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THE STUDY OF HUMAN BEHAVIOR AND SCHISTOSOMIASIS TRANSMISSION IN AN IRRIGATED AREA IN MOROCCO

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Abstract—This paper presents a research strategy for studying water contact, water use and schistosomiasis transmission in an irrigated area of Morocco. This setting, with many scattered water contact sites, many activities carried out at these sites, and the small number of people involved, was not appropriate for a conventional water contact study based on the observation of water contact sites, such as had been carried out in the Nile delta. The Moroccan study utilizes three related concepts: the household, time geography, and the gendered use of space. It seeks to understand processes and interrelationships underlying the daily mobility pattern of individual households, and seen as part of a larger system of organization and structure in time and space. The preliminary results of the study indicated the complexity and dynamism of water use and water contact, which need to be considered in planning disease control strategies especially in changing settings, such as those associated with environmental interventions in the study area. © 1998 Published by Elsevier Science Ltd. All rights reserved

Key words—schistosomiasis, irrigation, water contact, time geography, household, gender

INTRODUCTION

Next to malaria, schistosomiasis has in recent times been one of the most destructive diseases in tropical and subtropical areas. It weakens and debilitates the sufferer, affects people's ability to carry out physical labor and, if untreated, in the long term undermines the functioning of the liver and ultimately causes death (Farley, 1991). Irrigation and other water development projects present particularly favorable locales for the survival and spread of the disease. The possibility of extremely high rates of infection in newly irrigated areas, or those in which irrigation is being expanded, is demonstrated in the Richard Toll irrigation project near the mouth of the Senegal River. Here, a recent outbreak of *Schistosoma mansoni* in one village recorded an infection rate of almost 100% in people over 5 years of age (Stelma *et al.*, 1993). Schistosomiasis is not a disease threat to be taken lightly.

The transmission of schistosomiasis occurs when humans come into contact with water containing schistosomes which penetrate the skin, following the contamination of the water by infected humans who excrete schistosome eggs in feces (in the case of *Schistosoma mansoni*) or in urine (in the case of *S. haematobium*). To complete their life cycle, and infect humans, the schistosome requires an intermediate snail host in the water source. The disease persists because people in endemic areas continue to contaminate water during excretory activities, and come into contact with potentially infective water sources during domestic, recreational and agricultural activities.

An understanding of **who**, **where**, **how**, **when** and **why** people engage in behavior which puts them at risk of perpetuating or contracting schistosomiasis through water contact activities should be essential input in any integrated schistosomiasis control programs. Answering these questions requires collaboration between researchers in the social sciences and those in the fields of medicine, biology, parasitology and engineering. Planning and implementation should also involve the staff in various government sectors, including health, irrigation, agriculture, and potable water supply. However, there is frequently a lack of communication among these groups because of different professional and sectoral interests (Hunter *et al.*, 1993).

This paper presents a strategy for studying water use and water contact which has been devised for use in an interdisciplinary research project in the Tessaout Amont irrigation scheme in the Haouz plain of central Morocco. This setting, with many scattered water contact sites, many activities carried out at these sites, and the small number of people involved, was not appropriate for a conventional water contact study based on the observation of

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water contact sites, such as the author and her Egyptian colleagues had carried out in the Nile delta.

The strategy developed in the Moroccan setting utilizes three related concepts: the household, time geography, and the gendered use of space. Preliminary findings of the on-going project are presented. The setting for this study is briefly contrasted with that of the Nile delta villages in which an observational study was conducted. The suitability of the strategy in other settings is briefly explored.

METHODOLOGICAL ISSUES

The study of water contact

Epidemiologists and geographers have carried out water contact observations to identify exposure behavior in order to identify risk factors for schistosomiasis infection. These observational studies have been found to be more reliable than interview schedules because they identify what people actually do, rather than what they say they do. Farooq pioneered water contact observations in four villages in the Nile delta in the early 1960s (Farooq *et al.*, 1966). In 1978/79, the geographer Helmut Kloos and his colleagues conducted a detailed observational study of young boys in a village in Upper Egypt (Kloos *et al.*, 1990, 1983). Other studies in this genre include those of domestic activities in St Lucia (Dalton, 1976) and Zimbabwe (Husting, 1983); along the shores of Lake Volta in Ghana (Klumpp and Webbe, 1987; Dalton and Pole, 1978), and at a small dam in northern Nigeria (Tayo *et al.*, 1980).

