Pipes, Progress, and Poverty

Social and Technological Change in Urban Water Provision in Kenya and Uganda 1895-2010

DAVID NILSSON

Doctoral Thesis in History of Technology
Stockholm, Sweden 2011
Pipes, Progress, and Poverty

Social and Technological Change in Urban Water Provision in Kenya and Uganda
1895-2010

David Nilsson

Doctoral thesis in History of Technology
Royal Institute of Technology, Stockholm
# Table of Content, Part 1

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>PREFACE</td>
<td>vii</td>
</tr>
<tr>
<td>SAMMANFATTNING</td>
<td>ix</td>
</tr>
<tr>
<td>1. Introduction</td>
<td>1</td>
</tr>
<tr>
<td>1.1. Background and context</td>
<td>1</td>
</tr>
<tr>
<td>1.2. Research questions</td>
<td>6</td>
</tr>
<tr>
<td>1.3. Previous research</td>
<td>8</td>
</tr>
<tr>
<td>1.4. Outline of the thesis</td>
<td>12</td>
</tr>
<tr>
<td>2. Methodology and Theoretic Framework</td>
<td>18</td>
</tr>
<tr>
<td>2.1. Overall study methodology</td>
<td>18</td>
</tr>
<tr>
<td>2.2. Sources and data</td>
<td>19</td>
</tr>
<tr>
<td>2.3. Delimitations and periods</td>
<td>22</td>
</tr>
<tr>
<td>2.4. Theoretic framework</td>
<td>27</td>
</tr>
<tr>
<td>3.1. Colonisation of East Africa and the 'Lunatic Express'</td>
<td>37</td>
</tr>
<tr>
<td>3.2. The role of water in the early colonial economies</td>
<td>39</td>
</tr>
<tr>
<td>3.3. A state-led expansion of water supply</td>
<td>42</td>
</tr>
<tr>
<td>3.4. The colonial paradigm of large-scale water technology</td>
<td>48</td>
</tr>
<tr>
<td>4.1. The political economy of the young Kenyan Republic</td>
<td>56</td>
</tr>
<tr>
<td>4.2. Change and continuity in the water sector</td>
<td>59</td>
</tr>
<tr>
<td>4.3. Institutional change and technological inertia</td>
<td>63</td>
</tr>
<tr>
<td>5. Reform and reproduction (1990-2010)</td>
<td>71</td>
</tr>
<tr>
<td>5.1. Socio-technical change in the Kenyan reform</td>
<td>71</td>
</tr>
</tbody>
</table>
Table of Content - Part 2.

Annex I-VI: Scientific Papers of this PhD thesis


MAP OF KENYA AND UGANDA

Courtesy of University of Texas: www.lib.utexas.edu/maps
PREFACE

This study is about water provision in urban areas in developing countries and about technological and social change. Much has been written on the topic of the challenges for public – and private – actors to provide reasonable access to safe drinking water for poor people in urban areas in developing countries. However, few have looked into how these difficulties have come into being over time and to what extent today’s problems can be explained by historical factors. This thesis rests on the conviction that the situation faced today cannot be properly understood without knowing its history. When we say that something “is history”, we often think of events and processes that have passed by and whose traces can be observed from the vantage point of the present, but that are no longer active forces in the making of society. In general, we think of history as something we have left behind. In this study, history is something we carry with us, and it is something that keeps on influencing the present shaping and reshaping of our world.

My interest for history has developed in tandem with my interest for global development. In 1999, I had the opportunity of working as a consulting engineer in Zimbabwe, where I assisted the government in setting up municipal technical offices. In 2001, I took up a job as Environmental Adviser at the Swedish International Development Cooperation Agency (SIDA) in Stockholm, Sweden, working with urban water development mainly in Africa south of the Sahara. Fairly soon I realised that history studies had something to teach us about current development challenges. By 2003, I had established a contact with Professor Arne Kaijser at the Royal Institute of Technology and we started discussing my research plans. We received a research grant from SAREC:¹ making it possible for me to take up doctoral studies in

¹ This PhD project was partly financed by SIDA/SAREC (U-forsk), grant number SWE2004-130.
2005, first on part-time while still working at SIDA and during 2006 on full time. In November that year, I defended my Licentiate thesis with the title “Water for a few – a history of urban water supply and sanitation in East Africa”. After that I found myself back in Africa, working for SIDA in Kenya from January 2007 to July 2010. Finally, I have now reached the final destination of my PhD journey, defending my doctoral thesis in History of Technology.

My sincere thanks go to all of those who have helped and inspired me during the last eight years. I am afraid I cannot mention all of you by name here. However, a special vote of thanks goes to my supervisor Arne Kaijser for his unrelenting support and guidance. I am also grateful to my co-supervisor Dr Marianne Kjellén for giving valuable advice, and to Dr Pär Blomkvist for reading and providing constructive comments at the end. I further wish to thank Grant Chamberlain for his comments on the language and style as well as Dr Ezekiel Nyangeri Nyanchaga in Nairobi and my colleagues at KTH. You are all good friends and staunch critics in just the right mix! Finally, I want to dedicate this thesis to my wife Lova, who inspired me to get involved in global development issues in the first place. You are still my idol!

David Nilsson
Stockholm, May 2011
SAMMANFATTNING

Denna doktorsavhandling i teknikhistoria fokuserar på samspelet mellan samhälle och tekniska system för vattenförsörjning i städer i Uganda och Kenya. Syftet är att undersöka detta samspel under perioden 1895 och 2010 och att kunna klargöra vilka historiska processer som format såväl tekniska system som organisationsformer och institutionella ramverk. I många utvecklingsländer bedrivs idag reformer som syftar till att förbättra tillgången till rent vatten och sanitet och därigenom minska fattigdomen. En god kunskap om systemens historia samt tekniska och sociala förändringsprocesser behövs i dessa reformprocesser.


Det främsta motivet för att introducera moderna vattenförsörjningssystem var att minska risken för sjukdomar och smittspridning i städerna. Där fanns även ett idealistiskt inslag som jag kallar en 'developmental attitude'. Denna utgör en stark mental institution inom den koloniserande makten; en framstegstro och en önskan att utveckla och modernisera vad som kolonialisatörerna ansåg vara en 'efterbliven' del av världen.


i fattigare informella områden. Det blir därför intressant att se huruvida reformerna skapar de drivkrafter som behövs för att lösa denna ’reverse salient’ och anpassa de tekniska systemen bättre till dagens samhällsförhållanden.

Slutsatserna i denna avhandling pekar på att reformen i Kenya inte ännu har skapat skapat de incitament som behövs för att åstadkomma förändring av systemen så att även fattiga människor i informella områden kan nås av de offentliga vattensystemen. Incitamentstrukturen främjar nu ökad kostnadseffektivitet och bättre service främst i rikare områden medan service i informella områden tenderar att bli marginaliserat. Däremot har man i Uganda bättre nyttjat möjligheterna i reformen och skapat ekonomiska incitament som kan gynna en teknisk förändring till förmån för konsumenter i informella bosättningar.
Part 1
1. Introduction

It is November 12, 2007 and at last, the Wamalanda water supply in the Nyalenda informal settlement in Kisumu, Kenya, is about to be re-opened. Nyalenda is said to host some 100,000 people, to whom basically no basic infrastructure services such as water and sanitation have been availed over the years. The direct beneficiaries in the Wamalanda Development Group - a community based organisation - have been looking forward to the reinstatement of the supply for months now, after it being completely vandalised shortly after its construction in January 2007. This so called "delegated line" will at long last bring in water into the hitherto unserved area, and yet at a much lower price than what consumers have been paying to water vendors operating in the area. For years, most of the vendors have obtained water illegally from the main pipeline of the public water utility Kiwasco, bypassing the fringe of Nyalenda. The only remaining step before the new system is fully operational is to cut the illegal connections - which is now thoroughly done on this November day. Late the following night, the tranquillity of the neighbourhood is suddenly pierced by the shouts of a large group of young men and of the menacing noise of wilful destruction. For the second time in less than a year the water supply to this poor area is being destroyed. Methodically and purposefully the vandals move from one connection point to the next, smashing up the infrastructure and stealing the meters, leaving little to be pondered over at our visit two days later at the scene of the crime. All we can do, is to lament the sad state of affairs and to ask ourselves why this has happened?

1.1. Background and context

The above passage opens one of the academic papers forming part of this PhD thesis. It describes the situation in Kisumu, the third largest city in Kenya, at a time when my supervisor Arne Kaijser and I visited the area in 2007. The case of Kisumu reflects some of the
development challenges in a developing country and offers a glimpse of the reality behind the more academic chores presented in the rest of this thesis. Although it is a snapshot picture from a local context, it describes a global phenomenon.

Inadequate access to safe drinking water and poor hygiene lead to the deaths of at least one and a half million children in the world every year (UNICEF 2006:3). The global distribution of the reported water-related deaths is heavily skewed in such a way that the poorest countries generally bear the brunt of the death toll. Health problems, high child mortality and low access to water and sanitation services seem to go together with higher poverty levels, thus rendering the already vulnerable in a situation where they face multiple challenges for improving their quality of life (UNICEF 2006:4). This is the background to this PhD thesis in History of Technology.

The states of the world have come to realise that poverty in one country is a concern to all, which is why the United Nations (UN) have adopted the Millennium Declaration. This declaration made by the United Nations in the year 2000, makes it clear that the lack of a healthy and clean environment - including the access to safe water - in some countries is a global problem and not just a local one. The Millennium Declaration was not by any means the first collective effort within the UN framework to compel rich countries to come to the aid of poorer countries. However, this declaration contains a set of quite ambitious, quantitative and time-bound goals. These are accompanied by an elaborate set of target indicators as well as a system for reporting and monitoring these indicators. On an overall level, the “Millennium Development Goals” - or MDGs as they are commonly referred to - have set the target to reduce by half the levels of poverty on a global scale between the year 2000 and 2015. The specific target for water and sanitation services is to halve the proportion of people without access to ‘safe’ water and sanitation by 2015, using the situation in 1990 as a reference baseline (UN 2000;
UN 2002a). For a discussion on how to define ‘access’ and ‘safe water’ in an urban context see (UN-HABITAT 2003).

So far the results have been mixed. The world has taken important strides in combating poverty and delivering on the MDGs. The prospects for reaching several of the MDG targets on a global overall level appear good although the financial crisis that shook the world from 2008 has incurred a setback. Also in terms of water and sanitation, there has been considerable progress on a global scale. However, there is great diversity between the richer and poorer countries. In Africa south of the Sahara, where most of the poorest countries are situated, only a few of the countries are likely to achieve their target of halving the proportion of the population without access to water, while none of them will meet the sanitation target (UN 2009). Although Uganda is one of the few countries that may meet the water target, one third of the population still has no access to a safe water supply (Government of Uganda 2009). Kenya shows a negative trend since 1990. In 2007, the coverage ratio was estimated at 60% in urban areas and 40% in rural areas (Republic of Kenya 2007). As will be discussed in chapter 2, water supply coverage data in many developing countries is often unreliable.

If we agree that the lack of safe water and sanitation in some poor countries is of concern also to richer countries and that we need to make an effort to address this problem, then what is the best way of dealing with the problem? And who is to define the problem? There have been – and there still are - many different interpretations of what the root cause of the problem is. These interpretations have also influenced policy for how to improve the situation. Here I will quickly sketch an overview of the different policy positions that have surfaced.
over time, based on some threads of thinking predominantly in the rich part of the world often referred to as “the North”.  

The 1960s and 1970s saw technology transfer take place from the North to the developing countries, in line with Walt Rostow’s “take-off” theory, which prevailed in development economics (Gunnarsson and Rojas 1995; Easterly 2006). In East Africa this also coincided with a period of strong economic growth. After the oil crisis and global economic downturn in the 1970s, the “Basic Needs Approach” gained support on the international arena. The governments should now concentrate on providing certain basic infrastructure and social services, not high-end technology (Leys 1979; Curry and Rotchild 1980; Gunnarsson and Rojas 1995:35). Proponents of the ‘technology transfer’ ideal were increasingly concerned with the transfer process itself. Some scholars emphasised that technology must be embedded in a suitable social context through what Edquist and Edqvist (1978) termed ‘social carriers’. In the 1980s, there was a growing concern that maybe the problem was the technology itself; perhaps the developed countries had transferred technologies that did not match the local conditions well enough. Out of this concern grew the concept of using ‘appropriate technology’ such as reliable hand pumps instead of diesel-powered pumps that would better fit in the local context (Therkildsen 1988; Vaa 1993). As a downstream effect of the structural adjustment policies applied by the International Monetary Fund (IMF) and the World Bank, by mid-1990s attention had shifted from technology to institutional aspects. The end of the 1990s and early 2000s saw many developing countries carrying out institutional reforms of the water sector, generally with an emphasis on privatisation and commercialisation (see e.g. Bayliss 2003; Budds and McGranahan 2003; Kjellén 2006; Dellapenna 2009). This World

---

2 For reasons of space and clarity I only sketch an outline of different policies here. For more in-depth descriptions of development of water policies in the North, see e.g. Goubert 1989; Juuti and Katko 2005. For a critical analysis of development assistance see e.g. Easterly 2006 or Moyo 2009.
Bank-led push for reforms with a neo-liberal agenda was also supported by most donor countries such as Germany, France, UK and Sweden. However, public financing soon came back into fashion, against the backdrop of the poor outcome of privatisation of water services and the failure to attract private capital (World Bank 2003, Swyngedouw 2009). This happened simultaneously with a more general trend towards a revival of the take-off theory, where it was argued that solving the development problems including water and sanitation requires mass-transfer of capital from the developed world (Winpenny 2003; Sachs 2005). Policy prescriptions thus seem to have gone full circle. The most conspicuous addition to the debates recently has however been the argument that it can be considered a human right to have access to water. The UN committee on economic, social and cultural rights in 2002, and the 2006 UNDP human development report, argued for water as a human right (UN 2002b; UNDP 2006). In 2010, a resolution was passed in the UN General Assembly that declared “safe and clean water” a human right. It can be noted that a number of states chose not to vote in favour of this resolution, including United Kingdom, United States, Sweden, Kenya and Tanzania (UN 2010a; 2010b). In the footsteps of the human rights debate there has also been growing attention to the issue of equality of services and on how to better serve the informal settlements in urban areas using a combination of appropriate technology and institutional reform (UN-HABITAT 2003; Dagdeviren and Robertson 2009; World Bank 2009a).

Obviously, there have been many different interpretations of what must be done to improve water and sanitation services in developing countries. Many disciplines have been engaged: economics, public health, ethics, engineering and more. However, few attempts have been made to look at the current state of water provision in sub-Saharan Africa from a longer time perspective.
1.2. Research questions

A fundamental point of departure in this thesis is that whenever civilisations put in place systems for managing water and sanitation services, the time element is a critical and intrinsic dimension. In my Licentiate Thesis, I showed that this proposition is highly relevant also in the context of East Africa, and that the water supply systems that were put in place in the colonial period had a long-lasting effect on societies (Nilsson 2006). The significance of the time element is particularly strong when building large-scale infrastructure such as piped water supplies, dams and other waterworks. Such infrastructure involve very large investments, they are technically durable and require long-term engagement in order to recover costs for the investments. Once the systems are built, they are not so easy to change. This can be explained by technical and economic features mentioned above, but institutional aspects, power structures and attitudes also change slowly. Changing a particular technical device can be done fairly quickly, for instance replacing diesel-powered pumps with hand-pumps. However, changing the institutional framework, the attitudes and the prevailing norms about “how things should be done” is generally a more time-consuming process. As will be discussed in section 2.4 water supply systems are 'socio-technical’ systems; there is a high degree of inter-dependency between the technology and the social framework surrounding the technology. If we are to deal successfully with the precarious situation of global water supply and management we need to understand this interdependency and the complex and long-term nature of the change processes at the socio-technical systems-level.

Policy-making in international co-operation on water and sanitation seems to suffer from a light form of amnesia, where sector actors seldom refer to their own experience if it is older than five or - at best - ten years. As indicated by the string of policy prescriptions and development ideals described in the preceding section, new recipes seem to be produced regularly. But these novel “solutions”, as they are
presented, are seldom based on a self-reflective examination of what has previously worked and what has not, nor on any attempt to look at the problem at hand over a longer time period. Definitions and policy environments have shifted over time, requiring a cautious and history-conscious attitude when analysing policies, institutions and technology for water and sanitation. Having stated my case for looking at water and sanitation in developing countries in a longer time perspective, I now turn to define my research question.

This PhD thesis presents a history-based critique of the development of systems for urban water provision in two East African countries from the end of the 19th century and up until the present. My analytical focus is on change, continuity and inertia - or resistance to change. The purpose of this study can be defined as:

- to understand how urban water technology co-evolves with social change in Kenya and Uganda, and in particular; understanding the drivers of technological change and the barriers that impede change.

I also have a set of more specific, analytical questions. I will not overburden the reader already now with these detailed questions. Instead they will be presented, analysed and discussed in chapter three, four and five, respectively.

The geographical scope of this study is delimited to Kenya and Uganda, but I will at the end discuss the relevance of my findings in a wider context. I will concentrate on water supply in urban areas, for several reasons. The urban growth rate in Africa south of Sahara is now higher than in any other part of the world, and stands at around 3.7% per year (UN 2007). Approximately 62% of the urban population in Africa currently live in unplanned settlements most of which lack access to safe water (UN-HABITAT 2003; UN 2009). This situation could be a potential powder-keg for social unrest, as has been exemplified by the violence in urban areas in South Africa in 2008 and 2009 (Turton 2008; BBC 2009). Finding equitable and
sustainable solutions for supplying water to Africa’s rapidly growing urban populations is therefore imperative for sustainable development of African societies. Moreover, relevant historical data is more accessible for urban areas. Nevertheless, much of my analysis and conclusions regarding national policies and institutions I believe also to be relevant for rural water as well as for sanitation.

1.3. Previous research

In the introductory section, I presented some relevant research in relation to water supply policy in developing countries. Although these form an important policy backdrop to this thesis - especially for the findings and recommendations presented here - scientifically I wish to situate my research in the field of History of Technology. In section 2.4 I will also provide some key references from the field of History of Technology and from Science and Technology Studies (STS) which have a more theoretical bearing on my research. Below, I sketch an overview of relevant historically oriented literature on urban water supply, first in Europe and the US followed by Africa south of the Sahara.

The histories of urban water supplies in Europe and the United States are relatively well covered. New additions to this body of literature keep on surfacing continuously and below I will just mention a few highlights. Jean-Pierre Goubert (1989) describes the emergence of urban water supply systems in France, UK and the US from the early modern period and up to the industrialised era. In his study, he describes the establishment of rudimentary technology in the largest cities as linked to a new set of values and ethics in relation to water. What used to be a free resource provided by nature, gradually turned into a commodity provided as a commercial service from the 18th century. The 19th century also saw a shift in attitude towards increased cleanliness and hygiene: the ‘sanitary movement’ that swept across the industrialised world in the mid-1800s paved the way for an increase in water and sanitation services in urban centres.
The need for establishing city-wide networks for water supply and sewerage had to evolve hand in hand with new institutional frameworks and organisation of the services. As stressed by Halliday (2001), the Metropolitan Board in London was formed in order to build and operate a main drainage network. Such an undertaking had been virtually impossible under the previous extremely fragmented administrative framework, concerning more than three hundred various administrative units for the greater London area (Halliday 2001: 59). Szreter and Wollcock (2002) has shown that such large physical undertakings as well as the major changes of institutions in society were enabled by the mobilisation of social capital around the sanitary issue which was perceived to be of common interest to several groups in society.

