



Power and Empowerment in Transdisciplinary Research: A Negotiated Approach for Peri-Urban Groundwater Problems in the Ganges Delta

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Abstract. The co-creation of knowledge through a process of mutual learning between scientists and societal actors is an important avenue to advance science and resolve complex problems in society. While the value and principles for such transdisciplinary water research have been well established, the power and empowerment dimensions continue to pose a challenge, even more so in international processes that bring together participants from the global north and south. We build on earlier research to combine known phases, activities and principles for transdisciplinary water research with a negotiated approach to stakeholder empowerment. Combining these elements, we unpack the power and empowerment dimension in transdisciplinary research for peri-urban groundwater management in the Ganges Delta. Our case experiences show that a negotiated approach offers a useful and needed complement to existing transdisciplinary guidelines. Based on the results, we identify responses to the power and empowerment challenges, which add to existing strategies for transdisciplinary research. A resulting overarching recommendation is to engage with power and politics more explicitly from the inception of transdisciplinary activities, as a key input for problem framing.

30 **Key words:** transdisciplinarity, negotiated approach, stakeholder empowerment, peri-urban, groundwater management, Bangladesh, India



1 Introduction

Transdisciplinary research is on the rise as a process of co-creation of knowledge by science and society to offer solutions for complex problems in human-water systems (e.g. Krueger et al., 2016; Ferguson et al., 2018; Ghodsvali et al. 2019; Sapkota, 35 2019; Pohl et al., 2021). In the past years, useful guidelines, principles and strategies have been developed, building on earlier efforts with transdisciplinary research for water and sustainability challenges (Lang et al., 2012; Seidl et al., 2013; Steelman et al., 2015). These typically take the perspective of the science community (see e.g. Scholz and Steiner, 2015a), putting co-production of knowledge central, with stakeholder engagement and empowerment as a challenge (Massuel et al., 2018; Ghodsvali et al., 2019). Since transdisciplinary research aspires to have societal impact, addressing this challenge of 40 stakeholder participation and empowerment, as well as dealing with institutional ambiguity and informality, should become part and parcel to the effort (ibid., Van Breda and Swilling, 2019).

This means that transdisciplinary water science cannot be separated from issues of power, empowerment, and capacity development. The differences in the types of knowledge and the thought styles that different groups bring to the table, are mixed with established structures for social interactions and the associated power and political dimensions (Jahn et al., 2012; 45 Krueger et al., 2016; Brown, 2018; Pohl et al., 2021). Paying attention to this power and empowerment dimension is especially important in areas where power disparities are rife and where scientific knowledge is one ingredient in a larger mix through which stakeholders seek to solve societal challenges. This is the case for water management in peri-urban areas.

Peri-urban areas are spaces in transition that connect urban and rural environments and that show features of both (Allen 2003; Mc Gee 1991; Singh and Narain 2020). Here, rapid urbanization often results in an increasing pressure on groundwater 50 resources as a source of water for both livelihoods and household uses. A reduced availability of this resource affects livelihood security and contributes to vulnerability and inequality for among water users. Clearly, careful hydrogeology alone cannot expect to make the difference, local water users and state actors also need to be empowered (e.g. Narain and Ranjan et al., 2017).

In this paper, we report our experiences and insights from an attempt to combine transdisciplinary research with stakeholder 55 empowerment in peri-urban communities in Bangladesh and India. This is done by complementing insights from the literature on transdisciplinary water research with negotiated approaches for stakeholder participation and empowerment (Leeuwis, 2000; Koudstaal et al., 2011). The next section summarizes the relevant literature on the combination of transdisciplinary research and stakeholder capacity development. This is followed in subsequent sections by case experiences in the metropolitan areas of Khulna and Kolkata. The findings from these experiences result in suggestions for a more power-sensitive 60 transdisciplinarity, after which we conclude with some final take-aways.



2. Transdisciplinary research and stakeholder capacity development

2.1 Transdisciplinary research

2.1.1 Core concepts and known challenges in transdisciplinary research

Transdisciplinary research is a process of mutual learning among scientists across disciplines and societal actors aimed at
65 creating knowledge that benefits both scientific praxis and discourse, as well as societal problems (Jahn et al., 2012; Lang et
al., 2012; Scholz & Steiner, 2015a). Although transdisciplinary research has been developed since the nineteen seventies, it is
the focus of renewed attention now. The rising field of transdisciplinary research is producing a steady flow of publications.
There are various conceptualizations of transdisciplinary research, which describe transdisciplinary research as a process
whereby science and society interact to develop new knowledge (Max-Neef, 2005; Jahn et al., 2012; Lang et al., 2012; Brandt
70 et al, 2013; Seidl et al., 2013; Scholz & Steiner 2015a; Steelman et al. 2015; Krueger et al., 2016; Brown, 2018; Cundill et al,
2018; Djenontin & Meadow, 2018; Fam et al., 2018; Ferguson et al., 2018). With its emphasis on co-creation of knowledge
between scientists and local actors outside academia, it is closely related to, and for many practical purposes often
indistinguishable from participatory action research (Whyte et al., 1989; Bradbury, 2015) and other participatory, interactive
and community-based approaches (Lang et al., 2012).

75 All these approaches use a systematic method of inquiry to assist societal actors in improving their actions for addressing
societal problems (Bradbury, 2015), while generating methodological innovations and new empirical and theoretical
knowledge related to the problem field (Lang et al., 2012). In this process of knowledge co-creation and societal problem
solving, three types of actors play a key role: i) Stakeholders such as local water users and other people directly related to the
water resource, but also NGOs or companies; (ii) legitimized decision-makers such as policy advisors, government officials
80 and elected political representatives; and (iii) the science community with scientists from academia, applied research institutes
and think-tanks (Seidl et al., 2013; Scholz and Steiner, 2015a). In this interaction, different groups of scientific and societal
actors bring in their own perception of reality, thought-styles, roles and practices of communication, whereby (scientific)
knowledge is combined with understanding rooted in deep experience (Max-Neef, 2005; Jahn et al., 2012; Pohl et al., 2021).
Transdisciplinary science generally distinguishes three main phases: problem framing; co-creation of solution-oriented
85 knowledge; and re-integration of knowledge with scientific and societal practice (Jahn, et al., 2012; Lang et al., 2012; Scholz
& Steiner 2015b; Steelman et al. 2015). Each of these phases has various challenges, issues and obstacles (Lang et al., 2012;
Brandt et al, 2013; Steelman et al., 2015; Scholz & Steiner, 2015b). Table 1 shows an illustrative list of these phases and their
challenges, based on Lang et al. (2012) and Steelman et al. (2015). Table 1 also is in line with Jahn et al. (2012), Klenk and
Meehan (2015) and Pohl et al. (2021), who reflect on integration in transdisciplinarity. Without further scrutiny, the concept
90 of integration in transdisciplinarity easily conceals problems with differences in values, knowledge and power (Klenk and
Meehan, 2015). Table 1 shows that many of the key challenges relate to the participation of societal actors and the
representation of their interests. It starts from the very first phases, with potential lack of awareness, ownership and legitimacy.



