

## Original article

# Health risk assessment of a planned irrigation scheme along the Genale River, South Ethiopia

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**Abstract:** Health risk assessment of a planned irrigation scheme along the Genale River, South Ethiopia, was conducted in June 1994 covering parasitological, entomological, malacological and environmental/ ecological parameters. Malaria due to *P. falciparum* and *P. vivax* appears to be the main health problem. The implicated vectors are *Anopheles gambiae* and *A. pharoensis*. *P. martini*, the vector of visceral leishmaniasis in the Aba Roba focus, Southern Ethiopia, is present in the study area although the status of visceral leishmaniasis here is uncertain. Intestinal parasites, including schistosomiasis, were very low in prevalence. The possible health consequences of the planned irrigation scheme and precautions to be taken are discussed. [*Ethiop. J. Health Dev.* 1997;11(3):229233]

## Introduction

Water resources development, especially in arid and semi-arid environments, may bring about profound ecological changes which in turn may lead to the aggravation of existing diseases and their vectors and/or introduction of new ones (1,2). Many of the most serious diseases that affect mankind depend in one way or another on water for their transmission (2). In particular, the transmission and spread of parasitic diseases such as malaria and schistosomiasis are invariably associated with water impoundment (2). In Ethiopia, the development of irrigated agriculture in the Awash River Basin and Finchaa Valley is a vivid example of how such activities may lead to almost insurmountable schistosomiasis problem (3). For the control of the existing or prevention of the anticipated diseases and their vectors, it is strongly advised to undertake ecological and health risk assessment surveys of the envisaged development schemes at the initial stage.

The Oromo Relief Association (ORA), Addis Ababa, Ethiopia, is planning to undertake a stage by stage development of irrigation schemes at Genale village located along the Genale River for settlers, the majority of whom are Oromo refugees returning from neighboring Somalia. The plan of ORA is to install pumps along the river to irrigate initially about 100 ha of land. The main objective of the present study was to make health risk assessment of the development scheme planned by ORA. Hence, parasitological, entomological, malacological and environmental/ ecological surveys were conducted at the site in June 1994.

## Methods

*Study area and populations:* The Genale project site is at Genale bridge (Fig.1) and is located at a distance of 47 km east of Negele Borena town. The elevation is about 1000 meters above sea level in

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the basin. The communities involved are Genale village (population of about 2000) and Genale Dume village (population of about 1000) although more settlement is envisaged in the area. Genale village is located on the western side of the river on the Sidamo side while Genale Dume is located on the eastern side of the river on the Bale side (Fig.1).

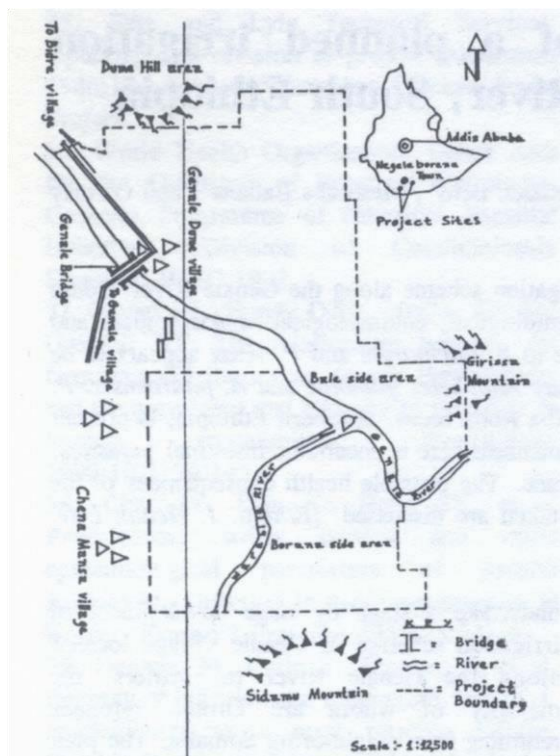


Figure 1: Sketch map of Genale project site

*Parasitological examination:* In each village every 5<sup>th</sup> house was selected by systematic random sampling method and all residents in the selected houses were summoned for parasitological examination.

