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**“To still have water, that is the dream”
Exploring a Transition to Sustainable Groundwater Management
in Aweil East, South Sudan**



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ABSTRACT

This thesis discusses institutional sustainability and transitions to sustainable development. These concepts are explored through a qualitative case study on rural groundwater management institutions in Aweil East, South Sudan. The primary question guiding the discussion is how a transition towards sustainable development is reflected in this particular case. The secondary questions supporting the discussion are, firstly, to what extent are the groundwater institutions sustainable and secondly, what are the barriers of sustainable groundwater management. Qualitative fieldwork took place in multiple locations in Aweil East county in the South Sudanese state of Northern Bahr el Ghazal through individual and group interviews with communities, organizations and government officials. The findings suggest that in spite of the barriers, including the dependency on organizations due to lack of community ownership and government capacity, a transition towards sustainable development was happening at the time of the study. Also, it was found that the groundwater institutions were quite fragile and in an early stage of transition. Based on this, the thesis highlights the importance of understanding a transition in order to adjust strategies for managing institutions. Furthermore, it opens discussion on how to assess a transition and what aspects still needs to be developed.

Key Words: transitions, sustainable development, institutional change, institutional sustainability, institutions, groundwater management, natural resource management, South Sudan

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TABLE OF CONTENTS

FOREWORD AND ACKNOWLEDGMENTS.....	5
INTRODUCTION.....	6
Definition of the Problem.....	6
Aim and Research Questions	7
Disposition	8
PART 1 BACKGROUND.....	8
1.1 Water Scarcity	8
1.2 Sustainability and Sustainable Development	9
1.3 Natural Resource Management	10
1.4 Sustainable Groundwater Management	11
1.5 Contextualization of Water Management in South Sudan.....	12
South Sudan.....	12
Aweil East, Northern Bahr el Ghazal state, South Sudan.....	14
Changing the framework for groundwater management in Northern Bahr el Ghazal.....	16
Part 2 METHODOLOGY	17
2.1 Design of the Study	17
2.2 Methods of Selection.....	17
2.3 Presenting Primary Sources	18
2.4 Data Analysis.....	19
2.5 Reliability and Validity.....	19
2.6 Ethical Considerations and Reflexivity	20
2.7 Limitations	20
Part 3 THEORETICAL BACKGROUND	22
3.1 Collective Action over Common-Pool Resources	22
3.2 Institutions and Institutional Change	22
3.3 Transition Theory	24
Part 4 ANALYTICAL FRAMEWORK.....	27
4.1 Analytical Framework for the Sustainability of CPR Institutions.....	27
4.2 Using Institutional Change to Analyze a Transition	29
4.3 Previous Case Studies Using Design Principles	31
Part 5 PRESENTATION AND ANALYSIS OF FINDINGS	32
5.1 Institutional Change in Ostrom’s Design Principles for Aweil East, South Sudan.....	32
A. Clearly defined boundaries.....	32
B. Congruence between appropriation and provision rules and local conditions.....	33
C. Collective-choice arrangements	34
D. Monitoring	35
E. Graduated sanctions.....	37
F. Conflict resolution mechanisms.....	37
G. Minimal recognition of rights to organize.....	38
H. Nested enterprises	40
5.2 Institutional Sustainability.....	41

5.3 Transitioning to sustainable development?	43
CONCLUSION	44
BIBLIOGRAPHY	46
APPENDICES.....	51
Appendix 1: <i>List of respondents</i>	51
Appendix 2: <i>Semi-Structured Interview Questions</i>	52

LIST OF FIGURES

FIGURE 1: REPORTING STRUCTURE AND COORDINATION MECHANISMS.....	14
FIGURE 2: MAP OF FIELD SITES IN AWEIL EAST, NORTHERN BAHR EL GHAZAL STATE, SOUTH SUDAN	15
FIGURE 3: ILLUSTRATION OF THE FUNDAMENTAL CONCEPTS OF TRANSITION THEORY	25
FIGURE 4: ANALYTICAL FRAMEWORK FOR USING INSTITUTIONAL SUSTAINABILITY TO ANALYZE A TRANSITION.....	30

LIST OF TABLES

TABLE 1: TYPES OF RULES GOVERNING A COMMON-POOL RESOURCE	23
TABLE 2: DESIGN PRINCIPLES TO ASSESS THE SUSTAINABILITY OF COMMON-POOL RESOURCE INSTITUTIONS	28
TABLE 3: SUMMARY OF ASSESSMENT FOR INSTITUTIONAL SUSTAINABILITY	29
TABLE 4: SUMMARY OF FINDINGS.....	41

LIST OF ABBREVIATIONS

CPR	Common-Pool Resource
CWC	Community Water Committee
GWM	Groundwater Management
IDPs	Internally Displaced Persons
MDG	Millennium Development Goal
NBeG	Northern Bahr el Ghazal
NGO	Non-governmental Organization
NRM	Natural Resource Management
RQ	Research Question
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organization
WASH	Water, Sanitation and Hygiene
WIMS	Water Information Management System (<i>South Sudan specific</i>)

FOREWORD AND ACKNOWLEDGMENTS

After nearly a year of preparation, we are proud to present our thesis based on fieldwork in South Sudan. Very early on we were determined practice development in a post-conflict environment and were excited by the potential of conducting research in South Sudan, one of the newest countries in the world. After accepting internship positions with United Nations Educational, Scientific and Cultural Organization (UNESCO) in Juba, South Sudan we had to narrow the scope of our research, which was no easy task. The country presented plenty of development concerns from emergency relief to literacy to building a national identity.

We realized that many of the development sectors experienced similar challenges, one of them being that aid for emergency activities was dwindling. More and more, development actors needed to re-strategize their priorities to long-term development projects. These circumstances presented us with the opportunity to research this transition to long-term, sustainable development, which we chose to do through a case study on groundwater management in Aweil East, South Sudan.

Our time in South Sudan with UNESCO was sadly cut short after an attempted *coup d'état* in mid-December 2013, leading to our evacuation. For us, these experiences highlighted even more the importance of returning our research to the country and its people in hopes that progress towards stability and development continues.

Because of the abrupt departure we did not have the opportunity to properly say goodbye and thank those who supported our research. To begin, we would like to sincerely thank our supervisor and head of the UNESCO Juba office, Salah Khaled. You were an inspiring mentor to us both and we are so appreciative that you pushed us out of our comfort zones. Likewise, thank you to our colleagues at the UNESCO Juba office who taught us daily and made us feel like a genuine part of the team. And thank you to our LUMID friends in Nairobi who took us in after our evacuation.

In the field we must especially thank our gatekeeper, Tes. You are the type of caring and passionate person who is meant for development work and we are grateful for all you taught us. Likewise, we want to thank the communities, government officials and organizations who welcomed us (you know who you are!) and who continue resilient efforts for the provision of clean water for all.

We must also thank our thesis supervisor, Martin Andersson, and supervision group for guiding us through the thesis process, which was new to us both. Thank you for all your great feedback. Finally, we thank our family and friends for putting up with our adventurous spirits!

Thank you all! These experiences and this thesis would not have been possible without all of you and your kindness.

Thank you,
Louise & Sofia

INTRODUCTION

Definition of the Problem

After more than five decades of conflict, the Republic of South Sudan gained independence in July 2011, making it one of the newest countries in the world (Fernando and Garvey 2013: 1; UNDAF 2012:6). One root cause of the conflict was the abundance of natural resources in the country (GoSS 2014; UNESCO 2014:6). Despite their economic value, South Sudan is one of the least developed countries in the world (UNESCO 2014:8). Because of the harsh dry seasons and the uneven distribution of water across the country, only 27% of the people in South Sudan have access to a safe water supply and more than a third have to walk at least 30 minutes to find a clean water source (Fernando and Garvey 2013:1; UNESCO 2014:13). In a country prone to droughts and scarcity, poor management over water resources exacerbates conflict, over-extraction, contamination, environmental degradation and overall depletion (Ostrom et al. 1999:279; Kundzewicz et al. 2007:177; UNESCO 2014:8). Therefore, many rely on unsafe water from *hafirs*¹ and surface water even though the ideal source for safe drinking water is groundwater (Concordis 2013:20).

However, accessing and managing groundwater resources is not simple. With half the population below the poverty line and such limited government capacity, people rely on aid and emergency relief (Concordis 2013:40; OCHA 2014:2014). This leaves significant responsibility to institutions such as community groups, newly formed government departments and non-governmental organizations to implement water, sanitation and hygiene projects, including drilling for groundwater. Due to the high demand for immediate water, many institutions prioritize short-term, emergency activities rather than long-term sustainability (ACTED 2012:2; Fernando and Garvey 2013:vii; WASH Cluster 2013:5). In terms of the provision of groundwater resources, these practices accommodate for the current emergency demand, but potentially compromise the groundwater needs of future generations (UNEP-DEWA 2003:20).

Therefore sustainable institutions (i.e., organization structures that work in a sustainable manner) are vital for the development process, especially in regards to natural resource management (Uphoff 1992:13). While it is only a small part of overall sustainability, it is a vital function of the process. As of yet, there has been little to no research conducted on the sustainability of institutions responsible for natural resource management in post-independence South Sudan. As an important part of the economy and development of South Sudan, sustainable natural resource management is vital,

¹ A *hafir* is an artificially made inlet in the ground for the collection of rainwater (UNEP-IECT 2001:42).

especially as organizations exit and the country transitions to a developed, independent state. With research institutions, adjustments in strategies and practices can be made to improve sustainability. Therefore, through a case study on rural groundwater management² in Aweil East, South Sudan, this thesis will analyze a potential transition towards sustainable development by examining the sustainability of institutions managing groundwater resources.

Aim and Research Questions

The aim of the study is to understand the management of rural groundwater, the sustainability of the management institutions and how they are reflected in a transition towards sustainable development. By discussing institutions, we can understand their role in the transition towards sustainable development. This is important in order to make adjustments in strategies and practices for increased sustainability (Grin et al. 2010:130). To understand the complexity of these topics, a case study on groundwater management institutions was conducted in Aweil East, Northern Bahr el Ghazal state, South Sudan. Primary and secondary data collected was complemented by theory on institutions over common-pool resources and theory on transitions to sustainable development. This thesis uses these components to discuss the sustainability of groundwater management institutions in the scope of a transition to sustainable development. In the analysis, we assess the state of a transition towards sustainable development by analyzing the sustainability of institutions for groundwater management. To guide the analysis, this thesis addresses the following research questions (RQs):

Primary:

RQ1: How is a transition towards sustainable development reflected in groundwater management in Aweil East, South Sudan?

Secondary:

RQ2: To what extent are current groundwater institutions in Aweil East, South Sudan sustainable?

RQ3: What are the barriers inhibiting sustainable groundwater management in Aweil East, South Sudan?

² Urban groundwater management entails different processes and practices regarding sharing of resources and accessing clean water (See MWCRD 2013).

Disposition

Based on the introduction and RQs, the remaining thesis is divided into five parts followed by a conclusion. *Part 1* presents a situational analysis through background information on water scarcity, sustainable development and natural resource management. These concepts are then used in a focused discussion on sustainable groundwater management in South Sudan and the situation in the field site, Aweil East. The purpose of this part is to define key concepts as well as give an overview of concepts surrounding the RQs, in the context of South Sudan. *Part 2* presents the methodology of the case study on groundwater management in Aweil East, South Sudan. This section includes a description of the study design, the data collected, and limitations of the study. *Part 3* introduces the theoretical background linking together institutions for collective action over common-pool resources, institutional change and transition theory. *Part 4* introduces the analytical framework, which is built in the theories presented in *Part 3*. It provides a framework to evaluate the sustainability of the institutions managing a common-pool resource, which can then give insight to the state of transition towards sustainable development. *Part 5* is the presentation and analysis of the findings in relation to analytical framework. The analysis aims to answer the RQs to assess the sustainability of institutions in Aweil East, South Sudan and further discuss the state of transition of this case study. The thesis ends with some final conclusions and considerations for future research in the field followed by a bibliography and relevant appendices.

PART 1 BACKGROUND

Situational Analysis of the Research

1.1 Water Scarcity

In 2010 the United Nations' Millennium Development Goal (MDG) target for drinking was met when over two billion people gained access to an improved water source (Onda et al. 2012:881; UNICEF-WHO 2012:1). Although this was a significant achievement towards the MDGs, resulting follow-up reports and household surveys found serious disparities in access to clean and sustainable drinking water regionally, especially in Sub-Saharan Africa which has the lowest drinking water coverage of any region (Onda et al. 2012:882; UNICEF-WHO 2012:29). Clean water for health and agriculture is shown to contribute to the overall economic success of a country and is a vital determinant of the overall development of a country (Vörösmarty et al. 2000:287; UNDP 2006:42-49; UNESCO 2009: 41-54). Therefore, improving access to clean water in a sustainable manner is critical for the future health and livelihood of global populations as well as an important component for the development in low-income countries.

