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WATER AND SANITATION FOR HEALTH PROJECT

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MAURITANIA

PUBLIC HEALTH ASSESSMENT OF PROPOSED DAMS, WATER-RELATED DISEASES AND COMMUNITY WATER SUPPLIES

MAR...1981

Contract No. AID/DSPE-C-0080

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March 19, 1981 File: T-16

Mr. Allan Reed
United States Agency for International Development
Nouakchott, Mauritania

Dear Mr. Reed,

I have the pleasure of transmitting herewith thirteen copies of a report on the health impacts of proposed dams and community water supplies in relation to a rural land reclamation project. This report was prepared in response to the Mission's request of December 9, 1980, in Cable Nouakchott 04977. The WASH Project was authorized to provide these services by the Office of Health in the Development Support Bureau, in Order of Technical Direction No. 16, dated December 15, 1980. The report was prepared by Dr. Emile Malek and David Goff, P.E., based on their work in Mauritania between January 8, 1981, and February 2, 1981.

We wish to acknowledge here the kind assistance your Mission provided to these consultants, and if you have any questions about this report we will be happy to try to answer them.

Yours sincerely,

Peter J. Kolsky
for the WASH Project

PJK/RS

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PUBLIC HEALTH ASSESSMENT OF PROPOSED DAMS:
WATER RELATED DISEASES AND COMMUNITY WATER SUPPLIES
(Rural Land Reclamation Project)

Report
by
Dr. Emile A. Malek and David R. Goff, P.E
WASH Project Consultants
for
USAID, Mauritania (GIRM): 682-0203
March 1981

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I. BRIEF PROJECT DESCRIPTION AND SCOPE OF WORK

Recession agriculture has probably been practiced for centuries in the water-short (150-400mm) "barrage" area of Southern Mauritania. Traditionally, these earthen dams are hand constructed by the farming families in order to collect the precious rainfall from vast flat watershed areas. The retained water is hopefully adequate to saturate the basin soils for the short seasonal crops. If planting must begin when water is still standing, the dam is broken and the water 'wasted' downstream. There is great potential for more effective use of scarce water resources in this Brakna/Gorgol region where success with GIRM[1] improved dams encouraged GIRM to request USAID to construct the proposed twelve (12) improved dams. These will have moisture compacted cores and reinforced release structures. USAID must also train and assist in the redevelopment of the GIRM Rural Works Department (Genie Rurale); especially their contract supervision capability. The project proposes to increase production and reliability of these recession agricultural sites to better support the development and livelihood of many currently struggling barrage communities; an estimated 13,000 people.

Properly designed dams will insure more effective catchment and, should adequate rains fall, result in longer periods of greater quantities of standing waters at these sites. Given a few favorable conditions, the prevalence of water related diseases might increase. We were therefore asked:

*to assess possible impacts of the projected dams on the prevalence of such disease and make recommendations for their surveillance and control.

Water is not only the limiting factor for cultivation but also for the welfare and continued existence of the community and their livestock. The provision of drilled wells was proposed. We were asked:

*to evaluate the proposed wells and make recommendations regarding adequate and safe water supply improvements.

In addition, various environmental/engineering tasks were requested:

*to evaluate proposed siltation basins, rain catchment ponds, hydrological and other testing for dam design.

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[1] GIRM is the abbreviation for the Government of the Islamic Republic of Mauritania.

2. SUMMARY AND CONCLUSIONS

A. WATER RELATED DISEASE

1. In November, 1980, GIRM -CNH (Centre National d'Hygiene) at the bequest of USAID, made an initial survey of the proposed dam sites for several water-related diseases in Southern Mauritania, (Annex III). Urinary schistosomiasis, malaria, and dracunculiasis were found. From seven of the drier Brakna sites (150-250mm of rain), only one positive case of urinary schistosomiasis was diagnosed out of 137 persons examined. At the three, more southern Gorgol sites (250-400mm), 19 of 56 examined were positive.

2. For the present assignment, a field trip was made (January 19-21, 1981), with the guidance of the Director of CNH, Dr. Sidatt, to most of the Brakna sites to investigate the epidemiology, presence, and control methods of these diseases. Host snails were not found at any of those proposed USAID sites during the brief field inspection. In fact, only two small puddles of water remained, heavily contaminated and well-used, out of those five proposed Brakna sites visited in January, 1981. However, those currently without snails or water are suitable habitats if snails are introduced. The two to three month period of rainfall catchment is long enough for seasonal transmission of schistosomiasis, malaria and guinea worm.

3. Host snails for Schistosoma haematobium were identified at Choggar Sud and Dionaba. Urinary schistosomiasis was reported to be prevalent in the nearby villages. These are two of the very few sites in the Brakna region which normally have substantial amounts of standing water for most of the year. Although these are not USAID project sites, they are GIRM-improved dams with reinforced release control structures. It is reasonable to assume that the disease prevalence, cultivation, livestock, dam operations and water use practices at these two sites are representative and should be used to assess probable development at USAID barrage sites.

4. From these cursory surveys, and as one would expect, it appears that the prevalence and probability of water-related diseases at these sites varies directly with the proximity to, and amount of, available surface water.

Information is inadequate for populations, health, water use and other characteristics of the barrage communities, whose size may vary drastically with the season.

5. In order to effectively evaluate probable developments based on representative information, a follow-up survey, when the basins are retaining maximum waters, is necessary for 1981. Future studies should be population based; determine systems of contamination and transmission; include diarrhea, skin diseases, dysentery, and more thorough examinations. Specific elements are more fully discussed in Section 5 and Annex I.

6. Future surveillance is essential since, at present, some dams do not pose serious water-related disease problems; while others vary from manageable to requiring considerable control efforts. A regional Surveillance and Control Team should be established. GIRM should provide the manpower and resources with USAID financed training of 2-3 Mauritanians for about 4 months in schistosomiasis-endemic areas where a surveillance and control program is in operaton. It is essential that the trainees learn how to recognize various water-related diseases, develop health data, determine routes of infection, proper hygiene and methods for control. Initially, a pilot project site should be chosen for careful study where urinary schistosomiasis is known to exist, supplemented by periodic regional surveys. Experience gained during 2-3 years will be applicable to the larger area and could eventually support the development of a national control program.

7. USAID should also provide funds for molluscicides, chemotherapeutic drugs and consultants.

8. Determine the molluscicidal efficacy of fruit from the common local tree, Balanites aegyptiacus, on the local snail fauna. Possible local production and distribution should be evaluated if molluscicide is effective.

9. Standard control measures for schistosomiasis and malaria should be practiced and evaluated; including regular rapid lowering of basin water levels to strand the snails and mosquito larvae; and draining and filling of small, contaminated rain-filled depressions. The alternative of providing safe and adequate water supplies for the communities is complex and requires further study and development.

B. COMMUNITY WATER SUPPLIES (CWS)

1. Based upon the reported findings, especially cost/effectiveness and uncertainty, and the complexity and long-term commitment required for developing this particular region, it is recommended that the currently proposed ten drilled wells be deleted from the project and water supplies for the Brakna/Gorgol region and barrage sites be addressed separately, in another project where adequate information and cost effective methods can be developed. (Section 7)

2. As there is a definite CWS problem which cannot be resolved reliably or cost-effectively by provision of permanent wells it is prudent and necessary to better define the problem. Appropriate alternatives can be evaluated and developed should actual needs dictate response, e.g., when community development is limited by lack of water or the healthy effects of non-potable water. Development of these alternative is essential should USAID further decide to provide improvements.

3. In addition to the 1981 survey components described above, the following should be determined at the same time: water availability, use and demand; sanitary improvements and interventions which will be accepted and effective; the separate effects of water-washed, -based, -borne, and related vector diseases; the probability of interbasin transmission of disease and the application/use of traditional land and water rights and water-finders (Rizateen).

4. Expand the proposed Surveillance and Control Team to include development and assessment of regional baseline data on items listed in 3. Utilize health posts in development of program. (See Annex III-p 10, and maps.)

5. Find out plans, regarding CWS and water-related diseases, of the other three donor projects to construct improved dams; also the Foum Gleita irrigation dam in Gorgol. Explore means of coordinating efforts.

C. PROJECT DESIGN

1. Potential effects of 'sealing' the cultivable basins by rain-transported 'fines' should be monitored but will not be resolved by the proposed siltation traps. The traps are expensive and should be deleted. Methods for

basin surface preparation for more effective charging of the soils should be investigated. (Section 9A).

2. Design elements, current experience and failures of the other donor dam projects should be sought and considered, especially regarding geotechnical and hydrological testing, which will require additional on-site testing during construction to verify adequacy of design.

3. REVIEW OF WATER-RELATED DISEASE INFORMATION IN MAURITANIA

Several water-related diseases are endemic in certain areas of Mauritania, among which are schistosomiasis, malaria and guinea-worm infection.

1. Schistosomiasis

Reports about schistosomiasis in Mauritania by Maril (1961a) showed that the urinary form of the disease due to Schistosoma haematobium is prevalent in the populated west and south-west of the country: the south of Trarza, the south of Brakna, the south of Gorgol, west of Kiffa, at Akjoujt, at Akar, the Tagant and at Aioun el-Atrous. In these areas, of 1580 urine samples of children 6 to 18 years of age 419 or 26.5% were positive. In Trarza the prevalence rate was 10.5%, in Brakna it was 24.5% and in the Gorgol it was 27.5%. Areas in which wells were the only source of water had no infection. On the other hand, in the northern area where the water was scarce and surface water was heavily utilized, infection rates were high. In the same year (1961b) the same author found high infection rates with Schistosoma bovis in cattle, sheep and goats in Kaedi, M'Bout, Aioun el-Atrous, Akar and Tidjikidja. This animal schistosome species utilizes the same intermediate host, bulinid snails, as the human Schistosoma haematobium, and occasional cases of S. bovis have been reported in humans in other countries.

It is difficult to estimate the overall prevalence of urinary schistosomiasis in Mauritania, but Deschiens (1951) put his figure at 31% and Gaud (1955) believed that the average prevalence is 40%. Deschiens (loc. cit.) mentioned prevalences ranging from 74% in the Gorgol area to 17% around Atar.

It is believed that the drought in the Sahelian region has affected water habitats of the snail hosts and thus resulted in a reduction of prevalence of schistosomiasis in Mauritania. No doubt some water habitats have dried up; however, surveys conducted during the 1970's still proved high prevalences, apparently due to increased rains and to agricultural development under irrigation.

During May and November 1974 Jobin, et al. (1976), carried out field surveys in the Fourth Region of Mauritania, along the Gorgol river to determine the prevalence of schistosomiasis and the relevant species of snails. The surveys were made as a basis for designing the irrigation systems to minimize transmission. A high prevalence of urinary schistoso-

miasis was found in M'Bout, the town nearest the proposed reservoir at Foum Gleita. The prevalence was greatest in the 13-year- old boys and there was a mean prevalence among the 7-to-10year old girls of 24% compared to 41% in boys of the same age. Skin test of 10-year old elementary school children showed the following rates: M'Bout, 78%, Lexeiba, 67%, Rindiao, 31% and Kaedi, 14%. During the period between the first and second survey the incidence rate among children in M'Bout became very high (68%), probably because of increased water contact related to the rains that broke the long drought in August 1974.

An O.M.V.S.,* USAID supported study on the environmental assessment of the proposed development in the Senegal River basin (1977-1979) showed 2 out of 53 (3.8%) individuals infected in Amadou Moussa (Kaedi Department), and 1.4% in Sore Male. The same study, however, showed negative results when individuals from the following villages were examined: Youmane Yirè (Maghama Department); Roufi Aoudi (M'Bagne Department); Olo Ologo (Kaedi Department); and NGorel (Boghè Department).

It should be noted that Amadou Moussa in the Gorgol Valley, where the positive cases were found, has lined concrete wells. In another area of the country, the same O.M.V.S. study showed 40.9% prevalence rate in Zeneiga Maures, located south of Selibabi.

At the request of USAID Nouackchott, the "Centre National d'Hygiene" (Sidatt et al. 1980) carried out a survey in October-November, 1980, to determine the prevalence of parasitic diseases in the barrage areas of Gorgol-Brakna. The survey showed the following prevalence rates of urinary schistosomiasis: Boussouelif 1/22 (4.5%); Moudi Founti, 8/21 (38%), Oudei Chrak, 10/23 (43.4%) and Toueizekre, 1/12 (8.3%). The survey showed negative results in Boudjoungal, Lem'Oudou, Toueidima, Timbara and Ameira. (Summary Report attached, Annex III)

With regard to the snail intermediate host(s) of urinary schistosomiasis in Mauritania it is noted that there has been no agreement in the literature about the specific identity of the snails responsible for transmission, nor has there been a definite demonstration by rodent exposure of the identity of the cercariae which were emitted by the snails. Maril (1961a) identified the snail host as Bulinus s.s., and the

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* Organisation pour la Mise en Valeur du Fleure Senegal.

cercariae he obtained from some infected snails could have been those of S. haematobium or S. bovis. Gretillat and Lacan considered Bulinus truncatus rohlfsi to be the host of S. heamatobium in the Tagant Plateau and B. guernei the Host near Rosso. Deschiens (1951) and Gaud (1955) mentioned bulinid species groups and did not indentify the species; whereas Jobin, et al., incriminated Bulinus guernei in the Gorgol area. In the report of the Centre National d'Hygiene, Sidatt, et al., identified the snails which they collected at Aleg as Bulinus truncatus.

