Local ecological knowledge in deteriorating water catchments
Reconsidering environmental histories and inclusive governance in the Taita Hills, Kenya

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ACADEMIC DISSERTATION
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Abstract

In many developing countries, formal natural resource management is still largely based on top-down approaches that rely on professional ecological knowledge and bureaucratic procedures and often fail to adequately address the linkages between different sectors, such as water and forestry. Despite general support for community participation in the context of neoliberal governance, perspectives of local people are often neglected in management planning and decision-making. Thus, participation is typically, at best, limited to consultation or information sharing. At the same time, local people are often considered responsible for environmental degradation, while historical political, economic and other wider structural changes, which have led to unsustainable land and water uses, are overlooked.

This dissertation focuses on examining the challenges and possibilities of enhancing community participation and the role of local ecological knowledge in environmental management through a case study from the Taita Hills, South-East Kenya. Political ecology provides the overall framework for the study and both theoretical and ethical guidance are drawn from postcolonial and decolonial thinking. The dissertation consists of four articles that are tied together by a proposed "pathway" towards decolonizing environmental governance and building symmetric dialogues between local people and state authorities. The steps on the pathway include recognizing the dependence of environmental problems on social and territorial structures and power dynamics, reconsidering responsibilities for environmental degradation through the local qualitative assessment of ecosystem services' change, using participatory mapping process as a concrete way to facilitate societal learning and connecting different ways of knowing and, finally, delinking from the domination of western knowledge, bureaucracy and economic interests in environmental negotiations. The study also stresses the importance of incorporating decolonial attitude into environmental research in socially and environmentally delicate settings such as the Taita Hills.

The first article of the dissertation is based on literature and focuses on the social aspects of water scarcity and droughts in the Global South. The other three case study articles on the Taita Hills fall under this overall subject matter, with specific focuses on changes in water-related ecosystem services, participatory mapping of water problems and asymmetric dialogues between local people and resource management officials. The material for the case studies was largely collected through a multi-method participatory mapping process in 2013-2014. The process is methodologically important, because it highlights the significance of the historical perspective for understanding socio-environmental problems and respects alternative histories and the local ways of knowing and thus provides the possibility to move towards decolonizing knowledge production for the environmental management.

This dissertation contributes to the political ecology research with a case study from the Taita Hills that combines political ecological approach to a study of local ecological knowledge. Particularly, this study shows how increasing vulnerability and decreasing resilience and resulting water problems can

be traced back to changes in land use policies, the impacts of the neoliberalization of environmental governance, and ultimately the subalternization of local people and their ecological knowledges. Furthermore, the dissertation locates the roots of the asymmetric environmental dialogues between local people and management authorities to the different framings of the environmental problems. Prioritization of the economic interests of the state in local environmental negotiations, instead of local perspectives and historical injustices, reproduces the coloniality of power. To overcome this vicious circle, societal learning and transformation would be needed.'

Keywords: ecosystem services, environmental histories, Kenya, local ecological knowledge, neoliberal governance, participation, participatory mapping, professional ecological knowledge, Taita Hills, water resource management

Tiivistelmä

Monissa kehittyvissä maissa luonnonvarojen hallinta perustuu vielä suurelta osin ylhäältä alaspäin suuntautuviin lähestymistapoihin, jotka nojaavat virkamiestietoon ja byrokraattisiin toimintamalleihin. Vaikka vallitseva uusliberaalin ympäristöhallinnan lähestymistapa onkin edistänyt paikallisyhteisöjen osallistamista, jätetään paikalliset näkökulmat usein huomiotta luonnonvarojen hallinnan suunnittelussa ja päätöksenteossa. Näin ollen osallistaminen rajoittuu yleensä parhaimmillaankin vain konsultaatioon tai tiedon jakamiseen virallisilta hallinnon toimijoilta paikalliselle tasolle. Paikallisten ihmisten nähdään kuitenkin usein olevan vastuussa ympäristön tilan heikkenemisestä, koska he eivät resurssipulan vuoksi pysty aina noudattamaan kaikkia ympäristösäädöksiä ja hallinnallisia käytäntöjä. Tämä tarkastelutapa ei kuitenkaan huomioi historiallisia poliittisia, taloudellisia ja sosiaalisia tekijöitä, jotka ovat johtaneet kestämättömään maa- ja vesivarojen käyttöön ja, joita tarkastelemalla, voitaisiin vastuita arvioida uudelleen.

Tämä väitöskirja tarkastelee mahdollisuuksia ja haasteita, jotka liittyvät paikallisyhteisöjen osallistamiseen ja paikallistiedon tuomiseen ympäristövarojen hallinnan prosesseihin Kaakkois-Kenian Taitavuorille sijoittuvan tapaustutkimuksen kautta. Poliittinen ekologia tarjoaa tutkimukselle teoreettisen viitekehyksen, jonka ohessa teoreettista ja eettistä opastusta on etsitty jälkikoloniaalisesta ja dekoloniaalisesta ajattelusta. Väitöskirja perustuu neljään tutkimusartikkeliin, jotka on sidottu yhteenveto-osassa toisiinsa ”polulla”, joka tarjoaa aineksia ympäristöhallinnon valta-asetelmien purkamiseen ja eri toimijoiden välisen symmetrisen vuoropuhelun rakentamiseen. Polun askelmat ovat seuraavat: ympäristöongelmiin liittyvien sosiaalisten ja territoriaalisten rakenteiden ja valtadynamiikkojen tunnistaminen; ympäristön tilan heikkenemiseen liittyvien vastuiden uudelleenarviointi paikallisten ekosysteemipalveluiden muutoksen laadullisen tutkimuksen avulla; osallistavan kartoitusprosessin käyttäminen yhteiskunnallisen oppimisen välineenä; sekä irrottautuminen länsimaisen tiedon, byrokratian and taloudellisten intressien ylivallasta ympäristöön liittyvissä keskusteluissa. Tutkimus myös peräänkuuluttaa dekolonisoivan asenteen tarpeellisuutta ympäristötutkimuksessa sosiaalisesti ja ekologisesti herkillä alueilla, joihin Taitavuoretkin kuuluvat.

Väitöskirjan ensimmäinen artikkeli pohjautuu kirjallisuuskatsaukseen ja tarkastelee vesipulaa ja kuivuutta globaalissa etelässä. Kolme muuta artikkelia ovat tapaustutkimuksia Taitavuorilta, jotka liittyvät samaan aihepiiriin ja käsittelevät veteen liittyvien ekosysteemipalvelujen muutosta, vesiongelmien osallistavaa kartoitusta sekä epäsymmetristä dialogia paikallisten ihmisten ja viranomaisten välillä. Tapaustutkimusten aineisto kerättiin pääosin useita laadullisia menetelmiä yhdistävän osallistavan kartoitusprosessin avulla vuosina 2013-2014. Kartoitusprosessi on metodologisesti tärkeä, koska se korostaa historiallisen näkökulman merkitystä sosio-ekologisten ongelmien ymmärtämisessä, kunnioittaa vaihtoehtoisia historioita ja paikallisia tietämisen tapoja tarjoten siten välineitä dekolonisoivalle ympäristöhallinnan tiedontuotannolle.

Väitöstutkimuksen anti poliittisen ekologian tutkimukseen liittyy erityisesti kytköksiin paikallistiedon tutkimukseen ja dekolonialistiseen ajatteluun. Tutkimuksen historiallinen näkökulma paljastaa kuinka ihmisyhteisöjen haavoittuvuuden kasvun ja heikentyvän resilienssin sekä niiden aiheuttamien vesiongelmien juuret ulottuvat muutoksiin maankäyttöpolitiikoissa, ympäristöhallinnan uusliberalisaatioon sekä paikallisten ihmisten ekologisen tiedon alisteiseen asemaan Taitavuorilla.

Lisäksi tulokset osoittavat kuinka epäsymmetrinen vuoropuhelu kytkeytyy paikallisten ihmisten ja hallintoviranomaisten erilaisiin tapoihin ymmärtää ympäristöongelmien lähtökohdat. Valtiontasolla muotoiltujen taloudellisten tavoitteiden asettaminen etusijalle paikallisympäristöä koskevissa päätöksenteon prosesseissa johtaa kulttuuristen näkökulmien ja epäoikeudenmukaisen resurssienjaon kysymysten sivuuttamiseen sekä uusintaa koloniaalista valtasuhdetta. Tämän muuttaminen vaatii yhteiskunnallista oppimista ja siirtymistä kohti tasa-arvoisempaa, eri näkökulmat ja toimijaryhmät tunnistavaa, vuoropuhelua.

Asiasanat: ekosysteemipalvelut, Kenia, osallistava kartoitus, osallistuminen, paikallistieto, virkamiestieto, Taitavuoret, uusliberaali hallinto, vesivarojen hallinta, ympäristöhistoriat

Acknowledgements

One thing I learned from yoga some time ago is that you cannot learn to stand on your head before every single muscle in your body is ready for it. For some reason, that principle came to my mind often when I was conducting research and writing my PhD dissertation. While the real similarities between yoga and research seem to be minimal (I would not look for the peace of mind in science!), you still need many "muscles" to do research. But in research, you can (and need to) borrow muscles from other people who support you, catch you when you fall and help you get up again. Finishing this work took way too many years, but it has given me an opportunity to meet several interesting and wonderful people (and non-human beings) who have given me their support in this endeavor.

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And for those who wonder, no, I still cannot stand on my head. But another thing yoga taught me is that it does not really matter, as long as I am going in the right direction.

At home in Joensuu, January 17, 2018
Johanna Hohenthal

Contents

List of original publications

This thesis is based on the following articles:

I Hohenthal J. & P. Minoia (2017). Social aspects of drought and water scarcity. In Eslamian, S. & F. Eslamian (eds.): *Handbook of Drought and Water Scarcity. Principles of Drought and Water Scarcity,* 607-625. CRC Press Taylor & Francis Group, Boca Raton.

II Hohenthal, J., E. Owidi, P. Minoia & P. Pellikka (2015). Local assessment of changes in water-related ecosystem services and their management: DPASER conceptual model and its application in Taita Hills, Kenya. *International Journal of Biodiversity Science, Ecosystem Services & Management* 11: 3, 225-238.

III Hohenthal, J., P. Minoia & P. Pellikka (2017). Mapping meaning: critical cartographies for participatory water management in Taita Hills, Kenya. *The Professional Geographer* 69: 3, 383-395.

IV Hohenthal, J., M. Räsänen & P. Minoia (2018). Political ecology of asymmetric ecological knowledges: diverging views on the eucalyptus-water nexus in the Taita Hills, Kenya. J*ournal of Political Ecology* 25: 1-19.

The articles are referred to in the text by their roman numerals.

Author's contribution

	I*	II	III	IV
Original idea and research questions	PM	JH, PM	PM	JH
Study design	-	JH, PM, EO	PM, JH	JH, MR, PM
Literature review	JH, PM	JH, PM	JH, PM	JH, MR, PM
Data collection	-	EO, JH, PM	JH, PM	MR, JH, PM
Analysis	-	JH, EO, PM	JH, PM	JH, RM, PM
Manuscript preparation	JH, PM	JH, EO, PM, PP	JH, PM, PP	JH, MR, PM

*Article based on literature review

JH=Johanna Hohenthal, PM=Paola Minoia, EO=Emmah Owidi, MR=Marinka Räsänen, PP=Petri Pellikka

1 Introduction

When I arrived in the Taita Hills in South-East Kenya for the first time in 2010, I saw a land that was by no means devastated, but in many ways scarred. I saw the cleared forests, drying streams and cultivated plots that sprawled over the forest boundaries and river banks. My eye was also caught by the constant flow of people carrying yellow jerry cans filled with water down the hills and then rushing back up again with the empty ones. I had just spent several months reading about the land use and land cover change in Taita (e.g., Pellikka et al. 2009; Maeda et al. 2010) and the potential impacts of these changes on water catchment hydrology (e.g., Bruijnzeel 2004). Thus, I knew that things were not how they used be – nor how they should be, in my view. I also knew who to blame. In my understanding, it was all caused by the excessive exploitation of natural resources and expansion of the cultivated land area by local people that had caused trouble for the very same people and - even to a more considerable extent - to the delicate natural environment of the hills, including its precious endemic plant and animal species (Rogo & Oguge 2000).

Now, many years later, I understand that I was reading the landscape through a lens that made me blind to many aspects of the social-environmental dynamics of the Taita Hills. I had adopted that lens from the discussions on the global environmental degradation that are typically dominated by the so-called declensionist narratives. While blaming humanity for the environmental degradation, those narratives stress separation of human and non-human worlds and fail to understand the ambivalent role of people as part of nature and simultaneously as agents of significant (but not always merely destructive) physical change due to their distinctive cultural being (Melosi 2010). Another problem is that the narrated causalities do not typically reach beyond the immediate actions and motives of different human actors and thus fail to understand the complex realities of human-environment relations and the impacts of the historical broader scale political, economic and cultural factors on them. In this vein, for example, human-induced environmental degradation is set as one of the core narratives of the darkest visions of the Anthropocene without considering who of the humanity are actually responsible for the severe anthropogenic changes and why (Malm & Hornborg 2014; Schulz 2017).

Although environmental historians and human geographers have for long recognized the agency of nature (McNeill 2003; Steinberg 2002, 2004) and its social construction (Harvey 1990; Williams 1994; Cronon 1996), the blaming attitude still tinge much of the positivist natural science approaches to studying environmental problems, also within the fields of Physical Geography and Environmental Sciences that constitute my academic background. In the early 2010s, my approach was shared by several like-minded geographers and biologists who had explored the natural environment and land cover changes of the Taita Hills already for a couple of decades. The newly established Taita Research Station of the University of Helsinki was also soon to become the major academic center of knowledge production in the area and I was given an opportunity to join the crew.

