Waterlines, 39:1, 24–43
<http://dx.doi.org/10.3362/1756-3488.19-00016>

Dimensions of water insecurity in pastoralist households in Kenya

Nancy Balfour, Joy Obando, and Deepali Gohil

Abstract: *Pastoralist communities in Northern Kenya face increasing water security risks attributable to disruptions in their socio-ecological environments. Sedentarized pastoralists, women, and children are most vulnerable to spatial-temporal variations in water availability. This vulnerability is exacerbated by embedded power relations within existing socio-cultural and water governance systems. A preliminary study carried out in 2016 examined pastoralist women's disempowerment in relation to the domestic water security constraints they face. The research found anecdotal evidence that women with diversified livelihoods and social capital are more resilient to water stress. The follow-on study was carried out in 2018 and aimed to provide empirical evidence on factors behind water security and to identify factors that enhance resilience for vulnerable pastoralist communities. The study covered both urban and rural communities in Samburu County and applied a mixed-methods research methodology incorporating quantitative and qualitative research approaches. The study was also used to test a scale for measuring household water insecurity which could potentially improve the methodology for assessing shock-related stress in these high-risk communities. Results show extreme levels of water insecurity, especially in rural areas, and indicate a close relationship between water security and social capital as indicated in the earlier study. Livelihood diversity does not appear to influence water security but households with higher numbers of livestock tend to be more water insecure than households with smaller herds. This is supported by reports from women that the additional burden of watering homestead-based livestock makes them more vulnerable.*

Keywords: water insecurity, pastoralist, household water insecurity scale

Introduction

Pastoralist water insecurity

Increasing climate variability in arid and semi-arid lands (ASALs) of northern Kenya has led to variability in rainfall, more frequent droughts (Njoka et al., 2016; Kirkbride and Grahn, 2008), pressure on grazing areas, and water resource depletion (Kirkbride and Grahn, 2008; Ouma et al., 2012). This has contributed to changing demographic patterns as evidenced by increasing sedentarization and

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rapid growth of small urban centres in pastoralist areas due to loss of livestock-based livelihoods and increasing insecurity because of conflict over resources (Sun, 2009; Galvin, 2009; Reid et al., 2014; Njoka et al., 2016). Water insecurity is a feature of life for both sedentarized and nomadic pastoral societies with women and children bearing the biggest burden for fetching water. Among Samburu pastoralists of Wamba and Weso locations in northern Kenya, women are responsible for both domestic water supply and watering of livestock, which requires them to travel long distances and spend a considerable part of their day fetching water (Boruru et al., 2011). A severe drought affected many arid and semi-arid parts of Kenya in 2016/17, including Samburu County. Routine monitoring by the government of Kenya's National Drought Management Authority (NDMA) (Government of Kenya 2017) showed that at the height of this drought, women in some areas were travelling up to 15 kilometres a day to find water, leaving them with little or no time for other chores including child care and feeding the family (see Figure 1).

Figure 1 Samburu women collecting water from a rapidly drying pan

Findings from an earlier study in 2016 (CHC, 2018; Balfour and Mutuku, 2018; Balfour, 2017) suggest implications on women's stress, household food security and child nutrition as a result of water insecurity. The study recommends certain avenues for enhancing water security for households in pastoralist communities by empowering women, providing access to different forms of capital, improving household water storage, increasing involvement of women in management of water resources and reducing distances to water sources. However, the study did not examine how factors such as social capital, livelihood diversity, and water governance influence water insecurity in pastoralist households. There is evidence of how water security has an impact on the health and welfare of households (Geere and Hunter, 2019; Evans et al., 2013), but evidence of the dimensions that influence household water insecurity and how, is scarce in literature. A diagnostic report on the water sector in Kitui County Kenya (Oxford REACH, 2015) identifies three main drivers of persistent water insecurity problems: lack of coordination in development activities, climate shocks and droughts, and persistent poverty and inequality. An earlier study (Mati et al., 2005) concluded that a combination of factors constrain access to water by pastoralists in Kenya, including under-investment in infrastructure, operation and maintenance costs, environmental degradation, high poverty rates, and weak governance. Other studies have highlighted how access to water resources, particularly in times of insecurity, involves social networks (Pearson et al., 2015). We report on the extent of water insecurity in pastoralist communities in Samburu and how different socio-economic and livelihood factors influence households' experience of insecurity.

Study objectives

The overall objective of the research project was to examine 'gendered dimensions of water security risk in the context of climate variability, sedentarization, and institutional pluralism for pastoralist households in northern Kenya'. The research explored multiple dimensions of water insecurity in both urban and rural communities in Samburu, including gender-related water insecurity, the role of livelihood diversification, access to social capital, and differences between governance structures in urban and rural areas. The study also provided an opportunity to test a scale for measuring household water insecurity. This paper will focus on findings relating to the following research question:

> **What are the roles of livelihood diversification and different forms of capital as determinants of household resilience to water insecurity?**

Study area

The study was conducted in rural and semi-urbanized communities within Samburu County in a semi-arid area of northern Kenya (see Figure 2 for map). Many authors have documented the adaptability of pastoralist communities such as these and the ways in which livelihood diversification and access to social capital (e.g. networks,

