally applicable criteria of comparability; for example, as argued by Constantinesco (1972:51), if the aim is an international standardization of laws, it would make sense to analyze those ordinances which should be included in a standardization process (Kramer, 2006:51). According to Kramer, there is a fundamental relation between state organization and sector law in communal water management, so that water sector reforms can only succeed if imbedded in broader reforms of the public sector (Kramer, 2006:282).

These (sub-) discipline specific debates have so far not travelled to other parts of water studies, illustrating our point, made in Section 1, on the compartmentalisation of water studies. It does mean that resources for a methodological debate on comparative water studies can at least partly be found within the domain of water studies (also see the sub-section on rigour); a systematic review of such (sub-)discipline specific discussion on comparative method in water studies remains to be done. Our cursory reading of these literatures suggests that they closely reflect general social science debates on comparative method. In this paper we have sought a way forward by positioning ourselves in that general debate rather than through such a detailed review (see Section 5).

### 4.5 Comparative research as situated knowledge

There is a plethora of water studies using comparison, as has been illustrated in Section 3 and immediately above. However, although the objective of comparative analysis is specifically to form new knowledge and apply it to practical and policy problems, this often seems lacking. Wescoat's description of the trajectory of comparative water research in the US is suggestive in this regard. Despite remarkable international exchange on water issues in the mid- and late 19$^{th}$ century (relating to water rights and water law systems to be adopted as well as engineering knowledge), in the 1910s-40s the search in the US for international lessons slowed down, until in the 1950s-80s western water policy documents ceased to refer to international experiences almost altogether (Wescoat, 2005:5). This coincided with increasing US involvement in water development in other regions of the world, and has resulted in an unclear interest and capacity in the US to use new knowledge emerging from other regions (Wescoat, 2005:7). (Colonial) South Asia has an almost inverse, and partly related, trajectory. In the early phase of British colonisation of South Asia, British engineers made visits to Italy, Spain and the south of France to study and document knowledge and experience with irrigation/water resources engineering – to inform the construction of large scale irrigation and flood control works in South Asia. By the

late 19th century Indian irrigation had become so reputed that it became the object of study by foreign visitors itself, for example from Australia. The first decades of the 20th century saw dynamic development of the technical water science in India, leading to regionally differentiated irrigation engineering traditions for instance, a dynamics that was superseded by a reorientation to particularly American water resources engineering from the 1950s. After independence Indian engineers made visits to the USA and some other countries to study 'scientific' irrigation and dam building; American universities became preferred places for doing engineering degrees. Wescoat's observation that by the end of the 20th century there was greater integration of scholarly and applied social research on water law and institutions in South Asia than in the US, can be considered as a next episode in this history. He further observes that little has been written about the international flow of ideas and associated technologies, commodities and institutions between irrigated regions of the world on the timescale of centuries (Wescoat, 2000:113).

Several general points can be derived from this impressionistic sketch. The first is that the emphasis on post-1990 globalisation of water resources management should not be over-stated and not be read to mean that globalisation was absent before 1990. Technical water knowledge has a much longer history of globalisation. The specifics of each phase or period of globalisation need to be specified. For the post-1990 period this is, we suggest, the globalisation of water resources management and governance frameworks as part of the phase of the globalising neoliberal capitalist development. Secondly, and more relevant to the present paper, the evolution/rise and fall of research approaches, and their impact on policy and practice needs to be understood as configured by developments in the broader cultural political economies that they are part of. The rise of the international development policy-connected water research is a case in point. Comparative water resources management research is 'situated knowledge' as much as any other knowledge, and this situatedness needs to be reflected upon.[75]

This section has demonstrated that there are many efforts to improve and extend the comparative methodology. However, generally in the theoretical realm, as well as in water resources management research, as was demonstrated in Section 3, a commonly accepted approach or set of approaches is still lacking. Nevertheless, comparison remains extensively used, debated and seen as a form or research to be pursued more systematically and rigorously. The next section outlines the contribution to such further development as envisaged through the research agenda framed in this paper.

# 5 TOWARDS STEPWISE SMALL-N/MEDIUM-N COMPARATIVE RESEARCH ON WATER RESOURCES MANAGEMENT

Sections 2 and 3 have mapped the many issues and controversies that are part of applying comparative research methods in the social sciences and in water studies. Section 4 has discussed some issues relevant to the question how to move forward with developing more rigorous comparative approaches. In this fifth section we provide our reading of these discussions, and suggest that Levi-Faur's approach to stepwise small-

[75] See Haraway (1991) on situated knowledge.

N/medium-N comparative research may be a useful approach to adopt for investigating globalisation-localisation dynamics in water resources management, as for other topics in (critical) water studies.

We do not pretend to be able to 'resolve' the question how to best do comparative research on water resources management. Such singularity is neither feasible nor desirable, and comparative water studies too little developed and reflected upon methodologically to allow detailed exploration of the issues involved. The many different approaches extant in water studies, spread across a variety of academic disciplines, associated with different paradigmatic (ontological and epistemological) convictions, and which are meant to serve different purposes in theory, policy and practice, will undermine any effort at positing a particular approach as 'the' synthetic approach. Interaction and debate on questions of method should, we suggest, be facilitated and intensified because explicit debate on (comparative) method in water studies seems wanting.

Any specific research programme, however, will have to define a starting point, particularly when it seeks not to just apply but also to develop methodology. In this section we sketch the methodological point of departure that the review of the literature has suggested to us as suitable for the comparative journey we envisage to undertake. This point of departure consists of a preference for stepwise, small-N/medium-N comparative analysis as suggested by David Levi-Faur (2004, 2005, 2006), which, as we will suggest, neatly fits the critical realist ontological and epistemological position that we favour. Apart from reasons of theoretical and philosophical preference and position, a pragmatic argument informs our choice of point of departure, which will be specified in sub-section 5.1. Sub-section 5.2 describes the basic characteristics of small-N/medium-N comparative approaches. In 5.3 we enter into more concrete territory by 'testing' the usefulness of a small-N/medium-N against an example of existing research and asking what explicit application of comparative method would have added. In 5.4 we discuss the fit of stepwise small-N/medium comparative method with critical realist ontology. And finally, in 5.5 we present the concluding remarks of the paper by summarising what contribution small-N/medium-N comparative research can make to knowledge accumulation and theory development.

## 5.1 The practical logic of a small/medium-N case study based design

Three key questions for any comparative research endeavour are:

1) Why do we compare: what is the purpose of the comparison?
2) What do we compare: what is the object of research?
3) How do we compare: which methodology will be used?

In the first section of the paper we briefly answered these questions for the envisaged research programme. The programme aims to investigate the post 1990 phenomenon of the intensification of the globalisation of water resources management as a significant qualitative transformation of freshwater management. It aims to undertake this research in comparative manner given the nature of the phenomenon, as well as to support the growth of critical water studies as a field, and to contribute to better contextualisation of policy approaches.

Three characteristics of the knowledge base provide a logic for a stepwise approach to theory formation and methodological development on this theme, and perhaps for comparative water studies generally. For the

purposes of this research programme no comparable data set is available across cases of globalisation-localisation (independent of whether the unit chosen would be nation states, river basins, policy processes, water sub-sectors, agro-ecological zones, or anything else). Secondly, given the multitude of literatures, developed in relatively self-contained ways, a high level of theoretical and methodological diversity exists, on top of the socio-material diversity of the multitude of grounded water resources management situations. Thirdly, in the more reflexive branches of water studies, from which this paper originates, (individual) case studies make up a significant part of the body of research. More importantly, case studies are considered by many as a preferred method, while positivist approaches with large-N methodologies are looked upon with suspicion.[76]

Given these characteristics, carefully defining and selecting cases as the research programme evolves, as is suggested in Levi-Faur's stepwise small-N/medium-N approach, seems to us the most feasible way forward. The type of work required in small-N/medium-N research approaches seems eminently suited to raise fundamental questions of method in concrete terms, and can thus help to profile the 'methodological question' in water studies – something that, we have argued, is not happening sufficiently at present. We outline the contours of that approach to comparative analysis in the following section.

