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AFFORDABLE WATER SUPPLY AND SANITATION

# 21st century water challenges in Kenya

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THE 21ST CENTURY water supply systems, irrespective of their geographical locations, should at least satisfy four broad requirements: 1). The systems should involve integrated water management in which minimum safety levels in quality are provided to enhance the quality of life. 2). Risk diversion in water management must be given due consideration. 3). Inter-sectoral and inter-state cooperation is required now more than ever to optimally utilize water resources which transverse state boundaries. 4). Recognition of global environmental problems which have direct influence on water resources such as acid rain, global warming, desertification, coastal erosion and land sedimentation.

Unfortunately, there are great disparities in levels of success to provide for the above requirements. The inequality lines divide the planet between continental entities that are adequately served and those that are not, between affluent countries and poor ones, between urban and rural areas and even within countries between regions which have achieved different population coverage and between cities and slum suburbs. It is a proven fact that the provision of potable water has a positive relationship with both child mortality and life expectancy (Fig 1).

Water in developing countries, such as Kenya, towards the 21st century is no longer a cheap and plentiful resource. This has been aggravated against the background of rapidly rising populations and scarcity of both tecxhnical personnel and resources necessary to sustain or expand the existing water capacity. This paper analyzes the state of both rural and urban water supply in Kenya and highlights the challenges for the 21st century. Some simple and inexpensive solutions that may be useful to other developing countries are proposed.

**Figure 1. Level of socio-economic development.**

**Figure 2. Water resources management in Kenya.**

## Water resources management in Kenya

Kenya is divide into 5 drainage areas (Fig. 2): Lake Victoria / Basin 1; Rift Valley / Basin 2; Athi River / Basin 3; Tana River / Basin 4 and Ewaso Ngiro / Basin 5. Only Basin 4 is wholly in Kenya. Water resources itself is an inter-disciplinary undertaking in Kenya. Among different agencies that have involvement in water undertaking are the central government, town councils and municipalities, institutions, private organizations and individuals. As can be immediately realized, each of these categories of water undertakers have different levels of access to technical services and financial support. As a result not all water projects undertaken can be expected to be efficiently designed, operated or maintained.

## Rural water supply: case study

A field survey was carried out in two very different areas of Kenya during the month of November 1993. Region 1 was located in the wet area and covered the districts of Kakamega and Bungoma. Region 2 was located in Kitui district of Eastern Province, which is a dry area. The annual rainfall in Region 1 is over 1800 mm while in Region 2 is about 900 mm. The locations are shown in Fig 2. The survey covered 287 households involving 1128 peofple in Region 1 and the corresponding figures for Region 2 were 49 and 150 respectively. The actual villages

surveyed and the number of people in each village (in brackets) were as follows: **Region 1: Kakamega District - Moi's bridge location:** Nyorutisi (112); **Bungoma District - Ndalu location:** Ndalu (65), Namwichula (62), Sinoko (15), Minyali (70), Nzoia (12); **Tongaren location:** Kakamwe (75), Wambichi (16), Sango (17), Nalondo (26), Sinoko (6), Mlimani (12), Mabusi (22), Namakhele (60); **Naitiri location:** Naitiri (15), Nabing'eng'e (21), Tabani (15); **Mbakalo location:** Nandorobo (73), Sango (225), Nasianda (40), Mbakalo (12), Karima (45), Makunga (35), Lutonyi (20), Nabiswa (49) and Matisi (8).**Region 2: Kitui District - Yatta location:** Kilala (6), Mulutu (12), Kwa Maingi (12), **Wamuyu location:** Kwa Ngawi (13), Kwa Vonza (10), Kibati location: Matheka (17), Matinyani (8), **Shongila location:** Shadaa (8),**Tungutu location:**Majengo (19), Monyenyoni (10),**Ivaini location:**Ivaini (16), Wanzua (8) and **Kiviini location:** Kiviini (11).

## Socio-economic details

Table 1 shows the socio-economic details for the rural areas covered in the survey. In Region 1 the average number of people per household was about 4 as compared to about 3 for Region 2. The size of farm holding per household was evidently different in both areas. In Region 1 an average household owns about 3 acres (1.2 hectares (ha)) while in Region 2 the average acreage is just less than 2 acres (0.8 ha). Region 2 seems to compare with the acreage found for arid rural Zambia where the land holding decreased from 1.7 ha in 1965 to 0.5 ha in 1985 (Chindumayo, 1987). For both regions, about half of the people owned iron roof houses from which rain water could be harvested. In Region 1, 18 households had to share one well. In Region 2, well water was ot so much used. Only one well was encountered among those people surveyed. Also Region 2 was not adequately covered by tap water at the time of the survey. Region 1 supposedly had alreayd been covered unde the rural water supply project by the government way back in 1970's. But many people had resorted to other water sources, thus abandoning the tap water source. Only a handful of households continued to use tap water. Out of those people surveyed, it became clear that upto 75 people had to use one tap point if everybody had to use only tap water.

