Impact of Water Scarcity on Pastoral Systems: Experience from the 1995–97 Drought and the 1997–98 El Niño Rains in the Greater Horn of Africa

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Abstract

A study was carried out by the ASARECA Animal Agriculture Research Network (A-AARNET) to identify the traditional coping mechanisms to crisis situations in pastoral areas of the Greater Horn of Africa through a survey on the effects and responses of pastoralists and livestock during the 1995–97 drought and the 1997–98 El Niño rains. Considering that water is one of the major factors affecting determinants.

Introduction

A survey study of 664 households in southern Ethiopia, northern and southern Kenya, northern, northwestern (NW) and central Tanzania and central/southwestern (C/SW) Uganda on coping mechanisms of pastoralists and agro-pastoralists, was conducted during the 1995–97 drought and the 1997–98 El Niño rains (floods). The purpose of the study was to obtain baseline information about what pastoralists did to sustain themselves and their livestock during the crisis periods of drought and flood. The survey focused mainly on the assessment of the effects of the crises on livestock dynamics and household welfare, the coping mechanisms adopted by the pastoralists to mitigate the effects of the crises and their efficacy.

Considering that during crisis periods, trekking for water sources is one important facet of the pastoral strategy affecting the capacity of the pastoralists to produce from the rangeland (Dyson-Hudson 1991; Niamir-Fuller 1998), the impact of the drought and El Niño rains on water sources for human and livestock was one of the areas investigated.

Methodology and Target Zones

Based on an analysis of the Cold Cloud Duration (CCD) and on the Normalized Difference Vegetation Index (NDVI), the investigation period was divided into the following five phases: a) pre-drought (January 1 to May 10, 1995), b) peak drought (May 11, 1995 to March 31, 1997), c) minor rains (April 1 to October 31, 1997), d) El Niño rains (November 1, 1997 to May 31, 1998), and e) La Niña dry period (June 1 to December 31, 1998).

A survey questionnaire was used that addressed the issue of types of water sources and distances trekked fetching for water inter alia during the climatic phases.

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The area demarcated as the S. Ethiopia zone is semiarid to arid. The main pastoral groups are the Borana people who are pure pastoralists. Somali clans are also found in this zone. The pastoralists in this zone are greatly dependent on livestock for food security.

The zone surveyed in northern Kenya is semiarid to arid. The major pastoral groups are Samburu, Turkana, Borana and Somali who are pure pastoralists or practice transhumance, i.e., the practice of moving between seasonal bases, while carrying out some cultivation at the wet season base (Niamir-Fuller 1998). The two major pastoral groups in the southern Kenya zone are the Maasai who are pure pastoralists, and the Kamba who are agro-pastoralists.

The Maasai, Barbaig (pure pastoralists), Iraqw and Pare (agro-pastoralists) peoples occupy the northern Tanzania zone. The Maasai, who are pure pastoralists, and the Gogo, Irangi and Nyiramba agro-pastoralists are found in the central Tanzania zone. The northwestern Tanzania zone is dominated by the Sukuma and Nyamwezi, who are agro-pastoralists.

The two zones in Uganda are combined as they have many similarities. The pastoral groups include the Bahima in southwestern Uganda and the Banyankole and Baruli in central Uganda. These groups are constituted by agro-pastoralists, who raise crops, and semi-transhumant pastoralists who divide livestock into core and satellite herds.

Major Results and Discussion

Impact of the Drought and El Niño Rains on Water Sources for Livestock

Figure 1. Livestock at a shallow river.

Trekking for water of consumable quality for livestock is one of the key determinants of pastoral movement and migration (see figure 1, 156). A number of different livestock water sources were used across the zones: boreholes (established by the use of drilling equipment), hand-dug wells, dug streambeds (excavated dry or sluggish streambeds to encourage seepage of water), ponds, concrete tanks on the ground, concrete tanks above the ground and reservoirs/dams.

In the arid and semiarid areas, surface water is scarce and most of these water sources are recharged by rainfall (see figure 2, 158). Other water sources are dependent on underground reservoirs; their supply is unknown and is often affected by insufficient recharge. Therefore, water sources reflect the climatic situation, and thus the number and proximity of the water sources will change with drought conditions. The quality of water is also affected by climatic factors. Extended dry periods result in the drying up of water sources making the dwindling water supply unfit for livestock and human consumption. Flooding causes excessive runoff from adjacent areas, resulting in disease agents and other pollutants washing into water sources.