Martin Melosi (2000) tells a similar story from the United States perspective. Networks for water supplies were established somewhat later in the United States, and private sector actors in many cases were pivotal in establishing the early systems in the 1800s. Apart from health considerations and industrial needs, fire fighting was also an important driving force in the building of water networks. At the turn of the century, most of the water supplies were taken over by public authorities. In the 20th century, environmental issues were given more and more attention. The history of environmental services including sewerage networks in cities in the United States has been studied by Joel Tarr (1988; 1996).

In Europe, some water supplies were built as private enterprises just like in the United States. However, according to a study of 29 European cities by Petri S. Juuti and Tapio S. Katko (2005), by the early 1900s ownership and management in most cities had passed over into the hands of public authorities, typically municipalities. Also in these European cities, public health concerns, a desire for higher industrial productivity and the need for fire fighting were all important factors for establishing large-scale water supplies.
Several cities in Sweden have been studied as well, and the historical pattern does not differ significantly from the European and North American experience. Jonas Hallström (2002) has shown that although industrial productivity was a key factor for constructing public water supply networks in medium-sized cities like Norrköping and Linköping, the subsequent expansion of services to low-income suburbs was prompted by public health concerns. In the capital of Stockholm, the opening of a piped water supply in 1861 was done against a backdrop of a series of devastating cholera outbreaks in the preceding decades (Gullberg 1998).

When it comes to the history of urban water supply in Africa south of the Sahara, the body of literature (at least in the English language) is markedly thinner. The historian Daniel R. Headrick has studied urban infrastructure and planning in the colonial setting (Headrick 1988). He shows how the regulation of housing and sanitation in Dakar (in Senegal in West Africa) served to reinforce segregation of the races. Another notable account of urban water history from Senegal include Kalala Ngalamulume’s (2005) paper on the establishment of a water supply in St Louis-du-Senegal during colonial times in the face of several cholera outbreaks in the city. A piped water system was built here in the 1880s, but inequalities in access to clean water caused epidemic disease to haunt the poorer parts of the population for a long time.

Urban water supply in the Anglophone part of West Africa has been studied from a historical perspective by several scholars. Ben Page (2005) has studied Cameroon while Matthew Gandy (2006) and Ayodeji Olukoju (2007) both have explored the history of urban water services in Nigeria. Furthermore, Anna Bohman has written about the history of urban water supply and sanitation in Ghana (Bohman 2010). A common observation from these studies is that development of water services in these countries has been fragmented and intermittent; what Gandy (2006) calls ‘incomplete modernity’. Ideals about development and modernity – of which a large-scale water
supply and sewerage system is a good representation – were taken up during the colonial period but were seldom carried through to completion neither during the colonial period nor later; hence the ‘incompleteness’. After independence, development took off along already established trajectories but was soon thwarted by financial and managerial problems. This set of studies also suggests that the socio-technical systems inherited from the colonial period have had a long-lasting impact on the development of urban water services.

From Southern Africa there is also a small array of literature, such as Harri Mäki’s (2007) study of urban water services in four South African towns and Kevin Wall’s study of the early Cape Town (Wall 2005). The fact that post-apartheid laws have been enacted in South Africa enshrining water as a constitutional right has also encouraged studies of water law in a historical perspective, such as that by Michael Kidd (2009) and by du Plessis (2010). Musemwa (2010) has made an extensive coverage of the history of water supply in Harare, Zimbabwe. The Southern Africa experience differs from West and East Africa in terms of population composition in urban areas during the colonial period. The populations in towns in Zimbabwe and South Africa had a higher proportion of people of a European descent. Furthermore, democracy came later to this part of Africa; 1980 in Zimbabwe and 1994 in South Africa. The quality and extent of the infrastructure was significantly better in these countries as compared to most other African countries at independence.

In East Africa finally, there are even fewer studies on the history of water and sanitation. Ellen Carlsson (2003) and Jan-Olof Drangert (1993; 2007) have studied practices of water management in rural areas in Tanzania, providing relevant background on institutional frameworks. Marianne Kjellén’s PhD thesis from 2006 on urban water supply in Dar es Salaam, Tanzania also provides a historical overview. Thompson et al (2001) presents the results from a repeat study of a much cited regional study on water supply by White et al published in 1972. This so called ‘Drawers of Water II’ study contains
a lot of important data and comparisons over a thirty-year period after 1967. Appelblad (2008) also outlines the key changes of the institutional framework in Uganda since independence. Nyangeri and Ombongi (2007) offer an account of key historical events and policies in the Kenyan water sector between 1895 and 2002. From this scattered picture, at least one emerging conclusion is that the service situation seems to have deteriorated considerably since the 1960s in the three countries. One can also note that the current sector arrangements differ significantly between Uganda, Kenya and Tanzania despite them sharing a similar colonial background. A conclusion of a more general type is that the history of urban water services in Uganda, Tanzania and Kenya seem to have attracted very little attention from other scholars, which merits intensified studies in this field of research.

1.4. Outline of the thesis

This thesis has been made in the format of a compilation ("sammanläggnings-avhandling"). The present part 1 of the thesis summarizes and discusses my findings, as presented in six scientific papers (part 2 of this thesis). After the present introduction, a description of the methodology and relevant theories follows. Thereafter, I outline my main findings in three chapters, one for each period under study. Each of these chapters includes an analysis using specific research questions and a discussion in the light of the theories introduced in chapter two. In chapter six, I summarise my findings and present a set of conclusions as well as some recommendations for further research and for policy development. Part 1 ends with the list of references used in this text.

Most empirical parts of the thesis - as well as parts of the theoretical framework - have previously been presented in the form of six individual papers. These papers, all attached in annexes I-VI constitute Part 2 of the present thesis. Five of the papers have been published in international academic journals and books, while the
sixth paper has been submitted for publication. Please note that I will often refer to my six separate papers but that sources used in my papers will not be repeated in part one unless necessary. Below I will introduce my six papers at a glance. The first three papers formed the basis of my Licentiate Thesis which I defended in November 2006, but here I will use all six papers separately, as basis for my Ph D thesis.

Paper 1 is called “The Evolution of Urban Water and Sanitation in East Africa from a public goods perspective” and was part of a book edited by Dr Johann Tempelhoff of North-West University in South Africa, “African Water Histories. Trans-disciplinary Discourses” published in 2005. In this paper I discuss several theoretical concepts of relevance for water and sanitation services. First, I sort out the difference between value, cost and price of water services. Grasping these concepts is necessary for being able to understand the dichotomy between water as an ‘economic good’ and as a ‘social good’, which dominated much of the policy debate in the 1990s and early 2000s. I also clarify why urban water and sanitation networks have economic and technical characteristics that render them as ‘natural monopolies’ and to what extent water and sanitation services can be said to be ‘public goods’. Although water services do not have the typical features of a ‘true public good’, the large-scale nature of investments, the large external effects on health and the environment, as well as water being a finite resource, make a case for strong public involvement. This could also be used to explain why the state (generally through local governments) historically has assumed a large responsibility for water and sanitation services in most developed countries. Finally, the paper explores the link between the state as a water provider and as a duty bearer for realising human rights, noting the Article 21 of the United Nations’ Declaration on Human Rights, which states that everyone has the right to an equal access to public services.
The second paper has the title “A heritage of un-sustainability? Reviewing the origin of the Large-Scale Water and Sanitation system in Kampala, Uganda” and was published in October 2006 in the international journal Environment & Urbanization. In this article, I investigate the establishment of the large-scale public water and sewerage system in Kampala, the largest city and today the capital of Uganda. I analyse how water supply in Kampala was contextualised by the local colonial administration mainly as a response to a public health problem but also as a matter of bringing development and modernity to a “backward” place. The establishment of the large-scale water supply and sewerage network follows a pattern of first mobilising the actors and the capital needed, followed by introduction of modern technology from United Kingdom and then a rapid local expansion. I was also able to show that a strict policy of recovering the full cost for the water supply directly from the beneficiaries/consumers was applied, however not for the sewerage services. Perhaps the most important conclusion was that although the African population was not officially prohibited from accessing the water supply, the large-scale technology chosen resulted in services that were unaffordable for most Africans at the time.

The third paper was co-authored with Dr. Ezekiel Nyangeri Nyanchaga of Nairobi University in Kenya and was published as an article in the Journal of Modern African Studies in March 2008. The title of the article is “Pipes and politics: a century of change and continuity in Kenyan urban water supply”. As the title indicates, we analyse the key institutional and organisational changes for urban water supply in Kenya from the onset of colonisation around 1895 up until the water sector reform in the mid-1990s. Similar to the Kampala case, large-scale technology based on European models was introduced in the early 1900s, primarily to satisfy the needs of the European and partially the Indian populations. The building of the railway to Uganda straight across Kenya between 1896 and 1901 gave rise to an early introduction of piped water supply. Urban water supplies expanded throughout the colonial period, and for most of the
colonial period full cost recovery was achieved. After independence, the policy of cost recovery from the users was still in place for most of the time but was not implemented. Underinvestment and mismanagement in the 1970s and 1980s held expansion of the water supply systems back while population in the cities increased rapidly. Thus, more and more people were left without access to the public water supply systems. Our conclusion in this paper is that while there were superficial changes in the organisation of the water supply sector in Kenya, the technological setup was preserved from the colonial period. The institutional framework had also changed significantly after independence, but not in such a way that it facilitated improved service provision or technological change.

Paper number four is called “East African Water Regimes: The Case of Kenya”, which was also co-authored with Dr Nyangeri. It appears as a chapter in a book edited by Prof. J W Dellapenna and Prof. J Gupta titled “The Evolution of the Law and Politics of Water” published by Springer in 2009. This provides an extension of our study in paper number three. Here, we look at the entire water sector (including water resources management) in Kenya from pre-colonial days to the present from an institutional point of view using the concept of ‘water regimes’. We define a water regime as a set of rules for collective action, their associated norms and a chain of command. We argue that there has been a succession of water regimes in Kenya, starting with a pre-colonial customary water regime, which for a short period co-existed with a customary colonial regime. This was followed by a state-centred colonial regime and finally a neoliberal type of regime, which is still under formation. We conclude that these regimes are not as distinct as one would imagine. In practice, they have not entirely replaced each other but continued to co-exist side by side. Our study also suggests that one reason for the colonial government to step up its involvement in water management in Kenya was the strategic importance of water for the agriculture export sector, by that time dominated by European settlers.
I have co-authored my fifth paper with my supervisor Prof. Arne Kaijser. The title is “Discrimination by Default: The Post-Colonial Heritage of Urban Water Provision in East Africa” and appears in Castro and Heller (eds) “Water and Sanitation Services: Public Policy and Management”. This book was published by Earthscan in London in 2009. We look specifically at the challenges of providing public services in low-income areas in Kenya using a case study from Kisumu, the third largest city in Kenya. We also make comparisons with two other cases: one from Kampala, Uganda and one historical example of electrification in rural Sweden. Our main argument in this article is that the large-scale technology faces high transaction costs in unplanned low-income areas due to weak property rights and difficulties in arranging payments. This dilemma is inherent in the large-scale technology as defined through the historical processes. However, we demonstrate that there are simple technological and institutional innovations that can significantly reduce these transaction costs, thus making the large-scale technology compatible with provision in low-income and unplanned areas. In conclusion, we argue that while history has shaped the present systems, there are ways these systems can be modified on the margin to better respond to today’s conditions if the incentive structure is right.

The sixth and final paper is a joint product between geographer Jenny Appelblad and myself, called “From ’All for some’ to ’Some for all’? A historical geography of pro-poor water provision in Kampala”. It was submitted to the Journal for East African Studies in April 2011. Here, we assess the current policies for reaching out with water services to poor people in Kampala, Uganda in a longer time perspective to see whether the new policies have made any significant departure from previous ones. Specifically we look at a system of pre-paid water supply currently tried in a low-income area in Kampala. We conclude that this model may well provide a means for adapting the systems to today’s condition. Moreover, we argue that Uganda has taken some important steps for creating institutional incentives that can lead to changes in the socio-technical system that benefit the poor.
Having introduced my subject and research question as well as this thesis itself, I now invite the reader to explore the methodology and theories of my endeavour to study urban water supplies in Kenya and Uganda from a historical perspective.
2. Methodology and Theoretic Framework

2.1. Overall study methodology

This is a doctoral dissertation in History of Technology and as such, it belongs to the discipline of history within the field of the humanities. Therefore, the methods used stem mainly from the subject area of history studies. I have taken almost all of my empirical data from written sources in public or private archives. The Weibull tradition known as ‘source criticism’ (in Swedish: ‘källkritiska metoder’) is strong in Swedish history research. Source criticism is based on a method of critical scrutiny of sources and their data, their context and purpose. In Sweden, this method has a more prominent role within history sciences than in most other parts of the world (Torstendahl 2005). Of course, the role of the historian is to try to understand and interpret, not simply to recount historical data. Sometimes the data says something more than the textual message. As argued by the historian Göran B Nilsson, all human-made data that a historian has to deal with also carries a contextual message (Nilsson 2002). What is not said, or how it is said, may be just as important as what is expressly said. It is for the historian to try to interpret data and discover this broader contextual message.

I have tried to adopt this critical and interpretative methodology throughout my studies, especially when using government sources in official archives. Whenever possible, I have tried to compare official statements with descriptions of the same phenomena from other sources (sometimes referred to as ‘triangulation’) including secondary sources such as literature and non-government reports. In doing so, I have also paid particular attention to contemporary observations, such as for example academic articles from the 1960s and 70s. This approach reduces the risk of making interpretations solely from the perspective of the present. I also tried to detect conflicting or contradictory messages in the official sources that could provide
interesting pointers to hidden contextual messages and to ‘what actually was going on’.

Although source criticism is essential for ensuring a reasonable and scientifically valid interpretation of data, it may not be enough for putting data into a wider context and for understanding the bigger picture. As expressed by the Swedish historian Rolf Torstendahl (2005), the historian has to present a story that is not only scientifically valid, it must also be convincing. To achieve this, he or she cannot rely only on the data and a method of source criticism, but must also make use of other methods and theories that can provide a convincing model of the real world. In section 2.4, I will present the theoretic framework I use for putting together - what I hope to be - a convincing model. Before that, however, I will discuss at more in-depth level the data I have had access to, delimitations and assumptions made.

2.2. Sources and data

My primary data consist mainly of government documents in a final and official form, correspondence or documents in draft format such as notes and internal memoranda. Official reports – and in some cases internal documents and drafts - from donor organisations and contractors in the water and sanitation sector make up another important data source. From the colonial period I have gathered this primary data in the British National Archives in Kew, London, which holds the complete archives of the Colonial Office, and at the National Archive in Nairobi, Kenya. At these two archives, I have had access to a wealth of data in the form of official correspondence between the Colonial Office in London and the colonial administrations in Kenya and Uganda, as well as administration reports and various technical reports. At the Nordic Africa Institute in Uppsala, Sweden, I have also found data in the form of various reports and official government documents from the colonial period as well as after independence. For the post-independence period, I have used primary data from the
National Archive in Nairobi, as well as copies of official government reports in the private archive of Dr Nyangeri at the University of Nairobi. Reports from international donor organisations and the United Nations I have found at the archives mentioned and at the library of Royal the Institute of Technology, the Swedish International Development Cooperation Agency (SIDA) and at the British Institute of Eastern Africa in Nairobi. For the most recent period, a wealth of official reports and documents, not to mention secondary literature, is available on the internet. It deserves to mention that although the National Archive in Nairobi holds a large collection of data, it can be difficult to find the relevant records and sometimes files are missing.

In the next section, I will discuss some general principles for how I have dealt with and interpreted data. It may be helpful to bear in mind the three key criteria proposed by historian Maria Ågren (2005) for a source critical approach: visibility, importance and reliability. The visibility criterion relates to the level of visibility a certain topic has in the source, which is likely to depend on the type of source and data, its origin and purpose. It is - for example - likely to find data in the archives of the Colonial Office in UK on issues that were of key concern to the colonial administration, such as financial matters. The importance criteria relates to representativeness and relevance. High visibility of a certain issue in the data cannot be taken for granted as a sign of the importance of this issue in general. Inversely, the absence of data does not always imply that the issue was non-important. The period 1939-1945 serves as a good illustration here. The reporting on water issues from the Uganda Protectorate back to the Colonial Office is virtually non-existent for these years. Certainly, water supplies continued operation during the War but the colonial administration’s attention was instead directed towards the war effort. The third criterion relates to the more general question of whether the data itself can be trusted. Problems with data bias and reliability always have to be dealt with in interpreting data. The issue of reliability will be discussed more extensively below.
To find reliable and representative data for water supply coverage (the proportion of the population with access to safe water supply) is a challenge, not just in Kenya and Uganda but worldwide. Official national statistics are in some countries known to be inconsistent and inaccurate (Satterthwaite 2003). Some countries and their international donor partners spend considerable resources on putting in place new and more robust monitoring systems specifically for the water and sanitation sector, but even these systems have serious flaws when scrutinised. Uganda has attained much international praise for its sector performance monitoring, building on a number of “golden indicators” through which the government and her partners should be able to monitor the water and sanitation service situation, both in terms of quantity and quality. However, this system also entirely depends on data collected and reported by the sector actors such as municipalities and small-scale providers. Serious deviations and irregularities on how this data is reported to national authorities by the local sector actors in Uganda have been reported (Quin 2010:13).

In Kenya, the government had previously relied on questionable data when reporting on the MDG indicators. As a consequence, the 1990 MDG baseline for safe water in urban areas was pegged at 91%; an unrealistically high figure. By 2007 the government of Kenya itself realised that this figure was completely out of touch with reality and they now estimated that the actual coverage ratio was around 60% (World Bank 2006; Republic of Kenya 2007). Comparing coverage ratios over time is complicated by shifts in the definitions used. In 1963, WHO reported that close to 100% of the urban population had access to public water supply systems in Kenya but the definition of ‘access to safe water’ was not well defined at the time (WHO 1963).

With the introduction of a new Kenyan water provision information system (known as WARIS) around 2005, more detailed data could be collected based on self-reporting from the water providers just like in Uganda. The reported coverage ratio for the year 2006/07 was now only 37% in the areas for which data was available, while the reported figure for 2008/09 was 45% (WASREB 2009; 2010). These figures
only relate to consumers reached by the public piped supply, which is a more narrow definition than ‘access to safe water’. If all these figures are taken at face value, it would appear as there has been a very dramatic decline of water services in Kenya from independence in 1963 to today. Since 1963, the definition of ‘access’ as well as the monitoring system and collection methods have changed several times. There are many indications that services have in fact deteriorated, but it is important to bear in mind the transient nature of data and definitions when making comparisons over time. In addition, there may be bias in the data, as will be discussed below.