Water scarcity adds additional challenges to clean water access. Water scarcity is when a large group of people in a specific area are water insecure for long periods of time (Hoekstra 1998:609; Rijsberman 2006:5). It is important to understand how such an infinitely renewable resource such as water can become scarce. Unlike oil or natural gas, the natural water cycle renews freshwater sources constantly. Meaning, there is physically enough freshwater for the global population, however on a regional level there are serious distribution disparities due to both population density and seasonal scarcity (ibid; UNDP 2006:135; Kumma et al. 2010:1).

The issues of water access and scarcity highlighted above are and will continue to be exacerbated by looming climate change. According to the Intergovernmental Panel on Climate Change, climate change is expected to have significantly negative impacts on freshwater systems, including groundwater which is essential for densely populated arid and semi-arid regions (UNEP-DEWA 2003:7; Kundzewicz et al. 2007; Kundzewicz et al. 2008). With climate change, these regions will experience longer periods of dry season (Falkenmark et al. 2007:4; Kundzewicz et al. 2007:178; Kundzewicz et al. 2008:5).

1.2 Sustainability and Sustainable Development

Aspects of sustainable development need to be considered and applied as a way to mitigate water scarcity (See UNDP 2006; Falkenmark et al. 2007; Kumma et al. 2010). In 1987 the United Nations (UN) released what is known as the Brundtland Report, which defines sustainable development as “development that meets present needs without compromising the ability to meet needs for future generations” (1987:27). The report was a trailblazer in bringing about the discussion of the relationship between humans and their environment (Sneddon et al. 2006:254). Discussions on climate change have brought sustainable development to the forefront as a potential solution to compromise for our generation - a way to get what we need today, without destroying possibilities for future generations (Brundtland 1987:15; Sneddon et al. 2006:255).

The Brundtland definition of sustainable development has been both criticized and expanded. The term entails a process where the economy, environment, society and ecosystem develop equally and improve over time, which makes it a difficult concept to grasp (Loucks and Gladwell 1999:6). Sustainable development is broad, incorporating economic, social and environmental dimensions (Robinson 2004:381; Loucks and Van Beek 2005:34; Sneddon et al. 2006:261). These are the foundations to the UN indicators for the assessment of sustainable development (Pfahl 2005:81). In

1995, the UN Commission for Sustainable Development added the institutional dimension as the fourth indicator for sustainable development (Pfahl 2005:81). Although it is important to understand all the components that encompass sustainable development, they are beyond the scope of this study. Therefore, our thesis focuses on the sustainability of managing institutions, which ultimately contribute to long-term availability of clean access to water. From these managing institutions, various levels of actors, especially communities, need to be incorporated to understand the overarching process (Robinson 2004:381). Therefore in this thesis, sustainability refers to long-term access to clean water and sustainable development is explored through managing institutions, which is elaborated on in *Part 3*.

1.3 Natural Resource Management

A vital component of achieving sustainable development is proper natural resource management (NRM) (Brundtland 1987; Loucks and Gladwell 1999; Loucks and Van Beek 2005; UNDP 2006; Falkenmark et al. 2007; Kundzewicz et al. 2007; Kundzewicz et al. 2008; Kumma et al. 2010). Garrett Hardin introduced the concept of NRM in his article “The tragedy of the commons” (1968), opening the doors for many discussions on the misuse of natural resources. He argued that there is a dilemma between an individual’s priority over self and the good of the community, which may lead to the depletion of a scarce resource due to unmonitored use (Hardin 1968; Ostrom 1990:2; Ostrom et al. 1999:278). The solution, Hardin argues, should be either socialism or privatization (ibid). Elinor Ostrom criticized Hardin, clarifying that both these solutions are also subject to failure and that people have self-organized management over shared, common-pool resources (CPRs) for thousands of years (Ostrom 1990:11; Ostrom et al. 1999:278). She agreed that CPRs can easily be over exploited, contaminated or depleted, but argued that proper collectively organized institutions for managing resources are vital for long-term sustainability (Ostrom et al. 1999:279). Ostrom’s theory on institutions for collective action is discussed in *Part 3* as the foundation for theory on sustainable institutions.

NRM is affected by many attributes such as the carrying capacity of the resource, the actors involved, and the amount of storage in the system and the speed of regeneration of the resource (Ostrom et al. 1999:279). A common constraint in the successful implementation of NRM is the lack of coordination between the various actors and their lack of capacity to implement change (Kundzewicz et al. 2007:199). If NRM does not address these issues, there is a risk of negatively impacting the resource (ibid). Therefore, it is vital to properly manage resources such as freshwater because they face scarcity and depletion throughout the world.

1.4 Sustainable Groundwater Management

In regions of water scarcity, groundwater is often relied upon as a clean freshwater source because proper wells and handpumps will maintain the cleanliness of the groundwater. Sub-Saharan Africa experiences both rainy and dry seasons and has significant population density in comparison to other regions of the world, which are two factors that dramatically contribute to scarcity (Vörösmarty et al. 2000:287; Kundzewicz et al. 2007:176; UNESCO 2009:18-35). Because of these challenging conditions, groundwater is a viable alternative for freshwater. Globally, groundwater is estimated to make up 95% of the world's useable freshwater reserves and it is a vital source for economic and social development in both urban and rural settings in developing countries (UNEP-DEWA 2003:2). Generally, water is considered to be a renewable resource, however in cases where communities *have to* rely on groundwater, water is regarded as non-renewable because of its sensitivity to depletion and contamination (ibid; Rogers 1985; Hoekstra 1998:608). As with any natural resource, human involvement for extracting groundwater comes with challenges including over-extraction, water contamination, and environmental degradation (ibid; Kundzewicz et al. 2007:177; Braune and Xu 2010:699). The use of groundwater as an alternative freshwater source and its risk for degradation in water-scarce regions highlights the need for sustainable groundwater management (GWM).

To access groundwater without contaminating the system, boreholes are drilled to reach the top of the water table, how deep the water lies in the aquifer. Then handpumps are installed to pump water from the aquifer. At this stage, the borehole/handpump is called a waterpoint. Usually a simple fence is built around the waterpoint to keep animals from drinking from the same source. Aquifers are connected underneath the earth's surface to a larger groundwater network. They naturally recharge, but the rate of recharge may vary, which is why some groundwater aquifers can run dry if they are overused (known as overdraft). Prior to drilling, hydrological and geological data may be collected, which can ease the drilling process to understand the sediment beneath the earth. It can also be used to assess if water will be found, the depth of the water table, and estimate the rate of recharge. For more on the drilling process see Van der Wal (2010).

GWM entails the systematic identification, planning, monitoring, use and management of both the quality and the quantity of groundwater resources (UNEP-DEWA 2003:107). These practices are considered sustainable when the development of groundwater meets the needs of present generations without compromising the needs of future generations (Brundtland Report 1987; UNEP-

DEWA 2003:20). As important as it is, proper GWM has constraints that impact the sustainability of the resource and the institutions managing it including (UNEP-DEWA 2003:110; Koniknow and Kendy 2005:318):

- a lack of data on groundwater supplies and usage trends
- the large number of users both pumping and polluting the aquifers
- the limited capacities of organizations or institutions managing groundwater

Both the quantity and the quality of the groundwater are affected by these constraints (UNEP-DEWA 2003:105). Since contexts vary there are no definite principles for ideal management (ibid; Robinson 2004:381; Allan 2005:192). Therefore, it is important to consider these constraints when designing GWM institutions.

1.5 Contextualization of Water Management in South Sudan

With the understanding of sustainable GWM, the following section discusses water management in the context of post-independence South Sudan followed by background on Aweil East where we conducted a case study on GWM.

South Sudan

After nearly five decades of civil war with Sudan resulting in over two million deaths and four million displaced, South Sudan signed the Comprehensive Peace Agreement with the north guaranteeing its autonomy. On July 9th 2011, the new nation celebrated its official independence from Sudan making it the 193rd member of the United Nations (Fernando and Garvey 2013:1; UNESCO 2014:5). Due to this, the new political infrastructure remains weak, leaving a backdrop of economic instability and fragile peace (ACTED 2012:2; Fernando and Garvey 2013:vii; UNESCO 2014:6).

Historical and political factors have played a significant role in the severity of clean water access. Water scarcity and access is dire, affecting more than half of the population, especially in the rural areas where most people rely on rainwater as their primary freshwater source (Fernando and Garvey 2013:1). One of the policies put forward by the national government states that “rural communities shall be supported to take an active role in planning, managing and financing of rural water supply and sanitation schemes on a sustainable basis” (GoSS 2007). The government and development organizations are working on water coverage in rural areas, but the sustainability of practices remains a challenge due to damaged infrastructure and the lack of spareparts, amongst other concerns (ibid:39-40).

A few years after releasing the rural water policy, the water, sanitation and hygiene (WASH) cluster was established as a coordination tool (See *Figure 1*). The purpose of the WASH cluster is to streamline implementation strategies for development and emergency WASH activities amongst relevant actors including UN agencies, government actors, community-based organizations and non-governmental organizations (NGOs) (WASH Cluster 2014). On the national level the WASH cluster meets once a month and in each state meetings between state-WASH clusters vary.

The Water Information Management System (WIMS) was initiated by the national Ministry of Water as a coordination tool for WASH actors to report and share the functioning, non-functioning and contaminated waterpoints throughout the country (See *Figure 1*). Use of WIMS could prevent the duplication of projects as well as increase effective monitoring. However, the system has not been fully utilized. There are reporting gaps in many of the South Sudanese states and the reporting of waterpoints, such as boreholes, do not go beyond the county level (MWCRD 2013:6). The WIMS data is either outdated, incorrect or nonexistent and is rarely used by WASH actors (MWCRD 2013:6).

In regards to water governance, each state has a State Ministry of Water³, with a specific department for water resource management (Concordis 2013:13). On the county level, county commissioners are responsible for each *payam*⁴, or sub-county, and for appointing *payam* water administrators. The administrative division below the *payam* is the community(ies) surrounding a waterpoint. *Figure 1* shows the general structure of institutions involved with GWM in South Sudan and their reporting structure. Our case in Aweil East reviews the structures from the state-level down, excluding national institutions, as it is too broad for the scope of our study. We also include the WIMS and the WASH cluster because they are a significant part of state-level coordination.

³ *The name of the Ministry responsible for water varies from state to state.*

⁴ *Payam is the South Sudanese administrative level beneath the county. It consists of multiple, widespread communities.*

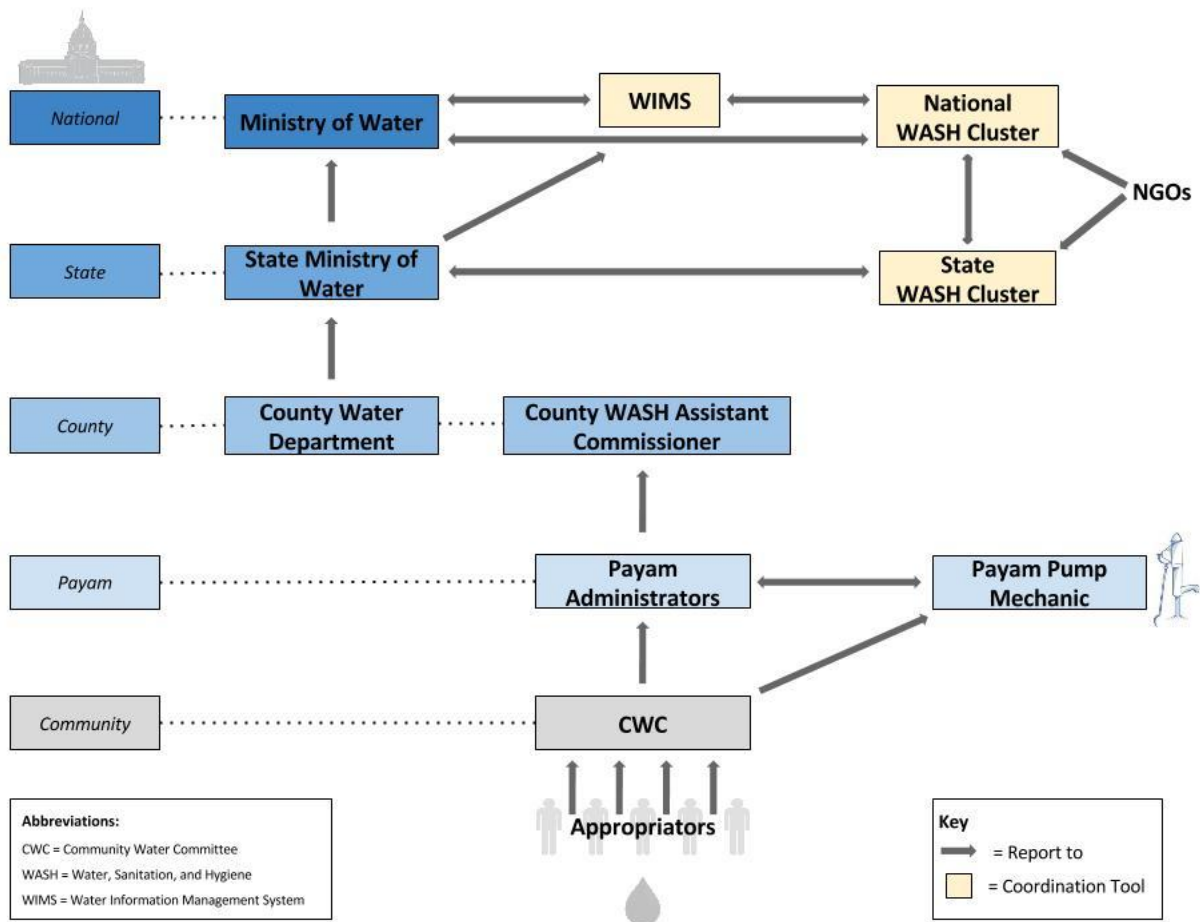


Figure 1: Reporting Structure and Coordination Mechanisms for Groundwater Management Institutions in South Sudan
Created by Authors

