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Shallow wells: A sustainable and inexpensive alternative to boreholes in Kenya

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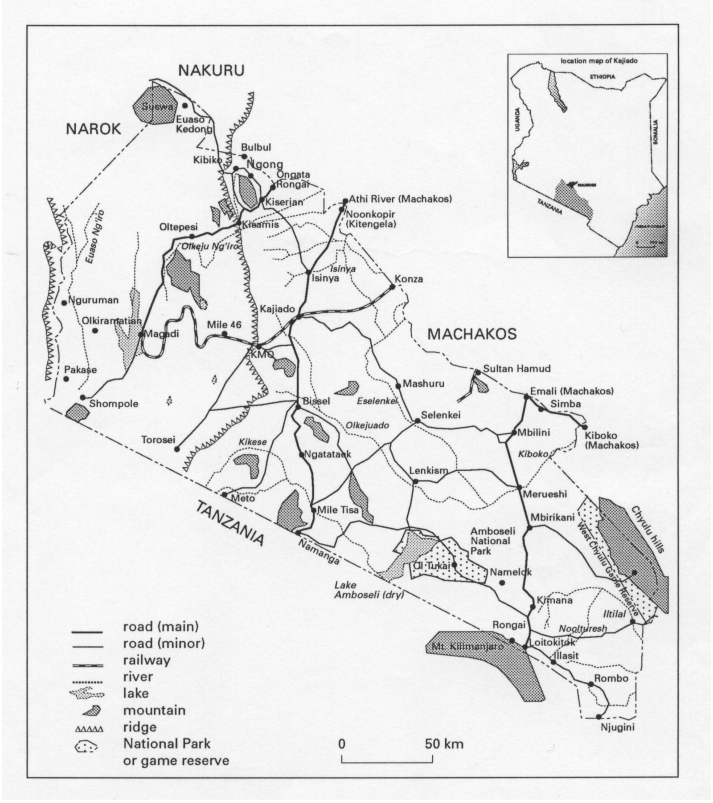
Abstract

Worldwide, the drawing of water is rising faster than the growth in the world's population. Between 1900 and 1990 the world's population increased from 1.7 billion to 5.5 billion, while the total consumption of water in that time went up by a factor of 10, from 500 to 5,000 km^3.[1] This explosive rise is not just due to higher human consumption of water but is also the result of an increased supply as well as the expansion of existing economic activities and the introduction of new projects. By describing the water situation in the semi-arid Kajiado District in southern Kenya (see map), this paper highlights the way specific interaction between political, juridical and economic processes has contributed to an upsurge in the pressure on natural water sources and available groundwater reserves. A comparison is made of the efforts proposed and implemented to solve the numerous problems in water provision in the area, focusing in particular on two types of water facilities – boreholes and shallow wells.

Figure 1. Location of Kajiado District in southern Kenya



Water problems in Kajiado District

Water is of major importance to the economy of Kajiado District but levels of precipitation are the major limiting factor to cultivation and keeping livestock. The water structures in this area are varied and include (perennial) rivers, natural wells and depressions, manmade reservoirs (pans), dams (above and sub-surface), modern and traditional shallow wells, boreholes, and piped water. The hills and valleys have a significant effect on annual rainfall figures.[2] Near the hills annual precipitation is high (800-1,000 mm), while the low-lying savannah regions experience less rainfall (300-500 mm).

The demand for water is growing rapidly and is estimated to be around 223,000 m^3 daily, with some 31,000 m^3 for livestock, 8,000 m^3 for wild animals, 15,000 m^3 for human consumption and 170,000 m^3 for irrigation. Boreholes, natural wells and rivers have a daily maximum potential of 180,000 m^3. This works out at a daily shortfall of 40,000 m^3. Alternatives – such as shallow wells, dams and pans – are of crucial importance in balancing this deficit.

The Maasai pastoralists who have inhabited this area for centuries consider this lack of water (*enkare*) primarily as a problem for their herds and less as a matter of concern regarding their own personal consumption. The herders and their livestock will in general settle within a radius of 5 km of a water source but during the dry season new pastures have to be found. The availability of groundwater near these dry-season grazing areas is of crucial importance because the physical condition of the animals requires access to water every other or every third day.

During the wet season, the animals spread out to make use of new grass and the fresh surface water in the pools, river-beds and dams. But when the next dry season comes, livestock will concentrate once again on nearby wetlands and higher ground, precisely the areas where there is competition from other economic activities such as cultivation and wildlife parks, which have increased over the last decennia.

For a better understanding of the Maasai's water problems it is important to discuss the history of land ownership among the Maasai following the arrival of British colonizers.

History of Maasai land ownership in Kenya

The history of the Maasai is one of a constantly decreasing territory, both in a quantitative and a qualitative sense. In the footsteps of the Scottish geologist and explorer Joseph Thomson, who was the first European to cross Maasai land in 1883/4, Britain and Germany struggled for hegemony of this area. The outcome of this battle was a sub-division of Maasai territory. The northern Maasai were placed under the rule of the British East Africa Protectorate and the southern Maasai came under German Tanganyika.[3]

The British authorities signed treaties with representatives of the Maasai in 1904 and 1911, respectively. The Maasai 'acquired' exclusive user-rights in two reserves measuring in total some 24,000 km^2. In 1911 the northern reserve was taken away from them and the Maasai were forced to witness their premium grazing areas being taken over by the settlers. The total 'white' area in Kenya covered some 31,000 km^2, of which 18,000 km^2 had originally belonged to the Maasai. The extended southern reserve – totalling 38,000 km^2 – was compensation for losing the northern area. In spite of this, the Kenyan Maasai saw a reduction of approximately 40 per cent (some 60,000-70,000 km^2) in their pre-colonial territory.

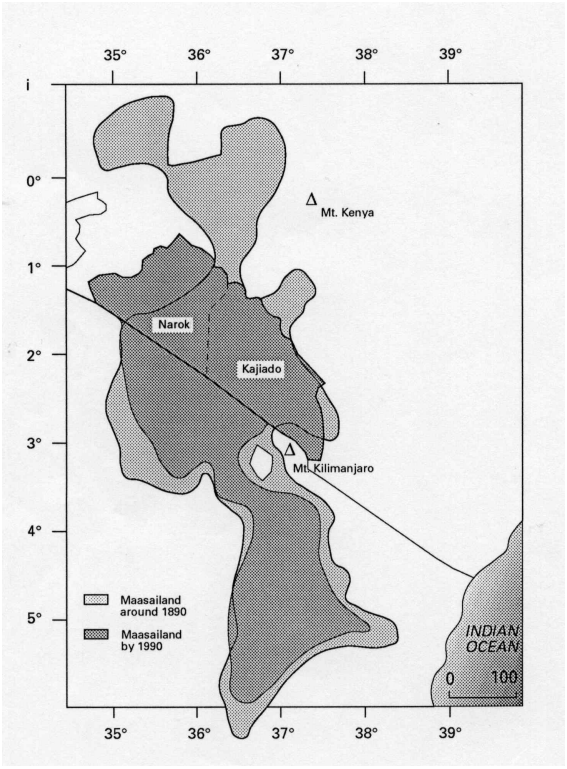


Figure 2. Maasailand around 1890 and in 1990

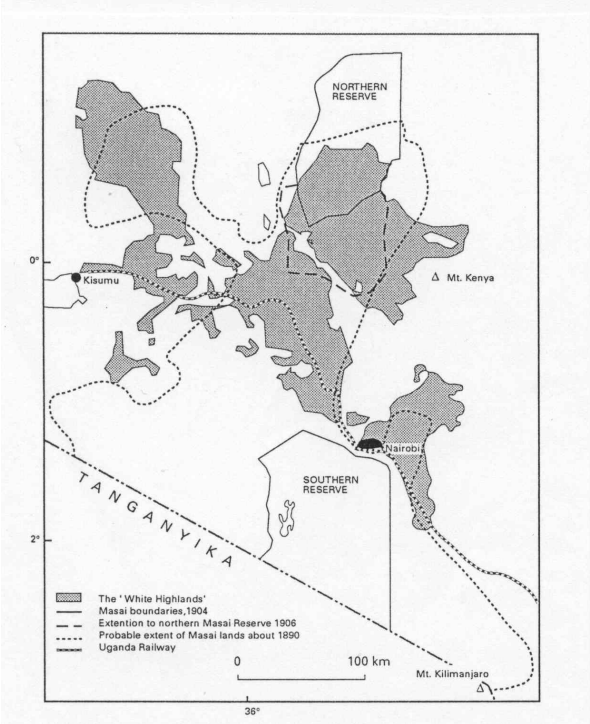


Figure 3. The Northern and Southern Reserve by 1906 (source: Hollis 1905; Sandford 1919; Morgan 1972)

The losses in a qualitative sense have been even more serious. The Maasai reserve – set aside for the Maasai – was a vast area but lacked water and grass, and the reserve's boundary was drawn in such a way that most rivers just run within territory that was in the hands of the colonialists. Protests by the Maasai, at one time supported by a British lawyer, a few colonial administrators and British investigative commissions, have all been in vain. At best, some minimal adjustments in these boundaries have been made, or the Maasai were allowed to make use of their former pastures and water sources at times of extreme drought.[4] After World War II the colonial authorities attempted to persuade the Maasai to agree to a system that limited the maximum number of families that could stay near a borehole. In this way an attempt was made to develop a kind of ranching but a lack of financial means and long periods of drought turned the project into a failure.

