Vanishing Knowledge in Water Resources Development and Management in the Arid and Semi-Arid Lands (ASALs) of Kenya

(draft paper for the Africa Knows! Conference; Panel B08)

Moses Mwangi

Abstract

The better part of the 1990s decade saw development being discussed in the context of social capital and development which encapsulated indigenous knowledge as part of mainstream development. The late dates of the same decade however experienced tensions between the indigenous and western claims. Local knowledge rejected western science's claim to universality and its institutionalization that it can be archived and transferred. Since then, there have been more claims that indigenous knowledge has failed to impact on development over the years. Three most commonly mentioned thematic areas are that indigenous knowledge is locally and geographically specific, doubts as to how the knowledge can be formally integrated with formal science and, issues of appropriation of indigenous knowledge into the prevailing discourse of neoliberalism. Indigenous knowledge systems have nevertheless shown to contain potential transformative tools if effectively integrated in the water sector of development to improve development and management systems not only as a matter of redress but also to enrich the current systems. This paper, based on a study carried out in the period between 2018 and 2020 among the Maasai pastoralists and Kamba agropastoralists inhabiting the south eastern arid and semi-arid lands (ASALs) of Kenya sought to identify and interrogate the indigenous knowledge practices in water resources development and management and, establish its claim. The utilized data collection methods were survey questionnaires, key informant interviews and observations. The findings indicate that failure to recognize and accommodate traditional tenets in developing and managing water affairs in the ASALs milieu may result in disappointments. Resulting from the letdown of the state to provide efficient water structures combined with the challenges the ASALs face with regards to water, the inhabitants use their knowledge to meet their water needs. The knowledge is socially constructed having been acquired through accumulation of experiences, society-nature relationships, community practices and institutions passed down through generations. Significantly, the latest water institutional dispensation brought by the water sector reforms takes cognizance of grassroots institutions, providing space for the traditional knowledge they possess which is enshrined in the successes gained in managing the ecological and hydrological environments. This may provide some saving grace.

Key Words: Indigenous, Pastoralists, Agropastoralists, Universalization,

Moses Mwangi who is a Visiting Fellow of the African Studies Centre Leiden lectures in the School of Environment, Water and Natural Resources (Department of Hydrology and Aquatic Sciences) at the South Eastern Kenya University. Prior to the post, he worked for the United Nations Children Fund (UNICEF) Water, Sanitation and Hygiene programme. Dr Mwangi has been involved in various researches, relief and, development programmes in the East African region with, particular allusion to the arid and semi-arid environments. He also has particular interests in researches and innovations that aid rural people emerge out of poverty.

Contact Address: South Eastern Kenya University
Email Address: mmwangi@seku.ac.ke; mnmwangi2000@seku.ac.ke
Tel No: +254 722 880937

Background and Introduction

Kenya's landmass constitutes of close to 90% arid and semi-arid lands (ASALs) environment characterized by low rainfall and high temperatures (Odhiambo, 2013). About a quarter of the country's population comprising mainly of pastoralists and agropastoralists reside in the milieu. The two farming systems suffer frequent droughts occasioned by water inadequacy, poor pasture growth, crop failure and, high livestock deaths which, lead to famine. The region has minimal water resources, the main sources being ground and rains. Due to unreliability, rainfall onset and distribution are issues of major concern to the inhabitant communities, in a setting where scientific weather forecasts are not well understood. As such, the ASALs indigenous water harvesting, use and management systems play an important role in increasing the water supply in the water stress-prone environments. There is dependence on local knowledge in locating, constructing, treating and, managing. This study was undertaken to collect information on the four aspects as used by the Maasai pastoralists and the Kamba agropastoral communities.