Annex figures 1–9 present the water sources used during the pre-drought, peak drought and El Niño phases in the different zones. Across zones, with the exception of south Ethiopia and north Tanzania, in the pre-drought phase, hand-dug wells were the most commonly used water sources. In south Ethiopia, ponds were the most important water sources while reservoirs and dams were the major water sources in north Tanzania. During the drought phase, hand-dug wells continued to be the most common water source across zones, with the exception of north Tanzania and C/SW Uganda where reservoirs and dams were more important. Pastoralists resorted to digging streambeds using boreholes, measures that indicated scarcity of water. The practice of excavating streambeds is resorted to when streams dry out. At some locations, boreholes carry a mandatory fee, and are thus avoided until other sources are exhausted.

During the El Niño phase, across zones, with the exception of C/SW Uganda, ponds were the dominantly used water sources. In C/SW Uganda, the most commonly used water source was dug wells.

The mean number of water sources for livestock used by pastoral households in the zones are provided in table 1. Two categories were identified in relation to environmental stress. They include those that were normally accessible to the households, which were designated as the primary water sources, and emergency water sources, which were those that the pastoralists had to seek out or were made accessible to them.

At some locations, because primary sources had dried out pastoralists had to utilize the emergency sources. At other locations, emergency sources were used to reduce the burden on the primary sources.

There were significantly less ($P<.001$) water sources accessible to pastoralists during the drought compared to primary sources used during the pre-drought phase in all zones except north and south Kenya, and north Tanzania. Due to additional emergency water sources, north Kenya had significantly ($P<.05$) more drought water sources than during the pre-drought phase. The difference was not significant for south Kenya and north Tanzania.

There was an increase in the number of water sources available for livestock with the onset of minor rains in all zones except in north Tanzania. A further increase was recorded during the El Niño phase, except in the pure pastoral areas of south Kenya and the agro-pastoral areas of north Tanzania. In all zones, emergency water sources were used during the El Niño phase; this could reflect contamination of primary sources.

Table 1. Mean number of water sources for livestock during each climatic phase in the zones surveyed.

Location	Pre-Drought 1995	Drought 1996	Minor Rains 1996–97	El Niño Rains 1997–98	La Niña Dry 1998
Southern Ethiopia PP	4	2 (1)[a]	5	6 (2)	2
Northern Kenya PP	3	3 (6)	4	5 (2)	2
Southern Kenya					
Agro-pastoral	1	1 (1)	2	3 (1)	1
Pure pastoral	2	1 (5)	2	2 (1)	2
Northern Tanzania					
Agro-pastoral	2	2 (2)	2	2 (1)	2
Pure pastoral	2	2 (2)	2	4 (2)	2
Central Tanzania AP	2	1 (1)	5	6 (2)	2
NW Tanzania AP	2	1 (1)	4	5 (2)	2
C/SW Uganda AP	2	1 (1)	3	6 (1)	2
Means: Agro-pastoral	2	1 (1)	3	4 (1)	2
Pure pastoral	3	2 (4)	3	4 (2)	2

[a]Values in parentheses are emergency sources.
PP = Pure pastoral; AP = Agro-pastoral.

Figure 2. A dry riverbed.

During the La Niña dry phase, across zones, the number of water sources used by pastoral households were reduced to pre-drought levels with the exception of south Ethiopia and north Kenya, where fewer water sources were available. This latter observation could reflect the prediction, through NDVI analysis, of another drought for these two zones. In general, the agro and pure pastoral zones had access to a similar number of water sources, with slightly more availability for pure pastoral groups during the pre-drought and drought phases due to emergency sources. There were also more emergency livestock water sources in the pure pastoral zones during the drought phase.

Distances Trekked to Water Sources

The number of water sources for livestock, however, belies true accessibility, i.e., accessibility of a water source must reflect both the presence of the resource and distance to the resource. The quality of a water source was also a key determinant of trekking distance. Poor quality/ contaminated sources that had water unacceptable to livestock were abandoned in preference to better-quality sources located further away. Mean distances trekked by livestock to water sources during the period under investigation are indicated in table 2 and figures 3 and 4. Trekking long distances to watering points reduced effective grazing time available to livestock, and in some zones, the frequency of watering of livestock was also reduced to once every 3 to 4 days. Coppock (1994) observed that restricted watering is a strategy that allows livestock to cover greater radii in search of grazing sites, reduces herding and watering labor and increases the efficiency of water use.