At early stage of my research, my goal was to find out how the change of the land cover (mainly turning the indigenous forests into farm lands) had altered the stream flows in the hills. Because I was not familiar with social aspects of water issues or social research methods, I decided to cut the human side to a minimum in my study. Even with this delineation - as anyone familiar with water

catchment hydrology realizes - my research goal was in fact enormous already due to mere data requirements related to open channel modelling. Thus, quite inevitably, my project failed in many ways, which technical details are a story of its own. Ironically, I was forced to admit that dismissal of the social aspects and their assumed complexity had in fact made my work more complicated and ultimately impossible. More importantly, however, I had also become haunted by some things that I had seen in the field but could not properly understand. During my walks along the rivers, I had met many local people, some of whom ventured to ask me: "How does this research benefit us, the community?" Some of them were also afraid that this white woman had come to survey and grab their lands. Eventually, after countless stubborn trials and errors with hydrological modelling, I gave up and chose to face a new path towards something that I felt quite unfamiliar and uncomfortable with.

My choice was accelerated by the TAITAWATER[1] project which I joined in 2013. One of the core goals of the "social research working group" of the project was to bring academic research closer to local people and to understand their perspectives on the environmental degradation and associated water crises. By using the approach of political ecology, the group aimed at explaining how complex human power relations are interrelated with the changes in the natural world and influence environmental (in)justice. Through its critical and empowering approach, and use of qualitative and participatory methods, the group differentiated itself from the prevailing positivist environmental research in the Taita Hills that, while sharing the same concern over depleting water resources, still had remained rather distant to local people's realities. This dissertation is one of the outcomes of that project. It focuses on reconsidering historical socio-environmental responsibilities and dialogues between local people and resource management authorities that are important for enhancing participatory approaches in environmental governance.

1.1 The problem of inadequate community participation

Participatory environmental management initiatives have become commonplace throughout the world following the numerous international and national agreements and guidelines (Gibson et al. 2000; Reed 2008). For example, the Sustainable Development Goals of the United Nation's 2030 Agenda support enhancing the participation of local communities in water and sanitation management (Goal 6) as well as equal and participatory decision making in all levels of management especially in the developing world (Goal 16) (UN 2015). Support to the participation of the local resource users is based on the assumption that it makes resource management more effective (Gibson et al. 2000), increases the resilience and adaptive capacity of resource management systems (Olsson and Folke 2001; Folke et al. 2002) and creates public trust and acceptance for the management projects (Bell et al. 2002).

Calls for enhancing citizen participation can also be viewed as resulting from the participatory rationalities embedded in neoliberal environmental governance and associated decentralization processes (Sletto & Nygren 2015). In many developing countries, since the 1980s, decentralization has produced environmental governance structures that include local resource users in management (Benjaminsen 1997; Ribot 2002, 2004; Baumann & Farrington 2003; Larson & Ribot 2004; Mumma 2007; Larson & Soto 2008). However, these processes and emergence of collaborative

1 "Integrated land cover-climate-ecosystem process study for water management in East African highlands", a project funded by the Academy of Finland in 2012-2016

arrangements between state and residents typically create new forms of dependencies rather than direct empowerment of local people in resource management (Sletto & Nygren 2015; Trnka & Trundle 2014). Yet, at the same time, the collaborative arrangements are tempting for the communities, because they resonate with traditions of civic engagement in the environmental governance.

Too often in participatory arrangements, the devolution of power remains inadequate (Bakker & Morinville 2013; Ribot 2004) and support to top-down approaches by middle- and low-level bureaucrats and politicians constrain genuine participation (Manor 2004). It is also common that participation is used as "a depoliticized technical tool" that fails to consider the societal and institutional conditions under which participation would improve environmental governance and empower local people (Coolsaet 2015). Especially the recognition of alternative ontologies and epistemologies may be missing when the local communities are merely "viewed as tools for, or commodities, of conservation rather than as active knowing agents" (Goldman 2003: 839), who should be "trained" within the western epistemic practice (Nygren 1999; Becker 2001) or whose knowledge becomes useful only when it has been extracted, interpreted, screened and scaled to fit into the state's bureaucratic environmental management structure based on the epistemological assumptions and the understanding of sustainability within western science (Nygren 1999; Watson 2013). According to Nadasdy (1999), such extension of the social and conceptual networks of formal environmental management into local communities serves only to concentrate power in the official administration.

In Kenya, the current cross-scale institutional linkages enable, at least on a structural level, the co-management (Berkes et al. 1991; Berkes 2002, 2010) of natural resources such as water and forests. Yet, some authors have criticized the system for still being rather state–centric. For example, the Water Act 2002 that has guided the water resource governance until recently[2], recognizes the role of non-governmental entities in water resources management and water service provision, but vests the ownership of all the water resources in the state and their control in the minister (GoK 2002: 945, sec. 3, 4; Mumma 2007; Onyango et al. 2007; Ogendi & Ong'oa 2009). Thus, the ultimate decision-making has remained centralized. The governance structure has also exposed the rural poor to the expensive and bureaucratic water use and water service provision permit application procedures, which financial and technical requirements they are rarely able to meet (Mumma 2007). This has restricted the ability of the Act to serve the needs of the rural poor.

In the Taita Hills, like elsewhere in the developing world, the decentralization and emergence of polycentric governance system has enabled non-governmental and community-based actors to find larger roles in water provision and resource management (Bakker & Morinville 2013). The TAITAWATER team, however, soon realized that the local actors and their knowledges were not fully included in serious environmental discussions, especially regarding resource management. We were told that a few participatory experiments to identify environmental changes and problems had been made, but so far, they had not become a common practice. The resource user groups that are part of the formal governance structure also lacked financial and technical capacity to carry out their tasks. Instead, the management planning and decisions were largely based on professional and bureaucratic knowledge (Fleischman & Briske 2016; Hunt & Shackley 1999) of government officials whose environmental perceptions are closer to western scientific understandings of ecosystem functioning

2 During the research process, a new Water Act (RoK 2016) was being formulated, but had not yet come into effect and therefore it is not discussed further in this work.

than local ecological knowledge. At the same time, there were several environmental regulations that, for example, restricted cultivation on river banks and collection of fire wood in the forests, which the local people could not always obey due to lack of fertile land and resources. This made them look guilty of causing environmental degradation in the eyes of management officials. This perception, however, overlooks the historical driving factors that have led to the land and resource scarcity in the Taita Hills.

1.2 Research questions and aims

This dissertation has two main goals that are linked to each other. The first goal is to critically examine the drivers of environmental deterioration and water resource problems in the Taita Hills through the lens of political ecology. For this purpose, I provide an analysis of water resources' change based on local perceptions that is alternative to the one made by the natural scientists and resource management "professionals". The second goal is to study the local ecological knowledge and to propose a pathway from the current top-down environmental governance towards the creation of area of possibilities that enables collaboration and dialogue-building between different actors. This dissertation answers the following questions:

1. How are water problems constructed through the interplay between natural, social and political conditions?
2. How marginalization of local people and subjugation of their knowledges contribute to environmental degradation?
3. How does the local assessment of the changes in water-related ecosystem services and participatory mapping help negotiating common understandings about water problems?
4. Which are the potential steps towards symmetric dialogues in environmental management and environmental justice?

The research questions are addressed in the four articles included in this dissertation. The political ecology approach is central in all of them as they highlight the historical role of national and international policies as drivers of water problems. The first article outlines the socio-ecological approach to understanding water problems based on the critical literature review. The latter three articles draw from the same empirical data set collected in the field in the Taita Hills in 2013-2014.

The contributions of the articles to the dissertation are the following:

Article I is a book chapter that reviews the social aspects of water scarcity and droughts with a focus on the developing world. Despite the long publication process, this article was written first and thus it sets the thematic basis for the dissertation. It addresses the first and third research questions by outlining the socio-environmental aspects of water problems and the need for the qualitative and participatory approaches and utilization of multiple knowledges in planning water scarcity and drought management and adaptation. The article first discusses water scarcity and drought in the light of the international development goals. That is followed by the definitions of the key concepts of water scarcity/stress, management strategies, water poverty and drought as well as a

critical scrutiny of the socio-environmental concepts of vulnerability, resilience and adaptation. The theoretical concepts are further explored through brief case studies illustrating a) the drought-resilient socio-ecological systems constrained by the sociopolitical changes (Tuareg people), b) the drought adaptation in the midst of the global environmental change (Mediterranean area, Sudan and Kenya) and c) the entanglement of power, governance and water scarcity (West Bank). The article concludes with a review of the international conventions and regulations addressing social problems related to water scarcity and drought.

Article II analyses the changes in water-related ecosystem services (ES) from the local perspective using the Drivers, Pressures, Actions, Ecosystem services, Responses (DPASER) framework adapted for the qualitative research from the Driver, Pressures, State, Impacts, Responses (DPSIR) model. The study draws from 44 interviews with the representatives of local government departments and agencies and key informants among the local community involved in the management of environmental resources in the Taita Hills. The study also employs the data collected during the participatory mapping process with the local community. It answers the first and second research questions by showing that historical changes in land policies and regulations are important drivers of changes in ecosystem dynamics. It also addresses the third question by highlighting the value of local assessment in the areas lacking the historical quantitative data of environmental changes. Furthermore, it argues that application of the ES approach in environmental management would require integration of the different management sectors that have, so far, been managed mainly separately in Kenya.

Article III focuses on critical cartography and describes the participatory foundation of the empirical part of the dissertation. The article is based on a multi-method participatory mapping process that includes sketch mapping, timeline exercises, focus group discussions, walking and semi-structured interviews with local people and various governmental and non-governmental organizations in the Taita Hills. It mainly answers the third research question. First, it shows that, unlike the authoritative and static images provided by scientific cartography, the participatory mapping can open a deliberative space and help identify local environmental problems, which contribute to the path of community empowerment. Participatory mapping also provides a practical tool for the communities to monitor and plan the management of the local resources and to present their knowledge in a way that is viewed as legitimate by the formal environmental management authorities. In addition, the article contributes to the first and second research questions by revealing how the participatory mapping provides a deeper insight into the political ecology of water in the area. This may assist in revoking the Malthusian narratives that blame local people for resource deterioration and recognizing the political responsibility of the state that leads to community empowerment.

Article IV goes deeper into the epistemological and power aspects of environmental disputes and addresses the asymmetry between local and professional knowledges in negotiations from the perspective of political ecology. The study is based on the analysis of discourses surrounding eucalyptus plantations and their impacts on water resources in the Taita Hills. It answers mainly the second and fourth research questions. The study shows that the problem of eucalyptus has so far

been addressed in an asymmetric dialogue, dominated by the bureaucratic problem framing and placation and manipulation of the local people with ambiguous professional explanations, while the knowledge uncertainty is used to justify the refraining from any concrete actions to remove the trees from the risk areas. Finding a solution to the problem would require societal transformation and building trust between the local and bureaucratic actors, but there are still many challenges on the way. The current management system and unbalanced interaction between the local people and state bureaucrats continue to reproduce the subaltern position of the local people in resource management, reinforce the domination of professional knowledge and produce unequal access to resources and thus the problems of environmental justice. To enable true synergies between the professional and local knowledge systems, the local logics, meanings and problem framing should be taken as a starting point for dialogue-building. Eventually, environmental justice could only be achieved through recognizing the plurality of values beyond economic goals.

1.3 Pathway towards decolonizing environmental governance

The articles of this dissertation are tied together by a "pathway" that draws from different theoretical strands of political ecology (discussed in more detail in chapter 2.1) and aims at moving towards decolonizing environmental management and building symmetric dialogues between different actors (Figure 1).

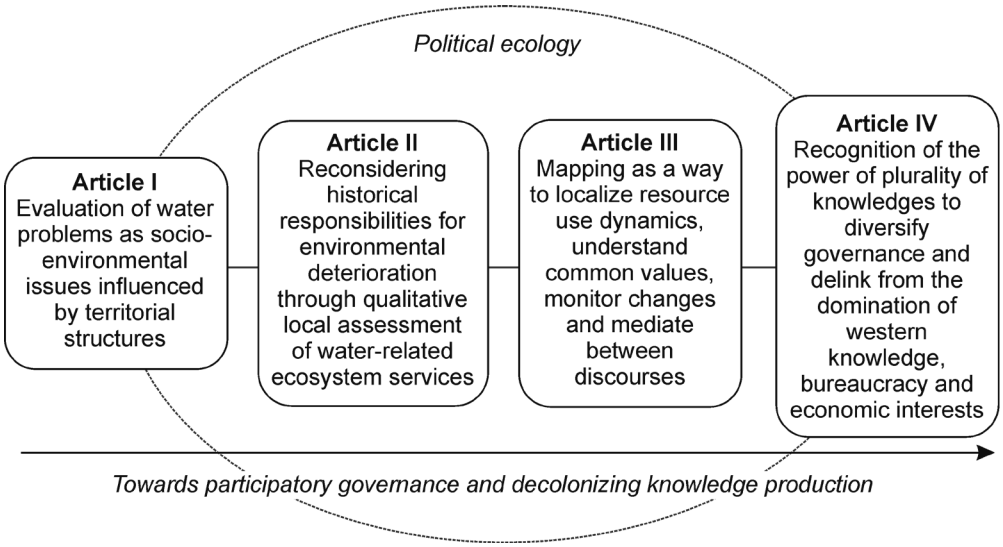

Figure 1. Articles included in the dissertation tied together by the "pathway" towards decolonizing knowledge production for environmental governance

The pathway proposes that a transition towards decolonizing environmental governance starts by expanding the understanding of the socio-environmental construction of water problems through perceiving them as truly social and geographical issues, dependent on hydrosocial territorial structures (Boelens et al. 2016) (Article I). This starting point sets the basis that resists the strategical depoliticizing of water problems through "naturalizing socionatural waters, hydrological cycles and even water distribution systems (by locating them in nature)" (Boelens 2014: 236). This is closely related to

the analysis of the historical dynamics of society-environment interactions through listening to local voices that potentially leads to reconsidering who is actually responsible for the environmental degradation (Article II). The analysis builds on the assumption that dismantling the declensionist and hegemonic Malthusian narratives removes the barrier that prevents local people to be seen as capable of managing their resources sustainably if given an opportunity. The local discourses can be formalized through the participatory mapping that can be used as a tool in negotiations with formal governance (Article III). The participatory mapping process provides a concrete way to facilitate societal learning and connecting knowledges for resource management and solving environmental problems. It is assumed that there is no reason to give scientists' or resource management officers' way of knowing a superior position over the local way of knowing and that combination of equal knowledges can provide an enriched picture of the matter at hand (Tengö et al. 2014). However, in order to reach a symmetric dialogue between local people and management officials, the reproduction of subalternization of local ecological knowledge should be overcome (Article IV).