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2.1.2 The role of societal stakeholders in transdisciplinary research

A multitude of publications on transdisciplinarity take researchers as the point of departure, describing their experiences of engaging with society in the co-creation of knowledge (Lang et al., 2012; Scholz & Steiner 2015b; Steelman et al. 2015; Cundill et al., 2018; Djenontin & Meadow, 2018) and the implications of transdisciplinarity for science and higher education (Max-Neef, 2005; Fam et al., 2018). Although these commonly discuss and identify the importance and difficulties of engaging effectively with stakeholder communities, literature that takes these stakeholder communities as starting point for transdisciplinary processes is less abundant. Ghodsvali et al. (2019) observe that fewer papers report stakeholder engagement in transdisciplinary water nexus research beyond the instrumental levels, and take this as an indication of the challenges involved.

Some noteworthy exceptions are present though. Brown (2018) describes experiences with collective learning to enable local communities to cope with sustainability challenges. The used transdisciplinary approach was modelled after the experiential learning cycles of David Kolb, modified for use in collective social learning processes (Brown, 2018). Process structure and open learning attitudes are identified as the two critical ingredients. Krueger et al. (2016) discuss fairness and competence as two important criteria for participation in transdisciplinary co-production of knowledge. Fairness signals the need for everyone with an interest to participate, and to be recognized as valid voices in the process. Competence emphasizes the use of clear rules and procedures in the participation process (Krueger et al., 2016). Cundill et al. (2018) similarly stress the importance of careful process design in their experiences with a global transdisciplinary research initiative, taking into account the influence of legal agreements, power asymmetries and institutional values and cultures.

Careful process designs and participation structures thus are critical building blocks for meaningful knowledge co-creation. The current body of knowledge on transdisciplinarity offers a range of process structures, all of which are based on so-called “rational” approaches for problem analysis and collective learning. The “rationality” in these approaches refers to the fact that they take an analytical problem-solving cycle as starting point, assuming a systematic debate on values and objectives, possible alternative solutions, and an assessment of the expected impacts of those alternatives, as basis for agreement on strategies to tackle societal problems.

These transdisciplinary approaches mirror time-tested processes for policy analysis (e.g. Enserink et al., 2010), community operations research (Johnson et al., 2018), social learning (Brown, 2018) and capacity development (Vallejo and Wehn, 2016). From the cited literature on these approaches, it is known that good intentions and analytical process designs are a necessary but not a sufficient condition for successful cooperation and joint learning. When it comes to complex and wicked societal problems, knowledge, learning, capacity and power are intertwined (Brown, 2018: 285). This limits and complicates joint problem solving (Jahn et al., 2012; Klenk and Meehan, 2015) and makes scientific knowledge and models limited as arbitrators. The questions, assumptions and scenarios included in scientific models will (need to) reflect those of societal stakeholders,



making them inherently subjective and suited for some problem framings but not others (Godinez-Madrigal et al., 2020). Therefore, in addition to structured problem solving processes, successful transdisciplinarity requires approaches that help navigate the dimensions of power and fairness in stakeholder participation.

130 **2.2 Power, empowerment and negotiated approaches for the co-production of knowledge**

Transdisciplinary scholarship is not blind to the issues of power and fairness. For instance, it recognizes the need for, and difficulties in, establishing a safe platform for joint learning and discovery (Jahn et al., 2012). It also recognizes the importance of representation of different types of stakeholders, including local water users and community stakeholders (Seidl et al., 2013; Scholz and Steiner, 2015a; Dyer et al., 2014). And transdisciplinary research in an international and developing world context
135 recognizes the importance of dealing with institutional cultures (Cundill et al., 2018), institutional ambiguity and informality (Van Breda and Swilling, 2019). What the transdisciplinary literature does not yet offer, is guidance on how to enable a process and platform for reflexivity and joint learning in a context of power differences, conflicting interests and institutional diversity, ambiguity and informality.

Current guidance and experience is shared only through fairly abstract phrases such as the need for “mechanisms to support
140 mutual learning” and taking the necessary time (Raymond et al., 2010). However, in many cases participation requires not just taking the effort and time to invite stakeholder representatives and raise their problem awareness, but also requires empowering and capacitating different types of stakeholders to participate and collaborate effectively (Richards et al., 2004; Krueger et al., 2016: 380). In a context of power differences and competing interests, transdisciplinarity requires two types of capacity building and empowerment. It is not just the capacity of all actors to participate in the knowledge and learning process on an
145 equal footing, but also the capacity to influence and act more effectively in processes of problem solving for water management. Since transdisciplinary water research seeks to combine scientific knowledge development with societal problem solving, those two types of empowerment are of equal importance. Truly engaging with this dual empowerment dimension is relatively novel and only more recently underscored in the transdisciplinary water scholarship (Massuel et al. 2018; Steelman et al., 2015: 596).

The need to accommodate rather than ignore power dimensions in stakeholder participation has been recognized earlier by
150 development practitioners (e.g. Bebbington et al., 2006; Sneddon and Fox, 2007). This has led to different approaches, including a negotiation approach, which has been developed into practical guidelines over the past years (Leeuwis, 2000; Both ENDS and Gomukh, 2005; Koudstaal and Paranjpye, 2011). Access to knowledge development for local platforms and continuous learning are important pillars in this approach, recognizing community knowledge as well as rigorous and
155 innovative science. However, the negotiated approach uses this as part of a larger aim, which is a transformation of governance, i.e. moving towards self-governance of local communities. For this, it follows the principle of ‘principled negotiations’ as described and popularized by Fisher et al. (2011). The approach offers eight tasks as guidance, and, as can be seen from Table 2, these tasks connect well to the phases and challenges identified for transdisciplinary research. This makes the negotiated approach an interesting match for transdisciplinary research.