## First hand information on water supply

### *Domestic water use*

It is clear from Fig.3 that no person from either region usually used river, pond or lake water directly for domestic purposes. In Region 1, 65.5% of the people never used tap water. In Region 2, 73.5% of people did not use borehole water. Well water was most popular in Region 1 where 62.4% of people always used it for domestic purposes. In Region 1 people had a wide choice of water sources. But in Region 2, the choices for water sources were restricted.

### *Livestock water use*

Livestock from either region normally never used tap water, though over 60% of the livestock from both regions either used rain, lake or well water (Fig. 4). In Region 1 morelivestock normally used river, lake and well water. In Region 2, the most popular source of water for livestock was river and pond water. It should be pointed out that the pond in Region 1 and 2 have completely different meaning. In Region 1 it referred to water impoundment often from a spring or runoff water.

But in Region 2, it often referred to rock catchments, and sand dams which are major methods of water harvesting in the arid and semi-arid lands (ASAL) of Kenya.

**Table 1. Socio-economic details for area surveyed.**

| | Item | Region 1 | Region 2 |
|---|---|---|---|
| 1. | No. of people surveyed | 1128 | 150 |
| 2. | No. of households | 287 | 49 |
| 3. | Persons per household | 3.98 | 3.06 |
| 4. | Acreage per household | 3.48 | 1.76 |
| 5. | Iron roof per household | 0.43 | 0.53 |
| 6. | Households per well | 18 | 49 |
| 7. | Households per tap | 19 | N/A |

**Figure 3. Domestic water use.**

### *Water for irrigation*

Irrigation did not seem to be widely practiced in either region (Fig 5). In Region 1 almost all those people surveyed said they never used any source of water for irrigation purposes. The implication was that they did not normally practice irrigation farming. But in Region 2, sometimes water from the river or ponds was used for limited irrigation. It also seemed like rain water was never directly used for irrigation. Some households in

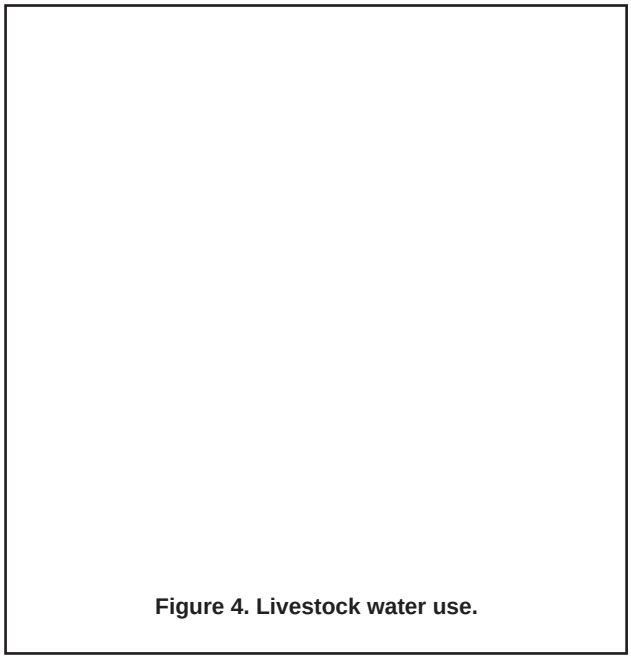

Figure 4. Livestock water use.

