Examining nature-society relations through urban infrastructure (NATURE)

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Summary

Historically, the modern infrastructure ideal has dominated the imagination of engineers and planners. As a consequence, urban water and sanitation networks comprising of pipes, pumps, and reservoirs, have largely been built in the same way all over world. However, the multilayered challenges experienced by cities worldwide demand a new approach as part of imagining future urban infrastructures. Building on recent urban scholarship, we mobilise the concept of 'Heterogeneous Infrastructure Configuration' (HIC) to advance theoretical and empirical insights on nature and society relations in urban regions where heterogeneous infrastructures and networks are - or are about to become - challenged. We will combine theoretical insights with grounded empirical work in Guwahati (India) Stockholm (Sweden) and Kampala (Uganda). These three cities are at interesting historical junctures in terms of their water infrastructures and appear to be breaking out of the modern infrastructure ideal. The project is timely in its attempt to learn across Northern and Southern urban experiences and will generate new insights about how to create more socially inclusive and resilient urban infrastructures.

Project description

1. Aims of the project

For over a century the 'modern infrastructure ideal' that promotes universal, uniform, networked infrastructure has dominated the imagination of engineers and planners (Graham & Marvin 2001; Furlong 2014). The implementation of this ideal (always imperfectly and unequally) has resulted in grid electricity, flush toilets connected to sewers, and piped water in cities across the globe. Scholars and practitioners have increasingly questioned this ideal as infrastructure fails to live up to modernist promises. Globally, actors are becoming aware that we may not be able to provide modern infrastructure to everyone (Appel, Anand & Guha 2018; Coutard & Rutherford 2015). Instead, we observe a growing set of questions across the north (largely based on ecological concerns) and south (largely based on economic concerns) about what a more resilient and socially inclusive way of providing basic services might entail. We are witnessing a set of transformative processes that vary globally, but at their core, are about **embracing diversity in infrastructure.** Existing infrastructure is losing its rigidity. Places off the networks are getting services without grid connections. The old way of delivering services through a top down monopoly is questioned. Elsewhere, we have articulated 'heterogeneous infrastructure configurations' as a phrase to capture the longstanding diversity of infrastructure in the south and increasing diversity in the north (Lawhon et al. 2018). In this project we frame these as different modes of infrastructure.

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Social science scholarship on urban infrastructure has attended to the complex relations between technical, social and natural elements. Many have observed the relationship between the modern infrastructure ideal and modernist notions of progress and development, including how these ideas continue to impact the aspirations of urban citizens. More recently there has been a burgeoning of critical scholarship examining the relationship between modernity, infrastructure and nature (Kaika & Swyngedouw 2000; Kaika 2004; Larkin 2013; Gandy 2014; Appel, Anand & Guha 2018; Anand et al. 2018). We draw on the argument that the design and implementation of infrastructure according to modernist ideals was based on the idea that, through the application of scientific calculations, nature could be harnessed to further a specific vision of social and technological development. The application of this vision is evident in many of the material infrastructures built over the last two hundred years (as are tensions between modernist and non-modernist ideas of nature) (Kaika & Swyngedouw 2000; Kaika 2004; Gandy 2014).

However, global inequality, population increases, urbanization and climate change have begun to fracture beliefs in the modernist visions, including increasing questioning of modernist ideas of progress, development, nature and infrastructure (Anand et al. 2018). Further, understandings of what nature is, what we can know about it, and our relationship with it in Western culture have never been homogeneous, and changed drastically over time (Merchant 1981; Descola 2003; Cronon 1996). While modern ideas of nature were carried globally through the colonial encounter, they never fully replaced alternative ways of viewing the relationship between people and their environment (Gandy 2006; Wilhems-Braun 2004). As with other components of modernity (see Latour1991), it was never fully embraced and has undergone significant challenges in recent decades (Castree & Braun 1998; Head 2016; Boyer 2018).