A second attempt, initiated by the World Bank at the end of the 1960s, pushed for the introduction of so-called group ranches in the northern part of Kajiado District. This resulted in the creation of 51 communal ranches that covered about 75 per cent of the district. In the mid-1980s calls for the abolition of the group ranches grew louder and pleas were made to subdivide the land into individual ownership.[5] Proponents pointed at the likely positive effects such as the (increased) possibility of getting a loan, the abolition of exploitation of the poor by richer households, better opportunities for intensifying other economic activities such as cultivation, and the improved management and extension of the existing infrastructure. Opponents of sub-division feared a sell-out of land to outsiders and also predicted that the ecology would suffer due to erosion in areas under cultivation and that there would be a loss of Maasai culture and increased restrictions on the mobility of both livestock and wildlife, which is of crucial importance to the district's tourism.

Water development in historical perspective

At the end of 1925 the British colonial government requested A.D. Lewis, the director of irrigation for South Africa, to advise them on the possibilities of irrigation in the Maasai Reserve. Lewis doubted the wisdom of spending huge sums of money on the improvement of water supplies in the African reserves, 'especially considering the huge and growing demand for labour of the natives in other parts of the country'.[6] In spite of this opinion, and pressurized by the Maasai, the second half of the 1920s was used to make an initial humble contribution to the construction of water pipes, boreholes, wells and water tanks. These were partly rewards for the exclusion of access to former Maasai-held water sources by the Magadi Soda Ash Company, a British mining company, or infrastructure such as water tanks, funded by the government to support the development of a cattle-trek route to the meat factory of another British company, Liebig's Ltd. The driving force behind most of these water projects (sand dams, boreholes, shallow wells) was the Kajiado Local Native Council (LNC). The financial means used came from tax payments made by the Maasai themselves in addition to voluntary donations and labour provided by the Maasai to conduct the required work. This illustrates how keen the Maasai were to actively improve the water situation in the area. A Dutch biologist travelling through Maasailand in 1924 also noticed this attitude. He wrote:

> The following morning everything was broken up and we moved on southwards, to finally reach the river Olgerey. Its bed was deeply cut and foremost dry. Only at isolated spots, one could observe some pools of water (..) In passing by the Maasai headman pointed to me, with a lot of proud, a construction they had erected in the river. (..) High up the river-bank there was a hole, in which a water well. In the past, I was told, the water would simply run over and form a water pool in the river the moment the well was fully filled. But recently they had made a construction out of stone, a large basin, in which the water would flow and be contained. This way it would take much longer if at all for the well to flow into the river. In the past, this water was lost because the animals would trample inside the pool and turn it into a mud pool. Now they could only reach with their heads inside the big trough to drink and the water would remain clean. I gave him my admiration for the job well done and I must admit that I was surprised to learn that a Maasai could make such a structure just by himself,[7]

After the war the government became more involved but the Local Native Council remained the major driving force behind water development in the district. District Commissioner Wainwright reported:

> The Local Native Council now has a very considerable balance which it is the Council's intention to devote to water supplies so I have no doubt they will become increasingly vocal in their demands for machinery to be made available this year. I think boring should start without waiting for a general survey of the district, which is not likely to be completed for some years'. He also noted that 'as soon as hand pumps become available I think they will sell like hot cakes among the Masai for use in their wells.[8]

He stated the availability of several prime spots for the construction of dams, but noted that the work force needed, but lacked, advice on soil suitability. In addition, the British colonizers pursued a strict policy characterized by a livestock management plan aimed at limiting the number of animals by setting specific conditions for the development of water sources. Most water development efforts were limited in scope and successes were minimal during this period.

The Development and Reconstruction Authority (DARA), specifically created by the government to implement the 'Ten Year Plan 1946-55', financed two boreholes for agricultural fields near schools. The Maasai paid for an additional three boreholes but unfortunately, only one was successful. Out of the five LNC boreholes, three have been total failures, while the other two have produced only a very little water. In spite of this, new plans were made to drill for another twenty boreholes.

The maintenance of water supplies was also below standard. In spite of Maasai protests, a water tax was introduced for the use of government-owned boreholes in 1950. That same year the 'Dam Construction Unit' suggested by Wainwright was set up to show the Maasai how to construct sand dams. Assisted by 60 Maasai and 56 oxen, eight dams were constructed in the first year. However, at the end of the year only two of them contained water.

Figure 4: Maasai youngster forming a new age-group

Pressure on available water sources increases

From the 1970s onwards, individual Maasai have pointed at falling water levels in the rivers in Kajiado District. Indeed, when comparing a list of rivers in the 1930s with the current situation we have to conclude that more rivers nowadays should be labelled as 'perennial' and fewer as 'permanent'. It is hard to know the exact reason for this development but one could point at causes such as mining, irrigated agriculture, deforestation and the loss of storing capacity in the rivers because of sand mining. The demand for water in the district has increased rapidly since the 1950s. Some mining companies, legally backed by the authorities, have constructed huge water facilities for their own private use. Thus the Maasai once again have lost access to a number of permanent water sources. Only in a few instances have the Maasai been able to demand the creation of a borehole or water taps as compensation. The Magadi Soda Company delivers 45,000 litres of water to neighbouring Maasai every day as a way of compensating them for the construction of a pipeline that carries 900,000 litres from the Oloibortoto River to the Magadi factory daily. A similar agreement has been made with the Magadi railway company that has been allowed to build a 100-km pipeline from Noolturesh on the lower slopes of Mt Kilimanjaro to the Mombasa-Nairobi railway line. Here the water is collected in a 12.5 million-litre reservoir. Alongside the pipeline, which was finished in 1956, five water taps have been installed for the local Maasai that should provide them with 250,000 litres per day.

In addition to the direct withdrawal of water, the water supply is affected indirectly by the activities of outsiders – the government, industry and agriculture. Firewood and river sand are officially allowed to be transported out of Kajiado District, and trees on the slopes of Mt Kilimanjaro are cut to provide the army with wood. Since colonial times, huge amounts of sand have been transported, both legally and illegally, out of the district to be used in

particular in Nairobi's construction industry.[9] Such exploitation has not yet stopped and, slowly but surely, the water conserving functionality of the local forests and river-beds is being eroded.[10] A similar problem is occurring with legal and illegal logging on the other hilly spots in the district, notably in the Namanga and Ngong regions. The immigration of cultivators intensifies the pressures on the available water resources. A similar threat is posed by the new flower, ostrich and chicken farms, private boarding schools and the training institutes that have emerged in the recently sub-divided areas of the district. All of these activities have a high demand for water and careful monitoring is needed to be able to determine if the above-mentioned development will indeed lead to the much-feared decrease in groundwater reserves.

The situation seems clearer concerning the loss of water supplies in the region bordering Mt Kilimanjaro, especially since the 1980s. The swampy areas in the lower areas are decreasing in size. In addition to the pastoralists who are confronted with a loss of dry-season grazing areas, irrigating agriculturalists in this area are heavily dependent on water from the Noolturesh River. All of them fear that a decrease in water availability will threaten their own existence.[10] The Noolturesh water pipeline project has been responsible for this. The project, supported by the Italians, was completed in 1992 and was immediately dubbed a white elephant because of its size, construction and its extremely high water detraction rates. The main source provides some 200 litres per second and the Noolturesh pipeline produces 168 litres per second. Together with the old railway pipeline, with its rate of 17 litres per second, and the supply to the Loitokitok network, the source is being too heavily used. At present, Kajiado Town receives some 11 per cent of Noolturesh's water and Machakos Town, which is in the neighbouring district but which does have any other alternative source of water, receives 66 per cent of the total supply. The remainder goes to Athi River that gets enough water from neighbouring boreholes. Technical advisors have warned that the Noolturesh will not be able to meet the growing demand of these three cities in the future and that extra sources will have to be found, while the 262-km pipeline should primarily provide water for the pastures and only offer an additional supplementary function for the urban regions. The local Maasai hardly see any profit from this mega project. Moreover, the Noolturesh line was linked to a rose farm owned by important (former) politicians. It has been estimated that this Stoni Athi Ltd. horticultural farm has a storing capacity of 6,000,000 litres, sufficient to provide water to some 120,000 persons per day.[12] Public water is thus being transformed this way and exported in the form of roses to Europe to the benefit of a small Kenyan elite only.

