Climate.UAR Final Written Assignment

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Analyzing the Barriers to Sustainable Food Systems in the Lake Victoria Basin: A Kenyan Perspective

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Introduction and Literature Review

Lake Victoria is one of the supereminent bodies of water in the world, not the least because of its sheer magnitude. The Basin encompasses over 58,000 square kilometers of area and includes five countries in East Africa: Kenya, Tanzania, Uganda, Rwanda, and Burundi. It is the principal source of food, employment, and clean drinking water for over forty million people (Nyamweya et al., 2023).

The Lake's importance stretches far beyond geography, however. Several areas make the Basin a key area of research for food systems. The region has suffered drastic changes in land use, with almost half of the land across the Basin by 2014 utilized as farmland, the vast majority of which is owned by small farmers, to the detriment of natural ecosystems which were often deforested or drained (Mugo et al., 2020). Additionally, in the years between 1985 and 2014, urban areas grew by 800%, showcasing a sharp increase in the population and resource needs of the region (ibid). These dramatic changes have led to the emergence of new challenges across the Basin, as well as the need for new paradigms to solve them.

The impacts of land use change are worsened by the consequences of global warming and environmental degradation—heavy precipitation events, for example, are expected to increase by

47% by the end of the century (Ogega et al., 2023). Since water levels on the area are largely determined by precipitation and evaporation rather than river inputs and outputs (UNEP, 2006, p. 38), this will lead to more frequent and damaging floods, such as the ones seen across Kenya in 2024 (*Lake Victoria Flooding*, 2024), in which dozens of thousands of residents were forced out of their homes compounded by an almost immeasurable economic impact.

Key to the future of food systems vis-à-vis climate change and shifts in land use and pollution is the implementation of agroecological concepts to the region. They promote safer and more sustainable ways to utilize the land but have been historically very difficult to achieve. There is additionally very little research done on the structural and physical challenges to innovation in the Lake Victoria Basin food systems—despite its importance for millions who live around the lake, the region is severely understudied (Nyamweya et al., 2023). It is with the goal of improving the understanding of organizational challenges to agroecological transition in the basin that we have embarked in this research.

Methods

This analysis is a preliminary study from a larger project by the team at J-WAFS (Abdul Latif Jameel Food and Water Systems Lab) which is still ongoing. Its main goal is to develop a policy brief to the Lake Victoria Basin Commission (LVBC), an organization based in Kenya responsible for sustainable development across borders in the Basin.

From the dozens of interviews done so far, five were coded and analyzed by the author. These were five individuals from a variety of backgrounds and genders; however, given the small sample size, this analysis is not meant to be representative. In fact, the pool leaned heavily to the government perspective, which certainly affected the development of its conclusions. And,

most notably, all five interviews are from the perspective of Kenyans. This decision was made both due to logistical considerations and its benefits as a starting point: the Commission itself is based in Nairobi, and so we intended our initial connections to be most directly relevant to their day-to-day operations, continuously developing into a more robust mapping of the food systems innovations system.

This is not meant to be taken as a comprehensive sample of the region; rather, this analysis is meant as an aid to understand the food systems landscape in Lake Victoria and its main challenges, as well as possible solutions. As a framework of analysis, the conclusions in this paper can be connected to our larger project and compared for a further understanding of the pervasiveness of these opinions and efficacy of eventual recommendations.

The five interviews which were chosen are from professional workers whose work largely involved the Basin, and who are based in Kenya. They took place in July 2023. After transcribing the interviews through the use of software, these interviews were coded using the Technological Innovations Systems frameworks (TIS), as detailed in Bergek et al. (2008).

The TIS framework is a systematic approach to social sciences analysis of complex systems and allows for patterns and relationships to be discovered (ibid, p. 2). As such, it has proven to be incredibly valuable for food systems research, uncovering root problems and benefits based on seven "functions": knowledge development; knowledge diffusion through networks; guidance of the search; entrepreneurial activities; market formation; resource mobilization; and creation of legitimacy. A summary of each function can be found in Table 1, adapted from Sixt et al. (2018). Additionally, a particular analysis of positive and negative aspects associated with each function as determined by analyzing the interview is included in Table 2.