The following chapter presents the theoretical and conceptual background for the dissertation. The third chapter discusses research methodology. That is followed by the discussion of the key findings of the study and conclusions.

2 Theoretical framework and key concepts

In this chapter, I first present the key fields of political ecology that are relevant to this dissertation. After that, I outline somewhat looser theoretical and ethical guidance framework of my study that draws from postcolonial and decolonial thinking. That is followed by a discussion on the epistemological and structural bases of asymmetric environmental dialogues and different knowledge concepts.

2.1 Political ecological research approach

One of the major original agendas of political ecology has been to criticize the dominating narratives that blame "the smallholders of the Third World" for the environmental degradation "through some combination of their own irrationality, numbers, or flawed institutions (common property)" (Turner 2014: 618). Thus, it provides a counterhegemonic perspective for studying environmental problems in the Global South. Political ecological scrutiny can show, for example, how local people's resource use and agricultural expansion, which are typically regarded as the immediate causes of tropical deforestation, are driven by the national and international societal, economic and political trajectories (Nygren 2000; Klepeis & Vance 2003; Scriven 2012).

More recently, political ecological research has focused on place-based qualitative case studies that pay attention especially on the power dynamics within society and aim at understanding linkages between environmental changes and differences in resource access between different groups and individuals (Turner 2014). Such case studies have formed the basis for the "degradation and marginalization" thesis of contemporary political ecology (Robbins 2012) that is important for this work. The thesis rejects the traditional Malthusian explanation of environmental degradation due to human population growth and seeks the causes from the wider scale national and global political processes and recognizes their linkages to disempowerment of local communities.

Political ecologists have also been interested in the social impacts of shifts to multi-level and polycentric water governance, enabled and accelerated particularly by the decentralization of governance in the context of neoliberalism (e.g., Bakker & Morinville 2013; Boelens et al. 2015; Dunn et al. 2015; Harris & Roa-García 2013; Hoogesteger et al. 2016). Water governance, defined as "the range of political, organizational and administrative processes through which community interests are articulated, their input is incorporated, decisions are made and implemented, and decision-makers are held accountable in the development and management of water resources and delivery of water services", has a significant role in shaping the long-term sustainability of water resources (Bakker & Morinville 2013: 1-2). Multi-level water governance refers to the devolution of power and responsibilities to the lower scales of management and service provision, and is typically associated with polycentric governance, which includes increasing participation of non-governmental and community-based actors and other stakeholders in management processes and decision-making. Multi-level governance also recognizes the importance of multi-scalar linkages within and beyond water catchments in conflict resolution and addressing the impacts of large-scale processes, such as climate change, on water resources.

Transition to multi-level governance from centralized systems typically has social and political consequences to the local communities. The studies have addressed, for instance, concerns over

the adequate devolution of power, unclear scales of authority, capacity challenges, knowledge asymmetries and challenges to building trust in emerging collaborative arrangements (Simms et al. 2016). Governance reforms have also been associated with estranging local people from their own cultural relationship with water resources through state-led trainings and reinforced bureaucratic control related to varying forms of governmentality - the "art" or rationality of government (Boelens et al. 2015). In the developing world, the emergence of neoliberal governmentality after the 1980s, besides contributing to the development of polycentric governance structures, has imposed private property rights and market rationality to the local resource governance. The downside of the participatory rationality within the neoliberal system has also been the transfer of the burden of organizing various activities and responsibility for their possible failures from the state to civil society actors (Lemke 2002).

A particular field of interest for this dissertation, which has so far not received excessive attention in political ecological research, is how local identities and knowledges under governance re-organization processes become subjugated and/or find new alliances or strategic uses with external actors and their knowledges through various forms of resistance and contestation (e.g., Boelens 2014; Sletto & Nygren 2015). An analysis of discoursive power-knowledge regimes is central in this vein of political ecology and it increases understanding of "how and why" the knowledge of different actors is being framed as it is in certain environmental negotiations (Bixler 2013: 282; Boelens 2014). Discourses shape power struggles and thus participate in the construction of "hydrosocial territories"[3], which "define processes of inclusion and exclusion, development and marginalization, and the distribution of benefits and burdens that affect different groups of people in distinct ways" (Boelens et al. 2016: 2; Hoogesteger et al. 2016). It is notable that especially under neoliberal governance structures, the local cultures, identities and knowledges are often supported and celebrated only as long as they fit into the official governance regime, which is termed as 'managed' or 'neoliberal' multiculturalism (Boelens et al. 2015, 2016).

In this work, I am particularly interested in knowledge subjugation, its socio-environmental consequences and potential to build dialogues between local and "official" dominant ways of knowing under the current environmental governance regime in Kenya. The relationship between local and professional ecological knowledges is discussed in more detail in chapter 2.3. Before that, I will outline another, somewhat more loosely applied framework for this study constituted by post-colonial and decolonial thinking. This framework is important theoretically, but even more so from an ethical point of view, because political ecology, despite its interest in power asymmetries and recognition of alternative non-hegemonic and pluralist ways of being-in-the-world, is still firmly rooted within the western territory of knowledge production (Schulz 2017), and as such, does not go as far in its critique of the formal western-based knowledges and practices as postcolonial and especially decolonial thinking that aims at building a new reality based on renewed power structures.

3 Boelens et al. (2016: 3) define hydrosocial territory as "the contested imaginary and socio-environmental materialization of a spatially bound multi-scalar network in which humans, water flows, ecological relations, hydraulic infrastructure, financial means, legal-administrative arrangements and cultural institutions and practices are interactively defined, aligned and mobilized through epistemological belief systems, political hierarchies and naturalizing discourses."

2.2 Ethical guidance from postcolonial and decolonial thinking

Postcolonial studies have focused on the critical scrutiny of the legacy of colonialism and related power relations and structures (Ashcroft et al. 2007). Decolonial thinking draws from and complements postcolonial theory. It shares the critical outlook on the concept of modernity with postmodern and postcolonial theory, but differs from them in an attempt to delink itself from the western theoretical foundations of those traditions by practicing "epistemic disobedience" and engaging with theoretical ideas by non-western thinkers (Mignolo 2012, 2013). Decoloniality opposes the Hegelian conception of western civilization and modernity as constituting the inevitable fate or "the ontological moments" of universal world history and attempts to fights against the superiority of western knowledge that Mignolo (2012: xiii) has characterized as "absolute knowledge" that "hides its own geopolitical grounding".

Decolonial thinking also employs the concept of coloniality to analyze the "long-standing patterns of power that emerged as a result of colonialism, but that define culture, labor, intersubjective relations, and knowledge production well beyond the strict limits of colonial administrations" (Maldonado-Torres 2007: 243). Coloniality forms the "darker side" of modernity (Mignolo 2012), which current forms are perpetuated by globalization and epistemic and ontological imperialism (Schulz 2017). In this dissertation, the concept of coloniality assists in understanding the current form of colonial power difference in the Taita Hills that resides in between local people and state officers who carry the burden of institutional coloniality, as well as - and not perhaps to any lesser extent - between local people and the numerous western scientists and students who spend time in the hills exploring its unique natural environment or taking the local communities and the environmental impacts of their livelihoods as the objects of study. The general goal of the "decolonial option" in research is to produce knowledge that contributes to eliminating coloniality and prioritizes improvement of living conditions over capitalist goods production at the cost of life (Mignolo 2009: 161, 2012). Decolonial thinking aims at understanding the reasons for unwanted phenomena (water problems in this study) rather than accepting those conditions as facts with an attempt to produce knowledge to reduce the extension of those conditions (e.g., the reduction of water scarcity).

I also need to recognize that decolonizing research has been an unattainable goal for me from the beginning because my work is deeply embedded within the structures of western academic knowledge production and because I do not have as much freedom to delink my thinking from the ontology and epistemology of modernity as perhaps a non-western researcher would have. However, decolonial theory and attitude (Maldonado-Torres 2016) have provided me the possibility to better understand and respect the non-western part of the humanity and its unique ways of knowing as well as my own privileged researcher's position. As Schulz (2017: 139) writes:

> *"decoloniality first of all means to listen carefully, and to accept the privilege of not being exposed to a variety of discriminatory experiences on a regular basis. It also means to learn how to make better use of this relative privilege, and to understand how to become a better ally to those who are directly exposed to the everyday realities of coloniality. […] decoloniality is as much about mutual learning and a different vision of 'becoming political' as it is about bridge-building and positions of 'betweenness' in order to spark a new conversation that enlivens the present."*

2.3 Asymmetric environmental dialogues

Various scholars have conceptualized the different degrees of inclusion of local people and their knowledges in formal governance and decision-making. In her famous "ladder of participation", Sherry Arnstein (1969) theorized citizen involvement as a continuum between the professional manipulation of the public and the citizen control over decision-making. The rungs of the ladder have later been developed and re-named by many (e.g., McCall & Dunn 2012). The recent work by Hurlbert & Gupta (2015) split the ladder and proposed that different types of policy problems require different degrees and types of community involvement. According to them, there are some well-structured technical management problems that can be taken care of through technocratic policy-making and that do not necessarily require community participation. In an opposite extreme, there are problems that are highly unstructured because the different actors disagree on the knowledge and value basis for solving them. Political ecological research has shown that water and social power are highly intertwined, constituting a hybrid (Swyngedouw 2004, 2006; Boelens 2014), and therefore water problems, such as water scarcity and droughts, are typically unstructured problems (Articles I and IV). In order to structure and solve such "wicked problems", it would be necessary to build trust and symmetric dialogues between different actors and allow the empowerment of local people in decision-making. In practice, however, these face many challenges due to epistemological privileging and structural constraints that I will discuss next.

2.3.1 Epistemological basis

My study of local ecological knowledge of the Taita people and their dialogues with the management authorities is inspired and informed by the literature on traditional, local and indigenous knowledge research, some of which is rather advanced in terms of addressing the challenges of empowering marginalized groups and transforming power relations (e.g., Agrawal 1995, 2002; Nadasdy 1999; Nygren 1999; Kothari 2002; Jos and Watson 2016; Watson 2013). Taitas share many common characteristics with indigenous groups[4] widely addressed in the academic literature. For instance, they are considered backwards by administrative powers as their livelihoods are mainly based on subsistence agriculture. In addition, they are socially, culturally, economically and politically marginalized and their struggles over their rights to land and resources based on ancestral ties are quite similar to those experienced by many indigenous communities around the world.

However, during my research, I realized that there was also something significantly different between the Taita community and the indigenous groups that was somehow related to the lack of confidence in the local ways of knowing by the local people themselves. It seemed that the grip of modernity had pierced deeper into the Taita community eroding especially their intergenerational

4 People have occupied the Taita Hills for several hundreds of years (Mkangi 1983; Bravman 1998) and their cultural tradition and rituals have evolved as strongly linked especially to the indigenous forest ecosystems of the hills. However, the Taitas are not formally recognized as an indigenous people in Kenya, and they are rather characterized as comprising of many ethno-liguistic minorities (Makoloo 2005). In fact, there has been immigration from other tribes to the Taita Hills more or less throughout its inhabited history and according to Bravman (1998), the people in the hills did not consider themselves a homogenous group, "one people", before the twentieth century when their ethnicity emerged as a reaction against political, economic and cultural changes introduced by Christian proselytism, colonialism and labor migration, which threatened older men's control over younger generations and resources. The concept of "tribe" was also enforced by the colonial rule, as a way of controlling people in one area (Ogot & Ochieng 1995).

spiritual ties to the land, forests and watercourses, which are typical of many indigenous groups (Watson & Huntington 2008; Berkes 2012). For example, compared to the Maasai herders (Jandreau & Berkes 2016), the Taita community seems to be further in cultural transition fueled by the tension between the survival of traditional knowledge and political, social and ecological changes. Despite this, the echoes of the traditional Taita culture and knowledge could be heard in people's stories and seen in the landscape although mixed with the coat of modernity and western influence. There were also signs that some of this traditional knowledge was respected by the management authorities but in quite scattered and superficial manner. People also told that they lacked "valid" knowledge and evidence to support their claims that would have helped them approach the management authorities with their problems (Article IV). Thus, it seemed that at least on a discursive level, scientific knowledge was given a superior position in environmental negotiations.

Academic research has highlighted challenges in dialogue-building that are related to epistemological differences between local people and state authorities (Goldman 2007; Berkes 2012). The problems may stem from the bureaucrats' and central administration's lack of trust in local ways to generate knowledge and monitor things (Houde 2007). Local or indigenous knowledge has sometimes been considered irrational "non-knowledge" and a constraint to development, whereas western science has been given a superior role in informing management due to its rational and universal character, which is thought to bring it closer to "truth" (Murdoch & Clark 1994, Nygren 1999). The authorities' understanding of the environmental history may also be tinged with the declensionist attitudes that blame local people for overpopulation and environmental degradation (Davis 2006) and thus they do not consider local knowledge a sustainable basis for environmental management. In many traditional and indigenous systems, resource use is also often linked to the abstract knowledge faces related to ethics, culture and worldview (Watson 2013; Berkes 2012), which may be difficult to incorporate in a formal management system that recognizes only factual form of knowledge (Houde 2007). Often, there are also differences in the ontological basis of knowledges. While in many traditional and indigenous knowledge systems, human and non-human worlds are perceived as spiritually connected, the philosophical basis of the bureaucratic thinking typically draws from the Enlightenment philosophy that regards human beings as separate from and superior to the nature that in the worst case is perceived as a mere "collection of commodities" (White 2006; Houde 2007; Watson & Huntington 2008; Melosi 2010).

The question of whether there exists a fundamental difference between western scientific knowledge and local ecological knowledge has received a lot of academic attention. For me, as a natural scientist, this appeared first as a "simple" methodological question when I began to do qualitative research and was wondering how reliable local people's stories of environmental degradation are compared to measured data. However, eventually I realized that the significance of this question goes far beyond that and the use of appropriate terminology (e.g., whether to talk about "different ways of knowing", or "completely separate knowledge types or systems"?) and has implications for the analytical approach that can be taken for studying the dialogues between different actors as well as the potential of reaching the symmetric dialogue itself. However, as I have also become painfully aware of the complexity of the theoretical debate and arguments for (Berkes 2009; 2012) and against (Turnbull 1993; Agrawal 1995, 2009) the fundamental substantive, methodological, epistemological and contextual differences between western science and local ecological knowledge,

I am tempted to accept both sides here to some extent and elude addressing the question itself in any further depth. Instead, I move on to reflect on the structural basis of asymmetric dialogues.