Table 2. Mean distances (km) trekked by livestock to watering points by zone/pastoral category.

Location	Pre-Drought	Drought	Minor Rains	El Niño Rains	La Niña Dry
Southern Ethiopia PP	22.4	77.3 (81.3)[a]	2.4	1.3 (3.7)	3.6
Northern Kenya PP	4.7	8.5 (19.2)	2.3	1.3 (3.3)	3.6
Southern Kenya					
Agro-pastoral	3.9	4.2 (3.5)	2.1	1.6 (1.6)	3.0
Pure pastoral	3.4	9.3 (12.9)	3.1	1.5 (1.3)	2.2
Northern Tanzania					
Agro-pastoral	4.5	7.1 (7.1)	3.1	2.0 (1.5)	2.7
Pure pastoral	8.1	9.2 (5.4)	2.4	1.3 (1.1)	1.9
Central Tanzania AP	2.9	3.1 (4.1)	2.4	1.3 (3.7)	3.6
NW Tanzania AP	2.2	3.1 (2.9)	2.3	1.3 (3.3)	3.6
C/SW Uganda AP	1.4	4.7 (5.8)	2.3	1.2 (3.6)	3.9
Means: Agro-pastoral	3	4.4 (4.7)	2	1.5 (2.7)	3.4
Pure pastoral	9.7	26.1 (29.7)	3	1.6 (2.4)	2.8
Overall	5.9	14.05 (15.8)	2.5	1.4 (2.6)	3.1

[a]Values in parenthesis are distances to emergency sources.
PP = Pure pastoral; AP = Agro-pastoral.

The overall data indicate that during the pre-drought phase, all livestock trekked from 1 km to 8 km to water except in south Ethiopia where livestock trekked an average of over 22 km. During the drought, all zones had some emergency water sources. Livestock in south Ethiopia, north Kenya, and C/SW Uganda trekked significantly longer ($P<.001$) distances while the distances to watering points in south Kenya agro-pastoral and north Tanzania agro-pastoral areas were significantly longer ($P<.05$) compared to pre-drought distances. The difference was not significant for other zones.

The onset of the minor rains dramatically reduced distances to watering points for livestock to below those in the pre-drought period across the zones. Distances to both primary and emergency watering points were further reduced during the El Niño period; however, generally, the distances to emergency watering points were further than to primary watering points. This reflects the preference of the pastoralists to the emergency watering points due to contamination of the primary watering points. During the La Niña phase, distances to watering points increased compared to those in the El Niño phase; however, they were still lower than those in the pre-drought phase except in the agro-pastoral zones of central Tanzania, NW Tanzania and C/SW Uganda.

In general, the livestock in the pure pastoral zones traveled longer distances to watering points during all the phases, with the exception of the La Niña dry phase. The onset of the minor rains equalized the distances traveled by livestock in the agro-pastoral and pure pastoral zones. Livestock in south Ethiopia, in general, traveled much further distances to watering points than those in all the other zones.

Figure 3. Distances trekked to primary watering sources for livestock across climatic phases for all zones except south Ethiopia.