2.3. Delimitations and periods

I have limited my empirical research to Kenya and Uganda. However, in order to understand for example global policy changes and economic trends, in certain instances I discuss my study in a wider global context.

Thematically, my focus is on urban water supplies. Due to the nature of my inquiry, I have frequently found myself looking into matters of urban planning and sanitation as well as water resources management, land management and political economy. This has been quite natural since urban water is part of a water sector, its politics and economics as well as influenced by physical planning and urban geography. I have however refrained from exploring these external or contextual subject areas unless I could see how they improved my understanding of the urban water provision in Kenya and Uganda.

It could also be argued that water supply cannot be separated thematically from sanitation in any study, or from water resources management. I believe that this depends on what you want to study. Had I been dealing with the quantitative studies of health impact from water supplies and sanitation, water demand management aspects or urban climate change impacts, I would agree that omitting
sanitation or water resources management would be a serious flaw. But these are not my areas of inquiry. I am tracing the lingering legacy of certain ways of organising and thinking about public water services in urban areas. Focussing on water supply itself will help me to find these particular traces and answer my research question instead of taking everything on board, which would risk my losing sight of what I am looking for. With regards to technology, the focus of this study is more on the normative level of technology – such as design principles, standards and norms - than on the actual technology itself. This is partly due to the need to limit the area of inquiry, and partly a result of my focus on how technology relates to policy, institutions and knowledge in society.

When it comes to the study periods chosen and my data coverage, I early on assumed that the colonial period was an important and formative stage which moulded the structure of water and sanitation services in Kenya and Uganda. The British had made and gradually defined their political claims of these areas from the 1880s. However, 1895 marked the beginning of a more effective colonisation and control of the Kenya and Uganda territories as British Protectorates, and the following year, the building of a railway from the coast to Uganda (Ssekamwa 1993). The railway also meant the introduction of technology and colonial administration into the interior of East Africa. I have hence studied the introduction and development of technology, institutions and organisation of water services for both Kenya and Uganda during the early stages of colonisation from 1895 up to independence in the 1960s. As a backdrop, I have also mapped some of the traditional pre-colonial water management arrangements in the region, but only through secondary sources. Indeed, the water issues have a high visibility in official colonial records between 1920 and 1950, as this was when much of the systems were put in place. No doubt, water supply was important before this period as well in the local context, but this formative period made a larger imprint in the records of the colonial state. When it comes to the reliability of data contained in the various documents from this period, in general I
have deemed technical and financial data in the colonial archives to be reliable. However, there is data where one would expect some bias; for example in despatches to the Colonial Office in London from the Uganda Protectorate which were used to persuade and influence London to make certain decisions.

The next period of particular interest is from independence and a few decades thereafter. A new political dispensation based on democratic principles emerged in tandem with a new social and political landscape. I am interested in understanding how this social change influenced the conditions for change in the area of water supply. For the late colonial period and first decades of independence, I have concentrated on Kenya. There has been more easily accessible data for Kenya during this period. Uganda underwent a period of turmoil and civil strife in the 1970s and 80s during the rule of Idi Amin and the subsequent period of armed conflict for which data can be difficult to find. My topic is rather wide in geographic and thematic scope and I believe that my focussing on one country in this period is therefore justified. The data encountered for this period is somewhat different from that found in the colonial archives for the previous period. I have found some interesting data in the Kenya National Archive in Nairobi, especially regarding Nairobi. There are also government reports, plans and strategies from this period in the Nordic Africa Institute in Uppsala. Dr Ezekiel Nyangeri Nyanchaga at the University of Nairobi has a large private collection of data regarding the history of water supply in Kenya, and he was kind enough to let me use this private archive. Most of the data in Dr Nyangeri's archive consists of reports and plans from the Government of Kenya and various donor organisations. I have also used more secondary literature for this period. In general, water issues have an enormous visibility in this period and there is an abundance of donor reports, government strategies and so on. Despite the increase in data production and storage in this period, the reliability of data becomes more problematic as there are more conflicting datasets than before. Some data may have a 'political bias'. That is to say, some official
government reports tend to confirm government policy and programmes rather than to confront them. This can result in over-optimistic accounts such as has been noted above in the case of water supply coverage. There is of course no blueprint method for filtering the information and distil something we call ‘the truth’ out of the datasets from any of the periods studied, but in the analysis one simply has to be aware of the different nature of the data used.

The third key period that I am studying is from the onset of sector reforms from around 1990. For this recent period, the emphasis is on Kenya in order to be able to make a continuous interpretation of the history of urban water supply in this country for the entire period of 1895 up to today. I have also looked at the reform processes in Uganda but using the narrower frame of water supply for the low-income population in the capital Kampala. It is not my intention to make a comparative study of Kenya and Uganda. Here, the case of Uganda after 1990 serves more as a sounding board for the Kenyan reform history, especially where there are important analogies or divergent trajectories.

This more recent period could be a dangerous zone for a historian. What is still under formation by contemporary processes could be seen as a no go area for history studies and should be left to economists, sociologists, planners and so on. However, my objective has been all along to bring the historical analysis to bear on contemporary processes, as I believe the historical processes are not separated from the present. I also think that my ‘historical method’ of using primarily written sources from official sources can be applicable also for contemporary studies. In fact, Ågren (2005) argues that many other scientific disciplines could benefit from subscribing to the empirical method of source criticism. Once again; what is important is whether the story I am telling makes sense and that my data can be objectively verified.
Kenyan legislation puts a thirty-year restriction of access to official government documents. Hence, I have not been able to get any relevant official government documents for the most recent period from the National Archive in Kenya. Instead, I have relied on documents from other sources from the last thirty years, especially strategy document and various project reports from the Government of Kenya and Uganda and from the donor organisations involved. There is no shortage of such data, but they do seem to be affected by the same type of reliability problem and political bias as for the earlier post-independence period. While one would have hoped to see an increase in reliability over time for relatively simple data such as water supply coverage, my account in the preceding section bears a testimony of the opposite.

Regarding my data coverage, in summary I think that I have been able to cover the periods that are of key relevance for the purpose of my study. Certainly, it would have been even better to cover the entire period from the 1890s to the present also for Uganda. However, these are the kind of delimitations any researcher will have to make in order to keep the task manageable. There is hence scope for future research to cover the gaps in this study.

In general, I have had few reasons to doubt the authenticity of the documents from any of the periods. In some cases, I have had to deal with draft documents, the validity of which has to be assessed with some caution. Drafts have often been produced by other parties or individuals and can therefore not be assumed to represent the intention by the official owner or warrantor of the document until they have been given an official ‘seal of approval’. For the despatches from Colonial Office to Uganda, only the final drafts are kept at the National Archives in UK. Engdahl (1999) has made comparisons between drafts and original despatches and found that there is good correlation. I have therefore assumed that final draft despatches at the UK Archives can be treated as if they were the original. For the two more recent periods, I have come across documents such as
government strategies and donor reports labelled ‘draft’, in which cases I have refrained from basing my arguments too heavily on these documents.

Up to this point, I have made an account of my methods for acquiring and interpreting data. In the remaining sections of this chapter, I will describe the theoretic framework I have used in order to put my data into a bigger and meaningful picture; my methods of thinking around what I see.

2.4. Theoretic framework

A theory must be able to add a higher level of understanding of what is under study, otherwise it is redundant. In the course of carrying out these studies of the history of water supply in East Africa I have gradually assembled theoretical concepts or parts of theories that I believe are helpful. I have come to realise that there is no one-size-fits-all theory for explaining all the processes and phenomena encountered here. For the different periods studied, the research questions are not identical and I am using slightly different empirical datasets. The theoretical framework in this thesis therefore consists of several ideas pieced together from different disciplines over time. Most of the theoretical concepts here come from the field of History of Technology and from the related area of Science and Technology Studies (STS), but I also borrow from the field of economics.

Large Technical Systems

Most of my analysis and reasoning regarding the historical broader patterns in my studies is based on the theoretical foundation in Large Technical Systems (LTS). LTS had its origins in a path-breaking study by historian Thomas P Hughes (1983) on the emergence of national systems for electricity supply in Western Europe and the USA. Hughes’ ideas about the predominant development patterns and
characteristic features of large-scale technological systems have gained many followers and LTS today encompasses quite a large body of literature. Studies using LTS has since come to include many types of large-scale infrastructure including water and sewerage (see e.g. Summerton 1994; Coutard 1999). The key elements of LTS relevant to my studies are:

i. the three-tier system structure of institutions, organisations and technology;
ii. the sequential development of large-scale systems over time;
iii. the idea of ‘momentum’ that makes systems gradually more resistant to change, and;
iv. the concept of ‘reverse salient’ which impedes expansion of the system

Below, each one of these conceptual strands will be discussed.

Studies of large technical systems over time need to take into consideration that these systems are not just technology. They are more than the physical artefacts that we intuitively think of, such as pipes, pumps, valves and tanks. The artefacts and systems also have people using, building and operating them. The structured interaction of people with these systems is what we refer to as ‘organisation’. In order to control and regulate organisation, and to regulate the technology itself, we have constructed social rules such as engineering standards, building codes and laws. These social rules are the ‘institutions’. The three parts technology, organisations and institutions of a technical system are inter-dependent and they make up a ‘socio-technical system’. As Jane Summerton (1994) has put it: “the technical is inherently social” and therefore the parts need to be understood as a whole. To understand change – or absence of change – in a technological system, we must define our system boundaries such that organisational and institutional aspects of the system are
included in the analysis. This socio-technical systems approach has been essential in my studies of the water supply system in East Africa.

Secondly, large technical systems develop over relatively long time and often through a characteristic sequence of development stages. The first stage is that of ‘establishment’ where different setups of the system are tried and where the uncertainty about the system is high. In the following stage of ‘expansion’ the system grows quickly. In this stage, a successful mix of technology, organisation and institutions has been found and demand is increasing. Thereafter the system matures; growth levels off and the system becomes increasingly difficult to change. At this stage the system can experience ‘stagnation’ where expansion virtually comes to a halt and eventually decline sets in unless ways of adapting and re-designing the system is found (Kajiser 1999).

The third key concept from LTS relates to ‘momentum’. According to Hughes, large technical systems have a tendency to increasingly acquire ‘momentum’ as the system grows, making it more and more adverse to radical change (Hughes 1983:140). This analogy stems from mechanics describing a body in motion: once the direction is set and the object has picked up speed, the object/system will require a larger external impulse to make it change direction or speed. The inability of urban water supply systems in East Africa to adapt to a new economic, social and political context has been a key concern in this study. The concept of momentum has therefore been essential in my studies, however, I will use the closely related term ‘inertia’. As I have discussed in my Licentiate thesis (Nilsson 2006), in the context of LTS in East Africa the term ‘inertia’ could be more suitable than momentum. Momentum and inertia are in the context of LTS used as metaphors for some properties making the systems slow to change. They are both derived from classical physics, where inertia is a property directly related to the mass of a system while momentum is a product of mass and velocity. Momentum therefore is associated with movement in a particular direction while inertia is a system-specific
property independent of motion. While ‘momentum’ conjures up a picture of a system in growth and development, ‘inertia’ implies resistance to change and a lack of development. Perhaps the distinction between the two concepts can be perceived as splitting hairs. What is essential to remember for the argument that follows, is that large socio-technical systems are slow to react to external forces that try to make them change direction or form, and I will use the term inertia to describe this property.

The fourth concept from LTS has to do more specifically with system-inherent mechanisms that impede development and expansion of a large technical system such as an urban water network. These mechanisms can at the same time act as triggers for innovation and change. Hughes has shown how an LTS after a period of growth typically encounters barriers and obstacles within the socio-technical system itself, preventing it from further expansion until this obstacle has been resolved. This type of obstacle is called a ‘reverse salient’ and in Hughes’ own words it can be defined as “[...] components in the system that have fallen behind or are out phase with the others”. Typically, when a reverse salient is encountered and identified, the system owner focuses on solving this problem through innovations that can be either ‘conservative’ or ‘radical’. For example, in the development of telephony over long distances in the early 20th century, energy loss became the key problem – a reverse salient – that had to be solved before the system could expand. The loading coil that was used to solve this problem is an example of a conservative innovation that added a new component to solve the problem but within the overall system framework. Other reverse salient problems have led to radical innovations. For example, the invention of the jet engine was a result of the reverse salient of conventional propulsion as the industry sought for increased speed of aircraft (Hughes 1989). In this case, the radical innovation ‘jet propulsion’ led to a new technology, thus opening up new areas of application.
Finally, two more things will be important to note concerning a reverse salient in relation to my research area. First, a reverse salient does not have to be a technical component. In a socio-technical system, a reverse salient may be of technical, organisational or institutional nature. Secondly, according to LTS theory, the actor in charge of the system (the system-builder) will first have to identify a reverse salient. After identifying the problem, efforts can be made to solve it. However, this presupposes the existence of a well-defined and sufficiently capacitated system-builder as well as a conducive incentive structure for solving the problem.

LTS thus represents a social constructivist view; technology is shaped within a social framework and the inter-dependency between society and technology works in both directions. To be able to deepen my analysis and explain the observed development patterns in a post-colonial setting I will supplement LTS with a few additional concepts. Below I shall pick out a few useful theoretic strands from Science and Technology Studies.

**Paradigms, techno-politics and post-colonial studies**

The concept of ‘paradigms’ is widely used today in many contexts. Thomas Kuhn showed in his classic “The Structure of Scientific Revolutions” (1962) how knowledge and science is embedded in society in a way that old ‘truths’ are only replaced once too many inconsistencies and challenges have piled up against them. The scientific community tends to cling on to knowledge until it becomes untenable, and therefore science is perceived to develop in leaps in a revolutionary way. Knowledge is a product of the social system within which it is produced, not just a result of a positivist process of laboriously and objectively distilling ‘the truth’ out of observation.

Out of Kuhn’s ideas, Giovanni Dosi has derived the concept of ‘technological paradigms’, which will be important in my study. In a similar vein to Kuhn, Dosi states that a technological paradigm “defines contextually the needs that are meant to be fulfilled, the
scientific principles utilised for the task, the material technology to be used”. The idea of the technological paradigm embraces both “a set of exemplars” as well as “a set of heuristics”. Moreover, innovation in the paradigm tends to be conservative as most practitioners within a technological paradigm are typically confined to thinking ‘within the box’ (Dosi 1988). The technological paradigm therefore is a normative model of how to conceptualise and frame the problem and articulate the need, it proposes a restricted set of solutions from within the toolbox of the paradigm, and it defines the technology to be used and the norms for how to use it. In short, the technological paradigm defines the problem as well as the solution from a restricted set of options.

What is important to note here is that components within the technological paradigm can be shifted and gradually replaced. There is thus scope for conservative innovations and even radical innovations within the paradigm. The radical innovation of the jet engine led to a new type of technology, but within the paradigm of aircraft systems. A technological paradigm is not a monolith unable of change, but typically the paradigm revolves around a characteristic component or technological design concept inscribed in the paradigm which will not be shed until a paradigm shift takes place. The cellular phone can serve as an example of an innovation leading to a shift of technological paradigm. Brian Arthur (2009) similarly talks about a paradigm-like structuring of technologies and knowledge into ‘domains’ while Joel Mokyr (1990) uses the term ‘techniques’. What emerges as the common ground – regardless of the term used – is the typically slow evolution and inertia of these paradigms, domains or techniques. However, radical innovations do come about. Wherever a technological paradigm exists, one should therefore not confuse this with technological determinism or with a state of total immobility. What will be of specific interest here is under what conditions this change – whether conservative or radical – will take place.
If knowledge and technology are socially constructed, then also power structures in society must influence the socio-technical systems. I have already mentioned that a technological paradigm embodies a normative apparatus; it prescribes how things should be done. Socio-technical systems can also be used to pursue social and political objectives in order to reinforce or alter power structures in society. In an influential article from 1980, Langdon Winner emphasises the power-dimension of technology using the example of how road underpasses in New York were designed as to keep buses – and the unwanted low-income population - from accessing the well-to-do leisure areas of Long Island (Winner 1980). Gabrielle Hecht has coined the term ‘techno-politics’ to describe how social power structures and national political objectives were articulated in nuclear science and technology in France after the Second World War (Hecht 1998).

My study objects are socio-technical systems in countries with a colonial past. Clearly, this offers the opportunity to introduce my topic into the discourse of post-colonial studies. I will briefly discuss some selected literature that can provide ideas on how to look at socio-technical systems in a colonial perspective. Daniel R. Headrick (1981; 1988) looks at technologies of imperial conquest, colonial development and control in a historical perspective. Headrick sees technology as a key component of the imperial system and stresses its socio-technical dimensions including knowledge, education, power structures and ideals. The process of technology-transfer from the West to its colonies must be understood in relation to its level of ‘cultural diffusion’. Modern state-of-the-art technology was regularly and swiftly relocated from its original place in for example Britain, to a colony such as Kenya, Ghana or India in order to provide economic benefits. However, the diffusion of cultural institutions and knowledge surrounding these systems was much slower and was even for much of the imperial period kept to a minimum in order to preserve the colonial power structure and keep the control of modern technology in the hands of the colonial ruling elite. Although there
was economic growth, the lack of cultural diffusion and the underinvestment in human resources precluded economic development of the colonies (Headrick 1988).

As Michael Adas (1989) has demonstrated, the economic and geopolitical motives of European empire-building in the 19th century were fused with a sense of duty to enlighten and civilise the “savages” in Africa or Asia, using technology and science. A widespread notion of the colonised people as “backwards”, “inferior” or “child-like” was commensurate with a gradual and limited cultural diffusion. Thus, elitist power structures were preserved. Achievements in technology were the ultimate litmus test on the level of progress in a society and therefore. Bringing technology to the “backward peoples” was regarded as a good way of fulfilling the civilising mission, but it should be done in small steps. This strong positivistic belief in “science and reason” permeated the entire imperial project, which led to an illusion of a colonial system built on knowledge and rationality (Richards 1993). But also illusions can be useful. As pointed out by Edwards and Hecht (2010), technology introduced as part of a techno-political strategy are not necessarily measured only by their success on the technological level; they can achieve their political goals even if they do not meet their technical objectives.

With this extension of the argument in LTS it is possible to argue that a socio-technical system evolves in a paradigmatic manner and should be seen as an extension of the structures of power in society.

**New Institutional Economics**

Finally, in my papers I have employed theories from the field of New Institutional Economics (NIE), specifically the Public Goods theory and Transaction Cost analysis. I have used them to explain two things: why do societies need collective (public) systems for water supply, and; what are the incentives and disincentives for expansion of public water supply systems especially in low-income urban areas in Kenya and Uganda.
My first paper describes the Public Goods theory and its applicability to water supply in East Africa. However, for the purpose of this thesis it will suffice to note that large-scale water networks have several features that are collective in nature and that have prompted public authorities to take a lead on developing and operating them in many countries. Citywide networks are large undertakings that require a stable and long-term investment climate. They are often ‘natural monopolies’, meaning that having similar competing systems is generally uneconomic. An urban water supply system has external effects such as impacts on public health and the environment and typically needs to be managed through public involvement. This serves as an important theoretical foundation for why public authorities have been involved in provision of urban water services in Kenya and Uganda, but I will not explicitly use Public Goods theory henceforth.