2.3.2 Structural basis

Structural problems causing asymmetric dialogues are related to the inadequate devolution of power (Nadasdy 1999). Arun Agrawal (1995, 2002: 295) who, while considering the separation between western scientific knowledge and local ecological knowledge untenable, warns about "the dangers that accompany efforts to keep in the foreground knowledge rather than people or their social and political context". This means that any attempts to strengthen local people's position in environmental management should consider how their knowledge is used, for which purposes and in whose terms. Therefore, rather than focusing on the difference between knowledges or arguing whose way of knowing brings us closest to the truth, it is more important to ask: whose interests the imbalances and problem settings of environmental dialogues serve? (Article IV).

Agrawal (2009: 158) also recognizes that the division between different types of knowledge is fueled by its political nature as it "effectively represents durable underlying social confrontations" between marginalized groups and scientific community. For example, it is rarely acknowledged that many fields of western natural and social sciences have actually evolved in close interaction with local ecological knowledge due to interaction between cultures and the exchange of ideas for hundreds of years (Agrawal 1995; Watson & Huntington 2008). Instead, western scientific research has a long tradition of displacing the local or indigenous voice within it, which is based on the difference in appreciation regarding the truthful representation of the world (Johnson & Murton 2007). The history of "narrating scientific truths" through western academic practices and scientific publishing has erased the knowledge of many indigenous collaborators (Watson & Huntington 2008: 275) and also led to the sidelining of understandings of hybrid and situated nature of all knowledge (Bjørkan & Qvenild 2010) in public discussions. This is promoted by the fact that history of displacement has also led to the lack of common concepts and understanding of the basic components of environment and management, which may also cause dissonance and frustration and thus problems in building dialogues without giving privilege to one type of knowledge over the other (Ayre & Mackenzie 2013; Ramisch 2014). To be fair, it must also be acknowledged that development of the division between scientific and local forms of knowledge has been a two-way process as, for example, the advocates of "indigenous knowledge" as a distinct form of knowledge, have promoted its use for the development purposes (Agrawal 1995).

In my view, Agrawal's perception of the political construction of the boundary between knowledges through scientific and indigenous discourses also opens a tottery point of agreement with the stand of Fikret Berkes (2009: 151) who, while conceiving the western knowledge as fundamentally different from local knowledge, thinks that the scholars have already "wasted […] too much time and effort" on debating the potential differences between different forms of knowledge while they should rather focus their attention on building dialogues and knowledge co-production. While for Agrawal the dialogue is to be built between "different ways of knowing and understanding the world", which fundamental separation is a myth created by the political discourses, for Berkes the dialogue should be built between fundamentally different but complementary types of knowledge.

The study of Andean water governance by Rutgerd Boelens (2014) provides an opposite

perspective for the discussion above, by showing how both dominant and subjugated actors can strategically draw from different knowledge domains and world views producing hybrid constructions to advance their own purposes. Also in his study, however, the political choices made under neoliberal governmentalities are masked with claims of scientific objectivity, giving scientific knowledge somewhat advantaged position, that is only slowly challenged through resistance of local water user collectives and emergence of alternative social orders.

While this lengthy discussion on the relationship between scientific knowledge and local ecological knowledge has provided a background for understanding asymmetric environmental dialogues, it is important to notice that environmental negotiations are often not informed by "pure" scientific knowledge, but rather so-called bureaucratic or professional knowledges, which enter the dialogues with local knowledges. I will now move on to the more specific conceptualization of these different ways of knowing.

2.4 Local and professional/bureaucratic knowledges and perceptions

In this dissertation, I understand *local ecological knowledge* as a broad category covering both the so-called traditional ecological knowledge, which is deeply rooted in the cultural tradition and transferred between generations (Berkes 2012), and knowledge, which is based on more recent human-environment interactions and adoption of external knowledge (Kothari 2002; Raymond et al. 2010). I also understand the term "ecological" in a broad sense to describe all kinds of knowledge about non-human nature, human-nature relationship and use and management of environmental resources. Knowledge itself I understand to consist not only of factual knowledge, but to include also the more abstract faces of knowledge related to values and worldview (Houde 2007; Berkes 2012). Local ecological knowledge, including its traditional parts, is highly dynamic, capable of adapting to new conditions and thus constantly evolving (Pottier 2003; Berkes 2012; Gómez-Baggethun et al. 2013).

In this study, local ecological knowledge mainly refers to knowledge held by local inhabitants in the Taita Hills. The resource management officers, who operate on a local level, may also have this kind of knowledge, but because they typically hold their positions only for a few years and have scientific training, their knowledge can be characterized as *professional* or *bureaucratic ecological knowledge* rather than local ecological knowledge. The professional knowledge system does not directly represent scientific knowledge, because even though it may claim to have some scientific basis, it typically lacks the rigorous and critical scientific approach to knowledge production and updating (Edelenbos et al. 2011; Fleischman & Briske 2016). In addition, both the professional and bureaucratic knowledges gain their hegemonic position through the state authority, which economic and political interests they serve. Even though an increasing number of scientists in different disciplines consider local ecological knowledge as a valid way of knowing (Kothari 2002), in the Taita Hills, many state bureaucrats still consider it non-scientific or at least not a legitimate basis for planning resource management (Articles III and IV).

Article IV also employs the distinction between established *knowledge systems* and *perceptions.* In the light of the discussion in part 2.3.2 regarding the social construction of the division between different types of knowledge, the concept of knowledge system is also understood here as a social construct or an analytic category rather than an existing delineated entity. Knowledge systems are thought to consist of the "institutions of knowledge", the rules of translating observations into

new knowledge (Davidson-Hunt & Berkes 2003) that are considered distinctive, for example, for each indigenous group and each academic discipline. Western academic science and professional/bureaucratic ecological knowledge can also be understood as distinct knowledge systems engaged in different aspirations towards formalized patterns of generating knowledge claims, their verification, articulation and making them explicit. However, these systems are not internally uniform and coherent as they also contain perceptions that are based on scientists' and bureaucrats' individual embodied experiences and valuations (Fernández-Llamazares et al. 2016; Pyhälä et al. 2016). Local people's knowledges have also sometimes been regarded as established systems and in those cases, the institutionalized term *indigenous ecological knowledge* is typically employed (Kothari 2002)[5]. However, it is actually difficult to determine what constitutes a knowledge system and it is more of a researcher's task to choose "which [concept] helps us better approach local people's creativity, power relations, survival issues, rights […]" (ibid.: 230). In this work, I avoid calling Taitas' current knowledge as an indigenous system but argue that Taitas' knowledge is still something more than just a bunch of scattered perceptions; it is *subaltern knowledge* (Kothari 2002; Mignolo 2012).

2.4.1 Local ecological knowledge as subaltern knowledge

Antonio Gramsci introduced the term "subaltern" to refer to the groups who are subordinate to the hegemonic power of the ruling classes (Ashcroft et al. 2007). The term was adopted to the postcolonial studies through the Subaltern Studies Group of South Asian Studies society (Guha 1982) and later critique by Spivak (1988) who brought up the problem of inability of the western discourse to communicate with disparate cultures without the appropriation of the dominant forms of representation or language (Maggio 2007; Ashcroft et al. 2007).

In this dissertation, my understanding of the subalternization of non-western knowledges draws especially from the decolonial thinking of Walter Mignolo. According to him, the subalternization of non-western epistemologies has been a significant consequence of the period of "the colonial modernities" or "the modern world system" that began in the late fifteenth century through the colonization of the Americas and the emergence of capitalism (Mignolo 2002, 2012). The western society also established the institutionalized way of knowledge production, the science, that was given the ultimate power to determine the "right" way of understanding the world due to its tie to groups with geopolitical, colonial power (Mignolo 2009). Knowledge subalternization refers to a process where subjugated knowledges are produced in the structure of coloniality of power. Historically, this process has been related to the production of binary relation between the colonizer and the colonized, or in Said's (1995) words "the Other". While the original conceptualization by Gramsci, linked subalternity to the class relations formed around labor, Mignolo (2012: 21) suggests that the subalternization of knowledge originated first and foremost at the level of religion through the establishment of hierarchical relation:

> *Christianity became […] the first global design of the modern/colonial world system and, consequently, the anchor of Occidentalism and the coloniality of power drawing the external borders as the colonial difference, which became reconverted and resemantized in the late eighteenth and early nineteenth centuries with the expansion of Britain and France to Asia and Africa. Global*

5 The use of different terms to describe the marginalized peoples' knowledges is, however, far from uniform in the literature (Kothari 2002). Indigenous ecological knowledge does not always refer to knowledge held only by indigenous peoples but also to "local knowledge unique to a given culture or society" (Berkes 2012: 9; Warren et al. 1995).

designs are the complement of universalism in the making of the modern/colonial world.

The concept of subaltern knowledge helped me understand the local ecological knowledge of the Taita people in a new way. I had noticed already at quite early stage of my research that, for example, the traditional "sacred" ecological knowledge (studied notably by Himberg 2011) was quite distant to the everyday realities of many Taitas. More often, people's explanations about natural resources or environmental phenomena reflected hybridization of their own experiences with western scientific understanding or Christian perspectives. To some extent this reflects the normal evolution and adaptation of local ecological knowledge through knowledge encounters. It is, however, significant how knowledge hybridization occurs and how much and whose knowledge is lost in the process operating in the networks of power. Viewed from the decolonial perspective, what these hybrid explanations may hide, is "the coloniality of power inscribed in the modern/colonial world imaginary" (Mignolo 2012: 41) mediated through prevailing scientific and religious discourses spread by various institutions.

Some elderly people in the Taita Hills still remember and respect the old non-western spiritual rituals, such as rainmaking, and associated knowledge and local conservational practices but claim that the really deep cultural knowledge does not exist anymore as part of people's everyday lives. On the other hand, some people hesitated or laughed when we asked about the traditions, which implied some sort of shame, possibly also because they viewed traditional knowledge as backward and inappropriate for a scientific study. Our presence as representatives of western culture may have also enhanced people's need to deprecate the old non-Christian traditions (see also Smith 2008, for the troubled feelings of the youth in between traditional culture and modernity in Taita). The expressions of oblivion and shame indicated that to some degree, the subalternization of Taitas' knowledge has possibly taken the form of assimilation, that constitutes the even darker side of coloniality. In the words of Mignolo (2013: 134), "to assimilate means that you accepted your inferiority and resigned to playing the game that is not yours, but that has been imposed upon you". This refers to accepting the rules of western way of knowing – its ontological and epistemological underpinnings – which leads to continuous struggle within the limits set by those rules to demonstrate that one is capable of being equal to those who created the rules.

Subalternization and knowledge assimilation are problematic as they have potential to divest local groups of their rooted being in the world. Subalternization process has possibly erased something crucial also from Taitas' local ecological knowledge, something from its structure that might have allowed calling it an indigenous system. Indigenous knowledge has been characterized as "an ethical knowledge whose ethics derive from its non-modern ontology, one that refuses to separate nature and society" (Watson & Huntington 2008, Watson 2013: 1096). However, this ethical relationality, or at least its cosmological underpinnings, may be lost in the subalternization process. Understanding Taitas' knowledge as subaltern also illuminates the challenges in building a dialogue with the professional/bureaucratic ecological knowledge from a new perspective. Along with potential epistemological or ontological differences and power imbalances, the causes of asymmetry also stem from the inadequate confidence in the local ways of knowing by the local people themselves. While for the state resource managers and scientist, the rules of knowledge production and criteria for valid evidence are somewhat clear (or at least there are full libraries of material to support negotiations of them),

the subaltern people have no other choice but to seek "the right kind of" evidence or mediums to express their claims that would be considered legitimate by the bureaucratic system. This struggle is illustrated especially by the Taitas' call for "valid" proof for their claims on the negative impacts of eucalyptus on water resources studied in Article IV, but also in the general need to find legitimate formats to introduce local perceptions to environmental planning and negotiations addressed in Article III. The question of how to connect local subaltern ways of knowing to the formal environmental management in the context of neoliberal governance system's "politics of truth" (Boelens et al. 2016: 7) in a way that would serve the local needs, remains crucial.

2.4.2 Connecting different ways of knowing

In the past decades, the western interest towards local ecological knowledge has often taken the form of "scientisation" that includes the processes of particularization, validation and generalization (Agrawal 2002). Especially, the factual or technical local ecological knowledge has been considered easy to digest, a "palatable disorder" (Gershon 2005: 103) by the scientific system (Houde 2007; Agrawal 2002). In the field of environmental management, the term knowledge integration is sometimes understood as a form of scientisation involving selection and manipulation of local ecological knowledge and validation of claims based on the criteria defined by the western scientific system (Tengö et al. 2014). The problem with this approach is that it does not support the real empowerment of local people in environmental management and fails to recognize the more abstract faces of local knowledge related to values and worldviews (Houde 2007; Berkes 2012), which have no direct practical use in western understanding. Finding other than integrative means of connecting different ways of knowing or knowledge systems would require thinking from outside the territory of science through the decolonial approach.

While not quite reaching the decolonizing goal, as explained better in the next chapter, this study still wishes to raise discussion and provide a step towards decolonizing research and environmental management in the Taita Hills and other local contexts.

3 Methodology

Political ecological research is not political just due to its interest in political processes as drivers of environmental changes but also because, like any other type of research, it includes choices in terms of definitions of environmental degradation, ontological assumptions, data collection methods and distribution of results that have political implications. Political ecology creates its own narratives to explain environmental degradation and they are likely to be very different depending on the chosen methodology (Robbins 2012). In this chapter, I present the methodological choices of this dissertation. These choices also marked the concrete way towards creating the areas of possibilities for community participation in research in the Taita Hills. I start this chapter with describing the onto-epistemological commitments of my work and after that I move on to the qualitative research project in the Taita Hills that forms the empirical basis for this work. The concrete methods and data analysis are described in the last section

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3.1 Situated view from the border

The epistemological interests of this study were already discussed broadly in the previous part. However, here I want to bring forward the concept of *situated knowledge* (Haraway 1988) that illustrates the onto-epistemologies of my research from another perspective. Situated knowledge characterizes all knowledge production as affected by the position of the knower in the networks of power. Consequently, all knowledge is context-specific, and social and epistemic positions are interrelated, implying that "'who' knows is just as important as what they know" (Kobayashi 2009). The concept of situated knowledge redefines the objectivity of "masculinist" science that aims to perform "God tricks" claiming neutral, impartial and disembodied external gaze, and replaces it with a partial perspective, which understands that knowledge is always socially produced and that there is no complete or universal knowledge. Central to this conception is the embodied relationship between the knower and the known. This embodiment retains the realist ontological perspective according to which the external world exists, but it depends on the social positions what one can know about it.