Schistosoma mansoni and intestinal schistosomiasis are poorly documented in Mauritania. There had been reports of the snail intermediate host Biomphalaria pfeifferi in a few limited foci. This was probably before the drought period, and no recent reports confirm the earlier ones. Even south of the Senegal River in Senegal this snail intermediate host is only found in two small locations in the entire delta region but no cases of intestinal schistosomiasis. It seems likely therefore that urinary schistosomiasis due to Schistosoma haematobium is the only form of human schistosomiasis in Mauritania. One however, should be on the look out for the intestinal form of the disease.

It should be noted that the usual source of infection with schistosomiasis is through human activities in waters where the cercariae of the parasite are found after their daily exit from the snail intermediate host. The cercariae penetrate the skin of individuals in the water. However, drinking water containing cercariae of the parasite could in some cases be also a source of infection. This is accomplished by some of these cercariae succeeding in immediately attaching to the mucous membrane of the mouth and later penetrating to the circulatory system. Howev°er, other cercariae when swallowed are killed by gastric acids.

2. Malaria

Malaria has always been a major endemic disease in Mauritania as well as in all of the Senegal River basin. Significant splenomegaly is exhibited among patients in hyperendemic regions. Plasmodium falciparum is the main species responsible for malaria cases. Few cases are due to P. malariae while P. vivax and P. ovale appear to be rare. Sidatt, et al., (1980), conducted a survey of hepatosplenomegaly due to malaria in the Brakna area of Mauritania. Although during October and November the malaria cases decreased they found the following percentages of hematosplenomegaly: Oudei Lefkerine, 4.5%; Boussoueilif, 9.1%; Boudjoungal, 8.3%; Toueidima, 37.5%; Timbara, 24.6%; Ameira, 10%; Oudei Chrak, 17.4% and Toueizekre, 41.7%.

The principal mosquito vector of malaria in Mauritania is Anopheles gambiae, while Anopheles funestus is present in large numbers and is probably a transmitter and Anopheles pharoensis is a suspected vector. Anopheles gambiae enters houses to feed upon humans after resting during the day. It is a species which becomes abundant during the raining season but is greatly reduced during the dry season starting about January or February in Mauritania. The larvae thrive in a variety of different habitats; they may be found in water accumulated in hoof prints, in ground pools, in rock holes, in rice fields and in containers.

3. Dracunculiasis

Dracunculiasis, or guinea worm infection, is due to the presence of the guinea worm, Dracunculus medinensis, in the deep connective and subcutaneous tissues of man. Superficial lesions are formed through which the larvae are discharged. The disease is known to occur in tropical Africa, India and in the Arabian Peninsula. It is known to be common in Mauritania. Man becomes infected from drinking raw water containing infected copepods, many species of which (Cyclops spp.) serve as intermediate hosts. Lesions in man occur most frequently on the appendages, through which larvae are released when an infected person wades in sources of water; the disease is spread when such water further downstream is used for drinking.

4. FIELD OBSERVATIONS ON THE BRAKNA DAM SITES WITH REGARD TO WATER RELATED DISEASES, JANUARY 19-21, 1981

1. LEFKARINE

Traditional dam with a cultivable area of 54 hectares. The area is cultivated at present. Water was retained in the reservoir from September to the end of October 1980, when cultivation started. At this time a small amount of standing water still remains in the basin which is extensively used by humans and animals, has no aquatic vegetation, and little algal growth. No snails or snail shells were found nor were there any mosquito larvae breeding. However, the habitat is ideal for snails because the pH of the water is 7, the afternoon temperature is 20°C, and some algal growth is present.

It should be noted that no schistosomiasis cases were found in the nearby village during the recent survey which was carried out by the Centre National d'Hygiene.

2. DIONABA

This is a designed dam, (not USAID's) with two sluices. A large area is cultivated. A large, long lagoon remains which is used by humans, cattle and donkeys, except the part close to the sluices which is deep and with steep banks. There is no aquatic vegetation, but there is algal growth and sticks and twigs.

The snail Bulinus guernei was collected, and it is assumed to be the intermediate host in this locality because this is the only source of water in the area and the children from the nearby village are infected with Schistosoma haematobium. They often bathe and swim in this reservoir during the warm season of the year. The early morning water temperature in January was 16°C, and the pH is 7.

3. BOUSOUELIF

This is a traditional dam. It was damaged this year after only about 15 days and thus there is no cultivation and no water left. Shrubs are in the bed of the oued.

The nearby village is at about one kilometer. There is only one case of urinary schistosomiasis imported from the Kiffa region.

4. CHOGGAR SUD

This is a small designed dam (not USAID's), which holds a vast flooded area, even at this time. There is a vast area with water until about April and whenever the water recedes, cultivation is

begun. There is considerable use of the water by humans and animals especially cattle, goats and sheep.

This reservoir is very rich in aquatic vegetation, water lilies (Nymphaea) and Polygonum sp.

Several shells of the snail Bulinus (Physopsis) globosus were collected, indicating a large population of these snails. This species of snails is a recognized intermediate host of both human urinary schistosomiasis and Schistosoma bovis of cattle, sheep and goats. The pH of the water was 8 and the temperature at mid-day was 17°C.

5. BOUTOUNGAL

This is a traditional dam, and the cultivable area is 140 hectares. The water was in the reservoir between August and the end of October. Very little water is left in January and it is extensively used by humans for drinking and for washing clothes. There is no aquatic vegetation and no snails or mosquito larvae were found. The village is about 200 meters only from the dam, and the children were found negative for human schistosomiasis.

6. LEMAOUDOU

This is a traditional dam and the cultivable area is about 170 hectares. There is no water left in January and no cases of urinary schistosomiasis were reported among this community.

7. Saq EL-MAHR

This is a small and low traditional dam. It broke this year and thus there is no water and no agriculture.

8. TOEDEMA

This is a designed dam, and has a sluice to one side. The area cultivated is about 50 hectares. The reservoir was full between August and September 1980, and no water was left in January 1981.

COMMENTS:

The dam sites vary from one to the other as to their suitability as transmission sites for water-related diseases. However, they all agree, with the exception of Choggar Sud and Dionaba, in the fact that the reservoir is full for only two months, from August or September through October. After this period only a few of the reservoirs may retain some water for a few months and the rest none at all, at least as observed in January. Also, some of the reservoirs harbor snails while others do not, whether snail hosts of schistosomiasis or any other associate snails. Most

basins appear to be suitable habitats for snails should they be introduced, because of the favorable pH of the soils and waters, the temperature and the algal growth. Of course, more water analyses and field work are necessary to substantiate this conclusion.

The fact that the water normally remains in the barrage basin reservoir for up to two months, deserves some comments with regard to transmission of schistosomiasis. This period may be enough in some cases for the breeding of the snails and the establishment of the life cycle of the parasite. In other cases this period may not be sufficient. The origin of the snails would be from the very few snails which had survived the drought period by estivation, or in the case of Dionaba, from the snails which remain in the lagoon close to the dam. That snails survive drought by estivation is a well documented phenomenon in temporary bodies of water throughout the dry regions of west and central Africa and northern South America. Recession agriculture would seem to increase the chances of survival of the estivating snails through increased soil moisture in the basin.

In the case of malaria the two month period seems adequate for mosquito breeding and the seasonal transmission of the disease.

It should be noted that the standing water remaining after the opening of the dam and the frequent use of this water by the human population is an ideal place for transmission of guineaworm infection, and the completion of the life cycle of the parasite.

The short observation period in the barrage area showed that no bodies of water exist other than the dam sites. This was corroborated by local people and others who know the area very well. Thus there should be little chance of introduction of snails from other water bodies into the dam sites. If this observation proves sound the necessary surveillance and control effort outside of the dam sites could be minimal.

The absence of snails, and accordingly, schistosomiasis in some of the dam sites visited in western Brakna may tentatively be explained by the absence of standing water most of the year and the reduced probability of interbasin transfer between eastern and western Brakna watersheds. Some environmental factors may also be responsible and the matter should be elaborated in future studies. (See SOGETHA watershed maps for Brakna/Gorgol area)

5. RECOMMENDATIONS REGARDING WATER-RELATED DISEASES

Although the significance of water-related diseases in Mauritania has been known for sometime, the recent survey by the Centre National d'Hygiene pinpointed some places where they occur in the Brakna region and revealed their significance. It is felt, however, that more detailed studies are necessary, on the epidemiology transmission and eventually the control of water-related diseases. There is a necessity for development of base-line data, and the selection and implementation of appropriate control measures.

A. SCHISTOSOMIASIS

In the case of schistosomiasis a disease surveillance system should be implemented. The surveillance group should be formed before project construction begins and should be continued as a vital part of the overall health program. The short observation periods spent at some of the dam sites showed that surveillance is essential. For example, surveillance may reveal that snail control measures may not be needed at some dam sites whereas they are necessary at others.

We agree with the statements in the Health portion of the Land Reclamation Project paper that the surveillance and control aspects of the program should be carried out by Mauritaneans trained in this field. We consider that about 4 to 6 months will be an adequate period for such training. The choice of a training center should be left up to GIRM (the Mauritanean Government); however, there is the possibility of the Sudan Gezira or Egypt. Although surveillance and control efforts carried out in these two locations are primarily for irrigation systems it is felt that the basic training will be acquired to suit situations such as the dam sites in Brakna. In the Sudan, there is a WHO control project on the Blue Nile at Barakat. Dr. W. Jobin, the director of the latter project, is familiar with Mauritanian conditions and other projects along the Senegal River in Mauritania; including the Gorgol Foum Gleita Dam and Irrigation Project (see reference 10-15). This IBRD/FED Project may be training Mauritanian nationals for their Schistosomiasis control program in the Gorgol area.

The surveillance and control team can be composed of two or three members, preferably college graduates or experienced health personnel, to be trained abroad and to be assisted by a laboratory technician, and a number of laborers. The team could be stationed in the Brakna region or at Makta Lahjar. A small laboratory should be established for urine examina-

tion, for detection of infection among snails and for preliminary laboratory testing of molluscicides.

The functions of the team are:

1. To conduct a survey of the snail fauna at all dam sites and to continue such surveys for some years.

2. To collect base-line malacological data at the dam sites (see Annex I).

3. To determine prevalence of the infection with urinary schistosomiasis and other water related diseases in the villages. This should be a population based survey, that is, house to house survey and not only of children. It should also be done qualitatively as well as quantitatively in order to determine the intensity of the infections among individuals in each village.

4. To observe and characterize practices and health effects of human-water contact at dam sites and investigate possible incentives and control methods to prevent infection.

5. To carry out control operations and post-control evaluation of these operations (see Annex I).

6. With the assistance of medical personnel, to carry out chemotherapeutic treatments of patients.

7. To provide basic hygiene education or program guidance.

Initially, it would be advisable that such functions be investigated through a pilot project at one of the dam sites where the disease is known to occur coupled by regular surveillance of the other sites. Experience gained from such a pilot project will permit more effective expansion of services to the entire region.

The composition of the team and its functions, and the experience gained from a pilot project will help in the evaluation and development of a national schistosomiasis control strategy and program for Mauritania.

We have reviewed the budget for schistosomiasis surveillance and control in the health section of the Land Reclamation Project paper and found it acceptable with minor modifications. The total budget for this is $96,000.

Other Recommendations

Some simple ecological or engineering control measures should be

considered, even at the beginning of the project, and before the Surveillance and Control Team starts its work.

If it is acceptable by the engineers operating each dam, and if it does not interfere with agricultural practices, the water level in the basin should be rapidly lowered regularly starting about three weeks after the reservoir is full. Rates of lowering the surface level of the barrage impounded waters will vary according to the slope of the banks at the water's edge. The snails and mosquito larvae are mostly found in the littoral zone - a shallow, photosynthetic perimeter; the optimum area for primary production and aquatic vegetation. The operator will want to drawdown the level at least beyond this area. For example, if the bank slopes are 5:1 an acceptable vertical drawdown rate would be 20 cm/hour; vs. at 100:1 slope, 0.1 cm/hour (Jobin and Michelson, 1969). The important measure is to drawdown as quickly as possible in order to strand the snails and larvae on the banks so the sun's heat can destroy them. Field observations must be made as each site is completed in order to design effective rates and schedules which reflect the rainfall periodicity and the farmers' needs to plant.

