

**From Water Scarce to Water Source:
The Governance of New Water in the Kenyan Drylands
A Multi-Disciplinary Research Proposal Team
FY2015 Project Annual Report**

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Project Description

Our FY16 Multidisciplinary Research Proposal Team's proposal was re-funded to continue our work from FY15 to look at the discovery of two large aquifers found to be sitting deep below the arid landscape of Turkana County, the driest county in Kenya, in 2013. This project embedded a study of the governance of the discovered aquifers' resources within a historical perspective of water policy, access and use in this dryland system over the past half-century. This pilot project (and its 2015 predecessor) was intended to serve as a proof-of-concept for the selection of methods to develop further into a full-scale NSF Coupled Natural and Human Systems (CNH) proposal to carry out a multi-disciplinary water study that crosses social and ecological disciplines and methods.

The goals of our project were to:

1. Conduct a multi-disciplinary proof-of-concept that: **a)** describes historical water use issues as framed by Turkana pastoralists themselves (water sources, policies, access, conflict, quality, quantity, or other relevant issues), **b)** identifies existing governance mechanisms for management and distribution of water resources, key actors involved in decision-making, and horizontal and vertical connections and information flows, *and c)* measures the spatial and temporal distribution of water sources, and locate the community-identified social and ecological costs and benefits of water development.
2. Plan, write/edit and re-submit a large research proposal to the NSF CNH program (November 2015) to build and expand on this pilot study, using information and insights gained through the course of this research project to design a longer-term study of water governance and social-ecological burdens and benefits of water development. This field research would also allow us to incorporate questions from a locally-framed demand-driven perspective, rather than limiting them to a theoretical perspective.

Progress to Date

In FY15 our team was unable to complete the field proof-of-concept work due to extenuating family circumstances of the PI. However, during our first funding year, our team did successfully complete a first submission of an NSF Coupled Natural and Human Systems (NSF-CNH) proposal, submitted in November 2014 with a total budget of \$1.8M for 4.5 years of work. We re-competed for Water Center funds in FY16 to continue our work, travel to Turkana, and resubmit our NSF proposal.

We were awarded a FY16 Water Center grant in Summer 2015, and immediately began planning for field work in Turkana for September 2016. Our first submission of the CNH proposal to NSF had been declined, but received very good reviews that encouraged us to resubmit. We believed that data and input collected from stakeholders in Turkana would contribute an enormous amount to our proposal's rationale, and turn it into a proposal that could be both demand-driven and theory-driven at the same time. In addition, we know that some of the hardest work in getting proposals submitted is having the right connections in place. We aimed to not only talk with community members, but to also visit the relevant county-level government ministries in Turkana County to establish points of contact, and elicit thoughts on what is needed in water research at this time.

Literature Review

Our graduate student, Conrad Marshall, MS student in CSU's Graduate Degree Program in Ecology, is co-advised by Drs. Lynn and Laituri. Conrad began his work on the project in January 2015, completing a first draft of a literature review on Turkana history, culture, ecology, land use, and the water discovery. He updated his literature review before our field trip in September 2016, and is currently revising it to again bring it up-to-date with the current state of the system. This literature review expands upon the literature contained in our NSF grant proposal, and includes gray literature to allow us to keep up with current developments through newspaper and NGO articles and other writings. For this particular topic which is changing so rapidly, keeping apprised of current events is extremely important. The final literature review will be submitted to the CSU Water Center before the beginning of the fall semester.

Research Study

The field portion of our study took place September 11, 2015 – October 3, 2015. Stacy Lynn and Conrad Marshall travelled to Turkana County, Kenya, to conduct 10 focus groups in five communities (one with men and one with women in each community), and to meet with government Ministry officials at the County level in the town of Lodwar. Our Focus Group guides were approved by CSU's Institutional Review Board (IRB) prior to our travel.