Understanding the situated nature of all knowledge had a fundamental impact on not just how I began to recognize the partiality of my own western perception, but also on how I began to perceive the ecological knowledge of different actors in the Taita Hills. According to Mignolo (2012: 13), the subaltern people "dwell in the frontiers between local non-Western and non-modern memories and the intrusions of modern Western local history and knowledge". Therefore, the situatedness of the subaltern knowledges can be understood only through *border thinking* that requires stepping away from the territorial perspective, the God's eye view and the ideal of "absolute knowledge". Border thinking constitutes "the necessary epistemology to delink and decolonize knowledge and, in the process, to build decolonial local histories, restoring the dignity that the Western idea of universal history took away from millions of people" (Mignolo 2012: ix).

As already outlined in the previous chapter, my own perspective is inevitably bound to the conventions of western academic knowledge production which sets limitations to the decolonizing goal of this work. Schulz (2017: 135) suggests that "developing a genuinely decolonial perspective requires us to practice border thinking from our own point of view, and to delink ourselves from the

hegemonic rationalities that are put in place to police the boundaries of modern scholarly discourse". I believe that for many western (white) natural scientists, the operationalization of this principle still remains to be explored. However, those who work closely with indigenous and other local groups cannot avoid facing the border between the academic and other ways of knowing and knowledge production. Some have tried to cross this border through co-produced ethnography and co-authoring academic articles with members of indigenous groups (e.g., Watson & Huntington 2008, 2014; Huntington & Watson 2012), which represents an insightful way to break the hegemonic conventions of academic publishing. Also, other knowledge co-production projects that contain collaboration with the stakeholders from the beginning to the very end seem promising (e.g., Bouamrane et al. 2016).

This study, however, does not go that far. In retrospect, I can see that the reason for that is not that I would not have liked to do so, but rather that I was not able to imagine that I could do so. Young academics, especially with the natural sciences background are often quite obedient regarding the methodological rules of their discipline, and so was I. Yet, for that reason, I can claim that I am writing this dissertation from the border between my background in positivist natural sciences and qualitative critical research that I had to familiarize myself with during this research process. This border is still strongly positioned within the western territory of knowledge production and is very different from the border that the Taitas are dwelling at in between their traditions and modernity. Nevertheless, a peek from that border probably still helped me see something that I could not have seen if I had stayed strictly within the territory of physical geography and positivism.

It is also perhaps possible to find linkages between the two borders. My journey towards the border began when I started taking seriously some of the claims and narratives of the local people that did not fit into my scientific categorization of the causes of water scarcity but that I could not just ignore as outliers because they seemed to reflect some significant pattern in people's lived reality. However, the attempt to analyse, for example, recurrent religious references in people's replies (e.g., "God only knows") did not mean including them as some conceptual categories of spirituality to the scientific study matrix nor to succumb to "ethical relativism by regarding all ontological propositions as equally justified" (Schulz 2017: 134). Instead, I attempted to apply decolonial perspective, which meant looking at how those claims represent power by acting as "*technologies of enchantment* to support various forms of dogmatism, extremism, exploitation, and coloniality" (Schulz 2017: 137).

Even though western scientific research cannot itself be a decolonial practice nor even an agent of decolonization, it can still have a decolonizing goal within the field of science and in terms of its relationship with the world. Decoloniality can also be understood as a political commitment that does not perceive the subaltern groups as mere subjects of research but gives them an active collaborative role in a study (Mato 2000; Schulz 2017). In this way, participatory approaches and thinking from the border(s) can offer a tool to restore the dignity of people's own knowing and provide a step towards "taking their destiny in their own hands" (Mignolo 2012, xxi). Due to its colonizing history, western academic science is at least responsible for setting this process in motion. Participatory research of subaltern knowledges may through the process of *conscientization* (Freire 1970) increase local people's respect for their own knowledge and critical and strategic understanding of western values and perspectives that they can employ to their own advantage (Kothari 2002) and help them claim "transformative multiculturalism" that would challenge the prevailing asymmetrical power relations in environmental governance (Boelens et al. 2015).

3.2 Qualitative research on socio-ecological aspects of water

In the Taita Hills, the TAITAWATER project of the University of Helsinki aimed to promote local people's conscientization through organizing a qualitative research on socio-ecological aspects of water in 2013-2014. The empirical part of my dissertation (Articles II-IV) is based on that research. The collection of qualitative data through local people's accounts of environmental changes and driving factors can fill the knowledge gaps caused by the unavailability of historical scientific measurements of the attributes of the physical environment, which is often the case in the developing world (Article II). The qualitative research, however, also has other benefits. Although quantitative participatory research might be an empowering experience for the local people, the qualitative approach has better potential to include the social meanings of studied phenomena. For example, quantitative approaches on determining the material basis of water stress or scarcity (e.g., Falkenmark index) or spatial presentations of resource abundance at national or regional scales typically overlook local issues of equity in water distribution, rights of access, quality standards, ecological sustainability, and power relations (Articles I and III).

In the Taita Hills, a significant part of the data was collected through a so-called multi-method participatory mapping process (Article III, Hohenthal et al. 2015). When combined to a qualitative research of the socio-ecological history of a place, participatory maps become more than just mediums to communicate knowledge of the materiality and spatial relations of the landscape, and hold information on social relations, temporalities and imaginaries that give them a deeper meaning (Sletto 2009). In this dissertation, participatory mapping is also understood as a form of *counter-mapping* (Peluso 1995) that challenges the formal cartography and thus serves the transition towards decolonizing methodology. Next, I will give a brief background to critical cartography and justification of multi-method participatory mapping as a knowledge co-production tool. The details of the case study setting and data collection methods are given in chapter 3.3.

3.2.1 Critical cartography

The multi-method participatory mapping process draws from the critical cartographic approach adopted mainly from the work of Denis Wood, John Fels and John Brian Harley (Wood & Fels 1986; Harley 1989; Wood 1992, 2010), who have criticized the western scientific cartography from a poststructuralist perspective focusing on examining how social power relations fix meanings and produce categorizations (Woodward et al. 2009) (Article III). Wood and Fels suggest that cartographic systems are semiotic systems rather than factual systems, and that they contain a level of myth – a sort of a hidden construct on top of the primary semiological or symbolic system - which is powerful, because it is not required to declare itself in the level of language, but is better defined by its intention (Barthes 1972). Wood and Fels state that these myths are created by mapmakers and thus they serve their intentions (see Box 1 for an example of the interests of early cartography in the Taita Hills). Thus, the semiotic system of a map is also a system of values and this is what makes maps always political. The selection of spatial attributes included in the map and their explanations, as well as things excluded and erased from the map (Sletto 2015), represent the choices of the map maker and, in Wood's (2010) terms, also his/her "proposition of the reality".

Box 1. Early mapping of the Taita Hills

The earliest "sketch of the Taita Mountains" that I could find dates back to the year 1895 and was made by a British colonial administrator C.W. Hobley in a scale of 1:500 000 (Hobley 1895). The map still shows the uphill area as a white spot, streams originating from its outskirts, indicating that at the time, those parts of the hills were either largely unexplored (by western people) or still uninhabited and perhaps covered by sacred forests to which access was prohibited. Based on the description of Hobley's journey, it is fair to conclude that the primary purpose of his exploration in the hills was to estimate the development potential of the area for trade with the coast. What he found was the abundance of good grazing land and fertile areas in the river valleys that had been taken for cultivation by the local people who irrigated their fields through an ingenious channel network that sourced water from numerous natural streams flowing down from the hills. Hobley learnt that some years before his journey, a severe drought had reduced the number of people and led to the abandonment of many cultivated areas. His suggestion for the colonial administration was "to encourage the Wataita to reclaim the large areas formerly occupied by their plantations" or in case they are too few, to introduce the "native colonists […], preferably Indians" in order to expand business with the passing caravans and assist in the food supply of the construction work of the railway, which he anticipated to start in the near future (Hobley 1895: 553). The map, despite having low spatial accuracy in current terms, and the associated description probably served some further explorations to this area.

Harley (1989: 11-12) used the term *internal power* to describe the process of normalization, which is "a power embedded in the map text", which makes the maps to "standardize our image of the world". This process also affects the practice of cartography itself by naturalizing the production of certain types of maps and thus the value choices of their makers (Wood and Fels 1986). In the field of environmental management, this often means naturalizing the economic or conservative values of the state authorities, while the local people's perceptions do not receive the attention they would deserve.

In Wood's terms, the seemingly value-free standard cartography makes propositions assuming "*linkages* among conditions, states, processes, and behaviors conjoined in the territory" that "are realized through *postings*, fundamental, spatial/meaning propositions expressed in the sign plane of the map" (Wood 2010: 52). These postings assert "an equivalence between an instantiation of some conceptual type (*a this*) and a specific location in the world (*a there*)" (ibid.: 53). Such postings can be transformed into facts when the maps are used for management purposes, which is problematic, because they do not tell anything about the social meaning of these "facts". Harley has stated that that maps themselves are "authoritarian images", which have the capacity to "reinforce and legitimate the status quo" (Harley 1989: 13). He asks:

> *"[…] where, on the page, is the variety of nature, where is the history of the landscape, and where is the space-time of human experience in such anonymized maps? […] The question has now become: do such empty images have their consequences in the way we think about the world? Because all the world is designed to look the same, is it easier to act upon it without realizing the social effects?"*

3.2.2 Participatory mapping as a knowledge co-production tool

The cartographic tradition became established in various parts of Europe and Asia only as late as in the 15th-17th centuries, and thus there are many cultures around the world, which traditions do not involve mapping in a space privileging, resource describing, let alone cartographic sense as it is normally understood in the western world (Wood 2010). Thus mapping, when it is practiced in the Global South by following the epistemology of the professional cartography, no matter how participatory it is, is typically a colonizing method and often serves the needs of an outsider (Wood 2010; Sletto 2015).

Participatory mapping often embeds the alternative spatialities in a western Cartesian representational (cartographic) form and rationality (Sletto 2015) and is oriented by the configuration of modern neoliberal politics that stress territory and property rights (Wainwright and Bryan 2009). Concerns have also been expressed that participatory practices in general do not always take adequately into account the power dynamics within the local communities (Chambers 2006; Morales & Harris 2014), often fail to serve their needs and translocal aspirations and do not transfer the intellectual authority to them (Coombes et al. 2014). Sometimes they may even lead to adverse impacts on participants (Madhok & Rai 2012). Therefore, it is important to consider what kind of conditions would make the participatory mapping relevant for the political empowerment of local people and what kind of agency does it promote or strengthen.

Despite the colonizing effect of participatory mapping, it can still serve as a tool for knowledge co-production between local people and scientific cartographers (Sletto 2015) and thus provide a means to communicate local ecological knowledge in a way that is viewed as legitimate by the environmental management authorities. The TAITAWATER project, while it still succumbed to the methods of western cartography, also viewed participatory mapping as a multi-method process (Sletto 2014) with an attempt to divert the focus away from the end product and towards the map production, its use and remaking. Historical perspective through timelines was also crucial for combining the historical meaning to the map signs (Articles II and III).

3.3 Data collection and analysis

I had visited the Taita Hills three times (around 8 months in total) between 2010 and 2012. Therefore, I was somewhat familiar with the area when the TAITAWATER "social research" team began its work in the hills in 2013. However, my knowledge, at the time, was mainly limited to the physical environment and particularly to the numerous springs and streams of the area that I had mapped during those first years. Despite my daily walks along the rivers, my natural scientist's mindset and accommodation inside the walls of the Taita Research Station in the village of Wundanyi had kept me rather distant from the local people's realities. I had, however, become friends with the local research assistant Mwadime Mjomba who worked at the station. Mwadime told me stories from Taita and took me to visit his family to the dry lowland village of Maktau, which gave me a first deeper touch to the life of local people. Later, when I was working as a coordinator of the research station, Mwadime also introduced me to some of the local government officials in Wundanyi, which was useful for the later work of the TAITAWATER team.

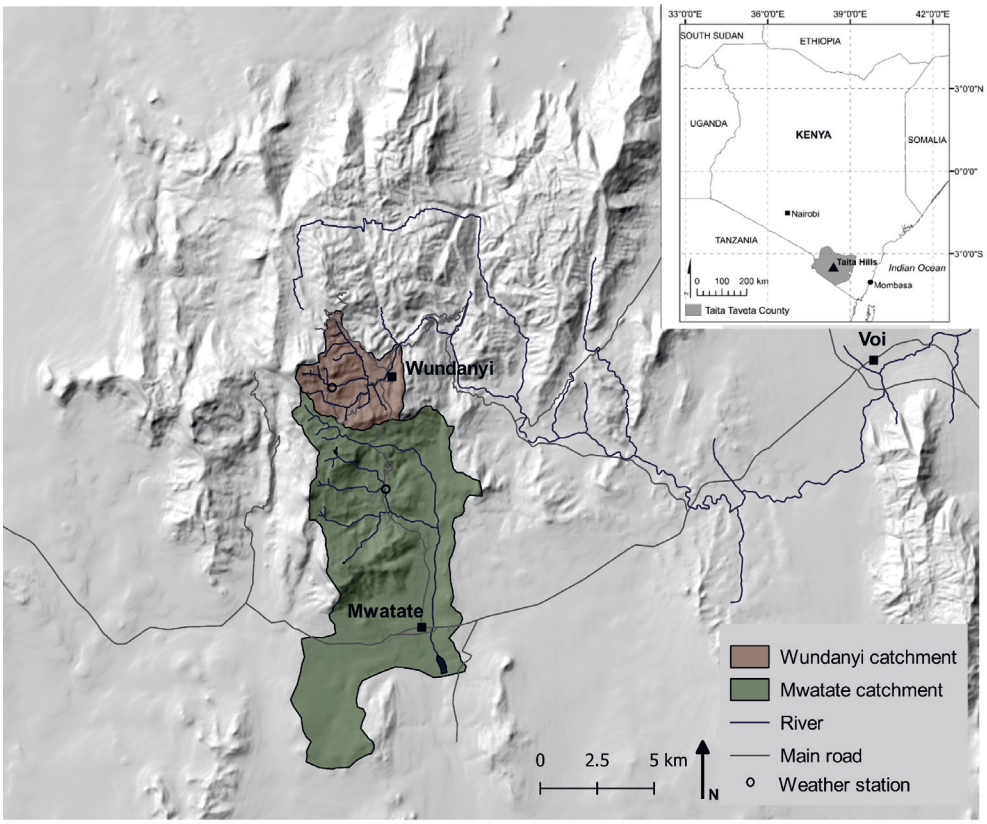
I participated in the field work for the current study in two phases in January-March 2013 and

January-February 2014 together with the other members of the TAITAWATER team including master's students Marinka Räsänen (University of Jyväskylä), Emmah Owidi (Kenyatta University) and Belinda Andersson (University of Helsinki) and our supervisor Dr. Paola Minoia (University of Helsinki). Marinka and Emmah mainly focused on interviewing different institutions and companies linked to natural resource management and water provision (also in March-September 2013). While I participated in a few of those interviews in Mombasa and Nairobi, in the Taita Hills, I mainly conducted household and other water user interviews with Belinda. In addition, the whole team participated in reviewing the scientific literature and government documents and organizing participatory mapping and concluding workshops and related transect walks together with local assistants.