## 5.2 Basic characteristics of stepwise small-N/medium-N comparative research

Levi-Faur advocates a 'medium-N' comparative research approach, which he defines as more than two and less than ca. 100 (given this range we prefer to refer to it as small-N/medium-N, but the exact terminology is obviously not the essential point). In developing his approach to comparative analysis, Levi-Faur (2004:196) acknowledges a) the work of Ragin (1987, 1994, 2000) in striving to improve urgently needed methodological training in comparative strategies, b) the *Compasss*[77] research network's stress on the use of a configurational logic, the existence of multiple causality, and the importance of a careful construction of research populations, and c) the efforts for example by Bennett (2002) and Liebermann (2005) to promote multi-method research. Levi-Faur seeks to contribute to the search for techniques that strike a useful balance between 'depth and breadth' (Ragin, 2000:22, referred in Levi-Faur, 2004:178) through a careful process of increasing the number of observations while staying in the framework of case-oriented research (Ragin, 1987, 1994, 2000 and King et al., 1994; referred in Levi-Faur, 2004:178), that is without compromising the strengths of case-oriented analysis.

[76] The strong presence of interpretative forms of anthropology, and social-anthropological method more broadly, and strong influence of 'constructivist' perspectives in critical academic water research, which is often conducted as counterpoint to (and critique of) more positivist and instrumentalist water policy and decision making affiliated research exercises, has made for some degree of qualitative/quantitative, small-N/large-N binarism. There seems to exist a stacking of paradigmatic, methodological, political and other dichotomies that do not necessarily neatly map onto each other. However, once such simplifications are taken for what they are and understood as, as we suggested above, cases of 'antagonistic interdependence' (Burawoy 2005) opportunities for innovative research abound, or so we suggest. For instance, Veronica Strang, (water) ethnographer *pur sang* suggests that in ethnographic analysis there is "a need for anthropological theory to recall its comparative foundations." Strang (2005, 92) She further states that "[i]t (...) seems remiss – and indeed irrational – to ignore [the] accumulated evidence [of numerous water related ethnographies from around the world] and cling to the political safety of culturally specific ethnography." (ibid., 93).

[77] 'Compasss' stands for Comparative Methods for the Advancement of Systematic Cross-case Analysis and Small-N Studies, see http://www.compasss.org/ .

Levi-Faur (2004:185) calls attention to the study *Freer Markets, More Rules: Regulatory Reform in Advanced Industrial Countries* by Vogel (1996) as an exemplary comparative research design: Vogel meticulously combines various comparative approaches but stays firmly in the framework of case-oriented research, by using a stepwise increase of the number of cases, starting from two primary nations then adding two sectors etc.

The two, interconnected, key elements of Levi-Faur's small-N/medium-N approach are 1) emphasis on the process of case definition and re-definition (as against simply case selection, as cases are not 'given'), and 2) the stepwise and systematic development (by adding and redefining) of cases in multiple ways, and thereby theoretically informed expansion of the scope of comparison.[78]

Research starts from one or more 'primary cases' on which in-depth knowledge and analysis is available. On the basis of this comparative research questions are formulated and case-comparisons for this with secondary and tertiary cases carefully designed.

> "To keep intact the strengths of case-oriented analysis, and primarily the in-depth knowledge of one's case, it may be useful to distinguish primary, secondary, and tertiary cases. In-depth analysis is a *sine qua non* for the *primary* cases on which theory was generated and where the primary purpose of the inquiry is to increase internal validity. Yet this in-depth knowledge is impossible, and even not desirable, for the *secondary and tertiary cases* against which the theory is examined in order to increase generalization. The element of explanatory surprise in one's research cannot be realized without imbalance in our knowledge, namely knowing more about one case than about another. Inference is a process of the examination of one case, which we know intimately, against another, about which we know much less. In this process we trade depth for breadth and dilute one type of knowledge for another. This also implies that cases vary in their 'inferential status' and that comparative analysis that rests on varying degrees of in-depth analysis is a legitimate scientific enterprise." (Levi-Faur, 2005)[79]

'Careful design' of cases refers to the use of a four box matrix as depicted in Figure 1, based on John Stuart Mill's methods for identifying causes (horizontal axis) and Przeworki's and Teune's (1970) work on the logic of comparative analysis (vertical axis).

Innovative is the idea that the matrix does not present a suite of approaches to be chosen from, but that the most fruitful approach to comparison is systematic 'travelling' through it. 'Systematic' here refers to a reasoned sequence in which first internal validity (stage 1) and then external validity (stage 2) is increased (as depicted in Figure 2).

To illustrate the multiple ways that secondary and tertiary cases can be designed, Levi-Faur's makes use of four popular comparative approaches in his own field, the study of regulation of national political economies in the context of globalisation from a comparative politics perspective. These approaches are based on specific theoretical preference in regard to the cases that need to be compared and the variations that they will display (Levi-Faur, 2004:178). They are:

[78] Though Levi-Faur does not make reference to Burawoy's work on the 'extended case method', Levi-Faur's framework could be considered a comparative analysis version of the 'extended case method' way of doing theoretically informed case studies, thereby, arguably, significantly increasing the analytical purchase of such case analysis.

[79] Use has been made of the internet Word version of this chapter, and hence no page numbers are given.

**Figure 1: Four Inferential Strategies**

| | Mill's Method of Difference | Mill's Method of Agreement |
|---|---|---|
| **Most-Similar System Research Design** | **MSSD+MMD**<br><br>**(dealing with differences in Similar Cases)**<br><br>*Minimize variance of the control variables, maximize variance in the dependent variable* | **MSSD+MMA**<br><br>**(dealing with similarities in Similar Cases)**<br><br>*Minimize variance of the control and dependent variables* |
| **Most-Different System Research Design** | **MDSD+MMD**<br><br>**(dealing with differences in Different Cases)**<br><br>*Maximize variance of the control and dependent variables* | **MSSD+MMA**<br><br>**(dealing with similarities in Different Cases)**<br><br>*Maximize variance of the control, minimize variance in the dependent variable* |

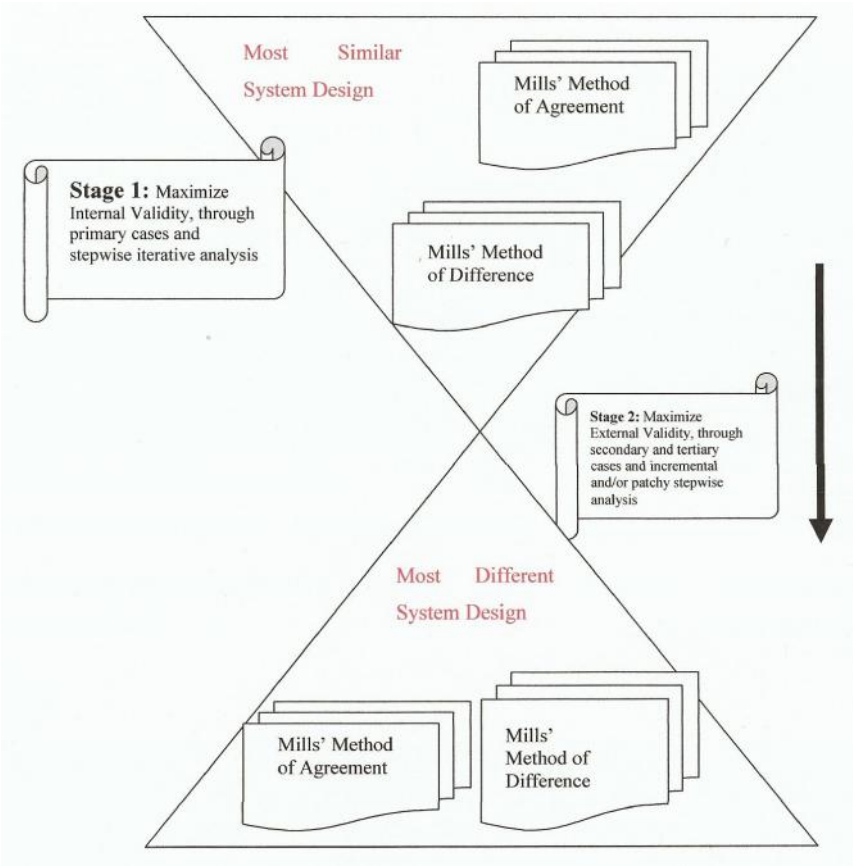
*Source*: Levi-Faur (2005)