I was given the names of two recommended field assistants, Ms. Mercy Theuri, a resident of Lodwar and student of International Relations at Mount Kenya University, and Ms. Sophia Achor, a Turkana woman by birth who had never lived in Turkana. Each of these students brought something important to our project. Sophia, who had relatives in Lodwar and who was ethnically Turkana, and Mercy who was a local but not ethnically Turkana. Both students had experience conducting focus groups, but I trained them on the specifics of our project and our methods prior to our first focus group. The four of us traveled together each day to a new community, interviewing first women and then men in groups of 9-22. We asked questions about how people use water each day, where they got their water and the type of source, recent climate and weather, droughts, floods, and water needs into the future. I found that in general, Turkana community members had a difficult time with placing events in time and attaching them to a particular year, which is a bit different from Maasai communities with whom I have more experience working. We were also interested in any water development in their village, how and why it was developed and whether it was still functional/used. Often, wells are dug with donated funds that run out after installation, preventing expensive repairs to keep the wells running.

We found that in the past two years there had been very, very little rain. Each group independently reported that when very little rain falls, the grass does not even grow. Indeed, every place that we went in the county was invariably (except in drainages) completely brown with no green groundcover whatsoever, and not much desiccated forage material either. Cattle had been moved to the west into the hills bordering Uganda (camels, goats and sheep largely remained local). While moving the cattle this far carries great risk to herd and human safety due to the likelihood of cattle raids, there was no other choice. To the east along the shores of Lake Turkana, people were extremely worried about both drought and the construction of the Gibe III dam on the Omo River which feeds the lake. The dam had just been completed and was being filled. Lake levels were reported to be decreasing, however it would be difficult to determine whether this decrease was due to the dam or the dry conditions.

In central Turkana we visited irrigation schemes that were fed by both river and aquifer water sources. We met with representatives of several County-level Government Ministries:

The communities that we worked in included Nayenae (22 Sept), Kakwenya (23 Sept), Lobei (24 Sept), Nadoto (25 Sept), and Nabei/Eliye Springs (28 Sept).

Research Proposal Submission: NSF CNH:L

I fully revised and resubmitted the NSF Coupled Natural and Human Systems proposal in November 2015. The project team (which is the same as in the 2014 CNH proposal) expands upon the team involved in this Water Center project to include Dr. Dana Hoag, Agricultural Resources and Economics; Dr. David Swift, Natural Resource Ecology Laboratory; Dr. Randall Boone, Ecosystem Science and Sustainability; two graduate students; and a project manager (all at CSU); Dr. Joana Roque de Pinho, Instituto Superior de Ciencias Sociais e Políticas, Lisbon, Portugal; Dr. Jesse Njoka, University of Nairobi, Kenya; and Dr. Moses Nyangito, University of Nairobi, Kenya). The original submission received very good reviews, with one reviewer stating that our conceptual diagram and explanation of system components was the best he/she had ever seen. In addition, reviewers stated that the research concept is novel, noted that our perspectives were clearly driven by and “nicely attuned to local pastoral contexts”, liked the education and training plan’s “tremendous potential”, and recognized the urgency of the questions and situation at hand. However, there were issues that we needed to address.

One strong recommendation from reviewers was that our team needed to, “have a stronger collaborative relationship with local entities that have responsibilities on the use and governance aspects of this resource.” We were able to demonstrate strong linkages and collaborative relationships with one local NGO (World Food Programme) which helped us with our field work in 2015 and wrote a letter of ongoing support for our project to continue with their support and partnership. We also met with the research leadership at Mount

Kenya University, Lodwar Campus, Turkana County, to discuss a partnership to bring research opportunities to MKU students, while contributing data to the greater project, and we received a strong letter of support from them as well.

Another comment was that our proposal did not have enough on-the-ground ecology work being done, and this was addressed, along with a request to narrow down the types of satellite imagery that we would use for image analysis and modeling. One reviewer wanted to know more about the government plan for water development, and we were able to address this via our conversations with Ministry officials. Another comment requested that we re-frame how we stated our project goals and water issues from an ecosystem dynamics perspective. There was some discussion of whether the research will be completed quickly enough to be influential in the outcome (we hope so!), and how we can conduct the work and influence policy without disrupting the system under study. It was requested that we train a PhD student, and we were able to incorporate this into the new version. We were also requested to create more testable hypotheses.