This measure has proven in other endemic areas to interfere considerably with the building up of the snail populations where reservoirs and storage ponds (Puerto Rico) are involved. This measure is also recognized as an advantageous method for control of malaria, by interfering with breeding of mosquito larvae.

1a. At least in some reservoirs it might prove advisable to clear aquatic vegetation, debris, twigs and any flotsam, since snails seem to favor such objects to cling on, to scrape for food and to deposit their eggs. This control measure should be enforced also when the reservoir is still being filled up. The idea of a "mechanical barrier" to stop the introduction of such objects was not found feasible or practical in the majority of the dam sites, because water is introduced from all directions over the vast flatland.

2. Whenever a small body of water is left after the opening of the dam it should be drained and filled up. This is also a well accepted ecological measure for the control of both schistosomiasis and malaria. Such water becomes fouled by human and animal use and a dangerous source for transmission of all water-related diseases including enteric diseases. It is preferable that shallow wells, instead of surface water be used for human consumption. This alternative, however, deserves further studies and

development.

3. The available molluscicides have proven to have no risk for both humans and domestic animals. The water is safe for consumption after one or two days from their application. There should be no hesitation in using them whenever it is necessary. Some may kill fish; however this is not yet considered a disadvantage in the Brakna dam sites.

4. Use should be made of local molluscicides of plant origin. It is known that Balanites aegyptiaea is a commmon plant in the dam site region. This plant has proven in other countries to have molluscicidal properties. This is especially so in the case of its fruits. Some small-scale laboratory experiments can be conducted to determine its efficacy on the local snail species in this part of Mauritania. If proven effective it would be a cheap source of obtaining a locally produced molluscicide. It is known that the active ingredient in this, and several other plants throughout Africa and other continents, is a saponin that kills snails.

5. The survey conducted by the "Center National d'Hygiene" deserves some comments and recommendations. Only one urine sample was examined per individual, only children were examined, and the examination was only done qualitatively. For this and for future surveys the following are recommended:

   - The survey should be population-based; more than one urine sample per individual should be examined to reveal the false negatives and the samples should be collected in early afternoon.

   - The examination for eggs of S. haematobium in the urine should be done quantitatively, that is, how many eggs are found per ml of urine. This will help in determining the intensity of the infection in the population, and accordingly will indiciate the morbidity of the disease.

6. Although the project area in Brakna and Gorgol is located in the territory of the Senegal River Basin, it will not be affected by the proposed developments in the Basin, involving the construction of the Diama and Manantali dams. Thus the Rural Land Reclamation Project area can be handled separately from the vast area under the authority of O.M.V.S. In this context it will be similar to the Gorgol Irrigation Scheme.

7. In addition to urine, stool examinations should be

carried out to be on the look out for eggs of Schistosoma mansoni which is the causitive agent of intestinal schistosomiasis. Snail surveys should also determine the presence or absence of the snail host Biomphalaria pfeifferi in the Brakna and Gorgol areas.

B. MALARIA

Malaria is endemic in the barrage region and it was found in several villages. An integrated malaria control program should be implemented including prophylactic chemotheraphy and curative services for malaria patients. The latter can be incorporated in a primary health care system at the community level.

The use of larvicides to kill mosquito larvae in reservoirs should be considered. Malathion may be applied at 0.5 pounds per acre. Larvae can also be killed by fluctuation of water level in the reservoir or by draining and filling of small bodies of water (also see section on recommendations for schistosomiasis control). Anti-adult mosquito measures should also be considered. Chemical control of adult mosquitoes in buildings and shacks is conducted in various ways through the use of contact or residual sprays. Aerosols or regular sprays kill mosquitoes upon contact at the time of application.

The development of a primary health care system is usually recommended as the most suitable and cost/effective mitigating measure for dealing with the problem of malaria. Its cost is competitive with that of a malaria control campaign. It should be noted here, in the way of criticism of the survey for malaria conducted by the "Centre National d'Hygiene," that the results were based on clinical diagnosis of the disease rather than on finding the parasite microscopically in thin or thick blood smears.

C. DRACUNCULIASIS

Control of dracunculiasis will be accomplished in the barrage region as water supplies are improved. In addition some of the measures recommended for the control of schistosomiasis and malaria will result in control of dracunculiasis.

Providing an alternative supply of water to the people through construction of safe and protected deep wells should reduce the consumption of water contaminated with copepods from infected individuals. However, costs, unreliable aquifers, and complex water use and hygiene problems preclude this alternative at present.

Most of the molluscicides which were recommended for the control of schistosomiasis have the advantage of also killing copepods in the water of the reservoirs, or small bodies of water. Moreover, drainage and filling of small bodies of water which were recommended for both schistosomiasis and malaria are also recommended for protecting the people against dracunculiasis.

6. PRESENT COMMUNITY WATER SUPPLIES

Throughout most of the Brakna region, oglats, shallow wells dug in the oueds, or seasonal runoff channels, provide the water. There are few year round surface or well supplies, all of which are known and used heavily during the drier season when they become especially comtaminated.

Surface water collected from annual rainfall, 150-250 mm, in small depressions and the traditional and designed barrages are used by livestock, humans and for agriculture. All uses occur at these surface water sites from bathing and drinking to defecation and urination. They become obvious sources of infection and disease.

There is traditionally a desire to keep the livestock away from the barrage sites once the planting has begun. Thorn bush and other wood is used to construct fences where livestock normally have access. However, there are recent deforestation regulations against this practice, which are practically unenforceable.

The oglats are dug in areas where shallow water exists from the saturation and recharge of soils during the storage of rain water behind the barrage. This includes around the perimeter of the cultivable zone behind the dam, below the dam in the oued which carries the water when released, and often behind the broken dam in the cultivable areas if saturation was not adequate for planting, i.e. less than 2-3 weeks normally.

In many areas throughout this water-short region, the rain water that has been impounded for cultivation is released by breaking the traditional dam or opening the sluice gate on designed dams. It is thus lost to the few oglats and the thirsty unproductive oued and watershed below. Means to more effectively utilize this scarce resource should be capitalized upon. For example, in a few watersheds other barrages exist downstream and use the water released from above. However, this is not often the case as the planting season, October, is a short time after the rains, August and September, and the same crops are planted everywhere, i.e. sorghum, cowpeas, melons and maize.

Water supplies for the family are collected by the women and children, often with great difficulty, as described elsewhere. Donkeys are often used to transport water for which purpose skins of goat and sheep are practical containers. The filling of these skins from heavily contaminated surface water and shallow unprotected wells using half-rubber tires or whatever is available for transfer is a process complete with many varieties and sources of infection.

The skins are used for storage in the home. Large ceramic or other containers are not used or practical for people who must transport their household materials often.

Latrines and other sanitary interventions are non-existent, except in a few houses of the wealthy in the large villages. Urination is practiced spontaneously, ignored and accepted by those close by, in both urban and rural areas. Defecation is in the open but privacy is sought where available. These practices have logically evolved from nomadic tradition, where vast flat, open sands along the route provide little privacy.

More people are settling permanently every year. In the last ten years a 2/3 nomadic, 1/3 sedentary Mauritanian population has been reversed. The war and loss of grazing lands, from overgrazing and the drought, is felt to be the major cause. However, there are many major drawbacks to this current trend, e.g. livestock herders, not being familiar with cultivation; the destruction of the balance and barter among these groups; the changing of sanitary habits to prevent contamination in more populated permanent settlements.

Two liters of water or liquid per day is the absolute minimum required for humans. For water-short drier regions like Brakna, populations adapt but normal activity requires more. Malnutrition, guinea worm, enteric dysentery, diarrhea, skin and eye infections, and other water related diseases sap the strength and growth potential of the people, especially the infants and children. Surveillance and control activities must be planned and evaluated in order to prevent the spread of disease and breeding habitats as surface waters are more effectively impounded and used for cultivation at the proposed dam sites.

In most cases, women and children perform the grueling tasks of collecting the family's water supply. This normally consumes several productive hours per day. If the water source is especially distant, as in the driest season, a day's trip to and from per week may sometimes find the well empty. In the Brakna area, it appears that 1-2 km distance may be an outside average with many of the groups settling closer to water sources.

From the above considerations, and in keeping with the USAID pledge to support the goals of the UN Water and Sanitation Decade, the project should seek to discover and develop effective alternatives for providing adequate quantities of safe water for those communities which will attempt to increase crop production.

Twenty liters of water per day per person is an amount which will satisfy most of the above problems and surpass most present rural Brakna consumption. Traditionally, water has been so scarce for

nomadic peoples, so precious, that customs evolved which limited or discourage its use:

- it is dangerous to bathe
- women should not wash away their natural smells
- reuse of water for various purposes: clothes, dishes wiping down inside surfaces, water for domestic animals
- water is heavy and it must be carried.

Sanitary or hygienic habits have therefore evolved which will be difficult to change. Yet, as more adequate supplies become available, consumption always increases. These two factors will surely lead to increased and complex problems related to water use and water-related disease. The most accepted and understood interventions, be they education, safe water supply or others, are those which provide logical, convenient, simple, maintainable, economical incentives for their use. Water supply, sanitation, hygiene and health education planning for these land reclamation and resettlement areas will require gradual, long term initiatives and should be evaluated. In rural development, areas of responsibility for such programs are generally multi-ministerial, low priority, and inefficiently operating. Initial efforts should therefore stress integration and coordination of limited resources and community input, in order to effectively extend adequate services to rural populations. For additional material see: "Pre-PID Manual for Near East Water Supply Sanitation and Hygiene Education Projects." (Contact Joe Haratani, AID/W/NE/TECH.)

The Direction de l'Hydraulique, under the Ministry of Rural Development, has the responsibilty for provision and maintenance of rural water supplies. It has had experience with well projects and performed other engineering analyses. More information should be sought regarding potential management resources for the Brakna area.

The responsibility and effectiveness of the Brigade de Direction de l'Hydraulique at Aleg should be determined. Ms. Donnat has stated that they do not have experience with heavy equipment or pumps and are principally involved in maintaining shallow hand dug wells. This seems appropriate as there was reported to be only two deep, bored permanent wells in the Brakna Region. The following describes field observations and comments on those barrage sites visited by Drs. Sidatt and Malek.

Lefkarine:

A proposed construction site and one of the more influential barrage communities. The chief of the tribe was aware of Service Hydraulique and had requested and received a 37m deep,

1.5m wide, dug and maintained well with concrete apron which yields ample water year round. However, he is astonished that the people continue to use the pooled water behind the barrage where the livestock drink and defecate. Thirtyseven meters is a long lift for 50-100 kg by a woman or child. This points out the need for assistance from the Aleg Department of Hydraulique brigade as to animal traction, hand-pumps, or one of many other methods for lifting water by mechanical advantage.

Another observation on our field visit was the gross disparity in population reported by the chief, of 4000, and the "impact" population computed by available hectarage of 500. The need for more accurate population estimates, among other essential baseline survey information, is evident.

Bousouellif:

The village was located 1 km from the barrage area, where shallow wells were dug in the oued below the broken barrage. This is a proposed construction site although the soil is reported alkaline and in need of fertilization to support increased yields. No cultivation was practiced this year as the dam only held for 15 days.

Dionaba:

A large modern dam with vast cultivation behind the remaining shallow lagoon nearest the sluice which is used by the town of several thousand for all water uses. It was reported to be the only source of water in town. This is not a proposed construction site.

Boudjoungal:

At this proposed barrage site there was one reinforced and protected well where washing of clothes and drinking were observed. This, or another well, was reported to have reached an impenetrable layer, preventing deepening of the well by villagers. (USAID Sociologist/Grayzell)

Choggar Sud:

Although not a proposed construction site, a modern dam with vast retention area which has pooled water until April. One of the few in the Brakna region.

Lemaoudou:

A proposed site, is a traditional barrage which was broken to release the captured water. There were several hand dug wells 4-5m deep 1.5m wide below the dam in the oued.

Cag el Mohor:

At this site, which was removed from consideration for socio-economical reasons, had one large hand dug well 5m deep and 3m wide which they were reinforcing and in the process of finishing. Their traditional barrage had also failed; no cultivation this year.

Touedima:

Proposed site, no water remaining, good crops, designed dam with sluice. No wells; however donkeys transporting skins were observed.