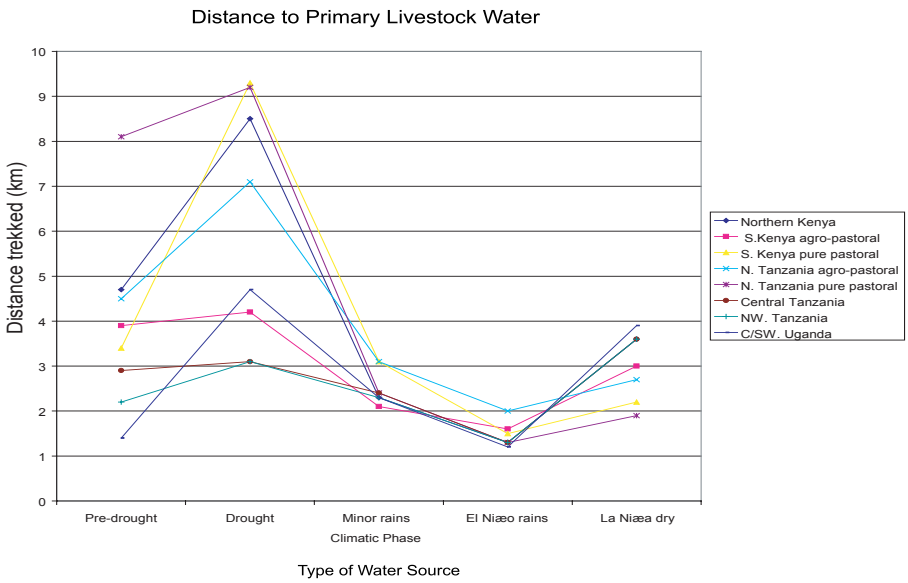
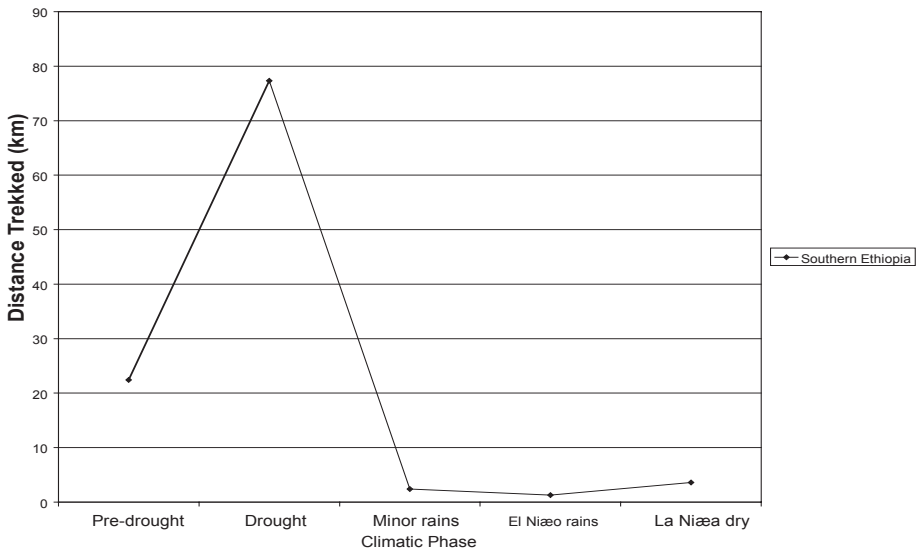


Figure 4. Distance trekked to primary livestock watering sources for livestock across climatic phase in south Ethiopia.



Sources of Water for Human Consumption

In most cases across zones, human beings shared the same water resource as livestock. However, in some zones, special sources of water such as boreholes were constructed by government agencies and NGOs to supply water for human beings only. These sources of clean water had a mandatory fee, which was a deterrent to some of the pastoralists who opted to fetch water from free, though less-hygienic, sources. Table 3 presents the two water sources most commonly used by pastoralists for their consumption in each zone during the different phases.

Generally, across zones, hand-dug wells were the most commonly utilized source of water for human consumption, being cited as one of the two most commonly used sources for all zones except south Ethiopia and north Tanzania. From table 3 it is evident that pastoralists in south Ethiopia, central Tanzania, NW Tanzania, and central/south west Uganda were heavily reliant upon their main source of water (more than 40% of the respondents in these zones used the most common water source across climatic phases). The use of the most common source decreased with the onset of drought in south Ethiopia, central Tanzania, and central/ southwest Uganda; it increased for north Kenya, where there was a greater reliance on wells and less on rivers/streams.

During the minor rains, all zones relied more on their most commonly used water source, however, going into the El Niño phase, pastoralists in north Kenya and central Tanzania relied less on wells which were generally their most commonly used source across phases. More pastoralists in north Kenya used rivers and streams, and those in central Tanzania used other sources. This may reflect the fact that wells may be further from households (in some centralized

Table 3. Percentage of respondent households using the most commonly used water sources during various climatic phases (1995–1998) in the zones surveyed.