The results of these water contact observations are usually presented in a **quantitative** form, noting the place, time of day of activity, type of activity, proportion of the body exposed to water, duration of exposure, and the age and sex of those involved. The data is then analyzed, and presented in the form of statistical correlations, associations between population characteristics and activities. Some epidemiologists have sought to increase the validity of these studies by looking for more accurate ways to measure water contact exposure, and hence the risk of infection for different groups in the population (Bundy, 1988; Bundy and Blumenthal, 1990). However, improved measurement may not be enough, and in many cases a broader understanding of the processes underlying these water contact observations is needed.

The study of process

An alternative approach to the study of water contact is presented here, based on a pilot study in Morocco. The strategy is designed to explore water contact, and associated water related activities, as part of a dynamic social process, and in a holistic village setting. It is anticipated that this strategy will develop insights which would not be yielded by a conventional water contact study which looks at individual water contact activities dislocated from their social and cultural context.

To capture the complexity of water use and water contact patterns, the Moroccan study developed a strategy to provide answers to the question **why**, as well as the **who, where, when** and **how** questions which are addressed in conventional water contact studies. The assumption here is that water use activities are **processes** taking place in a social, spatial and temporal context, rather than merely a series of discrete activities performed by individuals. To study these processes, three inter-related elements were incorporated into the research strategy: (1) the household; (2) time geography and (3) a gendered approach to the use of space.

The household

The household unit is the starting point for our study of the mobility patterns which bring people into contact with the disease agent. The definition of a household is somewhat problematic, because of the range of such groupings found in different cultural and social settings. In the study area the term *kanoun*, which is also used for a charcoal stove, refers to the central concept of a household, as a group who cook and share food in a common residential setting. In practice, the *kanoun* was found to be coterminous with the *khaima*, the house (originally meaning a tent), which is a distinct physical entity, a walled enclosure with a single entrance leading to a courtyard surrounded by single story rooms for household members, and stabling for animals.

Recent research has identified the value of health studies which begin with the household, identified as the locus for the production of health or power relationships, knowledge and strategies which support or undermine the health of the family members (Berman *et al.*, 1994). In the case of schistosomiasis, one aspect of the household production of health is the cluster of domestic activities associated with water collection, storage and use; such activities can result in water contact which exposes the individual to the risk of schistosomiasis infection.

Using a household focus for a study may also provide insight into the household clustering of disease, an often noted association which needs to be explored as a social, as well as a genetic phenomena. Household based studies may also offer the opportunity to study contamination behavior. Because of the private nature of these acts, they can only be inferred from water contact studies.

Time geography

Time geography, with its focus on the details of the activities and mobility patterns of individuals in space and time, provides an appropriate set of tools

to conceptualize and analyze processes involved in disease transmission, although it has rarely been used in such a study. Time geographers base their work on intensive studies of human mobility in space, with diagrammatic illustrations of mobility paths at scales ranging from the whole human life span to a single day (Schaerstrom, 1996). The time geography approach is implicit in studies of human mobility and disease transmission in Nigeria, and in Thailand (Singhanetra-Renard, 1993; Watts, 1987). A recent study of malaria in Colombia makes specific reference to time geography, to timing space and spacing time, in exploring the risks associated with micro-scale human movements involved in the cultivation of maize in hill, terrace and delta environments adjacent to homesteads, and identifying places where the activities of humans and anopheles mosquitoes converge to create conditions for disease transmission (Sevilla-Casas, 1993).

Studies of disease transmission rarely focus on the micro-scale, on daily activities within an action-space principally limited to the home community and surrounding land used for farming or grazing. Incorporating Hagerstrand's time-space model of behavior, Roundy identified small-scale daily mobility from the household base in rural Ethiopia, extending to the settlement and the production area (and including water collection). This range can be extended to include the more distant area of contact at markets and in disease environments different from the immediate home area (Roundy, 1987). The combination of a household focus and movement beyond this setting enables researchers to make a distinction between the domestic and the public domains in disease transmission, which also has implications for where, and to whom, one directs intervention strategies (Cairncross *et al.*, 1996).

Gendered space

Epidemiologists, as well as social scientists, now generally recognize that most adult males and females do different things in different places, and that these activities are reflected in differences in rates of prevalence, incidence and reinfection of various parasitic diseases (Bundy, 1988). However, until recently the activities of women have often been overlooked in epidemiological studies. This has been explained in terms of the researchers' unconscious extension of quantitative male models in biology and medicine to cover women (Kettel, 1996; Vlassof, 1994).

Because women's knowledge is so often marginalized, and researchers have shown little interest in the domestic and mundane activities which characterize most women's lives, it is appropriate to use **qualitative** techniques to capture women's spatial mobility and socially constructed knowledge (Mattingly and Falconer-Al-Hindi, 1995; Nast, 1994). In the study of schistosomiasis, the role of the wife and mother as the key person in the care of the health of the family, and as the provider of domestic needs sustaining the family, especially the provision, storage, and use of water, is an obvious focus of attention for researchers.