Given the needs of this analysis, however, we went further and coded for what we called "emergent themes": ideas that became patterns from the interviews, but which allowed us to understand more clearly the challenges and opportunities in dealing with the Basin's vast geographical and cultural dimensions. The themes we focused on for the scope of this paper involve: food system vulnerabilities; cross-boundary challenges; and methods for collaboration. The definition and summary of each theme can be found in Table 3.

1. *Knowledge development*	Fundamental to the innovation process and involves the learning processes related to developing and utilizing new knowledge on a technology or set of practices. The development of new knowledge can occur through formal research (e.g. at universities and governmental and non-governmental research centers), the private sector (e.g. agri-business), or at the individual level (e.g. farmers).
2. *Knowledge diffusion through networks*	The exchange of information through networks, where research and development (R&D) meets government and markets. Policy decisions should be guided by the latest technological research, and R&D agendas should be affected by changing environmental, market, and social conditions.
3. Guidance *of the search*	Refers to the creation of a vision for the innovation system and mobilization of incentive structures towards that vision. Incentive structures may change in response to factor prices and regulatory pressures (e.g. product prices, taxes, and subsidies), expectations in market growth potential, new knowledge, expression of interest by customers, cultural changes, and external events.
4. *Entrepreneurial activities*	Turn the potential of new knowledge, networks, and markets into concrete actions to develop and capitalize on business opportunities.
5. *Market formation*	Is about creating demand for the outputs of the innovation process. New technologies or practices often have difficulty competing with the *status quo*, so a market must be created via institutional change. Market creation can occur through changes in regulation and taxes and/or investment in infrastructure complimentary to the innovation.
6. *Creation of legitimacy*	It is necessary to overcome resistance to a new technology or set of practices from the existing production, trade, and consumption systems. The innovation must be considered appropriate and desirable by incumbent actors for resources to be mobilized and not blocked.
7. *Resource mobilization*	

	Is closely linked to the creation of legitimacy and concerns financing investment in innovation in the form of access to credit, seed funding, venture capital, investment in human and social capital, and the development of complementary products, services, infrastructure, etc.

Table 1: The seven functions of a TIS (Andersen, 2015; Bergek et al., 2008; Hekkert et al., 2007; Hekkert & Negro, 2009; Turner et al., 2016).

Analysis

A major piece of our research was coding, interpreting, and analyzing the interviews. Given the seven functions defined in Table 1, we then looked for patterns and connections between them to arrive at a better sense of the possible interactions between actors in the Basin, and where there are stopgaps in the current system. Following the analysis established by Bergek et al. (2008) , each function was analyzed in detail. The positive and negative aspects associated with each function were then summarized in Table 2.

Following a deeper dive into each function, the areas highlighted the most by our interviewees were related to influence on the area of search as well as the creation of legitimacy. These functions are often associated with, respectively, the beginning and the end of an innovation systems transition, suggesting that there is a particular need for a strategic shift in planning around sustainability in the region. New projects should place special emphasis on establishing new research and enhancing understanding behind fundamental processes on the lake. They must also pay particular attention to the ways in which the different participants interact, developing a plan to ensure that agroecological innovations can be sustained throughout the region of interest and beyond the limitations of the project's funding.

Knowledge development

The lack of data was one of the key points from all interviews. While some mentioned previous projects in the Basin favorably, all professionals mentioned not having enough information to do their work as required of them. This dearth is then shown in a cascading fashion across any attempts to make food systems more sustainable, as they do not use their resources efficiently or tackle the roots of problems efficiently.

Of particular importance has been the Lake Victoria Environmental Management Project (LVEMP), developed by the World Bank and deployed in multiple stages, with its second occurring between 2009 and 2017 and including a budget of over $100 million (*Development Projects*, n.d.). Despite its limited impact, as shown by the many vulnerabilities still seen today, the LVEMP has certainly shaped how the region perceives sustainability projects, and the Basin Commission should consciously consider which aspects of this comparison it must tackle to efficiently interact with its key partners.

