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Canal irrigation and the hydrosocial cycle
The morphogenesis of contested water control in the Tungabhadra Left Bank Canal, South India

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ABSTRACT

Using South Indian large-scale surface irrigation as a case, this paper combines emerging interdisciplinary conceptualisation in resource geography of the hydrological cycle as a *hydrosocial* cycle with Archer's theorisation of society's structure-agency dynamics as a morphogenetic cycle. Characteristic of large scale canal irrigation are a pronounced spatiality of social process, and a strongly cyclical nature of social interaction around water through seasonality and rotational supply, framed by irrigation infrastructure that is both grid and subject of water resources management practices. This allows an investigation of how human agency as the animator of structural elaboration reproduces and transforms a hybrid and multi-scale water control system, thus establishing a 'hydromorphogenetic' cycle of unequal irrigation water distribution. The detailed account of irrigation practice provides caution against simplified interpretations of dam + canals based irrigation as abodes of green revolution capitalist farming, and of the objectives of neoliberal irrigation reform policy. It is, lastly, suggested that the hydrosocial relations focus produces new insights and questions for irrigation studies, but that complexity and emergence rather than hybridity are the key analytical challenges.

1. Introduction: socio-technical systems and hydrosocial relations

In irrigation studies, conceptualisation of irrigation systems as combined physical and human socio-technical systems dates from the 1980s (Uphoff, 1986; Vincent, 1997). The interest in 'hybrid', socio-technical understanding of irrigation derived from the perceived poor performance record of irrigation interventions in the context of international development assistance and national planned development – both in mainstream and critical observation of the sector.[1] For large-scale formally government managed irrigation, a well known illustration is Uphoff's suggestion that the levels of primary, secondary, and tertiary canals of surface irrigation systems do not only have hydraulic significance for the physical conveyance of water, but also constitute social spaces for irrigation management activities as contested by irrigators and government officials (Uphoff, 1991: 33). For smaller-scale farmer managed irrigation Coward has shown that the creation and upkeep of irrigation infrastructure go hand in hand with the (transformation of the) social relations: they co-evolve and are each other's expression as 'hydraulic property' (Coward, 1990).

Theorisation of the socio-technical nature of irrigation processes received a boost with the advent of the 'social construction of technology' (SCOT) perspective (Pinch and Bijker, 1984). Theorisations from this SCOT, and later ANT (Actor-Network Theory) literature, mostly focusing on western societies, and without specific interest in irrigation or water resources, could be usefully transposed to the study of irrigation infrastructure. The social construction of irrigation artefacts, notably division structures,[2] the devices connecting Uphoff's levels and embodying Coward's hydraulic property rights, has been a central theme (Mollinga, 2013). The concept of 'water control' has posited that technical/physical, organisational/managerial and socio-economic/political control of water are internally related (Bolding et al., 1995). Methodologically, this

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[1] 'Critical' (irrigation studies) here refers to approaches explicitly addressing the social relations of power that are part of irrigation and which have a normative concern about its often problematic equity/poverty, democracy, and sustainability dimensions.

[2] In irrigation science 'structures' is the generic technical term for built devices in water control systems (like discharge measurement structures, division structures, outlet structures, escape structures, etc.). It needs to be distinguished from structure as used in 'structure-agency', and the more general use of structure as enduring composition and pattern of organisation of objects and processes (having structure, or being structured). All three meanings are used in this paper.

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current of work has articulated 'technography' as a method for interdisciplinary irrigation studies (Bolding, 2004).

Conceiving the hydrological cycle as a hydrosocial cycle is an effort to avoid the pitfalls of reductionist and depoliticised water resources management analysis.

> "In a sustained attempt to transcend the modernist nature – society binaries, hydro-social research envisions the circulation of water as a combined physical and social process, as a hybridized socio-natural flow that fuses together nature and society in inseparable manners (...). It calls for revisiting traditional fragmented and interdisciplinary approaches to the study of water by insisting on the inseparability of the social and the physical in the production of particular hydro-social configurations (...)." (Swyngedouw, 2009: 56)

In water studies binarism is clearly visible in early conceptions of the hydrosocial cycle like that of Falkenmark (1997), where the social and the material appear in conceptual models as separate boxes, linked with arrows.[3] What such modelling is unable to capture is exactly hybridity. In contrast, hydrosocial analysis conceives of the relation as internal and infested with social power (Swyngedouw, 2009). The hydrosocial perspective also suggests that 'scalar politics' is a key element; scale is not given but politically constructed (Swyngedouw, 2007).