In addition to huge water consumption, a lot is lost alongside the pipeline. Maasai herders in search for water have been known to destroy the pipeline, partly out of frustration at the limited number of taps available and because of high water-use bills. These uniform water payments, based on livestock numbers and not on real water-consumption rates do not offer any incentives to save water. On the contrary, this arrangement has led to the creation of irrigated cultivated fields emerging beside the pipeline.

Finally, another recent phenomenon is the rapid reduction in the quality of the water in the district's intensively cultivated regions. Especially in the Ngong region, boreholes have been constructed over too small an area, resulting in brackish water. Also the use of pesticides and fertilizers for cultivation is polluting the drinking water for both humans and livestock downstream. The Ewaso Ngiro South, for example, carries pesticide residues from the large-scale wheat farms in the neighbouring Narok District. And, what will be the effect of the use of pesticides in the horticultural industry? Mining and small leather industry activities in Athi River also pollute the streams in Kajiado District.

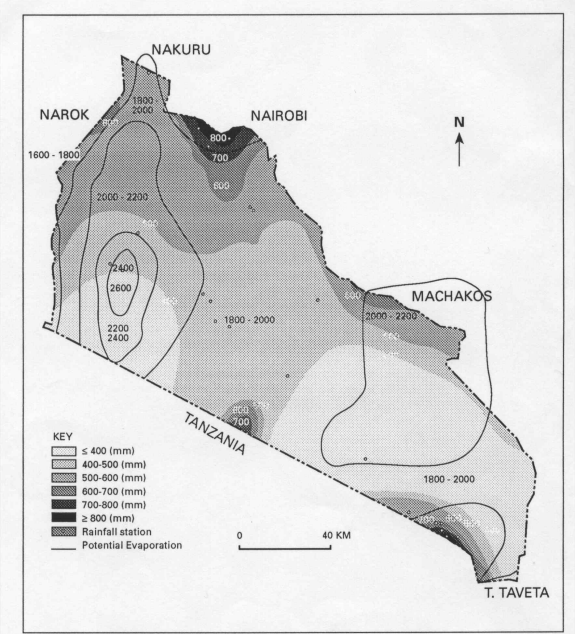


Figure 5: Kajiado District Mean Annual Rainfall and Evaporation (Kajiado District Atlas 1990)

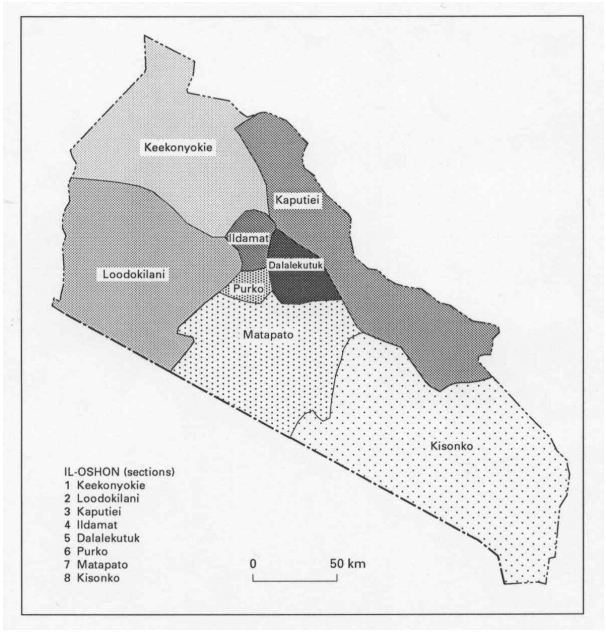


Figure 6: Kajiado Maasai *Iloshon* (sections)

Water facilities in Kajiado District

In 1960, Kajiado District had 38 boreholes and over 50 dams. These were in the hands of the African District Council, the central government, private enterprises and individual Maasai. However, in the early 1960s the Maasai were hard hit by a bad drought and huge numbers of livestock were lost. This and the earlier-mentioned fear that Kenyan independence might result in a possible loss (of the control) of their land made the Maasai finally agree to the creation of group ranches in the framework of the 'Kenya Livestock Development Project'. An important argument for the Maasai in accepting this World Bank-funded project was the promise that substantial attention would be devoted to improving water facilities on the group ranches by drilling boreholes and constructing dams, troughs and water pipelines.[13]

In the first phase of the project, from 1968 to 1974, water facilities doubled,[14] but in the final year the Maasai lost access to one of their most important dry-season grazing areas: Amboseli. This very green pasture that was set aside for survival in times of severe drought was turned into a national park by the Kenyan authorities due to pressure from the international conservation lobby. As a result, the area was no longer available to the Maasai and their herds. It was at the same time that a drought hit the region that would last until 1977. That year two boreholes became available as compensation for the loss of water sources inside Amboseli but unfortunately the design of the boreholes was not all that effective or sustainable and they turned out to be very expensive to maintain. During the 1984 drought, the Wildlife Department was not capable of pumping water outside the park because of budgetary restrictions, so by way of compensation the Maasai were allowed to enter the park to fetch water for their animals.[15]

Likewise, problems on the group ranches increased during the second phase of the KLDP as many pumps and spare parts were stolen.[16] On one of the group ranches, Erankau, members were forced to repay a loan used for a few boreholes that had been drilled in an area where no groundwater was found.[17] On other ranches, borehole repairs turned out to be very expensive and time consuming and the cost of constructing tanks, troughs and water pipelines has been rising fast.

Table 1: Water facilities in Kajiado District, 1988

	Division											
	Central		Loitokitok		Ngong		Magadi		Total Group		Total Kajiado	
FACILITIES	F	NF	F	NF	F	NF	F	NF	F	NF	F	NF
Boreholes (MoLD)*	33	23	8	3	4	7	-	1	45	34	82	45
Boreholes (MoWD)	45	93	10	22	27	30	1	4	83	149	139	248
Water pans	84	-	2	-	4	-	-	-	90	-	135	-
Water dams	20	2	4	-	5	1	9	1	38	4	50	7
Wells*	10	-	8	-	-	-	-	-	18	-	29	-
Springs	13	1	17	-	3	3	-	-	33	4	44	4
Rock catchments	4	-	2	-	-	-	1	2	7	2	7	2
Water tanks	57	14	12	-	17	-	20	-	106	14	170	14
Km water pipeline	129	18	87	-	113	-	85	-	414	18	574	18
Troughs	113	7	13	-	13	-	19	-	158	7	217	9

Source: MoLD (1988); Mwangi (1990)

F = Functioning, NF = Not Functioning, GR = Group Ranch territory, KD = Kajiado District

* underestimate. The figures refer to the facilities in the group ranches of Kajiado District, excluding individual ranchers. The latter facilities are included in the Kajiado District total. The borehole figures of the Ministry of Livestock Development (MoLD) are far lower than those of the Ministry of Water Development (MoWD) (1988). Non-functioning boreholes are either not operational (144), disbanded (21), have dried up (12) or are not traceable (71).

Table 1 provides an overview of existing water facilities on the group ranches in 1988. It is important to bear in mind that a majority of these were not constructed by the KLDP, which constructed only 15 boreholes, 19 tanks and 20 troughs.[18] Other donors also provided funds to drill boreholes and construct various water facilities on the group ranches.

As mentioned earlier, access to groundwater is of crucial importance to livestock during the dry season. Groundwater is available from natural sources, shallow wells and boreholes. Natural well-water is often of excellent quality but many of these sources are in hilly or even mountainous terrain and to gain access to this water it is often necessary to build a network of pipelines, which is costly. Boreholes and shallow wells could be a better alternative. Most of the wells in the district can be found in the dry river-beds and along the river-banks. The depth of a shallow well varies from three to thirty metres. The average depth before a borehole strikes water is 80 metres, yet water has sometimes only been found at a depth of 250 metres.[19]

Figure 7: Lining a shallow well

Development, ownership and operation of boreholes

The development of boreholes in the district is primarily the business of donors, the government and the churches. In addition, wealthy individuals have been drilling their own boreholes and others have organized themselves in groups. The costs involved in the drilling and equipping of a borehole (100 m deep) are high and worked out (in the early 1990s) at some Ksh 2 million (approx. US$ 40,000).