Another area in which knowledge development was mentioned by our interviewees was a frustration over the framework itself—rather than merely an increase in the number of research pieces, some of the professionals shared their desire for a change in the way scientists themselves saw the Basin, and more research in an interdisciplinary manner. According to them, the way in which knowledge about the basin has been researched so far has led to an insufficient understanding on the interconnectedness of the region, and thus hinders the development of co-benefits or the discovery of indirect consequences.

The reason behind insufficient knowledge development is multifold, and further interviews should try to reach deeper into these causes. However, some of the mentioned causes involve issues with funding (resource mobilization), data sharing practices (knowledge diffusion through networks), and the types of research which do receive funding not being the most useful

to them (guidance of the search). Some of these barriers and possible solutions moving forward were analyzed by Nyamweya et al., who provided a very useful roadmap to future research areas (2023). Our findings agree with their conclusions, which include the need for trans-disciplinary work and further training of personnel.

Knowledge Diffusion Through Networks

The Basin's massive scale, both in terms of size and number of relevant people involved, leads to many challenges in moving any information from theory to practice. Our interviewees from the Kenyan government shared a particular difficulty in interacting across boundaries, especially given the cultural and political differences. These aspects are further analyzed in "Exploring Solutions" given their influence on the implementation of any recommendation.

Additionally, the nature of current projects focuses on interactions with large-scale parties such as national or regional governments. While necessary, there is little interaction with the smaller farmers or organizations that often become the keys for implementation. One interview focused on the role of civil society associations in facilitating this diffusion and thus leading to higher efficacy in the transition to a more sustainable basin.

Another key aspect of knowledge diffusion is its ability to be sustained across time. Some interviewees mentioned a lack of training as a hindrance to their ability to implement farming techniques, for example. There are also challenges in incentivizing farmers to share agroecological practices with those around them, which may have root in the lack of personal incentives or relationships between them and researchers.

Guidance of the Search

Action around the basin suffers from a lack of clear vision. Interventions largely occur on an ad-hoc basis, and often target symptoms, not causes. One of such moments was a project to remove water hyacinth, an invasive species that has brought about significant destruction and economic damage, pushing many into poverty (Chrisendo, 2022). One of our interviewees detailed the large expenses to remove the plants but, due to the lack of scientific understanding of the species, they utilized mainly mechanical means to do so—which meant the plants returned little time after the project ended. A stronger vision for the Basin would include a deeper understanding of the factors behind the existence of the water hyacinth and any factors that may be causing it to flourish in certain areas of the lake, such as nutrient enrichment from pollution.

While these are large-scale changes and require significant resources, the Lake Victoria Basin Commission finds itself in a key junction to enact change. There are current efforts across many institutions to develop visions for the future, given the previous lack of efficacy across projects, but none have mobilized enough organizations to establish a common influence on the direction of the search that can work across bureaucratic systems. The Basin has the possibility of changing this paradigm by leaning into the connections formed from its international mandate.

Entrepreneurial activities

One of the most interesting aspects of the research; surprisingly, entrepreneurial activities were rarely mentioned across our interviews, and largely in terms of a hindrance to innovation. While some interviewees spoke of the importance of the private sector in improving Lake Victoria's transboundary work, especially non-governmental banks, they spoke of the limitations of such connections, arguing they have not been utilized to their full potential. There are few entrepreneurs focused on sustainability as, despite the gains they receive from investments that

come from projects in the region, they do not have incentives to choose more sustainable venues, such as agricultural extensions, compared to the status quo.

This lack in analysis of entrepreneurial activities across the basin could be because of our small sample, which leans towards those working in the government; however, even through a biased perspective, this may showcase the lack of interaction between the constituent parts of the innovations system. They also seem to be largely removed from the decision-making process, which may impact their willingness to adopt agricultural extension practices. This points towards a need to increase relational ties between the groups and attempt to map out their needs.