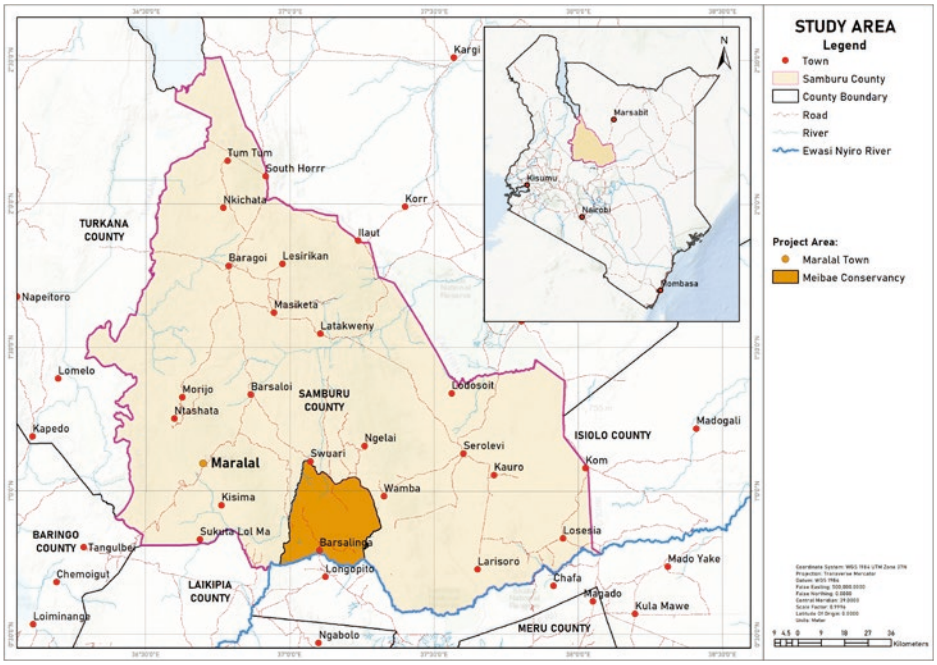

Figure 2 Map of study area

family/friendship ties, tribal affiliations) increase households' resilience to drought (Abebe et al., 2016). This study focused on a population comprising rural pastoralist communities located within Meibae community conservancy (a community-based organization created to support the management of community-owned land for the benefit of household livelihoods and for the conservation and protection of natural resources), which formed part of the study area under the 2016 research (CHC, 2018). This area has experienced significant land degradation as a result of population growth, frequent droughts, and climate change, and households survive with marginal livelihoods and high vulnerability to drought risk. Levels of literacy are low and women are left on their own with small children and small animals during the dry season months as men and boys move away with livestock herds. Peri-urban communities were identified from homogeneous sedentarized pastoralist communities located on the margins of the study town of Maralal, the county headquarters, and a key town serving communities in Samburu County. Repeated droughts and unsustainable pastoralist livelihoods have forced households to diversify their livelihoods and have created a large number of 'pastoralist drop-outs'. Families who have lost too many livestock have been forced to settle near urban centres to access services as well as casual work or trade opportunities. The study drew respondents from these pastoralists drop-out groups around Maralal.

During the study period Samburu County experienced extreme weather variations, with a normal dry season in early 2018 when the first round of data was collected followed by exceptionally high rainfall in the March–April–May rainy season extending into June and July 2018.

Methodology

Data collection

The study applied a mixed-methods research methodology incorporating both quantitative and qualitative research approaches. Innovative tools, including personal diaries and seasonal mapping were used to provide additional context to the study. In addition, water quality testing was conducted at the household level for domestic water supply.

A multistage random sampling strategy was used to identify a statistically representative sample for the household survey. Purposive sampling techniques were used to identify key informants and participants for the focus group discussions, and a sample size of 26 individuals and 10 groups was achieved. Sample sites for water quality testing were also purposively selected to cover the range of all water sources. A random sample of 370 urban households ('sedentarized' households) in Maralal town and 331 rural households in Wamba Ward in Samburu East was used for the study. A smaller sample was selected for survey in the wet season (101 households in Maralal and 103 in Wamba). This was justified as adequate for a seasonal comparison while reducing the time and expense of repeating the questionnaire with all respondents.

Quantitative data collection was done through a household computer-assisted personal interviewing (CAPI) survey developed on the SurveyCTO platform. The survey was carried out by Samburu-speaking field enumerators equipped with tablets. Qualitative data collection involved semi-structured interviews with key informants, focus group discussions, and participatory mapping techniques. Interviews were also audio-recorded for later transcription. The research team also trialled the use of personal diaries as a technique for examining the extent of water-related tasks at a household level. Data was collected during both dry (January and February) and wet (March to June) seasons. However, an unusually extensive wet season, extending into July and delivering more than 200 per cent of normal rainfall in the study area (NDMA, 2018) meant that some of the seasonal data collection (e.g. dry season water quality analysis) had to be cancelled because it would not have been valid for comparison.

Data analysis

Mixed methods analysis. Qualitative data from the 2016 study findings was used during this study's exploratory phase to help refine variables for design of the quantitative survey. In addition, a qualitative formative study was conducted in Maralal to inform the design of the study tools. After the quantitative data analysis, the qualitative findings were used to provide additional explanatory information to the quantitative analysis.

Quantitative data analysis. Raw data was downloaded from SurveyCTO, coded, and entered into an MS Excel 2016 spreadsheet and imported into RVersion 1.2.1335 for analysis. A total of 905 households were surveyed in the wet (n = 204) and dry (n = 701) seasons using a 26-item questionnaire to understand household water

insecurity. The data for both seasons was combined and screened for multivariate assumptions and outliers, which resulted in some data sets being removed from further analyses. A total of 695 complete cases were therefore used for the analysis.

Data was analysed for simple descriptive statistics and regression; bivariate and multivariate methods were used to test for relationships between variables of interest. Factor analysis methods were used to develop a composite variable for household water security. This resulted in a household water insecurity scale (HWIS) based on 14 instead of the original 26 questions. We used R (R Core Team, 2012) and lme4 (Bates et al., 2012) to perform a linear mixed-effects analysis of the relationship between the HWIS and individual parameters measuring social, knowledge, and economic capital. As fixed effects, we entered the respective capital parameter, survey season, and survey area (with interaction terms) into the model. As random effects, we had intercepts for respondents. Visual inspection of residual plots was analysed for any obvious deviations from homoscedasticity or normality. P-values were obtained by likelihood ratio tests of the full model with the effect in question against the model without the effect in question. If statistically significant, post-hoc tests were conducted to contrast the statistical significance of the parameter to understand the change in mean household water insecurity by season and area.