We also made changes to the proposal based on our honed understanding of the system following our field work's community focus groups and conversations with Ministry officials. Perhaps the most fundamental change to our proposal was a shift from looking at only the aquifer water, to incorporating ALL water in the system, including deep aquifer, shallow aquifer, river, rain, lake and dam water. This was a critical shift to make. I realized when we talked to people in Turkana, that decisions made about one water source may be impacted by availability of, access to, and decisions for other types of water. Our final proposal title is, "Governance and Ecology of Water in Kenyan Drylands." There are several overlapping threats to Turkana County's water sources that are important to incorporate (or at least leave open to incorporating), that would have been left out if we had focused only on "new" water as we had in our first submission.

We also added cattle raiding as a form of insecurity (in addition to climate), and incorporated quotes from our focus group participants that helped to reinforce the importance of particular questions, or shed light on why we were taking a particular approach. For instance, "Water is blood," and "Water is life," are two comments that we heard more than once. Our participants agreed strongly that everything is interconnected, and without available water and good water management the system would be at risk of collapse.

We narrowed down our proposed study area to 10 Sub-counties of Turkana County, avoiding areas of conflict while incorporating a range of water sources and issues. We elevated Dr. Dana Hoag's position on the proposal from Senior Personnel to Co-PI due to increased contributions in both the proposal and the proposed work. We expanded and clarified our modeling concepts, approach, and processes. We clarified the roles of the three CSU, five University of Nairobi and three Mount Kenya University students who we have proposed to work on the project.

Expenditures

The funds that we spent in FY16 went toward Salary for the PI (Lynn), Co-PI Betsill for time spent working with Marshall and contributing to the revised proposal, graduate student hourly support for literature review and travel time, plus travel for Lynn and Marshall to Turkana for three weeks of field work. We ended the year under-budget.

Future Directions of continued FY17 work

Our project will continue its work, despite the end of the project. Data analysis is still in progress, as this is my first time doing qualitative analysis with focus group data and I am learning new methods that I will continue to use in other current and future projects. However, preliminary data analysis and review of focus group content contributed an extraordinary amount to the resubmission of our proposal. Indeed, it reinforced the importance of this work, as the livelihoods of all who live in rural Turkana County may in fact depend on the equity and sustainability of water development in the County these next few years. Since we do not know the status of the NSF proposal, I am hesitating to produce a stakeholder report at this time. While we could produce an interesting report, I am afraid that if I distribute information gleaned from our focus groups and discussions with ministries, we could compromise the integrity of our future work should it be funded. If the funding does not materialize, we will complete and release a report immediately.

Timeline of Continued (no-cost) work <i>Activity</i>	FY17			
	<i>Q1</i>	<i>Q2</i>	<i>Q3</i>	<i>Q4</i>
Finalize literature review (August 2016)	X			
Continue qualitative data analysis	X	X		
Contribute an article to the Water Center newsletter	X			
Present seminar at CSU		X		
MSc Student to Present poster and/or oral session		X ?	X	
Reports to stakeholders, printed and delivered by our field facilitator, Mercy Theuri, Mount Kenya University		X ?		
	J-S	O-D	J-M	A-J

We thank the CSU Water Center for the opportunity to do this very important work. We found that there are many organizations – mostly NGOs – that are situated in Lodwar, Turkana. There is a lot of planned development. However, there is little in the way of research going on in Turkana. Our plans were met with a lot of optimism from both communities and ministries. We hope that our proposal will be successful.

**Summary of NSF Proposal, Re-submitted November 2015
NSF CNH-L (PI: Lynn) Governance and Ecology of New Water in the Kenyan Drylands**

Two large aquifers were discovered in 2013 lying deep below the arid landscape of Turkana County, Kenya (Figure 1). This discovery has initiated a compelling social-ecological situation: Turkana County, which has for thousands of years been severely water-limited and as such remained largely outside political and economic interest, may transform into a water source for the entire country. The discovery of valuable resource reserves can create complex challenges for governance, development, sustainability, and equitable distribution of benefits and burdens across resource stakeholder groups. Their study demands a multi-scaled, interdisciplinary approach that is founded on active public engagement and a deliberate systems approach to design and inquiry.