In this project we will examine the relationship between moves away from modernist infrastructure and moves away from modernist ideas of nature. Our starting point is that understanding the tensions between different ideals and infrastructural configurations will be crucial for developing socially just and resilient infrastructure trajectories. We will focus on the narratives people tell about the relations of nature, society and infrastructure in urban contexts where daily experiences are mediated through infrastructure. Our main research question is **how do different modes of infrastructure draw upon and reconfigure narratives of the relationship between nature and society**? Our sub-questions ask:

1. How is biophysical heterogeneity narrated in different modes of infrastructure? For example, we might find explanations that changing patterns in rainfall are making infrastructure planning more difficult, that infrastructure works well except when flooding happens, or that infrastructure might work well in higher altitudes but fail in low-lying parts of the city.

2. How are power and social difference narrated in different modes of infrastructure? For example, we might find explanations that infrastructure works if all users follow the 'rules', but certain social groups do not follow them. Actors might urge conformity, or suggest infrastructure that is more responsive to social difference.

3. How are the past, present and future mobilized in narratives about nature-society relationships in different modes of infrastructure? For example, we might find explanations that infrastructure worked in the past, but cannot accommodate future populations. Or that infrastructure does not work now, but will in the future with adequate (anticipated) economic growth.

4. How have answers to Q1-3 and wider nature-society narratives changed over time? While Q3 focuses on how time is talked about *in narratives* this question emphasizes that *narratives change over time*. For example, we might find that there is a decreasing emphasis on controlling nature, and an increasing articulation of nature as

dynamic and unpredictable. We might find narratives of 'good users' shift from racial to class-based, but continue to argue for the importance of modern education to create good users.

We will **compare** the narratives across three different case studies of **regime actors** (e.g. planners, engineers, city officials and civil society representatives) in **water and sanitation** infrastructure in **Guwahati** (India), **Kampala** (Uganda) and **Stockholm** (Sweden). By situating our case study investigations in cities of the global north and south, we will contextualize different reasons for heterogeneity, and build upon recent urban scholarship and critical infrastructure studies that calls for the 'worlding' of infrastructure (Furlong & Kooy 2017). By worlding we mean rejecting the north-south divide that dominates the analysis of infrastructure and developing insights across southern and northern experiences of urbanism.

2. State of the Art

Our project builds on insights from two fields which have largely developed in separate conversations: informal urban infrastructure and green infrastructure. We argue that both literatures reject the modern infrastructure ideal, but have not yet analyzed of how different modes of infrastructure draw upon and reconfigure narratives about the relationship between nature and society.

Challenges to the modern infrastructure ideal in the global south have been developed largely in response to the failure of cities to provide formal services (Silver 2015; Lawhon et al. 2018). Recent social studies of infrastructure in the global south have shifted from 'how to provide formal services' to examining ' how access to services actually happens' and usefully complement longer standing investigations in technical/engineering studies. Scholarship has primarily developed through case studies of technological artifacts and associated social arrangements. Critical contributions have been made to articulate the ways that residents actually use and navigate between the various options available to them and understanding the (always constrained) choices that residents make (McFarlane et al. 2014; Simone 2004; Acevedo Guerrero 2018).

The modern infrastructure ideal has also previously been challenged in the global north, but this has taken on particular significance in recent decades. This is evident in discourses such as 'working with nature', which brings into the discussion of infrastructure a different way of thinking about environmental risk and uncertainty (see e.g. Nature4Climate). These discourses draw attention to the importance of natural ecosystems as a key component of infrastructure (WWAP UN-Water 2018). Materially, this has, for example, prompted the removal of many concrete channels and an increasing use of green space for flood mitigation (Desfor and Keil 2004; Gandy 2014; Mehta and Movik 2014; Sutton-Grier et al. 2012; Gunnel et al. 2019). Most of these studies however have focused on northern contexts and formal infrastructure, and have focused on the material dimensions. We seek to complement these inquiries with consideration of their implications for how we think about nature, as well as to read them in conversation with global south literature.