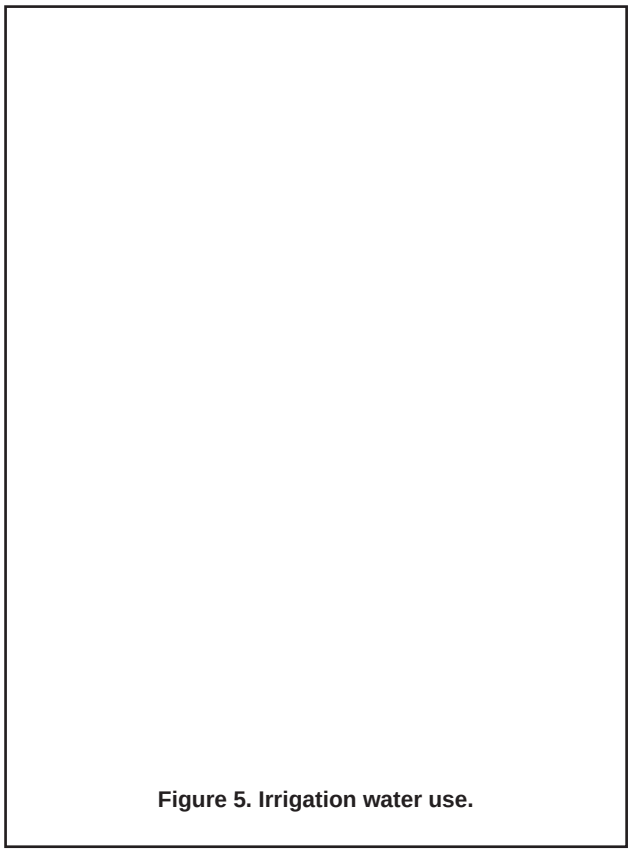

Figure 5. Irrigation water use.

Region 1 indicated that they used water from the river (3.5%) and from the well (30.7%) for limited irrigation mainly for market gardening.

### *Appraisal of water sources*

The appraisal of water sources cannot be standardized due different perceptions as influenced by the local environments. Even between Regions 1 and 2 very different appraisals were encountered (Fig. 6). In Region 1 no one particular source was ranked as a best source. In Region 1 therefore, those who said rain water was the best source were only 40.8% as opposed to those who thought the best source was river water (47.4%), pond or lake water (0.3%) and well water (56.4%). But in Region 2 the best water source was overwhelmingly indicated to be river (98%), rain (57.1%), well (16.3%) and pond 2%). Many people indicated more than one source as being a best source and nobody from either region indicated tap water to be a best source.

### *Reliability of water supply*

River water was rated as being the most reliable in both regions (Region 1 - 98% and Region 2 - 80%). A high percentage of people in Region 1 (50.9%) also indicated that well water was very reliable. Only 4.1% of people in Region 2 indicated that well water was a reliable source. Some sources of water were indicated to be very unreliable. In Region 1, only two sources were thought by some people to be unreliable: rain (73.5%) and tap (46%). In Region 2 all sources were thought to be unreliable: rain (22.4%), tap (59.2%), river (10%), pond (16.3%) and well (49%).

### *Water palatability*

In Region 1, 91.6% of the respondents said that rain water was the cleanliest as opposed to 8.2% in Region 2. This response for Region 2 is due to the first foul water which goes into the collection tanks from dusty roof tops (Makhanu et al., 1994). A mere 0.7% of people in Region 1 thought river water was clean, despite its availability throughout the year. This could be attributed to the high sediment load river water. In Region 2, 12.2% said river water was clean. Others said that well water was clean (Region 1, 12.5%, Region 2 8.2%). There were some sources which were particularly pointed out as not being clean. In Region 1 the various proportions of people who thought the different sources were not clean were: rain (1.4%), river (49.5%), pond (21.2%) and well (56.1%). In Region 2: rain (8.2%), river (55.1%) and pond (67.3%).

### *Those without iron roof houses*

Out of those who did not have iron roof houses, 4.9% from Region 1 said they sometimes used rain water and in fact 3% said rain water was the best source. Asked how they used rain water without iron roof houses, they said that they share such water with those who had iron roof houses. Such a situation was not so evident in Region 2 may be due to the scarcity of water.

### *Those with iron roof houses*

All those with iron roof houses sometimes used rain water. But only 34.1% of them from Region 1 thought rain water was the best source as opposed to 96.1% from Region 2. Almost everybody asserted that rain water was a reliable source (Region 1,94%, and Region 2, 100%). In both regions however, no one always used rain water for whatever purpose.

Figure 6. Rating of water sources.

Figure 7. Phase development of Nairobi water supply.

### *Opinion on tap water in region 1*

None of those interviewed said they always used tap water nor tap water being a reliable source. In fact only 11.2% said tap water was the best source. A further 34% said they never used tap water, as opposed to 66% who said they sometimes used either their own, another person's or a communal tap.