3.3.1 Case study catchments

The participatory mapping process and other data collection mainly focused on (but was not strictly limited to) two water catchments, which we named as Wundanyi and Mwatate catchments after the largest villages in those areas (Figure 2). The choice of a water catchment as a spatial unit of study was initially influenced by my previous interest in hydrological modelling and dynamics between upstream and downstream water and land use. However, focus on the catchments was also a way to limit the amount of data that had to be collected in the field. It can also be argued that even though water catchment is a concept that carries a bunch of scientific, generalizable 'surface meanings', a catchment as "an ecosystem is as much a socially constructed place as it is a scientifically delineated space" (Williams & Patterson 1996: 514). It forms a natural system, a material background to place-making that is potentially reflected in people's "catchment consciousness" (Tané 1999), i.e., in their understanding of the natural connectivity between catchment ecosystem structures, and thus in the place meanings (Article III). I had noticed conflicts between upstream and downstream water users already during my earlier visits to the area, which also made the catchment seem like a logical starting point. Water catchments are also recognized as jurisdictional areas in the multi-level water governance system of Kenya as the respective areas of the local Water Resource Users Associations follow the catchment borders (normally larger areas than in this study). Wundanyi and Mwatate catchments were chosen for the study because they were relatively densely populated and even their remotest parts were quite easily accessed from the main roads. These catchments also provided an interesting contrast between the semi-arid lowland parts of the Mwatate catchment and relatively moist uphill areas of both catchments.

Data collection, however, was not strictly bounded by the catchment borders. Relevant information and stories from outside the catchments that came to our knowledge by chance were included in the data. Also, because catchment level natural resource management is affected by regional and national governance, a few interviews were made with representatives of national and regional administration in Nairobi and Mombasa. On the other hand, as people's daily lives operate mainly in the village- and neighborhood-scales, the individual sketch mapping exercises with local people did not strictly follow the catchment borders and focused on smaller areas instead.



Wundanyi catchment
Area: 14,6 sq. km
Estimated population*: >10 237; 904 people/sq. km
Rainfall: 1205 mm/year; ann. ave. temp.: 18 deg. C
(Weather station: Wesu 1660 m a.s.l., 2011-2017)

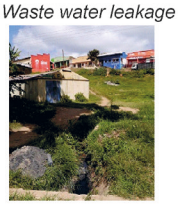
Examples of water-related issues:

Eucalyptus plantations

Sand harvesting and siltation

Fish ponds

Waste water leakage



Mwatate catchment
Area: 79,1 sq. km
Estimated population*: >36 156; 272 people/sq. km
Rainfall: 861 mm/year; ann. ave. temp.: 22 deg. C
(Weather station: Dembwa 1106 m a.s.l., 2012-2017)

Examples of water-related issues:

Wetland encroachment

Gully erosion and siltation

Flash floods

Water contamination

*Population estimations are based on Population and Housing Census 2009 (KNBS 2010) results for those sublocations that fall into catchments (Wundanyi catchment: Mteni, Mlondo and Wundanyi; Mwatate catchment: Mwatate, Mwachawaza, Wumari/Sechu, Kidaya/Ngerenyi, Mururu/Manganga, Chawia, Wusi, Kaya/Ilole and Kishamba)

Figure 2. Case study catchments in the Taita Hills with examples of water issues. The catchment borders were delineated based on the digital elevation model of the hills.

3.3.2 Data collection

The data collected by the TAITAWATER team included semi-structured interviews, material from the participatory mapping workshops, observations and GPS points from transect walks as well as informal conversations. In the following, I will explain the selection of informants and give details of the material that was used specifically for this study.

The informants for the so called "institutional" interviews were sought from different government departments, community-based and non-governmental organizations and large private companies that were somehow involved in water and related natural resources' use or management. Interviews with the local water officers and members of the Water Resource Users Associations were logical first contacts to the water sector and new relevant informants were identified when our understanding of the complex governance system increased through "institutional mapping" (a major contribution done by Marinka Räsänen, published in Hohenthal et al. 2015). For example, district officers and commissioners, chiefs and village elders were also interviewed, because they operate as mediators between local and national governance levels, having important roles in coordinating water-related activities, enforcement of laws and policies, dissemination of information, monitoring water resources, supervising conservation activities and arbitrating in water disputes. It is worth noting that especially the chiefs and village elders had strong double roles as the institutional representatives holding a mandate regarding formal resource governance and as the local inhabitants of the hills. Altogether the TAITAWATER team made over 70 "institutional" interviews in 2013, but 63 of those were considered relevant to this study, mainly in articles II and IV (Table 1).

In addition, altogether 82 semi-structured interviews were done in households and with other water users in the study catchments (Table 2). The household interviews targeted farmers and people who lived in village centres and typically had off-farm jobs. Questions addressed people's access to water and the changes they had experienced in water availability and forest resources during their lives. Also, hospitals, hotels, small businesses and a prison were visited. In those cases, the discussions focused on the available water supply and sewerage systems. The informants for 66 household interviews were selected semi-randomly, i.e., each morning we went to the sub-area of the catchment that we had not visited before and walked from house to house asking for people who would be willing to share their time with us. One interview took approximately 30 minutes. We interviewed people from different age groups, between 18 and 80 years (Table 3). A few more women than men were interviewed in both catchments. This was because more women were met working in the fields during day time and some husbands were absent because they had an off-farm employment in the village centers or they were working in big cities. We also met quite many women who did not have a husband, or he was deceased. The majority of the informants were small-farmers, but some also had small-businesses, typically selling of vegetables and fruits, and some worked casually on someone else's field. The analyses of the household and other water user interviews were mainly used for writing the article III, but they have probably also affected the thinking of the authors' in the other two case study articles. In 2014, additional 29 household interviews were also made by the TAITAWATER team, but they were used mainly for other research purposes.

Table 1. Institutional and expert interview data used in the study

Institution/expert	Number of interviews	Used in article
Government departments and agencies		
Coast Water Services Board	2	II, IV
County Council Water Office	1	II
District Agricultural Office (Taita and Mwatate districts)	2	II, IV
District Commissioner (Mwatate district)	1	IV
District Fisheries Office (Taita district)	1	II
District Irrigation Office (Taita and Mwatate district)	1	II
District Land Reclamation Office	1	II
District Officer (Wundanyi)	1	IV
District Water Office (Coast Water Services Board District Area Coordinator Office) (Taita and Mwatate districts)	2	II
Geology County Department	1	II
Kenya Agricultural Productivity and Sustainable Land Management Programme	1	II
Kenya Coastal Development Project, Hazina ya Maendeleo Pwani, county liaison office	1	II
Kenya Forest Service	3	II, IV
Ministry of Lands, Department of Land Adjudication	1	II
National Drought Management Authority	1	II, IV
National Environment Management Authority	1	II
Water Resources Management Authority	5	II, IV
Provincial administration		
Chiefs	8	II, IV
County Council Clerk's Office (W)	1	II, IV
Village Elders	7	II, IV
Community-based organizations (CBO)		
Star (Tavevo) Water Kiosk	1	II
Taita Environment Initiative	1	II
Water and Irrigation Projects	8	II, IV
Water Resources Users Associations	4	II, IV
Non-governmental organizations		
Taita-Taveta Wildlife Forum	1	IV
World Vision (water, sanitation and health project)	1	II
Companies		
Taita Taveta Water and Sewerage Company (TAVEVO)	1	II
Teita Sisal Estate Ltd.	2	II
Wildlife Works	1	II
Scientific expert		
Professor, university of Nairobi	1	II
Total number of institutional interviews	**63**	

Table 2. Number of informants in household (farmers and town dwellers) and other water user interviews by group and gender in 2013

Group	Wundanyi		Mwatate	
	women	men	women	men
Households				
Farmers	19	17	11	10
Town dwellers	3	1	4	1
Hotel staff	1	-	2	-
Entrepreneurs	2	4	1	1
Hospital workers	1	1	2	-
Prison staff	1	-	-	-
Total	27	23	20	12

Table 3. Number of informants by age group and gender in household (farmers and town dwellers) interviews in 2013

Age	Wundanyi		Mwatate	
	women	men	women	men
18-30	4	1	5	1
31-40	5	2	3	1
41-50	6	4	3	2
51-60	4	4	1	4
61-70	2	5	2	2
71-80	1	2	1	1
Total	22	18	15	11

The TAITAWATER team also organized participatory mapping workshops in Wundanyi and Mwatate villages in February 2013. 32 (20 women, 12 men) and 23 (8 women, 15 men) people participated in them, respectively. The participants were representatives from different organized community groups involved in water resource management, crop production, forestry and environmental conservation. The workshop activities included sketch mapping, timeline exercises and focus group discussions. Later, the researcher team visited the places that had been identified as important or somehow problematic in the workshops. These transect walks were accompanied by knowledgeable community members who told additional information on the issues. A hand-held Global Positioning System (GPS) was used to collect coordinates in the walks and were later used for georeferencing the participatory maps. After that, the researcher team prepared reports that were distributed to the workshop participants as first-hand feedback.

A second round of workshops was organized in February 2014. Its aim was to validate the results of the analysis that was done after the 2013 field work and to create discussion between community members and management officials. Thus, members from the same community groups were invited in the workshops as last year. In addition, representatives from different government departments, chiefs and village elders were invited. Later a draft of a final report was prepared and delivered to selected people who had a chance to comment on it. The final report (Hohenthal et al. 2015) was delivered to relevant groups together with printed maps. The analysed data from the workshops was used in all the empirical articles II-IV.

3.3.3 Data processing and analysis

The recorded interviews and focus group discussions were transcribed, and the transcriptions were coded and categorized in preliminary content analysis. Some triangulation was made between different materials with respect to literature in order to validate the content. For example, the timings of major historical events in the timeline drawings (e.g., timing of the world wars and establishment of the Teita Sisal Estate) were compared with literal knowledge sources whenever it was possible. Some of the events in the timelines, however, were small-scale phenomena and were mentioned perhaps only by one workshop working group and therefore their timing or impacts could not be confirmed. All the information on different sub-catchment timelines also went through some degree of generalization when they were combined to a single timeline and when the linkages between them and the current water problems were analysed (Hohenthal et al. 2015, Article III).

For the analysis of the changes in water-related ecosystem services, the analysed data was incorporated in the Drivers-Pressures-State-Impacts-Responses framework adapted for the qualitative assessment of ecosystem services and their management (Article II). For the analysis of spatial meanings, the sketch maps were analysed first through content analysis and then by applying a semiological analysis that focused on the social meanings of the signs and the mapping process itself (Article III). Data from the interviews, focus group discussions and observations on transect walks supported this analysis. For the study of the eucalyptus problem, a discourse analysis was applied on the institutional interviews and material from the workshops (Article IV).

4 Results and discussion

In this chapter, I discuss the main results of the study and answer the research questions. First, I look at the socio-environmental construction of the water problems through the concepts of vulnerability and resilience. Second, I bring in the historical perspective by engaging with the political ecological approach and analyzing how the water scarcity and droughts are produced through the interplay of physical and historical social and political conditions globally and in the Taita Hills. Third, I claim that due to the social construction of water problems, their understanding requires social and qualitative research approaches. And because the social aspects are complex, place-based and linked to people's livelihoods, the local perspective is also crucial. Finally, I discuss the challenges in building symmetric dialogues between different actors from the perspective of problem framing and reflect on what is needed to overcome the obstacles.

4.1 Socio-environmental construction of water problems

The review of the social aspects of droughts and water scarcity shows that the socio-environmental construction of water problems can be understood through the interrelated concepts of *vulnerability* and *resilience* (Article I). In this context, vulnerability refers to susceptibility or propensity of human beings to suffer from the impacts of scarcity or lack of water on their lives, livelihoods or property (Eakin & Luers 2006; Cardona et al. 2012). The concept helps understand how exposure to the natural world phenomenon (precipitation deficiency), leads to a socially constructed hazard depending on the sensitivity and adaptive capacity of the social system. Thus, vulnerability assessment requires understanding both the natural phenomena as well as qualities of the society. High vulnerability is generally related to poverty, weak social networks, inadequate communication and erroneous understanding of the risk, that are shaped by the historical changes in development policies and governance (Cardona et al. 2012).