Zone	Water Source	Pre-Drought	Drought	Minor Rains	El Niño Rains	La Niña Dry
Southern Ethiopia						
Pure pastoral	Pond	48	14	54	43	56
	River/stream	16	33	18	22	5
Northern Kenya						
Pure pastoral	Well	47	58	29	12	36
	River/stream	30	13	23	43	41
Southern Kenya	Borehole	20	17	17	17	23
Agro-pastoral	Well	27	27	10	10	20
Pure pastoral	River/stream	25	28	23	25	31
	Well	17	17	19	11	16
Northern Tanzania						
Agro-pastoral	River/stream	35	32	38	29	38
	Borehole	15	24	17	12	15
Pure pastoral	River/stream	28	26	31	25	25
	Pond	20	21	28	25	25
Central Tanzania						
Agro-pastoral	Well	47	38	43	24	40
	Borehole	28	36	29	22	24
Northwestern Tanzania	Well	61	67	61	58	64
Agro-pastoral	Borehole	13	15	12	10	12
Central/Southwest Uganda	Well	62	33	59	64	64
Agro-pastoral	Borehole	12	15	12	12	12

location) or may carry a mandatory fee charged to users. Usage of water sources during the La Niña phase was similar to that for the pre-drought phase.

A comparison of the pattern of usage of water sources for livestock and human consumption showed that there were similarities across the phases. Generally, with the exception of south Ethiopia, pastoralists relied on wells for both human and livestock water in the pre-drought and drought phases. There was a general shift toward usage of ponds, rivers and streams for livestock and domestic water with the onset of the minor rains, and the El Niño rains for all zones, except for central Tanzania, north Tanzania and C/SW Uganda, where wells were predominant sources of domestic water during the minor and El Niño rains.

Conclusions

Mobility is an inherent strategy of pastoralists to optimize production from a heterogeneous landscape under precarious climatic conditions. The search for forage as well as for water for human and livestock consumption triggers mobility and migration, which were shown to be intensified by drought.

Distances trekked to livestock water sources tripled with the drought, from an average of 5.9 km pre-drought to 15.8 km on average across zones, with pure pastoralists trekking further distances than agro-pastoralists. Distances to grazing sites increased from an average of 5.5 km to 20.4 km across zones, with pure pastoralists again trekking further distances. Emergency water sources and grazing sites were used but they were not necessarily further away from the homestead compared to primary grazing. For example, in some areas, swamps/marshlands that were closer than the primary grazing sources were used in emergency times. Pastoralists avoided these areas as much as possible during other times because they were disease-infested areas. In general, distances trekked to water were further than to grazing sites. Distances to emergency water sources and grazing sites were furthest for the most arid zones of south Ethiopia and north Kenya.

Annex

Percentage of Respondents Utilizing the Different Kinds of Water Sources in the Various Study Zones

Figure 1. Percentage of respondents in south Ethiopia utilizing the different kinds of water sources.

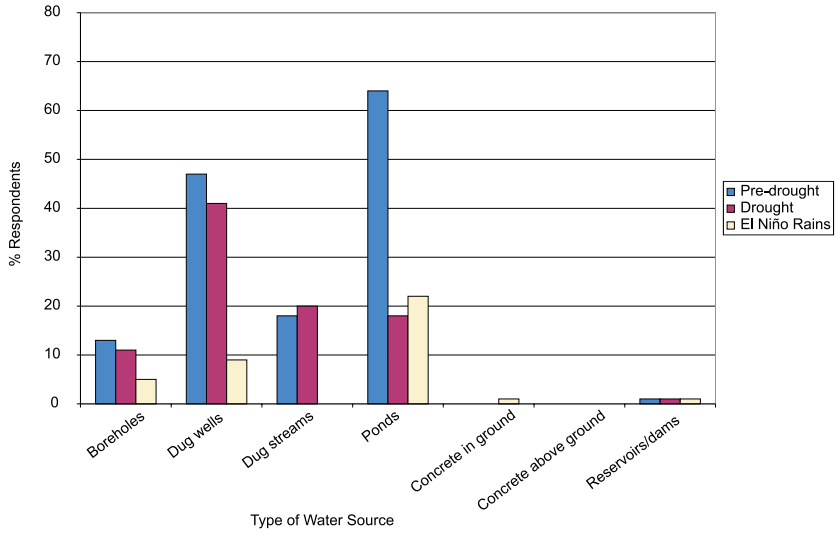


Figure 2. Percentage of respondents in northern Kenya utilizing the different kinds of water sources.