The essential question that this project proposes to address is “what are the social and ecological consequences of the transformation from water scarcity to water abundance, at a time when a new constitution and devolution of government makes the development of all water sources more pressing and possible?” We address this question from the perspectives of both governance and social-ecological transition. We investigate all four components of the Turkana coupled natural and human (CNH) system: 1) Dynamics of the Turkana ecosystem, 2) Dynamics of the Turkana pastoral social system, 3) The processes through which the Turkana ecosystem affects the Turkana pastoral social system, and 4) The processes through which the Turkana pastoral social system affects the Turkana ecosystem (Figure 2). The concept of non-equilibrium systems, which has had profound implications for the sustainable development paradigm, was formed in large part from research in Turkana. As the aquifers and other sources of water are developed, the potential for ecological and cultural transformation is profound. This project employs an array of

interdisciplinary methods to address its essential question. Methods include focus groups, detailed interviews, satellite imagery analysis, a linked social-ecological simulation model, and Photovoice. Our research team specializes in such areas as rangeland and pastoral systems ecology, agricultural and resource economics, political science and natural resource governance, simulation modeling, watershed management, Photovoice, systems thinking, online course design and implementation, and database design and management. Data collected and analyses conducted through this research will both use and contribute to the much larger shared efforts of the investigators to balance local livelihoods and ecological sustainability, and to identify potential mismatches in benefits and burdens of development in the drylands that could impact sustainability of the ecosystem, local to regional livelihoods, and the resources in question (Table 1).

This project takes an innovative approach to identifying and integrating the benefits and burdens that may be realized by multiple stakeholders for use in natural resource governance, policy-making, and sustainable resource and land use management using a combination of field data and simulation modeling (Figure 3). The integration of these interdisciplinary concepts and methods will be critical to studying and addressing issues surrounding the governance of the new water. We present the compelling question of whether Turkana, which has for thousands of years been water scarce and water limited, and which has for all intents and purposes sat largely outside the Government of Kenya's realm of interest, will be fundamentally transformed from a system driven by non-equilibrial dynamics, to one where these processes are buffered by newly-discovered water resources and follow a more equilibrial pattern.

This research is transformative in its approach to these questions, and looks at outcomes for both the ecosystem and dependent pastoralist livelihoods. Our team will contribute to broader societal goals by disseminating our research outcomes equally among ecosystem stakeholders in Kenya. Research outcomes and lessons learned from both field data and our social-ecological simulation model will be presented to diverse academic, research and lay audiences through conference presentations, publications in scientific journals, class lectures, popular publications, CSU newsletters and web site and multiple online networks. We will graduate three graduate students from CSU, will mentor at least 6 undergraduate students, and have proposed to develop and teach both a CSU graduate seminar on the globally relevant issue of natural resource governance, and two online short courses that have the potential to impact a large number of students, practitioners and community members working in African drylands.