Aweil East, Northern Bahr el Ghazal state, South Sudan

Our case study on GWM took place in Aweil East county, which lies in Northern Bahr el Ghazal (NBeG) state in South Sudan (See Figure 2). Its name originates from *Bahr el Ghazal* river meaning “sea of gazelles” and is one of ten states in South Sudan. NBeG borders Sudan to the north, with other South Sudanese states to the west, east and south. After decades of war with Sudan and communal conflicts with pastoralists from the north, NBeG is today one of the most stable regions of South Sudan, although the persistence of peace is always uneasy (Concordis 2013:11). The state experiences both wet and dry seasons with low-, middle- and highlands throughout. From May to November, lowlands are annually flooded and the areas can only be accessed in the dry season. Whereas highlands are fertile but have little to no water in the dry season, which extends from January to May (See Purnell and Venema 1976; IOM 2009:12; Concordis 2013:12). In addition, NBeG has several rivers running through, that eventually flow to the Nile (ibid). The state is broken into

five counties, with Aweil East being the most populated with approximately twenty-one *payams* (CBS 2009; Concordis 2013:17). The map below shows Aweil East in relation to South Sudan and highlights the field sites visited, which is discussed in *Part 2* (See *Figure 2*).



Figure 2: Map of Field Sites in Aweil East, Northern Bahr el Ghazal state, South Sudan
Created by the authors' based on Google Maps (2014).

Access to safe and improved drinking water through groundwater is an ongoing struggle in Aweil East, especially during the dry season (Concordis 2013:18; MWCRD 2013:2). A village assessment in NBeG by the International Organization for Migration, found that access to improved drinking water was the largest concern and only 30% of the villages had access to improved drinking water (IOM 2009:16). In particular, Aweil East relied primarily on unprotected wells and contaminated sources such as rivers. Of those that relied on handpumps for groundwater access over 20% were in disrepair (IOM 2009:18). Many areas of Aweil East have water tables so deep that drilling for groundwater is near impossible, challenging both governments and organizations (Concordis 2013:18). Furthermore, the influx of large numbers of refugees from Sudan after independence has put additional pressures on already scarce water resources (IOM 2009:13; MWCRD 2013:2).

In terms of water supply infrastructure, all supplies and the costs of labor are provided by UN agencies, bilateral actors, and NGOs (MWCRD 2013:4). From here on out, we use the umbrella term *organizations* to refer to these actors. Organizations train community water committees (CWCs) to encourage the collections of monthly fees per household to later pay for repairs (MWRDC 2013:21). The CWCs are also responsible for enforcing rules regarding the use of the water and for contacting the designated mechanic if the handpump needs repair (ibid; R1;R2;R3). The organizations decide where to drill and these decisions are usually driven by the demands of emergency or humanitarian needs (MWCRD 2013:5). As of yet, there is no formal coordination mechanism for reporting activities to the government regarding where boreholes have been drilled. Therefore data in the WIMS is not congruent and there is a need for better collaboration between the state and national ministries of water (MWRDC 2013:6).

Changing the framework for groundwater management in Northern Bahr el Ghazal

The issues facing Aweil East highlight the need for proper management amongst the various actors in the state. Prior to and shortly after independence, UNICEF delivered free spareparts to repair broken handpumps, which kept the number of broken handpumps in NBeG below 10% (MWCRD 2013:vi). However, in 20s13 UNICEF ended this policy, which highlighted the state's dependency on these free spareparts to maintain rural water supplies (MWCRD 2013:1). Instead of relying on other organizations to step in, NBeG's State Ministry of Water developed an operations and maintenance framework that requires the involvement public and private sector, organizations, and communities to uphold sustainable management practices of rural water supplies, namely groundwater.

The framework entails the collaboration of all these actors to change current practices. For example, in the past organizations or other actors would step-in to repair handpumps themselves. However the framework clearly states that communities are responsible for paying for parts and maintenance, which should be done through a trained pump mechanic, rather than an NGO (MWCRD 2013:vii). These types of changes require the cooperation of communities to contribute fees, as well as organizations to repair handpumps through local handpump mechanics. The overarching goal of the management framework is to transition the water sector from emergency activities to a long-term development (MWCRD 2013:1). The State Ministry of Water declared, "The vision is for Northern Bahr el Ghazal, through its own leadership and involvement of communities, to ensure sustainable access to safe water for all in the State," (MWCRD 2013:vi). In light of the shifting management and maintenance of groundwater supplies in Aweil East, a case study was conducted with actors and communities to understand the ongoing transition towards sustainable GWM.

Part 2 METHODOLOGY

Case Study in Aweil East, South Sudan

2.1 Design of the Study

According to Robert Yin's research on case study methods, a case study is "...an empirical inquiry that investigates a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident," (2009:18). In our case, we explore transitions to sustainable development in the real-life context of GWM in Aweil East. By asking *how* a transition is reflected in rural GWM in Aweil East, the case study method allows us to explore and explain the topic in depth, capturing the complexities of various institutions and factors that can impact the case (Creswell 2009:13; Yin 2009:9). Furthermore, Yin suggests that a case study is appropriate for distinctive situations that benefit from theory (Yin 2009:18). As a result of the findings, we were guided by theory (See *Part 3*), meaning a deductive approach was taken (Bryman 2012:711). However, our data was collected before deriving ideas from the theory, which is an inductive approach (Bryman 2012:26). Therefore, we use both a deductive and inductive approach to address our RQs. We shift between theory, the analytical framework and empirical observations, making our own inferences on the theory while also using theory to infer on the findings. The primary and secondary data collected in the field together with the theoretical background and analytical framework are used to answer the RQs.

2.2 Methods of Selection

The case study location in Aweil East, a county of NBeG state in South Sudan, was chosen based on its representativeness of the country. The location is very diverse geologically, having both low- and high- lands, as well as floods and droughts between rainy and dry seasons, which has brought in a variety of actors working on GWM (R1;R2⁵). Its typical features are found throughout South Sudan, making Aweil East an exemplifying case for our objective to capture the situations of everyday in order to explain a broader process (i.e., how transitions towards sustainable development are reflected in our case) (Yin 2009:32; Bryman 2012:56).

Case study sampling should "employ maximum variation as a sampling strategy to represent diverse cases and to fully describe multiple perspectives" (Creswell 2009:178; Creswell 2012:156). To do this, we conducted interviews in a variety of communities and with various actors including

⁵ Respondents from our data collection will be cited as (Rx). See Appendix 1 for full list of respondent numbers and their description.

organizations, government officials, drillers and communities facing different issues with their groundwater (See *Appendix 1*). To address the RQs and understand the scope of potential transitions, it was important to have a wide array range of perspectives on different levels of society - from government actors to community members (Grin et al. 2010:11-12, 109). Therefore, purposeful maximum variation sampling was used through the help of a gatekeeper in the NGO community in Aweil East (Creswell 2009:178; Creswell 2012: 156).

2.3 Presenting Primary Sources

In order capture a broad spectrum of data, one-on-one semi-structured interviews were conducted with government officials, UN agencies, technical specialists, WASH representatives, borehole drillers and NGOs, all working with GWM and borehole drilling (See *Appendix 1* for respondent descriptions). In total, 12 individual semi-structured interviews were conducted in the office of the interviewee or on location at drilling operation sites. The interviews lasted for approximately one hour and were conducted in English, the official working language of the organizations and the country of South Sudan (See *Appendix 2* for interview guidelines). All individual interviews were recorded with the exception of interviews with South Sudanese government officials⁶. When interviews were not recorded, notes were thoroughly detailed and transcribed. We crosschecked and triangulated each other's notes to ensure that the data conveyed was consistent.

Group interviews were conducted with three CWCs in Aweil East. Two of the CWCs were located in Wadweil and the third was located in Ajok Loal (See *Figure 2*). The CWCs included approximately 7 to 14 members, both men and women between the ages of approximately 20 and 60 (See *Appendix 1*). CWCs are trained by the government or organization that installed borehole and their primary responsibilities are to collect money from each household and take action if borehole repairs are needed.

During group interviews, on-the-spot translations were done from Arabic (for CWC1 and CWC2) and local languages (for CWC3) to English. NGO representatives who previously worked with the CWCs acted as translators during the interviews, which allowed the communities to be more comfortable with our questions and honest in their responses. Also because these translators worked for NGOs in the WASH sector they were familiar with the terminology used during our interviews. However, it is important to consider that in using the NGOs as translators there is a risk that sensitive or critical

⁶ *Due to decades of war and espionage, recording and photography of government officials or buildings is illegal without official permits and licensing. These permits generally take months to obtain.*

information about the organization itself may have been left out by the CWCs. Another consideration is that the translator for the first two CWCs was a female speaking to mixed male/female group and the translator for the third CWC was a male speaking to a majority female group. However, we did not note any significant differences in respondent behavior due to this and the respondents were relatively critical of the organizations and government, showing they were comfortable with the interview scenario. For a complete description of primary data collected, please review *Appendix 1* for a list of respondents and *Appendix 2* for the interview guidelines.

2.4 Data Analysis

For primary data, we transcribed the recorded interviews, typed up field notes and categorized by the type of data (i.e., individual interview, group interview). The data was then coded, categorizing the information into predetermined codes based on eight principles (categories) outlined in the analytical framework (See *Section 4.1*), with an additional category for outlying or surprising concepts found in the data (Creswell 2009:186). After sorting through the data, we did a second round of coding in relation to identifying institutional changes among our respondents (See *Section 4.2*). When coding was completed, themes were analyzed and interpreted in the scope of the theory (ibid) in the analysis section. Primary data was supplemented by secondary data including documents from organizations, documents from South Sudan's WASH sector, and documents from government ministries working on GWM and borehole drilling. The secondary data was collected and sorted. The documents were then used to compliment coded data.

2.5 Reliability and Validity

In any research process, the issues of reliability and validity of the data need to be considered. In order to assure the reliability and consistency of the qualitative data, we used codes to organize our data, as suggested by Yin for case studies (2009), through previously used methods derived from theory. Likewise, as a team, we crosschecked the transcripts and codes to ensure consistency (Creswell 2009:190). Validity is a strength of qualitative research and case studies (Creswell 2009:191; Yin 2009:41). In order to validate the data, several different approaches have been used throughout the research process. During data collection multiple sources of evidence were used to validate and triangulate responses (Creswell 2009:191; Yin 2009:42). For example, on-site observations were followed by group or individual interviews as a way to triangulate and validate certain findings from the observations (see *Appendix 1*).

Likewise, respondents were asked questions based on the responses of previous interviewees, as a way to review rival or opposing viewpoints (Yin 2009:43). Also we, as two researchers, validated each other by reviewing our notes and observations to ensure consistency. A potential downside of this study is generalizability because according to Yin, case studies “provide little basis for scientific generalization” (2009:15). However, the purpose of our case study is not to generalize to other cases or populations, but rather to contribute to existing research and to those that the study pertains to in South Sudan (Bryman 2012:71).

2.6 Ethical Considerations and Reflexivity

In terms of ethical considerations in the methodology, anonymity of participants was promised to protect the integrity and opinions of specific actors working for various institutions. Therefore participants are represented by a respondent number and a vague description to understand the relevance of the actor (See *Appendix 1*) (Creswell 2009:90). Informed verbal consent was taken before beginning the interview. Verbal consent was especially important for the group interviews as many of the participants were unable to read/write or speak English and therefore could not provide written consent (Creswell 2009:89). In the dissemination of this thesis, we are cognizant and careful in our interpretation and findings as to not demean or falsify findings (Creswell 2009:92).