The French anthropologist, Pierre Bourdieu, in an influential methodological study based on examples from his field work in Kabylia, on the coast west of Algiers, captured the complexity of gendered space in a rural Islamic society. Starting with illustrations of the daily rhythm of life, and its seasonal changes, as experienced by both women and men, Bourdieu recognized the importance of the ordered structure of circular (rather than linear) time in the rural community. He considered that the organization of the existence of the men and the women in accordance with different times and different places constitutes two interchangeable ways of securing separation and hierarchization of the male and female works, the women going to the fountain at an hour when men are not on the streets, or by a special route, or both at once (Bourdieu, 1972, p 163). In her study of the dynamics of female and male relationships in Morocco, Fatima Mernissi focuses on the gendered use of space on the grounds that it is an important expression of gender power relationships (Mernissi, 1975).

Thus both Bourdieu and Mernissi recognized that space is gendered, and expresses power as well as difference. Space can belong to men at one time of the day, and to women at another. While the significance of gendered space in Morocco has changed in the 25 years since Mernissi and Bourdieu wrote their influential studies, it is now generally recognized that the cultural and social use of space is an expression of dynamic and complex cultural and social realities.

STUDIES IN A MOROCCAN IRRIGATION SCHEME

The research project

The strategy discussed in this paper has been developed during a social science project, funded by WHO/TDR and operating in collaboration with a larger European Union/Avicenne study involving malacologists, epidemiolgists, physicians, parasitologists and engineers who are investigating the feasibility of environmental interventions to control the transmission of schistosomiasis in the Tessaout Amont irrigation scheme. The TDR social scientists are studying water use and water contact behavior in four villages. They are working with other team members to ensure that there will be a fruitful interchange between local people and the outside professionals who are developing what they hope will be appropriate and sustainable environmental strategies for schistosomiasis control. The project sup-

Table 1. Characteristics of the study villages

	North		South	
	Smoun	Baaja	Lakhoutcha	Ouled Mesbah
Intervention	no	yes	no	yes
No. households	77	17	100	170
Population	700	100	816	1372
Individual wells	30	13	-	-
Metfia	-	-	1	1
Distance from health center	7 km	9 km	17 km	15 km
Distance from primary school	3 km	3 km	2 km	in village
Mosques	1	1	1	2
Shops	4	2	2	3

ports the Moroccan Ministry of Public Health program to eliminate schistosomiasis by the year 2004; only *S. haematobium* is found in Morocco.

The major activity reported is the in-depth observation of selected rural households, with special attention being paid to movements in and out of the house, and activities associated with water collection, water contact and water use. Daily observations were scheduled to cover as wide a range of activities and situations as possible.

Even before the detailed observations were begun, the observer, a young Moroccan researcher, lived with a family in the village, rather than visiting daily from the nearby town. Gradually, her presence in the village became accepted. Before beginning the daily observations of each household, she was able to visit them, participate in domestic activities, talk to family members, and observe activities on an informal basis. She prepared a village map and identified canals and activity sites, and drew plans of the houses to be studied. This familiarization experience helped to minimize any modifications of household behavior which may result from the presence of the observer.

In each of the four study villages (Table 1), three households were selected for observation during full day sessions. On the basis of the possession of land, livestock and farm equipment, a relatively wealthy, an average and a poor household was identified in each village. Each household was observed individually on each of 4 days: Thursday, which is market day in the nearby town of Attaouia; Friday, which is the day when men attend mosque and when many of the self-employed farmers do not work; Sunday which is a school holiday; and another day which had no specific characteristics. For each household, activities and associated patterns of movement were mapped, and also presented diagrammatically for comparative purposes.

At an earlier stage in the research, researchers had found that using a questionnaire at the water source was of limited value; people could not understand why they were being asked about the things they do everyday, which, for them, have a taken for granted quality. However, we found that a single participant observer was not able to observe all water contact activities in the sample households and sometimes had to rely on the actor's account of these activities. Thus, it is planned to use an additional observer for monitoring activities at the water source, to identify more precisely human activities at particular sites which may be vector snail habitats, and to relate these to the qualitative studies based in the household.

The research setting

The Tessaout Amont irrigation system is situated in the Haouz region of central Morocco, *ca* 70 km north of Marrakesh (see Pascon, 1983), as shown in Fig. 1.