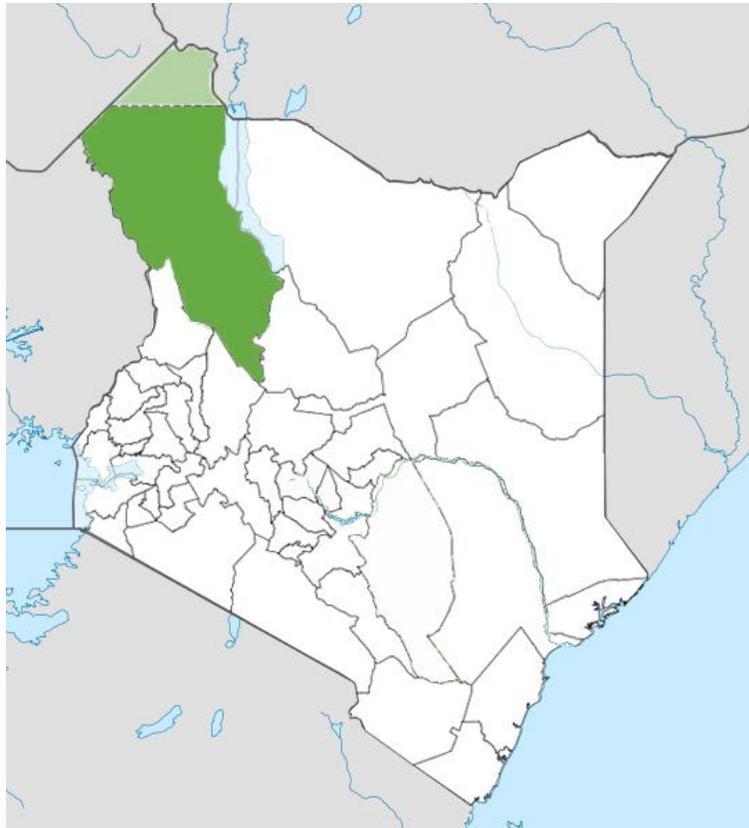


Figure 1. The location on Turkana County in Kenya.

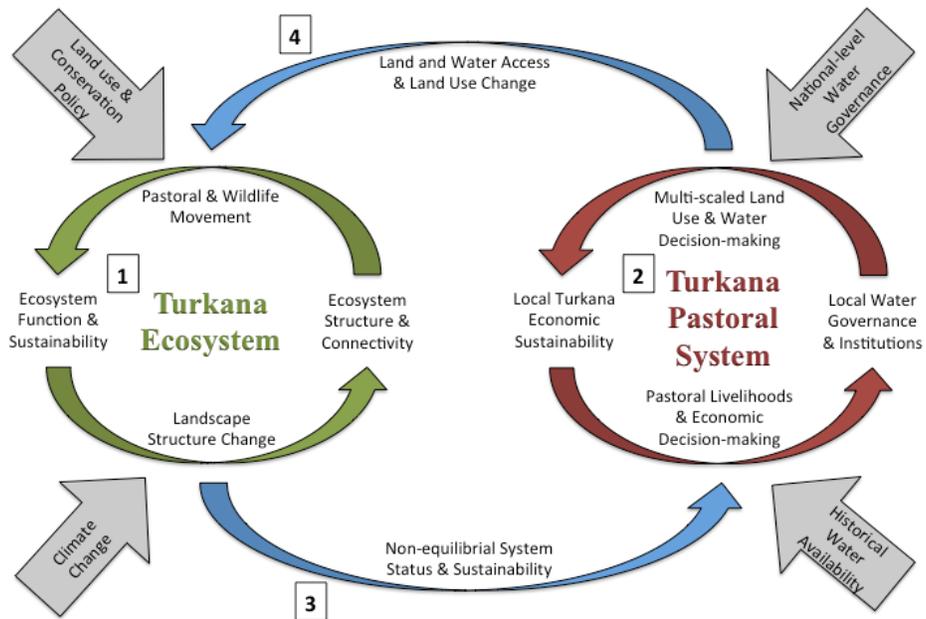


Figure 2. Conceptual diagram of CNH components, with the four major components numbered for reference.

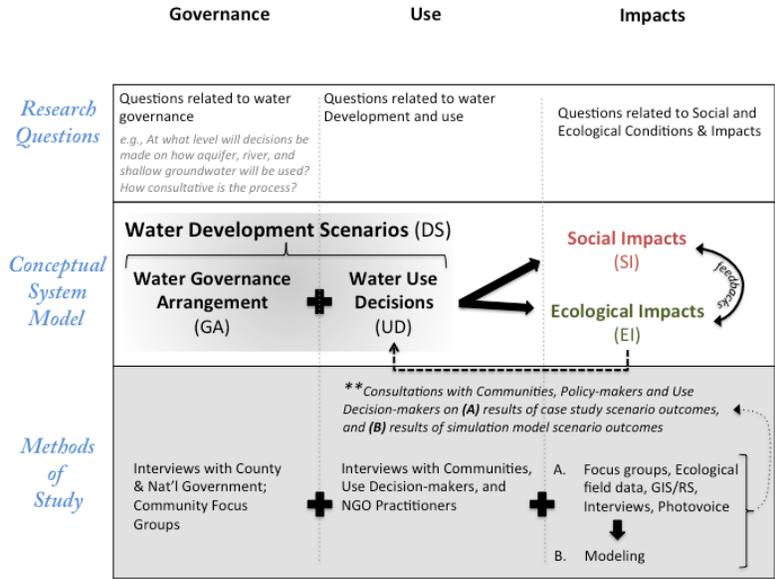


Figure 3. Our project’s conceptual framework lays out how a combination of governance and use decisions lead to social and ecological impacts. We align our research questions, conceptual model and research methods with the Governance Use Impacts pathway.