160 An open question is how to combine these empowerment processes with transdisciplinary knowledge co-production. We
investigate this question, using the main phases and challenges, combined with the main steps for a negotiated approach, as
provided in Table 2. We follow the negotiated approach tasks to provide a structured account of our experiences with a
transdisciplinary research project that emphasized the power and empowerment dimensions as part of its endeavour. Although
the phases and tasks help structure our account, it is important to note that these activities often overlap and that the process
165 always features various iterations, going back-and-forth between phases and activities.

[INSERT TABLE 2 AROUND HERE]

3. Experiences with transdisciplinary research for peri-urban groundwater management in Kolkata and Khulna

3.1 Peri-urban water management as testing ground for transdisciplinarity and empowerment

170 The above question is explored for peri-urban groundwater management in South Asia. Peri-urban spaces are spaces in
transition, undergoing socio-spatial transformations that defy uniform policy prescriptions (Singh and Narain 2020). In Khulna
in Bangladesh and Kolkata in India, rapid urbanization has resulted in increasing pressure on water resources in peri-urban
areas. Increased climatic variability, degrading surface water sources, land use change, coupled with unequal caste-class-power
structures, rules, norms and practices, create pressure on already stressed water resources and lead to uncoordinated
175 overexploitation of groundwater aquifers (Narain et al., 2013; Hasan et al., 2019; Banerjee and Hermans, 2020). The resulting
lack of access to groundwater during critical periods affects the livelihood securities of the vulnerable and contributes to the
incidence of poverty (Banerjee and Jatav, 2017; Butsch et al., 2021).

Earlier, participatory planning has been used in peri-urban contexts in India to improve peri-urban communities' access to
natural resources (Halkatti et al., 2003). These approaches focused on community mobilization for better management of
180 natural resources. Departing from this approach, Narain et al. (2020) describe an approach that sought to make state agencies
more responsive and accountable to water users. Through a process of action research, water users in peri-urban Gurgaon in
north-West India were brought into dialogue with representatives of the agencies of the state engaged in water provisioning.
This was done through a process of a series of dialogues between the two sides, seeking to break the 'anarchy syndrome' and
overcome a prisoner's dilemma in water management. This approach shifted the focus from the communities to the state,
185 making it more responsive and accountable to the needs of the water users.

3.2 Case Background and methodology

In the next sections, we share our experiences with combining transdisciplinary research with the negotiated approach to
address the challenges in groundwater management in peri-urban villages near Khulna, Bangladesh and near Kolkata, India.
Over the period 2014 to 2019, an international team of researchers and civil society organizations executed the Shifting
190 Grounds project in Khulna, Bangladesh, and Kolkata, India. This project was financed by the Dutch Research Council under



its Urbanizing Deltas of the World programme and had an explicit focus on transdisciplinarity, combining scientific research with sustainable development. In the project, team members from Bangladesh, India and the Netherlands cooperated to enhance understanding and build capacity with local stakeholders to support sustainable groundwater management in peri-urban Kolkatta and Khulna. Project partners consisted of staff from SaciWATERs and The Researcher in India, IWFM-BUET
195 and JJS in Bangladesh, and Both ENDS and Delft University of Technology (project lead) in the Netherlands.

The discussion is based on a large body of documented meetings, workshop reports, project progress and evaluation reports, research publications and a three-day team reflection and writing workshop at the end of the project, in 2018 in Khulna, Bangladesh. Many of the workshop reports and research publications can be accessed via the Shifting Grounds project website (SaciWATERs et al., n.d.). The report of the final team writing workshop is available as Hermans et al. (2019). Furthermore,
200 an overview of activities related to capacity building for institutional analysis in this project is contained in the dissertation of Gomes (2019). In the process of capturing our experiences, we follow the main phases, tasks and activities as identified in Table 2 above. In doing so, we pay specific attention to the interactions and interfaces between researchers, local communities, and state/government actors.

We start with a short description of project design and problem framing at the project level, followed by detailed descriptions
205 for each of the two main project sites, in Khulna and Kolkata.

4. International project level, Phase A: Preparing the process, early project design and problem framing

The Shifting Grounds project was jointly formulated in 2013 through international workshops of researchers in collaboration with government stakeholders and local community representatives. The aim was to combine research, capacity building and development activities to address peri-urban groundwater problems in cities in Bangladesh and India. Khulna and Kolkata
210 were selected as project cities, being both located in the Ganges delta, sharing some key hydrological and geophysical features, but being located in different institutional systems. The international project team sought a conscious mix between a research-initiated process and a community-initiated process to enable a balanced effort of co-creation of both scientific knowledge as well as practical solutions.

The project started with the ambition to combine transdisciplinary research and the negotiated approach. The consortium
215 benefited from earlier research cooperation on peri-urban water security between partners in India and Bangladesh, and from extensive experiences of civil society partner, Both ENDS, with the negotiated approach. The initial project design targeted peri-urban villages near each of the two cities. Site selection criteria included scientific suitability as well as willingness and (basic) abilities of village stakeholders to engage with the project. For the latter, we looked at the existence of a nucleus for self-organization, such as the presence of an active community-based organization or local village committee that had also
220 identified groundwater-related problems as an important issue for village development. The latter was used to ensure a workable fit with the initial problem framing around groundwater issues, which had been decided early on by the core project team members as a key research gap for peri-urban water security in the region.



The project was designed around three distinct research activities, along with community empowerment. Two PhD researchers and one postdoc researcher were engaged: one to study and model physical groundwater systems, one to study local groundwater governance and institutions, and one to study groundwater in relation to socio-economic and livelihoods dynamics. Community empowerment focused on capacity building within the peri-urban communities and on strengthening links of community actors with external government processes and state actors. The community empowerment was led by civil society partners in the project consortium and was referred to as the negotiated approach (NA) process; the research process was led by the research organizations. Both functioned together as one team, with joint problem formulation and frequent project team meetings. Within the core project team, and key policy-makers and local experts represented in a Project Advisory Group, this provided the first agreement on problem framing and process design, as well as the first steps in team-building.