The rural population live in village units, *douar*, which consist of a central nucleated settlement, with, perhaps, an additional hamlet or dispersed individual houses. Overall, population density is low and for an irrigated area cultivation is relatively extensive. Plots average around 5 ha, but there are some landless households in which the men work as seasonal farm laborers. Depending on the amount of water supplied through the irrigation system, the main crops are olives, cereals, vegetables and fodder crops.

Since the 1970s, in Tessaout Amont, a modern irrigation system has provided water from the Moulay Yousef dam, at the foot of the Atlas Mountains, through a network of major canals, and secondary concrete semicircular canals, elevated on stilts. This system of lined, above-ground canals is also found in parts of metropolitan France, for example in Provence, and in Francophone north and west Africa. From the technical point of view the design is efficient, with an optimum water flow and minimum seepage from lined canals, and with relatively easy maintenance. Lined canals and an interrupted water flow in the secondary and tertiary canals would appear to discourage the colonization of the vector snails of schistosomiasis.

In Tessaout Amont, siphons allow the water in the elevated canals to pass underneath access roads and paths, as shown in Fig. 2. A typical tertiary siphon box is approximately one meter square and 2 meters deep. Because the siphon boxes, and the linking underwater pipe, are below water level they remain full of water even when the canals are dry. These siphons have been found to be habitats for

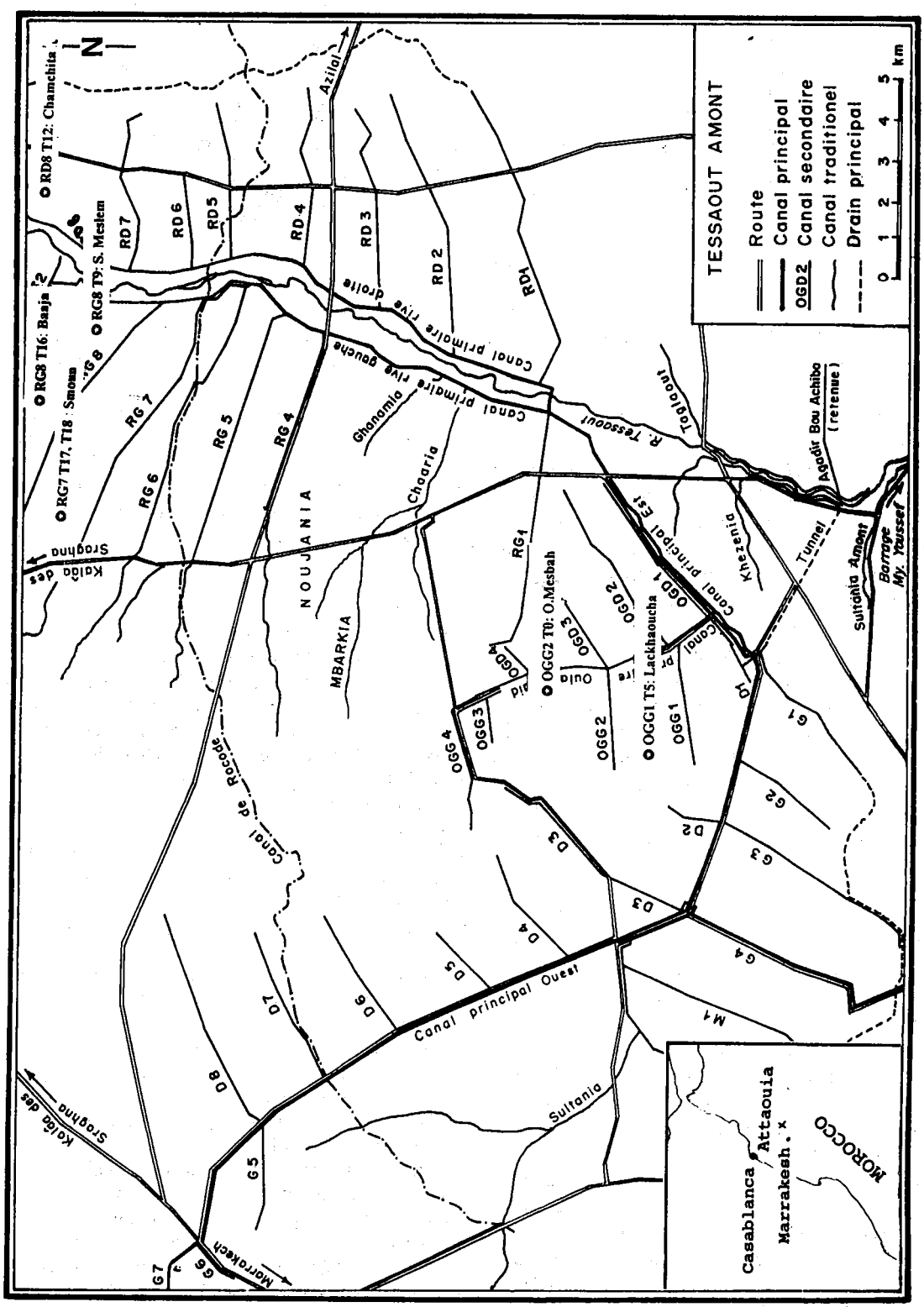

Fig. 1. Map of Tessaout Amont.