Finally, throughout the whole process, we as researchers were aware of our positions as two women from developed countries and as representatives of the university and organization that we were working for. By using gatekeepers and translators who are already established in the study location, we hope our positions as researchers did not significantly affect the comfort of the respondents. However, some of the respondents from organizations and governments might have been hesitant to fully disclose certain information because we were identified with Lund University and United Nations Educational, Scientific and Cultural Organization (UNESCO), the organization we were working for. Another ethical consideration in regards to our positionality was that some of the communities saw us as more than researchers. They saw us as people who could possibly contribute to resources or help them with problems they were facing, such as one community who asked for a health facility.

2.7 Limitations

In terms of limitations to the study, there are some important factors to consider. Due to strict security guidelines, our time in the field site was limited. We were constricted to an intense week of

data collection in Aweil East, giving us a very specific and concise snapshot of the situation on the ground. It took a day of travel to reach NBeG and once there, we were limited by poor road conditions that made it difficult to reach the communities and respondents. By vehicle, travel to each field site took between one and three hours. To alleviate these challenges, preliminary data was conducted in Juba, South Sudan with actors visiting from Aweil East several months prior to the actual field visit. The dates and locations of data collection can be reviewed in *Appendix 1*.

A major limitation to the study is that South Sudan, as a sovereign state, is fairly young. However, this can also be seen as a potential opportunity to influence change. It brings to question how an assessment can be accurately composed on such fragile institutions. Transitions generally take 25-50 years (Grin et al. 2010:11, 128), however it is important to remember that although the nation itself is new, the organizations, government structures and communities existed prior to independence, under the rule of northern Sudan. Therefore, the managing institutions are not as new as the country itself. Additionally, with new government of South Sudan in place, there are many ongoing changes, making it an ideal opportunity to study transitions.

Another limitation is that being such a newly independent country, there is limited secondary data to review because most secondary data prior to 2011 is focused on northern Sudan. Therefore, some of the secondary data collected comes from pre-independence when South Sudan was still a part of Sudan. This is feasible for research on GWM because Aweil East lies close to the border to northern Sudan and is therefore similar in terms of cultural diversity, climate, environment, and the types of actors working in the area.

The final consideration is that our study is a snapshot of how Aweil East *was* at the time of our field visit in early December 2013. In late December 2013, South Sudan broke into a renewed period of violence based on an attempted *coup d'état* tied to tribal tensions. Therefore, we must clarify that this case study is a reflection of what *was* current at the time of the study prior to the violence that continued after our departure. There is no way to speculate on what could have been or in what direction the country is headed now. Therefore we base our analysis and conclusions on the data we collected and the situation we saw in early December 2013, with the understanding that our study may be applicable again when South Sudan returns to a more peaceful state.

Part 3 THEORETICAL BACKGROUND

Common-Pool Resource Institutions and Transitions

3.1 Collective Action over Common-Pool Resources

In order to assess the case study on GWM in Aweil East, South Sudan, we must first understand the theory behind the institutions driving NRM. Discussions on NRM come to the forefront in Elinor Ostrom's (1990) *Governing the Commons: The evolution of institutions for collective action* where collective action is the foundation for institutions governing and managing shared resources, or CPRs. Collective action is defined as the actions *collectively* coordinated by a group to achieve returns as high as possible from a particular resource system. It is often referred to as community or collective management (Ostrom 1990:39). Criticisms of collective action over CPRs argue that there are documented cases where resources have been *unsuccessfully* managed and suggest privatization of resource management as a solution (Ostrom 1990:29; Leach et al. 1997:2). However privatization often risks increasing mismanagement and misuse of the resource, leading to even more unsustainable results (Ostrom 1990:22; Huang et al. 2012:98).

Shifting from privatized to collective management has become popular for the conservation of resources and the sustainability of management systems (Leach et al. 1997; Argawal 2002:43). Community management of CPRs is regarded as a way to overcome resource degradation and misuse, especially in the context of developing countries (Cousins 1996; Quinn et al. 2007). Therefore, in order to make adequate management decisions, collective action over CPRs needs to be considered as a viable option (Ostrom 1990:23; UNEP-DEWA 2003:107). In our case, groundwater fits the criteria of being a CPR as it is (1) a renewable resource, (2) a scarce resource, and (3) its misuse by one user can harm another user (Ostrom 1990:26). *Appropriators*, who withdraw groundwater from the basin/aquifer, are vital components of collective CPR management. Appropriators and CPRs are therefore interdependent and must be mitigated by institutions for collective action (Ostrom 1990:39).

3.2 Institutions and Institutional Change

Collective action is manifested in institutions that manage CPRs, which are important mechanisms for promoting sustainable resource management (Agrawal 2002:43). Ostrom defines an institution as,

...sets of working rules that are used to determine who is eligible to make decisions in some arena, what actions are allowed or constrained, what aggregation rules will be used, what procedures must be followed, what

information must or must not be provided, and what payoffs will be assigned to individuals dependent on their actions (1986; 1990:51).

In this definition, Ostrom encompasses important aspects of institutions that have been determined by other theorists (See Keohane et al. 1993; Pfahl 2005:83). Institutions are guided by working rules, which are common knowledge, both monitored and enforced (Ostrom 1990:51). The three types of rules that affect CPR situations are *operational*, *collective-choice* and *constitutional-choice* rules as described below (ibid:52; Agrawal and Ostrom 2001:489; See *Table 1*).

Table 1: Types of Rules Governing a Common-Pool Resource

Rule:	Explanation:	Example:
<i>Operational</i>	Apply to the processes of appropriation, provision, monitoring and enforcement on the day-to-day.	<i>Withdrawal: The right to obtain resource units from a resource system.</i>
<i>Collective-Choice</i>	Used by appropriators or external authorities to make operational rules about how to manage the CPR. These rules encompass the processes of policy-making, management and adjudication.	<i>Exclusion: The right to determine who will have rights of withdrawal and how that may be transferred.</i>
<i>Constitutional-Choice</i>	Determine eligibility and specify rules on how to create collective-choice rules, which then affect operational rules. This set of rules is most commonly associated with the processes of formulation, governance, adjudication and modification.	<i>Overarching rules usually set by government entities; rules that give operational and collective-choice authority.</i>

Based on Ostrom (1990) and Agrawal (2002).

The effectiveness of a CPR institution is assessed by the robustness of these rules and structures. Robustness is when an ecological system⁷ is prevented from moving into a state where it cannot support the surrounding human population (Anderies et al. 2004:24). Because robustness requires long-term development for future populations it can be considered sustainable, which also requires that the needs of current and future generations are met (See *Section 1.2*). By using Ostrom's institutional robustness criteria, we assess sustainability (Ostrom 1990; Argawal 2002:45). Therefore, from here on out, sustainability is defined by its level of robustness. The assessment for sustainable institutions is discussed in *Part 4*.

⁷ *In this case, ecological system refers to resource itself and the environmental factors surrounding it.*

An important aspect of these rules is for institutions to adapt to the contextual ecological dynamics (Anderies et al. 2004:12). The ability of institutions to adapt was emphasized in the World Development Report, which stressed that institutions have to respond to major global changes in order to achieve sustainable development (World Bank 2003:37; Pfahl 2005:85). For example, as the ecological system changes, institutions need to adapt to maintain their sustainability (ibid; Anderies et al. 2004:12; Quinn et al. 2007). Adaptation comes about through institutional change, which is “a change in any rule affecting the set of participants, the set of strategies available to participants, the control they have over outcomes, the information they have, or the payoffs ” (Ostrom 1986). Institutional changes are incremental and can occur within operational, collective-choice, and constitutional-choice rules. These incremental changes can also indicate changes in a larger system, especially when there is a collective effort for change amongst actors in a CPR institution (Pfahl 2005:83). Therefore, after several decades of incremental institutional changes, the entire institutional structure will have undergone a complete transformation (Ostrom 1990:141).

3.3 Transition Theory

Much like institutional changes described by Ostrom, transitions rely on incremental changes over a long period of time. By analyzing incremental institutional changes, we can better understand their place in a larger process. In this study, we look at these changes in the scope of a transition towards sustainable development, which entails institutional and actor level changes resulting in heightened sustainability (Loorbach and Rotmans 2006:2; Grin et al. 2010:11,109). A transition is a complex interdisciplinary concept with many components that have not yet been developed. To its core, transition theory⁸ is a theory of a process and its components. The foundations of transition theory for sustainable development as developed by Loorbach and Rotmans (2006) and Grin et al. (2010) provide us with a coherent framework to work around.

To use a broad concept such as transitions to sustainable development, one needs to understand the multi-actor process (Rotmans et al. 2001:17; Loorbach and Rotmans 2006:10; Grin et al.2010:12,24). Change is brought about through interactions between actors such as social groups, communities, and policymakers (ibid). These changes do not always bring about a transition, which can stagnate or regress. However, with enough pressure these interactions can create institutional

⁸ *This transition theory should not be confused with economic transition which revolves around market regulation. Transition theory, as presented in this thesis, refers to persistent societal problems such as water or health. crises (Grin et al 2010:1). It is an interdisciplinary concept that explores multiple societal dimensions that are involved in sustainable development (ibid:xvii).*

change, which drives a transition (Grin et al. 2010:24,109). By analyzing the relevant appropriators, organizations and local government (i.e., institutions), we can understand how institutional changes contribute to a transition towards sustainable development.

There are two main interlinked concepts that are the foundations of transition theory, namely multi-phase concept and multi-level concept (See *Figure 3*) (Rotmans et al. 2001:17,20; Loorbach and Romans 2006:4,5; Grin et al. 2010:126). Additional transition theory concepts exist, but we focus on the multi-phase and multi-level concepts, which are the most agreed upon concepts amongst scholars. *Figure 3* below displays the two concepts, which are further explained below.

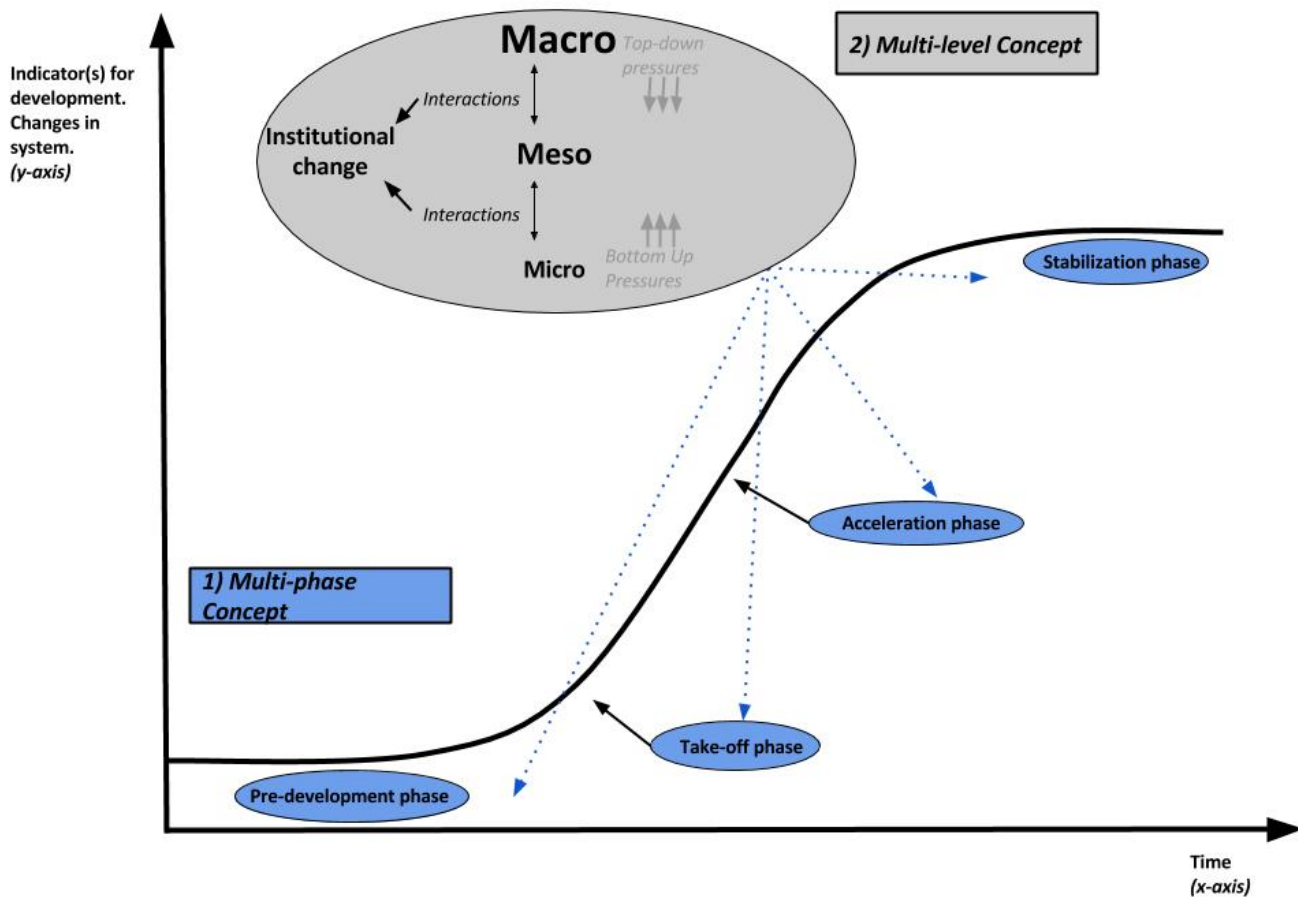


Figure 3: Illustration of the Fundamental Concepts of Transition Theory
Authors' interpretation of the multi-phase and multi-level concepts based on Grin et al. (2010), Loorbach and Rotmans (2006) and Rotmans et al (2001).