5. Kolkata experiences

5.1 Phase A: Preparing the process and Reaching agreement on process design

Problem framing, ownership and legitimacy at the research-government interface

At the government interface, the project worked with the two distinct systems in place for decision-making processes in the State of West Bengal: an administrative and a political system. The administrative government system was run from the State level, via Districts, to provide important services to the communities. This administrative system had a hierarchical structure, with an important role for the District Magistrate that operated from Kolkata, and the local Block Development Officer at the block level.

In the preparation phase of the project, connections with this administrative system were established via connections with the formal decisionmakers and state-level water agencies. Representatives of some of these agencies were invited as members of the project advisory committee. To gain access to these state representatives, the personal network of one of the Indian researchers proved to be essential. The research components in the Shifting Grounds project were highlighted, whereby especially the groundwater research and hydrogeological modelling had the interest of the government actors. The physical science, a cross-country study in Bangladesh and India on groundwater, turned out to be the main selling point in initiating the contacts with the formal government representatives. At the start of the project implementation, this support from different state government officials also made it possible to get support from the District Magistrate in charge of the district in which the project village was located. Given the relatively hierarchical setting and large power distance between District and State-level officials and local level stakeholders, this support was essential to undertake activities with government officials and stakeholders at the local block and village levels.

This created a supportive atmosphere, including state-level experts in the project advisory group, but the ownership at the district and state levels for the Shifting Grounds project remained limited. Although the groundwater problems in the peri-



urban areas were acknowledged as important issues, the project itself was too much focused on one specific local area, with relatively limited resources, to spark a more intensive involvement from the higher levels of administration.

255 **Understanding existing social arrangements: Ownership, problem framing and legitimacy at the community level**

In the beginning, the project team had visited various villages to explore suitability of villages as project sites. The selected project village was located alongside a canal of historic importance, south-east of Kolkata. It is part of the East Kolkata Wetlands, a Ramsar site. Recent developments included a growth in aquaculture for fish production, profitable with rising demand on fish in Kolkata and its suburbs, as well as an increased reliance on groundwater for aquaculture and rice paddy fields.

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In parallel to the administrative system, there is a political system with elected representatives at various levels. At the community level, these are the panchayat members and the gram panchayat. These are local self-governing bodies, with village councils (panchayats) being the lowest elected official body in rural areas in India, and gram panchayats consisting of a number of village councils. The project team benefited from the existence of a receptive village leadership. Certain members from the local panchayat shared their knowledge and support and actively participated in project activities from early on.

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Support from informal local community groups was present through a local youth club and various smaller women self-help groups, who were mobilized with the help of a local panchayat member. An initial informal community meeting was facilitated through the involvement of a youth club, which was asked to bring people from different occupational groups to ensure diversity in participation.

270 Access to safe drinking water was a critical issue, identified at the first stages of engagement with the village community in 2015. The existence of a private water-bottling plant inside the village was a controversial issue. The bottling plant was set up on purchased village land and had a bore well installed as the source of bottled water supply. In the first project community meetings we discovered two distinct interest groups, divided in a pro- and anti-bottling plant lobby.

The local water bottling plant proved to be very sensitive and linked to the larger village politics. Even before any choices on problem framing were made, the ability to continue within the community was threatened by these underlying sensitivities over the bottling plant. Therefore, as more information on village problems emerged, the project continued with a more specific focus on what was not the most contentious, but the most crucial issue, shared by groups across the village: access to safe drinking water, free from arsenic risks. This choice was informed by village concerns, later on combined with and confirmed by groundwater research information, and helped us to build confidence with the villagers as well as their social and political leaders.

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Gradually, the project team realized that the village was very much divided on political lines, a common feature of rural society in the state of West Bengal. The water bottling plant was one issue of contention, but not the only one. This put us in a difficult position. Already from the start, we realized the importance of remaining neutral as a project team, avoiding reliance on current political leaders who might represent one political faction only. At the same time, the village leadership and the officially



285 elected local bodies could not be by-passed, in order not to compromise the participation process and the safety of its participants. As a result, politics and associated legitimacy questions affected the further stages of the project.

Project team roles and learning on the negotiated approach

The researchers of SaciWATERS (Hyderabad) and TU Delft (the Netherlands) had easier access to the State and District level government officials than the local project organization, The Researcher, in Kolkata. SaciWATERS and TU Delft were
290 recognized as research institutes of national and international importance, which enabled them to access to the stakeholders at these levels. The local partner in Kolkata, The Researcher, cultivated a good rapport with the local community representatives. At the same time, across the project team, there was a steep early learning curve on the mechanisms and particularities of the negotiated approach. Even if guidelines were available, these were fairly generic, and their application in this specific setting in West Bengal, brought its own challenges and questions. During the first two larger project workshops in Kolkata, the
295 presence of professor Paranjpye, one of the original developers of the negotiated approach for water management in India, proved essential to support the team in the early phases of process design for stakeholder empowerment.

5.2 Phase B: Co-creation of solution-oriented knowledge

Joint fact-finding and situation analysis: Discontinuous participation due to village politics and power shifts

In the spring of 2016, State Assembly elections were held, resulting in political schisms reaching new highs between rival
300 groups. The deep political divides meant that some community members who had earlier been in leadership positions and had been very supportive to our activities in the initial project stages, could no longer play a role in support of the negotiated approach process. These political dynamics meant that the project team had to make continued efforts by bringing the various loose threads together, roping in new persons, and assuaging the conflicting interests to the extent possible. After two of the three initial village ‘champions’ left the stage due to the rising political tensions, we built rapport with the new leadership of
305 the youth club. One re-elected panchayat member who had previously shown support provided a stable factor and enabled us to connect with the community in the subsequent phases of the process and to maintain contacts with the women’s self-help groups. We attended several meetings of these self-help groups, urging the participating women to attend also our informal project community meetings. These efforts ensured a good participation of women in the subsequent meetings.

Situation analysis: Synchronizing longer-term research with short-term community needs

310 The initial idea was that an integrated groundwater security index, based on household survey results, could be shared with the community and would help to prioritize issues to be tackled in the negotiated approach. It would also have been useful to conduct an early survey, to get a better picture of socio-economic heterogeneity and structures. However, a survey could not be started without initial community engagement and support. As this was initiated, the first community meetings already helped to prioritize local issues and suggested that a lot of the issues represented in the scientific water poverty index might



315 not be relevant locally. Based on this, more questions towards water quality and water distribution could be included and wastewater irrigation was added – something that was not there in the standard set-up for the index survey. Also, conducting the household survey gave the NA team a better overview of the problems in the village, especially the differential access to water.