The Kamba and Maasai peoples' knowledge on water is accumulated across generations, tested and adopted to guide in interactions for social and economic benefits. The inherent dynamism of the knowledge systems lies at the heart of their ability to adjust and modify their actions in response to water and related changes. The inhabitants use their traditional knowledge on the environment and the wildlife such as the frequency of rains, flowering of certain plants, appearance of certain animals and, mating of animals among others to determine when to prepare their water resources for anticipated uses. Resident communities monitor the wind, clouds and stars to determine what species to plant and when and where to plant them. Strategies such as maintaining genetic and species diversity in fields and herds provide a response to uncertain weather conditions, while the diversified use of the landscape, mobility and access to multiple water resources increase the capacity to respond to environmental variability and change. This increases options for adaptation to water environmental changes. Some of the Maasai shift from herding to crop farming and zero grazing according to seasonal and environmental conditions. The Kamba farmers cope with the extreme heat and dryness of dry season by intercropping legumes and cereals to benefit from minimal water availability. Before land sub division, the Maasai herders would diversify their human and livestock food sources by rearing livestock and managing communal dry season water and grazing zones.

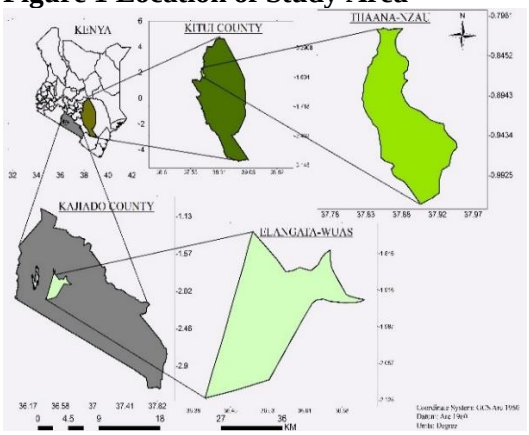
The two communities observe the dynamics of water availability which for several decades has been rapidly changing in light of the effects of climate change. They report visible indicators, such as the emergence of invader plant species as a sign of desertification, increasing runoff velocities and consequent water losses. Traditional institutions contribute to their communities' adaptive capacity and resilience. The two communities rely on reciprocity modes of social organization, especially during times of water stress, which allow to produce and exchange in access and use of water, among other resources. The peoples' knowledge of plant and animal cycles gives them ability to link events in the natural world to a particular climatic cycle, permitting prediction of seasonal events and the likely consequences to water availability. Migratory birds are important indicators of changing seasons and their duration, as well as of impending heavy rains, storms or droughts, allowing preparing of infrastructures to receive rainwater. Presence of low-flying birds signal occurrence of poor weather. Animals seeking higher ground is a warning sign of an approaching tidal wave and, floods. Leaches and caterpillars have been noted to appear before storms. When banana leaves and trees branches fall to the ground without strong winds, people prepare for storms.

Study area

Figure 1 shows the location of the two study areas of Thaana-Nzau and Elangatawuas in Kitui and Kajiado Counties of Kenya respectively. The physical setting of the two has predominance of aridity. The areas comprise of eroded basement complexes broken by residual hill masses and are occasionally overlain by tertiary volcanic. Rainfall is low and unreliable, the precipitation pattern being bimodal, with long rains falling between March and May and short rains from October to December. The soils reflect the largely metamorphic parent material, the dominant soil groups being alfisols, ultisols, oxisols, and lithic soils. The main vegetation is dry bush with scattered trees. The two areas are rural and rely on a combination of

subsistence and commercial agriculture practices dominated by pastoralism and agropastoralism. Recognition that rainfed agriculture is limited has made many people delve into irrigated farming practices and, improved livestock breeds, further raising water demand. Out-migration continues to form an important part of household livelihood strategies.

Figure 1 Location of Study Area



Results and Discussions

Evidently, the communities in the two dryland regions have learnt to cope with water scarcity, and often established water development and management approaches in close overlap with social and cultural evolution. The traditional knowledge practiced has taken salient features that lead to practices that are socially acceptable and, linked to sustainable utilization and management of natural resources. By making use of the physical and geomorphological factors, this has contributed in aiding sustainability building of water resources in the face of inherent scarcity, wide-ranging fluctuation on a seasonal and annual basis and potential conflicts and competition. The most pronounced aspects are in locating, construction, water treatment and, management of water resources.

1. Locating Water Resources

The Kamba and Maasai communities' understanding of hydrology is rooted in biological and spiritual and, knowledge of a healthy environment. The two conserve particular species of plants of importance for maintaining water flows, surface flow banks protecting and, for keeping the rivers and streams shaded. Some tree species are believed to be more critical for water conservation because of their spiritual or sacred importance, while others produce better roots, better branches, or better leaves for protecting the forest. During periods of prolonged hydrologic drought, prayers and sacrifices to appease the gods are offered. The communities protect particular trees and shrubs, recognizing that the roots prevent river bank erosion.