Table 1. For each of five preliminary water Development Scenarios (DS), we identify a water source, the water Governance Arrangement (GA) and Use Decision (UD) under consideration, our hypothesized Social (SI) and Ecological Impacts (EI), and methods.

Water Development Scenario: Water Source + GA + UD	Hypothesized Ecological Conditions & Impacts	Hypothesized Social Conditions & Impacts	Methods
1 State-run large-scale irrigated crop production projects in Turkana using deep aquifer water	<ul style="list-style-type: none"> • Loss of grazing pastures • Concentration of livestock in smaller areas • Livestock concentration leads to localized degradation 	<ul style="list-style-type: none"> • Loss of access to grazing • localized wage labor opportunities • in-migration of agriculturalists (with secondary impacts) • Food security impacts depend on access to produced food • Increased demand for local meat, milk and fish from Lake Turkana could increase food prices. 	<ul style="list-style-type: none"> • Government interviews on development plans • Household interviews on livelihood strategies, grazing access, food security, market prices • Participatory mapping of grazing pastures and watering point
2 County-run large-scale irrigated crop production projects for County-wide benefit using deep aquifer water	<ul style="list-style-type: none"> • Loss of grazing pastures • Concentration of livestock in smaller areas • Livestock concentration leads to localized degradation • Reduction in firewood/charcoal 	<ul style="list-style-type: none"> • Localized wage labor opportunities • Loss of access to grazing lands • Income benefits realized primarily by County • Access to produced food may depend on status and proximity 	<ul style="list-style-type: none"> • County interviews on development plans • Household interviews on livelihood strategies, grazing access, food security, market prices • Participatory mapping of grazing pastures and watering point
3 County-run large-scale irrigated fodder/forage production projects for County-wide benefit using deep aquifer water	<ul style="list-style-type: none"> • Some ecosystem impacts will depend on species grown • Livestock would have more stable access to forage • Possible conversion from non-equilibrium to equilibrium pastoral system 	<ul style="list-style-type: none"> • Increase in grazing access • Resource access may be uneven • Depends on water quality • Development will likely be determined by proximity to water source rather than by need 	<ul style="list-style-type: none"> • County interviews on development plans • Household interviews on grazing patterns, access to forage resources, access to water
4 River water diverted via canals for cultivation in designated areas near rivers	<ul style="list-style-type: none"> • Riparian degradation may lead to erosion, siltation, loss of soil • Faster moving river leads to less groundwater recharge • Offtake likely to reduce flows • If fertilizers are used, contamination could result. • Local wildlife conflicts increase • Increase in invasive <i>Prosopis juliflora</i> 	<ul style="list-style-type: none"> • Cultivation may be far from the household • Downstream communities may be affected by reduced river flows • Only possible for communities with access to rivers • Concentrated flood risk for crops • <i>Prosopis juliflora</i> leads to livestock deaths and cultivated area loss 	<ul style="list-style-type: none"> • Household interviews • Vegetation surveys of <i>Prosopis juliflora</i> • Longitudinal productivity assessments of cultivated fields via offtake surveys • Participatory mapping of flood zones
5 Village drills (with partner NGO) shallow groundwater borehole in central village location	<ul style="list-style-type: none"> • Draws down water table 	<ul style="list-style-type: none"> • Clean drinking water improves health indicators • Water for washing improves health indicators • May allow small-scale livelihood diversification • May allow cultivation of small kitchen gardens • Emergency livestock water source buffers droughts 	<ul style="list-style-type: none"> • Household interviews on health indicators, livelihood diversification, household water use and quantity analysis