Peri-urban spaces are zones of transition and great socio-economic heterogeneity (Allen 2003; Singh and Narain 2020), where
320 the socioeconomic dynamics change very rapidly with regard to status and income. In more remote rural areas it is easier to understand the status of the people as it is more stable. Here, the socioeconomic status became clear only during the survey, when we visited the households more intensely for several months. The survey also gave us the idea that there is a sizable section of population using groundwater for irrigation. This was not raised in the first community meetings, where the village community had predominantly raised its drinking water problems.

325 The household survey results eventually were only available well into the third year of the project. At this time, the NA had already started working on the particular issue of drinking water and arsenic. Still, the socio-economic research did reinforce earlier choices in the process. We came to know that there are over 900 families in that village and there were only ten available water sources. This reinforced the focus on drinking water.

Situation analysis and join-fact finding: Formal institutions and water rights

330 Formal institutions provide a key leverage point for sustaining future interventions and improvement in water management. For these national and state level policies, acts, and ordinances, an institutions brief was prepared by the institutions researcher to support the NA process. The brief was presented to the community in their own language, Bengali, printed as a brochure with many pictures and illustrations that made it attractive and helpful to understand. This was useful in respect of imparting knowledge to the community about people's rights to water and the official government acts and departments regulating water
335 in the state. The community had never heard of such rights to water or water governing acts. Not all of this knowledge could be translated immediately into action, but the knowledge remained an element of awareness and empowerment on community water rights.

Situation analysis: Groundwater data difficulties

The groundwater modelling, another key research component, struggled with the acquisition of regional-level data for the
340 Kolkata site, despite early efforts to establish good contacts and obtain the support from key government officials for our project. A very limited set of regional level data, combined with some local measurements during a local field visit, constrained the groundwater researcher in modelling and in-depth site-specific knowledge on the local groundwater specifics. Nevertheless, the groundwater knowledge that was available suggested that simply demanding more tube wells might not be advisable, as it would lower the water table of that particular village. Also, a review of groundwater data supported the focus
345 on arsenic mapping and awareness. The water quality data that were obtained for the groundwater research indicated the



presence of arsenic, which was validated by the Block Development Officer, Gram Panchayat, and the engineer of the public health department.

5.3 Phase C: Re-integrating and applying produced knowledge in science and social practice

Forging agreement: Limited, case specific solution options from research and government

350 In a project mid-term review meeting in September 2016, community representatives signalled impatience and dissatisfaction with project progress. Their feeling was that, until then, little direct benefits to the community were visible, endangering their willingness to continue the engagement. They requested the project team to do something concrete on the short-term, to gain confidence of the community and continue the process further. From a pure scientific research perspective, this was difficult to respond to. The research activities were nowhere near finalization and actionable results. Also, the three project researchers
355 by then had differentiated between project sites to focus on in their research, based on access to data, progress in the research and capacity building, and power dynamics. Two researchers were focusing relatively more on Khulna and one researcher was focusing relatively more on Kolkata.

As part of a reciprocal transdisciplinary effort, the international project team promised to make an effort to mobilize additional resources to address the pressing issue of arsenic contamination of water sources. This was started in the months after the mid-
360 term meeting and brought in new experts, doctors and equipment to enable visible actions focused on the arsenic contamination of local domestic water sources. An arsenic awareness and mapping campaign was started, with arsenic testing of various local water sources and a village health camp. For this, national and local experts were engaged, including a local medical college and water laboratory. This helped to get more detailed information on the local prevalence of arsenic in various water sources, and through the local health camps and workshops, villagers could be checked for symptoms and received medical advice, as
365 well as education about locally developed arsenic removal filters.

Communication with constituencies and continued involvement

Tackling the arsenic drinking water quality issue in the village was only possible with the consent of the panchayat officials. After the earlier friction, the panchayat officials eventually recognized the importance of our activities, as they invited us to the local Book Fair organized by three Gram Panchayats in early-2017, to make an audio-visual presentation on the water
370 security issue before a larger audience of several hundred people.

As drinking water had been the most crucial issue across the political divide, people belonging to both political sides were involved in the arsenic testing and education process in a more indirect and informal way. During the testing of water samples and the door to door campaign on water quality, political allegiance played no role, and people from the opposition camp were also involved. But in the formal process, i.e. in village meetings and workshops, these people were not always involved. Even
375 when present in less formal community meetings, they were not so vocal due to fear of being identified. In the second part of the process, we organized an arsenic health camp and an arsenic awareness workshop involving local health workers where



arsenic-affected tube wells were marked in maps of all the villages under the panchayat, as part of an effort to address the specific concerns regarding arsenic contamination of domestic water supply.

Strengthening capacity to become and remain equal partners in negotiations

380 A key dimension in the equal partnerships emphasised in the negotiated approach, is gender equality. In the informal meetings and the larger more formal community workshops, women were no less vocal than men. One of the key persons to mobilize the community for us was a local female panchayat member. That she was a woman probably helped the other women in the community to join our programme in good numbers as well as to speak out. However, if this lady in our project village had not been re-elected again in the panchayat elections that were held later in the project period in May 2018, our effort to involve
385 the women might have been thwarted. This shows that this effect, although visible, also is fragile.

The Government of India is giving much importance on the panchayat and allocates several hundred crores of rupees for water supply. Among the formal institutions supposed to be in place at this level, is the Village Water and Sanitation Committee (VWSC), looking after the water and sanitation problems of the gram panchayat area and formally chaired by the panchayat pradhan. However, in this panchayat, the committee mostly remained on paper. So our aim was to make it function as the
390 sustainability of the negotiated approach process was dependent on the functioning of this VWSC that works for the whole GP, consisting of seven villages. The panchayat pradhan (chairman) gave us permission and during the final project workshop, members of the committee participated and pledged to use the written project reports with the arsenic testing results forward, to improve the situation. If this committee will become and remain truly active, however, remains to be seen.

6. Khulna experiences

395 6.1 Phase A: Preparing the process and Reaching agreement on process design

Understanding social arrangements, selecting participants and boundaries of intervention

The village was selected for project work based on pre-assessment and pre-scoping visits in the first project phase, reviewing different potential villages as project-sites. The project activities were then initiated with a community workshop in October 2015. Following this workshop, several smaller group meetings were held in the village to further establish dialogue. Through
400 a series of village level meetings and workshops, people learned about the project and its negotiated approach.