In Thaana-Nzau and Elangatawuas, people able to recognize apposite water sites and exploiting their resources (Table 2). Scoop holes are an important source of water as they provide safe and perennial. Presence of water is indicated by hovering of butterflies and bees around a particular point. Monkeys and, warthogs are seen digging for water in shallow sand aquifers and, birds are observed to nest in the vicinity of points with scoop holes potential. Deep aquifer exploitation is a new phenomenon among the Kamba and Maasai communities. Notably, all the communally owned sources have applied both local knowledge and conventional knowledge. The institutional and individually owned sources depend purely on geophysical surveys, this being associated with the limited space owned and inadequacy in local knowledge. Involvement of the local knowledge is reputed to quicken geological surveys and success in obtaining water. Shallow wells that have incorporated both types of knowledge in locating ground water are indicated to yield more water.

Among the Kamba use is made of presence of trees such as *ficus malatocapra*, sycamore, tamarind, *ficus walkefieldii,* Naivasha acacia and, acacia seyal are an indication of presence of groundwater. The Maasai locate groundwater using indigenous trees *(olerai, oldorko, olgaboli, olmukushi, oreteti)* stones *(ekii, emoitet, etuturian)* for both shallow wells and boreholes location. *Cyperus rotundus* (reeds), some rocks and soils types and, seasonal river valleys provide most probable sites for deep groundwater. *Oseyia* indigenous shrubs, *olkereyian* and *naimurua* indigenous grasses, presence of butterflies, wildlife (warthog, monkeys, bees) along the valleys are useful indicators of water at shallow depths. Diviners successfully use pigeon pea and *croton megalocarpus* twigs, metallic rods, pendulums and, water bottle meniscus to pinpoint where to dig for water. Some diviners claim to possess mystical powers to direct where to develop gratifying groundwater resources.

Table 1 Locating Water Resource

Method		Scoop Holes	Shallow Well	Borehole	Sand Dam	Sub-Surface Dam	Water Pan	Earth Dam
1.	Trees	◯	◯	◯	◯	◯		
2.	Shrubs	◯	◯	◯	◯	◯		
3.	Stagnant water	◯	◯	◯	◯	◯		
4.	Moist ground	◯	◯		◯	◯		
5.	Rocks		◯	◯	◯	◯		
6.	River morphology	◯	◯	◯	◯	◯		◯
7.	Soils	◯	◯			◯	◯	◯
8.	Similar resources	◯	◯	◯	◯	◯	◯	◯
9.	Geophysics	◯	◯	◯	◯	◯		
10.	Animal behavior	◯						
11.	Insects	◯						
12.	Divination		◯					

Pans and earth dams are positioned across seasonal streams to hold rainwater, the location being guided by local soil type and stream flow regimes. Conventional knowledge has become handy in investigating appropriate soil characteristics. The sand dam technology is a new innovation by the government and development agencies. It has however missed out in following the mandatory requirements in correct siting. They have ignored geological and hydrological investigations for sound foundations, leading to failures through overturns and seepages. The local knowledge ignored include the history of the river flows and trees that indicate presence of shallow aquifers. Sub-surface dams are naturally occurring and remain entirely benefiting from local knowledge. Where river profiles permits their existence, the local inhabitants know suitable points to erect them.

2. Construction

Scoop holes are dug by hand using locally made tools, with fencing off the sources preferring recyclable acacia shrubs which house pricks that discourage animals interference. Being an external technology, all the boreholes have used conventional drilling techniques. The traditional wells largely use indigenous knowledge in digging and construction to accommodate the favoured human ladder water lifting. The users are largely against provision of narrowed lining offered by conventional knowledge which is construed to limit the water brought to the surface. The wide well diameters which accommodate the human ladder are also reputed to deliver more water at a given time than any motorized pump. The conventional shallow wells have combined knowledge application but with narrow shafts and installed with hand pumps. They are however not highly reputed by pastoralists as they mainly serve domestic water needs. Traditionally, lining of shallow wells is done using clay, natural stones and baked bricks. When digging deep wells, leaves of bananas, sycamore and fig trees are cut and taken inside to provide oxygen.