7. FINDINGS: COSTS, NEEDS FOR WATER SUPPLIES

Estimated

1. Costs for construction* of wells ($1 = 45 ougiyas)
   *not including maintenance, or management support

   a. Drilled wells. L. Weiss figures and estimates of Mrs. Donnat and Terrere of Direction de l"Hydraulique and Mrs. Oksengor and Moliere of SNIM* provide a range of 20-30,000 ougiyas per meter of well depth which varies according to diameter and terrain. Experience in other regions with drilling indicate an average depth of 40 meters, (between 25-70m). for productive wells and diameter of 20cm (heavy, large drilling rigs),

   800,000 - 1,000,000 ougiyas or $18-22,000 per drilled well with apron and hand pump, (even if it is not productive, i.e. dry).

   b. Hand-dug, (concrete-lined) reinforced wells. Again, discussion with Direction d'l Hydraulique and review of reports (PNUD, 1975 average of 21m depth) leads one to suggest limiting the depth of an average hand dug well to 25m, (although D.H. has dug several to 40m) and width of 1.5m.

   Local costs for materials and resources: (source-active Lebanese contractor, Nouakchott, 1981)

   Cement: 8300 ougiyas/tonne - increase for inland transport.

   Reinforcing rods: 45,000 ougiyas/tonne - increase for inland transport.

   Manual labor: 2-300 ougiyas/day possible decrease for rural.

   Material and resource requirements for construction of hand dug well; 25m deep, 1.5m wide (modified from initial attempt but similar estimate achieved).

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* Societe National des Industries et Mines

(GIRM currency ougiyas)

cement:	150 kg/m depth plus 250 kg for well head and apron	51,875
perods:	40m of 8mm rod/m depth plus 65m of 15mm for 3m caisson intake (use roughly 200 pounds/cf)	11,000
gravel:	0.6 m^3/m	on site
sand:	0.3m^3/m	on site
labor*:	1 puisetiere @ 400 oug/day (level 6^o-GIRM)	30,000
	1 treullstiere @ 300 oug/day (" 4^o ")	22,500
	4 manual laborers @ 200 "	60,000
	2-3 months per well (75 days)	175,375

*GIRM labor levels of 4^o - 6^o would give firm estimates of salaries in Aleg brigade of DH.

Therefore, 175,375 ougiyas per 25m well or about $4,000. (Again even if it is non-productive and imagine reaction of community after watching efforts for 75 days. Community should be involved in selection of site.)

Estimated Well Costs for Project Impacted Populations.

In the Brakna region, shifts are occurring annually in the ratios of nomadic and sedentary families. Populations are therefore difficult to estimate and should be followed at the barrage sites until implementation (if this has not yet been started by RAMS).* Estimates available for this mission were based on hectarage cultivable within the capture areas of each barrage, at present, approximately 13,000 people and an accompanying 6500 livestock will need adequate water supplies.

Assuming one well per 200 people:

200 people @ 20 lpcd = 4000 lpd = $4m^3/d$
100 livestock @ 5.30 lpcd = $\underline{1m^3/d}$

$5m^3/d$

Estimated yields of wells in Brakna Region
(CIEH et al) see section 10-6 0.5-1m^3/hr

*Therefore by wells extending 3m into the low-yielding water table, overnight collection will amount to at least 3m, requiring 2-4 hour period each morning for meeting the demands of 200.

At the estimated yield (0.5-1m^3/hr) a well could provide enough for the daily water demands of 200 people and their livestock.

Estimated Total number of wells to be constructed for barrage site in Brakna area .....80 wells

This includes a 25% factor above demand, to address the difficulty in siting wells of 40m depth of good yield in the Brakna area.

For purposes of comparison unit costs will be developed for both hand-dug and bored wells. To this date it appears that Direction de l'Hydraulique (service Hydraulique) does not have well drilling rigs at their Aleg branch, which performs maintenance of hand dug shallow wells through a brigade headed by Mr. Ba. The total cost using the "impact population" for the project, (which maybe considerably conservative), to construct 80 wells: (without administration + infrastructure)

BORED: 80 x 1.000,000 = 80,000,000 ougiyas
= $1.8 million

HAND DUG: 80 x 284,000* = 22,720,000 ougiyas
= $0.5 million
(*175,000 + another 109,000 for handpump)

At least three types of hand dug wells systems and improvements should be evaluated.

Standard hand dug reinforced open wells,
(collar, no pump)
Hand dug wells, reinforced closed wells,
(protected with pump)
Infiltration galleries flowing to hand dug,
reinforced storage wells located at perimeter
of or below barrage area.
(with and without pumps)

d. Although the hand dug wells appear to be considerably cheaper by my extimates, experience of DH suggests equal costs for drilled and hand dug wells. Figures presented

for hand dug reinforced and drilled wells at the 1980 Nouakchott Water Conference were also equivalent.

e. Lighter portable equipment for drilling such as the Atlas Copco Aquadrill rig used by PNUD* in 1975 or another model suggested by Grandjean of SONADER* (verify) seems more appropriate than current heavy, difficult to transport rigs of DH, for the Brakna and Gorgol regions. Transportation is already a major problem for the hand dug well brigade at Aleg DH.

f. Costs should be verified with PNUD, 1970-75, and the new 36 wells project.

2. High Risk and Low Yield

The March 1980 SONADER Hydrogeology and Field Reconnaisance Report (for this project) of available water sources for construction requirements presented a comprehensive review of existing information (most included in Section 10) and stated that most of the project region is considered or described as "sterile," i.e. no productive aquifiers. Only 2 zones were of interest:

- where the principal substrata, schistes, are fractured productive aquifers might be found at 50m depth. However, there has yet to be found or attempted, any wells of this type.

- alluvial aquifers in the oueds, however the flows are very low and the ground water tables of insignificant storage and size.

SONADER recommended field construction of rain catchment ponds with truck transport alternative from highway forages (drilled wells) and other permanent sources should pond fail. Further reconnaisance was suggested for six low- yield wells at certain sites (see 7-5).

b. During, initial attempts by PNUD in their 1970-75 project for "Reinforcement du Service des Eaux Souterraines," the probability of striking a productive well was 10% with field experience and the use of various size drilling rigs and hand dug brigades, and complementary preliminary methods for site selection, including hydrogeological mapping, geophysical testing (4 methods) test pumping et al. PNUD and DH were able to achieve an overall project average for forage (drilled wells) for all of Mauritania of:

PNUD =UNDP (United Nations Development Programme)
Societe Nationale pour le Developpment Rural

Sterile
(dry)

DOUCE
Suitable for human
consumption

too salty
unsuitable
for consumption

Suitable for
livestock

Eighteen of 22 wells hand dug in the Hodh region were productive. However, for this PNUD project they drilled and dug in the regions of highest probability which did not include the Brakna/Gorgol area where they simply mentioned approximately 220 oglats and puits cimente (hand-dug reinforced wells) from the DH files, almost all of which were located in the Gorgol and Eastern Brakna area which approaches the Assaba mountains and springs.

c. The BURGEAP (French) 1966 "Synthese Hydrogeologique et Amenagement Hydraulique du Sud Est Mauritania," which covers most of the water sheds for about half of our barrage sites (see Map), inventoried and located, on their hydrogeological maps, existing oglats, puits-cimentes, other sources of water, and their approximate yields. They recommended rehabilitation, further reconnaissance or immediate construction of the most probable and potential wells and well sites. For our entire area - not just the barrage proximities - only two temporary and one permanent low yield wells were suggested for rehabilitation and one site near Choggar for reconnaissance.

d. Yields: shown by BURGEAP; again by CIEH/TAMS for SAVANNA Regional Water Ressources and Land Use Project, and evidenced personally in the DH files (1962 - present); are very low indeed, averaging, $\leq$ 0.5m^3/hr with many 2m^3/day and mostly seasonal, for our barrage site areas.

e. Personal inventory of DH files and maps yielded only a few permanent and temporary wells within a 5-10 km radius of our barrage sites. There were none of record at several sites. (See inventory and map left at mission.)

3. Inadequate Hydrogeological Data and Geophysical Testing

Adequate hydrogeological data does not exist for the selection of appropriate sites for productive wells in most of the Brakna and Gorgol barrage sites. As previously mentioned (7-2c), BURGEAP mapped the hydrogeological information for about half of our sites. Even if adequate, additional preliminary testing such as geophysics would then be needed, in order to determine further probability of siting and constructing productive wells. Significant risk would still remain.

The costs for these studies were quickly estimated at 10% of a well construction budget by SNIM and DH. However, more accurate costs should be demanded for our records. Sources would be the SNIM contract for USAID Roads project/M'Bout-Selibabi.

SONADER, Mr. F. Steffan indicated he would share some bid prices they received; SNIM - Mrs. Oksengorn and Moliere, DH - Mr. Hlemanocki their geophysicist.

4. Inadequate Demand and Community Characteristics

The estimated number of wells needed to adequately serve the impacted population, i.e. 80, should serve only as an indicator of the extent of a program necessary to begin to address the water supply needs of these now seasonal and perhaps future permanent barrage settlements.

In order to satisfactorily determine the demand requirements and develop a cost effective plan for providing safe water; e.g. through construction of improved wells, the following unavailable data would be required:

a. More accurate population estimates, at different times of the year.

b. Per capita and livestock demands, desired increases, and acceptable quantities for improved diet and hygiene.

c. Infant, et al., diarrhea and malnutrition data not adequate. Present extent of incidence, cause and impacts of various water and sanitation related, and other diseases. (Movements of population, e.g. to determine sources of infection from remote area.)

d. Amount of time and energy spent by women and children or men for collection of water needs.

e. Sanitary survey to determine sources of water and contamination, water use and storage practices, optimum siting and methods for protection and convenience, livestock management defecation/urination practices and

likelihood, motives and manner for change.

f. Practical, cost effective methods of constructing and improving quality, sustained yields and convenience of water supplies.

g. Community ability and willingness to pay X or in kind goods or services for water and costs of local alternatives sources (cost in Nouakchott for donkey delivered 45 oug/200 liters).

h. Possible resources for maintenance of improved supplies and current costs for DH services.

i. Impact of ownership, land and water rights on growth of the barrage areas.

5. Wells Considered for Further Study by SONADER

Well sites to meet construction water requirements for compaction and concrete were suggested by SONADER: Timbara (2), Touedima (2), Lemaoudou (1), Bousoullif (1). Geophysical testing was felt to be required. In addition, these six wells, four hand dug and 2 drilled, would involve significant risks of not striking water, be of low yield (0m^3/hr) and have limited value for: future provision of adequate drinking water due to their location in the barrage basins and the oueds below the dams; or safe supplies protected from contamination in flooding.

For the water needed for construction their costs would also likely be prohibitive using our previous cost estimates and comparing to the alternative methods recommended.

6. Long Term Impact of Barrage on Local Aquifer

It is likely that the improved retainment facilities at the barrage sites will have positive effects on the recharge and storage capacity of localized aquifers. This has been reported elsewhere, including 17 years of record at Akjoujt, reported in 1968, to have tripled in size and reached the surface of the alluvial aquifer (restated in RAMS/USAID, Etude de base no. 1, part 3, towards the end).

Interventions to prevent possible "sealing" by colloidal siltation effects should be investigated. Experience reported by Grandjean of SONADER and others, suggests that the permeability of the soils may be decreased significantly over 5-10 year period where colloidal and suspended clay and silt particles form a thin dense layer on the basin surface as the waters recede. This would result in adverse impacts on cultivation and recharge/storage of the shallow alluvial aquifers which provide most of the local inhabitant's seasonal water needs through digging of

shallow temporary wells, oglats, in the basins and oueds, when the barrage water is finished or released.

The increase in permanence of water in the basin and local aquifiers may also increase the potential hazard for water related diseases including bilharzia, malaria and guinea worm by providing more moisture and better habitats for propagation of infections parasites and hosts, and transmission of such diseases.

7. Current Wells, Water Use and Sanitary Practices

a. As reported by SONADER and others maximum advantage is taken of available water sources by local inhabitants, however without consideration of health consequences. Shallow oglats, 1-3m deep by 1-2m wide, are dug in the basins as the barrage waters recede and below the barrage in the oueds. These are usually dug each season sometimes, deepened depending on their condition, regarding silted in, unpermeable, contaminated. Any standing water is used by one and all, humans and beasts, for all purposes. Defecation and urination are spontaneous.

b. Water is transported and often stored in goat and other skins which are light, flexible and portable. They do contribute to the overall problem of contamination as they are not sterile (if and when they are cleaned or changed is not known) and transport of waters between different watersheds provides possible routes for infection and reinfection.

c. Convenience and ownership appear to be important factors in the use and maintenance of one source vs. another. This is evidenced by Lefkarine where a 37m reinforced well has water, but is not used because of problems to the owner who has to pay DH Aleg to have it maintained, the energy required to lift that distance, and the availability of more convenient surface waters. Also in some locations each family digs their own oglat due to complications of sharing. For digging of new wells, deepening and maintenance requests must be made by the communities to DH and response effectiveness may vary according to ability to pay and political influence.