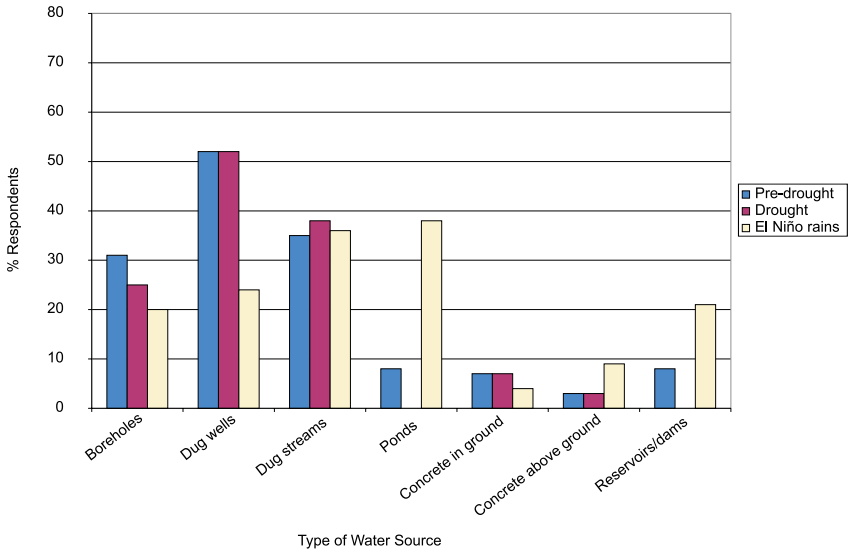


Figure 3. Percentage of respondents in S. Kenya agro-pastoral subzone utilizing different kinds of water sources.

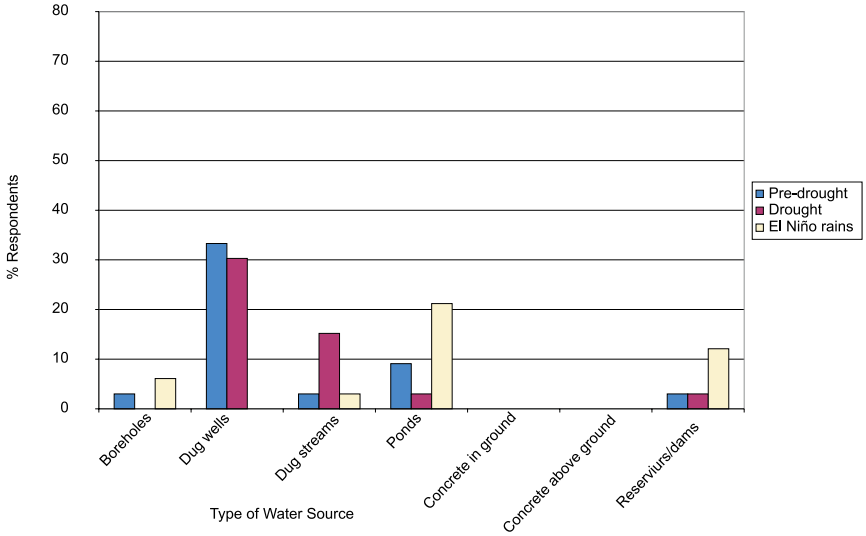


Figure 4. Percentage of respondents in southern Kenya pure-pastoral subzone utilizing different kinds of water sources.

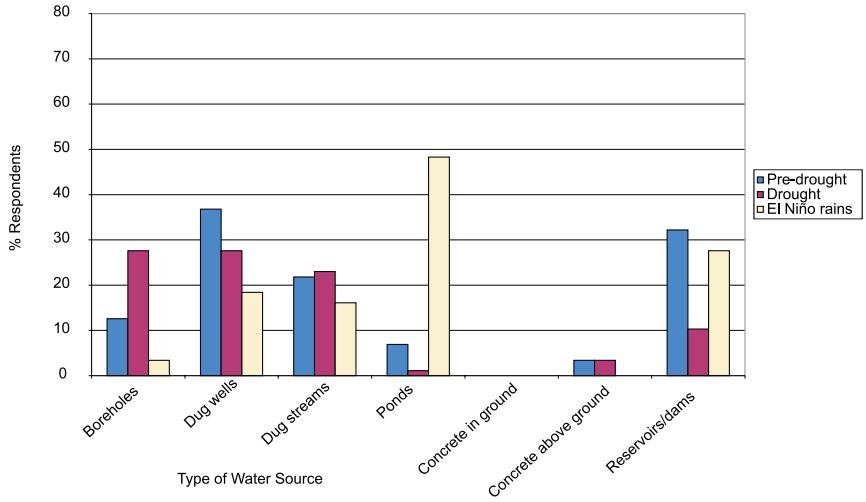


Figure 5. Percentage of respondents in northern Tanzania agro-pastoral subzone utilizing different kinds of water sources.