Table 2: Year of construction of boreholes, 1927-1993, per division in Kajiado District

Period	Ngong Division	Magadi Division	Mashuru Division	Central Division	Loitokitok Division	Total
1927-30	11	-	2	-	1	14
1931-40	-	-	1	-	-	1
1941-50	7	2	8	19	3	42
1951-60	15	-	1	13	6	35
1961-70	2	-	7	18	6	33
1971-80	19	3	10	46	12	90
1981-90	96	1	3	74	26	200
1991-93	30	-	20	3	-	53
Per year	2,7	0,1	0,8	2,6	0,8	7,0
Total	180	6	52	173	54	468
%	39%	1%	11%	37%	12%	100%

Source: Mwangi (1993)

Table 2 provides a detailed overview of borehole construction based on the Ministry of Water Development's borehole register. The rise in borehole numbers since the 1970s is mainly the result of Kajiado District losing its status as a 'closed district' at the end of the 1960s. Many of the new boreholes are now in the hands of non-Maasai immigrants, schools and the government. Some of the most recent immigrants are prominent national figures who seem to have bought the land for either residential or speculative reasons. Another reason for the increase in boreholes in Kajiado District is political. Especially at the end of the 1970s when Stanley Oloitiptip, a Maasai minister, was at the height of his power, large amounts of money were transferred to the Kajiado water sector in his constituency (Loitokitok and Mashuru Divisions).[20] Other Maasai politicians, like former Vice President Saitoti, later followed his example.

Unfortunately the borehole register does not give information about the operational condition of the boreholes. To answer this question the Arid and Semi-Arid Lands Kajiado District (ASAL) project, a Dutch-funded integrated rural development project, financed an exercise to collect this data in the whole district in 1988.[21] The major objective was to arrive at an up-to-date overview of property and to assess the condition of the boreholes. It concluded that from 1927 to April 1988 a total of 387 boreholes were drilled in the district, of which only 139 (36 per cent) were still operational.[22]

Technology and management of boreholes

An important aspect of boreholes is the way water is pumped. There are five possibilities: electric pumps, diesel pumps, solar panels, wind turbines, or manpower. In the past this choice was primarily limited to manpower (for shallow boreholes) or the diesel pump. In some cases a combination (e.g., solar panels and diesel pumps) is possible. The final decision is usually influenced by financial as well as technical factors, such as the depth of the borehole and the amount of water to be raised to the surface. Electric pumps are mainly found in the Ngong area because of the availability of electricity but a number of the Ngong boreholes are not (yet) functional because the owners are still waiting for three-phase electricity.

Pumps operating on solar power have been available since the mid-1970s. These systems are becoming cheaper but because of the devaluation of most developing countries' currencies they are benefiting less from the savings than the industrialized part of the world. The many hours of sunshine throughout the year make solar power, in principle, a very attractive source of energy. In Kajiado, a number of boreholes have been equipped with solar panels due to the assistance of foreign donors. They mainly embrace the sustainable character of solar energy.[23]

Finally, a few boreholes in Kajiado pump water using wind energy. In contrast to solar energy where multinational companies are primarily involved, it is local industries and NGOs that are promoting the use and the improvement of this source of energy for collecting water. A major limitation is the below-average wind speed during the month when water is in highest demand. The ideal wind speed should be above 2.5 metres per second and preferably it needs an average speed of 5-6 metres per second. An advantage of the windmill technique is that maintenance is limited, its lifespan is long and the chance of the mills being stolen is very small. A problem, however, is that information about wind speeds in Kajiado for different locations and seasons is not readily available.

Why boreholes often fail

The construction and maintenance of boreholes have at times encountered tremendous technical, physical as well as socio-economic problems. Diesel pumps have to be supplied with diesel and oil daily, oil and air filters need to be replaced after every 250 hours of operation and diesel filters only last about 1,000 hours. And because of the fine dust clouds, pumping houses need to be kept as clean as possible. All of this calls for a well-operated logistical set-up that allows for the timely availability of new materials and funds to purchase and transport them. The latter is not that easy considering the isolated areas the boreholes are located in. Sometimes, cheap (contaminated) diesel is bought which ruins the engines.

Most of the solar-driven boreholes are no longer in operation. Sun panels are popular with thieves and so need to be monitored during the day and at night. It is also necessary to avoid damaging the panels; youngsters throwing stones are a constant problem. The fact that there are in principle no running costs makes it hard to convince users to set aside money to cater for regular maintenance and repairs. These have to be conducted by experts, who are often not available at short notice. As a result, repairs are time consuming. Moreover, it has become clear that the enormous demand for water for animals cannot be delivered by solar-powered pumps in sufficient quantities and within a limited time period. This technical limitation increases the waiting time at the borehole in such a way that insufficient time is left to graze the herds in faraway locations. Maasai pastoralists are therefore not keen to pay for the renewal or repair of lost or damaged solar panels.

Problems with wind energy mainly deal with repairs to specific parts of the windmill,

which are also costly and take a lot of time. The problem of the so-called 'overflow' is a point of concern. Large amounts of water run away uncontrolled to natural depressions where the standing water is a potential health hazard as it is an ideal breeding ground for diseases. All types of boreholes have to tackle physical problems. The geology of the district is such that because of cracks in the lower ground layers water streams can redirect themselves all of a sudden. As a result, a borehole's production might be drastically reduced. The quality of water is also sometimes below standard. In specific regions it is too salty and this is frequently caused by uncontrolled over-pumping: too many boreholes working for too long hours in too small an area.

The latter suggests that, in addition to technical and physical problems, management issues should also be mentioned here. The introduction of boreholes in the Maasai community has been initiated top down. The local community has hardly been involved in the choice regarding a specific location, the installation, repairs and maintenance of the new technology. All of this has strengthened the impression that the new technology does not belong to the user but is the property of the donor. As a result, feelings of ownership – and consequently responsibility – are only weakly developed, or missing altogether among the users. Moreover, maintenance by the local council is below standard. Salaries need to be paid on time to borehole attendants. After the loss of the Amboseli National Park, which meant that now the central government receives the proceeds, the council has become a financially weakened institution and is charging pastoralists for the use of the borehole. The latter also have to take care of necessary repairs themselves. It has to be concluded that the development of boreholes in Kajiado District has involved an enormous financial investment on the part of the Maasai and other parties, albeit with disappointing overall results.

Searching for alternatives

During the ASAL borehole survey, attention was paid to alternative water facilities. The pan, and particularly the shallow well, turned out to be of major importance for the rural population. These two facilities are among the most-used water sources. However, shallow wells are not included in the Kenyan government's official water statistics. The boreholes are only able to provide two per cent of the total local demand for water. In the late 1980s, this situation made a Kajiado District water officer decide to collect more information about the ways the Maasai were providing their own answers to the search for water.[24] A conservative estimate was that at least three-quarters of the water demand for livestock was taken care of by shallow wells, pans and dams. The interest of the local civil servant was also awakened because of the affection the local Maasai show when talking about their well. In addition, it became clear that in the past Maasai pastoralists had indicated their willingness to invest considerable sums of money in the development of these water sources. The Maasai keep on making use of these wells, even if a borehole becomes available in a nearby neighbourhood. Apparently acquaintance with and the relatively low operational costs on top of the durability and reliance of these wells are responsible for this attitude.

Still, the Maasai had also indicated some of the negative aspects of the shallow wells. The civil servant's own field experience and professional training added to the idea that there was room for improvement. It was decided to collect data with the main purpose of improving the design, operation and management of the wells. With this experience and through improving local knowledge and management systems, he tried to list a number of problems linked to the wells. Silting emerged as one of the main problems, especially during the rainy season, but sand storms also make wells fill up with sand. A lot of time and money is needed each season for repairs. A second problem is the potential collapse of the sand walls. And a third problem

deals with pollution because wells are not covered and all kinds of vermin, chemicals to cure livestock diseases, animal urine and faeces accumulate in them, especially during the rains. The local people also wash themselves and their clothes near the wells.

The idea was well received by the ASAL programme management in Kajiado District. In 1993, a start was made with a survey whose main purpose was to visit each single shallow well in the district and collect data on its location, its construction, the quality of its water and the way the water was pumped. In addition, it was decided to conduct a pilot study involving the improvement of a limited number of traditional shallow wells by deepening them, putting in a filter, lining and strengthening the walls and, finally, covering the well in combination with placing and testing a number of hand and mobile diesel pumps on the surface.