1. The national patterns approach, which predicts that national variations will be the major determinants of reforms and advocates comparison of nations,
2. The policy sector approach, which predicts that sector-level variables will be the major determinant of reforms,
3. The international regime approach, which suggests that the major determinants of the spread and depth of regulatory reforms are variations in the strength and scope of international regimes, and
4. The temporal patterns approach, which suggests that the major variations in reforms are shaped by past events, that is by the particular situation of countries, sectors and international regimes at a particular time.

When looked at this with a methodological eye, the different approaches just provide different ways of designing additional cases, which can generate different types of knowledge and theoretical contributions.[80] Rather than forcing a single theoretical positioning, they can all be used for broadening the scope and depth of theoretical inquiry. More in general, there is always a variety of ways to do comparison, different aspects and dimensions of a case can be used for comparison with other cases, and different inferential strategies can thus be used, generating a stepwise process of systematic comparison, which is both rigorous and open.

[80] A 'case' has to be understood not as a 'thing' (like a country, or a district, or a sector, etc.) but as "a particular configuration of attributes" (Levi-Faur, 2005 referring to Ragin, 2000:66 and Verba, 1967:114). Cases thus need to be defined, or constructed, in a theoretically informed manner. This implies that case definition/construction involves choices with regard to the aspects or dimensions to be investigated of a particular situation, as well as the theoretical angle of focus with which that investigation will be done.

**Figure 2: Stepwise heuristic of comparative analysis**




*Source*: Levi-Faur (2005)

## 5.3 A small-N/medium-N reconstruction of canal irrigation management research

To test the plausibility and attractiveness of small-N/medium-N comparative research design for water studies, the first author reflected on the elaboration of his own research activities over the past 20+ years to find out if that research, not consciously planned as comparative research, but evolved in response to personal interest, emerging and evolving academic and policy puzzles, and funding opportunities, could have benefited from a more 'rigorous' comparative framework. Figure 3 summarises Levi-Faur's proposal for systematic small-N/medium-N research (including an 'economic reform' policy example modelled on his writing), and inserts into that an irrigation example – canal irrigation management being the area in which the first author developed his 'primary case'.

While having started this exercise with trepidation, and an anticipation of finding many missed opportunities and 'lack of rigour', the elaboration of the author's research on irrigation management could be fitted into the matrix surprisingly and remarkably well, which may suggest that the stepwise small-N/medium-N mode of

analysis is close to how reasoning and inference happen intuitively.[81] At the risk of irritating readers by excessive personalisation, the elaboration story is presented in some detail below, while in the subsequent sub-section the general considerations that this example suggests are presented.

**Figure 3: Case development in a small-N comparative research strategy**

**internal validity ---------- >**

<----------- external validity

| | ***Mill's Method of Difference***<br>**MMD** | ***Mill's Method of Agreement***<br>**MMA** |
|---|---|---|
| ***Most-Similar System Research Design***<br>**MSSD** | **MSSD + MDD**<br>(dealing with differences in similar cases)<br><br>Unequal water distribution: three secondary canals from one South Indian system, one water abundant (head), two water scarce (tail).<br><br>*Economic reform: Anglo Saxon countries, opting for either liberalisation or nationalisation, with assumedly different outcomes.*<br><br>**PRIMARY CASE** | **MSSD + MMA**<br>(dealing with similarities in similar cases)<br><br>Unequal water distribution: additional canals from same South Indian system, across degrees of scarcity.<br><br>*Economic reform: Anglo Saxon countries, all liberalising, with assumedly similar outcomes.*<br><br>**PRIMARY CASE - extended** |
| ***Most-Different System Research Design***<br>**MDSD** | **MDSD + MMD**<br>(dealing with differences in different cases)<br><br>Unequal water distribution:<br>1) secondary canals from a South Indian, a North Indian system, and a Western Indian system with different water rationing rules, and different attempts at irrigation reform,, with different patterns of inequality/differential access<br>2) secondary canals from a South Indian and a Khorezmian (Uzbekistan) system, with different infrastructure designs and different governance regimes, with different patterns of inequality/differential access..<br><br>*Economic reform: Anglo-Saxon and continental European countries, with dissimilar educational policies, having assumedly different outcomes.*<br><br>**SECONDARY/TERTIARY/…. CASE** | **MSSD +MMA**<br>(dealing with similarities in different cases)<br><br>Unequal water distribution:<br>1) secondary canals from an Indian and a Mexican system, with similar time-share based rationing rules, with similar patterns of inequality/differential access.<br>2) secondary canals from a water-scarce system (Pakistan) and from a water abundant system (Indonesia, Philippines), with similar irrigation reform programmes implemented, reproducing similar patterns of inequality/differential access..<br><br>*Economic reform: Anglo-Saxon and continental European countries, with similar monetary policies, having assumedly similar outcomes.*<br><br>**SECONDARY/TERTIARY/…. CASE** |

*Source:* Own compilation, based on Levi-Faur 2004, 2005, 2006.

The primary case study undertaken was that of irrigation management in one large scale irrigation system in South India. The core puzzle that the research addressed was how to explain (in interdisciplinary, socio-technical fashion) the recurring unequal distribution of irrigation water at different levels of the canal system – as an instance of the 'classical' head/tail distribution problem in canal irrigation. The research proposal for it was written in 1989; a long and intensive fieldwork period covered 22 months in 1991-92. Written

[81] Ragin (2008:5) comments in this vein too: "The most common route to general knowledge, especially to that of social phenomena, is through accumulated knowledge of specific instances or cases. In everyday experience we build knowledge of the general from knowledge of the specific."

intermittently between teaching and subsequent research, the PhD thesis was defended in 1998 and published as a book in 2003 (Mollinga, 2003).

The subsequent field research in the 1990s took the results of the primary case analysis to other locations in the geographical and socio-political vicinity of the primary case. Though done with policy-oriented objectives in mind, this can be reconstructed as an effort to enhance both the internal and external validity of the primary case analysis (the final presentation of which was pending during this period). The original results, based on three main locations in a single irrigation system, were tested against other locations in the same system ('location' being 'secondary canal', of which there were more than 80 in the system). The findings on the structures and mechanisms at work were confirmed, and the top right box of the table was thus filled (the subsequent research is not separately published; some of it went into the confidence with which the monograph on the primary case was written).