The first is the multi-phase concept, which describes the phases that a transition generally follows. However, there can be multiple ways for a transition to reach a point of sustainable development (Rotmans et al. 2001:17; Grin et al.2010:128). This concept consists of four phases: The pre-development phase, the take-off phase, the acceleration and the stabilization phase (Loorbach and Rotmans 2006:4; Grin et al.2010:126, 130). Together these phases form an S-curve, which is the ideal theoretical flow of a transition (Loorbach and Rotmans 2006:4; Grin et al. 2010:127). The pre-development phase is where changes are beginning to happen, but they are difficult to detect (Loorbach and Rotmans 2006:4; Grin et at.2010:126). In the take-off phase, institutional and structural changes become more visible. The acceleration phase is where these changes become a reality on all levels. The stabilization phase is where the transition is stable and the institution has reached institutional equilibrium (ibid) or what Ostrom considers a sustainable institution (Ostrom 1990:58). Because sustainable development is a process, the last phase is not an absolute end point, but rather a stable environment for another potential transition towards further sustainability (Grin et al.2010:139).

A transition does not start at one specific point in time or place. It is not until significant changes occur from many sources that a transition can occur. This is the idea behind the second concept, called the multi-level concept (Grin et al.2010:131,133). The concept entails three levels - macro, meso and micro. The macro-level is the global level, including global agreements, worldviews, cultural paradigms, or transnational actors such as the UN (Grin et al. 2010:111,313). The meso-level is related to governing practices used by groups of actors such as governments or organizations. Finally the micro-level includes individuals, local governments and other grassroots actors that create small incremental changes (ibid:132). The macro-, meso- and micro-levels play an important part in a transition. Changes on each level are required for institutional change to occur, which then drives the take-off and acceleration phase of a transition. Changes on the micro-level can create bottom-up pressures forcing the meso and macro-levels to adjust, but these changes generally take a long time. Whereas changes on the macro-level trickle down fast, pressuring the meso- and micro-level to adapt (Loorbach and Rotmans 2006:5; Grin et al.2010:133). Institutions are embedded in all three levels of the multi-level concept (Grin et al.2010:43, 136). Therefore in order to understand how a transition came about, it is important to look at the institutional changes that occur on all three levels.

The main criticism of transition theory is that certain components still need to be developed. It is not yet a complete theory because it contains gaps in the details of the fundamental concepts. In the

multi-phase concept, there are no indicators for measuring change, meaning there are no parameters on the y-axis to accurately estimate a phase on the S-curve (Grin et al. 2010: 130). This is problematic when analyzing a transition because the theory does not give a specific definition of the phases beyond that they are categorized through the visibility of institutional changes (Grin et al. 2010:130). Furthermore, there are additional concepts presented in transition theory that are not yet widely accepted and are not relevant for our research.

Part 4 ANALYTICAL FRAMEWORK

Analyzing Transitions to Sustainable Development

4.1 Analytical Framework for the Sustainability of CPR Institutions

The sustainability of CPR institutions is assessed through eight design principles that characterize sustainable CPR institutions. Although there are a variety of criteria for assessing institutional sustainability and other theorists have developed their own characteristics (See Wade 1988; Baland and Plateau 1996; See Pfahl 2005), Ostrom's design principles are based on characteristics from case studies of successful, long-enduring, and sustainable CPR institutions, including GWM cases (Ostrom 1990:88; Argawal 2002:46). The design principles were first introduced by Ostrom (1990) but further elaborated by Anderies et al. (2004; See *Table 2*).

The principles provide a guiding framework for CPRs, like GWM in Aweil East (Anderies et al. 2004:32-34). Criticisms of the design principles conclude that the principles are not applicable to *all* real-life situations, but only to certain types of CPRs (Steins and Edwards 1999; Campbell et al. 2001). While this may be true, cases used by Ostrom to develop the design principles included several studies on successful GWM institutions and therefore encompass defining characteristics that are important for our study. Furthermore the principles have been criticized because they are difficult to measure, but they are not meant to be an exact blueprint (Ostrom 1990:90). Rather they provide an outline of characteristics for long-enduring CPR situations, which should be adjusted to specific contexts (Ostrom 1990; Gautum and Shivakoti 2005:154-156). Therefore, we use them to assess GWM institutions in Aweil East, South Sudan.

The design principles directly reflect operational, collective-choice, and constitutional-choice rules because these are the foundations of sustainable institutions (Ostrom 1990:52). In order to assess the sustainability of GWM institutions in Aweil East, we assess if each of the design principles are fulfilled, weak or absent. Fulfilled means the principle is fully present in the management

institutions. Absent means it is not at all present in the management institutions. Weak means it is partially present, but lacking certain components of the principle. The data collected on GWM in Aweil East is used to assess each of the eight design principles as either fulfilled, weak or absent to give insight on the barriers to sustainability, answering RQ2 and RQ3 (See *Table 2*).

Table 2: Design Principles to Assess the Sustainability of Common-Pool Resource Institutions

Principles:	Explanation:	Principle Assessment:
<i>A. Clearly Defined Boundaries</i>	The boundaries of the resource system and the individuals or households with rights to harvest resource units are clearly defined.	<i>Fulfilled Weak Absent</i>
<i>B. Congruence between appropriation/provision rules and local conditions</i>	Rules specifying the amount of resource products that a user is allocated are related to local conditions and to rules requiring labor, materials, and/or money inputs.	<i>Fulfilled Weak Absent</i>
<i>C. Collective-Choice Arrangements</i>	Most individuals affected by operational rules can participate in modify these rules.	<i>Fulfilled Weak Absent</i>
<i>D. Monitoring</i>	Monitors, who actively audit biophysical conditions and user behavior, are at least partially accountable to the users or are the users themselves.	<i>Fulfilled Weak Absent</i>
<i>E. Graduated Sanctions</i>	Users who violate rules-in-use are likely to receive graduated sanctions from other users, from officials accountable to these users, or from both.	<i>Fulfilled Weak Absent</i>
<i>F. Conflict Resolution Mechanisms</i>	Users and their officials have rapid access to low-cost, local arenas to resolve conflict among users or between users and officials.	<i>Fulfilled Weak Absent</i>
<i>G. Minimal Recognition of Rights to Organize</i>	The rights of users to devise their own institutions are not challenged by external governmental authorities, and users have long-term tenure rights to the resource.	<i>Fulfilled Weak Absent</i>
<i>H. Nested Enterprises</i>	For CPRS that are parts of larger systems; Appropriation, provision, monitoring, enforcement, conflict resolution and governance activities are organized in multiple layers of nested enterprises.	<i>Fulfilled Weak Absent</i>

Based on Ostrom (1990) and Anderies et al. (2004)

The accumulation of *fulfilled*, *weak* or *absent* principles classifies the institutional as either sustainable, fragile or a failing institutions for CPRs (See *Table 3*). Sustainable institutions endure for over 30 years and *all* of the principles are fulfilled in the CPR institution. In fragile institutions *some* of the principles are fulfilled, whilst others are weak and or absent. Anderies et al. (2004:13) notes that institutions can also become fragile due to conflicts over the interpretation of rules, appropriators breaking rules and the punishment for said acts. Finally, a failing institution is not functioning as a CPR institution; meaning most of the design principles are absent (Ostrom 1990:179). *Table 3* below demonstrates the resulting institutional status based on the principles. The next section discusses how to operationalize these principles in the context of transition theory.

Table 3: Summary of Assessment for Institutional Sustainability

Summary of Principles	Overall Institutional Sustainability
All Fulfilled	<i>Sustainable</i>
Some Fulfilled, Some Weak, Some Absent	<i>Fragile</i>
Majority Absent	<i>Failure</i>

Based on Ostrom (1990) and Anderies et al. (2004)

4.2 Using Institutional Change to Analyze a Transition

Ostrom’s principles assess the sustainability of the institutions in our study, which can give insight to the transitional phase of the institution. The speed of a transition is constantly fluctuating due to series of unpredictable events, making it difficult to theoretically determine the pace of a transition or how long the transition will take. However, it is possible to evaluate *if* a transition is happening and what chain of events or group of actors influenced it, which is done through the interlinked multi-phase and multi-level concepts (Grin et al. 2010:128,139). Together they provide different perspectives to conceptualize an analytical framework for transitions to sustainable development (ibid:126).

The function of the multi-phase concept is to have a general idea about the path and phases that a transition follows. There are no distinct variables for measuring exactly what phase a transition is currently in (Grin et al. 2010:130). However, through the characteristics of each phase, highlighted by the visibility of institutional changes in the macro-, meso- and micro-levels, one can approximately determine the phase a transition is going through, or moving towards (ibid). By visible

changes we mean actions taken or undergoing which can be noticeable by our respondents and secondary data.

Incremental institutional changes are created through top-down or bottom-up pressures at the macro-, meso- and micro-level. These changes drive a transition forward towards sustainable development (Grin et al. 2010:11,109,133). However, in order to analyze whether such a change is sustainable in itself, we need to use a framework for institutional sustainability. To analyze how a transition towards sustainable development is reflected in GWM, we use Ostrom's (1990) principles as a framework to assess the sustainability of institutions and institutional change on the macro-, meso-, and micro-levels. Therefore, we are using transition theory (based on Loorbach and Rotmans 2006 and Grin et al. 2010) together with the design principles for institutional sustainability (based on Ostrom 1990 and Anderies et al. 2004) for our analysis. A manifestation of this combination is shown in *Figure 4*.

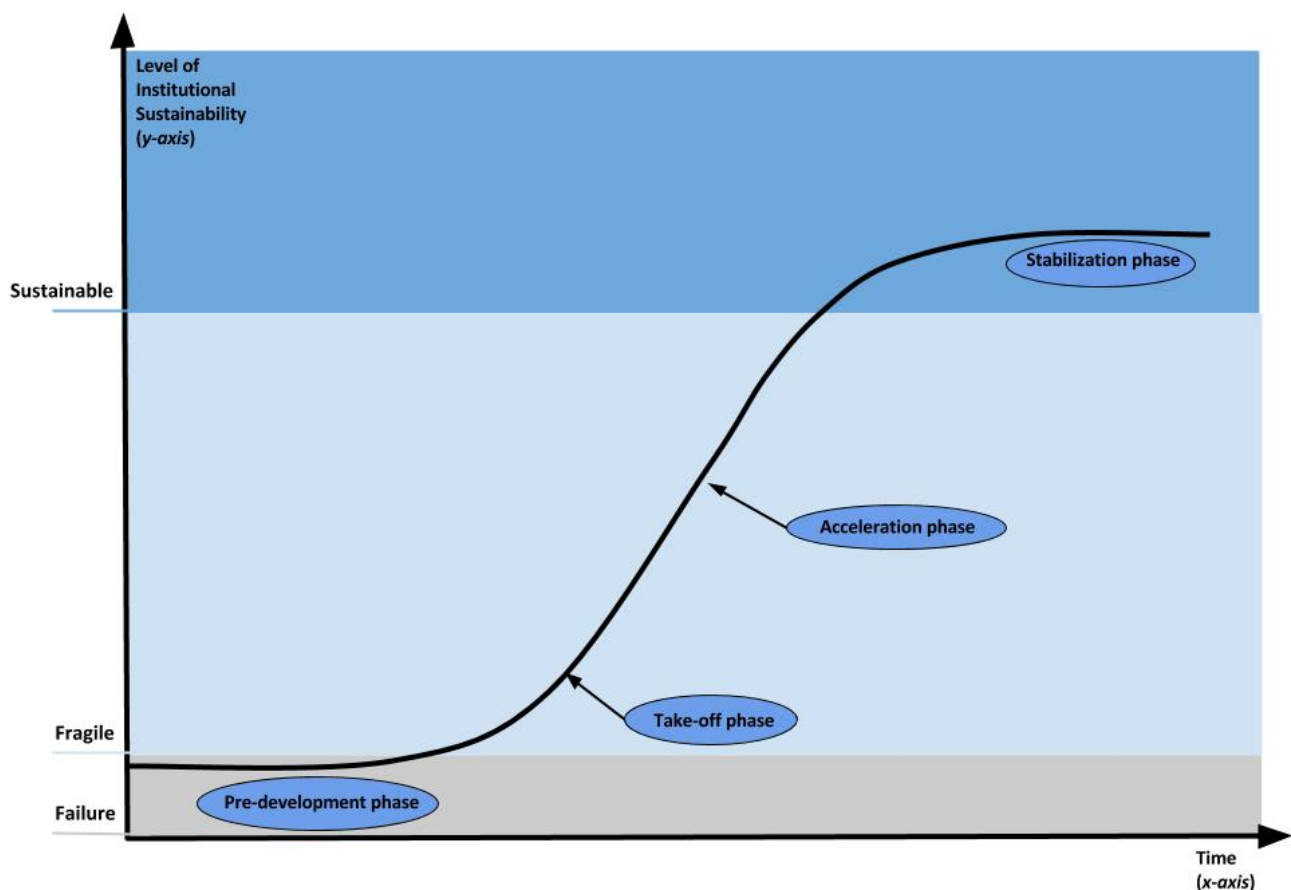


Figure 4: Analytical Framework for Using Institutional Sustainability to Analyze a Transition
Authors' interpretation uses an assessment of institutional sustainability (y-axis) from Ostrom (1990) and Anderies et al. (2004) to interpret a transition (x-axis) based on Grin et al.(2010), Loorbach and Rotmans (2006), Rotmans et al (2001).

