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Water resources management and health: general remarks and a case study from Cameroon

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ABSTRACT

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Public health aspects are often overlooked in the planning, design and construction of large water-management projects. Examples of dramatic increases in vector-borne diseases among local inhabitants demonstrate the need to include these risks in project planning and cost-benefit analysis. A small-scale fish-culture project in Cameroon offers a possible alternative approach in dealing with a vector-borne disease problem created by the construction of irrigation works, based on active participation and responsibility by the local inhabitants.

THE VECTOR-BORNE DISEASE PROBLEM

Of the estimated 2481 km^3 of yearly runoff water in Africa, only about 2% is actually used by humans (irrigated agriculture, community water supplies, hydroelectric power, industry and inland water transport; Oomen, 1981). On a continent with a rapidly growing population and an increasing demand for reliable water resources, one can easily foresee the need for an expansion of water-management systems. In the semi-arid regions of sub-saharan Africa, population growth has increased the pressure on the large floodplain rivers. By controlling these rivers, the former flood plains can be inhabited permanently by more people, and agricultural practices can be intensified.

Some well-known and widespread diseases are related to water, because they are transmitted by organisms (vectors) associated with water. Bradley and Narayan (1987) give a list of agriculture-related vector-borne diseases (Table 1). The pathways of several vector-borne diseases are illustrated in Fig. 1.

Water-management projects often show two characteristics favouring the spread of vector-

TABLE 1

Water-related vector-borne diseases (Bradley and Narayan, 1987)

Malaria	Anopheline mosquito vector breeds in standing water, stream and canal edges
Schistosomiasis	Major irrigation problem spread by aquatic and amphibious snails
Other trematodes (such as fascioliasis)	Transmitted by snail through undercooked freshwater animals
Drancunculiasis (Guinea-worm)	Transmitted through defective water supplies by small crustacean
Filariasis	Transmitted by anopheline and culicine mosquitos
Onchocerciasis (river blindness)	Transmitted by fast-water breeding simulium flies
Arbovirus infections (dengue, Japanese encephalitis, etc.)	Viruses transmitted by mosquitos, mainly culicines, breeding in irrigated fields and standing water

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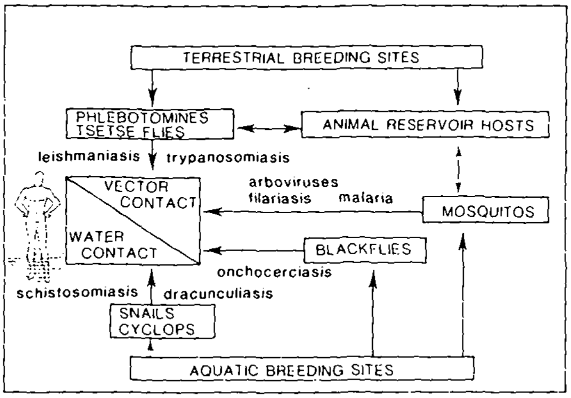

Fig. 1. The pathways of vector-borne disease transmission (PEEM, 1986).

borne diseases. (1) The natural water bodies, mostly affected by seasonal flooding and droughts are replaced by permanent ones, especially where dams and irrigation are involved. Consequently, permanent breeding places for many vector organisms are created, favouring year-round transmission of diseases like malaria and schistosomiasis. (2) The higher density of permanent human settlement increases the rate of transmission. Many opportunities for human water contact are created. In the settlements themselves, breeding places for vectors are created in many ways (borrow pits, rainwater containers, badly maintained water supplies and sewage systems).

The increase of such water-related diseases can have dramatic impacts on the local communities. Well-known early examples are those of the construction of the Panama and Sarda (India) canals. The first was abandoned by De Lesseps after a yellow fever epidemic; by the time the second was completed in 1927, 98% of the labour force was infected with malaria (Stanley and Alpers, 1975).

With the construction of an irrigation scheme in the Tiao valley in Burkina Faso in 1955, excellent breeding places were created for simuliid blackflies, the vectors of river-blindness. In 1962, 22% of people over 30 years old and 50% of those over 40 had become blind. As a result, the scheme was neglected and the dykes and spillways collapsed. It was only in 1969 that effective control measures were instituted (Le Berre in Oomen, 1981).

In 1950, a malaria outbreak in the Gezira irrigation scheme in Sudan led to hundreds of casualties and about one-third of the crop could not be harvested. This happened again in 1971–1974, owing to pesticide resistance in the mosquito vector. In 1978, a $159 million, integrated control project, the Blue Nile Project, was started (Gaddal, 1985; Oomen et al., 1988).

In 1967, Farooq estimated the number of people infected with schistosomiasis in Egypt at 14 million out of a total of 50 million inhabitants. Deaths from schistosomiasis were reported to amount to 5–10% of all deaths. The total economic loss for the country was estimated to be US$ 560 million per year, based on a 35% reduction in individual productivity in 14 million infected people who worked half days at a daily wage of 25 piasters. The Egyptian health budget in this period amounted to US$ 60 million a year. It was also estimated that 3 million more people would become infected after the construction of the Aswan High Dam (Farooq, 1967).

Until recently, the increased health risks have hardly been taken into account in the planning and construction of large-scale water-management schemes. It looks as if the proliferation of vector-borne diseases is considered inevitable, but of minor importance compared with the benefits of a water-management project. The examples given above show the necessity to include health aspects in cost–benefit analysis when planning such projects.