Shallow wells: The Maasai answer

Early in the morning, a number of Maasai herders meet with their herds near a well. The water is raised in buckets using the so-called human ladder. This could mean up to 6 or 7 people standing above each other in manufactured inroads in the wall of the shallow well. This way the Maasai are able to bring to the surface huge amounts of water is a very short time span. The buckets are emptied into a nearby trough where the thirsty animals are waiting eagerly. In small groups, the animals are allowed towards the trough to drink. The herders ensure that each animal drinks sufficient water. After all the animals have had their turn, the herd is on the move to look for grass and graze and the next Maasai family will bring their animals down to the well. The number of families using a single well depends on the season and its capacity, but numbers vary from 2 to 20.

The Maasai, like most nomadic pastoralists, make use of a dry river-bed during the dry season by scooping sand in search of water. In the past, water was lifted from these temporary wells making use of animal skins. The huge disadvantage of this type of well (*o-sinyai*) is that after the rainy season starts the sand will cover the well again, or at worst make its future use impossible due to strong currents. In addition to the *o-sinyai* type, there are also wells dug in the river-bank either in sand or in stone. Almost all of these wells (*o-lumbua*) have been made by the Mbulu ethnic group.[25] Certain members of the group, originating in Tanzania between Lake Eyasi and Lake Manyara, move all over Maasailand and construct these wells in return for payment.[26]

An important aspect is locating the right spot at which to dig a well and for this, expert knowledge is required. The presence of certain species of trees – *Oltepesi* (*Acacia Seyal*) and *Olerai* (*Acacia Tortilis*) – is a sign that water may well be found. An entrance route is then constructed to where a washing place is set up where the local women will wash their families' clothes. From this point the herders will be able to go down with their animals to the trough and well to drink.

The time required and the construction costs of a well depend on the type, the depth needed to reach water, the volume wanted and the density of the rock or soil. *Jembes* and picks are used and the trough is made out of mud and cement. When the construction work is completed, the area is fenced with thorny branches to keep out wild animals. An *o-sinyai* well to a depth of 3-5 metres takes about a month to complete, while an *o-lumbua* (10-30 metres deep) may take 3 months to a full year before it is ready for use. If finance runs out, it may take much longer. In the past the Maasai and his Mbulu worker would make a contract and payment was made in kind (animals). Nowadays the costs of building are calculated by the metre (depth and width) (approx. Ksh 500-1,000 per metre). In the end, the Maasai well owner will pay about Ksh 10-30,000 for a well but there will also be additional costs for de-silting (Ksh 5,000). All in all, the total construction and maintenance costs of a (traditional) *o-*

lumbua well are only a small percentage of what it would cost to construct a borehole. An additional benefit is the well's performance, which is impressive. In Kajiado, there is one well that is seven metres deep and three in diameter that after it is used by 40 families still has a volume of 6,000 litres of water. No borehole can beat this level of performance.

Use and maintenance of wells

Due to the seasonality and the irregularity of rainfall, livestock keepers use a traditional system for the management of their crucial natural resources: water and grass. Access to land and water is handled at the level of the so-called *olosho* (section). Maasai belonging to other sections are obliged to ask official permission before entering the territory of another section. Also at a neighbourhood level families work together, for example, by closing certain pastures in the wet season to save them for times of drought. The selective use of water is also part of the management of the natural resources available. Unfortunately, this collaborative sharing of responsibilities and tasks is beginning to fall apart due to new land-tenure arrangements, the immigration of non-Maasai and the arrival of new activities that do not embrace traditional ways of livestock keeping.

The shallow wells are either inherited from parents or newly developed. Rich families tend to own wells. They are owned by an individual (92 per cent), a family (3 per cent), a clan or a local community (5 per cent) but this does not imply that the use of a well by non-owners is prohibited. Only in extreme cases is a well in individual ownership used exclusively by the owner. In the morning though, the first herd to get water will be the well owner's. In the tradition of the Maasai, every well is in theory freely accessible, irrespective of one's clan or social status, and refusing someone water is unthinkable, especially during a dry spell. Some informants point to the belief among the Maasai that withholding water from others will eventually lead to repercussions for the family, either the death of their animals or illness in the family.

Men and women have their own specific sets of tasks when getting water from shallow wells. The women collect water for domestic use and help the men by allowing livestock to descend towards the well in small groups. This guarantees that all the animals will drink and no accidents or damage will occur. The men are responsible for drawing the water, washing the animals and making them drink, the de-silting of the well, controlling the surrounding pollution levels and making repairs to the well and the trough. This is an ongoing process. Each user has to keep the well and its surroundings in good condition during and after the watering of the animals. In theory only the more crucial maintenance tasks are left to the owner, but others will often assist as a sign of gratitude for being able to use the well. Sometimes a person is hired to guard the well and undertake these tasks.

Solutions through the marriage of traditional and modern knowledge

The count conducted by the ASAL programme totalled 1,505 wells.[27] The oldest well still in operation dated from 1920.[28] The survey highlighted the main problems: the danger of collapsing walls and the raising of water. In collaboration with the AMREF (flying doctors), the water department of the Masai Rural Training Centre and the Belgian Embassy, which is financing the testing of several pump brands, the ASAL programme is taking the lead in the implementation of the practical phase of this shallow well project.

On a cost-sharing basis, the project is assisting with the financing of the improvement of the wells. The costs of an improved well are a maximum of Ksh 150-200,000, about 10 per cent of the costs of a borehole; the siting (Ksh 5,000), the digging (Ksh 30,000), the lining

(Ksh 35,000), the covering (Ksh 20,000), drainage (Ksh 10,000), fencing (Ksh 15,000), the hand pump (Ksh 50,000), and miscellaneous costs (Ksh 25,000). The improvements include placing a filter, enforcing and lining the walls, covering the well and installing a hand pump. These pumps have proven to be able to produce at least as great a volume of water per time period as the Maasai human ladder can.[29] As we have seen already, District Commissioner Wainwright expressed his expectation in the 1940s that the Maasai would welcome the hand pump with enthusiasm.[30]

Figure 8: Placing and testing a hand pump

The ASAL programme trained the well users in the operation and maintenance of the pumps. The Maasai are also taught how and where to negotiate with suppliers about the cost of a pump. This way the users now know where to go in Nairobi if their pump breaks down. This makes them fully responsible for the maintenance and repairs of these modernized wells, as they were in the past for their traditional wells. For a number of wells it was decided to install two pumps; a hand pump to collect water for domestic purposes and a mobile diesel-engine-driven pump to pump water for the animals. This separation within the water-drawing system allows for a higher quality of domestic water because it is no longer taken from the troughs. Moreover, the women no longer have to wait their turn, because before they were only allowed to fetch water after all the animals had left.

A second change in the use of shallow wells was initiated by non-Maasai immigrants who had settled on newly acquired plots of land. In need of water, they started to dig a well next to their homes and would strike water at varying depths, usually at 5 to 30 metres depending on the specific position of their parcel of land. They showed the Maasai that water was not just restricted to rivers and their surroundings. Possibly the drilling of boreholes by the authorities had made the Maasai think otherwise. The Maasai followed swiftly with digging wells on their new individual ranches. We could therefore talk about a third type of shallow well. Many Maasai have combined their efforts in grassroots organizations: they assist in helping each other financially and by providing labour for digging or improving shallow wells.

By the late 1990s the number of shallow wells in Kajiado District exceeded 3,000 and the water drawn from these new sources was opening up a completely new set of opportunities. Some people placed a water tank next to their well to store water. Ferro cement, aluminium and more recently large numbers of black plastic tanks or combinations of these are sprouting

up all over the sub-divided group ranches of Kajiado District. These tanks serve as storage for the dry season. Through gravity, water is transported to a system of tubes to irrigate a few acres of agricultural land, to a trough to benefit young sheep, or to a water tap for domestic use. This has really revolutionized the economic base of a number of households. In addition to allowing the cultivation of tomatoes, onions, vegetables, and the like, a few Maasai have started to grow bananas, oranges, mangoes, paw paws and even grapes.

Figure 9: Maasai women showing a paw paw and bananas

Often non-Maasai are hired to work on these *shambas*, but increasingly the Maasai men and women are actively participating themselves. For the latter, this development in the water sector has significantly reduced the time and effort needed to fetch water. This can now be spent on other activities and food security seems to have significantly improved because of this diversification of the household economy.

In addition to new opportunities in cultivation, a whole new and barely explored terrain is opening up that in the long term might even be more promising for the Maasai – the growing of special kinds of high-quality grasses. Back in the 1930s the colonial authorities were already doing experiments in this field but now as a result of the sub-division of the group ranches and due to the fast changes in the availability of water, it is now possible to grow grasses such as *Napier* and *Bana* grass. The first results seem to indicate that a combination of run-off water harvesting and some extra irrigation at the height of the dry season would allow these grasses to survive. As extra fodder this could lead to milk yields five times as high as those presently being produced.[31] With the rapidly decreasing availability of land for keeping livestock, this might be the best answer so far for continuing to be able to make a living in pastoralism.