Fresh stool specimens were collected on pieces of plastic sheets and about 1 g each transferred into screw-capped vials pre-filled with 10% formalin. In the laboratory, the specimens were examined by the formol-ether concentration technique (4).

Urine specimens were collected in wide-mouthed plastic vials and examined on the spot for *Schistosoma haematobium* by the filtration technique (5). Examination of urine samples for schistosomiasis haematobium was undertaken because most of the people were refugees who just returned from somalia where the disease is known to be endemic (6).

Blood smears, thin and thick, were prepared by finger pricking of febrile and malaria suspected cases and were examined on the spot. For confirmation, duplicate smears were also fixed with 70% ethyl alcohol and re-examined after staining with Geimsa.

*Vector survey:* Mosquitoes were collected from within houses and animal quarters using suction aspirators and killed with chloroform. They were then transported to the laboratory where they were identified by species using appropriate keys.

Sandflies were caught using CDC light traps, sticky plastic sheets (smear with edible oil on both sides) and suction aspirators from likely habitats such as pipe-type termitaries, huts, tree holes, animal burrows and rock crevices. The specimens collected on sticky sheets were recovered with

camel-hair brush and were successively washed in 10% Savlon and later in 2-3 changes of distilled water. These specimens and those collected by other methods were then preserved in 70% ethanol and transported to the laboratory in Addis Ababa where they were first rehydrated in water for 24 hrs and then cleared in Nesbitt's solution for another 24 hrs. They were then mounted on a slide in chloral hydrate and identified to species using appropriate keys.

Volunteer human baits were used for catching blackflies (*Simulium* spp.) at selected sites along the bank of the Genale River.

For collection of tsetse flies, biconical traps, baited with acetone and cow urine as odor attractants, were put up for 24 hrs at selected sites along the Genale River.

Search for snails was conducted along the banks of Genale River. Collected snail shells were identified using appropriate keys.

#### *Environmental/ecological observation:*

Environmental characteristics such as presence/ absence of vegetation, other water bodies, termite hills, animal burrows, rock crevices and open defecation sites were observed and recorded.

## Results

*Schistosomiasis mansoni:* Altogether, 912 individuals from the two villages were stool examined. Of these only 7 (0.8%) individuals, aged above 20 years and who reported to have come from Meda Wallabu (Bale Region) and Negele Borena (Sidamo Region), were found positive for *S. mansoni* ova in their stools.

Table 1: Age-specific prevalence of intestinal parasites among residents of Genale villages, June 1994.

Age (yr)	No. Ex.	Al.	Tt	HW	TS	HN	ST	SM	EH	EC	IB
0-4	219	34(15.5)	8(3.7)	7(1.1)	3(1.4)	6(2.7)	1(0.5)	-	14(6.4)	30(13.7)	9(4.1)
5-9	224	52(23.2)	24(10.7)	12(5.4)	2(0.9)	10(4.5)	1(0.4)	-	34(15.2)	50(22.3)	21(9.4)
10-14	119	24(20.2)	10(8.4)	11(9.2)	1(0.8)	7(5.9)	1(0.8)	-	16(13.4)	34(28.6)	12(10.1)
15-19	52	7(13.5)	6(11.5)	8(15.4)	4(7.7)	2(3.8)	1(1.9)	1(1.9)	11(21.2)	18(34.6)	6(11.5)
20-24	51	6(11.8)	4(6.7)	2(3.9)	3(5.0)	-	0(0.0)	2(3.9)	6(10.0)	8(35.3)	14(23.3)
25-29	44	6(12.5)	1(2.1)	1(2.3)	4(8.3)	-	-	0(0.0)	10(20.8)	13(29.5)	8(16.7)
30-34	54	8(13.6)	3(5.1)	2(3.4)	5(8.5)	-	1(1.7)	2(3.4)	7(11.9)	12(22.2)	4(6.8)
35-39	38	4(10.5)	3(7.9)	3(7.9)	3(7.9)	1(2.6)	1(2.6)	2(5.3)	5(13.2)	8(47.4)	3(7.9)
40-44	28	1(3.6)	1(3.6)	2(7.1)	-	-	-	1(3.6)	5(17.9)	1(39.3)	5(17.9)
45-49	15	3(20)	1(6.7)	-	1(6.7)	-	-	-	3(33.3)	4(26.7)	2(13.3)
50+	68	3(4.1)	5(6.8)	4(5.4)	8(10.8)	1(1.4)	-	-	13(17.6)	28(37.8)	11(14.9)
Total	912	141(17.1)	66(7.7)	60(7.0)	34(4.0)	27(3.1)	5(0.6)	1(0.8)	123(14.3)	231(26.3)	95(11.1)