In the same research during the 1990s (and through supervised Masters and PhD thesis field research) the results of the primary case analysis were taken to other canal irrigation systems in the same state (Karnataka) with similar design parameters, to canal irrigation systems in a neighbouring South Indian state (Andhra Pradesh) with similar design parameters, but a different policy and governance environment (notably a World Bank supported irrigation reform programme from 1997 under a state government perceived to pursue a neoliberal development trajectory), and also to a Northern and Western Indian state (Haryana and Maharashtra) where both design and governance/irrigation reform parameters were different. However, this was all still within the socio-political context of contemporary India, and within the category of so called 'protective irrigation'. With hindsight, this can be reconstructed as exploring structural diversity within a relatively clearly circumscribed universe – no universal generalisation was implied or attempted.[82]

In hindsight, the somewhat haphazard expansion to other locations within India was a first way in which the external validity of the primary case was enhanced. A more drastic step in this direction happened through when the second author became involved irrigation and other research in Uzbekistan, including PhD supervision. Here, given the Soviet history, both governance and design parameters were rather radically different from India and other well researched places in the irrigation literature – which sparked the mind enormously (see Veldwisch, 2008). To this contrast was added, this time consciously, an Indian irrigation system from the colonial period with unique design and governance characteristics – a comparative publication is in preparation. At a more general level the issue of water management in (semi-)authoritarian states was pursued through an edited collection in *Water Alternatives* 3(3) October 2010. This is how the search for a systematic framework for comparison started, on the intuition that there are qualitative differences between say, the Indian and the Uzbek situations, and that these situations could be used to develop a broader ranging typology of irrigation situations capturing the interconnected technical and institutional characteristics of these situations. This amounts to taking the critical realist notion of 'relational typology' to the field of irrigation studies in an attempt to capture qualitatively different clusters of 'system characteristics' (that is, concentrations of many determinations).

[82] Publications on this research are mostly that of or together with Masters and PhD students: see Mollinga et al., 2001; Narain, 2003; Nikku, 2006. Looking back on this, it can be said that lacking was a method to add value to this collection of case studies through systematic comparative analysis.

The lower right box of the table is not research that has been undertaken as yet. It could easily be undertaken – a suite of intensively researched primary case studies is available for the examples given, as for several others. Systematic comparison is what remains to be done.[83]

## 5.4 Small-N/medium-N comparative research and critical realist ontology

Levi-Faur reminds us that 'methodologies are derivatives of ontologies' (Levi-Faur, 2005). Referring to Hall (2003) he argues that "[t]he deep divide in social and political inquiry is ontological rather than technical or instrumental." (Levi-Faur, 2005)

> "[T]o suggest, like Przeworski and Teune, that generality and parsimony of theories should have primacy over their accuracy is to assume that social reality is driven by only a few *'shakers and movers'* that are responsible for most visible outcomes in the political and social world. Consequently we might end up with ontology of 'simple' theories for a 'simple' world. But if one adopts a more complex ontology, and perceives social reality as a product of conjectural causality, then accuracy and intimate knowledge of one's case might be elevated to the same importance as the search for generalization. (...) Generalizations tend to fade when we look at the particular case (...) yet case analysis without an attempt at generalization is a mere anecdote."" (2006:371)

The non-pragmatic part of arguing for a small-N/medium-N approach to comparative research stems from the ontology it implies and is associated with. Levi-Faur develops his approach as an effort at bridging the divide between the two ontologies from the previous quotation – a long standing dichotomy in the social sciences. He phrases the challenge to address as how to increase the number of cases while maintaining the advantages of in-depth case studies, that is, basically as a strategy to 'get the best of both worlds' (see f.i. Levi-Faur (2006:371) and section 2 of Levi-Faur (2005) where he sketches how he came to develop his approach). Instead of positing the approach as a form of combination or mediation of two perspectives, that is, as a 'boundary object' able to facilitate interaction between two paradigms[84], as Levi-Faur does, we suggest that it can more assertively, and more fruitfully, be regarded as a methodological approach fitting a specific ontology (and related epistemology) different from the two that constitute the dichotomy.

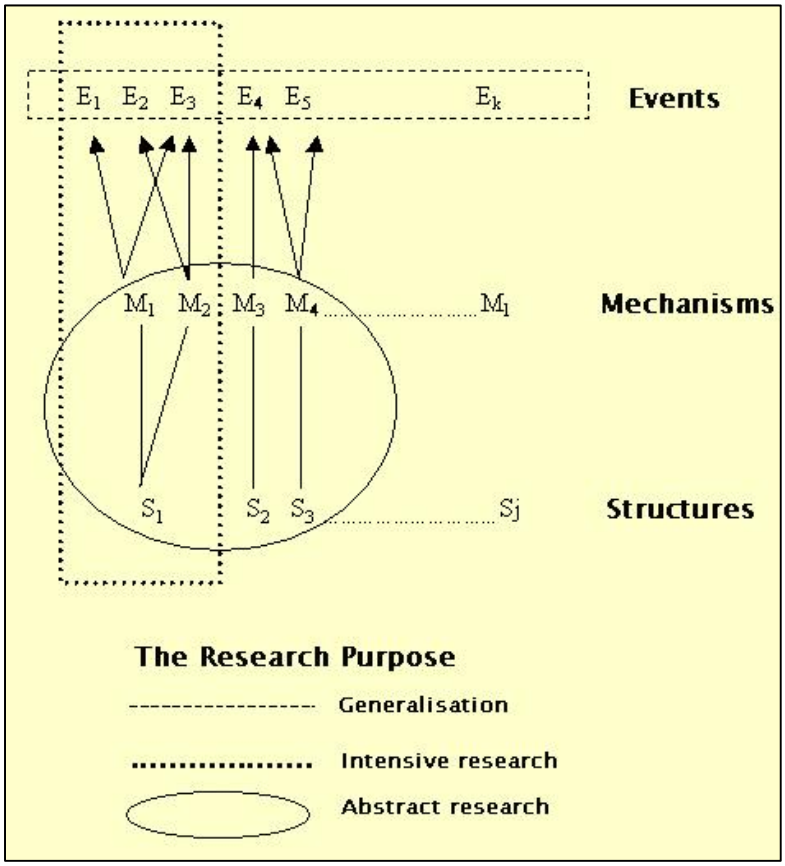
Ragin (2008) and Rihoux and Ragin (2009) also position their 'configurational comparative methods (CCM)' approach as a third position, rather than a compromise between two existing approaches. The set-theoretic perspective they adopt means that 'configurations of conditions' explain outcomes rather than independent conditions/causes each making their own (weighted) contribution to explanation – as in positivist, regression analysis based approaches. "Simply said, a configuration is a specific combination of factors (or stimuli, causal variables, ingredients, determinants etc. – we call these *conditions* in CCM terminology) that produces a given *outcome* of interest." The notion of 'configuration' is combinatorial – "the conditions will be envisaged in a combinatorial way" – while the key question of the analysis is "[w]hich conditions (or combinations thereof) are 'necessary' or 'sufficient' (or possibly both necessary *and* sufficient) to produce the outcome?" (Rihoux and

[83] On Pakistan see Merrey (1983); on Mexico see Van der Zaag (1992); on Indonesia see Suhardiman (2008). Many additional sources exist.
[84] On the notion of 'boundary object' see Mollinga (2010a).

Ragin, 2009:xix) In this way the complexity of causality is addressed as "multiple conjunctural causation" (ibid.:8)

This is also in our view a major improvement on the positivist/regression-based analysis that it criticises, but it seems to lack a concept of structure and stratification. Do the configurations of conditions not form 'structures', in the sense of enduring combinations, constituting an object or system, or is there large reservoir of conditions within which the appropriate selection and combination has to be found? The latter is the image that the CCM approach portrays (see Ragin, 2008: chapter 6).[85] Critical realist ontology can, we suggest, enrich the combinatorial perspective.