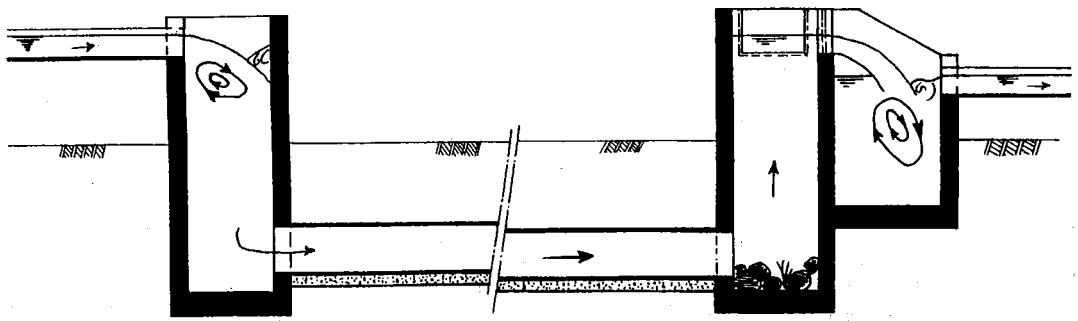

Fig. 2. Diagram of a siphon.

the *Bulinus* vector snails (Khallaayoune and Laamrani, 1992). The water in the siphons is used for domestic and recreational activities, and for watering livestock.

The modern irrigation system in Tessaout Amont is superimposed on an earlier network of earth lined canals, *seguias*, which in some places are still used for irrigation. These older canals feed locally constructed and maintained underground cisterns, *metfias*, which still supply part of the domestic water needs of some villages, especially in the southern part of the area where the water table is too deep for hand dug wells. In this area, some villages are now supplied with potable water from a deep well powered by a diesel pump and distributed through standpipes. In contrast, in the northern part of Tessaout Amont, with a higher water table, *ca* 20 m, rather than 100 m in the south, individual wells operated manually with a windlass, or by diesel pump, provide water for domestic use and to supplement irrigation water supplied through the canals.

The objective of the larger research program was to introduce environmental interventions in some villages, and monitor their impact on snail populations and on human water use and water contact. Therefore, four settlements were selected for the water use and water contact studies; two were non-intervention villages, Lakhoutcha and Smoun, and two were intervention villages, Baaja and Ouled Mesbah. The preliminary results discussed here are based on pre-intervention studies in the four villages. Further studies will identify the impact of two interventions. In Baaja village, the siphons identified as frequent points of water contact have now been covered; some have lids which allow local people to continue to draw water from them while, at the same time, limiting water contact. In Ouled Mesbah village the farmers who are members of the local irrigation water users association are emptying and cleaning the siphons to inhibit the colonization of vector snails.

Preliminary findings

The contribution of the research strategy to our understanding of water contact and use will be illustrated by the daily activities of one household over a 4 day period. This is a poor household living in Ouled Mesbah village, in a part of the Tessaout Amont which has a low water table. In this village, a deep well, with a diesel pump, provides water at standpipes for 2 hours every day. However, this water source is not sufficient for all domestic purposes.

The household observations took place on 4 days during April, 1996 and are illustrated in Fig. 3. The household has six members, grandmother, son, his wife and three children. On the school day observed the two younger children go to the nearby school in the morning and afternoon (Example 1). Radouane, aged 9 and his sister Malika, aged 6, get up at 07.00 hr and, before leaving for school have their breakfast, consisting of a cup of tea and a piece of bread dipped in olive oil. At noon, they return to the house for lunch, the main meal of the day, and rest until 14.00 hr, when they return to school. The afternoon class lasts until 17.00 hr and then the children stroll back slowly, chatting with their friends; their 2 km walk does not pass any canals or siphons.

On the non-school day observed, Radouane goes in the morning with his friends to play (Example 2). The contrast with the activity space of his sister, Malika, is clear; on that day she stays close to the house playing with her friends, within calling distance of her mother (Example 3).