Figure 10: Shallow-well water used for growing of *Napier*: The miracle grass

Conclusion

This article has stressed the importance of water for the Maasai economy, which explains the willingness of the Maasai now and in the past to develop sustainable water sources. These sources and the required equipment have over the years become less easy to obtain. This has been mainly due to an autonomous growth in the demand for water due to the rising population and larger cattle herds, but even more so because of a greater interference of political and juridical processes, in the past as well as now. Attempts by colonial and post-colonial authorities and donors to solve the area's water problems were mainly found in the drilling of boreholes.

Technical, financial and organizational problems linked to boreholes have contributed little to a solution for the growing water problems in Kajiado District, especially in those regions where another option is available. This alternative – digging shallow wells in or next to dry river-beds – is partly to be found in the traditional Maasai strategy of gaining access to sufficient amounts of water both for humans and animals alike. Down to a certain depth, these water sources are a non-expensive and sustainable substitute for boreholes. Research has shown that this local method of water collection has always played a significant role in the management of natural resources by the Maasai, but that top-down implementation of modern technology both by the government and foreign donors has meant that planners have ignored it until recently. The donor community for too long only valued modern, large-scale and expensive techniques, considering local, small-scale and cheap alternatives as inferior and less reliable. Finally, long-standing experience and interest from Kenyan water specialists and funds provided by a Dutch donor have raised the knowledge in donor and academic circles about shallow wells. Moreover, due to a parallel change in land rights in the Maasai area of Kajiado District – i.e. the sub-division of group ranches into individual plots – the construction of shallow wells has risen explosively. Even more important is the fact that this growing interest happened at the same time as a serious alternative to boreholes emerged in certain areas, i.e. the linking of modern techniques designed in a tailor-made fashion building upon local techniques, knowledge and problems. This has resulted in a merging of modern and traditional knowledge. This modern knowledge thus comes both from Western-trained technicians as well as from non-Maasai immigrants. The traditional knowledge likewise is a mixture of the wisdom of Maasai and Mbulu water specialists. Like the Maasai saying *Metolu lung' elukunya engeno*, – one single head does not have all wisdom, more heads are better. This collaboration has resulted in an improved well that it is now very sustainable from a financial, technical as well as a management point of view. The passive adoption of Western techniques has stopped and been exchanged for one that builds upon the resources, means and ideas of the local people. From a role of supplying and donating resources, the donor has moved to a position of translator and facilitator. If the outside threats on the quantity and quality of water sources in Kajiado District are kept to a minimum, this marriage will certainly last.

Notes

1. Falkenmark and Lundqvist (1994).
2. Norton-Griffiths, (1977: iii).
3. The British colonial power tried to interest Europeans in settling in Kenya. Part of the Maasai territory was offered to Jews in Eastern Europe to save them from persecution. The Jewish World Congress of August 1903, however, decided not to accept the offer but instead to strive for an autonomous state in Palestine. Still the Maasai had to make room for other newcomers, mostly South African Boers.
4. Before the Carter Land Commission the Maasai repeated once more their grievances about the loss of their dry-season grazing areas and water sources. They had every reason to be bitter because the northern boundary of the Maasai Reserve 'was so drawn as to exclude the most valuable water supplies, which are included in the land alienated to Europeans' (James,1939: 60).
5. Rutten (1992).
6. Spencer (1983: 130).
7. Blaauw (1927).
8. KNA/DC/KAJ.3/1 HOR, January 1946: 12.
9. KDAR 1929; KNA/DC/KAJ.3/1 HOR, January 1946: 17.
10. Back in 1975 it was already being reported that illegal logging was going on in the eastern part of the Loitokitok County Council Forest. Immigrants were felling trees to construct huts or to sell the wood as firewood or charcoal. This resulted in the reduction of the availability of water on the Kuku plains (DN 10/12/1975). The felling of trees for charcoal was prohibited. In April 1976, immigrants were allowed into the forest only within the framework of the 'plant by cultivation' project.
11. Masharen (1989: 11).
12. *The East African Chronicle*, 19 July 1996.
13. In April 1963 the Kajiado Agricultural Committee formulated a memorandum for a WHO-FAO mission concerning the development of water sources in the Maasai area. It mentioned the need to take a long-term vision with respect to the provision of water, and to improve the coordination of relevant water plans between all of the seven governmental bodies involved in water development in the district. A more sedentarized way of life was predicted for the Maasai pastoralists that would mean a change in the use of the land. It was concluded that the dams would turn out to be non-sustainable and for that reason the improvement of water extraction from the river should be promoted through the improvement of wells in the dry river-bed, the development of shallow wells and water harvesting roof catchments in de higher areas, the extension of pipelines and boreholes.
14. Njoka (1979: 181).
15. Moss (1989: 230).
16. Livingstone (1986: 271).
17. Peron (1984: 61).
18. Dietz *et al.* (1986: 12).
19. Ecosystems (1982: 13).
20. Van Klinken (1993: 9).
21. The ASAL Kajiado Programme had an annual budget of some 1 million guilders, of which about 10 to 20 per cent was spent on water projects. Attention has been mainly directed towards borehole rehabilitation, rural water supplies, micro water supply (shallow wells, tanks, roof catchments), sand and sub-surface dams (artificial aquifers in rivers) and training. In 1992 some Ksh 1.5 million was spent on borehole renovation and rural water supplies and some Ksh 1.9 million on micro water supplies, sand and sub-surface dams and training. In 1993 the principle of cost sharing was introduced (50 per cent of the costs needed to be paid by the community – Mwangi, pers. com.).
22. Mwangi (1990: 115). In the group ranches there are 45 boreholes, of which only 23 are operational. Individual ranchers possess 155 boreholes (56 functional). Institutions such as livestock training centres (59bh/22f), Ministry of Water Development (54bh/23f), other departments (27bh/2f) and Kajiado County Council (37bh/13f) are co-owners of the other boreholes. The owners of ten non-operational boreholes are unknown. Water from the boreholes outside the group ranches is primarily for human consumption in villages, schools and health centres.
23. An example of the top-down implementation of water projects with expensive modern techniques is the Swedish Amboseli Association (SAA) run by the Berggrens, a Swedish couple. Their purpose was to provide solar pumps to the Maasai around the Amboseli National Park. Initially a Swedish counterpart, Svenska

Amboseli Föringen (SAF) and SIDA, the Swedish government's development organization provided financial backing. The Berggrens in Kajiado acted independently and because of this ran into conflict with the Swedish organization. The financial support was stopped in 1996. A European Member of Parliament from the Swedish Green Party was contacted by the couple and he and his wife made a trip to Amboseli between 28/12/96-14/1/97. A letter of recommendation called upon 'anybody concerned to evaluate applications by the Berggrens for support to the continuation and development of the above-described project positively and in a spirit for the issues at stake: the survival of both wildlife and the Maasai people' (Gahrton 1997: 7). The MEP was convinced that 'solar panels might be part of 'high technology', but the experience of the Berggrens had shown that when they were established they were less vulnerable and more reliable and sustainable and - which is important - less expensive than other technologies available (ibid.: 2). The question though is who will benefit most from this request for support!

24. For specific information about this research I am much obliged to Dr Moses Mwangi.

25. In 1946 the authorities in Kajiado District reported Kamba and Mbulu well-diggers were employed by the Maasai. To prevent these people from settling permanently in the 'closed' Maasai District, it was announced that these labourers should request passes for the duration of their stay (KNA/DC/KAJ.3/1 HOR September 1946: 4).

26. The story of the Mbulu is that the Maasai in the past during their move southward regularly raided the Mbulu for cattle. The weaker Mbulu developed a way of hiding from the Maasai by digging underground hideouts, mostly in hillsides which provided shelter for both men and animals. The construction was covered with grass and shrubs and only a small entrance was left. This technique allowed the Mbulu to stay free from attacks by the Maasai for some time. While digging these bunkers, the Mbulu often struck groundwater and so they began to specialize in digging shallow wells in river-banks. The Maasai decided to put down their weapons in return for support from the Mbulu in their search for water (Tonkei, pers. com.). Nowadays, Maasai pastoralists still prefer to leave this hard manual labour to neighbouring groups like the Mbulu, Kamba, Luo and Kikuyu. But since very recently some Maasai, mostly due to poverty, have started to specialize in this kind of work. In Maasai culture somebody undertaking physical labour is considered to belong to a low social status.