**Figure 4. Structures, mechanisms and events**




*Source*: Sayer (1984)

The stepwise small-N/medium-N approach that Levi-Faur proposes can be neatly fitted to the ontology of critical realism (see Sayer, 1984).[86] This is a form of realism that rejects both a fully hermeneutic/interpretative perspective and positivism as general models for science – a position that also informs the 'configurational

[85] The approach states that the choice of 'conditions' needs to be 'theoretically informed' but does not say very much on what that implies. It also seems to us that a collection of very different things is united under the notion of 'conditions'. The language used is that of 'causal recipes' and 'causal paths', which seem to us rather imprecise ways of capturing the enduring instances and combinations of causal powers deriving from the structure(s) of society.

[86] Critical realism's foundational work is that of Bhaskar (1989). On the structure-agency question and on the question of emergence and emergent properties in social analysis, see particularly the work of Archer (1995).

comparative methods' approach. Against interpretative perspectives critical realism adopts the view that meanings (or reasons) are causes among a variety of causes; against positivism it holds a 'deep' rather than a 'flat' ontology considering the concrete as a 'concentration of many determinations' (Marx, 1973). The notion of 'emergence' is central to critical realist ontology as an object's causal powers (the mechanisms it generates) emerge from the particular configuration of the elements that constitute that object.[87] A summary depiction of the basic characteristics of critical realist ontology, and how different types of research relate to it, is given in Figure 4.

A critical realist perspective on small-N/medium-N comparative method would suggest that the in-depth analysis of cases (intensive research in Figure 4) allows for insight in the complexity of the structural configuration of causalities in a particular case. The stepwise comparison along different theoretically defined avenues that Levi-Faur proposes, can be understood from a critical realist perspective to do two types of work. The first is that stepwise comparison can help to identify the identification of 'contingent' and 'necessary' causalities in a situation (or the 'internal' and 'external' relations of an object) that is investigated. In other words, stepwise comparison can help to identify which mechanisms are generated by which structural configurations, and how these contingently or necessarily combine in the generation of events.

From this perspective, the limitation of the combinatorial perspective of the CCM approach can be understood as incorporating only part of the diagram. The combinatorial approach can be said to look only at the mechanisms and events: it sees configurations of mechanisms ('conditions') that produce events ('outcomes'), acknowledging, like critical realism, that different configurations of mechanisms can produce the same outcome, while a particular configuration of mechanisms can produce differential outcomes when operative in different circumstances (see particularly Ragin (2008: chapter 6) for this parallel). What the CCM approach does not do is to explicitly identify and analyse the structures from which the mechanisms, as emergent properties, derive. The CCM approach argues that the configuration of mechanisms ('conditions') used in the explanation of outcomes needs to be theoretically informed; in addition to this it also needs to be ontologically grounded.[88]

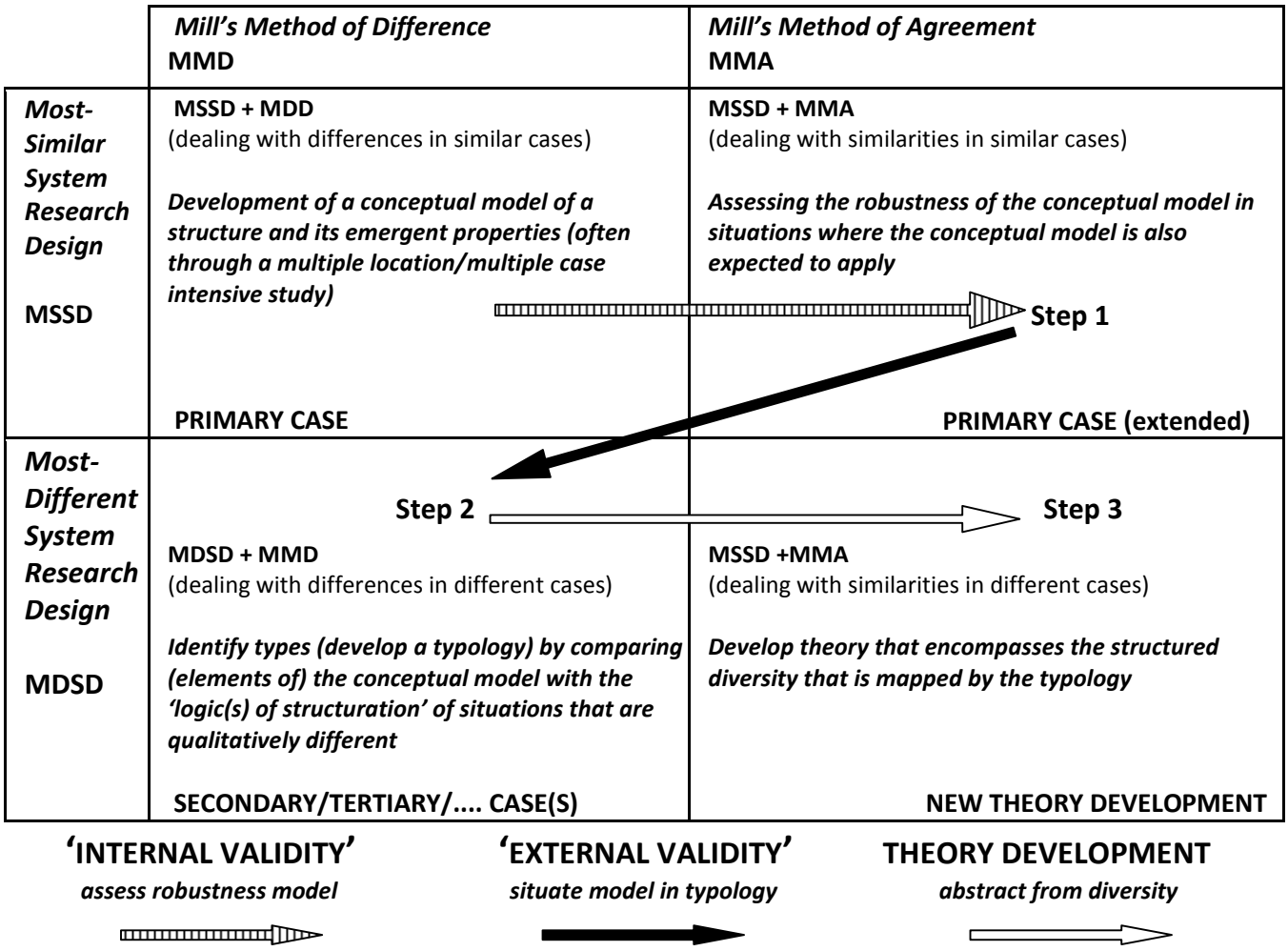
Taking the irrigation example discussed above to illustrate this point, the 'primary case' research on unequal water distribution in canal irrigation found that credit and employment relations (between large and small farmers) were internal relations of the structural configuration of the political economy of water management, that is, were a defining part of the causalities generating unequal distribution of water. I was also found that for instance caste relations were external to it (and only contingently shaped unequal outcomes). That this was not an individual attribute of the particular case intensively studied, but a characteristic with robustness across cases, could be established by comparing the intensively researched situation with other situations in similar irrigation systems (Step 1 in Figure 5). The same structure exists and produces similar outcomes across a

[87] For a typology of the structural, cultural and personal emergent properties operating in society, see Archer (1995).

[88] It might perhaps be suggested, given the wide array of things grouped under the term 'conditions', that in the CCM perspective structure(s) is/are understood as 'outcome'. From a critical realist perspective this would be seen as conflating events and structure, which is exactly Archer's 'central conflation' critique of Giddens' theory of structure-agency dynamics. Where Giddens argues that structure and agency are 'two sides of the same coin' (structures only exist as instantiated in practices), Archer argues, in our view convincingly, that structure needs to be understood as ontologically distinct from agency and practice, with reproduction of structure requiring time (see Giddens, 1984; Archer, 1995). Levi-Faur's observation that methodology derives from ontology is, indeed, spot on.

number of cases because the same mechanisms are at work, and when similarity in outcome does not exist despite the structure being in place, other structures and mechanisms can be traced that explain this.