Importantly, we develop our work through an understanding that both the relationship between nature and society and ideas about infrastructure are political and power-laden. These ideas have material implications that are not uniform across social difference (Woroniecki 2019; Karpouzoglou et al. in press).

3. Theory

Our project mobilises the concept of 'heterogeneous infrastructure configurations' which has been used to investigate the implications of heterogeneity in urban infrastructure (Lawhon et al. 2018). Our interest in this project is to widen our gaze to consider the relationship between different components of modernity, and specifically, modern ideas of

infrastructure and modern ideas of nature. We are also inspired by work that describes the notion that technology (and sociotechnical systems) carries values and ideas which are built in to the artifacts by designers and system builders and co-created by users (Akrich 1992; Edwards 2003). In other words, to demonstrate that the tensions between different infrastructures also entail contested meanings and values about the relationship between nature and society. We seek to contribute to two fields of inquiry: i) environmental studies scholarship on understandings of nature, including historical and contemporary examinations, and ii) critical infrastructure studies across the north and south.

4. Our contribution to the international research

Our key contribution to international research is to theorize the ways in which different modes of infrastructure draw on and respond to ideas of nature-society relationships through a comparative study. This will bring into conversation literatures on infrastructure across the global north and south as well as work from environmental studies on ideas of nature. In particular work in the South

under the VR project "Urban infrastructure challenges of the South: Waste and sanitation research in Ugandan cities to develop theory and methods for heterogeneous infrastructure" (2016-2019). In addition to the study of water infrastructure from a local actor perspective in African and Indian cities as part of the project "Making the water flow: Conflict(s) and cooperation between formal and informal urban water regimes in Asia and Africa" (2019-2021) led by Karpouzoglou. Furthermore, the project "Ensuring sustainability and equality of water and energy systems during actor-driven disruptive innovation" (2018-2022) by Nilsson has given as a strong foundation in the discussion of water infrastructure and services in the North.

5. Research strategy

We will answer our research questions through a comparative investigation of three case studies combining historical and contemporary evidence. We draw on recent challenges to and advances in thinking comparatively across cases, and our study will involve rich contextualization and attentiveness to global flows of knowledge (Robinson 2016a; 2016b; Lawhon and Truelove in press).

Central to our work is **narrative enquiry** (Sinclair 2002; Clandinin 2006; Ernstson and Nilsson 2019). In other words, instead of focusing on empirical processes, we are primarily interested in the story-telling of the actors. We will draw our informants from different organisations representing different infrastructure regimes ranging from the modern infrastructure ideal (large networks) to more heterogeneous configurations (smaller scale). We expect that our questions will not be easily answered directly by urban actors, and thus mobilize methods that encourage actors to iteratively reflect, articulate and communicate to researchers. Narrative inquiry allows us to explore the types of knowledge, politics, technology, socio-economic practices and power relations that informs regime actor strategies (Karmanov & Hamel 2008; Bene et al. 2017; Kaplan 1993). We will deploy creative techniques such as use of boundary objects (e.g. photographs, toy models of different kinds of infrastructure) that help structure and prompt respondents to explore unspoken ideas (Harper 2002; Lapenta 2011).

We focus on contemporary regime actors in the urban arena who have a role in planning, supervising or maintaining infrastructure (Kemp, Schot & Hoogma 2007). The case studies (stormwater and flood management in Guwahati, drinking water supply in Stockholm and sanitation provision in Kampala) draw on our own previous work and ongoing collaborations (Nag 2017; Blomkvist & Nilsson 2017; Lawhon et al. 2018). In each city, we have selected specific types of infrastructure based on our knowledge that regime actors are aware of their inability to provide the modern infrastructure ideal and are experimenting with heterogeneous modes of infrastructure.