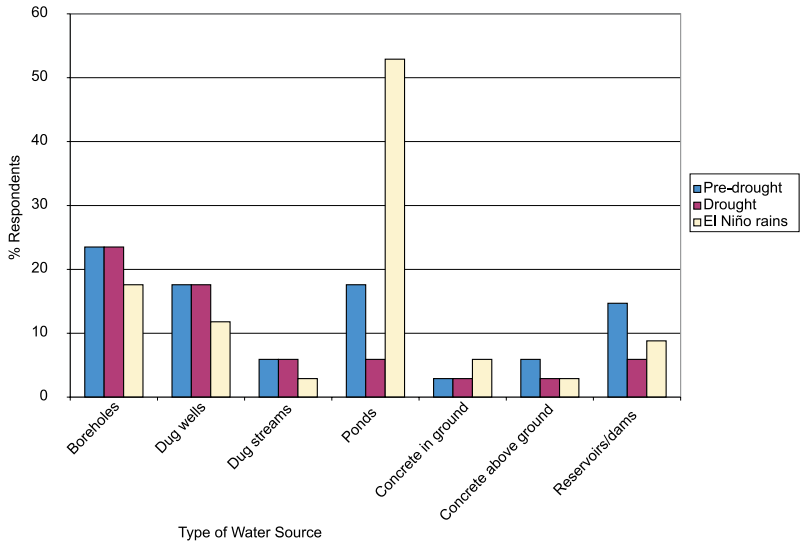


Figure 6. Percentage of respondents in northern Tanzania pure-pastoral subzone utilizing the different kinds of water sources.

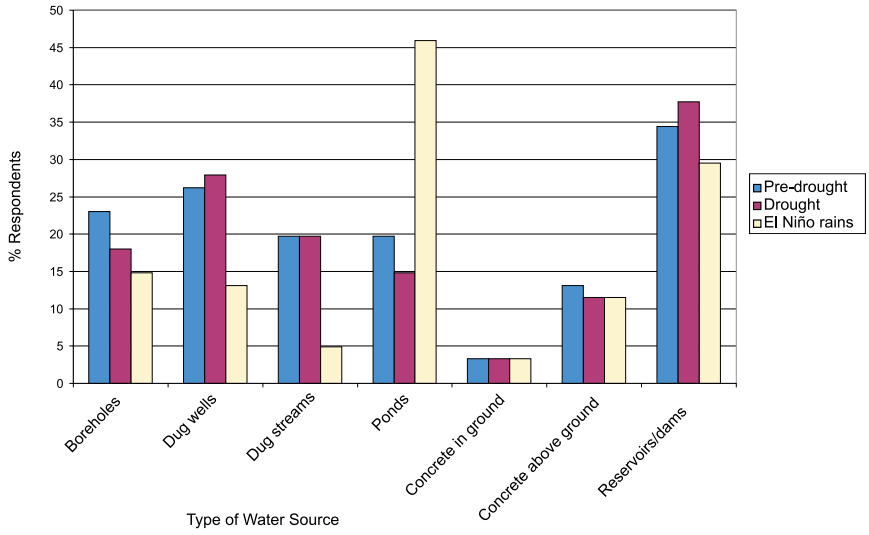


Figure 7. Percentage of respondents in central Tanzania utilizing the different kinds of water sources.