Qualitative data analysis. Qualitative interviews were audio-recorded during data collection, transcribed and entered into MS Excel 2016, and imported into NVIVO 12 for coding and subsequent analysis. Data analysis was done through a designed analytical coding framework using NVIVO 12. All the question clusters in the instruments of data collection were themed to match corresponding areas of inquiry in the thematic areas as well as the study protocol.

Water quality tests were carried out on samples obtained from households for both microbial and physicochemical parameters using a portable water laboratory, and basic analysis of chemical and biological composition were carried out.

Testing a water security measurement scale

One of the challenges for the study was to have a clear definition of water security against which to measure other variables. Following the literature review, the researchers decided to develop and test a scale to measure household water security using a household water insecurity scale (HWIS). Items for the scale have been adapted from recent work carried out in several countries, including Kenya (Boateng et al., 2018; Young et al., 2019; Jepson et al., 2017). The HWIS measures water insecurity on a scale of 1 to 4 (see Table 1 for the scale categories).

Table 1 HWIS categories

Score	*Water security*
1.00–1.99	Relative water security – limited experience of water insecurity
2.00–2.99	Moderate water insecurity – experiencing some form of water insecurity
3.00–4.00	High water insecurity – frequent experiences of water insecurity

A set of 26 questions on water insecurity was adopted for this study, with formative qualitative work carried out in 2016 (for rural communities in Wamba) and early 2018 (for urban communities in Maralal) informing the scale questions. The resulting HWIS was administered as part of the household survey with the responses ranked on a four-item Likert scale. The validity of the scale was checked by testing its relationship with other variables obtained from the survey (and that have been shown in theory to affect household water security) such as time taken to fetch water, quantity of household water, and type of water source. The scale was also regressed against other variables of interest such as a household's sedentarization status, household livelihood activity, and household size, among others.

Ethical review and quality assurance

The study was submitted for approval from NACOSTI (National Commission for Science Technology and Innovation) and a research clearance certificate was received (Permit number 16844) in December 2017. Ethical review and quality assurance throughout the study period was provided by the Centre for Humanitarian Change academic and technical steering group. Members of the group include academics from Kenyatta University and research experts. The research protocol was submitted to the steering group for review before data collection started and revised according to comments received from the group members. Ethical protocol was followed in the data collection and all individuals and groups taking part in the study were asked to consent to participation before any interviews took place. No payment was made to individuals or groups taking part in the study and all data was anonymized.

The steering group also reviewed and approved the data analysis protocol and provided a comprehensive review of all research outputs (reports, journal articles and research briefs).

Results and discussion

The scale of water insecurity

The study aimed to answer the question '**What are the roles of livelihood diversification and different forms of capital as determinants of household resilience to water insecurity?**' As a starting point, the data was analysed to determine the extent of household water insecurity in the study area and examine how it varies across seasons. This analysis also explored whether vulnerable peri-urban households ('sedentarized' households) are relatively more secure than households in rural areas. Table 2 presents the average HWIS scores for both study areas and both seasons. Figure 3 presents the distribution of households across the three categories of water insecurity.

As expected, differences are considerable in how rural, pastoralist households and peri-urban, settled households experience water insecurity. The average dry season score for Wamba rural-pastoralist households is 2.78 (at the high end of the 'moderately insecure' category), and for Maralal peri-urban households is 2.36 (see Table 1).

Table 2 Average HWIS score by area and season

Area	*Season*	*Mean HHWI score*	*Standard Deviation*
Maralal (peri-urban)	Dry	2.36	0.67
Maralal (peri-urban)	Wet	1.61	0.54
Wamba (rural)	Dry	2.78	0.56
Wamba (rural)	Wet	2.31	0.55

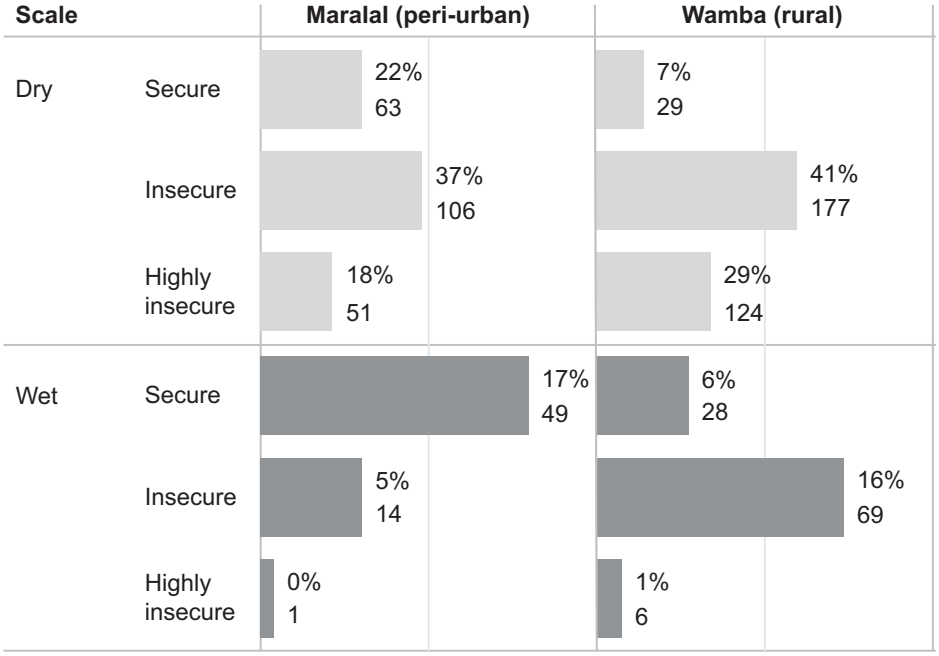

Figure 3 Household water insecurity in rural and peri-urban areas by season

This is still a high score for the more settled households around Maralal that we might have expected to have lower insecurity due to their relatively higher access to a permanent water supply. This reinforces the evidence that 'pastoralist drop-out' households continue to be significantly vulnerable to seasonal variation despite their relatively higher access to services and livelihood options (Catley and Akilu, 2013).