27. Illustrative of the neglect of shallow wells in official statistics in the past is the 1991/92 conducted survey by the Dutch-funded Water Resources Assessment and Planning Project (WRAP). This survey counted 287 shallow wells for Kajiado alone (Wagura and Kanyanjua 1992). Likewise, the totals presented for other water sources, though to a lesser extent, underestimated the facts on the ground. It turned out that Dutch development funds in Kajiado would be better used in long-tern integrated project support than in sectoral programme assistance.

28. Mwangi (1993).

29. Confidence in the traditional way of lifting water (the human ladder) is high. Other systems would not be able to move as much water in the same amount of time. To a certain extent this claim is right as in just a few seconds 10 litres of water can be collected from a 10-metre-deep well. But it is also a hard labour-intensive and sometimes dangerous job, Incidences are known whereby human beings have suffered serious injuries to their heads because of falling buckets (Mwangi, pers. com.).

30. KNA/DC/KAJ.3/1-HOR, January 1946: 12.

31. This is based on the outcome of a trial conducted by an Italian water expert who keeps the standard type of Maasai livestock. Just as his Maasai neighbours, his animals are taken around the area in search of pastures by a herder. Upon their return the cattle are fed with *Napier* grass. Their milk yield has dramatically increased and the time the cows are in milk has also become longer. During the 1996 drought, his Maasai neighbours were queuing up to buy milk because their animals were completely dry (P. Langui, pers. com.).

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APPENDIX 1. DROUGHT AMONG THE KAJIADO MAASAI

Drought can never finish the Maasai cattle, only the human mouth can.

1. Drought: Scientific definitions and the Maasai concept

1.1 Introduction

The African continent is often associated with below-normal precipitation, dying trees and grasses, failed harvests, decreasing groundwater levels and rivers drying up, all of which bring rural producers to the brink of famine or result in disaster and calls for outside assistance. However, the summer of 1995 with its sunny weather and lack of rain showed people in the Netherlands that drought is not exclusively a phenomenon of the world's arid and semi-arid lands but can also occur in the world's more humid regions.

Drought is a condition of temporary aridity. Aridity (lack of moisture) is caused by five main processes: continentality, cold offshore currents, topography and dynamic anticyclonic subsidence, and high-pressure systems. Thirty per cent of the earth has a dry climate and all continents have dry ecosystems from hyper-arid to sub-humid (Mainguet 1990).

People define drought according to their experiences of rainfall patterns in their own specific area. This underlines the notice that drought is a relative concept: it is time and location specific. The Dutch farmer will speak of drought when rainfall is far below the normal precipitation of some 220 mm in the June-August period and sunshine hours are extensive, resulting in poor harvests and financial losses. A similar rainfall of some 100 mm in the Kajiado area over that same period would make Maasai pastoralists speak of extremely high rainfall figures in a normal dry season. Likewise, Bedouin pastoralists are able to practise agriculture in the Negev Desert with an annual precipitation of only 50 mm. Because rainfall is concentrated in the winter season, evaporation (drying of water direct from the soil) and transpiration (via plants) is low and sufficient water can be stored in the soil allowing crops to mature.

1.2 Drought: A scientific definition

The opening lines above indicate that the phenomenon of drought may be analyzed in terms of meteorological, agricultural, hydrological, socio-economic and organizational aspects. Scientific literature defines droughts accordingly. A broad classification is given by Vincent (1981), who distinguishes three types of drought: *permanent* drought in the driest climates; *seasonal* drought in climates having well-defined wet and dry seasons; and *contingent* drought resulting from irregular and variable rainfall during a period when rainfall is anticipated. It is the latter we are concerned about in this article.

In general, drought is a protracted departure from normal water availability, a water deficit that exists for a long enough period to cause hardship. More specifically, whether or not drought occurs depends on the type of activity for which water is being used and on the expected or required availability of water (Farmer and Wigley 1985).

Meteorological drought occurs when precipitation is significantly below expectations. Its definition involves only precipitation statistics and depends on the time of the year and on the

location. For Africa, droughts are on a larger regional scale and are of a more recurrent nature in comparison with European droughts. So far, climatologists are still struggling to explain the phenomenon of African droughts. Some are able to find certain linkages. For example, one of the latest reports states that small changes in water temperature along the coast of Chile caused by El Niño, a periodic warm Gulf Stream in the Pacific Ocean, are strongly correlated with rainfall in Zimbabwe. The explanation has yet to be found.

Hydrological drought occurs when water resources for industry, for human or animal consumption, or to support agriculture (e.g. by irrigation) reach low levels. Hydrological drought is usually reflected in low levels of rivers or lakes, reservoirs or groundwater. These levels are determined not only by precipitation but also by water usage and by evapotranspiration (direct and indirect drying) (Farmer and Wigley 1985). For example, many Kenyan lakes including Magadi, Nakuru, Naivasha and Victoria saw an increase in lake levels in the early 1960s after heavy rainfall. Lately there has been a seemingly permanent decrease with seasonal fluctuations. For the freshwater lakes, mainly for Naivasha, this low level probably reflects less a rainfall deficit than human overuse and deforestation.

Agricultural drought occurs when the water supply necessary for agriculture becomes scarce. An agricultural drought depends on the amount of rainfall expected and the use to which water is put, hence a shortage of water is felt because of human activity, whereas a meteorological drought creates stress on plant life unconnected with people and their needs. Agricultural drought is a moisture deficit on a sufficient scale to cause disruption of the rural economy. In an extreme agricultural drought, crops fail, and animals, and perhaps people, die. In this sense, soil types are of importance also. Deep soils offer good soil moisture storage potential, shallow soils do not.

1.3 Maasai definition of drought

This brings us to the Maasai concept of drought. The variety in occurrence and intensity of a drought is reflected in the Maasai drought classification with three categories. The first (*olameyu*) implicitly links failing rains to hunger. Rainfall is insufficient, pastures dry up and animals become thin and produce less milk.

However, Herren (1991) states that *olameyu* starts from the impact side (i.e. lack of food - *endaa*), rather than lack of rainfall. Furthermore, any dry spell or dry season is *olameyu* even if it does not (yet) affect production and nutrition. One might thus say that *olameyu* is more than ‘drought’, at least in the sense of meteorological drought; it is rather a crisis in the reproduction of both herd and family (Herren 1991).

Emboot

Another term used by the Maasai is *emboot*. It describes a disastrous situation whereby, due to a severe drought, livestock as well as wildlife die in large numbers because of a lack of grazing. An *emboot* is not a seasonal phenomenon covering just a few months but occurs over a longer period of up to one year. Some of these disaster periods have been given their own names (see Box 1). It also mostly affects a larger area than in the case of *olameyu*. In addition to the severe and long dry period, a small caterpillar is sometimes mentioned as a characteristic sign of *emboot*. It is found in dry grasses only and causes animals to die once they enter their stomachs.

Finally, *emperi* is thought to be the most serious type of drought of the three categories mentioned. During *emperi* the drought lasts for a long time, for over a year. Water holes dry up and the land turns to bare soil causing whirlwinds to blow dust into the air. All Maasai land is affected. People and livestock have to wander for long distances to fetch water and find pastures. In this form of drought, they often collapse and animal carcasses on the landscape indicate the severity of the disaster. Human lives are also threatened and sometimes lost. This kind of drought is dwindling and is less known among young Maasai because food relief nowadays prevents the loss of large numbers of human lives.

The Maasai give names to the various months of the year. Often such names are descriptive of climatic conditions. They differ from section to section because climatic conditions vary within the Maasai territory. In Kisongo Maasai vocabulary, a year is sub-divided into that of nine months of green pasture, known as *olari*. The short rainy period (November-December) is called *oltumumen*, while the long rains (March-April) are named *inkakua*. Finally, there is a period of some fading rains (drizzles) called *oloirujuruj* (May-July). The three months of drought (*olameyu*) (August, September and October) are called *pushuka, kipure* and *ndungus* respectively. In *pushuka*, the grass dries up and its green colour is lost. Water is not a problem. In the month of *kipure*, trees start shedding their leaves and at the end of this month, they start flowering. *Ndungus* is the worst month of drought in Maasailand. The Maasai say they do not invite people to come for a visit because the family cannot offer anything (i.e. milk). It is the month of hard work and an absence of ceremonies. It is also the time of dwindling livestock prices. At the end of this month, the trees (esp. *iloirero*) start producing a typical smell making the donkeys stroll. Two kinds of plants will also flower (*olagunguan, inkosikosi*) as a sign that the rains are near.