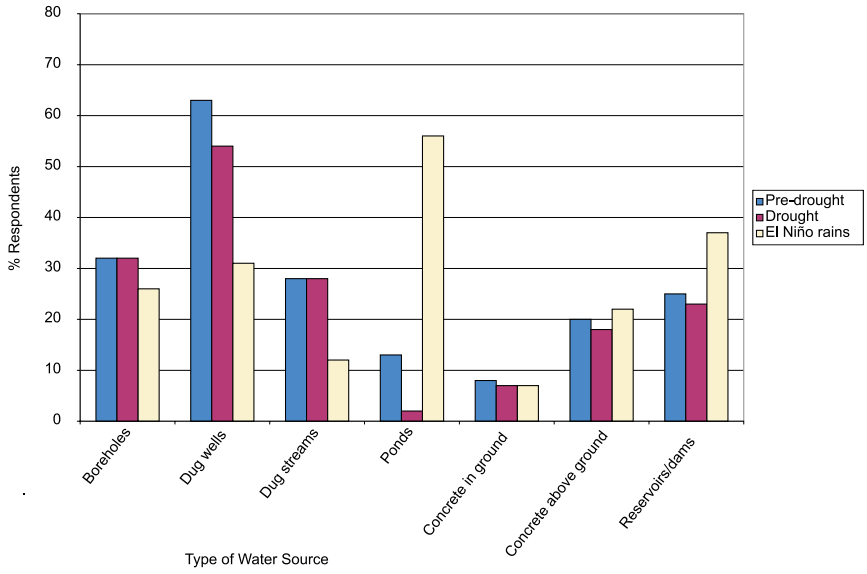


Figure 8. Percentage of respondents in northwestern Tanzania utilizing the different kinds of water sources.

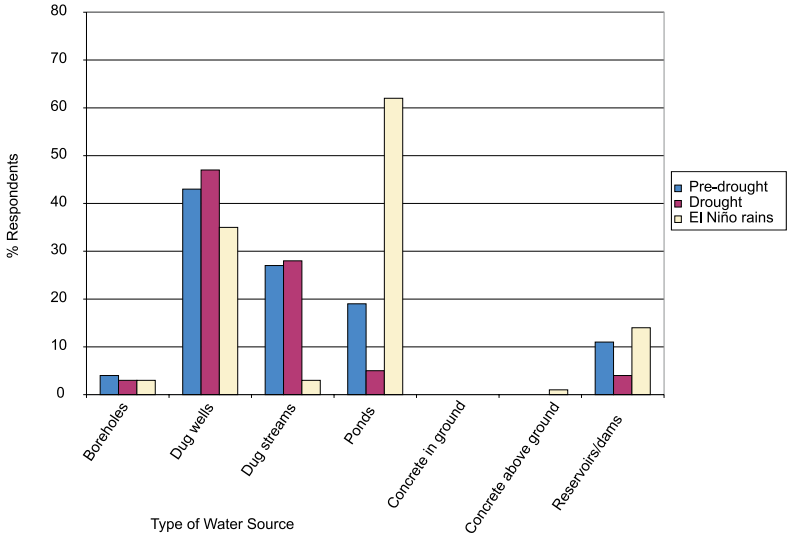
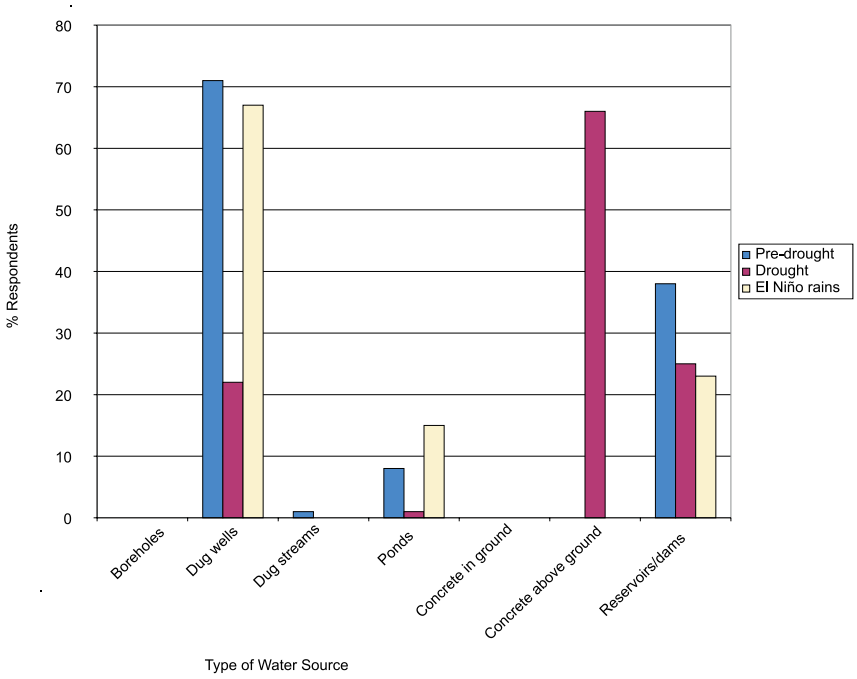


Figure 9. Percentage of respondents in C/SW Uganda utilizing the different kinds of water sources.



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