The distribution of water insecurity in the dry season indicates a high level of stress for women in the rural areas. Ninety-one per cent of rural households are categorized as insecure or highly insecure on the water insecurity scale in the dry season. This drops to 73 per cent in the wet season but this is still surprisingly high considering the availability of surface water closer to the homesteads in this season. This suggests that the pattern of water insecurity may change in the wet season but not the overall extent of water insecurity. For example, households may face more stress over not having *enough* water in the dry season, which decreases in the

wet season when access to water is easier. The persistent water insecurity in the wet season also suggests that opportunities for water harvesting are not being effectively exploited (Odhiambo, 2013).

Data from qualitative interviews supports these findings and goes further to explain the main sources of water insecurity stress for women. Responses from personal diaries indicate that distance to water and encounters with wild animals are the biggest challenges for women in rural areas whereas women in peri-urban areas faced challenges with paying for water and long queues at water points.

Time taken to fetch water

The time taken to fetch water (go to the source, collect water, and return) emerged as a key determinant of water insecurity. This was true across the HWIS survey questions, discussion groups, and key informant interviews. The time taken to fetch water is more than 2 hours for more than 60 per cent of households in rural areas in the dry season and surprisingly still more than 37 per cent in the wet season (Figure 4). This was confirmed by the results of the personal diary study where women in the rural areas reported an average time of 1.5 hours per day to collect water in the wet season. Diaries also confirm that the majority of households make two trips per day, typically fetching 20 litres of water per trip.

In the dry season, the amount of time taken to fetch water increased the household water insecurity score. The relationship is particularly striking for households with

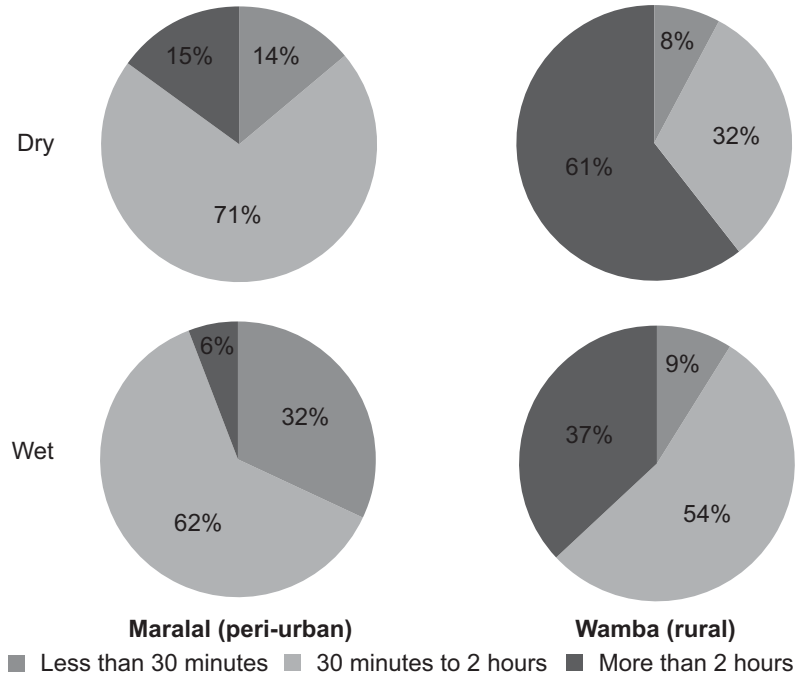

Figure 4 Percentage of time taken by households to fetch water by area and season

long return journeys to fetch water (greater than 2 hours), as shown in Figure 5, which demonstrates that time taken to fetch water is a key determinant of household water insecurity.

In the wet season, for both areas, the differences in the household water security scores were not found to be statistically significant between the various times taken to fetch water.

Twenty per cent of women overall reported that time spent fetching water had prevented them from caring for their children more than 10 times in the last four weeks in the dry season (Figure 6). This is an important finding for the analysis into causes of persistent, chronic malnutrition in pastoralist households.