The older son, Hamid, aged 11, does not go to school. On the school day observed he plays in the morning with his friends near the canal. In the afternoon he collects the household allowance of four 30 liter jars of water on a wheelbarrow from the nearby tap; the water generally flows between 16.00 and 18.00 hr, but he has to arrive earlier to take his place in the queue (Example 4). The daily allowance of water, the same for every household, is not enough for the domestic needs of the household; the school children can only take a bath every other day, and water must be saved up from day to

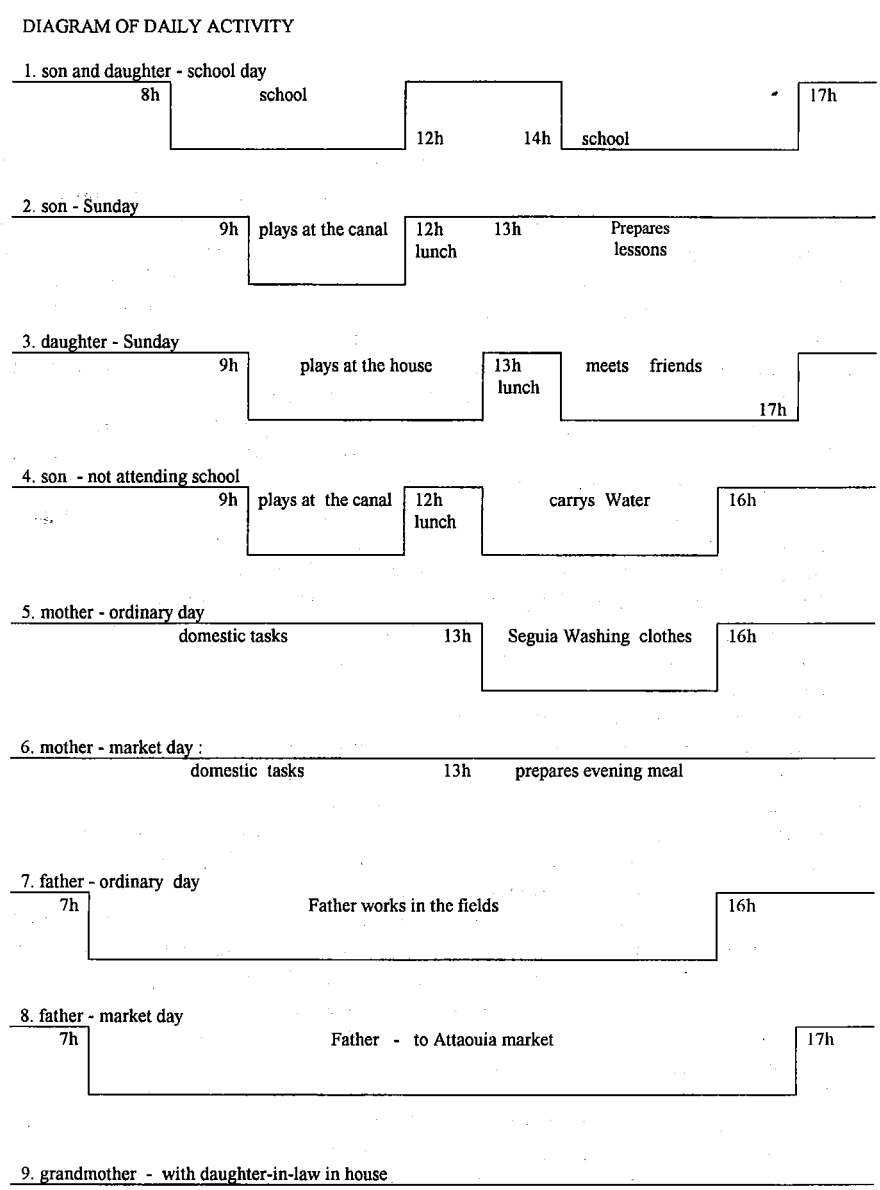

Fig. 3. Daily mobility patterns.

day for tasks such as washing children's clothes when there is no water in the nearby *seguia*.

Fatima, the 30-year-old mother, gets up at 06.00 hr to prepare breakfast for the family. After her husband, Omar, leaves for the fields and the two youngest children have left for school, she begins the household chores, making bread in the traditional oven, cleaning the house and yard, washing the utensils and cooking lunch. These activities take place within the house, *khaima*. In the afternoon, she goes out to wash clothes in the *seguia*, the traditional canal only 10 m from the house, and then returns to prepare the evening meal (Example 5). On the market day Fatima stays in the house in the afternoon to prepare a large evening meal, which is the most elaborate meal of the week (Example 6).