More important for my arguments in this thesis is the application of Transaction Cost analysis. Transaction Cost analysis is often traced back to the seminal work of Ronald Coase in 1937. Many other scholars have contributed since, and applications are found in many different fields (Williamson 2010). Transaction costs are present for any type of economic exchange and arise from acquiring information about the market conditions, from preparing and arranging the terms of exchange (such as a contract), the actual quid-pro-quo exchange, enforcement of the contract etc. Often investors may need to include a risk premium to offset risks in relation to property rights. For my application of Transaction Cost analysis, I have been inspired by a study of Ostrom, Schroeder and Wynne (1993). In my study, transaction costs have been broadly defined as: costs arising from acquiring market information; from insecure property rights, and; from organising payments.

Historically, peripheral expansion to new areas on the fringe of existing service area has been less lucrative (Kaijser 1986; 2003; Tarr 1988). When margins are small, the cost of transactions for
investments, operations and payment for services becomes increasingly important, regardless if the service provider is public or private. From a practical point of view, reducing transaction costs can mean building confidence in the market and in the investment climate, enforcing property rights and finding ways of facilitating the actual exchange through easy and reliable modes of payment. Although Transaction Cost analysis has been described here in a very crude way, it promises to be helpful in the analysis of expansion of service to low-income urban areas in subsequent chapters.

Having laid out the background, purpose and scientific approach of this study I shall now turn to the story of how water supplies in towns came to be established and developed over a period of more than a hundred years in Kenya and Uganda.

Take up the White Man's burden--
Send forth the best ye breed--
Go bind your sons to exile
To serve your captives' need;
To wait in heavy harness,
On fluttered folk and wild--
Your new-caught, sullen peoples,
Half-devil and half-child.


3.1. Colonisation of East Africa and the ‘Lunatic Express’

An international conference was held in Berlin in 1884 and 1885 that would have a significant impact on the relationship between Europe and the African continent. At this conference, the Western empire-builders including Britain, France, Germany, Italy and Portugal, agreed on the demarcation of geographical ‘spheres of influence’ in Africa. They also agreed on the routines for making legitimate claims to these areas. The arrangement included a doctrine of effective occupation; a coloniser could not just make claims on paper but had to also show physical establishment on site in order to make the claim legal (Wesseling 1992). With the blessing from the other participants at the conference: the USA and most western European states including Sweden, the coastal area of today’s Kenya became part of the British sphere of influence. Britain already exerted a strong influence over Egypt and thus could secure control of the strategically important Suez Canal. However, the Berlin accord did not regulate
the control of the interior of Africa. Land-locked Uganda was understood at the time to hold the source of the Nile River. The state that controlled the Nile would be able to control Egypt and thus the Suez Canal, according to contemporary doctrine (Miller 1971:7). With difficult access from the coast, the British were challenged by both Germany and France in securing control of the ‘source of the Nile’. In 1890, Frederick Lugard had secured a treaty between the United Kingdom and the kingdom of Buganda, by then regarded as the most powerful ally in Uganda. In 1894, Uganda was declared a Protectorate, followed by the territory of today’s Kenya the year after (Ssekamwa 1993). But this did not solve the problem on the ground; how to effectively control the source of the Nile, in the interior of a landlocked country virtually without roads. The answer lay in quickly building a railway from Mombasa at the coast to the Lake Victoria, by which you could reach Uganda by boat. This daunting task took off from 1896. Traversing more than 1000 km of previously uncharted territory and at the whopping expense of around 5.5 million pound sterling this enterprise soon was dubbed the ‘Lunatic Express’ in British press. In 1901, the last rails were laid at the dock of Port Florence at the shores of Lake Victoria (Hill 1949; Miller 1971:390ff).

No doubt, geo-political strategic interests were very important in the building of the “Uganda Railway”, as it was called. This notwithstanding, it is safe to assume that commercial interests and the mission of civilising the ‘backwards areas’ also contributed to the decision of constructing the railway. As pointed out by Adas (1989), colonial officials regularly expressed their enthusiasm over the introduction of railways and steamboats to the colonies to bring civilization and modernity. Wherever the British empire expanded its political control, trade was soon to be introduced according to the principle of ‘trade follows the flag’ (Pakenham 1991). Sometimes trade interest was the main driver behind political expansion. As expressed by Daniel R. Headrick: “Trade did not so much follow the flag as come wrapped in it.” (Headrick 1988:379).
Whatever the ‘actual’ motive of the railway from the coast to Uganda, its construction had tremendous impact on the colonial enterprise in Uganda and perhaps even more for Kenya, not least for the introduction of modern urban water technology. In the following, I will explore how socio-technical systems for urban water supply were established and developed during the colonial period in the two colonial settlements of Kenya and Uganda.

3.2. The role of water in the early colonial economies

Along the railway, urban settlements started springing up around the railway depots and stations. In 1899, the railway had reached a small river crossing approximately halfway to Lake Victoria. At this place, known by the local Maasai people as Nairobi, a major depot was established. Nairobi rapidly became populated and grew quickly; in 1900 it had its own municipal administration and in 1905, the colonial administration headquarters moved to Nairobi from Mombasa (Thornton White, Silberman and Anderson 1948; Smart 1950). Other towns also grew up along the railway: Naivasha, Nakuru, Eldoret and Kisumu, then called Port Florence. The railway thus defined the urbanisation pattern of Kenya (Obudhu and Obudhu 1992). In Uganda, the first larger colonial settlement was established in today’s Kampala. Here, the Kabaka (king) of the Buganda Kingdom had already established himself on Mengo hill. When Frederick Lugard arrived here in 1890 with his expedition, he simply pitched his camp on the adjacent hill of Kampala. Later, he also had a fort built on Kampala hill (Miller 1971: 211). Out of the combined settlements of the Kabaka and Lugard would grow today’s capital of Uganda; Kampala.

These early urban centres saw rapid and unregulated growth resulting in sanitary problems and public health hazards. Both Nairobi and Kampala repeatedly faced threats of plague, typhoid and cholera during the two first decades of existence (paper 2, and 4). In order to control development and reduce public health risks, the first
municipal administration in Nairobi was given the responsibility in 1900 for policing, fire-fighting and sanitation (Smart 1950). The local colonial administration in Kampala tried to keep the development in check by providing sanitation services, vaccination campaigns or by simply burning entire parts of the city that were deemed as insanitary. In 1926 no less than 121 persons were employed just to empty the over 1,000 latrines. The colonial administration tried to enforce – with mixed success – the draconian regulations known as the Township Rules. Violation of these rules even carried corporal punishment in the 1920s (paper 2).

Water supplies, however, were not in the hands of local municipalities in the early period. In Kenya, the building of the railway led to an early development of urban water supplies. The organisation in charge; the Uganda Railways, depended on water for its steam engines and for its workers and had to develop water supplies along the railway as the laying of tracks progressed towards its final destination at Lake Victoria. As was noted above, the railway administration was in place before there was any local government administration in the newly established urban centres. It was obviously the most logical and practical solution that the Uganda Railways assumed the main responsibility for developing and operating the water supplies in towns along the railway. As a result, for the first two decades of the 1900s most urban water supplies in Kenya were in the hands of the Uganda Railways (paper 3). These were supplemented by private operators and investors, such as the privately owned and operated water supply in Muthaiga; an up-market sub-urban area of Nairobi (paper 4). In Uganda, on the other hand, there was no major public undertaking for water supplies until the 1920s. Here, water supply was a private endeavour in the first decades, using mostly springs, wells and rainwater collected in tanks (paper 2).

In order to generate income for the colonies, the colonial administration sought to develop agriculture for export production.
The railway now came in handy; an agricultural export production would have been impossible without it. At the same time, the railway had been an expensive venture and the colonial administration wanted to get at least some of their money back from transport charges (Miller 1971). Farmers of European origin were encouraged to settle in the colonies, and in Kenya a considerable settler community would develop with time. Kenyan white agriculture was concentrated to the fertile highlands, and would come to include a variety of products such as wheat, coffee and tea, dairy products and cattle. The European settler community in Kenya peaked around 60,000 people in the 1950s (Davidson 2001). In Uganda however, white settlement never became the key to economic growth and accordingly, the “white community” was also much smaller. Early attempts at introducing European-style cotton farming failed. Instead, indigenous production of cotton by Africans became the main source of supply for the Uganda cotton exports (Engdahl 1999). The different agricultural systems and owner interests between Kenya and Uganda would, as will be discussed below, influence water policy in the two countries.

As agriculture was the backbone of the colonial economies of both Kenya and Uganda, legislation regarding the use and ownership of land and water was early on put in place by the colonial Governments. The Kenyan soil was divided into Crown Lands and Native Lands. The Crown Lands were made up of prime farmland and other land of interest to the colonial administration. On Crown Lands, statutory written law applied while in the Native Lands - or ‘reserves’ - the Africans were supposed to apply their own customary law. Thus a dual legal regime was erected. While the European settlers and the colonial administration soon got busy trying to organise water supplies in the areas under statutory jurisdiction, the Africans in rural reserves carried on water management much as before. Traditional practices of regulating the use and management of water resources have existed in East Africa for centuries, sometimes with fairly elaborated property rights systems. These traditional regimes co-
existed with the statutory regimes throughout the colonial period and beyond (paper 4).

The Crown Lands Ordinance governed land use and ownership in Kenya’s “white” areas, and it had provisions for regulating use of water resources already in 1902. English common law based on centuries-old practices in England came along with the settlers from Europe and was practised in the early colonial period. However, the use of common law resulted in many disputes that had to be settled in court and already in 1916 Kenya’s colonial administration - unsuccessfully - tried to develop new legislation for water (paper 4).

In Uganda, an agreement in 1900 with the Kabaka set the stage for land ownership. Crown Lands were under British administration, while the Kabaka and traditional chiefs administered the remaining areas (Nawangwe and Nuwagaba 2002). There was less activity to develop statutory law for the use of Uganda’s water resources, possibly because Africans did most of the farming. Instead, the focus appears to have been on facilitating public water supply in urban centres (paper 6). The medical authorities of the colonial administration in Uganda complained in 1913 that the springs supplying Kampala with water were “a most unsafe supply, very liable to pollution, and should as soon as possible be replaced by a public supply brought from the lake” (Simpson 1915). Also the sanitary situation in the colonial capital Nairobi was an eye-sore to the authorities. The colonial administration was involved in the building of a new water supply to Mombasa in 1912-17 but apart from this, the state was not ready to take on responsibilities for urban water supplies (paper 4). But after the First World War this would all change.

3.3. A state-led expansion of water supply

From around 1920, the state gradually assumed the role as the main water supplier to urban areas. In Kenya, this meant taking over water supplies from the Uganda Railways and from various private
suppliers. Responsibility to operate and develop water supplies was instead vested in the colonial Government’s Public Works Department. By 1931, the Public Works Department owned and operated water supplies in eleven towns. The Kenyan colonial administration early on also sought to devolve responsibility to local authorities whenever possible. In the capital Nairobi, the responsibility for the water supply was devolved to the municipality, who bought the water supply system from the Uganda Railways in 1922. The municipality of Nakuru soon followed Nairobi to run its own water supplies. The state kept on investing in new and expanded water supplies for Kenya’s urban centres up until the global economic recession affected East Africa in the mid-1930s (paper 3).

In Uganda, the colonial administration - with its headquarters in Entebbe not far from Kampala - was anxious to get a public water supply to Kampala. The possibilities of taking water from the Lake Victoria some 10 kilometres away had been discussed at least since 1913. The Colonial Office in London had repeatedly refused the idea on the grounds that it would be too expensive (paper 2). But the administration in Uganda pressed on, mainly arguing for the introduction of a piped water supply in order to safeguard public health. The poor quality of the existing water supply was repeatedly lamented in despatches to London:

“...the community must perforce continue to drink polluted and contaminated water, and to be exposed to the risk of epidemics of a serious nature and the loss of valuable lives”

(Mr. Jarvis, Acting Governor of Uganda. Source: Uganda Protectorate 1927).

Finally, the Colonial Office yielded. In 1930, the water supply had been completed at a cost of £104,000. It was designed to supply about 14,000 people with purified water using a reticulation network covering mainly the “white” areas of Kampala plus the hospital at Mulago Hill and the college at Makerere (paper 2). Two years earlier,
the smaller water supply in Jinja had been completed and was operated by the Public Works Department (paper 6). By 1939, the Public Works Department had also completed the sewerage and drainage network of Kampala at a cost of over £400,000 (paper 2). The type of devolution to local authorities that was used in Kenya never took place in Uganda, where the Public Works Department continued to run all urban water supplies at least well into the 1950s (paper 4; East Africa Royal Commission 1955:137ff).

The expanded role of the state for water supplies in Kenya and Uganda from the 1920s was matched with changes in the institutional framework, most notably new legislation for water. In Uganda, a new Water Works Ordinance was passed in 1928 (Uganda Protectorate 1928). The 1928 Ordinance was necessary in order to create a legal framework for the urban water supply under construction in Kampala, but it did not regulate the colony’s water resources. In Kenya however, the lawmakers were more concerned with legislation for the management of water resources. Water for farming was a critical and sensitive issue, not least for the white settler community. Throughout the 1920s, the colonial administration tried to develop a new water law that would give the state supreme rights to all water. This came under heavy fire from the settlers who accused the administration for theft and “bolshevism”. The Colonial Office in London, on the other hand, were concerned that the law did not properly secure the rights to water for Africans living on Native Lands. After more than a decade of preparation and debate, Kenya Water Ordinance was passed into law in 1935. It secured state supremacy over all surface waters and closely regulated urban water supply in Kenya. The law would be revised over the years but in its essence, it remained until 2002 (paper 4).

During the Second World War, the British colonies focused on the war effort and little development took place. After the War however, development took off, partly thanks to the infusion of funds from UK under the Colonial Development and Welfare Act. In Kenya, an
investment programme in agriculture and water was launched in 1946. This programme sparked a rapid development of water supplies in smaller towns. The number of water supplies operated by the Public Works Department grew to 57 in 1950 and to 80 in 1958, while delegation of responsibility continued to a handful of municipalities that were deemed capable of managing water supplies independently (paper 3). How were the colonial administrations able to finance these major civil works? And how did the colonial administrations in Kenya and Uganda regard urban water supply in terms of its commercial nature?

“[…] it is quite out of the question at present to contemplate any subsidy from general revenue for a municipal water supply of this nature.”

Mr Gowers, Under-Secretary of State for the Colonies 1926 (Source: Colonial Office 1926)

"In a backward country, the provision of water supplies in townships is in the nature of a social service, undertaken in the interest of public health and sanitation, rather than a commercial venture undertaken with a view to profit.”

Deputy Governor of Uganda 1952 (Source: Uganda Protectorate 1952.)

The quotes above relate to the Kampala supply but are typical for this period of colonial state-led water management from the 1920s. In official statements, water was to be provided in the public interest and not as a for-profit venture. On the other hand, to subsidise water supplies from other Government resources was unthinkable: the cost for water supplies had to be carried by the consumers themselves. Furthermore, before 1945 very little money came from UK for investments of this type. The investments had therefore to be financed from locally generated funds or from loans on the international finance markets. The Uganda Protectorate financed the
water supply in Kampala using “stock”, a kind of government bond sold on the international finance market. To recover the costs for capital, operation and maintenance the Public Works Department levied a water fee on all houses within the service area, based on the property value. Part of the fee was levied regardless of whether you had a connection or not, which created a strong incentive for all property owners to install a connection. There were also some major consumers - such as government institutions - who paid according to metered consumption. In all, the colonial administration thus was able to recover all costs on the Kampala water supply from 1938 and onwards. The sewerage system built in Kampala a few years later was a different story. The cost for sewerage – which was four times that of the water supply - had to be subsidised by the Protectorate’s general revenue (paper 2).

In the sister colony Kenya, official policy on cost recovery was similar, but here payment in relation to metered consumption became the norm. Nairobi municipality decided already in 1925 to install meters for all consumers (paper 3; Nairobi Municipal Council 1925). From the 1930s and up to the 1970s the larger towns were successful in recovering full costs for capital, operation and maintenance while the smaller had to be subsidised. Special arrangements were made for financing investments. Nairobi Municipal Council was authorised to take up international loans independently in 1949, followed by the Mombasa Pipeline Board in 1957. Medium-sized municipalities running their own water supplies could access finance through the Local Government Loans Authority, which was commissioned in 1953. From the data available, it appears as the urban water supplies in Kenya and Uganda were more or less financially self-sustaining in the colonial period (paper 3).

The technology used in the early systems erected by the Uganda Railways had been quite rudimentary, with low per capita supply and simple distribution networks. Standpipes were frequently in use. From the 1920s and onwards the systems became more sophisticated
and were aligned with British standards (paper 3). The large-scale system for water and sewerage built in Kampala in 1930 used British engineering standards, and a British engineering firm - Howard Humphreys and Sons – produced its final design. The Kampala water supply was designed based on a water demand per capita of 40 gallons per day for the Europeans (paper 2). In Kenya a norm of 50 gallons per day prevailed from the 1930s and onwards which was in the same range as the accepted norm in Europe (paper 3).

The design of these systems bears a testimony to who the administration regarded as their main beneficiaries: the Europeans, and to some extent the Asians. In Kampala, it was part of the original plan to provide the African part of the town - the Kibuga which was administered by the Kabaka – with water from the new public supply. When the Kabaka rejected the idea - reportedly on financial grounds - focus was henceforth mainly directed towards the European and Asian households, although water was still to be sold to Africans at standpipes (paper 2). The significance of these standpipes in the colonial period from the viewpoint of public health should not be downplayed. Certainly, it could have been an important water supply for people with lower incomes. However, the revenue from sales at standpipes in Kampala never exceeded 1% of the total annual revenue between 1931 and 1948 (paper 6). From an economic point of view therefore, standpipe provision was insignificant for the PWD. Furthermore, while the design demand per capita was put at 40 gallons per day for Europeans, for Africans it was calculated that 20 gallons would suffice (paper 2).

Similarly, in Nairobi and other Kenyan towns there was in practice segregation of the races and little effort was made to develop service in the African areas. At the same time urban population grew significantly from 1920 to 1960, as illustrated in Fig. 1. The rapid urban growth was not matched with housing and infrastructure for the African population, which had a significant impact on the way urban areas developed later on (paper 3). The East Africa Royal
commission stated in 1955 that in the urban centres, Africans “are denied the rights and advantages that members of the other races enjoy” (East Africa Royal Commission 1955:209). Just as in Uganda, the design norms for daily water demand was segregated along racial lines with 50 gallons for Europeans but only 10 gallons per day for Africans (paper 5).

![Figure 1. Population in Nairobi. (Source: White et al 1948; Morgan 1969; Republic of Kenya 1994; KNBS 2010. NB 2009 census figure is for Nairobi province)](image)

3.4. The colonial paradigm of large-scale water technology

In this section, I will analyse and discuss the period of colonial rule from 1895 to 1963 in relation to my research questions, using the relevant theories suggested in chapter three. For this period, three key analytical questions are of particular interest:

- did the introduction and development of piped water supplies in Kenya and Uganda follow a typical LTS progression?
- what were the motives for the state to construct urban water supplies; why where they built and for whom?
what was it specifically in the emerging ‘technological paradigm’ that created inertia?