8. Regional DH Services in Aleg

Through discussions with Mr. Donnat and Mr. A of the office of Coordination of DH, I learned that Mr. Ba is the chef du brigade in Aleg with four puisetieres, two or three treuilletiere (run the winch), three or four administrators and chauffeur staff, and some laborers to perform requested and planned services in the Brakna region. A crew usually consists of a puisetiere and

treuilltieres plus two or three laborers. Reports are submitted monthly or bimonthly to DH Nauakchott listing work completed, equipment and supplies purchased and salaries. I did not see costs for work completed, if they are separate, or projected schedule for next period. However, they are digging reinforced wells, deepening in existing wells more often, and occasionally not achieving production wells. They concrete line when possible and use aprons to protect the lip of the well. The are not familiar with and do not install or maintain hand pumps, to date. They have considerable difficulty with transportation and logistics in the Brakna Region. This is a resource with experience and potential for improving their progress with water supply development in Brakna.

9. Well Construction Immediately Below Barrage

In some instances this can increase the chance of channels or trous des renards developing under the dam, leading to possible failure and collapse.

8. RECOMMENDATIONS REGARDING SAFE AND ADEQUATE WATER SUPPLIES FOR BARRAGE COMMUNITIES

Based upon the reported findings, especially cost/effectiveness and uncertainty, and the complexity and long-term commitment required for developing practical solutions for provision of safe and adequate water supplies in this particular region, it is recommended that the currently proposed ten wells be deleted from the project and water supplies for the Brakna/Gorgol region and barrage site be addressed separately, if so desired by USAID, in another project where adequate information and cost effective methods can be developed.

As there is a definite community water supply problem which cannot be addressed reliably or cost-effectively by provision of permanent wells it is prudent to better define the problem. Appropriate alternatives can be evaluated and developed should actual needs dictate response, e.g., when community developments is limited by lack of potable water or unhealthy effects of non-potable water. Development of these alternatives is essential should USAID further decide to provide improvements.

The suggested methods to integrate Disease Control and Water Supply Teams

Investigate and develop cheaper, more effective methods for drilling and digging safe productive wells and providing alternative techniques and equipment for storage, lifting, protection and recharge of water resources.

Investigate present projects such as the 'PNUD 36 wells' along the route from Nouakchott to Kiffa - which passes thru Aleg and Makta Lajar. Request information relative to costs of preliminary studies, risk involved, equipment used and alternative, yields, lifting devices, and maintenance. See if they have gone back to evaluate their 1970-75 project. Determine their activities in Aleg during project as state on page 14 of report. (10-4)

Determine GIRM experience through DH and SONALEC, and other groups with hand pumps; cost, type origin, parts, repair and maintenance records and resources.

Investigate cost effectiveness of DH-Aleg providing maintenance and well construction services in Brakna region and on barrage sites.

Investigate utility of other forms of water lifting as chaloup, animal traction, and even hydraulic rams should

stored water be desired for use elsewhere, e.g. cultivation on hillsides; livestock which are stockaded.

Investigate and test effectiveness of techniques for preparation of basin surface prior to rains to improve degree of saturation of soils and augmentation of aquifiers. (See siltation recommendations.)

Always involve the community in the well site selection, especially if it is to be hand-dug, so they will understnad the risk involved and time/ effort required.

Check with Dr. WanGanga of Renewable Resources/USAID to see if Teledyne aerial photography for the OMVS basin covers the Brakna/Gorgol Region. The scale and detail of these photos are incredible and would be useful for reconnaissance site planning and inventory.

More consideration be given to water supply as a site selection criteria in the development of future barrages in this region. Both Zmeidatt and Ameira will have problems regarding water supplies should local population desire to settle nearby seasonally or annually.

9. RECOMMENDATIONS (other)

A. Siltation Traps and "Sealing" of Basin Soils

1. Recommendations

a. Based on previous findings delete the proposed design and budget for siltation traps of approximately 30 million ougiyas ($670,000 US).

b. According to construction period observations and possible hydrological data, be prepared to provide low cost alternatives such as rip-rap or diguette placement in upstream oueds. This will provide baffling for reduction of runoff velocities and sediment transport capacity should site-specific problems be evident. Environmental restoration efforts could be used to stabilize living dunes adjacent to barrage sites.

c. Low cost techniques of basin surface preparation before the rains, could be demonstrated for and tried by the communities cultivating the basins; if they understand the potential problem of 'sealing' - which traditionally seems to be the case in their techniques of planting where they add sand when they pry up the mud cakes. The practice of manuring, when the livestock eats the remaining crop stubble, also breaks up the surface layer of soils with their hooves. The use of animial traction and plows or hoes by each plot tender would aid in stemming sealing, and the charging of soils and substrata by retained rain waters.

2. Findings

a. The major potential for problems with siltation in the Brakna/Gorgol region is reported by several to be a gradual decrease in permeability of the basin soils due to the depostion of fine silt and colloidal particles in a thin dense layer which seals the soil surface. This gradually decreases the soil's effectiveness for cultivation, and recharge or storage capacity of local aquifiers below the impounded water.

b. As designed, 4m x 0.5m x oued width, the desilting traps or sedimentation channels may remove a portion of the heavier sediment but will not aid the removal of the more depth deleterious colloidals and fines. The traps' depth and volume with respect to basin volume seems inadequate. Although the terminal velocities entering basins will decrease; they would have to be cleaned each year (if they remove adequate sediment loads to make them cost effective) and the little water remaining would not be of limited significant volume for livestock.

c. The costs proposed for construction of the siltation traps are approximately 25% of the total construction budget.

d. Heavier sediments and particles may contain nutrients needed for soil fertility, and are reported by several to be of minor significance at our barrage sites. Review of the agro-pedological tests should provide some additional data regarding sediment and silt layers in the basins. Also it is possible that the larger particles will help to prevent extensive sealing as they create larger interstitial spaces and provide variation in the surface layers thereby making it more difficult to develop a dense, thin layer for sealing.

e. There is a need for baseline hydrological surveys which will include velocities entering the basins and could also determine suspended and settling solids and various sediment and colloidal loads.

f. Problems could develop from sedimentation filling in certain basins from runoff and erosion during flooding or from wind transport of dunes.

B. Additional Recommendations and Comments Regarding Land Reclamation Project

1. Concurrence with rain-fed ponds for entrapment of adequate compaction and concrete waters. Reported success in Hodh region barrage projects using this method. Inquire as to Tagant and UNSO proposals.

2. Failures in the Hodh region due to trous des renauds, undermining of foundation by water, subsequent crumbling of embankment, and inadequate foundations for sluice gate structure; lead one to suggest that additional geotechnical data should be collected during construction. SONADER's preliminary engineering-pedalogical studies only provided 5 samples across a wide barrage line and to an average depth of only 1-1.5m. Once the trench has been dug, on-site hand held penetrometer tests, moisture content and substrata may be tested and observed to determine if design and construction specifications are adequate. Recommendations have been offerred by Isambert, Genie Rural, and SONADER upon return from their field trip (2/10/81), for necessary testing equipment of the mobile labs. Requirements regarding additional on site geotechnical testing should be requested from contractor.

3. As observed by L. Weiss in his review of engineering design, inadequate hydrological data exists for Mint Aou Aou. This is based at least in part on the model used by SONADER (and Il Nuevo Castoro for Tagant) which is only designed for basins up to 200 km2. Mint Aou Aou is 344 km^2. However, Mr. Steffan of SONADER feels that the model has adequate safety factors to represent larger basins. It should be noted that the Tagant design for Mint Aou Aou is considerably different than USAID's. The same is true for Boudjoungal. Mr. Freddie Isambert, a conseillee technique requested from the French embassy, is reviewing these differences and SONADER's designs for our five sites of the first construction season. His comments should be sought. He will leave February 16 or 17.

4. As mentioned in 3, preliminary data, testing and designs for Boudjoungal and Mint Aou Aou were performed both by Il Noeuvo Castoro and SONADER (USAID). Mr. Appel of Genie Rural has also re-expressed concern about the hydrological calculations. From the 3-10 of February Mrs. Steffan, Isambert and possibly Mr. Appel will be visiting the Brakna barrage sites and the Hodh sites. They have indicated a willingness to report on their findings, suggest the best sites and methods for installation of hydrological and meteorological equipment at Mint Aou Aou and two of our 1st year sites so that years-of-record can begin to be developed.

5. Two means for collection of hydrological data seem possible during the rains.

   a. Emplacement of automatic equipment with guard to protect. Readings taken by someone from Nouakchott periodically

   b. Use of manual equipment by someone trained for each site who lives in the vicinity. This would probably also require a guard, training and salaries for the technicians.

   c. ORSTROM had difficulties with up to 50% of their field metering equipment when they performed their hydrological surveys. It disappeared, was broken, or stolen - some felt the local people feared the results which would alter decisions to build dams at their sites.

   d. Installation of hydrological and meteorological metering equipment would not be expensive at the constructed dams, such as flow measurements from height of water flowing over spillway and rainfall tray guages nearby. The guard could be trained to take the measurements or remote equipment could be used. Typical instrumentation diagrams were filed in the Project Info Packet.

10. AVAILABLE DATA AND INFORMATION RESOURCES

A. Reports

1. All of the Land Reclamation Project Documents:

   PP, Engineering, Social, Environmental and Health Annexes
   Schistosomiasis, W.D. Davies (79?)

   Reports Prepared by SONADER
   Hydrology - 1978, 1980
   Hydrogeology 1980 (March)
   Pedology - Engineering - 1980 (December)
   Pedology - Agronomy - 1981 (February)
   Construction Engineering Design - 1980
   Geotechniques - 1980

2. RAMS, Unite de Recherche Geographic/Environment (USAID/NKT)
   "Etude de base no. 1
   Les Grandes Zones Agricoles de Mauritanie"
   (especially les parties 3 and 4 les eaux 'de surface et l'eaux souterraine)

   Les Etudes Demographique des Regions Brakna et Gorgol.

3. PNUD: "Renforcement du Service des Eaux Sonterraine," DP/UNMAU-67-502/2 - USAID Library.
   Well inventory and maps of most of Mauritania.
   Methods used and work completed.

4. Tous les Rapportes d'un Conference De l'Eau a Nouakchott 15/12/80. Direction de l'Hydraulique, SONALEC, PNUD, tous les gens qui travaillent avec l'eau ont donne un rapport. Attende par Mrs. Carr and Hauser of USAID. (12 or 15 short studies plus maps of Resource d'Eau)

5. B.U.R.G.E.A.P. (French) "Synthese Hydrogeologique et Amenagements Hydraulique du Sud Est Mauritanie," Mars, 1966 (R415). Copy at Direction de l'Hydraulique au bureau de Mr. Terrere. A good map from Makta Lajar and South to the East of Mauritania.

6. TAMS/CIEH (Comite Inter Africain D'etudes Hydrauliques) "Projet D'Utilisation des Resources en Eau des Terres des Regions de Savarre." (English and French). I couldn't find a copy of report - only a few maps of the area covering the barrage sites.

7. SOGETHA (Societe Generale de Techniques Hydro Agricole) (French). Service du Genie Rural (1958?), "Mission d'Etudes Hydro-agricoles en Mauritanie." (Lots of good information still valid and maps)

8. Guiraud, Rene, "Projet de Gestion des Resources en Eau dans la Region du Brakna Oriental et de l'Aftout." UNESCO, Direction de l'Hydraulique. (Professor of Geology at University of Dakar reports on Inferoflux, underground reservoirs).

Engineering report to follow Yugolsavian engineer coming January/February 1981. Also, for specialized questions in underground dams M. Dubus, UNDP Dakar, M. Ban-thieu, BCEOM/Dakar and Sidi El Haq at PNUD, Noukchott - worth investigating.

9. Sidatt, Moustapha, M.D. Centre National de Hygiene, GIRM, "Enquete Epidemiologique Concernant les Barrages du Gorgol et du Brakna," November, 1980.

10. Other Barrage Studies, Proposals for Construction, Designs etc.

Hodh region - finished first year of construction for 5 barrages, 2 failures, 2 without water. Contruction by SONADER. More to do, and equipment. Reports in offices of Mr. Seffan, SONADER, and Mr. Appel, Genie Rural.

UNSO - building barrages with forced brigades, using dry compacted earthworks. Building upon request, equipment. Report in offices of Mr. Appel, Genie Rural.

Tagant - designed by Il Noevo Castoro, Italian Contracting Firm, designs done for Mint Aou Aou, Boudjougal and 10 or 12 others in the Tagant Region. More detailed geotechniques, and more concrete than SONADER designs for USAID.

11. ORSTROM - Hydrological Surveys, ten or more years old? but collected information close to our areas. Report in Mr. Steffan's office SONADER. Used field equipment, had trouble with vandalism on barrage sites.

12. Mr. Gene McJunkin: Engineering Control Measures for Schistosomiasis, USAID, 1970.

13. Snail Control in the Prevention of Belhrziasis, WHO Monograph, Series #50; 1965.

14. Haratani and Goff, AID/WAS/NE/TECH. "PrePID Manual for Rural Water Supply Sanitation and Hygiene Education," 1980. Presently under review by NE Missions.