Land use change is a common feature of peri-urban environments. This is accompanied by a rise in the price of land and efforts at occupational diversification (Narain 2009; Narain and Nischal 2007). This dynamic was also visible in the project village. Traditional fish farming and agriculture were on the decline. Some people were selling their agricultural land to land developers and others to migrants.

405 During the first visits, it was observed that the village road acted as a rough division between migrants and permanent residents. The permanent residents were located mostly on the right side of the road, and appeared to be more homogenous, with less



rivalling groups within them. The village part on the left side of the road had more migrants, who were not as well organized. This made it easier to start the community engagement process mainly at the right side of the road. The project timeline and resources did not allow for complete community mobilization and organization, given that activation and organization of the
410 migrant households would have taken significant additional efforts and resources.

Reaching agreement on process design

In the course of the first year of engagement, farmers and fishermen groups were formed to represent the community in the project's negotiated approach process. These village negotiation groups would be supported in a participatory problem analysis, for which the main steps had been outlined in a local Bengali guide for the negotiated approach, developed by the
415 local team (JJS) after the support received from international negotiated approach experts from the Netherlands and India (see Kolkata experiences). This local project partner also facilitated the implementation of these steps with the community, to prepare them for a purposeful dialogue with other stakeholders, including government actors. Contact with government officials had also been initiated from early on in the project. Although government resources seemed constrained, the rapport with government officials based in Khulna City, including the Khulna Development Authority and district agencies, was good
420 and no real problems were foreseen for later stages.

6.2 Phase B: Co-creation of solution oriented knowledge

Joint situation and solution analysis

The village negotiation group identified several water-related problems, out of which three priority problems were identified:

- i. accessible safe drinking water,
- 425 ii. canal encroachment and water logging,
- iii. waste dumping by the city corporation.

These priority problems followed community needs and priorities, and thus were not all directly related to groundwater. Nevertheless, all three issues were incorporated in the project, even if the research interface for some of these problems was fairly weak or even absent. This was part of the implicit process agreement between project team and local community
430 stakeholders. For these three priority issues, some researchers contributed their expertise, and the local team helped the villagers to develop a small-scale management plan to address them. Part of this was also a stakeholder mapping, for the priority issues and possible solutions.

Although migrants were not represented in the smaller village negotiation group, they were part of the research activities and were invited at some of the workshops. This suggested that the drinking water problem was also acutely felt by this section of
435 the community. The group of migrants included both relatively wealthy and relatively poor households. Most migrants in the vulnerable category used one of the three shared tube wells in the village and they (as well as other poor persons) needed over one hour to collect water. This was especially a problem for the women, who were responsible for water collection.



Research contributions to situation and solution analysis

440 The groundwater researcher made several field visits to the village for primary data collection. During these field visits, awareness on groundwater issues was raised through discussions with village community members. When first results were available, information on groundwater quality and groundwater over-pumping fed into the village negotiated approach process, among others via a lecture by the researcher on groundwater scenarios to the village water group. Further, researchers assisted with a Bengali translation of key groundwater terminology.

445 Community-based groundwater monitoring was considered during the project mid-term deliberations, as way to combine village capacity building with groundwater research data collection. Eventually, this was not initiated, mostly due to project research priorities – in which a PhD study was a key element, for which data collection results would come too late – and time and resource constraints.

450 Research findings from the developed groundwater models indicated that local groundwater abstractions might not have a very large effect on local groundwater availability, which seemed more influenced by regional level forces tied to the river (Hasan et al., 2019). This provided a confirmation of the participatory management plans, reducing the need to focus on local water-demand management issues for the short-term.

455 The development of a community-based participatory approach for institutional analysis was a core objective for the institutional research component. This approach was developed with the Kolkata and Khulna sites in mind. The steps in the approach were mostly explored and applied with the Khulna village community for the prioritized drinking water issue. During the earlier stages in the project, an institutions brief on water supply and groundwater management was prepared, translated and discussed with the participants in village. The brief outlined the different organizations, rights and responsibilities for water resource management in Bangladesh. It also contained an infographic about the process for tube-well applications in peri-urban areas. It supported the village group in its awareness of the situation, and the stakeholder mapping for the solutions planning. At the same time, the institutional research used local reports of the negotiated approach meetings as a source of data on the community's problem perceptions.

460 Combined, these groundwater and institutional research efforts helped to deepen the knowledge of villagers about the groundwater management situation, in such a way that they were able to talk about this to the authorities.

6.3 Phase C: Re-integrating and applying produced knowledge in science and social practice

Forging agreement and communication: drinking water management and institutions

465 The institutional research followed a sequenced design for a participatory analysis process, aligned with the negotiated approach in the Khulna village (Gomes, Hermans and Thissen, 2018). In the final stage, this resulted in two gaming- simulation workshops, where the analytical results were shared and discussed with participants in a structured role-playing format. One workshop was with the village negotiation group, a second workshop was with government representatives from different agencies involved in drinking water and/or groundwater management at the local level in Khulna. The purpose of these



470 workshops was for participants to explore strategies to address drinking water related problems experienced in peri- urban
Khulna. The workshops provided a platform for research uptake where the results of the institutional analysis were shared with
local stakeholders in the form of a role-play game. These workshops were valued by the community participants with
suggestions for future uses to engage more groups (Gomes, Hermans, Islam et al., 2018; Gomes, 2019).

Forging Agreement

475 For the direct engagement with the government officials, a specific six-member community negotiation group was formed by
the villagers for negotiation and advocacy with authorities for their water related problems. They were trained by the local
NGO (JJS) and at a local university on advocacy and strategy development.

The community negotiation group shared their water related problems with the identified authorities and agencies during a
workshop meeting. This workshop enabled the community negotiation group to continue discussions with the individual water
480 related authorities after the meeting. During these individual follow-up meetings, there was more time and opportunity to
discuss the specific problems and the authorities shared their plans and initiatives for overcoming those problems. Through
these follow-up meetings, all three priority problems were taken up by various government authorities. The public health
agency in charge of rural water supply committed to test drillings to establishing a functioning deep tube well for drinking
water in the village, in recognition of the declining water tables and the need for sufficient safe public drinking water supply
485 points. The Khulna City Corporation cleaned the waste dump near the village and selected two new sites for landfilling. The
local level government administration (called upazilla) took the initiative to remove canal barriers. Linkages with the national
water development board and an ongoing internationally funded water management project resulted in an effort to further
clean up the drainage canal.