5.1 Case Studies

Guwahati (stormwater and flood management)

Guwahati is the capital city (1.26 million people) of north-east Indian state of Assam and is located at the banks of River Brahmaputra (Hemani and Das 2016), dividing the city into two – North and South Guwahati. North Guwahati is peri-urban with urban land mixed with agriculture fields and wetlands, while South Guwahati has the features of a rapidly growing city. Guwahati city is surrounded by Nilanchal hills (in the west), Sarnia and Fatasil hills (in the east), Agiathuri hills (in the north) and Asvaklanta Hill (in the south), with large areas of the city under various water bodies such as wetlands (*beels*). These wetlands have been historically supporting the city by reducing the intensity of flash floods and water logging in the city (TERI 2013).

However, in the recent past Guwahati has seen decadal population growth rate of 18.29% between 2001 and 2011, far ahead of all the major cities in the north-east India (Census 2001 and 2011). With growing population pressure urban development has become more unplanned leading to the encroachment of wetlands and other water bodies. As a result, urban flooding (stormwater) pressures have increased. The city also surrounds one of the Ramsar wetlands (*Deepor Beel*) that is under threat from urban growth (Deka et al. 2011). In the present, the planned flood infrastructures are proving to be inadequate to accommodate floods due to marked reduction in the water accommodating capacity of *Bharalu* channel and siltation of embankments along the Brahmaputra River. The purpose of this *Bharalu* channel is to discharge the rain water into the Brahmaputra, but currently it is challenged by backflow and storm water surge. Moreover, the natural or green infrastructures such as wetlands, natural tanks and grasslands have been rapidly degrading due to encroachment and infrastructure development, which were integral part of the city to protect from floods and water logging. With climate change and increased intensity of rainfall, regime actors are uncertain whether they should aim for green infrastructure by protecting the wetlands or for engineering new grand infrastructures to protect the city from storm water surge. It is therefore an interesting time in the history of Guwahati to understand the tensions between different infrastructure configurations.

Regime actors representing department of water resources, public health engineering department, disaster management department, Flood and River Erosion Management Agency of Assam (FREMA), Assam state disaster management authority (ASDA) will be interviewed. We will also conduct interviews with experts working on thepreservation of wetlands and green areas in the city (e.g. NGOs such as Aranyak; academics at IIT Guwahati and Guwahati University and local activist groups).

Stockholm (drinking water supply)

The capital of Sweden is home to 950,000 people within the city boundaries itself, while 2.3 million live within the greater region, the Stockholm county. The annual population increase currently stands around 1% which is high by European standards (Stockholm City 2019). A modern water infrastructure has been in place since 1861 and nowadays boasts universal access to drinking water and water-borne sewerage (Cronström, 1986). Stockholm has one of the lowest water tariffs in the country, combined with one of the highest water use per capita, 283 litres per person and day (Svenskt Vatten 2018; Stockholm City
2019). While Stockholm has branded itself as a sustainability leader and was dubbed Europe's first "green capital" in 2010, the overall picture is a complex one, where low water efficiency and high waste generation blend into several other infrastructural and eco-political challenges

(Metzger and Rader Olsson 2013). In the coming years the city will face multiple water challenges, some brought about by contextual shifts in climate, security and demographics (Arekrans 2016). Currently plans are being made for increasing the capacity of the large-scale water production by the Stockholm Water and Waste Company, with an estimated investment of 1 billion euros. At the same time, other city development regime actors are pushing for small-scale alternative solutions which can lend itself to water re-use (see: http://www.macrosystem.se/about-macro-english/).

The Stockholm case study will focus on regime actors particularly in the area of drinking water, both in the city and in the peri-urban area of Värmdö. Key actors include the Water Utilities, City administration of planning (Stadsbyggnadskontoret), housing development (Exploateringskontoret) and political leaders at City Councils of Stockholm and Värmdö. We will also talk to other experts, notably engineering consultants, planners and architects and influential groups like environmental movements (e.g. Fältbiologerna, WWF, Naturskyddsföreningen), business community (Stockholm Chamber of Commerce, Real Estate Developers).