While the quantitative assessment of the occurrence of precipitation deficiencies in the Taita Hills is out of the scope of this study, the local people's assessment shows that they suffer from droughts frequently, often due to delayed rainy seasons (Articles II and III). The community timelines showed that severe droughts occurred, for example, in Wundanyi area at least in the 1950s, mid-1960s, 1970, 1980, 1989. Taitas' sensitivity to inadequate rains or their unusual timing is increased especially by the high dependency of livelihoods on subsistence farming. To some extent, people can also adapt to water scarcity and droughts (Article I). In Taita, off-farm employment, such as small-business or office work in a rural center, secures the income for some people during droughts, but not all have this option (Article II). Some families also get remittances from family members who have migrated to work in the big cities of Nairobi or Mombasa. Labor migration, however, is often an unjust form of adaptation as most labor migrants are men, which increases the burden of women in taking care of children and farm work. Labor migration has also historically contributed to the loosing of family ties and weakening social networks (Bravman 1998).

The combination of subsistence farming and labor migration became an established livelihood pattern in the Taita Hills a long time ago and therefore its link to political and socio-environmental drivers are not currently well recognized. The labor migration was initiated by the intentional

underdevelopment of the native agriculture and taxation by the colonial government, which guaranteed the constant flow of cheap labor to the cities (Mkangi 1983). From the 1960s onwards, it was also enforced by the increasing food insecurity caused by the consolidation and privatization of the common land holdings that had traditionally been scattered in different agroecological zones of the hills, which used to guarantee food production during dry seasons and droughts (Fleuret 1988; Meinzen-Dick & Mwangi 2008). Currently, the growing population, decreasing land productivity and the continuing industrialization of Kenya, which ensures the need for labor in the cities (Njue et al. 2007), maintain the migration flow of the male workers.

High vulnerability to water scarcity and droughts is also linked to the low resilience of the socio-ecological system (Article I). Resilience refers to the magnitude of water scarcity the social system can withstand before it must reorganize itself (Holling & Meffe 1996; Mumby et al. 2014). Socio-ecological thinking has especially highlighted the system's adaptive and transformative capacities as the important qualities of resilience that help the system to learn, adjust and potentially create a totally new system when the old one becomes untenable (Béné et al. 2017). From the ecosystem point of view, cutting down of the indigenous forests and encroachment of wetlands in the Taita Hills have probably lowered the capacity of the natural ecosystems to absorb and retain moisture, which means that dry season flows have decreased, and thus the impacts of precipitation deficiencies are felt more quickly and dramatically in the whole socioeconomic system (Article II). However, when assessing the whole socio-ecological system's resilience to land use changes, it is crucial to expand the analysis beyond social and financial capital, political legitimacy, dependency on resources and technical capacities to the understanding of historically produced social dynamics and power relations that are the interests of political ecology (Turner 2014). Taitas' resilience, for example, is weakened by their subjugated position in environmental resource management planning and decision making, which has long historical roots (Article IV). I will next discuss more about this through disentangling some of the hegemonic narratives of environmental degradation in the Taita Hills.

4.2 Reconsidering the responsibilities for environmental degradation

Two common narratives in the Taita Hills, and in many other areas of the globe, try to explain environmental deterioration by blaming population growth (Article II) and nonchalant behavior of local people. In the following, I try to evaluate these narratives in the light of the whole complexity of human-environment dynamics in the Taita Hills. By doing this, I call for reconsidering the historical socio-environmental responsibilities that have typically fallen solely upon local farmers.

Certain scientific studies have tied human occupation and deforestation closely together in the Taita Hills. According to Newmark (1998), 98 percent of the original indigenous forest cover of the hills have been lost due to significant population growth during the past 200 years. However, determining the spatial and temporal variation of the population growth rate and population density on the Taita Hills massif is difficult. Archaeological evidence suggests that humans have occupied the hills for over 2 000 years, but the population growth and associated deforestation have been more significant since the turn of the 19th century (Schmidt 1989; Newmark 1998). The formal censuses have been carried out six times (1962, 1969, 1979, 1989, 1999 and 2009) in Kenya based on administrative areas. However, since the earlier population estimations are difficult to find and later the administrative areas have changed, it is not easy to estimate the longer-term population

growth or density change for any particular area. According to the latest census, the population density in Taita varies from over 1500 people/km^2 in the highland area (Wundanyi village) to a few people/km^2 in the lowlands (KNBS 2010). The population densities of the upper parts of the hills are relatively high compared to that of the overall Taita district, which is only 13 people/km^2.

While it can be assumed that the population growth of the Taita Hills has somehow followed the general upward trend in Kenya (UN 2017) and that the growing number of land and natural resource users certainly have increased pressure on natural ecosystems and water-related ecosystem services, I argue that the ultimate drivers of environmental degradation and decreasing water resources are related to changes in people's livelihoods and organization of resource use, largely triggered by the political and economic changes (Articles II, III and IV). For example, the historical drivers of agricultural expansion and planting of exotic tree species, which have led to the shrinkage of indigenous forests, can be traced back to the national land reform initiated in the 1960s and changes in forest and development policies. These again have roots in the British colonial governance and Christian proselytism which questioned the communal landholding systems, resource sharing and conservation practices based on traditional spirituality. As illustrated in the Article IV, the impact of conversion into Christianity on Taitas' relationship with their pre-colonial traditional ecological knowledge has been far reaching and strengthened by the introduction of neoliberal governance regime during the post-colonial decades.

As the major historical colonial and post-colonial state policies have significantly contributed to the development of the complex web of pressures and actions that have produced the present state of the water-related ecosystem services in the Taita Hills, it can be argued that the current water problems are the consequence of the coloniality of power, interlinked with and exacerbated by the fluctuation of the world market prices of cash crops and possibly also by natural and anthropogenic climatic changes (Article II). The dynamics can also be analysed from the perspective of the impact of coloniality on people's vulnerability and resilience to water scarcity and droughts. As was mentioned in the previous chapter, the colonial rule and land reform challenged the traditional livelihoods and resource uses in various agroecological zones, which decreased society's resilience to recurring droughts. The increased sense of vulnerability and lowered resilience may also explain some people's behavior and attitude towards environmental issues in the Taita Hills, which the management officials sometimes interpret as expressions of greed, indifference or lack of awareness, which cannot be controlled to a similar extent as before land privatization and reduced authority of the chiefs (Article II). People's increased vulnerability is related to their sense of having lost connection to the place and control over the resources as, for example, a 68-year-old man from Wundanyi explained:

> *"In shrines […], the old men could go there and perform some rituals during drought spell. And the same day, whatever they do, it starts raining. But nowadays it's different. Even if you go to church to pray, it won't rain. […] So, all those people who were involved in that kind of traditional way of sacrifice and all that, they are not there anymore. The generation, which is left behind, they are the Christianity group."*
>
> *(Household interview, 17 January 2013, translation from Kitaita into English by Mwadime Mjomba)*

The quote illustrates how the western religion is not able to provide a similar sense of control over the weather as the old traditions. Ceremonies, like rainmaking, may have had an important role in the past in promoting community cohesion and making the reasons of hardships, such as droughts,

seem external to socioeconomic relations thus reducing the likelihood of social disruption and enhancing the resilience of the community (Gómez-Baggethun et al. 2012).

Proposed solutions to water problems stemming from the Malthusian perspective typically support improving the water/population ratio either through the reduction of consumer numbers or increasing water supply through large-scale technical solutions, for example, building dams or transferring water from distant sources (Article I). Such plans have also been proposed for alleviating the current water problems in Taita (Article II). However, such supply-side management would not guarantee sustainable long-term solutions to increasing socio-ecological resilience and would probably require strengthening of authoritative space control and forced displacement of people, which would compromise land and human rights (Minoia 2012). Such propositions also typically stem from and are legitimized by the powerful discourses of water scarcity that naturalize the phenomenon, disregard the social and political factors increasing local people's vulnerability and decreasing their resilience and potentially benefit large companies or other external actors more than local people (Mehta 2007).

Since the mere population growth is rarely the main driver of water problems, as I have argued in the case of Taita, the ultimate solutions to these problems should also be sought from elsewhere. Even though, the local participatory management responses to water issues and other environmental problems cannot change the historical and large-scale external drivers, such as the period of colonialism and world economy, or certain physical realities such as hilly topography or climate change, they can potentially moderate the pressures induced by the drivers and people's resource use (Article II). For example, in Taita, the planting of indigenous tree species and removal of eucalyptus trees from the vicinity of water sources could alleviate the social impacts of coloniality and restore the catchment hydrology. Strengthening such forest policy could also increase natural water supply and decrease the water problems in the long-run better than the current commonly used water demand management tools: dry season water rationing and increased water prices. Some other small-scale supply-side technical management options, such as rainwater harvesting, wastewater recycling and fog water collection, as well as water demand management through education in water saving and technical solutions to decrease leakage from pipes, for example, could also provide sustainable and just solutions (Article I). These means, however, require funding and infrastructure and transfer of technical know-how from external experts to local people. Therefore, as ready-made solutions that they represent solutions from the coloniality to the problems it has created, and thus do not guarantee the exit from the subalternization of local people.

Ecosystem service approach to water resource management might also increase understanding of the holistic functioning of the ecosystem (Article II). However, combined with the current governance system that prioritizes economic needs, the dichotomy of 'nature as a service provider/human beings as service users' may lead to increased commodification of resources. Therefore, it should be backed up by participatory approaches and support for community based environmental management. In the next section, I discuss more about the possibilities to decolonialize local resource management through participatory assessment of the water problems.

4.3 Decolonizing potential of qualitative participatory methods

Determining the local socio-ecological system's vulnerability and resilience to water scarcity and droughts is not a simple task, and due to their complex and place-based nature, qualitative and participatory local assessment is needed (Article I). Community participation is also important in planning possible adaptation as the concrete actions and technical solutions are often closely linked to local livelihoods, such as agriculture.

The qualitative local assessment of water-related ecosystem services (Article II) and multi-method participatory mapping (Article III) proved to be useful methods for increasing the understanding of political ecology of water resources and socio-ecological aspects of local vulnerability and resilience in the Taita Hills. The inclusion of the historical perspective to the research was especially important as it helped better understand the sense of place and the socio-political trajectories leading to water problems. The qualitative research outcome also complements and complicates the image provided by the earlier quantitative scientific studies and mapping, for example, by revealing issues of environmental justice.

The participatory exercises can create spaces for societal learning and thus potentially contribute to societal transformation (Article IV). This, however, leaves us with two important questions: *what kind of* transformation do they serve and in *whose terms*? It is important to address these questions in order to evaluate the decolonizing potential of these methods. This dissertation has addressed the negotiations between subalternized local ecological knowledge and professional management knowledge. In the Taita Hills, these two positions are stagnated by the coloniality of power that currently operates through the state's neoliberal resource governance system, creating the boundary conditions for the playground where academic research has only limited chances to intervene. Next, I will discuss the potential of the qualitative assessment and participatory approaches to capture the different faces of local ecological knowledge and the challenges their incorporation into formal environmental management may meet. That is followed by the reflections on the limitations of the study to observe the potential impacts of the process on local people's empowerment in practice.

4.3.1 Incorporation of various faces of local ecological knowledge into environmental management

The study on the Taita Hills showed that the multi-method participatory mapping process has potential to reveal the various faces of local ecological knowledge beyond the mere factual understanding of the ecosystem dynamics and its components (Houde 2007; Berkes 2012). The process can address knowledge regarding local management systems, historical changes in resource use and associated rationalities, socio-environmental ethics and values, significance of the environment to culture and identity as well as local worldviews.

In Taita, the local perceptions of land and resource use came up in conversations when people told, for example, about their traditional spiritual and ritual relationship with indigenous forests and criticized the planting of eucalyptus trees due to their drying effect (Articles II, III and IV). People's references to their belief systems and how they perceive the human-nonhuman relations also reflected their cosmological understanding. This is an important aspect as it largely determines people's relationship with their environment and whether they see themselves as equal to non-human

beings or as external superior users of commodities and services provided by the ecosystem. The participatory mapping gave people also the possibility to express their concerns and opinions over the state of the environment and suggestions to improve the conditions (Article III), which revealed their underlying ethics and values. As expected, people's perceptions were not homogenous (Chambers 2006; McCall & Dunn 2012). For example, while there was a clear general negative attitude among the local people against the exotic trees, there were also those who supported planting them because of the desired quick economic returns (Article IV).

Incorporation of information from qualitative local assessments and mappings into formal environmental management may be challenging. The knowledge in the participatory maps and timelines that is probably viewed as the most relevant by the management officers consists of the factual empirical ecological knowledge that describes people's observations of the ecosystem components and their changes (Houde 2007). Thus, in the nominally participatory processes, there is a danger that only this kind knowledge is included in the official management discussion and documentation – possibly through the process of scientisation (Agrawal 2002) - failing to capture the full potential of local knowledge, let alone the sense of place.

Considering the training of many management officers in natural and engineering sciences, it would be also logical to them to doubt the validity of local ecological knowledge. For example, a common criticism towards the oral histories has targeted the subjectivity and unreliability of memory (Perks & Thomson 2006). It was also noticed in the timeline exercise in Taita that the historical periodization in people's memory lacks accuracy, and therefore large timeframes were required, for example, decades or wide classifications such as "before independence" and "after independence" or temporal images like "old things that are no more"[6]. Even when the local events are related to political events occurring at the national scale, their timing may be uncertain especially the farther we go back in history. It must also be noted that local memory is always a social negotiation practice (Halbwachs 1951) and thus the timeline exercises themselves can raise and shape people's memories.

Nevertheless, I claim that the temporal accuracy of the data is not as relevant as the possibility to understand the causal relations between historical events and the experienced changes in the environment. However, it is not always easy to distinguish the different causalities in a multivariate socio-ecological system. For instance, while local people's knowledge of the forest-water nexus is quite convincing since it is based on a long-term observation and experiential knowledge (Article IV), it remained more unclear how people perceive the connection between the more recently introduced fish ponds and reduced river water quality.

The human assessment of an environmental change may also be affected by a "shifting baseline syndrome" (Pauly 1995), whereby the baseline with which the current environmental condition is compared has shifted from its departure point, either due to lack of intergenerational communication ("generational amnesia") resulting in the lack of awareness of the past condition, or personal lapse of memory whereby a person forgets her/his past experiences ("personal amnesia") (Papworth et al. 2009). For example, even though the perception of decreasing water resources was widely shared among the Taitas, there were a few younger people who had not experienced changes in water resources during their lifetime nor remembered stories from the elderly people of the more

6 These were used in the timelines by the participants themselves in the first workshop in Wundanyi 2013 where decadal division was not given in the instructions unlike in the second workshop in Mwatate

abundant resources in the past, which may either indicate a slow or stagnated phase of the water resources change or the loss of intergenerational communication or both.