Since the S-curve lacks assessment parameters on the y-axis, we use Ostrom's sustainable institution principles to measure y-axis changes (Grin et al. 2010:130). The S-curve is navigated through the sustainability of the CPR institutions. Changes on each level, within Ostrom's principles, will be identified through our empirical data. For example, if the CPR institution is a failure, it means there are no indicators for institutional change happening on any of the macro-, meso- or micro-levels, placing it within the pre-development phase. In contrast, if the CPR institution is sustainable, institutional changes have already undergone, are fully in-line with Ostrom's principles and has reached a level of stability, placing it in the stabilization phase. Understanding the phase of a transition is a starting point for institutions on each level to make adjustments or new targets towards increased sustainability (Grin et al.2010:130). Therefore, in the analysis we will present our findings on incremental institutional changes that have occurred on the macro-, micro-, and meso-levels throughout the design principles in order to analyze the transition.

4.3 Previous Case Studies Using Design Principles

In lieu of a literature review, we have chosen to present prior case studies on sustainable CPR institutions that are relevant for the analysis of our findings. These cases, along with the background, theory and analytical framework provide sufficient foundations for addressing the research questions in the analysis. Although no case study has used both Ostrom and transition theory, several have used the design principles to assess the sustainability of the CPR managing institutions. The studies presented below give insight to our GWM case in Aweil East and contribute to the analysis of our findings.

One exemplary qualitative study uses Ostrom's principles to analyze and compare various CPR institutions in semi-arid villages in Tanzania (Quinn et al. 2007). Quinn et al. (2007:105) finds that management over water supplies is more likely to be a *failure* than management over other CPRs. This study is especially relevant as it is one of the only case studies to use the eight principles in an area of climatic variability, much like Aweil East which experiences extremely rainy and dry seasons impacting the CPR (Quinn et al. 2007:102). Ostrom (1990) also reviews several cases on collective GWM, the most relevant being a case in San Bernardino that was found to be a failure. This case was deemed relevant because it shows many of the complexities involved with GWM (180), including overdraft conditions, multi-levels of institutions, and issues over determining congruent rules.

Another exemplary case in Nepal reviewed sustainability of institutions managing two forests using Ostrom's principles (Gautam and Shivakoti 2005). As with our case, the study areas were similar

environmentally and economically, but varied regarding number of users, resource conditions, and the functions of the managing institutions. The study found that there are differences between forestry management institutions in regards to rules over use, monitoring and maintenance of the forests and that an extension of many of Ostrom's principles is needed to encompass the complexities of the institutions. Aweil East also deals with varying CPR sites and institutions, including the involvement of organizations that lie beyond the traditional scope of Ostrom's principles. Therefore, the Nepal case is relevant for the analysis.

Based on these examples, we expected to find the institutional sustainability for GWM in Aweil East to be a *failure*. The Tanzania and San Bernardino highlight that CPR management over groundwater resources is generally very difficult and results in failure, especially in young institutions, like Aweil East. Also much like the case in Nepal, Aweil East deals with many factors, such as the involvement of organizations, which lie beyond Ostrom's principles. Therefore, these cases are a launching point for the analysis and are further discussed in *Section 5.2*.

Part 5 PRESENTATION AND ANALYSIS OF FINDINGS

Transitioning to Sustainable Groundwater Management?

The following section presents our findings and analysis of data from Aweil East, addressing the RQs. We begin *Section 5.1* by assessing the strength of the institutions in Aweil East through the design principles. Within these principles, we highlight incremental institutional changes that have occurred on the macro-, meso-, and micro-level. *Section 5.2* presents our conclusions on the overall institutional sustainability of GWM institutions in Aweil East, discussing RQ2 and RQ3. Finally, *Section 5.3* discusses the extent of the transition towards sustainable development and how the transition is reflected in GWM in Aweil East, discussing RQ1.

5.1 Institutional Change in Ostrom's Design Principles for Aweil East, South Sudan

Using the analytical framework, the following section presents data that classifies each of the eight principles as either *fulfilled*, *weak* or *absent* and discusses institutional changes occurring on the macro-, meso- and micro-levels.

A. Clearly defined boundaries

Principle A implies that those with the rights to access (i.e., operational rules) and use the resource (i.e., collective-choice rules) are clearly identified (Ostrom 1990:91). In terms of groundwater in

Aweil East, the ideal is that households paying monthly fees have the right to use the borehole (R2;R3;R5;R8;CWC1;CWC2;CWC3). In the field we found that there was uncertainty regarding *who has the right to use* the borehole and *who actually was using* the borehole. In Wadweil, CWC1 expressed that although they collect monthly fees from 110 households to appropriate the water, when the borehole runs dry in the evenings they cross over to the neighboring borehole (CWC1). CWC3 also mentioned that when neighboring boreholes break down, they must share resources (CWC3). Likewise, both CWC1 and CWC2 mentioned that the number of households fluctuates as returnees, internally displaced persons (IDPs), or pastoralists arrive in the *payam*, saying, "...the number is not constant," (R2;R3;CWC1;CWC2). This implies that each borehole is not necessarily tied to specific appropriators, but rather that appropriators change as borehole infrastructures fail. Although the ideal is for each borehole to be used by the households paying monthly fees, the experiences above show that the resulting principle is not entirely fulfilled. Therefore the *principle A* is classified as *weak*.

B. Congruence between appropriation and provision rules and local conditions

Principle B suggests that rules are in place surrounding the resource and are adjusted to local conditions (Ostrom 1990:92). In Aweil East we found that there are generally rules set in place. However, most rules lack clarity and certain practices are followed, which contradict the existing rules and thus diminish their validity. Below are our findings on *principle B*.

When a borehole is broken, ideally communities contact the *payam* handpump mechanic for repairs. Prior to independence, there were very few - if any - handpump mechanics trained, but currently training is a primary activity for WASH organizations (R1;R3;R6;R8;R9;R11). Therefore, the training of handpump mechanics is an institutional change that has occurred on the micro-level, in the communities and *payams*. Payments for handpump mechanic services and any necessary spareparts, come from the community's monthly fees (R3;R4;R6;CWC1;CWC2). Although this is a general collective-choice rule and the procedure for a broken borehole, communities are often unable to provide payments for the mechanic to do the repairs. Instead communities call organizations to fix it, which they do for free (R3;R6;R11;R12;CWC1;CWC2;CWC3). "We just [repaired the borehole] for nothing, then [communities] will not understand and they say they will just wait for the next agency because it will be for free" (R6).

Another flexible collective-choice rule is in regards to spareparts, which ideally should be purchased by mechanics or *payams* in order to conduct repairs (R3;R4;R5;R6;R7;R8;R11;CWC1;CWC2).

However, in reality communities and local governments rely on free handouts from organizations. The discrepancies between the ideal and reality imply there is a lack of rules regarding the acquisition of spareparts. The lax rules diminish motivation for mechanics to purchase spareparts themselves. *Principle B* also encompasses collective-choice rules on how much of the resource can be used (Ostrom 1990:92), but in Aweil East there were no rules in place on how much groundwater can be used per household.

While there are some rules in place, our main finding is that most rules lack clarity encouraging alternative practices, such as organizations fixing boreholes for free. Alternative practices diminish the set operational and collective-choice rules because desired outcomes (e.g. a fixed borehole) are delivered either way. These practices also diminish the micro-level changes and progress towards sustainable development made through the training of handpump mechanics because the newly trained handpump mechanics are not utilized when organizations fix the boreholes themselves. Therefore in Aweil East, *principle B* is classified as *weak* because existing rules surrounding the groundwater system often lack clarity and alternative practices are followed instead.

C. Collective-choice arrangements

Collective-choice arrangements imply that those affected by the rules are also able to modify said rules. This principle is a vital component of adjusting rules to local contexts (Ostrom 1990:93). As discussed above, the rules guiding this CPR institution lack clarity and therefore give space for alternative practices. In regards to collective-choice arrangements, alternative practices do, unofficially, allow for those who are affected by the rules to modify them. One example of that being the communities setting the monthly household fee. The fee can change depending on the population of the community. Populations in *payams* change frequently due to returnees, IDPs or pastoralists arriving to the communities (R2;R3;CWC1;CWC2). Because there is no rule on the population-to-fee ratio, the CWC is free to set the monthly fee as high/low as they please. This is in agreement with the principle for collective-choice arrangements because the appropriators (i.e., the CWCs) are able to modify the rules.

Another example highlighting the modification of rules is the organizations' modification of government guidelines. Ideally the state and county government are responsible for regulating where organizations drill (Concordis 2013:13;R1;R3;R4). However, due to what was described as a lack of leadership from the government, some organizations do not consult with the government and drill in areas they self-assesses as "needs-based", such as targeting areas with malnutrition or

IDPs (R1;R3;R4;R10;R12). Therefore the lack of government leadership allows organizations to modify and dictate the rules of the CPR, especially regarding where to drill and which communities to target, which can have significant implications for the appropriators. A technical WASH specialist clarified that institutions are dominated by organizations saying, “You go to the communities, decide on a location, send the contracted driller to drill. Whereas normally you should involve the department of rural water, on a state level,” (R4). Therefore, although the modification of rules is primarily due to a lack of clarity and enforcement of the rules, we classify *principle C* as fulfilled.

D. Monitoring

To ensure that a resource system will endure, monitoring of both the *CPR conditions* and the *behavior of the appropriators* is vital (Ostrom 1990:94). In Aweil East we found that from the overall conditions of the groundwater system to the community’s borehole there is generally little monitoring done, especially appropriator-monitoring.

CPR conditions

Monitoring groundwater conditions is a primary role of the Ministry of Water by tracking boreholes through the WIMS (R5). However, the WIMS is practically useless; the online⁹ database showing functioning, non-functioning and contaminated boreholes on the map of South Sudan is missing significant data (MWCRD 2013:6). One respondent described it as a “dead donkey” while both organizations and government officials blamed its failure on limited government capacity (R5;R6;R7;R9;R11). At the county level, where the lack of capacity significantly impacts the data collected, one actor explained:

The problem starts on the field level. Information flow is not going from the counties to the state levels and then to Juba...They don't know how to report... they don't have money! These problems are not solved from a ground level. The county [government] knows really well which boreholes are working. But [the government knows] the names of [the boreholes], not the GPS coordinates, or on a map (R6).

Since the government does not have the capacity, they turn to organizations to monitor groundwater levels. However, not all organizations return to test recharge rates after drilling, which can have significant implications on the communities, as expressed by CWC1 who experienced a dry borehole each evening (R3;R10;R11;CWC1). Blame was also put on organizations for not providing data (R1;R2;R6;R7;R9;R11), which is a constitutional-choice rule set by the government. Although government forms are provided, it was said that organizations “are not aware of [their] importance”

⁹ At the time of this thesis, WIMS was available at <http://www.mwri-goss.org/> but its function fluctuates daily.

(R4). Without data, it is difficult for the government to monitor and map the condition of the resource system (R4).

Since WIMS did not exist before independence, it is an institutional change in support of Ostrom's *monitoring* for CPR conditions (Ostrom 1990:94). Since a transition is a multi-actor process requiring reaction from other levels, it does not always contribute to driving a transition forward (Rotmans et al. 2001:17; Grin et al.2010:12). Although meso-level institutional change occurred with the development of WIMS, it has not been successful because the micro- and macro-levels are not engaged. Therefore it has not created any bottom-up or top-down pressures to initiate change on these other levels and has had little impact on the transition.