Kampala (sanitation provision)

Uganda is a small, densely populated, landlocked country in East Africa and was recently ranked as the 25th poorest country in the world (Gregson 2017). According to World Bank calculations, Uganda loses a net $177 million every year due to poor sanitation, which contributes to 23,000 annual deaths (Maina and Sittoni 2012). Kampala is the capital of Uganda, with an estimated population of 1.5 million and annual growth rate of over 4%, making it one of the fastest growing cities in the world (Vermerien et al. 2012; see (for more on Kampala, see Mukwaya et al. 2010; Buyana and Lwasa 2011; Kareem and Lwasa 2011). It is estimated that 60% of the population live in informal settlements, and as is widely true in southern cities, these settlements are largely without adequate services including but not limited to sanitation (ibid). Central Kampala has a sewage network, including an over-stretched sewage treatment plant (and plans for a new one) which treats wastewater from the formerly colonial areas of the city; it is estimated that less than 10% of the population is connected to this network (Terreni-Brown 2014). Kampala is located on the edge of Lake Victoria, but unlike many other cities that contain large water bodies, the city center is actually several kilometers away from the water's edge. This land was once a wetland but is now home to many informal settlements; while the wetlands used to provide ecosystem services, filtering wastewater from the city before it entered the lake, informal settlements now regularly flood with contaminated water from the lake (Vermerien et al. 2012). Studies of sanitation in Uganda largely mirror trends found elsewhere: they predominantly examine efforts to improve sanitation off the large network, often focused on a single area or design, and find that various social and environmental reasons cause disruption or abandonment of the improved sanitation intervention (e.g. Katukiza et al. 2010; Tumwebaze et al. 2013). Our experience suggests that scholars and practitioners in Kampala are aware of the implausibility of achieving universal access to 'formal' networked sanitation, and many are seeking alternatives modes of delivering adequate urban access.

Key actors to interact with will include regime actors working under the Kampala Capital City Authority and National Water and Sewerage Company. We will also interact with the boards of residents' associations and national and international civil society platforms responding to the problems of sanitation provision in Kampala such as Water for People, Water Aid and UWASNET.

5.2 Methods

A. Archival and contemporary literature study

Drawing on historical documents we will situate infrastructure narratives in a long-term context over the last century (Q3, Q4). We will then compare the historical with the

contemporary moment of infrastructure by including in our analysis documents such as development planning strategies, municipal plans, regulation and bylaws from the last decade in the arenas of stormwater and flood management, drinking water supply and sanitation provision.

Important archival sources and document repositories include:

Sweden: National Archive (Riksarkivet), City Archive of Stockholm (Stadsarkivet), Stockholm City museum (Stockholm Stadsmuseum), Collections of Stockholm Water and Sewerage Company, Centre for Business History, Company archives of Vattenbyggnadsbyrån (VBB)

Uganda: National Records Centre and Archives, Kampala City Council archives

United Kingdom (for colonial period): National Archives / Public Records Office, Senate House Library with collections of Institute of Commonwealth Studies

India: Public Library of Guwahati, IIT Guwahati, Brahmaputra Board, Department of water resources, Flood and River Erosion Management Agency of Assam (FREMA), Assam state disaster management authority (ASDA)

In addition, online repositories that are deemed of relevance will be explored, such as the World Bank document database, see http://documents.worldbank.org/curated/en/country.

B. Interviews with regime actors

We will conduct 20-30 individual interviews in each city, including officials, planners and engineers involved in the decision-making and operation of the identified infrastructure configurations (water, stormwater, sanitation). We will use photo elicitation as a technique designed to help respondents articulate under explored ideas as part of structured and semi-structured interview formats. Specifically, we will ask respondents to agree/disagree with a series of statements related to images of infrastructure. The images will include samples of different modes of infrastructure, including modern networked infrastructures, green infrastructures, and 'informal' infrastructure. These interviews will be followed by open-ended questions to generate wider narratives.