The father, Omar, works as a farm laborer; on the day of observation he leaves at 07.00 hr, and returns at 16.00 hr (Example 7). He takes his midday meal to the fields, but sometimes the son who does not go to school brings it to him. On market day, he leaves home at 07.00 hr, and returns at 17.00 hr, when all the family gathers for the main meal (Example 8); on non-market days, the main meal is at midday. The grandmother, Fatna, aged about 60, is not expected to do any regular domestic work, though she may help her daughter-in-law with light tasks, as on the school day (Example 9). On this day, she is visited by women friends

from neighboring houses; on other days she may leave the house to visit them.

DISCUSSION

Understanding water use and water contact patterns

The preliminary findings reveal the **complexity and variability in water collection and water use in space and time, and the possibility of water contact.** Within each household water related activities can be understood in terms of the complex interrelationship between household resources and composition, and the availability and accessibility of water for various tasks. Choices of which water sources to use are made within the context of water scarcity and the changing patterns of water availability. Water collection, use and contact exhibit daily, periodic and seasonal rhythms, and also reflect the gendered nature of the space of the village.

The presence or absence of livestock in a household illustrates the impact of the material resources on household water use patterns. Households with livestock often water them at the canals or siphons, and this frequently results in water contact. Without a horse or a donkey, the poor household in Ouled Mesbah has to rely on the 11 year old son to fetch water every afternoon from the standpipe in a wheelbarrow. If a donkey or a horse drawn cart were available for water haulage, in addition to saving time collecting water from the standpipe the animal could be used to collect supplementary water supplies from the more distant canal during periods when the standpipe was not functioning because of the shortage of fuel for the pump.

Generally, the source of water for domestic needs is based on a number of factors, including availability at a particular time, the amount and quality of water, and closeness to the house. Although the quality of the water is usually taken into account when deciding on a source of water to use, it may be more convenient to use water from a nearby siphon than from a more distant protected source. Even if a good quality water source is available in or near the house, it may not be used for all domestic tasks. For example, in the villages of Smoun and Baaja, where many households have their own wells, if the well is hand operated the amount used is limited because it is hard work lifting the water; therefore some tasks are performed at more distant water sources.

Tasks such as clothes washing, requiring a lot of water, are usually carried out at the canal or siphon, while domestic utensils are washed inside the house. An additional reason for not using a lot of water in the house is the difficulty of disposing of large amounts of waste water, as only a small drainage ditch leads from the courtyard to the street. In Ouled Mesbah, Fatima, the 30-year-old mother observed above, uses water brought from the standpipe to wash domestic utensils inside the house, and washes clothes outside the house, at the *seguia*.

Water collection, water use and water contact exhibit daily, periodic and seasonal patterns. Regular periodic use of canal water is determined by the times of water flow in the canals; such activities include irrigation, when farmers spend long hours guiding the water onto their fields, and the watering of livestock at canals while the water is flowing. Domestic activities also reflect this rhythm, as when women wash clothes in the *seguia* and in the tertiary canals. Heavy washing, of coverlets and mats, occurs at the times of peak irrigation flow in the canals, also taking advantage of the concrete canal sides to spread out the heavier articles to dry.

Water use and contact at canals and siphons is likely to display a seasonal variation, exhibiting peaks during the summer for both domestic and recreational activities. In view of the markedly seasonal transmission of schistosomiasis in most settings, this requires a longer observation period than that covered by the preliminary observations discussed here.

The designation of a household member to fetch water is based on a functional hierarchy within the household, but is flexible as it takes into consideration specific conditions at the time the water is needed; these include the amount of water needed, the transport available, and which person is available. Generally, the adult male collects water only when there are no children in the house. If all other members of the house are away, a married woman can fetch water without any religious or cultural restriction. If the girl and the boy are both present in the house, the boy should fetch water, unless he is too young, in which case his elder sister should do it.

The study noted a number of occasions not directly related to water use which may offer the opportunity of water contact or contamination. Occasionally, researchers walking by siphons and canals found evidence of urination or defecation, which is likely to be followed by the washing of private parts and hands. Observations of household members indicated that water contact may occur during daily journeys to the fields, and to school, as villagers walk along paths next to canals and siphons. In the case of the Ouled Mesbah household, for example, the children's journey to and from school does not pass by a canal or a siphon, so they are not likely to be involved in casual water contact, such as splashing, hand washing or cupping water to drink, or even paddling. Here, water contact is more likely to occur on days when the boys do not attend school, but go out to play. In contrast, children in Baaja walk 3 km from the village to the nearest primary school alongside a tertiary canal and many siphons, thus providing abundant opportunity for both boys and girls to

come into casual contact with potentially infective water.

