Ground water resources and their seasonal variability - vulnerability to rural communities in the middle Nzoia River catchment, western Kenya

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Rationale. Water is essential for livelihood as well as socio-economic development of any community (Mato, 2002; Kleiner, 1999). The study was carried out in the middle Nzoia catchment in the western part of Kenya (Fig. 1a,b). The area has no tap water and surface water is degraded (Fig. 2a). Groundwater is the major source of water for domestic use by the rural communities. Kenya is classified by the U.N. as a chronically water-scarce country (Republic of Kenya, 1992). Global warming impacts are likely to accentuate the water scarcity and vulnerability to the rural communities. The integrated assessment of the seasonal variability of shallow wells and spring-water yields could be preliminary indicators of the impact of climate change on water resources in the study area.

Objectives

- Determine spring discharge rates and shallow well yields.
- Evaluate seasonal variability of spring discharges and yields from wells
- Identify dominant land use in the watershed

Fig.2a: River water laden with sediments

Fig.2b:Developed springwater

Results. The results (Table 1a) show that a majority (58.8%) of springs were rated 6th class (63 – 630 ml/s) at the onset of rainfall. They improved during peak rain (August) - a majority (76.5%) rated 5th class (0.63 - 6.3 l/s). Water depth of shallow wells (Table 1b), followed the same pattern. Highest water depth at onset averaged 4.2 m and at peak rain the highest were 5.43 m. The net spring discharge and well yields increased +3 l/s and +3.9 m, respectively (Table 1a,b).

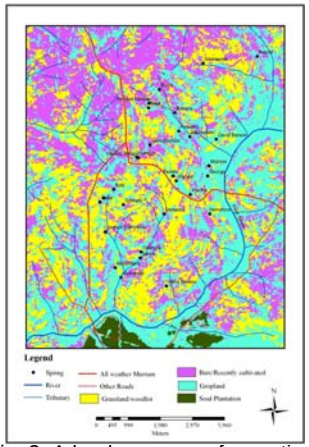

Fig. 3: A land use map of a section of the study area

Conclusion 1: Yields from the springs and shallow wells were sensitive to rainfall intensity

Conclusion 2: Land use maps showed that a majority of the watershed is more or less barren, therefore recharge of the ground water aquifers in the study area is reduced.

Conclusion 3: The communities are dependent on rainfall for adequate ground water availability; therefore there is a high vulnerability to changes in climate.

Recommendation: From these conclusions it should be recommended that the local communities be empowered by the government and/or development partners (NGOs) to conserve their respective spring catchments and the entire Nzoia River watershed.

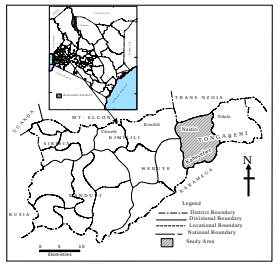

Fig. 1a: Location of the study area

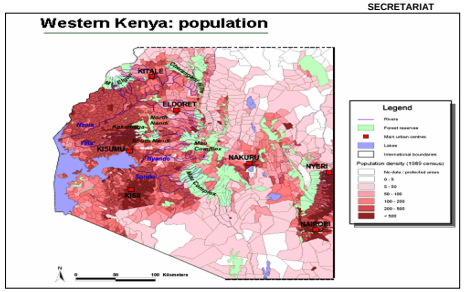

Fig1b: Western Kenya population density

Methodology. Developed springs (Figure 1b) and shallow wells were located with community assistance. A Global Positioning System (GPS) was used to record the coordinates and elevations of each water source. Sixteen springs and eight shallow wells were randomly selected for water discharge determinations. Enclosed watersheds with a minimum threshold value of 45,000 sq. meters were established using GIS software. Dominant land use in each watershed was identified using a land use map derived from 2003 Landsat images, so this will be updated. Rainfall data were also collected.

Table 1a: Spring water ratings

Spring	MARCH-MAY		AUGUST		RATING
	YIELD l/s	CLASS RATING	YIELD l/s	CLASS RATING	
S1P	0.50	6th	0.65	5th	+1
SP2	0.25	6th	0.77	5th	+1
SP3	0.03	8th	2.42	5th	+3
SP4	0.16	6th	1.27	5th	+1
SP	0.67	5th	1.12	5th	0
SP6	0.07	6th	2.03	5th	+1
SP7	0.08	6th	0.48	6th	0
SP8	0.40	6th	0.91	5th	+1
SP9	2.85	5th	5.40	5th	0
SP10	0.27	6th	0.54	5th	+1
SP11	0.41	6th	0.76	5th	+1
SP12	0.17	6th	0.85	5th	+1
SP13	0.25	6th	0.96	5th	+1
SP14	<8 ml/s	8th	0.12	6th	+2
SP15	0.86	5th	0.73	5th	0
SP16	0.06	7th	<8 ml/s	8th	-1

Table 1b: Yields from shallow wells

Shallow Wells	Water depth (m) May	Water depth (m) August	Water depth Increase (m)
SW1	1.23	1.83	+0.6
SW2	--	2.94	ND
SW3	1.53	5.43	+3.9
SW4	0.85	3.43	+2.58
SW5	1.07	3.77	+2.7
SW6	0.5	2.28	+1.78
SW7	2.73	2.05	-0.68
SW8	4.42	3.50	-0.92

Discussion. Apparently the system in the study area is very sensitive to modest changes in rainfall. The aquifers seem to be replenished by effective rain water rapidly reaching the aquifer, probably through macro-pores or fissures (Mailu, 1992). A change in the amount of effective rainfall tended to alter recharge. In cases of severe droughts the study area could be water stressed, thus exposing communities to unreasonably conditions of water scarcity. According to WHO/UNICEF (2000) and Cairncross (1990), too little water makes it virtually impossible to maintain the necessary sanitary conditions in the home, which can lead to the outbreak of debilitating and/or fatal diseases for children. There is a need for the application of an integrated water resource management plan to adapt local communities to the hydrologic effects of climate change to provide improved health and lessen vulnerabilities.

Cairncross, A.M. (1990). Health impacts in developing countries: New evidence and new prospects, J. Chart. Instit. Water and Env. Man, 4(6), pp 571-577; Mato, R.R.A.M. (2002). Ground Water Pollution in Urban Dar es Salaam, Tanzania: Assessing Vulnerability and Protection Priorities, Univ. Press, Eindhoven
Kleiner, S M, (1999), Water: an essential but overlooked nutrient. *J. Amer. Die.c Assoc.* 99 (2), pp 200-206; Republic of Kenya (1992), The Study on the National Master Plan. Government press. Nairobi; WHO/UNICEF (2000). Global Water Supply and Sanitation Assessment 2000 Report. WHO/UNICEF, USA.