To summarize, the participatory mapping and timeline projects have potential to convey the various faces of local ecological knowledge to resource management, but their limitations in terms of spatial and temporal accuracy need to be acknowledged. However, it would be better to keep the focus of analysis in what these exercises tell about people's historical relation to their environment and how these tools could empower people in resource management than in factual correctness.

4.3.2 Empowerment of local people through multi-method participatory mapping?

The changing environmental governance systems have also restructured Taita's subject positions with respect to environment forcing them to learn new social strategies for surviving (Gershon 2005). Local people's accounts reflected some degree of assimilation of western ideas or at least adjustments to the changes in governmentalities. For example, many people had adopted the idea of private land ownership, but did not consider it ideal for the year-round food production in the mountain environment. Therefore, some people's attempts to diversify their land ownership through purchasing land in the lowlands or other places, for example in Taveta near the Tanzanian border, can be interpreted as aspirations to move towards the old pre-reform rotating agricultural system. Simultaneously, land purchase or renting, along with livelihood diversification through off-farm employment, represent means to restore the social resilience to water scarcity using the means that are legitimate within the bureaucratic governance system.

Decentralization of the environmental governance has also added pressure on the local people to increase their understanding of the bureaucratic and professional practices related to catchment management and to find legitimate means to communicate their own knowledge and perceptions to the officials (Articles III and IV). While people are given more formal venues to participate, for example, through the different resource users' associations, genuine collaboration and empowerment is compromised by the fact that the institutional framework is subject to conditions from the bureaucrats that are not negotiated with local people. Thus, for example, the eucalyptus plantations have become a major source of conflict between community's and state's interests. Furthermore, learning of the new strategies has been impeded by inadequate support from the state, which has left local people in some kind of intermediary position. Instead of support that would empower people, the awareness raising campaigns represent an attempt of the bureaucratic system to expand and increase control by enveloping people's life strategies and forcing them to observe their own resource use in line with rules set by the state authorities.

Some interviews also indicated that Taitas' worldviews and rationalities are approaching the bureaucrats' worldview in a sense that Taitas' perceive nature as a source of commodities and often consider economic aspects. While the utilization of natural resources is normal part of every culture, what is crucial here, is the change in how the ethics of human-nonhuman relations is considered. According to my observations, these relations were not as much reflected in present everyday resource use as in the historical accounts, which is probably related to the erosion of ancestors worship in natural elements and abandonment of traditions incompatible with Christianity (Himberg 2011). On the other hand, Taitas' Christian spiritual system still seems to perceive people and nature as somehow connected (through God) as illustrated by the response of a woman in Wundanyi who

stated that there are more droughts than before "because people have been acting against God and made sin". As a point of comparison, in Taita's traditional spiritual system, landscape was also thought to reflect people's state of mind (Harris 1978).

Could the multi-method participatory mapping process contribute to the empowerment of local people in resource management and possibly even to building resistance to knowledge assimilation through increased conscientisation? As, discussed in chapter 3.2.2, participatory mapping has difficulties in detaching from its Cartesian basis, and therefore, it cannot be a decolonizing process as such. Nevertheless, it can still act as a knowledge co-production tool that increases understanding of the situated nature of both scientific and local ecological knowledge. Unfortunately, the assessment of the practical impact of the multimethod participatory mapping is out of the scope of this study.

One severe limitation of this study is that it was not possible for me or the rest of the TAITAWATER research team to do a comprehensive follow-up of the influence of the research process. However, a short enquiry made by one of the research group members, Marinka Räsänen, in February 2016, indicated a rather disappointing impact. First of the four representatives from different Water Resource Users Association who she interviewed told that they had not even received the paper maps nor the research report. The second did not remember the report and the maps either although those had been delivered to the association personally by the researcher team member unlike in the first case. The third one regarded the catchment maps as useful because they had been made by the community and thus they understand those better than the ones made by "experts". However, he did not tell whether they had used the maps afterwards for any purpose. The fourth one also considered maps potentially useful in the future for indicating the water problems in the project funding proposals. The problem was also that many of the associations had had problems in making any concrete progress in catchment management planning due to lack of funding and other support. However, as things proceed slowly, it remains to be seen whether the research report or the maps prove to be useful for the groups in the future. Indeed, often the participatory processes have difficulties in reaching their full potential and turn the dialogue into action because the local people do not have enough control over the resources which they rely on and lack financial and other support (McKay 2009).

The impacts of the mapping and timeline exercises on the community empowerment would require more detailed scrutiny, which should be addressed in the future studies. Considering the inhomogeneity of the communities (Carlsson & Berkes 2005) and gendered nature of knowledge and resource access (Nygren 1999; Sultana 2009) it would be fruitful to carry out these exercises separately in groups of local women, men, the youth, the elderly and people from certain ethnic backgrounds to capture the variety of interests also in the easily marginalized groups. Comparison between the results might provide a deeper understanding of the plurality of perceptions of the prevailing resource problems and management issues and facilitate the formation of agent groups. However, to ensure that the participation of the marginalized groups would not remain short-lived and superficial, their participation should also be supported by the broader cultural, social and institutional structures (Morales & Harris 2014). In the future, multimethod-participatory approaches could also be used, for example, for the local-scale water poverty assessment (Article I). In addition, as suggested by the local people themselves, the negotiation of the issues related to private land ownership and resource accessibility would require mapping and spatial analysis (Article III).

It is also important that the management officers and researchers, possibly carrying out similar

exercises, consider their own positionality and interference with local social and political relations in environmental resource management, community capacity building, development and politics. Building mutual trust between the external experts and the local community as well as openness to different worldviews are important in collaborative research (Coombes et al. 2014). However, this too rarely materializes in the projects due to time constraints and/or officers' or researchers' inability to delink from the western onto-epistemologies.

4.4 Towards symmetric environmental dialogues

In this final section, I suggest that the move towards more symmetric dialogues in environmental governance requires reconsidering the origins of the environmental disputes and recognition of the plurality of values. This can begin with the analysis of how the different actors involved in the environmental discussions frame the problems and whose interests do the dominant framings serve. As shown in the Article IV, the problem of eucalyptus in the Taita Hills is framed in very different ways by the local people and by the state officers. Local people's framing of the problem focuses on the negative impacts of the eucalyptus on local water resources and on the loss of indigenous forests and associated cultural values due to exotic tree planting, while for the state authorities it is more of a matter of answering the national demands of commercial forestry. The authorities cannot sufficiently recognize the local perspective and have different kind of knowledge and value basis in approaching the problem, which is why it seems highly unstructured. The local people do not have the power to influence the terms of negotiation dominated by the bureaucratic practices and knowledge. The problem, as it is defined by the local people, also remains unresolved because the officers use knowledge uncertainty to justify inaction.

The claims that promote growing of eucalyptus in the Taita Hills reflect the operation of a "modern myth" that adds neoliberal governmentality to historical colonial power dynamics and "shape hydrosocial cycles and mask political choices by claiming scientific objectivity" (Boelens 2014: 244). By enhancing the powerful myth of the superiority of western natural science and by refusing to take the responsibility of the historical or future marginalization of local people in resource management and ownership, the neoliberal system continues to reproduce the subalternization of local people. This also diverts the attention away from the internal incoherence within the formal management system as well as from the problem of eucalyptus as ultimately a problem of environmental injustice that is linked to the violation of people's right to safe and adequate water resources. This finding complements other studies that have highlighted the challenges to realizing rights and environmental justice in the post-colonial context in the global south (Williams & Mawdsley 2006; Mehta et al. 2014). The structuring of the environmental problems and better policy outcomes would require building trust between different actors starting from acknowledging the historical origins of injustice. However, this requires changes in the management system, the recognition of the plurality of values regarding the resources.

The case of eucalyptus illustrates how the forest policies are linked to people's vulnerability and resilience to water problems through the hydro-social cycle (Linton & Budds 2014). As noted in Article I, it is important to get rid of conservative practices that aim to retain the system in the same state during disturbances if the resilience they provide is based on unequal and unjust social conditions that increase system's exposure to the hazard and hinder recovery from the disaster and societal

transformation (Weichselgartner & Kelman 2015). In the case of Taita, the continuing marginalization of people in the resource management and state control through neoliberal structures represent this kind of conservative approach that, at least so far, has not been able to provide sustainable solutions to the water problems and is not likely to do so in the future. Instead, the system should aim at "bouncing forward" (Manyena et al. 2011; Brown 2014) by shaping alternative futures through empowering local people.

Co-production of knowledge through new creative means that combine local and scientific or professional disciplinary ways of knowing is also important in order to find solutions to local problems affected by national and global-scale political and economic trajectories and environmental changes. This should, however, occur through mutual respect and openness (Berkes 2009) and serve local needs (Noe et al. 2015). Future studies should, however, pay more attention to the internal power relations within the community that were largely out of the scope of this study. This would be crucial for understanding the challenges of knowledge co-production and potential transition towards the community-based environmental management system. While some aspects of the traditional culture in Taita have been eroded, some still remain. Some of these also contradict, for example, the western sense of gender equality as explained by a representative from a local NGO speaking about introducing western-based models of water management in the patriarchal society in Taita:

> *"Are we putting women in organizations? […] but now you're talking of gender equality in all systems. How much influence from husband is she getting? There are a lot of challenges in culture aspect in managing these organizations. These are just government bodies that are put in place, without looking anthropologically who is the best placed person to gain respect from the community. If they're three men, from the community, why must you break the rule, and say we're imposing a woman on you? […] So, cultural values have been washed away."*
>
> *(Interview with an NGO representative, Wundanyi, 14 May 2013)*

Ultimately, participatory approaches and knowledge co-production should encourage the creation of new categories of thought through a process of reflection that is independent of western framings. After all, Taitas themselves have a power to act as the agents of decoloniality as they are subjects dwelling in the border between local histories and colonial experiences and thus having a unique "world-sensing" (Mignolo 2013: 136).

5 Conclusions

This dissertation has addressed the socio-environmental construction of water problems by applying the approach of political ecology. First, this research has shown how the socio-environmental construction of local water problems can be understood through the concepts of vulnerability and resilience. In the Taita Hills, people's vulnerability to water problems is increased by the unreliability of rainfall patterns, dependency on subsistence farming as well as the lack and gendered distribution of opportunities for adaptation through alternative livelihoods. Socio-ecological system's resilience to droughts and water scarcity is also weakened by the cutting down of the indigenous forests and encroachment of wetlands. In addition, Taitas' resilience is affected by their subjugated position in environmental resource management planning and decision making, which has long historical roots.

Second, the incorporation of the historically produced social dynamics and power relations in the analysis has shown that the marginalization of local people and subjugation of their knowledges has significantly contributed to environmental degradation in the Taita Hills. Disentangling the Malthusian narratives that blame the increasing numbers of local resource users (typically farmers) for environmental degradation is important in this respect. While the growing number of land and natural resource users certainly have increased pressure on natural ecosystems and water-related ecosystem services in the Taita Hills, I argue that the ultimate drivers of environmental degradation and decreasing water resources are related to changes in people's livelihoods and organization of resource use due to historical land reform and changes in resource and development policies, which have roots in the colonial governance and proselytism. This can also be perceived as the operation of the coloniality of power that has increased peoples' vulnerability and challenged their resilience. This approach also suggests that solutions to water problems stemming from the Malthusian perspective that typically support improving the water/population ratio fail to address the ultimate causes of water problems and are not sustainable. Instead, the local participatory management responses to water issues and other environmental problems could potentially moderate the pressures induced by the economic and political drivers. Giving the priority for planting indigenous tree species and removal of eucalyptus trees from the vicinity of water sources would not just restore the catchment hydrology but also alleviate the social impacts of coloniality.

Third, I have argued that qualitative and participatory local assessment is crucial for the evaluation of the socio-ecological construction of water problems and local vulnerability and resilience. As a methodological contribution, this study has shown how qualitative assessment of the changes in water-related ecosystem services and multi-method participatory mapping process including a historical perspective help negotiating common understandings about water problems. While these methods have only limited chances to decolonize knowledge-production for environmental management due to their embeddedness in western scientific tradition, by revealing various faces of local ecological knowledge, they are still able to complement and complicate the image provided by the quantitative scientific studies and mapping, and create spaces for societal learning that potentially contributes to societal transformation. Ideally, the participatory management processes should contain transfer of true decision-making power to local people, or at least to the organized community groups within the formal management structure (e.g., Water Resource Users Associations), and negotiation of matters

through local terms and spatial practices (e.g., using a spatial reference system meaningful to local people), not those determined by the authorities or western scientific conventions.

Finally, I have suggested that in order to move towards symmetric dialogues in environmental management the origins of the environmental disputes should be reconsidered, and the plurality of values recognized. This can begin with the analysis of how the different actors involved in the environmental discussions frame the environmental problems and whose interests do the dominant framings serve. Currently, in the Taita Hills, negotiations are dominated by professional and bureaucratic approaches that serve the state's economic goals, while the local perceptions are disregarded. In order to reach genuine community participation in environmental governance, it is important that the role of local ecological knowledge is properly recognized. The management authorities should aim to understand the contexts in which the local knowledge has been produced before judging its feasibility into resource management. Local knowledge may reveal important nuances of the local people's relation to their living environments, its historical development and people's everyday needs. In this way, the management can be planned to support the local livelihoods instead of imposing the state agendas on the local communities. By reducing the hegemony of the western perspective in knowledge production, it is possible to find new ways to hybridize these knowledges for more sustainable resource management.

Although true collaboration between local people and authorities necessarily requires transfer of some power to local people, it does not has to mean granting the total autonomy to the people in resource management, especially when that is not a likely option in the current situation. The local communities are not ready to face all the challenges by themselves. Some education and capacity building are necessary, but they should be planned through an equal dialogue with local people based on their interests. On the other hand, western scientific knowledge has a lot to offer, for example, for understanding the dynamics of both the micro level physical processes and the macro-scale global environmental, political and social changes with local level phenomena. However, combining such knowledge with local perspectives should not be an act of coloniality but made with a decolonial attitude. What matters is the balance of perceptions in negotiations. And when disputes emerge, those who suffer from the most severe social and environmental impacts should be heard.

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