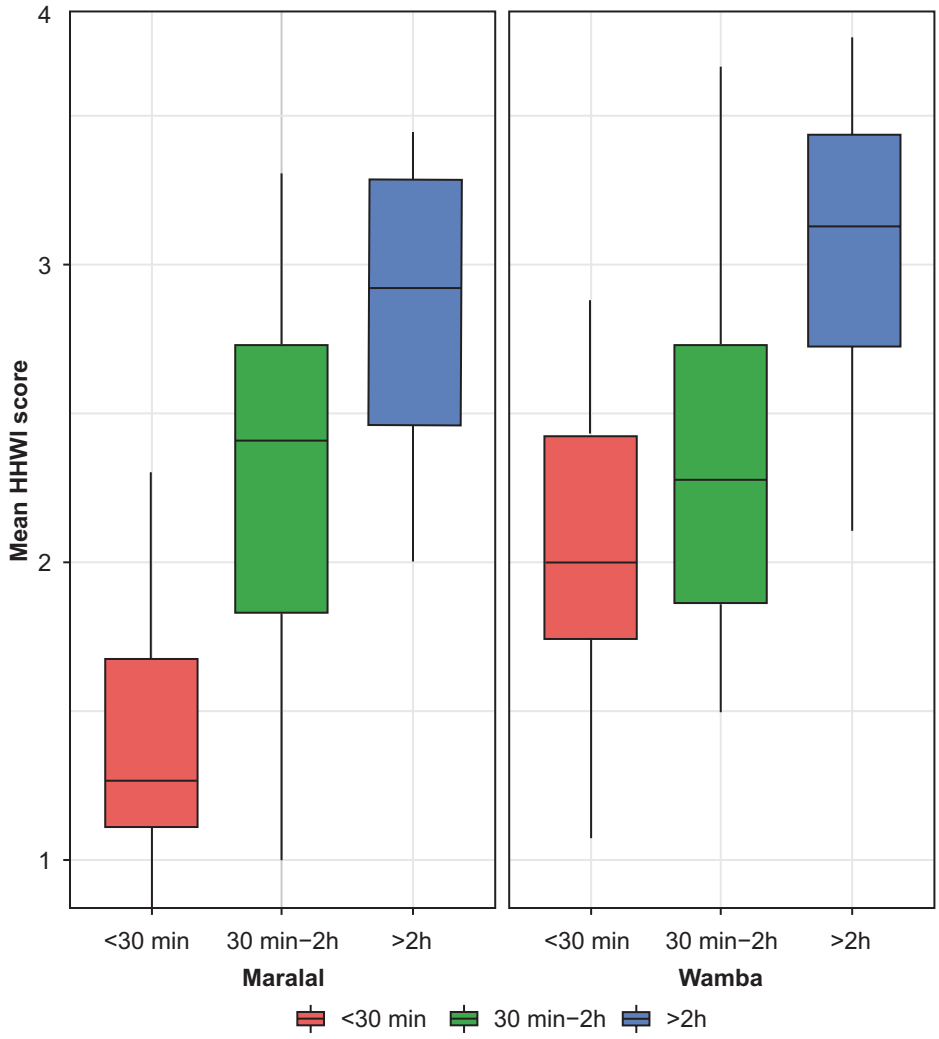

Figure 5 Relationship between time taken to fetch water and water insecurity

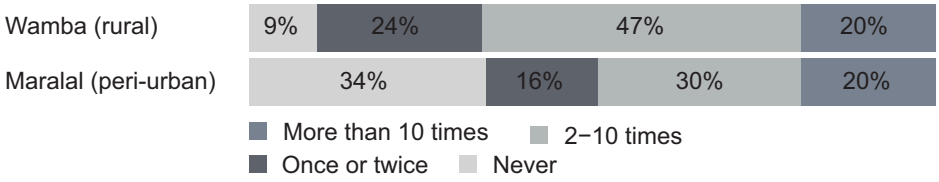

Figure 6 Percentage of women reporting reduction in childcare due to water collection

Table 3 Mean quantity of water used per day

Season	*Area*	*Mean water use per person*	*Standard deviation*
Dry	Maralal	12.40	9.99
Dry	Wamba	8.25	8.12
Wet	Maralal	10.87	5.85
Wet	Wamba	7.08	5.70

Quantity of water used

Multiple studies have shown that quantity of water used in the household is directly related to the distance from the water source or time taken to collect water (Pickering and Davis, 2012). The study gathered information on the quantity of water used by households in different seasons (see Table 3). It is notable that the mean water use per person is below humanitarian standards (Sphere Association, 2018) even in the wet season, which suggests that water-related health impacts are likely in many of the study households. These figures also assume that all water collected for the household is used for domestic purposes, whereas qualitative results indicate that many households also use this water for watering livestock at the homestead.

Dimensions of water insecurity

The role of livelihood diversity. The study examined the extent to which diversification of household livelihoods into non-pastoral activities increase a household's capacity to cope under conditions of water insecurity. Livelihoods in the peri-urban households near Maralal are predictably more diverse than livelihoods in the rural communities. In fact, many of the 'pastoralist drop-out' households reported that they had been forced to diversify out of pastoralism due to water insecurity or scarcity. The analysis of primary livelihood for the household against water insecurity showed no statistically significant difference in HWIS score with more diversified livelihoods. The analysis clearly shows higher water insecurity for rural, pastoralist households than settled households around Maralal that rely more on cash-based income (Figure 7). However, this seems to be related to distance to water, smaller livestock numbers, and financial capital rather than the diversity of livelihood in itself. Figure 7 shows the analysis of livelihood activities for households in different