Al = *Ascaris lumbricoides*

Sm = *Schistosoma mansoni*

Tt = *Trichuris trichiura*

Eh = *Entamoeba histolytica*

Hw = Hookworm

Ec = *E coli*

Ts = *Taenia saginata*

Ib = *Iodamoeba butschellii*

Hn = *Hymenolepis nana*

St = *Strongyloides stercoralis*

*Schistosomiasis haematobium:* Only one boy, aged 10 years and who reported to have returned with his parents from Somalia, was found positive for *S. haematobium* ova in his urine.

*Other intestinal parasites:* The species and the age specific prevalence of other intestinal parasites in the communities surveyed are presented in Table 1. Among helminths *Ascaris lumbricoides* was the most prevalent followed by *Trichuris trichiura* and hookworms. All helminth parasites except hookworms, *S. mansoni*, and *Taenia saginata* were more significantly ( $p < 0.01$ ) prevalent among children aged below 15 years. Protozoan cysts were more or less equally distributed in all age groups.

**Malaria:** Of 32 febrile and suspected malaria cases examined 10 (31.3%) children aged below 15 years were found positive for malaria (4 *P. falciparum* and 6 *P. vivax*).

**Entomological findings:** Anopheline mosquitoes : *A. gambiae s.l.*, *A. pharoensis*, and *A. marshali* were collected from within soil cracks (outdoor), animal shelters (indoor) and human baits (outdoor).

The sandflies collected were *Phlebotomus martini* and *P. rodhaini* and a number of *Sergentomyia* species, mostly from shafts of termite hills.

No blackflies and tsetse were collected during the survey.

**Molluscan vectors:** Only shells of *Bellamiya* spp. and bi-valves were collected along the banks of the river.

**Environmental/ecological observation:** The banks of the Genale River contained little or no micro-vegetation and the water was fast flowing and appeared to carry lots of silt. A small seasonal stream entering into the River had sandy bottom and was dry at the time of the study.

Table 2: Age and Sex specific prevalence of malaria at Genale project site (both villages combined), June 1994.

Age (yr)	No. Exam		No. Positive			
			<i>P. falciparum</i>		<i>P. vivax</i>	
	Male	Female	Male	Female	Male	Female
<1	1	0	0	1	0	0
1- 4	2	2	1	0	0	1
5- 9	7	3	0	1	2	0
10-14	8	5	0	1	1	1
15+	2	2	0	0	0	0
Total	20	12	1	3	4	2

The reverine macro-vegetation was grass woodland dominated by a number of *Acacia* spp. Furthermore, the area is characterized by abundant pipe-type termitaries.

Table 3: Sandfly fauna in the project site of Genale River basin, June, 1994.