In regards to monitoring the conditions of the CPR, another meso-level change has occurred through the State Ministry's operations and maintenance framework implemented with the goal of ensuring sustainable access to water for all in NBeG (MWCRD 2013:vi;R5). Through this, a water quality testing lab has been built by the Ministry and is used by organizations, whereas before organizations would send samples away or conduct their own testing (R5;R10). Although the protocol for required sampling is still being developed, many organizations use the laboratory willingly (ibid). This meso-level change is a positive step towards incremental changes towards a transition.

Behavior of appropriators

In a CPR institution, Ostrom emphasizes that it is important for active appropriator-monitoring takes place in order to hold other appropriators accountable (Ostrom 1990:97). Although this is not yet a major component in Aweil East, we did find examples of non-formal, non-active community monitoring of both the CPR condition and the behavior of other appropriators. CWC1 expressed that community members (i.e., not CWC members) had noticed the slow recharge of their aquifer, which left the borehole dry in the evenings (CWC1). Other respondents expressed that communities self-monitor to make sure that children do not play with the handpumps and that animals do not drink from them (CWC1;R3). These examples show that in Aweil East, communities do not yet have *one* appropriator *actively* monitoring with accountability to the community, but rather it is the communities themselves who monitor the CPR. As one respondent summarized, "Water is the priority for communities, but they don't see taking care of the water as an individual responsibility," (R3). Overall, our findings conclude that the *monitoring* principle is *weak* because monitoring of the resources system is left to the organizations, rather than the government, and monitoring in the communities is not *active*, meaning there is little accountability to other appropriators.

E. Graduated sanctions

Graduated sanctions are meant to be increasing penalties on appropriators who break the rules and continue to break the rules that surround the resource (Ostrom 1990:94). In regards to our case, it is generally expected that the government, the organizations and the communities hold themselves accountable for following the daily operational rules, which should be determined by the CWCs themselves (R3;R4;5;CWC1;CWC2). We found that little to no sanctions are being put in place (R3;R4;R5;CWC1). The only mentioned sanction was by an NGO WASH representative mentioning “[The CWCs] fine people *sometimes* if someone bathes in the borehole” (R3).

The operational rule that households pay a monthly fee to the CWC was not consistently followed by the communities we spoke to. They mentioned they could not afford repairs because they were unable to collect monthly fees from each household. However, none mentioned penalties imposed on households who do not pay the fee (CWC1;CWC2;CWC3) showing that there are no clear sanctions when this rule is broken. These examples highlight that this principle is not entirely fulfilled because although there may be fines in some communities, there are no clear sanctions for those who break the rules governing the borehole. Therefore *principle E* is classified as *weak*.

F. Conflict resolution mechanisms

In the field we found various levels of conflict occurring and a need for conflict resolution mechanisms. One level of conflict is between the drillers and the organizations contracting the drillers. Although most drillers work under the “no water, no pay” contract¹⁰, often times organizations fail to “specify the risks to the contractor if the borehole fails” (R3;R4). In many instances this has been a point of tension between the organizations and drillers resulting in a “need to find a middle-ground where it’s fair for the drillers and the contractor,” as one technical WASH specialist put it (R4).

On the community level, there can be conflict at the waterpoint and quarreling between women. The CWC in Wadweil expressed that most of these conflicts arise due to the slow recharge of their borehole, especially in the dry season (R9;CWC1):

They are saying they have conflicts because...the water is not coming enough, she wants to come... and fetch because the kids are in the house saying they don't have water to drink. Another [woman] will come and say well I also have

¹⁰ “No water, no pay” is a contract type for drillers. It entails that the drillers are given a specific number of boreholes to drill, regardless if water is found or not. “No water-no pay” means the organization will not pay the driller unless water is found and certain criteria, such as the rate of recharge, is met (R2;R3;R4).

kids. So conflicts. They begin quarreling here and its the same with the kids... This is all because of the recharge. Maybe if it was enough they wouldn't have that. So the problem could be the ground.

The other CWCs expressed that they do not have issues at the waterpoint because they have enough water, but conflict does occur when appropriators come from other communities when their own waterpoints are in disrepair (CWC2;CWC3). These examples reveal that conflicts occur on several levels of the CPR system and are primarily caused by the inability to access water, both for the drillers and the communities. One government official epitomized these findings on conflicts by emphasizing that “If people have access then there will be no problem,” (R:9), but until access is universal, *conflict resolution mechanisms* are needed. Unfortunately, the findings reveal that there is no arena for resolving these conflicts so the principle is *absent* as it does not yet exist.

G. Minimal recognition of rights to organize

This principle entails that appropriators “devise their own institutions” without being challenged by government authorities (Ostrom 1990:101). If they are challenged, it becomes difficult to sustain an appropriator-governed CPR in the long-term, which is why this principle is vital for a sustainable institution (ibid). In the case of groundwater in Aweil East, we found little evidence of the government undermining appropriator institutions (i.e., CWCs). However, we did find that organizations perpetuate the dependency of communities and government. In turn, this dependency undermines the appropriator-ownership that is necessary for *rights to organize*. Therefore, the principle is classified as *weak*. Below we discuss the findings that led to this conclusion.

Dependency

As discussed in the *Monitoring* section, the government does not always have the capacity to manage the CPR. Throughout the study, we found that when capacity is lacking the government relies heavily on organizations. *Minimal recognition of rights to organize* was overridden by organizations enforcing communities to manage their boreholes while the organizations themselves chose a drilling site, contracted non-national drillers, and trained CWCs and mechanics (R1;R3;R4;R5;R7;R10;R11;CWC1;CWC2;CWC3). Respondents replied that nearly all boreholes are drilled by aid agencies and that it is very organization-driven, whereby it should be driven by the government or the users themselves (Ostrom 1990;R1;R3;R4). Some respondents blamed organizations for creating dependency by providing free spareparts or repairing the boreholes for free (R4;R5;R6;R11;R12).

Overall, we found inconsistencies in the procedures of organizations; some require payments, others work for free, which impedes sustainable user-driven management. Ostrom argues that such dependence on aid and external organizations threatens the ability of the CPR institution to sustain itself (Ostrom 1999:9). Therefore, the dependence on organizations does not sustain a user-driven approach for CPR management and threatens the principle for *minimal recognition of rights to organize* because organizations seemingly have the ruling authority (Ostrom 1990:101; Ostrom 1999:9).

Some of these dependency issues stemmed from the distribution of free spareparts. Up until 2013 UNICEF was one of the main suppliers of free spareparts for repairing broken handpumps to both the government and communities in NBeG. While it kept the percentage of broken handpumps in NBeG below 10%, it heightened dependency for handouts (MWCRD 2013: vi, 1;R5). Argawal argues that major changes in the market, such as this one at the macro-level, may impact the sustainability of the institutions beneath them (2002:57). Meaning, this change on the macro-level puts top-down pressures on the meso-and micro-levels to make institutional changes, potentially improving sustainability by minimizing dependency through means such as requiring communities to pay for parts (Grin et al. 2010: 133; MWCRD 2013:vi; R4;R5;R6;R11;R12). Trickle-down effects were seen on the meso-level surrounding the implementation of the NBeG's operations and maintenance framework for rural water management (MWCRD 2013:vi;R5). On the micro-level trickle-down effects were apparent with the training of handpump mechanics (R6;R11;R12). While this is only one example of a macro-level change with trickle-down effects, it does show change related to ownership and appropriator monitoring. Grin et al. (2010:313) argues that changes made on an upper level trickles from top-down faster than visa versa. This implies that changes on the micro-level are difficult and take a long time to create bottom-up changes. With changes on the macro-level, the local spareparts market can continue to develop on the meso-level.

Ownership

Ownership over rights to organize the groundwater was also contested because of the dependent culture. When asked, respondents replied that the communities owned the borehole or the government did or that there was no owner at all (CWC3;R3;R4;R5;R6;R8). Ownership discrepancies are reflected in the actions taken by various organizations. One respondent expressed that although CWCs were trained to contact the pump mechanics themselves, communities would instead call the organization saying (R11):

... 'Hey, your borehole is broken'
'What do you mean, it's YOURS,' I answer.
'No YOU gave us a well that is broken'

Organizations expressed that they try to minimize dependency and build community ownership through capacity building, CWC training, allowing communities to choose locations for boreholes, and borehole handover ceremonies with communities and county government officials (R3;R7;R8;R9;R12). However, sense of ownership is difficult to change and some believe that people listen to government authorities more than organizations (R3;R4;R5;R11;R12). Therefore, to minimize dependency and improve ownership, the process of handing over the CPR management to the government and communities must begin (ibid). With ownership unclear, appropriators are not devising their own institutions, as Ostrom suggests, but rather being told by organizations how to manage the CPR. Likewise, although they are not being challenged by the government, the existing institutions are dependent on the organizations that challenge the functions of the existing institutions (Ostrom 1990:101). Therefore, the principle is *weak* because appropriators are not clearly “devising their own institutions,” (ibid), but rather following the institutional structures devised by the organizations.

H. Nested enterprises

The principle for *nested enterprises* entails that appropriation, provision, monitoring, enforcement, conflict resolution, and governance are organized on the macro-, meso- and micro-levels (Ostrom 1990:101). In the case of Aweil East, *nested enterprises* are especially important because groundwater resources are larger systems that are not bound by space and may travel through many levels of authority, from the community to the national government (Ostrom 1990; Quinn et al. 2005; Cox et al. 2010). This principle simply informs that CPR management should occur on multiple levels, but does not indicate the efficacy of the management practiced on each level. As seen in the discussions above, there are clearly multiple levels organizing and managing groundwater. *Nested enterprises* is seen in *monitoring* through WIMS (See *Figure 1*) as well as coordination mechanisms of the WASH cluster, which operates with the national government, down to state and county to incorporate the communities (R4;R5;R6;R9;R11;R12).

Additionally, the implementation of the State Ministry’s operations and maintenance framework is an institutional change that creates more organization and coordination between the meso- and micro-level (MWCRD 2013:vi; R5) and contributes positively to *principle H*. Although, all of the principles are not consistently fulfilled on every level, there are overall indications that nested enterprises exist in the institutions because GWM includes communities, CWCs, organizations and the various levels of government (See *Figure 1* in *Section 1.6*). Therefore, we concluded that this principle is *fulfilled* because nested enterprises are present in the current system.

5.2 Institutional Sustainability

Based on collected data and the findings presented above, we conclude that the majority of the principles are weak and therefore the sustainability of the institutions for GWM in Aweil East is found to be *fragile* (See Table 4).

Table 4: Summary of Findings
Institutional Sustainability of Groundwater Management in Aweil East

A.	<i>Clearly Defined Boundaries</i>	WEAK
B.	<i>Congruence between appropriation/provision rules & local conditions</i>	WEAK
C.	<i>Collective- Choice Arrangements</i>	FULFILLED
D.	<i>Monitoring</i>	WEAK
E.	<i>Graduated Sanctions</i>	WEAK
F.	<i>Conflict- Resolution Mechanisms</i>	ABSENT
G.	<i>Minimal Recognition of Rights to Organize</i>	WEAK
H.	<i>Nested Enterprises</i>	FULFILLED
OVERALL	Institutional Sustainability	FRAGILE

Although we expected to find a failing institution based on previous CPR cases by Ostrom (1990), Gautam and Shivkoti (2005) and Quinn et al. (2007), we found evidence that nested enterprises (*principle H*) and collective-choice arrangements (*principle C*) are fulfilled and contribute to the sustainability of the management institutions. The fulfilled principles highlight the extent to which components of the GWM institutions are sustainable, however significant improvements need to be made as the weaknesses in the institutions outweigh the strengths. While conflict-resolution mechanisms (*principle F*) were simply absent, several other principles in Aweil East were especially weak. From these weaknesses, we can identify some important barriers inhibiting sustainable GWM in Aweil East.

One such barrier to institutional sustainability is the lack of clear operational and collective-choice rules (*principles A and B*) and the lack of sanctions for those who break said rules (*principle E*). Some argue that flexibility in rules is needed in order to respond to social and ecological uncertainty (Quinn et al. 2007:107;Cox et al. 2010). This is evident in the Tanzania case where setting rules over

CPRs was especially difficult, especially in CPR institutions related to water, primarily due to the semi-arid and unpredictable climate (ibid). Likewise, in San Bernardino Ostrom found that groundwater scarcity and overdraft made rules and boundaries unclear (1990:148). Much like the uncertainties of groundwater infrastructures described by the CWCs in Aweil East, these cases suggest that rules and boundaries need to be flexible in order to adjust to fluctuating condition (Quinn 2007:107; Cox et al. 2010).

The counter argument to flexibility is that clear rules strengthen the perseverance of the resource and the managing institutions (Ostrom 1990:92). Rules are important to maintain the sustainability of the resource, which is put at risk when “outsiders” use the resource without contributing to the CPR institution (ibid:91; Huang et al. 2010:111). Gautam and Shivakoti found that when rules were flexible, communities lacked ownership and responsibility over the resource, putting it at risk for misuse (2005:163). Although the rules in Aweil East are flexible to uncertainties, it impacts ownership and the long-term sustainability of the resource, especially when aquifer conditions vary from community to community (Huang et al. 2010:111).