To prolong the period of oxygen discharge, water is sprinkled on the plants and the surfaces being dug. Pulleys used to withdraw debris are made from local plants such as *ikuu* and, ropes extracted from the baobab tree. Lubrication of the of the moving plant parts is done using animal fat. The wells are dug in circular form for maximum strength. Rocks beyond the capability of the local tools are exposed to firewood heat and cooled with water to flaw. Acacia type of firewood which are nonpoisonous are used for the firewood. In some cases, the hard rocks are burnt using animal manure or fat to break the rock. Dams are constructed using machineries while some of the water pans have been hand dug using shovels, picks and wheelbarrows. Majority of the sub-surface dams are naturally occurring with a few made out of the local clay and rubble stones.

Table 2 Construction Methods

	Method	Scoop Holes	Shallow Well	Borehole	Sand Dam	Sub-Surface Dam	Water Pan	Earth Dam
1.	Rotary Drilling		◯	◯				
2.	Percussion Drilling		◯	◯				
3.	Hand Digging	◯	◯				◯	
4.	Plant Leaves		◯					
5.	Plant Twigs	◯	◯				◯	
6.	Animal Fat		◯					
7.	Animal Manure		◯					

3. Water Treatment

Whiteet al (1972) explored and found value in practitioners utilizing local decision-making in evaluating the relationship between water quantity, quality, and health of water users. The water resources users' perceptions of water quality are often at variance with ones of technical experts who assess water quality only in terms of bacterial and other contaminants. Localized ability exists to predict diurnal and wet and dry season changes in water quality. Water is traditionally treated using a variety of methods (Table 3). Alum, backs of Naivasha acacia tree and, *moringa oloifera* are administered in water pots as coagulants. Wood ash obtained from trees and shrubs are added to kill pathogens in water. Salt found floating on sand and rocks in seasonal rivers is collected and added to decant water to remove pathogens. Some households use ordinary Portland cement to clear turbidity in water. Boiling is not common and, is largely believed to be ineffective. Sand is used for filtration and taste changing while, acacia trees charcoal is used to remove smell. The Maasai believe that a water source frequented by buffaloes is not contaminated.

Table 3 Water Treatment Methods

	Method	Scoop Holes	Shallow Well	Borehole	Sand Dam	Sub-Surface Dam	Water Pan	Earth Dam
1.	Alum	◯	◯		◯	◯	◯	◯
2.	Plant Ash	◯	◯		◯	◯	◯	◯
3.	Bone Ash			◯				
4.	Animal Instincts	◯	◯		◯	◯	◯	◯
5.	Charcoal	◯	◯		◯	◯	◯	◯
6.	Naivasha Acacia	◯	◯		◯	◯	◯	◯
7.	Sand	◯	◯	◯	◯	◯	◯	◯
8.	Storing	◯	◯	◯	◯	◯	◯	◯
9.	Salt	◯	◯		◯	◯	◯	◯
10.	Moringa Oloifera	◯	◯		◯	◯	◯	◯

11.	Boiling	◯	◯		◯	◯	◯	◯

Borehole water supplies attract least quality worries, arguably because of its protected nature. However, there is the belief that storing borehole water in sand has chances of reducing salinity taste. There were two instances where borehole users applied livestock bone ashes to lower the fluoride levels in their water as advised by geologists. As unprotected wells are prone to siltation and contamination from human and livestock, thorny twigs are placed at the mouth to control access and, daily cleaning of the entrance done to remove possible contaminants. Conventionally, sand dams guarantee safe water. However, the construction and management failure in the existing sources have led to polluted waters. The sub-surface dams are natural but not protected inviting pollution. Scoop holes dug for human consumption are fenced off to protect from contamination by wild and domestic animals hence. Water pan and earth dam whose waters are presumed to have better 'tastes' and minerals for livestock wellbeing are protected with twigs to control access.

4. Management

The Kamba and Maasai people have own management structures within a system and across the systems (Table 4). A primary driver of different traditional water resources management in Elangatawuas and Thaan-Nzau is water shortage and need for survival in line with local situations. The management relies on communities valued identities, lifestyle, and customs. Water is believed to have a strong tie to physical and spiritual well-being of humankind. Management of water sources in Thaana-Nzau is particularly associated with water spirits believed to possess certain likes and dislikes. Most dislikes are related to contamination, thefts and, destruction aspects. The water spirits is the means to protect water sources from abuse.