2. Kajiado District rainfall and evaporation

In Kajiado District rainfall is the single most important factor influencing agricultural activities, whether crop or livestock production. Rainfall figures vary from an average of 400 to 800 mm per year depending on the specific location. Norton-Griffiths (1977) showed that annual rainfall figures in Kajiado District are strongly influenced by mountains, hills and the Rift Valley. High rainfall occurs around the Ngong, Machakos and Chyulu Hills, on the slopes of Mt Kilimanjaro and the western side of the Rift Valley, with even isolated hills such as Namanga (Ol Doinyo Orok) having locally higher rainfall.

Mount Kilimanjaro

The rangelands of Kajiado District are characterized by lower rainfalls, particularly around Lake Magadi, and in parts of the Amboseli basin. This is either due to the rain-shadow effects from neighbouring hills and mountains or, as in the Amboseli case, to divergent wind flows between the mountain ranges (i.e. Chyulu Hills and Mt Kilimanjaro).

The rainfall pattern is characterized by a sequence of four seasons per annum. In general, the 'long rains' occur in April and May. This is followed by the main dry season until October. Then the 'short rains' of November and December bring relief until a short dry period in January, which lasts until March. Average monthly temperatures vary with altitude between 16ºC and 30ºC. Potential annual evaporation ranges from 1,700 mm to about 2,500 mm. As a result, water availability in the district is limited and droughts frequently occur.

BOX 1: DROUGHTS IN THE KAJIADO AREA

1925-27: *Olameyu Loolonito*
This is a drought during which people fed on the skin and hides of their animals. They chose good and soft parts in the skin and cut it and burnt and ate it with fat (hard fat) known as *enkurriny*. This drought was very dangerous according to the leaders interviewed: it killed nearly all the animals and people. It was also a very long drought, when it went for almost a full year without raining. Shortage of grass especially in the Magadi area

1929: Severe drought in the whole of the district. Some 50,000 animals lost. Provision of famine relief.

1933-35: *Olameyu Looloyik*
Great famine due to drought and locust invasion. In this drought, bones were sold to the people living in the urban areas. The bones were collected (dry bones) and were sold in exchange for a packet of maize flour. Also, in this drought a large number of cattle died and many people died because of hunger.

1938/39: Serious drought.

1943-46: *Emboot Enkurma Nanyokie*
Bad famine after severe droughts and hopper infestations. The government supported the Maasai by giving out maize flour. In those times, there was not white maize flour but it was a brownish maize flour.

1953-56: Period of drought, famine relief provided.

1960-61: *Emboot Enkurma Sikito*
Extremely severe drought. Again, the government distributed maize flour for the benefit of the Maasai. Many animals died. The maize flour came from the yellow maize.

1963 Food by Helicopter
During this drought, planes were used to transport food relief to the people. This was done so that everyone got his/her share. The helicopter was used for quick transport.

1973-76:
Severest drought since 1961. Some 60,000 people received famine relief. During this drought, the government sponsored people and gave them white maize flour. This time the drought did not kill many animals but just a few cattle.

1979-80
Rain was absent for a short period only. We cannot call it a drought because it did not last for a long time and the animals were not affected as much as in other droughts.

1984
This was a severe drought. It also killed animals but not as many as the *Olameyu Loolonitok*.

1992-94
This was not a drought but the rains came late. Nothing was affected meaning that animals did not die but people lacked food and were given food relief by the government. The government is still giving out food to the people.

1999-2000 A serious drought that wiped out large numbers of cattle, especially in the Magadi region.

APPENDIX 2. MAASAI RIGHTS TO WATER

Water is called *enkare* in the Maasai community and is believed to be life. It forms a vital part of the Maasai economy in addition to its domestic uses in cooking, washing and drinking. For example, it is used to water, wash and spray the animals. In Maasai society water has other very special uses especially in circumcision and marriages ceremonies when it is mixed with milk and poured over the participants of the ceremony.

Maasai dependence on rainwater forces them into a nomadic way of life in search of drinking water and green pastures. In the past, they looked for water in dry river-beds, a method known as *enturore oo'lchorroi* i.e. digging the river channels or any water source until the water table appears. Bare hands and pieces of wood were used to do this digging. After the *ilchorroi* were dug, troughs were made near the well to assist pouring.

For the Maasai, water is believed to be a natural gift from God and no other being can provide this gift. In the olden days the Maasai would organize themselves to find water and dug the river-bed on a clan basis. The clan or the community also sat down together to arrange the order for water use. One group of clan members would water for one full day and the other on another day. The owners also agreed to outsiders having water but without full responsibility, i.e., when the owners are through and if there is still water left. Because water is a gift from God, no person is left to die of thirst when other people have water. If a person is thirsty he or she is given water (blue water- *enkare pus*) which is water added to some milk. The thirsty person will quench his thirst and then thank the helper.

According to Maasai beliefs, there is no direct ownership of man over water. The Maasai follow this law strictly, and that is why no one is denied water when he or she claims to be thirsty. This law is only applicable for a Maasai who is fully dedicated to following Maasai taboos and values. On the other hand, one can own a source by having worked on it (by providing labour, power or finance).

The upkeep, control, utilization and maintenance of wells are the constant concern of the owners (families, clans). Access to wells and the work connected with their maintenance are a basic consideration of any stock management unit. The ownership of wells and the regulation of access to water in Maasai areas are a complex matter. In general every well is known as belonging to a certain clan and as being maintained and organized by the group of elder owners. This is to assist in solving problems among the division and rules for taking water. It is also up to the group of elder owners to plan the cleaning of the well and the water trough everyday since they do not allow unused water to remain because this could attract wild animals during the night who might destroy the trough or contaminate the water source.

The wells are owned by the father of the clan or the father's sons if he is absent with assistance from the clan elders. The son will inherit the well. He cannot lose it even if the well collapses or is in disuse for some time and people other than his descendants re-excavate it. Nowadays the wells are just known by the name of a certain clan who it belongs to but are used by the community without any thought being given as to who owns it. Only if a person from that clan is around is he given first priority when it comes to taking water. But working inside and any other contribution to the well makes everybody using it responsible and having certain user-rights. The major sanction underlying the Maasai system of water control is of course exclusion from water. Failure to supply labour at the well and failure to participate in the politics of water will soon lead to exclusion from the well.

BOX 2: The Iloogol-ala Maasai

Literally this means in Maa: the-who-are-hard-as-to-the-teeth, those of the hard teeth. The Iloogol-ala is a distinct Maasai section. Remnants of this group live near Selengei in the vicinity of Ilasit near Mt Kilimanjaro and Enkorika. The exact place within the group of Maa speakers is not clear. Some suggest links with the Ilbaraguyu in Tanzania, others refer to the Ilkuoni (Maasai blacksmiths and an assimilated group of people). The Iloogol-ala were wiped out in 1830-1840 by a combination of Southern Maasai sections (see Voshaar 1979: 39). They found refuge among other Maasai sections. Some old Maasai can still be found who claim to be descendants of the Iloogol-ala.

The Iloogol-ala were said to be well organized, cooperative and united, especially towards heavy-duty activities. Nowadays the Maasai remember the Iloogol-ala especially for their water-harvesting structures. It was tradition among the iloogol-ala that a new age group would not be circumcised unless they showed their 'togetherness' by producing a well that could satisfy both men and animals. So the *ilayiok* (uncircumcised boys) had to struggle to qualify for circumcision. These boys were ready when they were 28-30 years of age. Even today these water-harvesting pans can be found in the Selengei area.

Some of these wells or water catchments are still being used today. In areas like *olokii* there are some sites believed to be the iloogol-ala's efforts to harvest water. In another area like *olemankalio* 2.5 km from *ololakir* there are two broad wells i.e. *ilturot uasin*. Near that spot there is also a *lenchoni* i.e. a 'skin well' – all these were known to be iloogol-ala activities.

From the stories given by informants it is suggested that the Selengei River was flowing before the fight between the Iloogol-ala and the Kisongo. After their defeat, the Iloogol-ala community cursed the water. Then the river dried up and the Kisongo were forced to dig for water in the river-bed.

The traditional pattern of user-rights changed during the introduction of boreholes and dams. The County Council constructed several boreholes within Maasailand that are used by the community living around and paying taxes to the county council employee who is there to count the livestock taking water. In terms of maintenance and in case of any damage, the community is responsible for contributing a certain amount and involving the county council in repairs. There is an elected committee who, together with the employee, organizes and agrees on who is to get water first. The boreholes support the communities with enough water as long as fuelling and maintenance are guaranteed. The boreholes are not regularized by any clan or even ethnic group and are used by the whole community under communal ownership.