**Figure 5: Stepwise comparative analysis for theorising structured diversity**




Secondly, stepwise comparison can help to distinguish the qualitative differences between the different instances of a particular kind of structural configuration (in the example, the set of components and relationships generating the mechanisms that explain unequal water distribution). In a critical realist perspective specific, robust configurations or sets are not unique or singular, but represent 'types' because reality is structured and layered, and exhibiting endurance, against ontologies that are 'flat' (and aim generalisation based on regularity in 'events', see Figure 4). Hence, critical realism has a strong interest in 'relational typologies'.[89] Small-N/medium-N comparative research allows the case to be understood as representing a type, and through systematic and stepwise comparison explore the characteristics of that type

[89] Critical realist examples of relational typologies include those of landlord-tenant relations in the London housing market in the 1980s (Allen, 1983) and types of family farms in British agriculture in the 1980s (Whatmore et al., 1987). In water resources management studies concepts like 'water policy regimes' can be considered as efforts to capture structured diversity, while maintaining the time and space contextuality of the typology, or a 'domain of relevance' (for example, a typology of national water policy regimes within the liberal democratic states of the European Union).

*against other types*, and thus develop an ontologically based typology of qualitatively different structural configurations (Step 2 in Figure 5). [90] In this way, the comparative analysis can be taken beyond the explanation of 'outcomes' to making a distinct contribution to theory development: the identification of types, as elements of typologies, with each type having a different 'logic of structuration' (Kontopoulos, 1993). This, thus, allows generalisation at the level of mechanisms generated by different structural configurations; the 'abstract research' in Figure 4 represents this (Step 3 in Figure 5).[91] [92]

In addition to explaining 'outcomes' we thus suggest that stepwise small-N/medium-N qualitative comparative analysis can fruitfully be used to map and theorise 'structured diversity', as summarised in Figure 5.[93] We would further suggest that such analysis may support the contextualisation of policy – one of the narratives underpinning comparative research advocacy in Section 1.

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[90] It is of course a theoretical possibility that there are as many structural configurations as there are situations, and there are senses in which, indeed, every situation is unique. The fact that many situations have structural features in common – say a parliamentary electoral system, a free market for consumer goods, a nuclear type of family, a Buddhist religious framework, a centralised form of piped water supply, etc. – makes for the existence of finite variation for specific phenomena, and allows for useful abstraction and the construction of typologies. Also Rihoux and Ragin (2009) emphasise that social phenomena have 'limited diversity' (also see Ragin, 2008:chapter 8),

[91] This framing has similarities with forms of complex systems theory that adopt an ontology of open, non-linear systems that are capable of adapting/learning, with emergence in a key role (see f.i. Trosper, 2005). Water resources management systems are such complex systems. Remarkably, however, water control systems for irrigation, water supply, flood control and hydropower, are hardly the subject of analysis in political ecology – a field of study focusing on the analysis of socio-ecological systems (Robbins, 2004). Political ecology mainly focuses on forest, land and biodiversity. On the paucity of political ecological focus on hydrological issues, also see Budds (2009).

[92] The lack of an explicit comparative analytical framework in the irrigation research discussed, may explain that a typology of structural configurations explaining patterns of (un)equal water distribution is yet to be articulated precisely. What shines through in the narrative of the evolution of the irrigation research is that the initial interest in explaining inequality in resource distribution expanded to include broader questions of the role of irrigation in rural/agrarian development and transition, and the role of irrigation in state rule. In a 'strict' application of QCA method as described in Rihoux and Ragin (2009), one would take a hypothesis on the unequal, head/tail pattern of water distribution in canal irrigation across all four boxes of the matrix, to develop a theoretical explanation of that unequal, head/tail pattern. What happened in the irrigation research described (without comparative methodological reflection) is that the 'travelling across the matrix' functioned to reframe the original object of research – unequal water distribution patterns became an element of an effort to conceptualise the complexity of irrigations systems more broadly. The primary interest in theoretically explaining particular water distribution outcomes, shifted to a broader theoretical endeavour. Put differently, the phenomenon of unequal water distribution served as an entry point for theory development on canal irrigation, with the comparative matrix allowing a stepwise, systematic approach to that, which Figure 5 begins to formalise.

[93] The development of this attempt to use Levi-Faur's stepwise small-N/medium-N comparative approach for research within an explicitly critical realist framework has been strongly shaped by inputs of and discussion with Nadine Reis and Amrita Lamba, which is gratefully acknowledged. The notion 'conceptual model' is chosen as a general referent to both theorisations of particular structural configurations (like, for instance, unequal irrigation water distribution, or bureaucratic process reproducing state legitimacy) or conceptual designs of particular policy frameworks (like, for instance, institutional arrangements and processes that facilitate inclusive governance). The 'outcome' focused analytical exercises of Qualitative Comparative Analysis (QCA) would seem to be useful tools *within* each of the three steps, notably fsQCA (fuzzy set QCA; see Rihoux and Ragin, 2009). It is important to note that the attempt is a tentative one, and these suggestions preliminary, to be developed in further research. Rihoux and Ragin (2009:16) state that "As such (...) QCA does not yield new theories. What it may do, once performed, is to help the researcher generate some new insights, which may then be taken as a basis for further theoretical development or for re-examination of existing theories." We have suggested that within the framework of a critical realist ontology systematic, stepwise small-n/medium-N comparative analysis can structure and support theory development more strongly than these authors state.

## 5.5 To conclude: comparative research in water studies and theory development

To reflect, in conclusion, on the kind of theory development that can be aimed at with comparative analysis, we return to the reasons for the weak articulation of comparative method in the domain of water studies, starting from the irrigation example discussed above. What general observations can be derived from that account?

*Reasons for the weak articulation of comparative method in water studies*

A first question that the irrigation research narrative raises is why the coin that a rigorous method of comparison would be helpful and required for enhancing analysis and theory development took so long to drop. More generally put, why is there no practice of comparative research in irrigation studies of the kind promoted in this paper? The answer to this question can only be speculative at this stage. We suggest that the history of the field of irrigation studies, and water studies more generally, may provide part of the answer.

In Section 3 we suggested that before the 1970s the positivist marriage of the engineering and hydrology disciplines on one hand and economics on the other characterised the field of water studies, that in the 1970s the socio-cultural and institutional aspects of irrigation and water resources management gained prominence, a social science extension of irrigation/water research that was strongly sociological and anthropological in character, in the context of development policy priorities like community development and participation. This identified a second characteristic of the water studies field – the strong connection between the new type of irrigation/water research and global development policy and funding, a connection continuing till today. This may have had the following implications for comparative research frameworks to the extent that these were used implicitly or explicitly.

Given the technical and positivist origins of the water studies field, comparison seems to have been primarily conceived as an instance of experimental designs as used in the natural sciences, by employing *before/after* and *with/without* models focusing on single variables (cf. also the discussion in the *Appendix*). A famous, because very influential, example, is research in the Philippines in the early 1970s that experimented with the introduction of rotational water distribution in 'lateral' irrigation canals in a larger canal system (Valera and Wickham, 1976; Wickham and Valera, 1978). The research reported that the introduction of rotational water distribution rules (*with*) resulted in more equal water distribution and higher crop yields compared to the existing situation (*without*).