I have already argued that the LTS theory could be relevant in analysing the history of urban water supplies in Kenya and Uganda. However, I also want to validate this argument, by assessing if the development of these systems has the characteristic dynamics of an LTS in the early stages. This would motivate the use of LTS theory to provide guidance on the dynamics of the subsequent stages.

The early period between 1895 and 1920 corresponds to the stage of ‘establishment’. The first water supplies using large-scale networks in Kenya were constructed by the Uganda Railways. These were supplemented by various private suppliers and by the colonial administration in the case of Mombasa. The organisational structure was hence heterogeneous and the institutional framework was fragmented rather than streamlined for urban water supply. Modalities for finance were also in their nascent phase. This type of sector-level vagueness contributes to a high degree of insecurity, which commonly constrains development during the stage of establishment (Kaijser 1999). In addition to the above-mentioned factors, in Uganda unclear consumer demand (market uncertainty) posed a significant challenge, to the extent that no large-scale urban water supply was constructed until 1928. It is worth to note that uncertainty about technology does not seem to have been a major constraint during the establishment. The technology had already been tested in Europe for decades and the engineers designing the early water supplies in East Africa could bring in ready-made solutions for the most varying needs, such as a plant for producing desalinated seawater in Mombasa in the last few years before 1900 (Hill 1949: 148; paper 4).

During the establishment phase of urban water technologies in Kenya and Uganda, the main mode of introduction is through transfer from the UK. When large technical systems are introduced by transfer, the
system transferred typically goes through a period of initial adaptation to local conditions. Being a socio-technical system, not only has the technology to match local physical conditions and needs, but also its organisations and institutions must be adapted (Hughes 1989). As demonstrated, a number of organisational and institutional changes had to take place in Kenya and Uganda before expansion could begin.

The emerging role of the state for water supply in Kenya and Uganda, the homogenisation of the institutional framework including dedicated water legislation and a defined structure to source finances, all this paved the way for the next stage of development. Both Kenya and Uganda experienced a rapid expansion phase from the 1920s at least up to the end of the 1950s. The expansion was done both through enlargement of existing systems, and through successive replication in growing towns “which had reached such a stage in their development as to justify piped supplies being laid on” as it was expressed by the Kenyan administration (Colony and Protectorate of Kenya 1930). Between 1922 and 1958, the number of towns in Kenya with piped water supply thus increased from 13 to 85 (paper 3). Uganda had a slow start, but once the institutional and financial hurdles had been overcome, Uganda could move quite rapidly from establishment to expansion. Jinja was first with a water supply in 1928, followed by Kampala in 1930 and Entebbe and Mbale in 1938 (Uganda Protectorate 1929;1931;1939).

Thus far, I believe it is safe to say that the trajectory of large-scale urban water supplies in colonial Kenya and Uganda seem to follow a ‘typical’ LTS progression.

Having asserted the relevance of the LTS theory for my study, I shall now turn to my second research question: why were the systems built and for whom? My findings suggest that in Kenya as well as Uganda, the introduction of large-scale public water supplies in towns was mainly motivated through a combination of public health concerns
among the Europeans and the notion of bringing development and modernisation to these “backward” places. There were many perceived and real threats to public health in towns in the early colonial period; outbursts of plague, cholera and typhoid have all been recorded. Furthermore, medical statistics were used to convince the Colonial Office of the necessity of investing in urban water supplies (see papers 2, 3 and 4). Similarly, drainage and sewerage were motivated as efforts to combat water-borne disease as well as malaria (paper 2). Improving public health has been a key objective for the introduction of large-scale water supply systems in cities all over the world in the 19th century, from smaller towns like Stockholm to mega-cities like Paris (see e.g. Goubert 1989; Gullberg 1998; Melosi 2000). The public health effects typically provide a strong case for public involvement in order to control the externalities of contagious disease, and hence for building city-wide public water supplies (see paper 1). Even the expansion of the water supply network to peripheral low-income areas has historically been motivated by disease control. Although providing these areas with clean water was often deemed unprofitable, the public health externalities could only be effectively curbed with an inclusion of these ‘slums’ in the network supply area (Hallström 2002). It is therefore quite understandable that it was in the interest of the authorities to include a mechanism to sell water also to the African population in Kampala, even if these could not afford a connection. In addition to the public health externalities involved, other public goods features of urban water supplies, such as the natural monopoly, should have compelled the state to act.

While the objective of providing water for fire fighting has not been as pronounced in East Africa as elsewhere in the world, the issue of bringing modernisation seems to have been all the more influential. After all, had Britain not heeded Livingstone’s call to bring ‘Commerce, Christianity and Civilisation’ to Africa? The Nairobi Sanitary Commission of 1913 eloquently expressed this general sentiment:
“Nairobi as a largely European city situated close to the Equator is almost unique among the cities of the world. [...] Considering the advances made in sanitary science, [...] it would be deplorable if all possible advantage were not taken of modern science to render Nairobi at a comparatively insignificant expense, a model of a sanitary tropical city.”

(Source: Nairobi Sanitary Commission 1915)

This ideal of modernisation of a “backward” area and turning it into a “model of a sanitary city” was mirrored in the following quote from Governor Gowers of Uganda from 1929:

“ [...] much remains to be done if Kampala is to extend on the lines of a modern township and if the health of its inhabitants is to be reasonably safeguarded.”

(Source: Uganda Protectorate 1929)

The ideal of bringing modernisation and progress was evidently an important factor for the introduction of large-scale technology for water supply. This ideal took root among decision-makers in the colonial period in Kenya and Uganda. The ideal of progress was underpinned by the general sense of duty to bring civilisation and modernity to “backward” places, of which Michael Adas (1989) has written. The same spirit surfaces in the introductory quote from Kipling, a spirit that was to be expressed and manifested in tangible public works such as large-scale urban water supplies. Large-scale water systems were just one of the ‘tentacles of progress’ that Daniel R. Headrick described in his book with the same name (Headrick 1988). This ideal of modernisation and progress, I will henceforth call the ‘developmental attitude’. I will argue later on that this developmental attitude did not depart from the scene along with its British originators after independence.
So, for whom were these systems built? My study clearly indicates that although these systems were to bring modernity to backward places, primarily they were designed to cater for the needs and preferences of the European minority. In 1912, the Europeans made up around 6% of the population in Nairobi, then estimated to be close to 20,000 (Nairobi Sanitary Commission 1915:56). Yet, the Nairobi Sanitary Commission had labelled it “a European city on the equator” and advocated to expand the piped water supply in order to bring it closer to European standards. In Kampala, European technology was introduced to safeguard health and satisfy the needs of the Europeans, who counted only 457 out of a total population of around 11,000 in 1929, not counting the African Kibuga (paper 2). Racial segregation was officially prohibited in Kenya after 1923 (Ssekamwa 1993). Despite this, the modern lifestyle and European-style public service were mainly meant for those who could pay for it, namely the colonizers. The annual cost for the water supply in Kampala in 1939 was £19,900, or roughly 20 Shillings per capita. Given that the annual income of African labourers was in the range of 100 Shillings per year, clearly the cost level of the large-scale water supply was out of touch with the economic reality of Africans at that time (paper 2). Although the Public Works Department sold water to the African population at standpipes, there is no doubt about who were seen as the main customers; the Europeans and the Asians. This was also reflected in the racially biased norms for design demand, where European water consumption was pegged at between two and five times that of the African consumer. Although the prevailing ‘developmental attitude’ subscribed to the ideal of modernisation and progress, its manifestations in technology had a clear bias towards serving the colonial elites.³

³ Similar water policies based on segregation have been described also for Ghana (Bohman 2010) and Senegal (Ngalamulume2005).
I shall now close this chapter with a discussion of my third question; what was it in the configuration of water supplies in the colonial period that contributed to inertia? I will discuss this using the concept of technological paradigms. What characteristics are intrinsic in the technology, in the “set of heuristics” and engineering practice associated with it? One could of course talk of the entire technological setup, its organisational and institutional structure and their local adaptations as a technological paradigm. However, such a wide approach would not add much analytical capability. I will here expose some particular characteristics that I argue were intrinsic in the concept of piped urban water supplies, and that led to certain robust and change-resistant features of the system. In short, I will point to certain characteristics in the technology that have contributed to inertia.

Urban water systems are capital-intensive undertakings with a high degree of sunk capital and therefore, investments should preferably be done in a stable financial environment and as a long-term undertaking (paper 1). The large scale of the constructed systems was unprecedented in Kenya and Uganda, which is why organisational and institutional change had to be accomplished prior to the major investments during expansion phase. The organisational and institutional structure thus erected was specifically built for these large-scale systems. An important characteristic of the technological paradigm employed was simply the large scale itself. This may seem superfluous and self-evident at first glance. Below, I will elaborate why I believe ‘large-scale’ is a non-trivial characteristic.

First, we need to remind ourselves of the institutional framework surrounding the technological paradigm of large-scale water supply in the colonial period and the economic realities it created. The colonial administrations enforced a strict policy on full cost recovery for water supplies. The large-scale systems meant large investments that had to be recovered directly from the consumers. This was best accomplished through tapping the high-value consumers first and by
trying to sell more water. In Kampala, the largest consumers (Government institutions) paid according to metered consumption, while all properties within the network service area paid a flat rate fee. Part of the fee had to be paid even if the premise did not have a connection to the public water supply. This way the Public Works Department maximised revenue from the start. However, this arrangement also prompted the property owners to get an individual connection to their property in order to benefit fully, since they had to pay anyway.

In Nairobi, on the other hand, the large investment costs were recovered from the users based on metering of the consumers. The metering had started taking place already before the state became involved in water supply in the 1920s. The Uganda Railways had no powers of taxation and metering had therefore been a logical response. To change from metering to a tax-based system would have proven difficult, as the British would discover in Ghana where such an attempt met with large public protests in the 1930s (Bohman 2010:72). Kenya hence retained a system of metering from the early period, which created an economic incentive for the supplier to encourage individual connections, particularly among the wealthy who typically would consume more.

A norm on individual connections thus emerged as part of the technological paradigm. ‘Individual connections’ means physical pipes being laid up to each property. As will be discussed further in the next chapter, this would come to have great importance in the post-independence period. In conclusion, I argue that a technological paradigm emerged in Kenya and Uganda, characterised by large-scale and capital-intensive technology transferred from UK, coupled with a norm of individual connections in response to the strict policies on cost recovery.

“With independence, Kenya intends to mobilize its resources to attain a rapid rate of economic growth for the benefit of its people. Under colonialism, the people of Kenya had no voice in government; the nation’s natural resources were organized and developed mainly for the benefit of non-Africans; and the nation’s human resources remained largely uneducated, untrained, inexperienced and unbeneffited by the growth of the economy.”


4.1 The political economy of the young Kenyan Republic

In 1962, Uganda was granted independence from the United Kingdom, followed by Kenya in 1963. In this section, I will focus on Kenya to study in detail what independence meant in terms of new policies for urban water supplies. Between 1952 and 1960, the Kenya colony had been in a state of emergency due to the violent liberation struggle of the Mau Mau rebellion. Through the democratic elections in 1963, Jomo Kenyatta, one of the leaders of the fight for an independent Kenya, was installed as Prime Minister and later he became the first President of Kenya. In 1965, the Government adopted Sessional Paper no.10, “African Socialism and its Application to Planning in Kenya”, which would provide a development policy blueprint for many years. The aim was to develop the country and its infrastructure in order to become an industrialised country as soon as possible, to do away with the social inequalities that colonialism had brought and lift all Kenyans out of poverty. These overall goals were made operational in the Government’s five-year development plans. The “African Socialism” applied in Kenya was not very socialist; Kenyatta’s policies were soon regarded as more capitalist-friendly
than most other former colonies in Africa. Kenya initially enjoyed economic prosperity with annual GDP growth of around 6% for most of the 1960s, mainly based on agricultural exports such as coffee but also manufacturing and a burgeoning services industry, see Fig. 2 (Jerven 2011). The government adopted a very expansive and supply-oriented programme for public water supply and in 1970 set the specific objective to provide all Kenyans with water in the year 2000. As indicated previously, the towns had quite well developed water services and claims were made from the Government, supported by the WHO, that Kenyan towns had near universal access to piped water in 1963. Much of the efforts to provide all Kenyans with drinking water therefore took place in rural areas that had been neglected in the colonial period. This notwithstanding, the development budget for urban water supplies of the Republic of Kenya increased with a factor 15 from 1965 to 1984 in absolute numbers.

Figure 2. GDP annual growth rate in Kenya given as average for each period (from Nilsson and Nyangeri 2008).
Hence, at independence the prospects looked very bright for the young democratic nation. From 1973 however, economic growth slowed down considerably, while population growth continued at around 3% per year. Cost overruns, delays and staffing problems marred the programmes for urban water supply. Inflation started soaring and would eventually undermine the budgetary allocations so that from the 1980s, the Government's allocations in the 5-year development budget for urban water were decreasing in real terms (paper 3).

While economy slumped and the government programmes for expanding water supplies met with problems, population grew rapidly in the urban centres. The official statistics show an increase in urban population in Kenya from 671,000 in 1963 to 4,170,000 in 1990. Given the segregated structure of urban areas inherited from colonial times and the long neglect of developing services in these areas, problems with informal settlements worsened. Informal settlements - sometimes called 'slums' or 'peri-urban areas' - are unplanned areas either on the urban fringes or scattered within the urban landscape, where predominantly poor people build simple structures without official permission. The independent government continued the colonial practice to bulldoze informal settlements. To relieve the acute shortage of urban housing, the Government embarked on housing programmes from the end of the 1960s. Before long, the housing programmes ran into the same type of problems as the water development programmes with cost overruns and severe delays (paper 3). While few new housing units were constructed, the "illegal" dwellings in informal areas were still being bulldozed. The number of dwellings in informal areas razed by the government overshot the number of new housing units built in these programmes, hence exacerbating the housing shortage (Mitullah 1999).
4.2. Change and continuity in the water sector

What happened to the quality and coverage of urban water supplies in this period of initial euphoria followed by economic stagnation up to 1990? As mentioned in chapter two, water supply data can be treacherous. The WHO figure of near universal coverage in urban areas by 1963 is comparable with the official figure of 91% from 1990. However, later the Government has rejected its own official figures and estimated much lower coverage ratios. The overall picture based on available data is one of long-term decline of water coverage ratio. According to Hukka, Katko and Seppälä (1992) the urban water coverage went down from 85% to 78% between 1980 and 1989. Kenya hence saw declining urban water services during the decade dubbed the ‘International Water Decade’ by the United Nations. In 1997 a repeat study was made by an international team of researchers on the widely cited “Drawers of Water” study. This study included detailed surveys of water use in a large number of households in East Africa in 1967 (White et al 1972). The repeat study showed that the quality and reliability of water supply in rural as well as urban areas had deteriorated over thirty years, and that consumption was lower (Thompson et al 2001). The Drawers of Water repeat study confirms the picture of decline in urban water supply quality and coverage.

On a technological normative level little changed in the first three decades after independence. The focus on large-scale and expensive technology based on European standards persisted and alignment with British standards was strong. For example, the Kenya Building Code from 1969 stipulated that for all new houses:

4 The International Water Decade could be seen as a fore-runner to the UN Millennium Declaration, focussing on improving the access to water and sanitation worldwide.
“The water supply installation whether taken from the Council’s water reticulation system or otherwise, shall comply with British Standard Code of Practice C.P.310[...]

(Source: Republic of Kenya 1969:52)

By the 1970s, the problems with affordability could no longer be ignored. In 1974, the Government acknowledged that there was a need to develop simpler and more affordable ways for providing urban services and to “adopt standards for urban infrastructure which closely relate to what can be afforded by the country as a whole” (Republic of Kenya 1974:119). However, not much happened in terms of standards and norms. The design demand was adjusted down from 220 to 160 litres per capita per day, but on the whole, standards and norms remained the same (paper 3). The Government acceded again in 1983 that the “current design standards for both urban and rural water supplies appear to be too high in relation to needs and the costs” (Republic of Kenya 1983: 161). Individual metered connections remained the Government norm throughout the 1970s and 1980s and few alternative solutions were put into practice. In Nairobi, simpler distribution methods such as communal water points or water kiosks were tried in some low-income areas by the local authorities but generally, these were insufficient in capacity and resulted in high retail prices for the consumers (Odira and Nyangeri 1994).

On a superficial level, the Kenyan water sector saw a lot of organisational change after independence. Responsibility for water supply to small towns was originally entrusted to the Public Works Department, then transferred to the Ministry of Natural Resources in 1964 and to the Ministry of Agriculture in 1968. In 1974, the Government placed the water portfolio in a new ministry, the Ministry for Water Development. The policy to devolve responsibility to larger municipalities continued, but a short-lived attempt to decentralise operation of urban water supplies also in smaller rural municipalities was discontinued in 1968.
In summary, for the larger towns the organisational structure was unchanged from the colonial period as the municipalities continued to run their water supplies under the supervision of the Ministry for Local Government. The structure for financing water supplies was also left intact from the colonial period. Nairobi City Council raised commercial loans independently, the Mombasa Pipeline Board – a financing corporation created 1957 – was also retained, while all the others accessed finance through the Local Government Loans Authority (paper 3).

The institutional framework shows a complex dynamics after 1963. The old colonial Water Ordinance from 1929, which had been revised in 1951, was revised again in 1972. It was now called the Water Act, Chapter 372 of the Laws of Kenya but in principle, the law was unchanged. A curious detail is that the 1972 Water Rules – subsidiary regulation under the revised Water Act – retained the racially segregated water allocations, see Fig. 3 below (Republic of Kenya 1972).

Figure 3. The Water Rules of 1972 under the revised Water Act Cap 372. Application form for Water Permits.
Almost ten years after independence, the form for permit application still indicated that while Europeans were allowed 50 gallons per day, Africans (and cattle) should make do with 10 gallons per day.

The colonial policy on cost recovery for urban supplies was also officially kept intact. Although Kenya did not get an official Government policy document on water services until 1999, policy was manifested in other ways. The Government reiterated in its Development Plan in 1974 as well as in 1983 that urban water supplies should recover their costs for capital, operation and maintenance through user fees.

“It is intended that systems for urban supply and sewage disposal become self-supporting financially as rapidly as possible. Rates will be established, therefore, on the basis of a full recovery of capital, operating and maintenance costs of all schemes taken together in the long run”

(Source: Republic of Kenya 1974: 328)

But according to data analysed by Hukka, Katko and Seppälä (1992), in 1986 no municipality recovered more than a third of their actual costs for the services. In the smaller towns operated by the Ministry, a study in 1984 found that these supplies only recovered costs for operation and maintenance but nothing of the capital costs (Republic of Kenya 1984). Inflation and accelerating costs have already been mentioned as part of the reason behind the poor cost recovery; it was difficult to revise tariffs fast enough to keep in step with inflation (paper 3).