15. Water Related Diseases - Drawers of Water: Bradley and White, 1972.

16. IBRD, 8/80, Mauritania, Gorgol Irrigation Project, #2517a-Mau (also Jobin, W. - Gorgol Schistosomiasis Report).

B. Contacts (five digit telephone numbers included)

USAID/NKT:

Allan Reed, John Grayzell, Mona Fikry and Patrick Hauser (RAMS) and project Infor Packet in room next to Library.

SONADER: (Societe National de Development Rural)

515.00 Mrs. Philippe Grandjean, Francis Steffan, [illegible], Alain Thalman (formerly with Genier Rural), Freddie Isambert-Conseille

Direction de l'Hydraulique:

516.11 Mrs. Donnat, Terrere,* Bruno*, Mamidou*, Alkmendha?
526.08* (Office of Coordination), Hlemanocki, Moussa Smedina, Dubernet*, Mr. Ba-Aleg

Genie Rural: (Rural Works)

Mr. Appel 515-04

Centre National d'Hygiene:

Dr. Moustapha Sidatt, Director

SNIM: (Societe National des Industries et Mines)
Mrs. Oksengorn*, Moliere, bureau de recherches hydrogeologique, *here for many years, both are working on USAID Rural Roads Project.

UNDP/PNUD:

Mrs. White, Res. Rep, Kosukovski (36 wells project) difficult to reach, 524-09, Siddy El Haq.

WHO/OMS:

Mr. Dow, Sanitary Engineer

US Peace Corps:

Roger Conrad, Assistant Director

UNDP/PNUD

Mr. Dubus - underground reservoir engineer.

11. ANNEX I

A. Essential Malacological Data

These comprise field and laboratory information to be obtained by the Surveillance and Control Team. Field surveys are necessary to determine the presence or absence of snails. If snails are found they are to be identified to species. Size of the snail is to be recorded and search for egg masses should be made.

Survey for the snails should be made every two or three weeks to determine fluctuation in snail population density throughout the period.

In the laboratory positive identification of the snail species involved can be made. The snails can then be examined individually in the laboratory for their natural infection with the schistosome. Prevalence rate of infection among the snails should be determined.

Information is also to be obtained on snails undergoing estivation after the water recedes.

Information is to be obtained on water chemistry and the presence or absence of aquatic vegetation.

B. Control of Schistosomiasis

Various measures are known for the control of schistosomiasis. They are to be used separately, but preferably in combination. These measures are:

1. Snail Control

   a. Environmental Control: Such measures are applied to upset the habitat necessary for the survival of the snail and the building up of colonies. For situations such as the reservoirs of the barrage area, fluctuation of water level has proven to be effective. Also the habitat may be rendered less suitable by the deepening and straightening of the margins, where the snails live, and by clearance of all aquatic vegetation, sticks, twigs and any flotsam. For such marginal areas a combination of ecological control with chemical control may be necessary, especially in foci with dense snail population.

   b. Chemical Control: this is by the use of molluscicides. There are several compounds known to have molluscicidal properties. The most recently known

molluscicides whose efficacy in the field has been demonstrated in several endemic areas are Bayluscide and Frescon.

Bayluscide (niclosamide) is produced by the Bayer Company in Germany and is provided in two formulations. The wettable powder and the emulsifiable concentrate. They can be applied by knapsack in situations such as the reservoirs in the barrage area. The cost varies depending on transportation costs, custom duties, etc. The price per kilogram varies between $9 and $13. Normal dosage is 4-8mg/l.

Frescon is produced by the Shell company in England and has several formulations. Unfortunately, at present, it can only be obtained in large orders.

Some of the known molluscicides have also been incorporated in a matrix of rubber or polystyrene. This technology is for slow or controlled release of the chemical from the matrix.

There are also molluscicides of plant origin prepared from various plants throughout the endemic areas of the world. Unfortunately, they have only received limited field evaluation. One of these compounds is known as Endod and is prepared from Phytolacca dodecandra, a shrub that grows in Ethiopia and some other parts of Africa.

2. Chemotherapy

Several chemotherapeutic drugs are known to be effectiv against schistosomiasis, among the recent ones ar Ambilhar, and Metriphonate. They, however, have some sid effects. Metriphonate has proven to be effective agains urinary schistosomiasis in Tanzania, and could be used i Mauritania.

The most recent compound is Praziquantel produced by th Bayer Company in Germany (brandname Biltricide) and probably has less side effects than other compounds. It i being used now in Egypt for mass treatment of about 5,00 patients.

3. Prevention of Human-Water Contact

At present, livestock and humans use surface waters for al purposes creating foci of infection and reinfection. Huma and livestock sources should be separate. Separation o

contaminated surface waters and safer ground waters is essential. Defecation and urination where eggs hatch in the water and infect the snails. Alternative sources of safe water have to be provided in the form of protected wells and piped water for human and animal use.

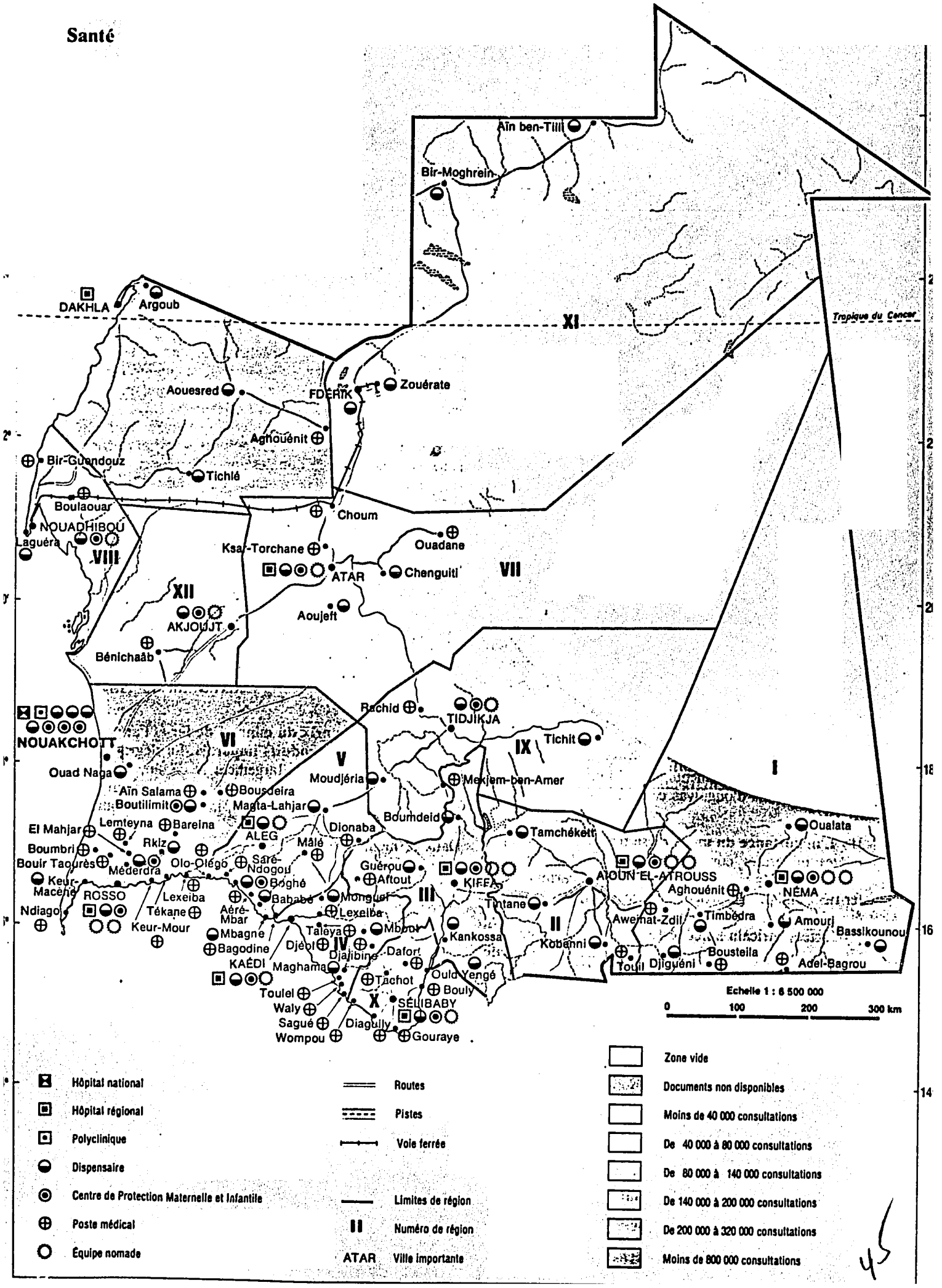
4. Health Education

Comprises educational programs about the life cycle of the parasite and health hazards from contaminated waters.

11. ANNEX II

MAPS

Santé


Aïn ben-Tili
Bir-Moghrein
DAKHLA
Argoub
Tropique du Cancer
XI
Aouesred
FDERIK
Zouérate
Agnouénit
Bir-Guendouz
Tichlé
Boulaouar
NOUADHIBOU
Laguéra
VIII
Choum
Ksar-Torchane
ATAR
Chenguitt
Ouadane
VII
XII
AKJOUJT
Aoujeft
Bénichaâb
Rachid
TIDJIKJA
Tichit
IX
NOUAKCHOTT
VI
V
Ouad Naga
Moudjéria
Mekjem-ben-Amer
I
Aïn Salama
Bousdeira
Boutilimit
Magta-Lahjar
Bourndeid
El Mahjar
Lemteyna
Bareina
ALEG
Dionaba
Tamchékett
Oualata
Boumbri
Rkiz
Malé
Bouir Taourès
Méderdra
Olo-Olégo
Saré-Ndogou
Guérou
Aftout
KIFFA
AIOUN EL-ATROUSS
Keur-Macène
ROSSO
Boghé
Bababé
Monguel
III
Aghouénit
NÉMA
Ndiago
Lexeiba
Tékane
Aéré-Mbar
Lexeiba
Tintane
Awemat-Zdil
Timbédra
Amouri
Keur-Mour
Mbagne
Taleya
Mbout
II
Kankossa
Bassikounou
Bagodine
Djéol
IV
Djalibine
Dafort
Kobenni
Bousteila
KAÉDI
Maghama
Tachot
Ould Yengé
Touil
Djiguéni
Adel-Bagrou
Toulel
Bouly
Waly
X
SÉLIBABY
Echelle 1 : 6 500 000
0 100 200 300 km
Sagué
Diagully
Wompou
Gouraye
Hôpital national
Hôpital régional
Polyclinique
Dispensaire
Centre de Protection Maternelle et Infantile
Poste médical
Équipe nomade
Routes
Pistes
Voie ferrée
Limites de région
II Numéro de région
ATAR Ville importante
Zone vide
Documents non disponibles
Moins de 40 000 consultations
De 40 000 à 80 000 consultations
De 80 000 à 140 000 consultations
De 140 000 à 200 000 consultations
De 200 000 à 320 000 consultations
Moins de 800 000 consultations