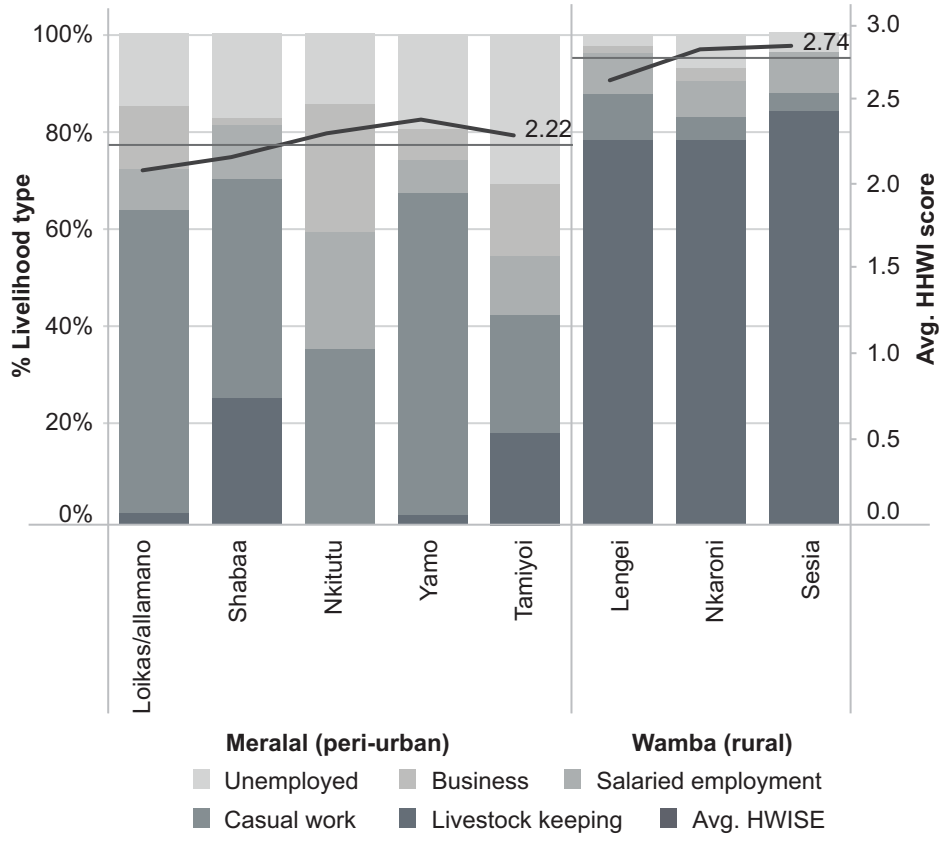

Figure 7 Relationship between livelihood diversity and water insecurity

sub-locations or villages within the study area (five peri-urban and three rural) with the average HWIS score for these areas.

> 'Even in this village where we know people well, it is not everyone who has kept goats. And even the ones who have kept them have not kept many. Just three or four and this is because of water shortage. You see even goats are just like humans: they need grass, and they need water. So that's why not everyone has kept livestock.' Female Discussant, Maralal

Interviews during the earlier study suggested that family ownership of large herds of livestock was a liability in terms of water security. This study explored this empirically and asked whether households with large numbers of livestock experience more water insecurity. Livestock ownership was measured using the standard, aggregated measure of tropical livestock units (TLU) where 1 TLU is equivalent to 2 camels, 3 local cattle, 1 grade cattle, 5 donkeys, or 15 sheep/goats. The average livestock ownership was 11 TLU for Wamba households and 2 for Maralal households. The analysis showed a positive relationship between livestock

ownership and water insecurity and we can conclude that the household water insecurity experiences (HWISE) score and TLU are significantly correlated (correlation coefficient of 0.30 and p-value ≤ 0.001). This corresponds with anecdotal evidence from focus group discussions with women who repeatedly stated that women from households with larger numbers of livestock have more water-related stress. The earlier study indicates that the responsibility for watering small stock (including young calves) falls on the women, adding to their domestic water burden (CHC, 2018).

> 'Nomadic pastoralists are affected the most because of the distances they have to move in order to access water. Those without livestock are affected the least because they can settle and invest in water security.' Key informant, Maralal

Sedentarization. As expected, the degree of settlement is considerably different between rural (30 per cent fully settled) and peri-urban (82 per cent fully settled) areas. The study explored differential water insecurity with patterns of sedentarization (degree of settlement). The cross tabulation of HWIS score with settlement status is shown in Figure 8.

The HWIS score was similar across settled, partially settled, and nomadic households, which suggests no significant increase in household water insecurity with increasing mobility. However, in the wet season fully settled households in Maralal appear to be more secure than partially settled households. The mean household water insecurity score increased by 0.58 points for the partially settled population (mean = 2.07, SD = 0.15) compared with the fully settled (mean = 1.49, 0.08). This inconclusive result may be partially due to the difficulties in differentiating between 'fully settled' and 'partially settled' households.

The effect of different forms of capital on household water insecurity. Evidence from the earlier study with women in Laikipia and Samburu Counties (CHC, 2018) strongly suggested that households with more capital (knowledge, financial, and social) coped better with water stress and were less likely to be water insecure. This study therefore attempted to examine the relationship between water insecurity and these three different types of capital.

Responses to eight relevant questions were combined into a **social capital** score and a regression analysis was carried out to explore the relationship with water insecurity. This method of measuring social capital is experimental and requires more research to validate it as a reliable model, but for the purposes of this study it was considered good enough to indicate a positive or negative relationship with water insecurity. Household water insecurity appears to have a significant correlation with social capital (higher social capital corresponds to lower water insecurity). Social capital positively affected the HWIS score ($\chi^2(4) = 17.14$, $p = 0.002$), with a one-degree increase in the composite score (less social capital) leading to a 0.08 ± (0.05) increase in the HWIS score (more insecurity). This relationship holds across the seasons and for both rural and peri-urban areas.

> 'Members of the association of the church (*jumuia*) help provide water to less fortunate/disabled members of the community.' Female discussant, Maralal