The Philippines case is all the more interesting because Oorthuizen's (2003) reconstruction of it shows that the irrigation research experiment abstracted from and did not report on several significant complexities of and events in the research situation. The reduction of complexity that was committed allowed the research to become a model for global policy intervention by suggesting a clear-cut and actionable causality. The findings were important in legitimising massive investment in local farmer organisation in irrigation management in the 1970s and 1980s with the stated aim of enhancing system performance (the key message of the research being perceived as 'social/institutional interventions hold the key to performance improvement and can work').[94] The

[94] The complexity that Oorthuizen (2003) reports on identifies key factors that help explain the subsequent poor results of such policy interventions. This example illustrates nicely, though somewhat depressingly, that there is a 'politics of method'.

point to highlight for this paper is the strong affiliation of irrigation/water research with policy development and implementation, and policy and political logic of looking for clear-cut, actionable, generally applicable 'solutions' to problems. 'Lessons learnt' and 'best practices' frameworks are the contemporary version of it (see Molle, 2008 and Mollinga et al, 2007 for more discussion).

The objective of generalisation in water studies is thus often not primarily explanatory, but oriented at 'what to do'. Comparison informed by this policy logic boils down to deriving general lessons/policy advice from a varied collection of cases. This together with a predilection for 'experimental design' research strategies, would lead to the expectation that large-N comparison based on appropriate data sets would be the comparative research route most likely to be pursued. However, data availability problems hamper large-N studies in developing country settings. Evaluation studies of Irrigation Management Transfer (IMT) programmes as discussed in our review illustrate this.[95]

Taken together, the positivist history of the field of irrigation/water studies, its strong policy affiliation and data availability issues do not make the pursuit of small-N/medium-N qualitative comparative analysis very likely, and neither that of systematic large-N comparative research. Irrigation/water research that has critically reflected on the 'dominant paradigm' has mostly taken a case study approach, regularly as an explicit counterpoint to the standardisation and universalising inherent in positivist perspectives, in order to show convincingly how standardised approaches do generally not work, and to argue for 'context-specific' policy approaches. Thus the well-known binary in the sciences that we commented upon above is enacted.

A second general comment that can be derived from the reconstruction narrative is that without an explicit method comparison does not travel very far and very fast. The narrative illustrates the more general argument presented in this paper that there are analytical and policy gains to be made through the pursuit of the systematic application of explicit comparative research methods in water studies. In the example discussed, time could have been saved, and cases could have been selected more systematically on their possible theoretical contribution. It is easy to imagine, now, for the example presented, more suitable cases for comparison, and particularly more precise case definitions that would allow richer and more creative analysis.

This triggers a third general inference. Adopting a comparative strategy as suggested above is obviously not the only way to develop an original intensive case study into a more encompassing research programme. Routes that are frequently travelled in water studies, and as we would assume elsewhere, seem to include the following.

a) Expanding the substantive scope of the primary case study's research is a first route. In the example trajectory presented this happened in at least two ways. One expansion was from 'irrigation' to 'water resources', a second from 'management' to 'policy and politics'. Irrigation management thus became framed as an instance of a more broadly conceived 'politics of water', if not 'politics of natural resources management'. This amounts to a broader theoretical framing of the primary case, which allows using it, and other cases, to explore newly framed theoretical questions, in an expanding but demarcated subject field (see Mollinga, 2008).

[95] The current 'benchmarking' emphasis in international policy-related research programmes on irrigation system performance as implemented and supported by the World Bank for instance, seeks to address the data availability problem.

b) Shifting to a new but similar research object, or one derived and developed from the original study, is a second route. An example for the narrative presented might be a shift to research on forestry or livestock management (new but similar objects) after having completed one or more projects on irrigation/water resources, or a focus on, say caste relations or political brokering as significant themes identified in the original study (derived/developed objects). The 'new but similar object' shift can start to build a comparative research programme when the shift is done with that objective in mind, but it can also be done simply for reasons of personal interest or circumstantial reasons (like the availability of research funding). The 'new, derived object' shift would seem to fit those wishing to profile themselves (as individuals or organisations) as area scholars or regional experts.

c) A third, and in our impression increasingly common, route is development of research agendas and research programmes in relation to changing policy controversies and priorities. An example in relation to the narrative presented would be shifts in research focus from participatory irrigation management, to inclusion of gender dimensions in these, to addressing the ecological aspects of irrigation water management in addition to its social distribution dimensions, to framing the issue in terms of desirable responses to climate change, and so forth. These shifts may or may not match with changes 'on the ground'. When there is a match research findings may be of great strategic importance, and facilitate 'social learning'[96]; when they don't the research findings may not speak to concrete problems and only help to reproduce research (policy) careers, agendas and institutes.[97] Regular changes in research priorities in relation to the politically defined cycles of policy priorities is a clear characteristic of global development policy related research, a form of 'external funding' on which many academic institutions increasingly rely.

Each of these routes is associated with specific forms of theory development, each with their own logics and purposes. We do not believe they can or should be ranked, and comparative research is not a *sine qua non* for theory development. However, the specific and significant contribution that a stepwise small-N/medium-N comparative research strategy as discussed in this paper is able to make seems to be a concerted effort at abstract theorisation of the structural diversity of water resources management situations, and to embed such analysis in, and contribute to, broader theories of development. In terms of purpose, this may, we have suggested but not systematically argued in this paper, support more contextualised forms of water policy formulation and implementation.

*Theory development through comparative water studies*

In conclusion, we would suggest we can hope to achieve the following types of knowledge accumulation and theory development through small-N/medium-N comparative analysis of water resources management (while adopting a critical realist ontology and epistemology).

1. Concept and framework formation based on intensive research or suitable datasets. Capturing the 'concentration of many determinations' requires concepts and frameworks that are non-reductionist and effectively articulate the multidimensionality of phenomena, situations and processes.

[96] The most explicit formalisation of such an approach to research are concepts of 'transdisciplinary research' (see for instance Pohl and Hirsch Hadorn, 2007).

[97] An example of non-fit is that the enthusiasm for IWRM (Integrated Water Resources Management) underlying much water research funding of the European Union, may lead to funding research projects that set out to map IWRM policy and practice in regions where none exists.

2. Development of ‘primary cases’ through intensive research to generate substantive theory on specific phenomena, situations and processes.
3. Based on a series of analyses as under 2., theorise structured diversity and its implications: this involves abstract research for developing typologies of qualitatively different structural configurations, and showing how these differentially shape the phenomena, situations and processes under investigation, and subsequently embedding the structured diversity maps into more encompassing theory.

From the standpoint of comparative research, the third type of work is theorisation through comparative analysis proper, and the first two necessary conditions for it. Without concepts and frameworks able to capture complex configurations, the analytical work under 2 and 3 will be severely handicapped; without rich primary cases to refer and go back to, the comparative analysis under 3 is not feasible or risks losing touch with reality.

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# APPENDIX

## Comparative Studies on Water: an Epidemiological Comment

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'Comparative studies on water' is a topic that initially makes one wonder whether, like Moliere's *bourgeois gentilhomme's* use of prose, one has been doing it all one's life, or whether some special or particular connotation is intended by the term 'Comparative.' In trying to read the relevant social science literature I had initially failed to look back to my own experience as a physician and epidemiologist in water research. This comment therefore addresses two areas that may have something to contribute: (i) the comparative component of descriptive exploratory water use studies, where sample size within and between the entities concerned is comparable, and around n=30; and (ii) a rather simplistic review of comparative studies from the health sector which may be of interest and extends the range of methods available for consideration.