The overarching barrier that impacts the sustainability of the system is that many of the management functions, such as monitoring, are left to the organizations, leaving little to no accountability or ownership to appropriators (*principle D and G*). When this happens, the conditions of the resource may dwindle, which was found to be true in the Nepal forestry case as well (Ostrom 1990; Gautam and Shivakoti 2005:164; Cox et al. 2010). In our case, with monitoring responsibilities left to organizations, there is little opportunity for communities to oversee monitors meaning they are not held accountable. Dependency on organizations undermines appropriator-ownership, which is the foundation to CPR systems (*principle G*; Ostrom 1990).

Weakness of these principles resulting in dependence on organizations was partially due to UNICEF’s changed policy on free spareparts. Quinn et al. (2007:112) argues that the weakness of management institutions lies in their inability to cope with change, while Ostrom argues that CPR situations are difficult to change because of the level of uncertainty regarding the consequences of such changes (1990:207). Uncertainty makes it challenging for CPR institutions to change their rules and thus difficult to cope with changes coming from macro-level (ibid;Quinn et al. 2007:112). Therefore in Aweil East, the weaknesses in institutional sustainability encourage alternative practices and dependence on organizations, which impacts the perseverance of the CPR and the institution’s ability to cope with change. These changes are discussed in the context of transitions in *Section 5.3*.

Overall, the main barrier to sustainability of GWM in Aweil East is dependency due to communities lacking ownership and the government lacking capacity. Instead, they rely on organizations to sustain the system. In sum, as one community said to an organization in Aweil East, “You are the one giving us the water, you have the money, you have to make the rules,” (R11).

5.3 Transitioning to sustainable development?

In accordance with Ostrom’s principles the GWM institutions in Aweil East are fragile, meaning they lack sustainability and are not yet long-enduring CPR institutions. Despite fragility, there was significant evidence showing that organizations *want* communities to be independent (R11):

When we leave this area, we want them to still have water, that is the dream.

In the field we found evidence that progress towards sustainability has been made. The findings on institutional change within the macro-, meso-, and micro-levels show that incremental changes have occurred in Aweil East making some of the GWM institutions from the past more sustainable. By understanding institutional changes within the multi-level concept, we can apply the multi-phase concept to analyze if there is a transition happening and if so, where it could theoretically be placed (Loorbach and Rotmans 2006:2; Grin et al. 2010:11,109). From this, adjustments can be made to targets, practices and strategies for achieving sustainable development (Grin et al. 2010:130).

So is a transition towards sustainable development happening? The phases of a transition towards sustainable development are mainly characterized by the visibility of institutional changes in the macro-, meso- and micro-levels (Grin et al. 2010:130). This is why we have analyzed the visible changes that support Ostrom’s principles. On the macro-level, UNICEF’s decision to stop supplying free spareparts pressured lower levels to create ownership (*Principle G*). Meso-level changes to improve water quality with lab testing (*Principle D*) and the micro-level having trainings of handpump mechanics.

Since we found institutional changes on all three levels, it is theoretically not in the pre-development phase because this phase is defined as not having noticeable changes (Grin et al. 2010:126; Loorbach and Rotmans 2006:4). In contrast, the take-off phase has visible institutional changes (ibid). From our case, we know that institutional changes are happening in Aweil East and these changes address the barriers of sustainable GWM as brought forward by our analysis based on Ostrom’s principles. However, the changes on the meso and micro-levels are rather minimal and are primarily driven by

trickle-down from drastic macro-level changes. Until micro-level reacts to the changes on the macro- and meso-levels, such as communities paying for their own spareparts, the take-off phase cannot be reached (Grin et al. 2010:139). Therefore, according to our analytical framework there is a transition towards sustainable development happening to an extent and it lies somewhere between the pre-development and take-off phases.

Although this is only a preliminary assessment and more research should be conducted, we consider this study on the sustainability and changes of GWM institutions in Aweil East as a microcosm of sustainable development in South Sudan. While GWM institutions have progressed, other management institutions, as well as economic, social and environmental dimensions must also progress for a transition to sustainable development to occur (Robinson 2004:381; Loucks and Van Beek 2005:34; Sneddon et al. 2006:261). Even though progress is being made, we have shown that within GWM certain aspects are weak, such as community ownership and dependency on organizations. However, progress was shown through the institutional changes relating to Ostrom's principles on the macro-, meso- and micro-level. Incremental changes in GWM in Aweil East contribute to institutional changes, which ultimately can contribute to a transition towards sustainable development in South Sudan. Therefore, we conclude that a transition towards sustainable development is happening to an extent and from our analysis we can argue that it lies somewhere between the pre-development and take-off phase, however the rate of the transition is unclear.

CONCLUSION

The political and historical context of South Sudan has significantly shaped the way groundwater is managed in Aweil East, putting emphasis on emergency relief for accessing water. In light of this, our study has analyzed a potential transition towards sustainable development by examining the sustainability of institutions managing groundwater resources. Our findings reveal a *fragile* and mostly unsustainable management institution that is significantly hindered by governments and communities that lack capacity, making them highly dependent on organizations. Likewise, sustainability is hindered by a lack of clarity in operational, collective-choice and constitutional-choice rules on the micro, meso and macro-levels (Ostrom 1990:52; Argawal and Ostrom 2001:489).

In our study we used Ostrom's principles to analyze institutional, incremental changes that contribute to a transition. While we argue that a transition is happening somewhere between the pre-development and take-off phase, further research is needed to develop recognized tools to

analyze transitions for various fields. Although outside the scope of our study, we recommend future studies compare different points in time of the same institution, because it is difficult to fully understand a process such as sustainable development or transitions without looking at multiple points in time. Likewise, sustainable development is difficult to capture in such short periods of time as it is a long-term process, closely connected to transitions, which take approximately 25 years to complete (Grin et al. 2010:11, 128). Therefore, the development of transition theory is important for future institutions to make adjustments in strategies and practices for increased sustainability. Finally, because transitions can be sped up, slowed, halted due to significant outbreaks of war, further studies in South Sudan will need to assess the impact of the ethnic/tribal violence that broke out in December 2013 on the transition to sustainable development.

The implications of this study suggest that changes can be made to improve the sustainability of CPR management institutions on various levels. Although challenging, micro-level changes in communities and CWCs can improve ownership over the CPR and lessen dependency on organizations working in Aweil East. In doing so, organizations will also become more independent to focus their projects on other areas of emergency relief, if needed, or long-term development. However, as we have shown, the various levels and concepts of sustainability are integrated whereby the autonomy of communities can only be successful with government support and the cooperation of organizations. Understanding these concepts is therefore vital for changes to be made and progress towards sustainable development.

We conclude by saying that groundwater management is only a small part of a larger economic, social and environmental system driving sustainable development in South Sudan and cannot generalize the state of sustainable development in the country. However, the study is meant to provide a general framework for assessing transitions to sustainable development through CPR institutions. We hope to have opened the discussion on the role of institutions in transitions to sustainable development and paved the way for future research that will contribute to understanding the long-term sustainability of managing CPR institutions. Finally by returning this study to its country of origin, we hope to continue the discussion on development in South Sudan and contribute to achieving the dream of local ownership and improved water access for generations to come.

“When we leave this area, we want them to still have water, that is the dream”

- NGO WASH Specialist, Akuem, South Sudan.

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APPENDICES

Appendix 1: List of respondents

<i>Respondent:</i>	<i>Description:</i>	<i>Interview Conducted:</i>
1	Representative from WASH Cluster, UN	Juba, 16 Oct 2013
2	Representative from WASH Cluster, NGO	Juba, 16 Oct 2013
3	Emergency WASH Coordinator, UN	Juba, 25 Oct 2013
4	Technical Specialist from WASH Cluster, NGO	Juba, 1 Nov 2013
5	Representative from State Ministry, Government	Aweil Town, 2 Dec 2013
6	WASH Specialist, Donor Agency	Aweil Town, 2 Dec 2013
7	Drilling Operation Coordinator, NGO	Akuem, 3 Dec 2013
8	Driller, NGO	Akuem, 3 Dec 2013
9	Representative, County Government	Wanjok, 3 Dec 2013
10	WASH Officer, UN	Malualkon, 4 Dec 2014
11	WASH Specialist, NGO	Akuem, 4 Dec 2014
12	WASH Specialist, NGO	Malualkon, 5 Dec 2014
Group 1	CWC: approx. 10 members, men and women	Wadweil, 4 Dec 2013
Group 2	CWC: approx. 12 members, men and women	Wadweil, 4 Dec 2013
Group 3	CWC: approx. 7 members, majority women	Ajok Loal, 5 Dec 2013
Observation 1	Completion of Drilling Site	Warawar, 2 Dec 2013
Observation 2	Initiation of Drilling Site	Warawar,, 2 Dec 2013
Observation 3	Partially Functioning Borehole	Wadweil, 4 Dec 2013
Observation 4	Functioning Borehole Use	Ajok Loal, 5 Dec 2014

Appendix 2: Semi-Structured Interview Questions

Each question has the possibility for follow-up questions. These questions acted as a guideline for semi-structured interviews. The questions are divided up in regards to background information about the respondent and which research question it relates to.

Background Information
<p><u>For Organizations</u></p> <ul style="list-style-type: none">• How long has your organization had activities in South Sudan? (pre-independence?)• What are your primary WASH activities?• What is your role in regards to groundwater management?• How is water primarily supplied to target communities? (i.e. surface water, groundwater, pipelines, delivery, etc.)• What is the process of drilling like?• How are drillers contracted/Why subcontracted or self contained? <p><u>For Community Water Committees</u></p> <ul style="list-style-type: none">• What is your role in the community (position, occupation)?• How were you chosen for this position?• How often do you meet? How many are you? How much do people participate? <p><u>For Drillers</u></p> <ul style="list-style-type: none">• How long have you worked in South Sudan?• What are your primary areas of work? (Primarily drilling or also maintenance, other?)
<p>Research Question 1: <i>How is the transition towards sustainable development reflected in groundwater management in Aweil East, South Sudan?</i></p>
<ul style="list-style-type: none">• What can/should be done to improve the management of groundwater resource?• Do you consider groundwater usage as a temporary or permanent solution to supplying water?• How do emergency activities regarding water differ from non-emergency activities?• What are some improvements that need to be made in the management of groundwater?
<p>Research Question 2: <i>To what extent are current groundwater institutions in Aweil East, South Sudan sustainable?</i></p>
<ul style="list-style-type: none">• How is the borehole/well/groundwater managed?• Do you collaborate with any other organization over WASH activities?• What is the coordination system like?

- *Is there a system for reporting back to WIMS or the WASH cluster about the success of drilling operations?*
- *What type of analysis or evaluation is done prior to drilling?*
 - *(How is the location selected? How is the depth determined?)*
- *What type of analysis or evaluation is done after drilling, if any?*
- *Who is responsible for maintaining the boreholes?*
- *Is there any training for borehole maintenance?*
- *Are the mechanics paid?*
- *Who owns the water?*
- *Have you seen water as a source of conflict?*
- *How sustainable is it to use groundwater?*
 - *What are the benefits of using groundwater?*
- *How is the borehole/well/groundwater managed?*
- *What is your role in the process of using groundwater?*
- *Are you involved with selecting the site for boreholes/wells?*
- *How are you involved if a well/pump is broken?*
- *Who is responsible for maintaining the borehole?*

Specific For Government

- *How is the government involved in determining groundwater use, such as location of extraction?*

Specific For Communities

- *How important is groundwater for your community? Are there alternative sources for water?*
- *What is groundwater used for (domestic/irrigation use) in your community?*
- *How is it shared?*
 - *(Amongst families, different communities, different tribes, and pastoralists)?*
- *Do you work together with any NGOs or government actors to help with water resources?*
 - *In what way?*
- *How involved are you in the selection of location for drilling?*

Specific for Drillers

- *Do you work with the same partners or are you commissioned by different ones?*
- *What do your contracts usually entail (i.e. no water no fee)?*

Research Question 3:

What are the barriers inhibiting sustainable groundwater management in Aweil East, South Sudan?

- *What are some of the main challenges of maintaining a borehole/well?*
- *What are the limitations of groundwater resources?/What problems do you foresee with using groundwater resources?*

- *What are the biggest challenges or problems the community faces with using the borehole?*
- *How would you address/improve the situation?*
- *What are the challenges specific to dry-season?*
- *What are the challenges specific to rainy-season?*
- *Have you encountered conflicts over water resources?*
- *What are some improvements that need to be made in the management of groundwater?*

Specific For Organizations

- *What are some of the main challenges your organization faces in the South Sudanese context regarding these activities?*

Specific For Drillers

- *What are some of the main challenges of drilling?*