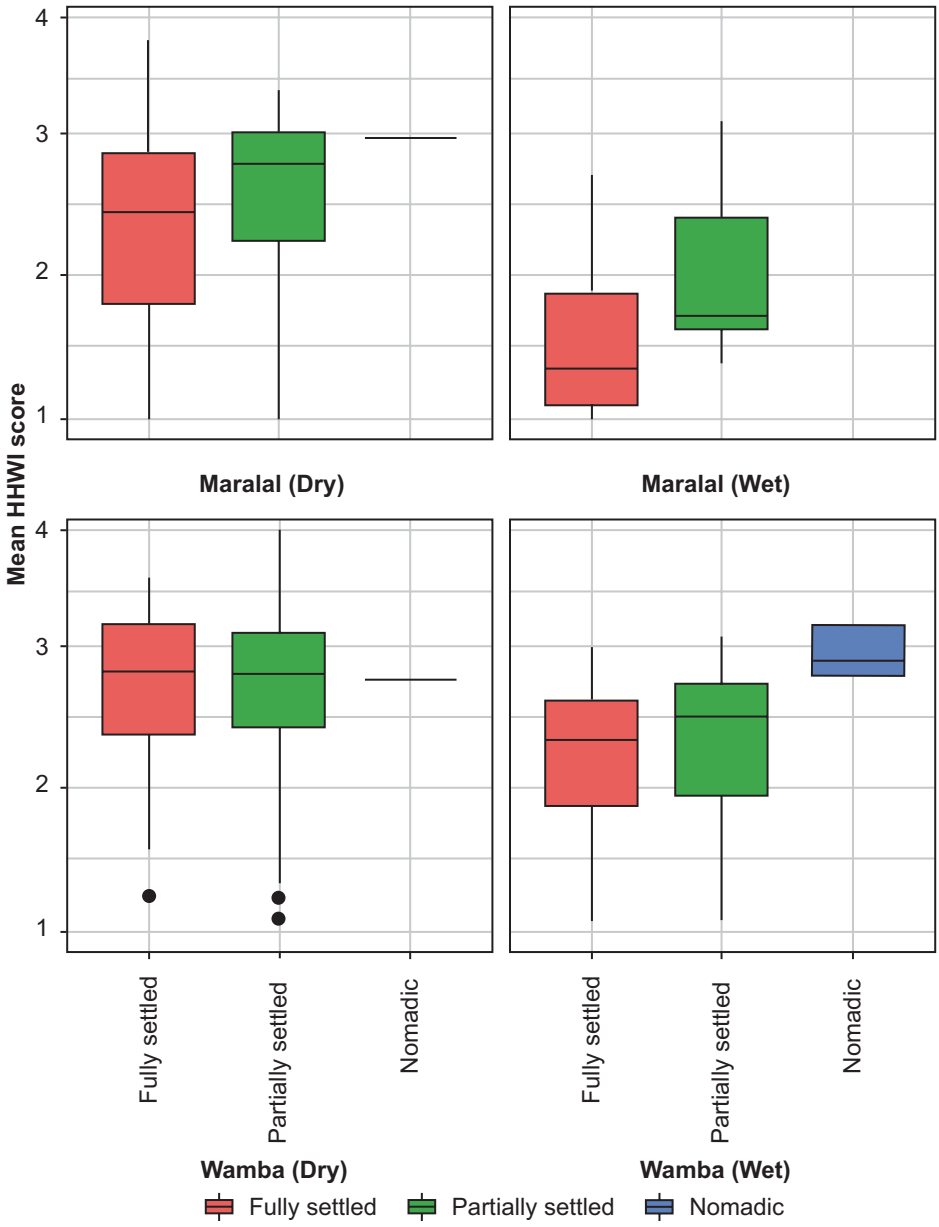

Figure 8 Household water insecurity by settlement status, area, and season

The study also examines water insecurity related to group membership as a proxy for social capital. Many women are members of groups (savings and loans, income generating, and social welfare groups) and anecdotal evidence suggests that this is where some women draw social capital from.

> 'The group helps women access water storage tanks through table banking.' KII Respondent

Membership of groups does appear to affect HWIS score. This doesn't change across seasons or areas. The group membership affected the HWIS score ($\chi^2(7)$ = 23.67, p = 0.001), decreasing it by –0.28± (0.08) between those belonging to no groups and those belonging to one to three groups, and by –0.42± (0.34) between those belonging to no groups and those belonging to more than three groups.

The study tools were not set up to explore wealth in detail so to analyse a relationship between HWIS score and **financial capital**, we used self-reported cash income as a proxy. We can conclude that the HWIS score and annual cash income are negatively correlated with a correlation coefficient of –0.10 and p-value of 0. 009. This would be expected from the responses of women during interviews who repeatedly stated that households with the capacity to pay for water or pay people to collect water were better off than others. This effect was seen in both Wamba and Maralal, even though we would expect this to be more significant in Maralal where cash-based livelihoods and payment for water are more common.

> 'Those with money cope because they can buy water. If you don't have money and you are near the water source then it is useless.' Female discussant, Wamba

The **knowledge capital** was explored through the proxy of the education of the senior woman in the household. The first thing that is striking from these results is the high proportion of women in the study areas who are illiterate or have no formal education (93 per cent in rural households). The HWIS score does appear to decrease with increasing levels of education (see Table 4) but a statistically significant difference was only found between respondents who are illiterate and respondents with no formal education but who are literate in Maralal for the dry season (see Figure 9). This suggests that literacy is the key determinant rather than formal education. There was no significant relationship between the education of the head of household and water insecurity.

Conclusions

In Samburu, the high levels of water insecurity in both peri-urban and rural households appear to be driven by **time** taken to fetch water and inadequate **quantity** of water, although **cost** is also a factor for sedentarized households in peri-urban areas. The cost of water is not a significant factor in this study because very few households in the study area pay for water. It is likely that in other areas, different factors such as water quality or cost of water would have more influence on the score.

Table 4 Levels of education for female respondents (%)

	Illiterate	*No formal education – literate*	*Nursery*	*Primary*	*Secondary*	*College*	*University*
Maralal	54	7	0	30	6	1	1
Wamba	90	3	0	5	0	0	0