The main difference with respect to cost recovery in the post-independence period was not a change of official policy, but a lack of mechanisms and lack of political will to enforce the official policy. To understand how this could come about, the increasing political influence over the water sector in Kenya in combination with the emerging political system of patron-client relationships needs to be
taken into account. In the next section I will discuss how the new political landscape affected urban water supplies, and how politics fused with the lingering technological paradigm to create a dysfunctional urban water sector.

4.3. Institutional change and technological inertia

The Kenya of 1963 was very different from Kenya of 1895. The development challenges were different, and a completely different political and social landscape had come into being, in which these challenges were to be met. It is natural therefore to ask different questions when analysing this period. Of particular interest to me is to explore institutional changes after independence and to analyse how they contributed to technological inertia. For the period 1963 to 1990, I want to concentrate on the following three questions:

- How do motives and public objectives for urban water supply change after 1963?
- How did the new political environment affect the urban water systems?
- Why did not technology adapt to the new economic and social conditions?

First, I will look at public objectives in development policy and specifically for water development. Overall economic development policy in the early years after independence was basically carried over from the colonial period (Green 1965; Ochieng 1995). Economic development and growth came as a first priority for the new government. Accordingly, when the ambitious water expansion programmes were launched in the 1970s, although the public health objective was still present, the importance of water for productive purposes and economic growth was stressed much more. In this period, the need to address inequality also appears on the political agenda. Old colonial inequalities were to be done away with, through ensuring that all Kenyans had access to a safe and adequate water
supply by the year 2000. There was thus a shift of public objectives from public health to economic development and equality (paper 3).

I have also found that some of the ideals of progress - as manifested in the ‘developmental attitude’ - were preserved from the colonial period. I have noted above that costly technologies were not replaced by cheaper and simpler solutions although the Government had identified this as a problem already by 1974. A glance at the related area of urban housing will be helpful here. Werlin noted in 1973 that the Government did not stimulate simpler and cheaper housing solutions because policy-makers could not accept that Africans should have lower standards than those of the old colonial elite (Werlin 1973). Modernisation and progress thus retained their symbolic values, and the developmental attitude among policy-makers appears to have survived decolonisation.

I found support for such a hypothesis while studying the history of the informal settlement in Mathare Valley, Nairobi. In January 1969, the Nairobi City Council’s engineers started preparing a development project to raise the standards of living in this low-income area on the outskirts of Nairobi. Previous attempts by the Council to redevelop other informal areas had resulted in service levels that were unaffordable for “the man with no means”. In June 1969, the City Engineer of Nairobi therefore proposed very simple solutions for housing, water and sanitation services in Mathare Valley, including the “cheapest type of [housing] unit yet designed”. However, the Ministry of Housing would have none of that. They vetoed the simple housing units and directed that the redevelopment of Mathare Valley should aim for a higher standard and for “tenants who are able to pay” while the “destitutes and unemployed” should be “[...] resettled in other schemes, such as agricultural schemes etc”. 5

5 Based on hitherto unpublished research. Data for Mathare Valley is from Kenya National Archives, file RN/6/21, Redevelopment of Mathare Valley.
The case of Mathare Valley supports the hypothesis that the ideal of modernisation and progress prevailed among public decision-makers after independence. The colonial developmental attitude seems to have translated into pride and unwillingness among politicians to accept a reduction of standards for government-initiated infrastructure. Ideals of progress, as represented by European-style urban water supplies, fused with the notion of having to ‘deliver’ progress to the citizens. What we see here is perhaps the reflection of what Gabrielle Hecht (1998) calls a ‘techno-political strategy’. By concentrating on costly state-of-the-art technology, the Government created an impression of development, progress and modernisation. Even if politicians knew it was unsustainable, there could have been political mileage to gain from this strategy. As Edwards and Hecht (2010) reminds us; such a strategy can fulfil its political objectives even if it is a technological failure.

One should not be too quick to label such a post-independence developmental attitude as retrogressive or as a sign of incompetence. After years of civil strife, it is quite understandable that the general sentiment among politicians and leaders was that now was the time for Africans to enjoy the fruits of development. Moreover, in the first years after independence, Kenya experienced a sustained economic boom and at the time it must have been easy to believe in Rostow’s take-off theory. Be this how it may; the point to stress here is that the developmental attitude did not facilitate a policy-driven re-orientation of the technological paradigm in the early years after independence.

This leads me to my second analytical question: how did the new political environment affect urban water provision? I have shown that cost recovery was forgotten about in practice. Urban water supplies in

Nairobi City Council, Minutes 7 January 1969; Nairobi City Council, City Engineer’s report to Social Services and Housing Committee 30 June 1969; Ministry of Housing, letter to City Engineer 5 August 1969.
the 1980s were running huge deficits forcing them to cut down on maintenance and rehabilitation, let alone expansion. At the same time, Government policy still officially professed the principle of full cost recovery. How could such a contradiction be understood? Not long after independence, the political environment in Kenya developed into a patron-client system where politicians needed to secure votes by promising favours in return (Barkan and Chege 1989; Cohen 1993; Southall and Wood 1996). The politician who wanted to become popular could not easily advocate increased payment from the consumers when Government’s water bill started going up. ‘Interest group appeasement’ as a means of carrying out resource allocation was noted already in the early 1970s in Kenya (Chege 1973). The perhaps most conspicuous flirt with the voters within the water sector came in 1981 when the President abolished metering of rural supplies in conflict with Government’s own stated policy (paper 4). In practice, such political handouts undermined the cost recovery of the entire sector and contributed to the decline of public water supplies. Inasmuch as the post-independence political objectives for water supply were laudable on paper, they did not facilitate setting urban water systems on a course to expanding into low-income areas.

At municipal level, the politicians controlled the stream of revenue through the budgeting process. It was common that the money collected from the water consumers were diverted for other purposes. This weakened the incentives for the municipal water departments to increase revenue. If the water department improved billing and collection, there was no way of securing that this money went back into operation and maintenance of the water supplies (paper 3). Political interference in the first decades of independence thus changed the institutional and economic conditions in a way that undermined financial viability of existing systems. For the politicians this vote-buying exercise was politically expedient and carried no direct personal risks. While the patron-client relationship undermined cost recovery and led to long-term deterioration of the
systems, politicians could safely ignore this for a long time from the comfort of their well-serviced up-market suburbs.

Why did not technology adapt to changing social conditions in this period? I noted above that the post-independence developmental attitude may well have proved an obstacle for changing technological norms if such a change was perceived as a step backwards. It may first appear as a remarkable contradiction, but the politicians’ and policymakers yearning for modernisation and progress may indeed have provided an inertial force preventing change. However, changing or preserving technology is about more than politics. Technological paradigms also embody knowledge; a set of heuristics and a toolbox for solving problems. As noted by Headrick (1988), colonial policies offered a minimum of investment into African human resources such as the education of African engineers and technicians. Due to a lack of trained personnel, Kenya depended on experts coming from outside for many years after independence. These experts were trained and ‘confined’ within the old paradigm. In the 1970s the World Health Organisation noted that the Kenyan water sector depended on consultants, who “[...]tend to over-estimate their requirements. There is little incentive for the consultants to keep the total cost down.” (WHO 1971).

Moreover, much of the technology as well as the technical assistance have come from the donors in the sector, which contributed to a dependency on knowledge from abroad. Technological paradigms are conservative. Those who already provide technical expertise in the sector - consultants, contractors, researchers and aid workers - have no incentives to change the technical setup of the system as their knowledge would then become redundant. As pointed out by historian Douglass C. North (2005), resistance to change can stem from influential organisations and individuals who believe that they will not benefit from changing the system.
At the end of the day, knowledge is power. The preservation of technical norms and the overall large-scale provision mode could have been a way of securing the power-structure of knowledge, and of power structures in society. This also meant preserving an elitist provision system even if this was never the immediate intention of these knowledge bearers. There appears to have been few political incentives for reconstructing knowledge in the sector, as the new African elite “[...] took up residence in the fully plumbed mansions abandoned by the departing colonial elite” (Braadbart 2009). Politicians and engineers thus all contributed – through attitudes, incentive structures and knowledge management - to the inertia in the public urban water systems by preserving knowledge that mirrored the colonial power structure in society.

As the knowledge and practices were preserved, the post-independent Kenya kept on providing urban water according to the colonial technological paradigm; large-scale systems with individual connections. But this paradigm had evolved in an economic environment quite different from the one in the 1970s and 1980s; it presupposed full cost recovery. With cost recovery removed from the formula, and with no means of substituting the revenue stream from consumers with other Government sources, the system instead started to stagnate and fall apart. Thus, already from the 1980s it is possible to talk about a stage of stagnation of the Large Technical System for urban water supply in Kenya.

The phase of stagnation of an LTS typically experiences saturation of the market and minimal or no expansion, sometimes decline. Is it possible that market saturation has led to a period of stagnation? In the early post-colonial period, the coverage ratio was relatively high and a hypothesis of stagnation through market saturation could hence be plausible. However, some things do not add up in this explanation. As the urban population grew, markets expanded, but the systems did not. Therefore, market saturation would not be a strong candidate as a cause of stagnation in the post-independence period.
Other studies of LTS also suggest that in the stages of stagnation, the systems are under pressure from competing service systems (Hughes 1983; Kaijser 1986; 1994). This has been observed for the East African water supplies in a number of studies; public systems based on large-scale technology have met increasing competition from small-scale private providers (Collignon and Vezina 2000; UN-HABITAT 2003; World Bank 2009b). However, alternative modes of provision start growing mainly from the 1990s. Small-scale providers have filled a need and responded to market demand through what Kjellén (2006) has termed ‘privatisation by default’. The “competition” from alternative providers is thus unlikely to have caused the stagnation of large-scale water supplies, but should rather be seen as a result of the stagnation that had commenced earlier.

In applying LTS theory, one could argue that the need to find cheaper technology as well as the eroding cost recovery constituted a ‘reverse salient’. Without solving these problems in the system, the expansion could not proceed. But as indicated above, urban water supply became a pawn in the patron-client game of political survival and dominance. The system-builder was ultimately the state, whose machinery had been captured by an elite that employed a technopolitical strategy to gain political support. Even if the system builder could identify the reverse salient, it was not – at least not always – in his/her interest to solve the problem. Thus, the incentive structure for the system-builder for urban water in Kenya in this period was quite different from those in place in western capitalist economies where LTS traditionally has been applied.

In summary; it was not possible to achieve the political objectives of ‘water for all’ using the technological paradigm inherited from the colonial period. This paradigm was developed for serving relatively wealthy consumers and not for predominantly low-income people. The politics of post-independence Kenya gradually eroded the mechanisms for cost recovery. Moreover, the Kenyan water sector lacked incentives for technological change in the period 1963-1990.
This resulted in a peculiar double squeeze on the system: on one hand, there was not enough money to invest in expensive technology. On the other hand, institutional incentives in the socio-technical system prevented a change towards less expensive technology. Interestingly, both problems had been identified, and options were available. But as demonstrated, the political landscape, entrenched knowledge and the developmental attitude did not favour solving either of the two problems, which resulted in a reverse salient in the system. This inertia and lack of incentives for technological change would have serious repercussions as the society and the urban landscape around these systems changed radically through the rapid urban growth.

The next chapter will look at the attempts starting in the 1990s to put the water sector in Kenya back on track to achieve universal access to safe water. Of particular interest will then be to look at whether these ‘sector reforms’ actually provide better incentives for overcoming the reverse salient.
5. Reform and reproduction (1990-2010)

5.1. Socio-technical change in the Kenyan reform

In this section, I will describe the key institutional, organisational and technological changes resulting from the sector reform in Kenya. The reform process is still an on-going exercise. Today, actors in the reform process often refer to the adoption of a new Water Policy in 1999 or the new Water Act from 2002 as the starting point for these reforms. However, the water sector reform needs to be seen in the context of widespread neoliberal reforms that swept across Africa from the 1980s under the Structural Adjustment Programmes, led by the International Monetary Fund and the World Bank. Many countries in Africa subsequently undertook reforms of their water sectors in the 1990s, often with strong backing of donor organisations such as the World Bank, German GTZ or the French AFD (Bayliss 2003; Ballance and Tremolet 2005).

Kenya had participated in programmes for structural adjustment and in 1986 the Kenya Government adopted a policy for Economic Management for Renewed Growth (Sessional paper no 1, 1986) which underscored commercial principles of public service. In line with this policy, some of the state’s undertakings for water supply were transferred from the Ministry of Water Development to a new state corporation, the National Water Conservation and Pipeline Corporation (NWCPC) already in 1988. A series of studies were carried out to prepare the ground for a reform of the entire water sector, such as the Delineation Study and the Water Master Plan from 1992. These preparations culminated in the adoption in 1999 of Kenya’s first Water Policy and three years later, the enactment of a new water law (paper 3 and 4). The ongoing reform thus has a much longer history than what is generally believed in the sector.

In the Water Policy of 1999, the Government made one clear distinction: water resources and water supply were to be managed
separately henceforth. It also enshrines the fundamental principle that the Government should not be directly involved in service provision but should instead concentrate on long-term policy. The Water Act of 2002 is the legal document governing the water sector, building on the policy. Through the implementation of the Act a whole new sector structure has been erected. Figure 4 below outlines the structure for water supply, which is now separated from water resources management. In the following, I provide a quick overview of the key changes concerning water supply.

Figure 4. The sector structure for water supply under the Water Act 2002 (Republic of Kenya 2002).
The Ministry of Water and Irrigation is in charge of policy, overall strategic directions and planning investments at sector level through a National Water Services Strategy. But the Ministry cannot continue with service provision to consumers, save for exceptional cases. Eight new regional semi-independent government entities called the Water Service Boards (WSB) have the statutory responsibility for water services to the consumers. However, they are only supposed to be asset holders and secure the long-term investments for the systems. The WSBs contract service providers to operate the systems and to take care of the actual service delivery to the customers. The Water Service Providers (WSP) can be private companies, civil society organisations or individuals, but they must be issued with a license and operate under a contract. To oversee that the different actors follow the law and also comply with licenses and contract, a new regulatory body has been created: the Water Services Regulatory Board (WASREB). There is also a Water Appeals Board where consumers can make complaints.

Under the old sector structure, the urban water supply networks were owned by the municipalities. The new Water Act prohibits local governments from providing water services and the infrastructure assets were supposed to be transferred to the WSBs. However, urban water supply was an important source of income for many municipalities. Infrastructure assets have in most cases not been transferred but are instead leased out to the WSBs. Moreover, most municipalities have formed municipally owned water companies to which they have transferred their own staff who were previously involved in the water supply. The Water Service Boards therefore lease the infrastructure from the municipalities while they have also contracted companies owned by the same municipalities, as Water Service Providers to operate the leased infrastructure (Republic of Kenya 2008; WASREB 2009). Through this somewhat peculiar arrangement, at least two things have been achieved. First, all service provision is now contract-based as the WSB has a performance contract with the supplier, who in turn is bound by service
agreements with the customers. Second, revenues for water services cannot easily be diverted for other purposes since the water companies are separate legal entities from the local governments. Furthermore, the Act (article 57, item 5d) specifically states that the licensed Water Service Providers shall operate under commercial terms.

The Kenyan water reform is notably silent on technology, technological change and low-cost options. The Water Act does not mention affordability or technological aspects, only that the National Services Strategy shall include a plan for “extension of water to underserved areas”. The WASREB shall then be responsible for developing suitable technical standards for the sector (Republic of Kenya 2002). WASREB also monitors and ranks all WSBs and WSPs in terms of their performance using a set of indicators against which the organisations’ performance is scored. The indicators are weighted so that water coverage, economic performance and efficiency rate high, while performance on equality in service (the WSBs efforts to provide service to low-income areas) can score a maximum 3 out of a total of 120 points. There is no indicator that monitors the Water Service Providers’ effort to provide services to low-income areas (WASREB 2009).

The Water Act of 2002 (article 83) also created an institution called the Water and Sanitation Trust Fund (WSTF) with the mandate to “assist in financing the provision of water services to areas of Kenya which are without adequate water services.”. Thereby the financing of new infrastructure in low-income areas has become the responsibility of the WSTF, an organisation that has no responsibility for providing services. The WSTF depends on external funding from donors. The funding through WSTF has also been very small; for the years 2005-2009 it hovered around 3% of the entire sector funding (see Table 1).
<table>
<thead>
<tr>
<th>Year</th>
<th>2005/6</th>
<th>2006/7</th>
<th>2007/8</th>
<th>2008/9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total WSTF</td>
<td>134.6</td>
<td>261.8</td>
<td>573.6</td>
<td>443.5</td>
</tr>
<tr>
<td>Total sector</td>
<td>7,255</td>
<td>8,870</td>
<td>12,830</td>
<td>18,551</td>
</tr>
<tr>
<td>WSTF share of sector</td>
<td>1.8%</td>
<td>3%</td>
<td>4.5%</td>
<td>2.4%</td>
</tr>
</tbody>
</table>

Table 1. WSTF annual funding, amount in Million Kenya shilling.
(Source: Republic of Kenya 2010)

Over the past two decades, the number of urban poor living in informal areas within or on the fringes of the cities has grown dramatically. Today there are around 12.5 million urban inhabitants in Kenya (Kenya National Bureau of Statistics 2010). More than half of them live in informal settlements with poor access to public infrastructure (UN2010c). In Kenyan towns – as in so many other parts of Africa—poor people today depend on private, small-scale suppliers (Collignon and Vezina 2000; Dagdeviren and Robertson 2009). The reported national average for access to public water services in Kenyan towns was 45% in 2009 (WASREB 2010). In Kisumu, only about one third of the population get water from the public water network while the remainder rely on alternative sources such as private small-scale providers (Owour and Foeken 2009). The service these small-scale informal providers offer is typically of a lower quality and is generally much more expensive than the public water supply. The poor who rely on service from alternative providers regularly pay five or ten times more per litre than what the public

---

6 According to the official United Nation MDG indicators, 54.8% of the urban population is estimated to live in informal settlements. These figures should be used with caution as they are highly uncertain.
water supplies charge (UN-HABITAT 2003; Kjellén 2006; Owour and Foeken 2009).

5.2 Unpacking ‘inertia’: what it means today

In this section, I will analyse what happens to the technological paradigm during the recent period of reforms. If there is still inertia in the socio-technical system, what is this inertia really about today? As argued in previous chapters, inertia can best be understood in the context of a technological paradigm and its institutional setting, and it can be analysed using the concept of reverse salient. In the following analysis, I will therefore concentrate on two questions:

- what does the reverse salient look like in recent times in Kenya?
- what type of change in the technological paradigm in Kenya would be able to address the reverse salient?

The answers to these questions will be key for analysing and discussing what kind of change the ongoing reforms may actually lead to, which will be done in the last section of this chapter.