45

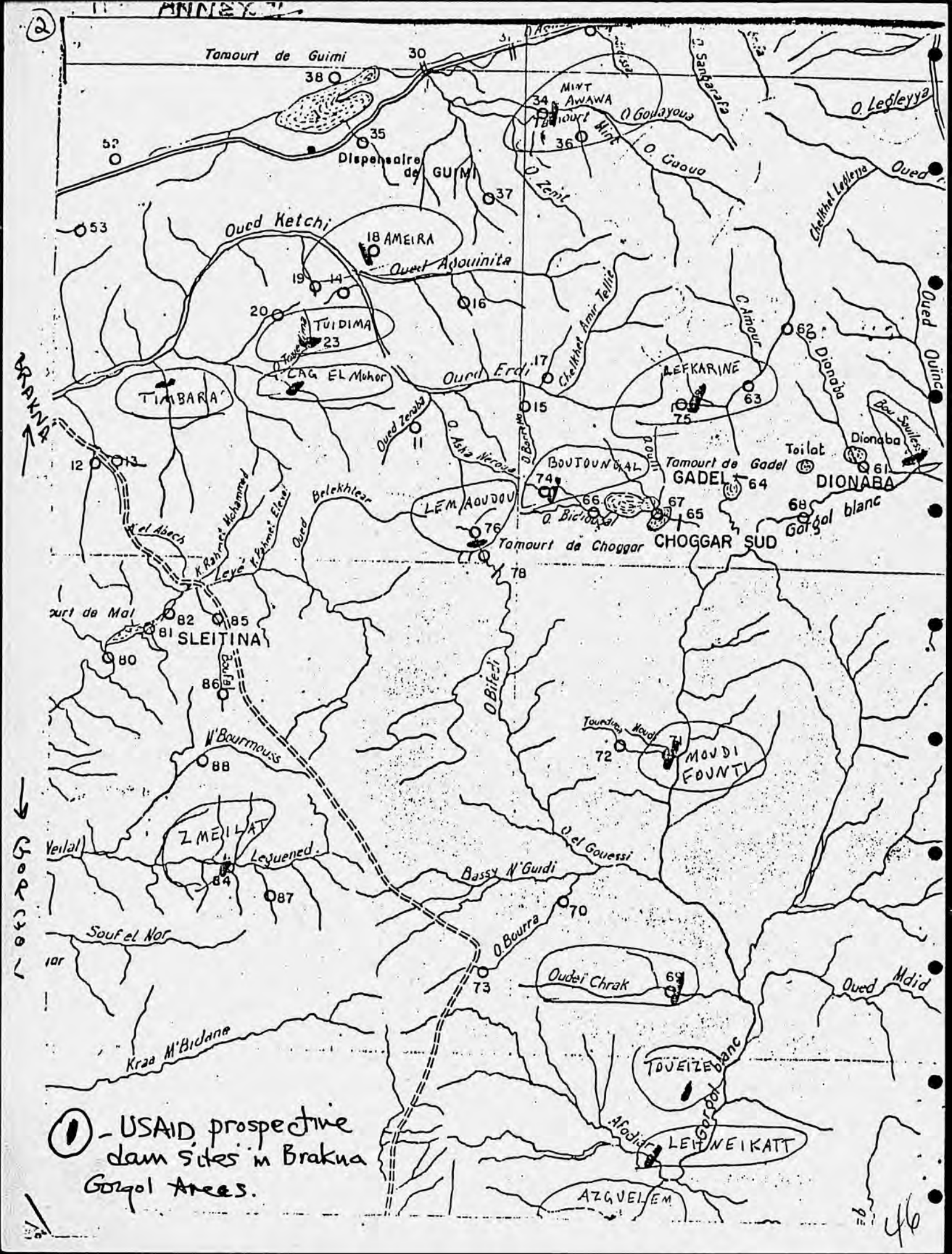
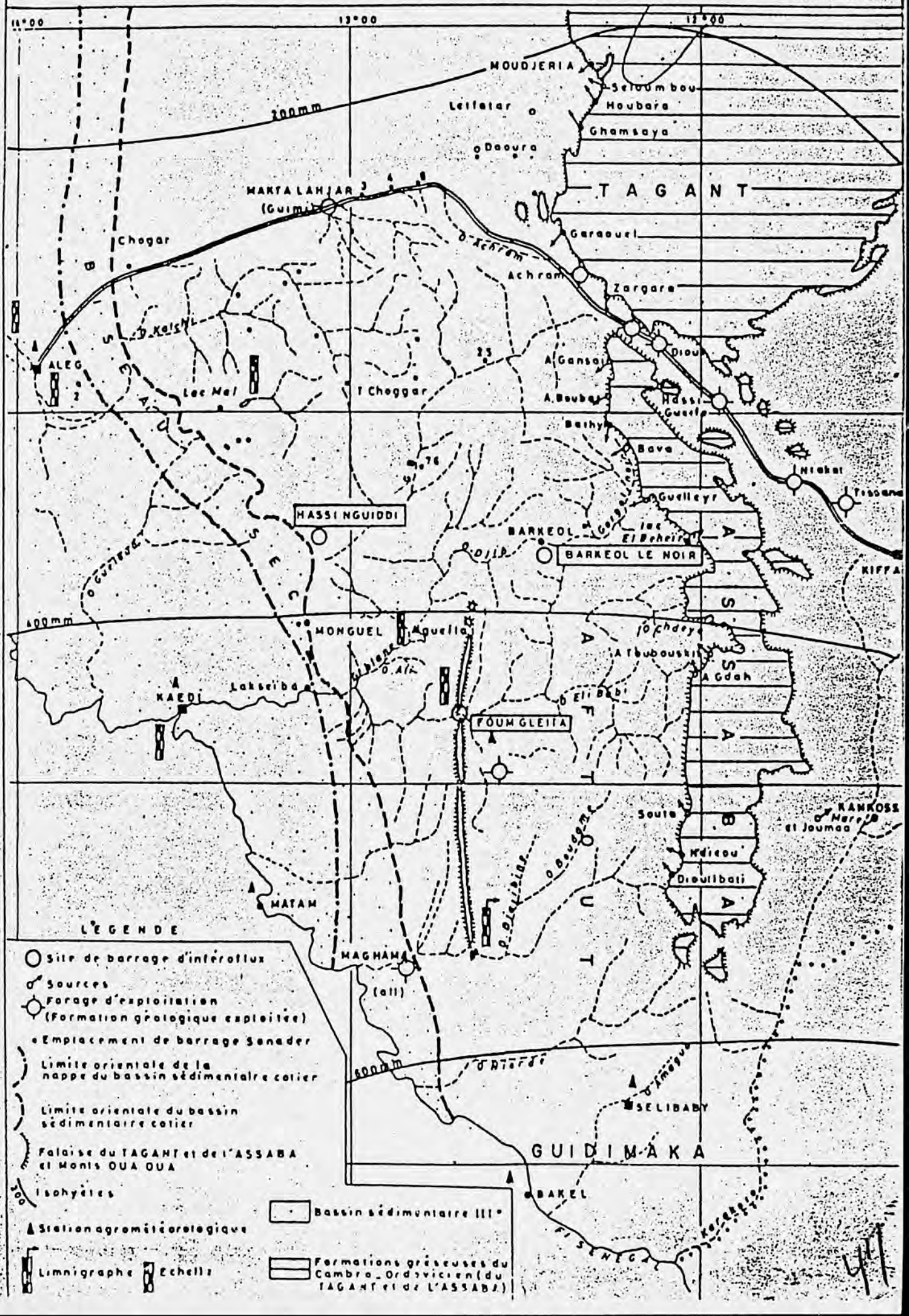

(2)
ANNEX
Tamourt de Guimi
Dispensaire de GUIMI
MINT AWAWA
O. Goulayoua
O. Sangarafa
O. Lesleyya
O. Guoua
O. Zenit
Oued Ketchi
18 AMEIRA
Ouert Aglouinita
TUIDIMA
CAG EL Mohor
TIMBARA
Ouerd Erdi
Chelkhet Amir Tellis
C. Aimour
LEFKARINE
O. Dionaba
Oued Ouinc
Chelkhet Legleya
Oued
Bou Souiles
Dionaba
Toilat
Tamourt de Gadel
GADEL
DIONABA
BOUTOUNKAL
O. Bicholkal
LEM AOUDOU
Tamourt de Choggar
CHOGGAR SUD
Gorgol blanc
Oued Belekhleur
K. el Abech
K. Rahmet Mohammed
K. Rahmet Ehmet Eleva
SLEITINA
O. Bifedi
Touadiza Moudi
MOUDI FOUNTI
W'Bourmouss
ZMEILAT
Veilal
Legueried
O. el Gouessi
Bassy N'Guidi
Souf el Nor
O. Bourra
Oudei Chrak
Oued Mdid
Krad M'Bidane
TOUEIZEbanc
Gorgol
LEIT NEIKATT
AZGUEILEM
BRAKNA
Gorgol
(1) - USAID prospective dam sites in Brakna Gorgol Areas.
46

fig. I _ CARTE DE LOCALISATION



REPUBLIQUE ISLAMIQUE DE MAURITANIE

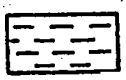
MINISTERE DU DEVELOPPEMENT RURAL

DIRECTION DE L'HYDRAULIQUE

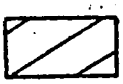
CARTE DES RESSOURCES EN EAU

B R A K N A

LEGENDE



Nappe généralisée des alluvions recentes du fleuve sénégal



Socle métamorphique "stérile" des Mauritanides

Nappe generalisee du Bassin sédimentaire côtier.

Alluvions d'oued
Aquifères discontinus périodiques
Exploitation par oglat:

Courbe d'égale profondeur de l'eau sous le sol (m)

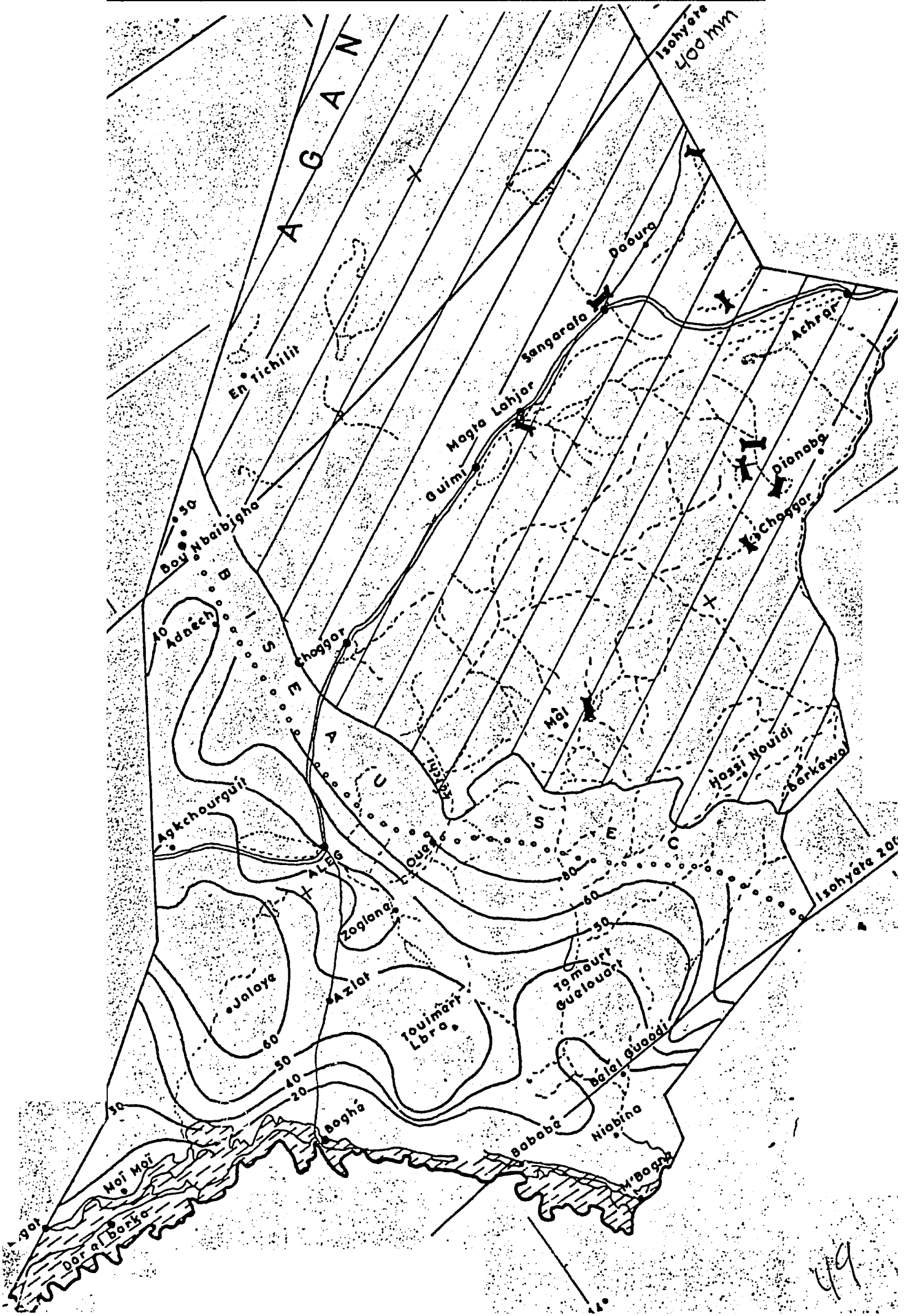
Barrage.

Piste

Limite Est de la nappe généralisée

Scale 1/1,000,000

(SEE NEXT SHEET)


SAHARA
Isohyète 400 mm
Doourg
Sangarata
Achrar
En Tichilit
Magta Lahjar
Guimi
Dionoba
Choggar
Boy Nbaibigha
50
40
Adnèch
Choggar
Mâl
Hassi Nouidi
Barkewol
Agkchourguit
ALEG
Ouad
Zoglana
Isohyète 20
80
60
50
Jaloya
Azlat
Touimart Lbra
Tamourt Guelouar
Bâlal Guaadi
40
20
Bogha
Niobina
Bababé
M'Bagne
Moï Moï
Dar al Barka

11. ANNEX III

GIRM - Centre National d'Hygiene Epidemiological Survey of Brakna - Gorgol Region, November, 1980

REPUBLIQUE ISLAMIQUE DE MAURITANIE — HONNEUR FRATERNITE JUSTICE

CENTRE NATIONAL D'HYGIENE

ENQUETE EPIDEMIOLOGIQUE CONCERNANT LES BARRAGES DU GORGOL ET DU BRAKNA

Dans le cadre d'un Projet de Restauration et de Construction de Barrages dans les Régions du Gorgol et du Brakna, l'U.S.A.I.D., a chargé le Centre National d'Hygiène d'effectuer pour son compte une enquête épidémiologique dans ces régions.
Cette enquête devait fournir un rapport sur :

1°/ - L'état de Santé des populations devant bénéficier des barrages ainsi que leurs besoins de santé.