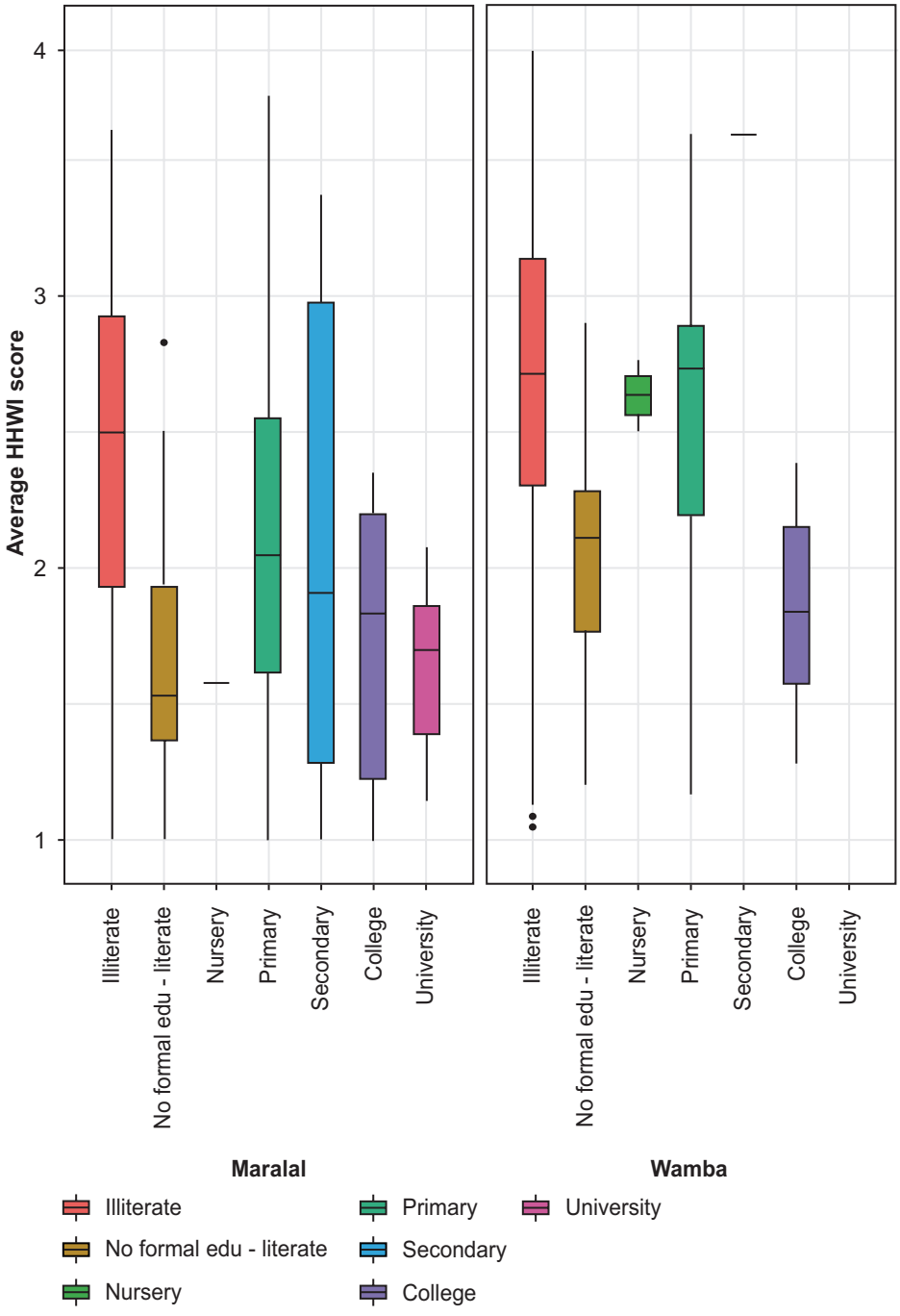

Figure 9 Relationship between women's education and water insecurity

Households with high social and financial capital appear to have lower water insecurity in both areas and this seems to be related to the ability to get credit to buy or borrow water and also to access transport to fetch water from distant sources. During periods of severe water insecurity and when individual women are indisposed, it is other women that come to their aid by helping with the collection of water and even 'loaning' water. A woman's membership in women's groups and her ability to mobilise her network in such groups to support her during her time of need is also where social capital plays a role in easing the burden of water. Ownership of large livestock herds (more than 10 TLU), while providing financial capital for the household, increases water insecurity and places an additional burden on the women who are responsible for water provision.

The household water insecurity scale appears to reliably measure water insecurity in pastoralist households, but the number of questions (14) make it cumbersome for quick, regular surveys. Ideally the scale should be adapted for different uses (surveillance, early warning, situation analysis, etc) with statistically relevant, key questions selected to represent the full experience scale in different contexts. The HWIS score has a number of advantages as an indicator of water stress in households in drought-prone areas because it reflects the experience of the women, who have primary responsibility for water provision, and clearly changes across seasons and with covariate as well as idiosyncratic shocks.

Recommendations

How can this knowledge be used to more effectively reduce household water insecurity?

- Investment should focus on **reducing distances** to reliable water supplies and hence time taken to collect water for pastoralist households.
- Increased water security can have an **impact on care practices** and hence on nutrition and health of children, as well as opportunities for income generation in sedentarized households. Efforts to reduce persistent chronic undernutrition in ASAL areas are likely to be unsuccessful without addressing water insecurity in these households. This goes beyond interventions to improve hygiene and water quality and should focus on reducing women's water-related work burden.
- **Livelihood diversification** does not reduce water insecurity on its own. However, households with less livestock and households settled near urban centres are likely to be more water secure. Interventions to **reduce livestock herd size** and supplement income through **seasonal safety nets** and insurance cover are likely to improve water security.
- Providing women with **social capital** (e.g. through opportunities to join a group), access to increased **financial capital** (e.g. through savings and loans schemes), and **knowledge capital** (particularly literacy) are likely to have a significant impact on reducing their water insecurity.

- Findings from this study suggest certain avenues for enhancing water security for households in pastoralist communities by **empowering women** – through access to different forms of capital that seem to enhance a household's water security, improved household water storage, increased involvement of women in management of water resources, and reduced distances to water sources.
- The fact that women are responsible for collecting domestic and livestock water, water storage, and managing water supplies for the household implies that **initiatives to improve household water security should be addressed to women** (individually or as a group) rather than through the community or through male-dominated water committees.
- Peri-urban households still have high water insecurity, so more attention needs to be paid to **increasing access to urban water utilities** (including through subsidized supply) for this group.

Acknowledgements

This study was funded through a research grant provided by the REACH programme, which is itself funded by UK Aid from the UK Department for International Development (DFID) for the benefit of developing countries (Aries Code 201880). However, the views expressed and information contained in it are not necessarily those of or endorsed by DFID, which can accept no responsibility for such views or information or for any reliance placed on them.

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