Market formation

The demand for changes to the way food systems are organized is increasing significantly. Recent climate disasters across the Basin are leading to an increased understanding of the crisis in the system and are driving countries to seek joint solutions. Additionally, the high rate of immigration into the region increases its relevance on the international stage, alongside pressures to make changes to accommodate the population.

However, there are many barriers to an effective transformation of this impetus for change into an organized market via institutional change—and, from our interviews, very few professionals directly reflect on this aspect of agroecological change. This was the function that was least mentioned across all our conversations by a wide margin and may reflect the current focus of our stakeholders. Rather than think about market regulation or investment infrastructures, their work is more directly connected to projects that can work upon current regulations. It is important for future interviews to understand whether there are people working on forming more financial incentives for the development of a sustainable food systems

market—and, if there are none, possible positions which would have decision-making power to change.

Resource mobilization

Rather than a singular "step" in the innovations system process, resource mobilization largely functions as a limiting factor across all functions in Lake Victoria. Our interviewees spoke of it both in terms of lack of funding and lack of financial planning for the future, associating it with the guidance of the search.

Capacity in agricultural extension services is woefully underfunded, and this has shown itself to be perhaps the clearer barrier to innovation across the Basin. A vast majority of funds for sustainable work comes from international sources and, given the changing status of climate finance incentives across the world, our interviewees did not feel confident in the stability of these funds for the future. However, national governments have very little funds on their own, making resources extremely varied with time. This shows itself in the way that, once funds from international organizations end, projects rarely continue, and any progress is quickly abandoned.

While international and national funding gathering is a challenge experienced across all of development, our interviewees also mentioned inefficacies in the way that any funding that does exist is allocated. Institutional financial planning is an area in which the Basin Commission can work on a shorter term, and which may bring significant improvements to local food systems. The LVBC may also function as a connector between local organizations that need funding and international groups such as the World Wildlife Fund and the World Bank, once again leveraging its location on the food systems landscape for the region.

Creation of legitimacy

This function was, alongside guidance of the search, the most frequently mentioned in our interviews. Legitimacy is strongly tied to the efficacy of any innovations system and has a key impact on the success of agroecological processes. Ensuring that all actors move beyond the status quo area to implement more sustainable practices is a major challenge for organizations, and is one firmly rooted in the trust between the different groups. Since the Basin involves such varied interests, establishing legitimacy in its own actions and in agroecology in general is key for the Commission's goals, and should be one of its main areas of work moving forward.

While important in the international sphere, the LVBC's position and responsibility remains murky for local stakeholders. According to one of our interviewees, many still do not know of its existence; several seemed skeptical of its decision-making and enforcing capabilities due to the bureaucracy often tied with federal organizations. To improve its legitimacy with those in the Basin, the LVBC must increase its transparency and provide reasonable initial objectives, the completion of which may increase trust in its vision.

There is also skepticism associated with agricultural extension projects themselves, and the values of agroecological transitions. This is associated with value systems which can only change with time, but there are still several ways in which successful implementations of projects may increase trust and work to the Commission's favor.

Civil society organizations can also be important partners in this process by bridging the gap between the government and the farmers that make up most of the people responsible for enacting food system changes in their properties. Therefore, to improve its sense of legitimacy in the food systems landscape, the LVBC must engage consciously and deeply with its own mission and utilize the relative strengths of the different groups to which it is already connected.