Gendered space

Some spaces are defined as male spaces, but on certain occasions they may become women's space, or a neutral space for women and men household members. Fields are usually men's space. During the reported observation period in Ouled Mesbah in April, the women were not working in the fields. However, in May they were working alongside their husbands harvesting the wheat, thus converting the fields into a non-gendered space.

The space around the canals and siphons is not regarded as women's space, except on occasions when women are washing clothes or heavier items such as mats or coverlets; this usually occurs at times when men are in the fields. Streets primarily are men's space, especially during the rest after lunch (if they are not in the fields) and during the evening after work when they are sitting outside their houses discussing the events of the day. However, when men are working in the fields the streets of the village, including the area around the *seguia* in Ouled Mesbah, are reclaimed by women going about their daily tasks, and younger children, especially girls such as Malika, playing with friends close to the house and running messages.

The Egyptian and Moroccan settings compared

In considering the value of the strategy presented here it is useful to compare the settings of irrigated farming and settlement patterns in the study area of Morocco with the Nile valley of Egypt. The Moroccan villages are small, and have access to many scattered water contact sites, which are used for a great variety of domestic, farming and recreational activities. Sites rarely attract more than a few adults at the same time, or two to four children. These characteristics made the area unsuitable for the type of water contact study conducted in two villages in the Nile delta by the author and Egyptian colleagues in the early 1990s.

The Egyptian landscape is visually very different from that in Tessaout Amont. The Nile delta is intensively irrigated and densely settled. The two typical villages identified for the water contact study are large, with populations of around 8000 people each. The settled area is threaded by canals, which also reach the irrigated farmland in a network of secondary, tertiary and field canals. In the villages there are many identifiable, regularly used activity sites along the canals, some with steps down to the water. These are used chiefly by women for domestic activities and observers can record these activities during daily observation periods (Watts and El Katsha, 1996). Scattered sites in the fields, where portable diesel pumps or fixed water wheels lift water to field canals, were more difficult to observe in a systematic manner (Watts and El Katsha, 1997).

The value of the strategy

Based on our preliminary studies in Morocco, the strategy presented here, combining the interrelated features of household, time geography and gendered space, provides the opportunity to study water use and contact practice as on-going processes taking place in a social setting, rather than as discrete events. The strategy examines water contact, water use and water use decisions and priorities taking account of household roles and gender relationships. The picture of water use processes is gradually built up from observations of routine, daily activities in their social context. In contrast, conventional water contact studies based on the water contact sites are structured around categories conceptualized by outside researchers at the beginning of the research. In addition, the strategy described here requires different skills, as the observer is not only observing, but employing empathy to capture a wide range of behaviors, rather than a set range of tasks. Thus, a decision about which technique to use depends on the geographical setting, on questions which need to be answered, and the resources available for the research project.

The strategy developed here provides the opportunity to study water use and contact practices in settings, such as the Moroccan study area, where environmental interventions are being implemented and monitored, identifying changes in water use and water contact before and after the intervention. For, if the conditions surrounding one water source change, then the whole complex of water use decisions is also likely to change. As indicated in our comparison of the situation in the Nile delta and in Tessaout Amont, the strategy presented here could be used in areas where the population, and the sources of water used, are scattered. This is likely to occur where schistosomiasis infection rates are low, as in Morocco.

The strategy is also likely to be feasible in areas where an irrigation system is being developed or extended, or where people are moving into an area to take advantage of new farming opportunities. Here two features are likely to co-exist; initial water contacts will be scattered rather than focal, and the water use system is particularly dynamic, changing in response to population growth and the establishment of new water use and water contact points. It will therefore be important to identify the potential for future disease transmission by exploring the total water needs of the growing population, the choices and decisions with regard to the use of certain sites or types of water source, and the dynamics of water related activities. For example, in the Richard Toll irrigation scheme, a preliminary study indicated the presence of vector snails, *B. pfeifferi*, of *Schistosoma mansoni*, but failed to con-

sider the impact of human behavior, especially of changing water use and water contact patterns, which contributed to the explosive growth of *S. mansoni* (Stelma *et al.*, 1993; Chaine and Malek, 1989, 1983). Similarly, the strategy might be appropriate in newly irrigated areas of Egypt, which currently have a relatively sparse population and few protected water sources; these areas are being settled by farmers from areas in the delta and the Nile valley which are endemic for schistosomiasis (Mehanna *et al.*, 1994). It would also be fruitful to explore the possibilities for adapting this strategy to studies of other water related diseases and hygiene behavior, and in planning integrated water development projects.

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