The programmatic announcement of 'hydrosocial research' as a new perspective focusing on analysis of the "intricate and multidimensional relationships between the socio-technical organization of the hydro-social cycle, the associated power geometries that choreograph access to and exclusion from water, as well as the uneven political power relations that affect flows of water" (Swyngedouw, 2009: 59) for many a critical irrigation scholar may sound like sticking a new label on already existing research. However, much critical irrigation research has remained irrigation system confined, taking the boundaries of the infrastructural systems and the communities using and managing them as defining the object of research.[4] The emerging hydrosocial research perspective can be used to bring together in a single framework the different scales and dimensions of the socio-technicality and hydrosociality of irrigation. It resonates with the increased (largely policy-driven) interest in irrigation studies to 'scale up' analysis from the system level to the level of the basin (Wester et al., 2003), and is able to provide a political economy and political ecology infusion into that research (cf. Lebel et al., 2005 on scalar politics in the Mekong basin). Simultaneously the detailed socio-technical analysis of irrigation studies can help to elaborate the general notion of hydrosocial relations. By unravelling the contestations ongoing within irrigation projects, it can add to the space and landscape focus of hydrosocial analysis an emphasis on time and technology. The latter is virtually absent in political ecology.[5] It can also nuance all too sweeping analyses of the role of dams + canals for irrigation in the project of state and/or market-led modernisation and assessments of neoliberal irrigation reform.

This paper, thus, seeks to combine 'hydrosocial analysis' and the socio-technical study of irrigation. It does so in three steps, and by investigating one particular case, unequal water distribution in the Tungabhadra Left Bank Canal irrigation system in South India (Mollinga, 2003). First it discusses in general theoretical terms how Archer's (1995) morphogenetic approach resonates with the endeavour of hydrosocial analysis, providing the general framework for investigation of the Tungabhadra case. In a second step the paper looks at irrigation 'from without', interpreting the meaning of the 'slicing off' of irrigation from the hydrosocial cycle. It is shown that the storage and diversion of river water for the productive purpose of irrigation is an act of power, a strategy of state rule, and an effort to singularise the value and meaning of water to serve particular trajectories of political economic development. Third, the paper looks at the irrigation system 'from within' along the axes of technology, time and space. It provides an analysis of the hydrosocial dynamics within the system that produce a recurrent pattern of unequal water distribution,[6] and shows that the project of state rule and political economic development is far from accomplished and inherently contradictory. The paper concludes with reflecting on how hydrosocial analysis can be elaborated beyond confirmation of the fact that, indeed, water resources management structures and practices are 'hydrosocial relations of power'.

2. Hydrosociality, structure-agency and morphogenesis

The basic theoretical puzzle of hydrosocial analysis is to capture the ontological complexity of water resource management situations, as being structured, stratified and heterogeneous, and in critical perspectives, contested, systems and processes, animated by configurations of actors networked in variety of social relations of power that shape their individual and collective agency. Conceptualisations of the circulation of water, as for example in models of the hydrological cycle, need to be combined or integrated with conceptualisations of social dynamics, as for example, and foundationally, in models of structure-agency dynamics.

The hydrological cycle as understood in hydrology is a circulation process in which water moves through different phases and 'compartments'. Details are too well known to bear repeating – the intricacies of the circulation have been documented and modelled in great detail. With the advent of Geographical Information Systems, spatially explicit modelling has become possible (Sakthivadivel, 2006). Combined with a river basin history perspective, trajectories of hydrosocial evolution of basin structure may be described (for the Krishna river in South India, see Venot, 2009). The 'social (re)construction' of the hydrological structure and stratification of the water circulation system can thus be mapped, modelled and understood in relation to societal dynamics, mediated by technology and institutions. Time plays a role in such trajectories as the (short term) yearly climatic cycle and the (long term) gradual change of the hydrosocial configuration.

This imagery closely resonates with that of Archer's (1995) picturing of the morphogenetic cycle. She uses the term morphogenesis to refer to the way societal structuration and stratification develops through the interaction of agency and structure.[7] Against Giddens (1984), for whom structure and agency are inseparable and two sides of the same coin, she argues for analytical dualism in

[3] I thank Susanne Mauren for collecting conceptual models of the hydrosocial cycle.

[4] Theorisation of irrigation as a 'large technological system' in SCOT/ANT mode (cf. Hughes, 1987) has, to the knowledge of this author, not been undertaken.

[5] Political ecology has focused on knowledge rather than technology, while water has not been a particularly popular topic in such research (Budds, 2009; also see Linton, 2008; Shah, 2008; Trottier and Fernandez, 2010).

[6] The Tungabhadra irrigation system exhibits the classical head-tail pattern of water distribution, in which those located upstream along a canal (at its head) appropriate water beyond their entitlement, depriving those located further downstream along the canal (towards its tail). In the perspective of this paper 'locational advantage' (implying queuing for access) is an emergent property, constituted by a complex hydrosocial structure, that needs to be explained, rather than a geographical 'given'.

[7] And morphostasis in case of reproduction.

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