The issue of canal encroachment and water logging was caused by clogged drainage canal structures but was exacerbated by
490 local fish farming practices. Although fish farming was decreasing, a few local elites did engage in fish cultivation. Branches
of the drainage canal were captured to put temporary bamboo structures to keep fish. However, these bamboo fences and
temporary dykes for fish cultivation reduced the water flow and exacerbated problems with drainage during heavy rains and
water logging. The fish cultivators earned a lot of money and shared the benefits with local powerful individuals. This made
it difficult for the local open-water fishermen and smaller farmers to deal with them. The village negotiation group first tried
495 to involve these powerful canal encroachers in the project meetings, but they were not interested as they thought they would
lose their livelihood. After these initial efforts, the focus was put on capacity strengthening of the more marginalized groups,
to help them to negotiate and improve their knowledge. Illegal activities, especially canal encroachment, were condemned by
the officials at the meeting and in later press coverage.



500 **Strengthening capacity of participants to become equal partners in negotiations**

Community empowerment for water management in Bangladesh carries a specific gender-challenge. As women were most affected by drinking water problems they were interested in participating. During initial field visits it was observed that, though women got a voice in village matters, the last word was always with the men. In the community negotiation group that spoke with the government officials, three of the six members were women. In the first workshop, only the men spoke and when we
505 asked women to speak, the men did not allow them. Towards the end of the project, the women had no problem to speak during workshops and meetings. During the final project workshop, the women gradually spoke up during the course of the conversation and eventually were discussing directly with male senior government officials.

The success on empowerment, fairness and legitimacy was mixed in the project. Although efforts were made, both powerful and powerless groups were eventually excluded from some of the most intensive part of stakeholder participation activities in
510 the village, mostly dictated by limited timelines and resources. Within the group that was represented, the role of women seemed to grow over time.

Strengthening capacity of participants to remain equal partners in negotiations, and sustaining societal impacts

At the end of the project period, peri-urban water issues were being discussed at different levels, at universities and in the local media. A gaming-simulation seminar and workshop were organized at the local university, as well as more conventional
515 workshops and meetings. A linkage between community and government stakeholders was developed. A peri-urban water forum was established with representatives of several communities (beyond the project village community only), related government authorities and civil society. This forum connected the Shifting Grounds project with similar projects and activities in other peri-urban villages around Khulna City. In this way, the peri-urban water forum could become sustainable.

A small spin-off project after the ending of Shifting Grounds continued work with the approach for participatory institutional
520 analysis, whereby local professionals were trained to develop gaming workshops for other water-related issues, with external support from Delft-based researchers.

7. Discussion of the Shifting Grounds project experiences with transdisciplinarity and empowerment

The project experiences described for the research and negotiated approach activities in peri-urban villages near Kolkata and Khulna, partly confirm the challenges known for transdisciplinary research trajectories. Project designs had to be continuously
525 adapted and changed, and, in some ways, had been over-ambitious. Project activities had to be tweaked to the site-specific conditions and constraints, and as a result, the activities across countries were not uniform, neither for the stakeholder empowerment, nor for the research components. The resulting process was very intensive and time-consuming, for all parties involved, much more than 'standard' projects aimed at either research, or some local water management interventions. Nevertheless, there also seem to have been synergies and added values, and, minimally, the societal process with community



530 and government stakeholders has shaped research activities and results, and in turn these research activities and results have influenced the societal dialogue within communities and between communities and government officials.

In addition to the confirmation of these prior experiences, the Shifting Grounds experiences also surfaced new challenges and responses, not previously emphasized in reviews for transdisciplinary research. These challenges and responses are specific to transdisciplinary research in situations where power and empowerment shape the process of co-creation of knowledge and solutions and building capacity to implement these. These are summarized in Table 3. These challenges will be familiar to experts working on community or stakeholder empowerment projects, but so far, remained either invisible or fairly abstract for transdisciplinary research. Table 3 is a step in filling this lacuna, based on our experiences in this project.

INSERT TABLE 3 AROUND HERE

540 **8. Conclusion**

We have applied explicitly a negotiated approach in our transdisciplinary process, recognizing the importance of power dimensions and empowerment, in addition to more neutral co-learning experiences in transdisciplinary research. Overall, our experiences confirm that, at least when working with relatively vulnerable and underrepresented local communities, employing a negotiation approach is useful, if not critical. It forces researchers to pay much more attention to the social and political realities, and to community leadership and representation, early on in the process. Our experiences further confirm those earlier reports on transdisciplinarity that stress the importance of early and ongoing joint problem formulation, the importance of flexibility, and the struggle to match longer-term ambitions with short-term needs of both researchers and societal stakeholders. In addition to these insights, we also added a specific list of challenges and responses for transdisciplinary research that seeks to address power and empowerment as part of its efforts. In earlier publications and reviews, this power and empowerment dimension received less explicit attention. The list that resulted from our project reflections, will help to build a better articulated set of principles and guidelines for future transdisciplinary water research.

An uneasy conversation that we further will need to engage with, is to discuss the limits of transdisciplinarity and the various dilemmas it raises. Whereas many overviews may give the impression of an ever-expanding list of principles, tools and approaches for an ideal-type transdisciplinary process, the reality will be served better by a perspective on transdisciplinarity as yet another craft and “art of the feasible” in which tradeoffs between multiple and sometimes conflicting objectives and perspectives need to be made. An overarching message for transdisciplinary water researchers from this paper, is to engage with power and politics more explicitly, as part of this process. This is critical from the (pre-)inception phase of activities, as a key input for problem structuring and research agenda-setting. Engaging with power and politics is difficult but fundamental to societal change. Even if some researchers will feel uneasy with this dimension, it cannot be ignored in transdisciplinary research. Ignoring it is just another way of dealing with it –allowing existing structures and forces of power and politics to co-shape transdisciplinary results in an unobserved manner.