To answer Q1, we will develop lines of inquiry to address: What might disrupt the use of this infrastructure? What happens if this infrastructure breaks? What will users do in the meantime? Who will fix it? If the weather changes, will this impact this infrastructure? Is this infrastructure good for the environment?

To answer Q2, we will develop lines of inquiry to address: Would you want to use this infrastructure? What kinds of people use this kind of infrastructure (anticipated responses: everyone; rich people; poor people)? Is this 'good' infrastructure?

C. Experimental workshops using toy models

This method will be used to deepen the insights developed from the document analysis and interviews and respond to Q1 and Q2. It also gives opportunity to investigate narratives of time, responding to Q3. We conduct experimental workshops in each city, with 10-15 regime actors as participants in each. With help from designers, we will develop three different infrastructural models based on three different modes of infrastructure (e.g. modern, green, informal).

Participants will be able to 'play' with the different models during the workshop, and if feasible seeing how water moves through the configuration. Then, participants will be put into groups in which each group has to respond to a series of provocations. For example,

the research team will design 'disruptions' (natural, economic, social) to the configuration, and ask participants to respond to the disruption (see Graham 2010 on the importance of disruption for elucidating understandings of infrastructure). We will also ask groups to plan for how the configuration could be improved, enabling us to see how actors imagine the future and possibilities for more just, sustainable and resilient infrastructures.

6. Timeframe and implementation

Our anticipated timeframe is as follows:

- Archival, gray and scholarly literature study: months 1 - 10, Year 1
- Interviews with regime actors: months 11-23, Year 1-2
- Experimental workshops: months 24-32, Year 2-3.

Please see Activity Plan with deliverables in Appendix.

Karpouzoglou will coordinate and lead the overall project and will also be responsible for the implementation of the case study in Guwahati. Blomqvist will be responsible for the investigations of the case study in Stockholm. Lawhon will be responsible for the investigations in Kampala. Nilsson will be responsible for the project overall communication strategy that will span continuously throughout the project (see Section 8).

7. International collaborations

Given the comparative and cross-regional nature of this project, we place our project in a strong international network of research collaboration. In addition to the University of Oklahoma, we will strengthen our international network through a collaborative arrangement with the Indian Institute of Technology, Department of Humanities and Social Science through Associate Professor Anamika Barua and Professor Arupjyoti Saikia. Dr. Anamika Barua is a specialist in water security and climate change vulnerability in the eastern Himalayan region and has excellent contacts with regime actors in Guwahati. Professor Saikia is an expert on the social and environmental history of Assam, focusing on changing infrastructure in floodplains and along the Brahmaputra River. As part of our case study work we will also collaborate with Wageningen University & Research, Public Administration & Policy through Prof. Art Dewulf and Dr Sumit Vij. Prof. Dewulf is a world leading expert on narrative enquiry, sense making and decision making in policy and Dr Sumit Vij is an expert on the relations between climate change adaptation and water infrastructure policy in South Asia (India, Nepal and Bangladesh).

In Kampala we have a long-standing collaboration with the Department of Geography at the University of Makerere, through Associate Professor Shuaib Lwasa. He has written extensively on the infrastructure and urban environment of Kampala and also directs the Urban Action Lab, a knowledge and collaboration arena for urban sustainability. This project enables us to build on our earlier successful collaboration on heterogeneous urban infrastructures.

8. Research communication

We aim to interact with a diverse set of actors in the urban arena: planners and engineers, policy-makers, and other influential groups.