Before attacking the two key questions outlined above, I first want to discuss if it is at all possible to use large-scale systems for provision to low-income groups. In Dakar in Senegal, the water utility reports an increase to over 90% coverage ratio over the last ten years. Dakar has a large-scale network, and applies subsidised connection fees for low-income consumers in formal settlements and water kiosks in informal areas (World Bank 2009b). The reported urban coverage of 73% in Kampala also indicates that large-scale technology can work in a low-income country, at least to achieve higher coverage ratios than the 45% presently achieved in Kenya. There is no evidence so far that large-scale technical systems are by definition unable to provide
services affordable also for low-income people. The argument that ‘the poor cannot pay for services’ has been repealed by experience time after time: they already pay more than the more wealthy consumers do. Hence, the cost for production appears not to be the crux of the matter. Large-scale systems could indeed provide water services to low-income people in towns but the missing link seems to be in the distribution system. It is important to note that alternative models of distribution have co-existed with the norm of individual piped water all along, such as water vending at stand-posts, water kiosks or automated ‘coin-in-the-slot’ machines (paper 3 and 6). As demonstrated, when the large-scale water system in Kampala was established in the 1920s, selling water at regulated sales points to the African population was part of the system design from the beginning.

Now to my first analytical question. This links back to the previous discussion on the characteristics of the technological paradigm. In chapter three, I described the emergence of a technological paradigm in the colonial period, based on large-scale technology and individual connections. In chapter four, I discussed how institutional changes gave rise to a reverse salient, resulting in stagnation from the 1980s. I have also noted that rapid urban growth mainly has taken place in informal and unplanned areas, where people with low income typically live. In the discussion that follows, I intend to demonstrate how this new socio-economic environment has created yet another challenge to the colonial technological paradigm.

Large-scale networked systems for urban services tend to grow from the centre - typically associated with higher economic activity and incomes - and gradually expand outwards. Through the use of a suitable distribution network, economies of scale can thus be achieved. Consumers on the periphery are generally less profitable as the distance to reach them is greater and they often consume less (Kaijser 1986; 1999; Tarr 1988). In addition, if the system is already operating at or near design capacity, a marginal expansion can require costly investments to increase the overall capacity. Water
supplies can experience rising marginal production cost per unit as new, more distant, water sources have to be utilised (Briscoe 1996). Any network would eventually face these boundary conditions during expansion. Furthermore, experience from all over Africa shows that the cost of connecting individual households is a bigger obstacle than the cost for the water service itself (Plummer 2003; World Bank 2009c).

In addition, there are specific barriers for expansion into the informal areas where most of the urban poor live. First, water supply networks are capital-intensive and have a high degree of ‘sunk capital’; initial investments are very large compared to running costs. Whenever large initial investments are made, the possibility to secure the property rights is crucial, both for the infrastructure itself and for the right to use the land on which it is built. This correlates well with the observations from the establishment phase in Kenya and Uganda, as described in Chapter 3. Securing property rights of the distribution infrastructure involves staving off water theft, illegal connections and vandalism, a very real problem as demonstrated by the Kisumu account in chapter one. Similar problems with theft and vandalism have been recorded elsewhere in Africa (see e.g. Kjellén 2006; Gandy 2006). Furthermore, in order to secure a proper use and operation of the network, land tenure and land use become critical for the expansion of networks. Land tenure and land use planning are highly erratic in the informal settlements where most of the low-income and rapidly growing population live. Uncertainty of the property rights in informal areas, both in terms of protection against theft and vandalism and regarding land tenure, generate high transaction costs for the provision of services from the network in informal areas (paper 5).

I indicated in chapter two that transaction costs also arise from the actual exchange of services against payment. The issue of how best to collect payment from those who benefit from the water network was an issue for debate during the colonial period and different methods
evolved in Kenya and Uganda. We saw that while the Public Works Department in Uganda chose a water rate (basically a tax) levied on property, the Kenyan administration opted for individual billing based on metering (papers 2 and 3). Every method comes with a cost, but for a poor household with a low consumption, the cost for installing and reading a meter as well as administering a bill may become prohibitive. Moreover, monthly or annual billing may be suitable in a developed country but for a poor household such long billing periods are not compatible with the variability of household income (Plummer 2003; Sohail 2004). The conventional Europe-based norm of individual and preferable in-house water connections with payment based on metering therefore creates yet an additional cost for service provision to low-income consumers. Finally, uncertainty about the ‘market’ in low-income areas could also make up an additional transaction cost. Water utilities used to providing services in high or middle-income planned urban areas have faced difficulties even in understanding what the social structures look like in informal areas and how water provision could be organised. This lack of market knowledge resulted in failure of a programme for increasing supply in an informal area in Nairobi (Katui-Katua and McGranahan 2002).

To sum up, the norm of individual connections to each property as the main mode of distribution is a serious obstacle for expansion into informal areas because of the high transaction costs that arise. The reverse salient of low-cost technology from the previous period has now become a ‘reverse salient of informality’. The informal character of the spaces where a majority of urban inhabitants presently lives is incompatible with the current technological paradigm. Overcoming the reverse salient of informality is necessary if the systems are to expand significantly.

Here I move to my second analytical question: what type of change in the technological paradigm in Kenya would be able to address the reverse salient? As the Dakar example indicates, the large-scale
paradigm can work but must be adapted through ‘conservative innovation’ on the technology of distribution. Paper five and six demonstrates several real-life examples that could be able to ‘do the trick’. I have already alluded several times to one example from Kisumu in Kenya and in the following, I will present it more in detail.

The large-scale city-wide distribution network in Kisumu has been expanded into low-income informal areas through a model of ‘delegated management’. In this model, the extension and operation of a simple water network in informal areas is managed under a contract with a local private operator. Through delegating responsibility to a local actor – for example an individual, a private enterprise or a co-operative organisation - the utility avoids the uncertainties associated with the expansion of the distribution system. The local actor has better knowledge of local conditions and can more easily monitor property rights and payments, which results in lower transaction costs. The consumers themselves make the connection to the delegated line, thus reducing the need for collective investments. More or less exactly the same model was used in Sweden for electrification in rural areas in the early 1900s. In Sweden, the state-owned electricity utility Vattenfall had an incentive to sell excess electricity but faced a reverse salient in the prohibitively high transaction costs involved in distributing electricity in the rural communities. The reverse salient was solved through delegating to the community, who organised themselves to build and operate the distribution system (paper 5). See Box 1, below.

In the introduction, I demonstrated the kind of challenges that the actors face when trying to introduce a new model of provision. One of the delegated lines in Kisumu was vandalised twice during its introduction by those who wanted to preserve status quo: the informal water providers who stood to lose out on this new model of distribution. It is worth to note, however, that this initial friction has been overcome. Overall, the experience from the delegated
management model in Kisumu shows that this option is socially as well as financially sustainable (World Bank 2009d).

**Box 1.** The schematic structure of a co-operative or ‘delegated management’ distribution model. The main provider (utility) outsources the distribution of services to a private entrepreneur or a co-operative, and regulates the terms of service in a contract. At “A” the supply to the operator is metered. The operator is responsible for managing the distribution sub-system “B” which can be owned either by the utility or the local operator. The operator provides services to the customers “C” according to a pre-defined tariff structure that also the utility can control. The model was important for connecting sparsely populated rural areas to the main electricity grid in Sweden in early 1900s. It has also proven to be useful in low-income informal areas in Kenya. One key feature of the model is that the main provider has an economic incentive to sell more, but faces a reverse salient in too high transaction cost for distribution to a certain type of community. This is solved by having the community organise the distribution themselves, thus lowering transaction costs.
Another example is the introduction of a more efficient payment system using new technology in Kampala, Uganda. Consumers in the informal areas can purchase water through water vending machines using electronic tokens. With pre-paid delivery, there is no need for costly metering and billing (paper 6). The Dakar example provides yet another example, with metered yard-taps serving neighbourhood communities. All of these examples represent small additional changes to the existing system; these are conservative innovations. This is good news because conservative changes are easier to implement than radical innovations, let alone paradigm shifts.

In summary, I want to suggest that a reverse salient has occurred within the large-scale urban water system as a result of a technological paradigm prescribing individual connections, while the market grew predominantly in informal areas where transaction costs for provision through individual connections became prohibitively high. Many workable and practical solutions exist that can help the large-scale technical systems for water supply to overcome its ‘reverse salient of informality’. These solutions are generally conservative innovations that do not fundamentally alter the paradigm itself. What is required is a shift of mindset among decision-makers and knowledge-bearers to pave the way for the technological (albeit conservative) change. We saw how the reverse salient in the 1980s could not be addressed because of the political system that had emerged, which did not create the incentives for technological change. In the final section, I will discuss if the water sector reforms in Kenya and Uganda have created the incentives necessary for this technological change within the paradigm.

5.3. The sector reforms: will they lead to real change?

Many different institutional and organisational solutions have been tried over time in the North concerning private and public ownership and operation of urban water supplies. In Europe and the USA, the
public involvement has been very strong for most of the 20th century (Jukka and Katko 2005). I also noted earlier, that from the early 1990s privatisation or commercialisation was a key component of sector reforms in many developing countries. Privatisation efforts in for example the Americas or South Africa in the 1990s have attracted much criticism for reducing availability of water for poor people (Lobina and Hall 2000; Pape 2001; Swyngedouw 2009). On the other hand, my own study shows that the public urban water supply in Kenya has favoured middle- and high-income people while excluding the poor. As argued by Budds and McGranahan (2003), the privatisation-debate around the sector reforms in poor countries “misses the point”. The management type and the legal status of the asset owner do not appear to be decisive for the ability of water supply systems constructed in colonial times to adapt to a changing society. I will now focus on how the reform alters the incentive structure for urban water systems. My discussion revolves around the following question:

- Do the reforms in Kenya and Uganda enable change in the technological paradigm or do they merely serve to reproduce it?

To start with, incentives for cost recovery are today much stronger under the reformed sector in Kenya. The Water Service Providers (WSP) licensed to operate the urban water networks have to operate on commercial terms. Certainly, this is positive for long-term sustainability of the sector and cost recovery has improved. Although only about 25% of the WSPs break even, at least the largest utilities – servicing over three quarters of the total number of consumers - are operating at a small profit (WASREB 2009).

However, in terms of technological change that can enable expansion into informal areas, the incentives are still weak for the system-builders and operators; the WSBs and WSPs. The incentives for the WSPs to offer services in low-income areas have to be linked to their
commercial interests; they must see a good business case. So far, there is limited experience regarding the commercial viability of provision in informal areas. There must also be some minimal investments in the network to extend services into informal areas. However, it is the Water Service Boards (WSB) that make the investments and thus can spearhead expansion into informal areas. The WSBs also are public entities with the responsibility to serve the population within their areas of jurisdiction. The annual performance scoring by the regulator WASREB is one important incentive structure for change. However, efforts to develop service in low-income areas are rated very low and can be disregarded by WSBs and WSPs. Furthermore, the incentives arising from a commercial re-orientation of the sector have not been harnessed. By externalising the responsibility of financing low-income areas to WSTF, the WSBs are not as strongly compelled to look for innovations that can work for these customers. WSTF on the other hand, has no mandate for service provision. I argued in the previous section that the ‘reverse salient of informality’ must be overcome if the systems are to expand significantly. The organisational and institutional framework must enable key actors – private or public – to drive such a process of innovation and change. However, under the current sector structure in Kenya, the reverse salient of informality has become a no man’s land.

Overall, the current sector reform in Kenya will be able to increase cost recovery and solve the reverse salient of financial sustainability. However, this appears to be a solution for the past. Restoring cost recovery will be useful to reproduce the old technological paradigm, but the social environment of these technical systems have changed so much that the old paradigm is out of touch with reality. Simply restoring cost recovery will not be enough for sustainability; there must also be technological change to bring the systems in balance with today’s social conditions. The water sector reform in Kenya is today a mechanism of reproduction, not a vehicle for change.
To close this discussion, I want to mirror some of the observations above in the Ugandan sector reform. The reforms in Uganda picked up in the 1990s, backed by several donors such as the World Bank, Germany and Sweden. At this time, the situation in Uganda was as bad as - or worse than – in Kenya with poor revenue collection and a deteriorating public water service. The MDG baseline for 1990 indicates a coverage ratio of 60% for safe drinking water in Uganda’s urban areas, but two subsequent monitoring reports gave the coverage to be below 50% (WHO 2001; World Bank 2006). Here, as in many other African countries, privatisation and commercialisation of services have been part of the reform agenda. Already in 1972 the National Water and Sewerage Corporation (NWSC) had been formed to manage all water supplies in major urban areas (covering about three quarters of the total urban population). In 1995 the NWSC was revamped and launched its first commercially oriented business plan in 1997 in order to improve efficiency and cost recovery. Unbundling and privatisation of the NWSC was originally part of the reformers’ plan, as well as introducing an asset-holding authority and a regulator, similar to the Kenyan structure.

However, Uganda eventually chose another road and still today the NWSC - as a state corporation - is in charge of all major urban supplies. The Ministry for Water is still acting as the regulator and the plans for an asset holding authority were never realised. NWSC has today turned the previously unprofitable water supply business into a commercially viable enterprise. The coverage ratio of the NWSC piped supplies have steadily increased, now reported to be 73%, partly thanks to a policy on subsidised connection fees. Although this connection policy has mainly been beneficial to middle-income people the NWSC is today actively pursuing activities to reach low-income strata using simple and alternative technologies including new ways for facilitating payment for services. Of particular interest is an innovative approach of installing pre-paid water sales-points in informal areas of Kampala where the poor can purchase water using an electronic token. There are several differences as compared to
Kenya. First, the organisational structure is much simpler; the ministry is both the policy-maker and the regulator.

Second, the centralised organisational structure was retained, with the NWSC taking care of water and sewerage in all major towns. Most importantly, Uganda did not create a parallel structure for expanding service to the poor (paper 6). The main urban water provider, the National Water and Sewerage Corporation, is also operating on commercial terms, just like the WSPs in Kenya. Although the Ministry of Water and the donors in the sector have offered subsidies for new connections and for testing new technologies, the responsibility of providing services to low-income areas has been internalised within NWSC. This is important as it vests responsibility for managing the ‘old’ network as well as responsibility for expanding to new (low-income) markets in the same organisation. Innovation activities to modify the technological paradigm can thus take place within the socio-technical system itself; the search activities necessary to solve the reverse salient are internalised in the organisation instead of externalised.

As shown in paper 6, this is what has been observed already in Uganda: new methods for providing services through conservative innovations in the large-scale network, such as pre-paid meters and yard-taps have already been tested. The NWSC is increasingly seeing the low-income market as a good business case to the extent that they have started using part of the revenue for investing in alternative technologies (paper 6). Just as in Kenya, the indicators for monitoring the performance of NWSC are not very specific on efforts for low-income provision, but the direct incentives for NWSC are stronger since low-income areas are not ‘someone else’s problem’.
6. Summary and Conclusions

Is it possible to summarise over a century of development of socio-technical systems in just a few pages? Well, on the cover page of this thesis I boldly summarised it into three words: “Pipes, Progress and Poverty”. These three words represent three key components in my study of socio-technical systems. “Pipes” represents technology and its associated practices and knowledge; “Progress” stands for the social objectives and values that the system is supposed to contribute to, and; “Poverty” represents one facet of the social and economic reality in which the system must be able to operate. In short, the three words represent “what”, “why” and “where/who”.

In this chapter, I will summarise my thesis in order to offer some conclusions on how urban water technology has co-evolved with social change in Kenya and Uganda. To do this, I will allow myself more than three words. This chapter will by necessity repeat many things already said. My main conclusions are formulated in relation to the specific research questions presented in chapter three to five. Thereafter, my findings are discussed in a wider context. Finally, I offer some recommendations for policy-makers as well as for future research.

6.1. Urban water technology and social change 1895-2010

1. The introduction and development of piped water supplies in Kenya and Uganda followed a typical LTS progression of ‘establishment’ and ‘expansion’ in the colonial period.

Large Technical Systems for urban water supply were introduced by the British first in Kenya, as a result of the urban development taking place along the Uganda Railway which was constructed from 1896 to 1901. In this early stage of establishment, urban populations were small, the organisation of urban water provision was fragmented with several different actors involved. Initially, there was no dedicated water legislation in Kenya and Uganda, but European settler-farmers
brought with them English common law to govern water rights. The Uganda Railways stands out as the key actor in early urban water supply in Kenya, supplemented by some state-owned supplies and a few private providers. Large-scale technology for urban water supply prompted the development of an array of institutional and organisational structures in Kenya and Uganda in order to manage and operate the systems, and secure finances for them. In the 1920s, uncertainty was reduced through the emergence of the colonial state as the most important water provider and through the development of dedicated water legislation in both Kenya and Uganda. This gave rise to several decades of rapid expansion of urban water networks in the two countries. In both Kenya and Uganda the state has since continued to be the largest provider of water in urban areas, but the two colonial administrations chose different forms of organising urban water supply. While in Kenya, responsibility for service provision was delegated to the municipal authorities in the largest towns already from the 1920s, in Uganda the responsibility for provision in larger towns remained with the central government.

2. In Kenya as well as in Uganda, the two main drivers identified for the introduction of large-scale urban water networks were: to safeguard public health, and; a ‘developmental attitude’ that built on an ideal of bringing progress to the colonies.

The need to protect public health was frequently used as an argument by the colonial administration for the introduction of modern piped water supplies. There was also a deeply embedded ideal of progress and modernisation, which I have called a ‘developmental attitude’. This attitude among decision-makers sought physical representation in large-scale technology and modern amenities such as piped water. The systems developed used British technology and standards and were designed to primarily cater for the needs and preferences of the Europeans.
3. The introduction of British technology and ideals gave rise to a ‘technological paradigm’ based on large-scale and capital-intensive water networks with individual connections.

The transfer of water technology from Europe also embodied transfer of a ‘technological paradigm’, which includes the technological artefacts as well as the knowledge, practices and values associated with European modern water supplies. The combination of imported large-scale technology – associated with large investments – and a strict policy on cost recovery, led to an emphasis on individual connections in order to maximise revenue. Different methods were used in Kenya and Uganda for collecting payment for the water from the users; in Kenya a standard of individual metering early on became the norm while in Kampala property tax was used to finance the water supply system. Within the technological paradigm, a norm of individual connections to each property emerged in both countries. Full cost recovery – costs for capital, operation and maintenance - was achieved for most of the colonial period. The alternative distribution models such as standpipes and automated water vending machines – which had co-existed with the individual connections all along - proved insignificant from an economic point of view. By the end of the colonial period, Uganda and Kenya had relatively well developed urban water systems.

4. The Government of the independent Kenya tried to accomplish equitable development and ‘water for all’ using the colonial technological paradigm, but its high costs undermined economic sustainability.

Independence from Britain came to Uganda in 1962 and to Kenya in 1963. An ambitious programme for expanding water supplies to cover all Kenyans by the year 2000 took off from around 1970. However, the expansion programme applied the old technological paradigm based on large-scale capital-intensive technology and individual connections. The economic slow-down in the 1970s made it difficult
to finance these costly programmes. Inflation accelerated from the 1970s, leading to cost overruns and delays for the new supplies, while water tariffs did not keep in step with inflation. The economic stagnation in Kenya from the mid-1970s created the outer boundary for the development of urban water systems as a weakened cost recovery from the users could not be compensated from general Government revenue.