### Comments based on Drawers of Water (DOW I and II).

The survey of water use in East Africa (DOW I) by White *et al.* (1972 *=30*) can best be viewed as a comparative study. Some 30 communities were studied, aiming to have 30 households from each community. The communities were deliberately selected for diversity, to illustrate the range of environmental and economic situation is under which people live. Consequently mean values for water use and other measured variables were not national or regional means since they were not based on random sampling. Rather, insights were gained by comparing and contrasting data from the various sites and this comparative approach yielded many of the key findings. To some degree the approach was because of our interest in diversity of coping mechanisms, situations, and the relation of water use to environment and livelihood. The relatively large number of communities allowed of quasi-norms of use for simple comparisons, and undoubtedly we gained far more insights into the situation then would have been gained from comparison of two or three much larger samples. This was an early or pioneering study and even with hindsight seems a reasonable approach to previously poorly studied questions.

DOW II (Thompson *et al*., 2001 *=27)* was a follow-up 30 years later which aimed to replicate DOW I in measurement methodology, same sites and sample size and actual households as far as possible. It was primarily a pair-wise comparison in time but the number of comparisons made it possible to determine trends and changes with relative confidence. Selecting the same sites both strengthened the validity of the pair-wise comparison and also meant that the originally non-random selection of communities was of minor importance in analysis and interpretation.

## Comments based on health research methodology.

The comparative method permeates medical and other health research, especially in relation to attempts to determine the efficacy of interventions aimed at treatment or prevention of disease. These highly rigorous methodologies are being increasingly put forward as a way to tackle questions in the applied social sciences. This note is to list and comment briefly upon these methods, not to discuss at length how appropriate they are for social science research.

The original driving force of comparative trials in health sciences was the need to determine the efficacy of the drug treatment of disease. The discovery of new chemotherapeutic agents and antibiotics for the treatment of infective disease created a need to determine efficacy as each new compound became available. Initially the need was to determine whether it had a beneficial effect, then later to compare a new antibiotic with the currently accepted treatment. Where an untreated infection is uniformly fatal as with tuberculous meningitis, sophisticated methodology was not critical, but this is fortunately a rare situation. For others, the controlled clinical trial has become the key methodology of choice. Here, in the previous absence of effective therapy, the method is to randomise allocation of the new treatment to a group of patients and follow the course of disease to a predetermined endpoint. It has been conclusively shown that the results may be biased if either the patients or the physician and staff conducting the trial are aware of who is receiving the active drug and who is not, or rather, who is receiving a placebo – a medicine made to resemble the drug under test but without the active ingredient.

The ***double-blind controlled clinical trial*** *[6,18,20]* has become the gold standard for assessing the value of clinical therapeutic interventions applicable at the individual level, and is essentially comparative, comparing those receiving the new therapy with those who do not.

Some water interventions can be assessed in this way, particularly some types of point-of-use water treatment to improve microbiological quality and reduce diarrhoeal disease.*[3,22]* The intervention could be at household level but with the observations focused on one member of the household, such as a child, who may be at particular risk of waterborne disease in the narrow sense. Ethical questions may be raised, as to give ineffective water treatment without informing participants would be

deceitful, but if all participants are aware that only some will have effective water treatment, the duration is sharply defined and backup clinical help is available to prevent serious adverse consequences, there may be a place for such work. To those unaccustomed to think in these ways one would have to make it clear that only where there is substantial doubt of efficacy is a trial justified, and then one could argue that it is ethically flawed not to do a trial.

However in water research relatively few relevant changes/interventions are of this type. Many that appear individual matters are in fact greatly dependent upon whether their neighbours receive the same intervention and it may be difficult or impossible to conduct the work in a double-blind manner without creating serious ethical dilemmas or a ridiculous situation.

In public health research it was realised some decades ago that public health interventions often have to be at community level. Flood prevention actions are of this type, as are sanitation improvements where the benefits depend on one's neighbour's actions as well as those of an individual household, and most sorts of hygiene education where messages diffuse within communities as well as being received by particular individuals. The methodology of ***community randomised trials*** *[8,9,10,14,15,24,25]*, as these are called, is well defined from a statistical viewpoint and will often require at least a dozen villages to attain statistical significance. The type of study, common in the past, where two villages, one with the intervention, are compared using data from many individuals in each village, and simple comparison of the data from those individuals, is erroneous because the individuals are not independent with respect to the intervention so that the sample size is effectively one in each category. The practical problems of random allocation of community interventions have sometimes been solved by very public discussion of the issues followed by public drawing of lots.

It may well be that such methodology could be much more widely used for social science intervention trials. Where this is unfeasible, various alternative approaches may be used, such as a step-wedge design. It takes time to create many water-pumps or sanitation interventions and it may be possible to compare not only village populations before and after the interventions but also villagers who have received the intervention with those who are about to receive it in the next year or so. These types of quasi-random intervention trials may again be worth wider use, although those used to the health sector will be concerned about bias in any relaxation of the randomised controlled trial methodology *[19, 21,31,17,28]*.

A separate set of problems arises when, for practical and cost reasons, there have been several or many trials of a particular intervention or aiming to answer the same question but where many are underpowered for a significant result, or the results vary or are discrepant. This situation is common in health research and has been addressed by the **Cochrane collaboration** *[1,4]* which has led to the formalization of methods for ***meta-analysis***, or combining the results of several trials with appropriate weighting of the trials to reach a pooled result *[2,11,13,16]*. There is extensive experience

of this. The critical issue is to lay down the inclusion criteria for studies before the search for trials begins. This means that usually a substantial number are excluded as not being of sufficient rigour.

The Cochrane approach has been applied to reviews of the literature on a critical issue generally. The search criteria: both the databases to be searched and the features of an acceptable contribution, must antedate the search for what is called in the health literature a ***systematic review*** *[5,7,23]*. When the question addressed by research is relatively narrow and the great emphasis is on answering that particular question, the method can be very powerful *[26,28]*, but in the case of much water research there may be causes for concern. For example, the relevant material may be concentrated in the grey literature which is hard to review systematically, or in the early literature that has not systematically reached the computer databases. For example, the bulk of work on environmental control of mosquito vectors of disease was carried out prior to 1940 (USPHS & TVA, 1947 *=29*). Recently attempts have been made to answer sociological and socio-economic questions related to health by systematic reviews, which have tended to produce over 4000 relevant papers at the first search, which narrowed down to less than 10 when the selection criteria were applied rigorously. This raises deeper questions of bias and the peculiarities of very small samples, as well as whether asking simple questions of very heavily contextualized and complex problems will actually give helpful answers *[12,31]* Nevertheless these are comparative (meta-) studies.

In looking at issues of risk in a comparative manner, epidemiologists tend to use one of two population-related methods. In cohort studies, two or more human populations, varying in the putative risk factors but relatively comparable in variables not of relevance to the questions under study, are followed over time and the incidence of disease in the populations is compared. This is usually expensive and takes time as it is generally a prospective study, but it can give precise and clear results. The other method, the usually retrospective case-control study, takes a group of people with the disease under investigation and matches them with another group, similar in non-relevant variables, and then records the frequency of putative risk factors in the two groups. The method is usually faster and cheaper than a cohort study but less precise, and more open to the vagaries of bias and frustrations of over-matching. Cohort studies have clear relevance to many types of water related research outside the health field.

Partly because of the expense of creating separate cohort studies for each epidemiological investigation, there have been created populations, each of about 30,000 people, under continuous monitoring and demographic surveillance where many variables are regularly recorded or updated and with whom other studies may be carried out at a more modest cost. There are over 30 of these demographic surveillance system (DSS) sites worldwide in developing countries, the majority in Africa, and they may well be suitable for large-scale comparative water studies at reasonable cost (see <*Indepth-network.org*>).

These issues arising from the health sector's approaches are outlined to fill out the range of comparative studies available that have, or could have, relevance to water. Also there are efforts

from several quarters to bring this methodology into research beyond the health sector, rightly or wrongly, and they form part of the spectrum of comparative studies of water for our consideration.

## Further Reading and Bibliography

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