	Method			
	Sticky trap	CDC light trap	Aspirator	Total for all methods
<i>Phlebotomus martini</i>	19	8	-	27
<i>P. rodhaini</i>	2	-	-	2
<i>Sergentomyia</i>				
<i>vorax</i>	2	3	-	5
<i>antennata</i>	1	1	-	2
<i>bedfordi</i>	191	3	-	194
<i>clydei</i>	1	-	-	1
<i>garnhami</i>	55	10	-	65
<i>ghesquerei</i>	5	7	-	12
<i>inermis</i>	-	1	-	1
<i>ingrami</i>	3	3	-	6
<i>kirki</i>	-	1	-	1
<i>kitonyii</i>	63	1	3	67

<i>magna</i>	4	-	-	4
<i>multidens</i>	-	-	-	
<i>schwetzi</i>	84	1	-	85
<i>suberectus</i>	22	2	1	25
Total	452	41	4	497

Although there were no piped water supply and sanitary facilities in any of the villages, open defecation was observed in very few sites, the probable reason being people defecating in the bushes away from homes.

## Discussion

The absence of snail hosts and the extremely low prevalence of schistosomiasis indicate that the disease has not yet established in the Genale project site. Absence of snails along the banks of Genale River may be related to the velocity and silt content of the water and lack of aquatic microvegetation. However, irrigation development may create a conducive habitat for the breeding of snail hosts in the future. Hence, with irrigation related environmental/ecological modification and increased population movement to the newly developing area, *schistosomiasis mansoni* may become established. Regular malacological and parasitological surveillance must be instituted in time to prevent it.

Although the altitude of the Genale River basin is about 1000 meters above sea level (m a.s.l.), at the project site its microclimate, especially as it descends towards the Somali border, may make the ecology receptive to the transmission of urinary schistosomiasis if the actual and/or potential snail hosts are introduced. Hence, regular malacological and parasitological monitoring is required in conjunction with that of *schistosomiasis mansoni*. Particular attention should be given to people returning or coming from neighboring Somalia since the Ethiopian snail hosts of *Schistosoma haematobium* are known to be susceptible to the Somalian strain of the parasite in the laboratory (7).

As regards malaria, both of the vectors of malaria in Ethiopia - *A. gambiae* s.l. and *A. pharoensis*, and the parasites- *P. falciparum* and *P. vivax*, are present in the area. The creation of perennial waterbodies resulting from irrigation and drainage canals will certainly create more conducive breeding habitats for the mosquito vectors which may lead to perennial transmission of malaria unless control is strengthened. The concern should also be viewed from the increasing occurrence of drug resistant malaria parasites in Ethiopia (8).

*The presence of A. gambiae*-complex, the most important anopheline mosquito transmitting malaria in Ethiopia (9), is of concern, since this mosquito species, by virtue of its endophilic and exophilic tendencies, is known to show varying biting and resting habits thereby posing difficulty in its control. This calls for the need of supplementing intra-domiciliary application of insecticides with other vector control measures such as environmental management and larviciding. The fact that mosquitoes were collected from animal shelters may help as zooprophyllaxis as this may reduce mosquitoes entering human habitation. Hence, the residents should be taught, in addition to other measures, to breed and keep cattle close to their habitations. On the other hand, *A. pharoensis* commonly breeds in, among others, irrigated areas (10). Hence, intermittent drainage of the canals will be important for its control.

The presence of *P. martini*, the known vector of visceral leishmaniasis in the Aba Roba focus, southern Ethiopia (11) and in neighbouring Kenya (12), in the study area shows that the disease, if introduced, could become a public health problem. According to local information the disease is said to be endemic in Filtu district, about 150 km east of Genale project site.

No blackflies and tsetse flies were caught although the Genale River basin appears to be ecologically conducive for their breeding and transmission of both onchocerciasis and trypanosomiasis. The Genale River is a fast flowing waterbody bisecting a grassed woodland located at a relatively low elevation of 1000 m a.s.l or less. The absence of the vectors during the study may simply be related to season. Hence, more longitudinal entomological study and parasitological survey are necessary to monitor the situation.

Compared to many areas of Ethiopia (13,14) the prevalence of intestinal parasites in the Ganale project site are very low. The present status may be due to high temperature which results in the desiccation of the parasite eggs, larvae and cysts. With increased population settlement and modification of the microclimate by the irrigation to be developed the parasites may increase in prevalence. Hence, the residents should be taught about the importance of personal and environmental sanitation for their control.

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