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List of Tables:

Table 1 Challenges and strategies in transdisciplinary water research (source: Lang et al., 2012; Steelman et al., 2015)

Table 2. Activities for the negotiated approach (NA) in transdisciplinary research (TDR) (Source NA tasks: Koudstaal and Paranjpye, 2011)

695 Table 3. Challenges and responses used in negotiated approach for transdisciplinary water research in peri-urban cases



Table 1 Challenges and strategies in transdisciplinary water research (source: Lang et al., 2012; Steelman et al., 2015)

Phases and challenges	Exemplary strategies (Lang et al)	Coping strategies (Steeleman et al)
Phase A: Problem framing and team building		
Lack of problem awareness or insufficient problem framing	Primary study to build problem awareness	Iterative refinement of problem based on on-going discussions
Unbalanced problem ownership	Joint leadership	Hiring community-based monitors and research design with inputs local community members
Insufficient legitimacy of the team or actors involved	Stakeholder mapping, creating structures that enable participation	Continuous effort to broaden stakeholder representation as problem aspects are re-framed
Phase B: Co- creation of solution- oriented transferable knowledge		
Conflicting methodological standards	Systematic comparison of methods, demonstration projects	Use of creative scientific publishing opportunities, more on process than on results
Lack of integration	Structured and formative knowledge integration methods	Identify publishable units that document smaller aspects of broader research effort, responsive to use to partners
Discontinuous participation	Design low thresholds for, and appropriate levels of, participation	Created reflexive experience, regular contact, with local leaders
Vagueness and ambiguity of results	Specification and explicit conflict reconciliation	Collected more data to create greater confidence and delayed conveying findings to broader community until realistic solutions can be recommended
Fear to fail	Initialize actions first to stimulate learning-by-doing	N/A (Did not apply)
Phase C: Re- integrating and applying the produced knowledge in both scientific and societal practice		



Limited, case-specific solution options	Comparative studies for generalizable results	Continue to collect, scientific credibility data set will grow with time.
Lack of legitimacy of transdisciplinary outcomes	Take into account existing socio-political context into design	Continue to build research-informed constituencies. Maintain long-term, on-the-ground presence
Capitalization on distorted research results	Establish ongoing collaborative and reflexive discourse	N/A (too early in process)
Tracking scientific and societal impacts	Employ advanced evaluation methodologies	N/A (too early in process)



Table 2. Activities for the negotiated approach (NA) in transdisciplinary research (TDR) (Source NA tasks: Koudstaal and Paranjpye, 2011)

Tasks	Sub-tasks and points of attention/challenges
TDR Phase A	Problem framing and team building
Task 1: Preparing the process	Understanding past initiatives and existing social arrangements Selecting committed participants that represent a ‘balance of power’; Identifying broad areas and boundaries of intervention
Task 2: Reaching agreement on process design	Understanding of institutional context, its possibilities and limitations, by all participants; Specifying agenda and procedures, while allowing flexibility
TDR Phase B	Co-creation of solution-oriented transferable knowledge
Task 3: Joint fact- finding and situation analysis (problem analysis)	Ensure participants understand each other: Clarity on the backgrounds, aspirations and interests of various stakeholders; Access to and understanding of objective information on natural system; Joint fact-finding might be needed
Task 4: Solutions analysis	Establish prior agreement on criteria, separate from weight given to them by different stakeholders; All solutions identified by the stakeholders should be considered and discussed seriously
TDR Phase C	Re-integration and applying the produced knowledge in scientific and societal practice
Task 5: Forging agreement	Positional bargaining by one or more parties might require active mediation by independent outside facilitator
Task 6: Communication with constituencies	Allow representatives with ample time and documented information to maintain communication with constituencies
Task 7: Monitoring agreed actions	Long-term commitment by stakeholders for monitoring of agreed actions and impacts of those actions
Task 8: Strengthening capacity of participants	Local communities may need extensive training to build knowledge and skills needed to become equal partners in negotiations – among themselves and with the other key stakeholders and government officials



705 **Table 3. Challenges and responses used in negotiated approach for transdisciplinary water research in peri-urban cases**

Phases and tasks	Observed challenges	Responses used
Phase A: Problem framing and team-building		
Task 1: Preparing the process	Existing balance of power and socio-political dynamics could not be observed by project team at start of process (neither time nor resources to conduct thorough political study prior to initiating engagement) (Kolkata)	Assure community is “best available” project site through careful selection, including community stakeholder competence and willingness indicators Continuous attention and modifications in process design during four years of project
	Differences in existing community organization structures caused uneven representation of groups in the negotiation process (Khulna and Kolkata)	Observe and accept as limitation of project. Inclusion of under-represented groups in research data collection and analysis to make interests and roles visible.
	Large power distance government decision making and communities (Kolkata)	Use research process and participation of international science team as leverage to engage government decision makers
Task 2: Reaching agreement on process design	Project team was learning about (NA) process design and steps themselves	External facilitation of first workshops by internationally recognized local NA process expert
Phase B: Co- creation of solution- oriented transferable knowledge		
Task 3: Joint fact- finding and situation analysis (problem analysis)	Competence to articulate and share problem views was differentiated among stakeholders and team members alike	Visual methods for problem appraisal (e.g. “social village maps”)
		Development of joint language through establishment of vocabulary and list of terminology
		Use of role-play games to share analysis insights
Task 4: Solutions analysis	Urgent problems demand short-term visible results for community stakeholders (Khulna and Kolkata) – threatening longer-term engagement in TDR process in absence of visible results	Free project resources and mobilize additional resources to work on emergent issues of immediate need in villages, with less direct fit for research agenda of project.



Phase C: Re- integrating and applying the produced knowledge in both scientific and societal practice		
Task 5: Forging agreement	Deeper lying conflicts and issues could not be addressed in project limits	Focus on other significant issues for community and research
	Some powerful actors did not engage (fully), making agreement with them difficult	Ensuring participation of other actors with influence in process (local government mainly); mobilizing media (Khulna)
Task 6: Communication with constituencies	Language barrier and illiteracy local community members	Preparation of specific stakeholder communication materials (translations and visuals)
	Heterogeneity in community groups	Frequent organization of small-scale community meetings with different sub-groups
Task 7: Monitoring agreed actions	Limited project timespan, with first agreements reached only after initial years	Monitoring within project time frame through continued periodic visits and workshops with community and government representatives
		Establish platform linked to other projects and initiatives with continued monitoring by local project partners ((Peri-urban water forum Khulna))
Task 8: Strengthening capacity of participants to become and remain equal partners in negotiations	Sustained capacity threatened by short project timespans (& capacity strengthening challenges discussed with some of above tasks)	Link up to existing structures for collective action and planning (Village Water Council Kolkata village)

* NA: Negotiated approach ; TDR: Transdisciplinary research