Many authors do not blame agricultural development itself for creating or intensifying vector-borne disease problems, but only badly planned and badly managed development. Very simple alterations in the design and water management of an irrigation scheme, for example, can reduce vector breeding and need not be more expensive, as shown by Hydraulics

Research (1986) in Zimbabwe. Irrigation designers have never learned to take health risks into account; therefore unsatisfactory irrigation structures are still being built all over the world simply because of the lack of awareness of this problem. For this reason The Panel of Experts on Environmental Management for Vector Control (PEEM) was established jointly by the World Health Organization, the Food and Agriculture Organization and the United Nations Environmental Programme, aiming at "an intersectoral collaboration at national, regional and global levels and the solution in an early warning system and in the incorporation of health and environmental safeguards at the earliest stages of projects' development and planning" (PEEM, 1981).

A CASE STUDY IN NORTHERN CAMEROON

The construction of the dam in the Bénoué River at Lagdo (1982) caused changes in the ecosystem of the flood plains and in the social system of the people living there. Upstream, the basin has been filled up gradually and at its maximum level the lake will cover 700 km^2. Fish production and fisheries have increased explosively during the last 7 years. It is expected that there will be a decline in fisheries in the future owing to diminishing nutrients in the lake and overexploitation (for more detailed information see Drijver and Marchand, 1985).

Downstream of the dam, the natural depressions that were formerly flooded and filled with fish every year formed an important source of revenue and protein for the local inhabitants. During the dry season the vegetation of the flood plain provided food for the herds of the nomads. With the absence of the yearly floods, opportunities for the traditional sorghum culture (mouskouari) have been reduced as well as the fish production in the small lakes on the flood plains.

The former flood plain is being converted into irrigated land for rice- and polyculture. The first 50 ha have already been given three harvests of rice, based on a 6 months rotation. Many immigrants from the densely populated Extreme Northern Province come into the area, partly stimulated by a governmental migration program. They are attracted by the prospect of irrigated land being given out.

The Cameroonian authorities have recognized the importance of primary health care in this immigration region and have, with the help of the Swiss "Médecins Sans Frontières", installed public health workers in most villages. The majority of people therefore have access to basic medical facilities.

Near the village of Gounougou a small scale fish culture and water management project started in 1987. This project is funded by the Dutch government and executed by the University of Leiden and Haskoning Consultants, Nijmegen, under the responsibility of the "Mission d'Étude et d'Aménagement de la Vallée Supérieure de la Bénoué" (MEAVSB) in Garoua, Cameroon. The main goals of the project are: (1) to restore the fisheries potential of the former flood plain; (2) to prevent the spread of vector-borne diseases.

In spite of the attention being paid by the government to the public health aspects of the region, the irrigation systems (constructed by the Peoples' Republic of China) are creating vector-breeding habitats very near the village. Drainage water is discharged through some natural depressions towards the Bénoué river. Instead of drying up in the dry season, these depressions now contain water all the year round. Villagers have already begun to complain about the increased number of mosquitos and the frequency of malaria attacks.

If this drainage system could be managed properly, mosquito and snail breeding could be reduced significantly, but so far the irrigation authorities do not feel responsible. If the system could be developed for fish culture, the local people would be interested in managing it for economic reasons, and vector populations would also be reduced, because: (1) the water management involved in fish culture (feeding, vegetation clearing, water level control, etc.) reduces vector breeding places; (2) the introduced fish (*Tilapia*) eat mosquito larvae, and a snail-eating fish will be introduced experimentally (Slootweg, 1989), putting extra pressure on vector populations.

The local people will welcome the prospect of fish production, especially at the end of the dry season. The loss of flood plain fishery will be partly compensated for by fish culture. Entrusting the responsibility in local hands leads to a more logical decision structure, on a village level instead of on a regional level.

Fish culture is also being introduced into some experimental plots of irrigated rice. Fields are adapted to fish culture by digging some trenches as refuges for the fish when the fields are drained. It is hoped that mosquito and snail breeding will be reduced and fish production will be rewarding enough for the farmers to continue the program on a larger scale.

With the help of the well-organized existing health infrastructure, an integrated control program has been formulated that includes the following elements. Experimental biological control of snails and mosquitos by predatory fishes will be carried out in rice fields, canals and fish ponds. A water-management system for all water bodies around the villages will be created, and managed by the villagers themselves. Measures such as changing the water level and clearing the vegetation reduce vector breeding, and periodically drying the reservoirs will prevent it. Unnecessary water contacts will be prevented by environmental management. For example the construction of small dykes or bridges could reduce the need to wade through infested water. Local health authorities will be involved in monitoring the prevalence of parasitic diseases and in drug administration. Health education will accompany the project activities.

The project only began to introduce fish culture and water management into one village last year, but the reaction of the local community has been encouraging. In the coming months, the first fish harvest will be collected. Then we will know more about production levels and the willingness of the people to continue with the program.

If fish culture pays off and if it reduces vector populations to levels where the health care system can prevent any major outbreaks of disease, this approach may be a cheap and longer-lasting alternative to the expensive large-scale health campaigns which become necessary when the adverse effects of a poor water-management system have developed.

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