2°/ - La prévalence du Paludisme et de la Bilharziose Urinaire.

3°/ - L'état Nutritionnel et Alimentaire des Collectivités.

4°/ - Les influences éventuelles des barrages sur la santé des populations concernées.

Une équipe composée :

- Du Dr. SIDATT MOUSTAPHA, Directeur du Centre National d'Hygiène.
- De Mr. ABDERRAHMANE OULD HAMDI, Infirmier Chef de service de la Vaccination Internationale.
- De Mr. ABDALLAHI OULD ATIGH, Aide Laborantin
- De Mr. DIALLO IBRAHIMA, Manoeuvre

s'est rendue sur les lieux du 30 Octobre au 13 Novembre 1980.
Melle LINDA NEW HOUSER a rejoint l'équipe le 10/11/1980.

MATERIELS ET METHODES

En moyenne 20 à 50 enfants de chaque localité ont été éxaminés ainsi que 10 personnes adultes choisies au hasard. Les enfants sont pris dans les écoles quand celles-ci éxistent.

1°/ - LA BILHARZIOSE URINAIRE

10 à 20 cc d'urine sont prélevés, centrifugés pendant 3 minutes à 250-300 tours/minute. La mission dispose d'un microscope et d'une centrifugeuse à main. Les urines sont éxaminées directement au microscope par le Dr. SIDATT. Les recherches de bulin n'ont pas pu être correctement effectuées durant cette mission. Cependant il est correcte de se baser sur les rapports de la mission du Centre National d'Hygiène effectuée conjointement dans la région du Brakna.

2°/ - LE PALUDISME

L'indice de la spléno et de l'hépatomégalie est mesuré par une appréciation manuelle, un travers de doigt correspondant à 1,5 cm. Pour des raisons de facilités, on ne fait pas de différence entre la spléno et l'hépatomégalie. Le paludisme étant la principale cause de splénomégalie, on peut, avec une faible marge d'erreur, faire le rapport entre celle-ci et le Paludisme.

3°/ - LES EXAMENS DENTAIRES sont effectués par le Dr. SIDATT.

On tient compte du nombre de dents touchées et on néglige la profondeur de l'atteinte par la carie.

4°/ - LES EXAMENS OCULAIRES sont effectués par le Dr. SIDATT.

5°/ - La Croissance est appréciée par la mesure du poids et de la taille, à l'aide d'une balance toise ainsi que le pourtour du bras à l'aide d'un maître ruban.
Ces mesures sont effectuées par Mr. ABDERRAHMANE OULD HAMDI.

Le dépouillement des données est effectué au Centre National d'Hygiène par l'équipe qui a réalisé l'enquête.

-=- R E S U L T A T -=-

BILHARZIOSE URINAIRE

Lieux		Nbre de Personnes Examinées	Nombre de Cas Positifs	Pourcentage
Oudei Lefkarine	B	22	0	0
Boussoueilif	B	22	1	4,5 %
Modi Founti	G	21	8	38 %
Bédingal	B	24	0	0
Lem'Oudou	B	8	0	0
Toueidima	B	24	0	0
Tembara	B	7	0	0
Ameira	B	30	0	0
Oudei Chrak	G	23	10	43,4 %
Toueizekre	G	12	1	8,3 %
Total.....		193	20	10,3 %

B is Brakna (150-250 mm) rainfall
G is Gorgol (250-400 mm) rainfall

TAUX PAR AGE ET PAR SEXE

MASCULIN				FEMININ			
Age	Nbre de Personnes Examinées	Nbre de cas Positifs	Taux	Age	Nbre de personnes Examinées	Nbre de cas Positifs	Taux
4 ans	9	1	11%	4ans	6		
5 ans	12			5ans	9		
6 ans	5			6ans	5		
7 ans	8	1	12%	7ans	4		
8 ans	35	5	12,2%	8ans	14	1	5 %
9 ans	31	1	32 %	9ans	2		
10ans	19	6	31,5	10ans	8	3	37,9%
11ans	4			11ans	1		
12ans	6			12ans	4	2	50 %
13ans	6			13ans			
14ans	3			14ans	2		
15ans	1			15ans			
Total	138	14	10,14%		55	6	10,9

La Bilharziose Urinaire, a des degrés variables dans les sîtes de barrages.

Certaines zones ne sont pas encore atteintes. Cependant, les conditions sont reunies pour qu'une fois les barrages construits, la bilharziose subisse une recrudescence. En effet, si Oudei Lefkarine et Boussoueili sont encore indemnes, Dionaba, situé à 7 km à mi-chemin entre les deux sîtes est fortement infesté. Une bonne proportion des enfants que nous y avons visités urinent du sang.

Les bulins peuvent être chariés par les eaux des Oueds et amenés de distances éloignées.

HEPATOSPLÉNOMEGALIE

Lieux	Nbre de Personnes Examinées	Nbre de cas Positifs	Pourcentage
Oudei Lefkerine	22	1	4,5
Boussoueilif	22	2	9,1
Modi Founti	21	0	0
Bédingal	24	2	8,3
Lem'Oudou	8	0	0
Toueidima	24	9	37,5
Tembara	7	2	24,6
Ameira	30	3	10
Oudei Chrak	23	4	17,4
Toueizekre	12	5	41,7
TOTAL.....	193	28	14,5

HEPATOSPLENOMEGALIE SELON LEUR IMPORTANCE

Nbre de Cas positifs	1 à 3 travers de doigts	4 à 5 travers de doigts	6 travers de doigt et plus
	26	2	0
Total.....	92,8	7,2	

A cette saison de l'année le paludisme regresse. I
a fait ses dégats durant l'hivernage. Le chiffre de 14 % n'est pas
loin de celui de Kankossa, situé en pleine région de Haute endémicité
Les villages les plus touchés Toueidima, Oudei Chrak, Toueizekre) son
situés dans les Oueds où s'effectuent les cultures.

ANEMIE CLINIQUE

Lieux	Nbre de personnes Examinées	Nbre de cas Positifs	Pourcentage
OUDEI LEFKERINE	22	4	18,2
BOUSSOUEILIF	22	3	13,6
MODI FOUNTI	21	5	23,8
Boudjoungal BEDINGAL	24	3	12,5
LEM'OUDOU	8	1	12,5
TOUEIDIMA	24	0	0
TEMBARA	7	0	0
AMEIRA	30	1	3,3
OUDEI CHRAK	23	4	17,4
TOUEIZEKRE	12	0	0
TOTAL.....	193	21	10,8

- COMMENTAIRES

Le nombre de cas d'anémie est trés variable suiva
les localités.
Ceci peut être en rapport avec la richesse de l'alimentation en lait
Les villages constitués, Ouedei Lefkarine, Medi Founti, Boussoueilif
Oudei Chrak sont plus touchés que les localités à orientation Pastor
le(Toueidima, Ameira, Toueizekre, Tembara). De toutes façons, le
chiffre de 10,8 % nous semble trop élevé pour cette saison, la meil

ATTEINTES OCULAIRES

Lieux	Nbre de personnes Examinées	Nbre de Cas Positifs	Pourcentage
OUDEI LEFKARINE	22	1	4,5 %
BOUSSOUEILIF	22	2	9,1 %
MODI FOUNTI	21	0	0
BEDINGAL	24	4	16,7 %
LEM'OUDOU	8	0	0
TOUEIDIMA	24	2	8,3 %
TEMBARA	7	1	14,3
AMEIRA	30	0	0
OUDEI CHRAK	23	2	8,7
TOUEIZEKRE	12	1	8,3
TOTAL.....	193	13	6,7 %

COMMENTAIRES

La saison des épidémies de conjonctivites n'a pas encore commencé. Parmi les atteintes oculaires rencontrées, seuls deux cas de Panus, soit 15,3 %, peuvent être attribués aux Sequelles du Trachôme.

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AFFECTIONS DENTAIRES

Lieux	Nbre de Personnes Examinées	Nbre de Cas Positifs	Pourcentage
Oudei Lefkarine	22	6	27,3 %
Boussoueilif	22	5	22,7 %
Modi Founti	21	5	23,8 %
Bédingal	24	3	12,5 %
Lem'Oudou	8	1	12,5 %
Toueidima	24	6	25 %
Tembara	7	1	14,28 %
AMEIRA	30	8	26,7 %
Oudei Chrak	23	5	21,73 %
TOUEIZEKRE	12	3	25 %
TOTAL	193	43	22,3 %

IMPORTANCE DE LA CARIE DENTAIRE EN SE BASANT SUR LE NOMBRE DE DENTS TOUCHEES

Nbre de dents touchées	1 à 2 dents	3 à 4 dents	5 à 6 dents	7 et plus
	28	13	1	1
Pourcentage	65,1 %	30,2	2,3	2,3

Le Chiffre total de 22,3 % n'est pas loin de celui des autres régions : 21 % dans l'Assaba, 20 % dans le Guidimakha. Il est moins important que celui du Trarza = 69 %

AUTRES AFFECTIONS RENCONTREES DANS LES DIFFERENTES COLLECTIVITES

OUDEI LEFKARINE	Rhumatisme articulaire aigu Bronchite
BOUSSOUEILIF	Marasme Début Epidémie de Rougeole (Cinq cas)
MODI FOUNTI	Bronchite Pyurie Hématurie
BEDINGAL	
LEM'OUDOU	
TOUEIDIMA	Fièvre chez plusieurs personnes l'origine palustre est trés probable
TEMBARA	Malnutrition
AMEIRA	Teigne
OUDEI CHRAK	- Fièvre probablement d'origine palustre - Teigne - Siphylis endémique (Trois cas) - Dracunculose - Hématurie - Malnutrition
TOUEIZEKRE	Dracunculose Malnutrition

Ce tableau reflète les besoins en soins de Santé de ces zones trés peu couvertes sur le plan Sanitaire.

DISTANCE ENTRE LES BARRAGES ET LES POSTES DE SANTE

Barrages	Poste de Santé de Dépendance	Distance de ce Poste
OUDEI LEFKERINE	Maghta-Lahjar	70 km
BOUSSOUEILIF	Maghta-Lahjar	100 km
MODI FOUNTI	Maghta-Lahjar	85 Km
BEDINGAL	Maghta-Lahjar	60 km
LEM'OUDOU	Maghta-Lahjar	70 km
TOUEIDIMA	Maghta-Lahjar	50 km
TEMBARA	Mâle	20 km
AMEIRA	Maghta-Lahjar	25 km
OUDEI CHRAK	Mouguel	35 km
TOUEIZEKRE	Mouguel	30 km

CONCLUSION ET RECOMMANDATIONS

- Les barrages que nous avons visités sont tous situés dans une plaine en dépression, limitée à l'Est par la chaine de l'Assaba, au Nord-Est par la chaine du Tagant, au Nord-Ouest et à l'Ouest par les dunes désertiques du Trarza, au Sud par le Fleuve Sénégal.

Les eaux des montagnes du Tagant et de l'Assaba parcourent des centaines de kilométres à travers cette plaine rocailleuse pour se jet dans le fleuve.

- Les populations de cette plaine sont essentiellement agricoles et pastorales. Elles sont trés peu couvertes sur l plan Sanitaire. La malnutrition, le paludisme, la Dracunculose y constituent des problémes de santé publique.

- Un projet de barrage aura des effets favorable

1 - Alimentaires en diminuant le déficit en grain

2 - Sociaux : en fixant les populations, ce qui facilitera la solution des problémes de scolarisation, de couverture sanitaire etc...

3 - Hydraulique : L'eau est extrêmement rare dans cette zone. Les retenues permettront une alimentation en eau des populations et des animaux, de même qu'elles fourniront l'eau à la nappe phréatique.

Ce Projet augmenterait sans nul doute le nombre de cas de Bilharzio Urinaire et de Paludisme.

En conséquence, il nous semble important d'é dier pour l'avenir les possibilités :

1 - De lutte contre la Bilharziose dans la région, par des méthodes adaptées.

2 - De prévoir le forage de puits à margelles, quest urgente surtout à Toueizekre et Oudei Chrak.

3 - De prévoir un petit projet Chloroquinisation des villages en période de pluies.

Le Directeur du Centre National d'Hygièn

Dr. SIDATT MOUSTAPHA

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