The conceptions of cost recapture, possession experience, evenhandedness, enforcement, veracity, and unity, which are highly pronounced in modern systems, can be found in the traditional water managements of the two ASAL communities. Beliefs associated with water are created whose absconding is taken to annoy the gods, leading to some punishment. Astronomy come in handy in predicting the onset of hydrologic droughts and onset of rains as part of water resources management.

Table 4 Management Practices

Method		**Scoop Holes**	**Shallow Well**	**Borehole**	**Sand Dam**	**Sub-Surface Dam**	**Water Pan**	**Earth Dam**
1.	Individual	◯	◯	◯			◯	◯
2.	Household	◯	◯	◯			◯	◯
3.	Communal (traditional)	◯	◯	◯	◯	◯	◯	◯
4.	Communal (Informal)	◯	◯	◯	◯	◯	◯	◯
5.	Astronomy		◯				◯	◯

Management of scoop holes is bestowed to owner households, social and cultural settings. Culturally, the women are mostly concerned with domestic water sources while the men are more into water for livestock. The bicycle and trolley technologies have been encouraging men to involve in domestic water collection. Continued land tenure changes from communal to individual land ownerships has led to disappearance of communal management of scoop holes. Adverse dry seasons lower water availability in scoop holes, making people congregate in particular locations where traditional rules and regulations prevail to avoid conflicts. The lessened water attracts communal water use with strict controls on access and use. Among the Maasai, the respect to elders and set customs in relation to water resources environment prevail. Land individualization is however working to the detriment of this.

Management of communal earth dams is carried out through formal management committees nominated by beneficiaries. Individually owned water sources prefer household set water resource governance parameters. Sand dams are communally owned, having been sponsored by the government and development agencies. The donors demand formal gender inclusive management structures and adherence to formal management structures whose mandate includes monitoring structural stability of the infrastructure, devising and enforcing laws governing the usage of the sand dam, blockage of sand harvesting, control in use of the stored water for irrigation in order to sustain the water resource.

Communal boreholes experience formal management committees charged with operation and maintenance. Some of the boreholes are governed by government and private institutions. In communal boreholes, a mix is found in management where banking of the revenues generated is banked in the form of livestock. All the boreholes have minders who keep records of operations. Where illiteracy prevails, records of operation and maintenance hours are kept by forming marks on pump house walls and nearby trees. Boreholes are closed down during the rainy season when users go for rainwater sources.

Conclusion

ASAL communities use a wide array of methods to develop and manage their water resources. They use indicators, mostly plants, animals, insects, astronomical objects and meteorological factors, among others to be able to plan for construction and rehabilitation of water structures. Some of the indicators, like those based on plants are easier to understand while others like those using astronomy and divination require particularized experience to follow. Despite some inconsistencies in the information given by inhabitants relating to the phenological sequence of events for some indicators, the general indicator value is maintained and inhabitants express great faith in them for planning and executing their social and economic activities. The reliance on the indigenous knowledge is noted not to be a hindrance to uptake of the modern scientific knowledge. Therefore, recognition of the place of local knowledge has chance to play part in strengthening knowledge, technologies, practices and efforts of local communities and establish a platform for the exchange of experiences and sharing of best practices in a holistic and integrated manner. The Western knowledge is noted to being prioritized by development agencies while it largely ignores local social, cultural and economic priorities. Briggs and Sharp, (2004) concurs, reiterating that indigenous methods have not been utilized in development initiatives.

References

Briggs, J. and Sharp, J. (2004) '*Indigenous Knowledges and Development: A Postcolonial Caution', Third World Quarterly*, 25 (4). pp. 661-676. ISSN 1360-2241

Odhiambo, Michael (2013) *The ASAL Policy of Kenya: Releasing the Full Potential of Arid and Semi-arid Lands – An Analytical Review*, CORDAID/RECONCILE, Kenya

White, G. F., Bradley, D. J., and White, A. U. (1972) *Drawers of Water*, University of Chicago Press, Chicago.