### *Those who owned hand dug wells*

All those who owned wells in Region 2 said they sometimes used well water, that well water was the best source and that it was a reliable source. But contrasting opinion was given by those in Region 1. Abut 97% of them always used well water. Only 90% of them thought it was te best source, though they owned wells. A small but significant percentage (1.6%) said they never used well water though the water from their own wells was used by others. A similar proportion said they only sometimes used well water. A rather surprising response was received on the reliability of well water by those who owned wells in Region 1. Only 8% of them thought it was reliable. But a further scrutiny revealed that, 9.2% of the same people usually used rain water instead. In fact 60% of those people who owned wells in Region 1 also had iron roof houses.

### *Those without wells of their own*

In Region1, 120 households out of 287 households surveyed never owned a well but 53.3% of them always used a neighbour's or a communal well. A further 12% sometimes used well water and in fact 48% said well water was the best source of water. Only 34.7% said they never used well water but 11% confirmed that it was indeed a reliable source of water. In Region 2, none of those without a well always used well water. Also, only 23.4% said they sometimes used well water and only 3.6% said well water was the best source. A further 4.2% said well water was reliable. In fact 76.6% of them said they never used well water.

### *General comments on water resources*

Each person admitted that the issue of water was preoccupying most of their lives. In Region 1 each person used an average of about 40 litres of water per day with the highest being about 80 litres per day. In Region 2, corresponding figures were only 20 and 40 litres respectively. Severe water shortages in Region 1 were felt in the dry months of January, February and November. In Region 2, severe water shortages were experienced all the time except during the months of January, October and sometimes December. It was also realized that what those in Region 1 called severe water shortages were considered average or even above average water conditions in Region 2.

### *Methods of water transfer and collection*

In both regions, rain water was harvested by many methods such as direct collection of water into buckets and drums, use of sisal leaves to direct more water into containers, roof ridges converted into water gutters and modern water collection systems. River water was collected in large buckets and transferred home by head, bicycles, oxen, donkeys or tractors. Few peofple had installed hand pumps on wells. The burden of water collection and transfer still rested on women. Some unemployed youths had evolved water colection into commercial ventures. The cost of 1000 litres being about US$ 1.45 (at an exchange rate of 1 US$ = Ksh. 70 at the time of the survey).

## Urban water supply

The urban water supply is well documented in Kenya and no effort has been made to repeat it here. However a brief overview of Nairobi's water supply is presented as a representative case for urban water problems (Fig 7). The first developed water source was at the turn of the 20th century when wholesome water was harvested from Kikuyu springs. Around 1940, the Ruiru pipelines were commissioned to raise the source capacity to 27,000 $m^3$ / day. This sequence of source development was continued consistently with further development of Sasumua pipelines in 1956, Chania II in mid 1980's and finally the present Ndakaini water supply to be fully commissioned around 1996. As a result Nairobi will soon drawn its water from 5 different sources with a total capacity of about 500,000 $m^3$ / day. This is expected to serve Nairobi's population o about 3 million people by the year 2010. This level of water supply translates into a per capita water availability of about 150 litres / capita / day assuming less than 10% water losses in the systems. Of course Nairobi is among the few cities in Africa with sufficient surface water resources, but not all other cities and towns in Kenya or elsewhere in Africa have had such average water supply systems.

## Water for the 21st century

It is evident that if the present rate of rapid population increase in Kenya is sustained into the 21st century, grave challenges face the provision of safe drinking water - especially to rural areas where over 70% of the population will stay.

The traditional water sources, such as springs and wells, which seem to have been neglected in favour of piped water systems must urgently be conserved, preserved and improved.

The notion that it was the responsibility of the government to provide water must be discarded through appropriate education and demonstrations.

Potential sources such as rain and well water should be fully developed where viable.

Different areas have specific needs and therefore it is important to take such local needs into consideration when prescribing any water management solutions.

Finally but not least, global efforts must urgently be made to conserve all upstream source areas if human kind has to enjoy the full benefits of nature.

## References

1) Chindumayo, E.N. (1987), A Shifting Cultivation Land Use System Under Population Pressure in Zambia, Agroforestry Systems, 5, pp. 15-25.

2) Makhanu K.S., S. Ikebuchi, H. Nakagawa and M. Tsunoda (1994), Engineering Challenges in Control of Soil Erosion and Desertification Versus Demand for Scarce Water in the ASAL of Kenya, 1994 International Conference on Hydraulics in Civil Engineering, 15-17 February, 1994, Brisbane, Australia, NCP No. 94/1, pp. 191-197.