Function	*Positive Aspects*	*Negative Aspects*
Knowledge development	• Basic knowledge gathering and framework developed through previous projects (especially LVEMP) • Many issues identified and categorized into different areas in LVBC	• Not enough scientific data on Basin • Lack of stakeholder analysis • Issues silo-ed instead of seen as system
Knowledge diffusion through networks	• Development of LVBC showcases increased interest in cross-boundary interactions • Many organizations involved and interacting in basin	• Not enough training • Both legislative and cultural barriers • Geographic size of basin poses a barrier • Bureaucracy leads to significantly increased timelines and little interaction (a problem both at the country and organizational level) • Implementation of projects and sustainable innovation does not reach "smaller" stakeholders such as local farmers—community stakeholders left out • Prejudice may pose a barrier
Guidance of the search	• Civil society interaction between countries was able influence projects through advocating for different outputs • More initiatives between countries in development, seen as more of a priority by Kenyans interviewed	• General lack of cohesion or common vision for the Basin • Extreme focus on deliverables, which can be harmful when new information is developed or there are co-benefits/extra value added beyond the measurement • Hesitation to innovate from previously created models
Entrepreneurial activities	• Private sector plays a major role in environmental protection • Benefitted from previous and current projects in region	• Their needs and particular stakeholders not well-mapped • Large differences in land use, particularly increasing construction, due, at least in part, to drought • Information and innovation do not reach entrepreneurs
Market formation	• Immigration leads to an influx of farmers to region, increasing economic value of region • Some services have been able to outlive initial program support dates and become self-sustained due to profits	• Environmental/sustainability markets not developed enough to allow countries to have enough resources—most money comes from foreign sources • Only a few sectors have incentives to become more sustainable or even act in the region
Resource mobilization	• International donors from large entities (World Bank, UNEP)	• Projects end when the funding goes • Much more difficult to utilize resources in a sustainable manner due to natural abundance and geographic extension • Most interventions and resource allocations are ad hoc instead of following a vision • Lack of funding from national governments

Creation of legitimacy	• Meeting in larger international events under a common banner (such as "Africa") requires more unity and leads to more collaboration in the face of more external pressure	• Need to determine the LVBC's capability to enforce any guidelines • LVBC not known by many local stakeholders • Civil society organizations not engaged significantly in supervision/implementation stages • Lack of determining accurate/helpful/? local partners • Corruption/a view of the system as corrupt makes collaboration and innovation much more difficult, derailing projects

Table 2: Summary of positive and negative aspects associated with each TIS function in the Lake Victoria Basin. Adapted from Schiller et al. (2020).

Exploring Solutions

Despite the many challenges posed by the current food system in the Lake Victoria Basin, this project also allowed us to hear from our responders what solutions they can see as implementable and urgent. By looking for patterns in the topics they brought up, we developed a series of additional codes for the interviews, our "emergent themes." While there were several, this project decided to delve deeper into the topics most impactful from our chosen interviews—the food system vulnerabilities, cross-boundary challenges, and motivations for collaboration. We then took these connections as the basis for what further work can be recommended to the Basin Commission.

The need for better communication between the varied constituents on the Basin is clear. Given the complexity of the ecological and human components, establishing zones of common understanding is key to navigate the challenges of including representatives from five countries and countless organizations. There appears to be large misalignments in policy because each country's bureaucratic process varies significantly from the others. Additionally, there are many cultural preconceptions; multiple interviewees mentioned either how they were seen by those in

partner organizations in other countries or how they saw them. These differences should not be understated, but they cannot be resolved unless there are more opportunities for interactions and clear connections. One of our interviewees mentioned the important role of going to international conferences to talk about the Basin together—since they have this shared marker and want to show other countries their progress, communication and action becomes much easier between the countries. Therefore, increasing opportunities for contact and protocol that foster collaboration is key.

The Commission itself was also a topic of conversation during the interviews, and there appeared to be a need to increase clarity and trust in the organization. Given the lack of enforcement capabilities by the LVBC, some argue that the projects are doomed. Given current legislation, such as the LVBC Act of 2022 ("The EAC Presidents Assent to LVBC Act.," 2022), there appears to be a trend to let the Commission have more power and administrative capabilities across different countries. Clarifying—and effectuating—any eventual further changes is very important in establishing legitimacy and improving the relationship between different agencies. Since the number of actors around the Basin is so large, ensuring there is no redundancy in the Commission's goals will improve its efficiency and decrease some of the cross-boundary challenges our participants detailed in their interviews.