Our **Communication Strategy** identifies three important target groups:

1. Urban Regime actors (experts and policy makers in case cities)
2. Social Influencers and Civic Leaders (green movement, neighborhood associations, opinion leaders, media and journalists, cultural leaders)
3. Academic community (scholars in urban studies, STS, Southern Urban theory, political ecology)

To reach our target groups we aim to use the following channels:

	Regime Actors	Influencers and Leaders
Interviews and narrative enquiry	x	
Research Workshops	x	x
Social media groups	x	x
Public Exhibition (Stockholm)	x	x
Summary reports	x	x
Webpage	x	x

Interviews and narrative enquiry described in section 5.2 will be the most direct form of communication, which will only reach a small group of actors (20-30 interviewees in each case study).

Research workshops described under section 5.2 are more open and explorative forums, which include experimental modes of interaction using toy models. These can also include influencer groups.

The participating actors will be invited to share ideas and give feedback using closed social **media groups**, for instance using WhatsApp which is in widespread use in Uganda and India, and easily accessible in Sweden as well. This will provide a relaxed form of moderated interaction between the participants themselves, and with the research team, across the varying geographies. We will also have the option to invite Influencers into these groups, alternatively, developing "twitter-friendly" messages that we encourage Influencers to push.

We will explore the format of **Public Exhibitions**, focusing on the Stockholm context. In this activity we collaborate with Färgfabriken, a well renowned centre for urban arts, culture and design in Stockholm. Färgfabriken is now staging the project "Symbiosis" on the dynamic re-casting of urban space in the face of multiple challenges of nature and technology. We will participate through curating a specific part of the exhibition and leading a series of clinics in 2020 we tentatively call *"The Future of Infrastructure"* as part of stimulating wider discussion with various actor in society on different infrastructure configurations. During the course of the project we will evaluate the exhibition and clinics and assess the most feasible options for replicating in Kampala and Guwahati, under separate funding.

As our project moves along, we will document the main activities in short **Summary Reports** of 5-10 pages in accessible language and post them to a dedicated project **Webpage** under the KTH History division main site.

For reaching our peers in the academic community we intend to publish 4 papers in Academic journals (mainly in urban studies, political ecology, STS, and development studies). We also intend to present papers to international **Scientific Conferences** such as RGS-IGS (Geography), IST (Transition), WCEH, (Environmental History), and/or national conferences in urban planning, anthropology and environmental humanities.

During the first 3 months of implementation we will develop a detailed communication plan. The communication activities will be anchored in WaterCentre@KTH, and led by its Director, David Nilsson.
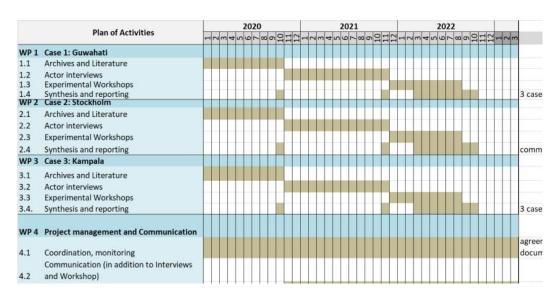
Scientific competence

Timos Karpouzoglou (PI) is a full-time researcher at KTH, Department of History, Science & Environment. His expertise is in water governance, science & technology studies and urban political ecology. He has worked extensively in India.

Mary Lawhon is an Assistant Professor at the University of Oklahoma, Department of Geography & Environmental Sustainability. She specialises in urban infrastructure and political ecology and has worked extensively in African cities, including a ongoing project in Uganda.

Pär Blomkvist works as a researcher at Mälardalens högskola (MDH). He also holds a position as Associate Professor (Docent) at KTH, Department of Industrial Economics &Management. He is a historian specialised in socio-technical change processes from a comparative perspective in Sweden and East Africa.

David Nilsson is an Associate Professor at KTH with a diverse professional background in water, urban environment and global sustainability. His area of expertise is African history and water development and is currently the Director of the WaterCentre at KTH.

APPENDIX

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