5. The new political environment in Kenya after independence eroded the incentives for cost recovery.

Kenya saw several re-organisation exercises in the water sector between 1963 and 1974 but these changes were mainly superficial. The revision of the Water Act in 1972 did not lead to any major changes and there was still a heavy colonial legacy in the legislation. According to official Government policy, urban water services were to be priced for full cost recovery throughout the 1970s and 1980s. But cost recovery from the users was abandoned in practice. The emerging political landscape after independence led to changes in the institutional framework surrounding urban water supply. A political system based on patron-client relationships eroded the incentives for cost recovery as politicians refrained from making unpopular tariff increases. This in turn resulted in stagnation, system-level decay and dwindling service levels.

6. The incentive structure of Kenyan politics, prevailing ideals of progress and entrenched knowledge prevented an adaptation of the technological paradigm to the new economic and social conditions. The system encountered a ‘reverse salient’ that held back expansion, but which could not be solved due to the institutional framework.

There was a growing awareness in Government from the 1970s and onwards that there was a need to find simpler and more affordable technology. Despite this, the norm of individual connections and metering prevailed, as well as costly large-scale technology banking
on European standards. The technological paradigm based on European standards was increasingly associated with inertia and was unable to change in step with society. Alternative low-cost solutions could have been applied as a solution and the technological paradigm could thus have been modified. However, the incentive structure did not favour change as those who had power to influence the paradigm risked losing on changing the status quo. There were few incentives for designers and engineers – often experts from abroad - to replace old norms and ideals with new; they simply continued doing what they were best at doing. Dogmatic and conservative thinking among technocrats and politicians in the sector also contributed to inertia as they resisted changes that could be perceived as anti-development. The traditional design norms fused with ideals regarding progress and development into a developmental attitude among politicians after independence, similar to that of colonial times. Decision-makers could have come to equate simpler technologies with failure to 'deliver progress' to their political 'clients'.

With poor cost recovery putting stress on the systems, a reduction of standards would have been necessary to continue expansion of the systems. This is what Thomas P. Hughes calls a 'reverse salient'; a problem that has to be solved before expansion can continue. Alternatively, the standards could have been maintained and the cost recovery identified as a reverse salient. In Kenya, however, the institutional framework discouraged the actors in charge of water supplies from addressing any of these two problems. This led to a double squeeze on the system and a reverse salient of almost permanent nature.

7. The current reverse salient in Kenya and Uganda is about developing socio-technical systems for distribution of water from the large-scale systems in informal settlements.

While the Large Technical Systems for urban water supplies were preserved in a colonial technological paradigm, urban centres grew
rapidly, mainly in informal and unplanned settlements. Between the 1960s and up to the end of the 1990s the urban systems for water supply saw a decline in terms of service quality and in relative coverage. Although data is unreliable, in Kenya the coverage ratio of urban water networks have decreased considerably since independence, with official figures going from close to 100% to 45%. While population has grown rapidly, under the prevailing technological paradigm, systems could not expand in the geographic areas where population has grown the fastest, i.e. in the informal urban and peri-urban areas. The technological paradigm of large-scale systems and individual connections is not compatible with the social and institutional conditions in informal areas. To start with, individual connections require a planned environment and a reasonably stable legal environment where property rights can be enforced. The reverse salient for the urban water supplies in Kenya and Uganda is about changing the mode of distribution to make it compatible with the conditions of informal areas. Provision in informal areas using the old paradigm is theoretically possible but is associated with prohibitive transaction costs arising from weak property rights, complicated and costly arrangements for payment, and possibly poor market information.

8. Conservative innovations already exist that can reduce transaction costs and solve the reverse salient of informality, given that the sector has the right incentives.

While the reverse salient of informality holds back the systems from a major expansion particularly in Kenya, solutions are already available, some of which have been tried in the region. These solutions can significantly reduce transaction costs and thus help resolving the reverse salient of supply to informal settlements through ‘conservative innovations’. This means that they are small additional technologies and institutional arrangements that can supplement the existing systems without requiring a complete shift of the technological paradigm. Such conservative innovations include
delegating service provision to communities or private operators, either through delegated distribution systems or through yard-taps, or pre-paid water vending machines. However, these solutions need to be enabled by reforms in the sector in Kenya and Uganda to change the mindset as well as the incentive structure for the actors in the sector. The solutions exist, but the sector reform must create the incentives for technological change and innovation.

9. The current sector reform in Kenya creates better incentives for cost recovery, which is necessary as a first step, but fails to create strong incentives for technological change. Uganda has created better incentives for achieving cost recovery as well as technological change.

Current sector reforms in Kenya can mainly achieve improved cost recovery and thus financial sustainability. This means that those that already enjoy access to the public water systems can hopefully continue to have a decent water service in the future, although they will have to pay some more. The problem is that the reform falls short of creating incentives for changing the technological paradigm. It does not encourage innovation to overcome the reverse salient of informality. While the necessary cost recovery can be achieved, the reform now serves to reproduce the old technological paradigm, not to change it. Two major shortcomings have been identified: the regulator does not put pressure on the providers for increasing provision to informal, low-income areas, and; the responsibility for low-income areas have been externalised through the creation of the Water and Sanitation Trust Fund. Uganda appears to be in a better position. In the Ugandan sector reform, the responsibility for serving informal areas has been internalised within the main urban water provider National Water and Sanitation Corporation (NWSC). The Uganda reform has better harnessed the positive driving forces for change through incentive structures. Neo-liberal policies can be criticised for many things, but at least the ensuing commercialisation of public service provision introduce one important driver for
innovation: the search for more customers. The NWSC is now increasingly trying new modalities for distribution in informal areas on commercial terms. The result is a win-win; more paying customers for the utility and safer and cheaper water for the inhabitants of informal areas.

I will also offer a few conclusions in relation to my method. What has my historical approach been able to highlight that had otherwise been omitted? I argue that the historical approach puts a spotlight on the issue of political choices in relation to technological and social change. With a static analysis of the current situation, you could easily arrive at the conclusion that the root cause of the problem is all about poor cost recovery. You would then neglect to see that bringing the system back into economic ‘equilibrium’ could also mean to resurrect a system belonging to a technological paradigm that is not compatible with today’s social, economic and geographic configuration. The historical analysis thus not only shows where we come from, but also exposes development paths not followed and policy changes that looked good on paper but which were either not matched with the right incentive structures, or simply got out of touch with reality.

On a theoretical level, I have demonstrated that the LTS-approach can be useful also for studying large technical systems such as urban water supplies in Africa. However, the peculiarities of the context call for complementary analytical concepts to look at the special post-colonial dynamics. The political environment and the institutional framework in post-independent Kenya were worlds apart from those in for example the late 19th-century England, USA or Germany, for which Thomas P. Hughes originally developed the LTS theory. The histories of urban water supply in Kenya and Uganda also show that a Large Technical System can remain in a stage of stagnation for a long time. The ability to resolve and overcome the reverse salient depends on the incentives within the system and in the surrounding institutional framework. Transaction cost analysis has also proven an important analytic tool for describing the dynamics and interface
between large-scale water provision systems and distribution at the micro-level. I believe the combination of LTS and New Institutional Economics holds many new exciting possibilities for future research.

In relation to previous history research on urban water supply in former British colonies, my study contributes some novelty. This aspires to be the first attempt to apply an LTS approach to urban water systems in Africa, at least in the Anglophone part of Africa. Being a study on technological and social change processes, the dynamics of technology has been central throughout this thesis. The main scientific contribution of my study to the existing literature and to the policy debate, is to introduce urban water technology as a dynamic and active component in history. Similar trajectories of urban water supply from colonial times to the present have already been described for Ghana (Bohman 2010), Nigeria (Gandy 2006) and Cameroon (Page 2005). Also in these countries, European technology was introduced mainly for the colonial elites. After independence, ambitious programmes were launched just to be thwarted by economic crises within a decade or two. Corruption and political clientelism were part of the problem also in these countries. But in these previous studies, technology has been taken more or less as a given, a constant and external factor. Problems and solutions have instead been framed as issues of governance, of economics and institutions. I have demonstrated in this thesis, that the inclusion of technology as a dynamic and socially constructed component offers a deeper and more complete frame of analysis. Even more important; it brings up technology on the reform agenda.

Furthermore, I hope to have shed some new light on the ‘incomplete modernity’ observed by Gandy (2006) in the colonial urban setting. One plausible explanation to the incompleteness of the modernisation of cities with a colonial past may well be found in the ‘techno-politics’ surrounding the systems. As I have suggested, the introduction of modern technology and ideals in the colonies and their subsequent development could be seen as part of a techno-political strategy of the
elites. While the socio-technical systems did not produce the direct benefits anticipated in the form of sustainable services, they served to produce political benefits for the elite and to reproduce society’s political system and power structure.

6.2. The historian’s creed: criticise and convince

Maria Ågren (2005) underscores the need for the historian not only to critically review sources, but to also apply a healthy dose of self-criticism. Having just presented my conclusions, let me also be the first to criticise them.

The unreliability of quantitative data with regards to water supply coverage has already been discussed. Nevertheless, this study abounds with this kind of data and without discussing trends over time, my argument of the stages of ‘expansion’ or ‘stagnation’ would be unfounded. I would like to stress that my research questions do not entail determining the exact coverage ratios. For the arguments presented in this thesis, the relative change over time is much more important. Instead of declaring the research objective impossible in the light of poor data, a pragmatic approach must be employed in assessing and using available data. However, the negative trend is unambiguous; the reported coverage for urban public water supply in Kenya going from close to 100% in 1963 to 45% in 2008. Comparing the 45% reported for Kenya with the 73% coverage in Uganda or the 90% in Senegal also warrants a discussion. I have not been able to spend as much effort on assessing the quality of data from Senegal and Uganda. But at least there is one important difference between Senegal and Uganda on one hand and Kenya on the other; the former countries show improving coverage data for the last 20 years while Kenya’s situation clearly has deteriorated. One recommendation coming out indeed pertains to the need for putting much more emphasis on collecting and managing data for these systems.

I have brought in other disciplines as well as observable phenomena in the social setting and in similar sectors that I deemed to be relevant
for my study. For example, I used the political system of clientelism in Kenya in the post-independence period as one important cause for the dwindling cost-recovery for water. Furthermore, evidence for reluctance among some politicians and technocrats to reduce the standards in the housing sector in the 1970s was used to offer one explanation why government retained costly large-scale technology for urban water supply. I have endeavoured to paint a rich picture, yet I have tried to focus on the key processes. It is possible to criticise this trans-disciplinary approach as being too wide, or for not following each lead to its end. However, this is a question of choice of research method. Focussing on the aggregated picture rather than on the detail can lend just as much strength to the argument. As posited by Torstendahl (2005), the historian cannot rely only on data, the story also has to be convincing.

So what about my story? I hope it is convincing to the reader, but I am aware there are other ways of framing the problem. Those active in the sector reforms in Kenya might want to disagree with some of my findings. In 2010, the regulator WASREB in Kenya congratulated the sector actors that:

“The trend clearly confirms that after a decade of decline and stagnation of service provision in towns, sector reforms have led to significant improvement. Thus, more people have access to safe drinking water and sanitation than ever before.”

(Source: WASREB 2010)

I am not saying that the architects behind Kenya’s water sector reform have got everything wrong. But I believe they have left some important parts out of the problem analysis. Disagreement can be useful, if it adds clarity on the point of disagreement. Let me therefore respond to the statement above. There are indeed positive signs in the Kenyan water sector and arguably, it is in a better position than ten years ago. Financial sustainability is within reach and sector level
investments have come up again, although they are still lower than in the 1970s. More people than ever is said to be enjoying access to safe water. This may be true when looking at absolute numbers, but the share of the urban population with access to a public water supply is the lowest since independence. The current reform builds on the tenet that cost recovery is the key to sustainable service provision and that expansion to low-income areas can only be achieved once the old networks are financially viable. However, the singular emphasis on economic viability may obscure the need for changing the technological systems. Cost recovery at sector level is indeed necessary to move from a phase of stagnation and decay, but the systems would also need to modify the technological paradigm established in colonial times in order to serve the majority of citizens.

The new Kenyan constitution that was approved with acclamation in the general referendum in August 2010 includes in its Bill of Rights that every citizen has a right to “clean and safe water in adequate quantities” (WASH United 2010). The Bill of Rights lends political importance and legitimacy for claiming the right to have access to public water services. However, to claim the right is one thing, to have it fulfilled is another. Politicians, experts or donors that for various reasons do not favour change within the technological paradigm may seek refuge in economic arguments; these rights can be fulfilled only when the economic resources of Government allows. But why not instead re-arranging water provision such that these constitutional rights can be fulfilled?

6.3. Epilogue: now what?

As I am nearing the end of my thesis, as well as my eight-year research undertaking, it is time to discuss how my results can be used. First, I will discuss some lessons for policy-makers and then I will suggest some future research activities, emerging out of my study.

Policy-makers in Kenya should be clear about the objectives of reform and they could do better to create the incentives for changing
technology. Once that is done, it will be easier to find finances beyond the current level of three percent of sector investments to underserved areas. The onus is upon the main actors in the current reforms – governments and donors - to demonstrate how change can be accomplished. But there is a role also for civil society and academia here; Europe’s sanitary movement in the 1800s did not come about as a result of politicians work alone. Specifically, I believe that creating incentives for the WSBs to carry out conservative technological modifications will be of key importance. The responsibility for service to low-income population should be internalised within the WSB instead of externalising it to some specialised ‘pro-poor’ institution such as WSTF or aid organisations. If the task of solving the reverse salient is externalised, the main actors operating within the paradigm have no need for innovation. In a best-case scenario, this will result in a dual system; one public water supply for the rich and one for the poor.

Here I would like stress the responsibility of the public actors in urban water supply and relate this to the discussion on human rights. As noticed, public actors have several strong motives for investing in, regulating or operating public water supplies. This strong rationale for public involvement stems from the need to manage external effects associated with a water supply as well as features of economies of scale and natural monopolies. Once an urban water supply is deemed a public service, then the state becomes a duty bearer and the citizens are claim holders. Few in the water sector seem to be aware that “equal access to public services” is a human right laid down in Article 21 of the United Nations Universal Declaration on Human Rights (UN 1948). In this context, the state’s responsibility is to protect from discrimination. A state that has signed the 1948 UN Declaration should therefore design public service systems such that all citizens can have equal access. The current situation where one-half of the population does not have access to the public service of urban water is in fact discrimination, and a violation of Article 21 in this declaration. The option of creating one public system for the rich
and one for the poor would hardly provide “equal access”. The human rights perspective therefore could be an important driver for changing the technological paradigm.

One lesson for policy-makers in these countries would be that changing technological systems also requires a change of mindset. The design standards and development ideals of these systems must move from elitist to public. This also goes for the international donors involved. Donors wanting to contribute to poverty reduction may want to revisit their policies and look at how they can promote change and reduce discrimination in their partner countries. Supporting public service systems that favour middle- and high-income groups and that discriminate the poor may not be compatible with donors’ aim of poverty reduction and a human rights approach.

Another recommendation to policy-makers and reformers pertains to data in the sector. Regardless of objective of reform, data collection and management must improve if reform efforts shall be of any use at all. How is it possible to manage change if it cannot be measured?

Is it possible to transfer the results from this study also to other countries? Each setting has its own history, its own particular configuration of technology, organisations and institutions, but there may also be similarities, based on a common colonial past. I think the results of this study could provide some lessons also for policymakers and reformers in other developing countries. In particular, my arguments on the role of ideals and knowledge, lack of incentives for technological change and the ‘reverse salient’ of provision in informal areas could probably serve as useful input in other contexts. The contradiction of a public service system that discriminates a large part of the population ought to be a revelation for politicians as well as citizens in many countries.

Finally, a dissertation would be incomplete without a proposal for “what next” for the research community. Indeed, there is scope for more research. First, I believe that more researchers, from rich
countries as well as developing countries, need to be involved in these change processes. My observations suggest that there is a high degree of ‘co-production’ of knowledge in the sector; that our interpretation of facts and truths is closely related with our beliefs and world-views, even of how we want the world to be. I do not think acknowledging that facts and beliefs are mutually defining is a bad thing. However, beliefs cannot replace facts. The deplorable state of data and how it is used in narratives of success around reforms to support preconceived beliefs, is just one reason why there is an urgent need for having more researchers ‘embedded’ in these processes, adding critical and evidence-based interpretations of contemporary processes.

One straightforward research area worth exploring is why Kenya and Uganda ended up on slightly different paths. Thomas P. Hughes talks about the emergence of unique technological ‘styles’ through the adaptation of transferred technology in its new local environment. I have noted that Uganda has had a centralised organisation for urban water supply ever since 1928, while Kenya has had a decentralised model all along. I have also hinted at differing interests in overall water policy from the colonial administration; while in Kenya securing access to water resources for European farmers appears to have been important, in Uganda the focus was on the Europeans in towns. I think that such an analysis would provide interesting insights on the development of long-term organisational culture for public service provision in these countries.

More research is needed on the phenomenon of ‘developmental attitudes’ described here. We need to understand how knowledge and ideals are produced and traded within the development arena. The construction of development narratives and success stories is also part of the question: how do we learn? As a counterbalance to the policy-heavy context I have found myself submerged in we also need to understand how social ‘grass-root’ movements can become drivers of change. The crossbreeding of contemporary studies of East African
civil society and history studies of the European ‘sanitary movement’ could be particularly exciting.

Indeed, historians are needed in this endeavour because history and the present cannot easily be disentangled. I hope this thesis has been able to convince the reader of that, if nothing else.
7. References

Literature


Easterly, William, The white man's burden: Why the west's efforts to aid the rest have done so much ill and so little good, Penguin books, New York, 2006.


Moyo, Dambisa, Dead aid : why aid is not working and how there is another way for Africa, Allen Lane, London, 2009.


Nawangwe, B. and A. Nuwagaba, “Land tenure and administrative issues in Kampala City and their effects on urban development”, Research Report, Makerere University, Kampala, 2002.


Pape, John, *Poised to Succeed or Set Up to Fail? A Case Study of South Africa’s First Public-Public Partnership in Water Delivery, Municipal Services Project, Occassional Paper no.1*, Queens University, Canada, 2001.


Archive sources:
Colonial Office, Letter from Mr. Gowers, Under-secretary of state for the colonies to the secretary of state, Mr. Amery, dated 19 October 1926. UK National Archive: CO 536/143/6.


Nairobi City Council, Redevelopment of Mathare Valley, City Engineer’s report to Social Services and Housing Committee 30 June 1969. Kenya National Archives: RN/6/21.


Uganda Protectorate, Despatch dated 1927-01-26 from Acting Governor Mr. Jarvis, to the Secretary of State for the Colonies, UK. UK National Archive: CO 536/145/3.


Uganda Protectorate, Despatch dated 1952-01-4 from Acting Governor to Secretary of State for the Colonies. UK National Archive: CO 822/551.


Other sources:


Winpenny, James, Financing water for all: report of the world panel on financing water infrastructure, Global Water Partnership, 2003.


World Bank, Global experiences on expanding water and sanitation services to the urban poor, Water and Sanitation Program, World Bank, Washington DC, 2009b.


Part 2

Annex I-VI: Scientific Papers


VI. Jenny Appelblad and David Nilsson, “From 'All for some' to 'Some for all'? A historical geography of pro-poor water provision in Kampala”, (paper submitted to Journal of East African Studies, UK, April 2011)