Many of the areas highlighted as key to determine motivation for collaboration were connected to the TIS function of knowledge development. This included multiple references to the importance of shared data and some baseline knowledge, scientific or organizational, across institutions. Interestingly, motivation for collaboration was also associated strongly with cross-boundary challenges, suggesting that there is awareness and active work on supporting improved relations—and highlighting the interconnectedness of the two areas. Any solutions in the

collaboration space must take into consideration the unique needs of working across such differing governments.

One such solution, as developed from the challenges faced by our interviewees, rests in leveraging the previously established lack of information about the Basin, something experienced by all countries. Research itself (knowledge development) can thus be used as a tool for the creation of legitimacy by creating a shared pool of information that can drive collaboration. Its place as a key need for a more sustainable food system should not be understated.

However, scientific research is not everything—as shown by the many vulnerabilities in the system, institutions, whether formal or informal, and the relationships between them are key. The Commission must take and further define its role as a conjoiner across the Basin: to successfully address the vulnerabilities found in these food systems, a decision-making framework must have resources and trust, both of which can be improved through strong ties of collaboration and support. The LVBC, by establishing guidelines and a space for mutual gains, can positively impact Lake Victoria's sustainability practices for the future of millions.

Theme	*Brief Description*	*Comments*
Food system vulnerabilities	The ways in which people perceive weaknesses in the food system, particularly as they relate to sustainability	• Climate change • Population growth • Lack of enforcement • Pollution
Cross-boundary challenges	Understanding the limitations of working on issues that cross national boundaries	• Need to harmonize policies and guidelines across countries to facilitate information sharing and collaboration

Motivation for collaboration	Areas of agreement proposed by interviewees that have led or will lead to increased collaboration	• Increasing economic ties between countries • Establishing a ground level of understanding between parties • Data sharing protocols

Table 3: Emergent themes from our interviews in the Basin.

Conclusion

This paper is a preliminary analysis of the main challenges currently facing the Lake Victoria Basin as it tries to become more sustainable—and some areas in which solutions can be found. While only based on a select subset of interviews, we found particular prominence in the role of guidance of the search, or the establishment of a common vision, and the creation of legitimacy as functions. Utilizing the Technical Innovations Systems framework allowed us to connect the differing interviews and focus, instead of on specific actors or institutions, on the interactions between them.

Our coding of emergent themes found across interviews also showed that solutions must come from across borders and involve the most varied levels of authority, from local farmers and workers to international bodies of governance. This will require a common set of values. Economic ties and stronger connections may be a valuable strategy given current animosities and cultural differences across the basin. External pressure may also be helpful, since it allows for the enforcement of previously agreed-upon rules and creates a sense of unity in the countries involved in the Basin. Additionally, there appears to be a lack of clarity and involvement from the private sector on the decision-making process in the Basin—although they are key constituents, the lack of interaction can be a cause of the low levels of adherence or

internalization of norms of sustainable behavior. Their inclusion in the decision-making process, while more resource-intensive, can bring about improvements in the food system vulnerabilities, particularly taking into consideration the destruction brought about by climate change.

This research also showcased some areas in which more data-gathering is important, therefore helping shape the future of the larger report and possible integration of questions regarding the role of civil organization and the development of a market for sustainability innovation, whether through tax or financial incentives. The dynamism of this project will allow us to expand on these vulnerabilities and define more finely tuned recommendations for the Commission.

Our work has been able to expand a framework that allows the Commission to understand its mandate as a cross-boundary organization and ensure the sustainability of the Lake for future generations. Given the complexity of the food systems in the region, our interviews and their subsequent analysis allow us to examine the true reasons behind the lack of advancement in the area which cannot be told from surveys or modeling alone. It has allowed us to digest immense amounts of information, and the recommendations may be used to enact meaningful change across the Basin.

While the road to improve sustainability in food systems in the Basin may be long, our research has shown the key role that hopeful individuals with the correct tools have in changing the world. By furthering both research and relationships at Lake Victoria, the Commission will be able to facilitate the arrival of that future.

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