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Schistosomiasis Control in Irrigation Systems

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Introduction

Schistosomiasis is a parasitic disease of hydric origin. The transmission occurs in natural surface waters both in still and flowing ones, under suitable ecological conditions.

The socio-economical consequences of the disease are still not quantified but in Brazil where the parasite S. mansoni is the only species present, the highly endemic areas may show prevalence rates of 90% or more among the inhabitants and 10 - 20% of the infected persons may show "non-compensated spleno megaly" and/or other symptoms of the disease. The severe forms will incapacitate the person for work and reduce considerably the life expectancy. This fact is the main argument for the control of schistosomiasis.

The irrigation of a formerly arid area, on the other hand, creates conditions favourable for the transmission of schistosomiasis by introducing changes in the human-animal and plant ecology of a certain region. These changes, as a rule, have increased the prevalence and severity of the disease near the endemic areas (e.g. Quixada, Brazil). The following two cases will illustrate the important connection between schistosomiasis and irrigation in Brazil.

The "Green-belt" of Belo Horizonte (MG).

Several hundreds of small farms growing vegetables and flowers are distributed along the streams which form the two important watersheds (Pampulha and Arrudas) of Belo Horizonte. The size of these farms varies from a few hundred square meters to several hectares.

The water for irrigation is taken from a small impoundment made on the stream and is regulated by wooden boards and earthen dams. The water is conducted in canals (0.5 - 2.0 m wide) to the gardens and farms along the stream where it is diverted into secondary canals, interrupted by watering holes (small reservoirs of about 100-200 l of capacity). The irrigation is manual: either using sprinkling cans or "Shovelling" the water of the watering holes over the vegetables and flowers.

The canals and ditches are regularly covered by algae and semi-aquatic plants and require periodic cleaning 2-3 times a year.

The flow in the canals is slow and permits the formation of deposits. The water is well oxygenated and contains a relatively high content of organic matter; its reaction is neutral (pH = 6 - 7). These conditions create excellent environment for the colonization of the schistosoma-bearing snail (Biomphalaria gi-brata).

Human habitations on the farms are localized a few meters away of the canals and use the canal water for washing clothes and domestic utensils. Latrines when existing always drain to the canals.

These sanitary conditions explain the relatively high prevalence in the area. Parasitological survey among schoolchildren (7-15 years old) showed 10 % of prevalence rate at seven years old with a steady increase until fifteen years old when the rate was 40 %. The rate of prevalence showed statistically significant difference between two groups of families: those living on irrigated farms showed twice the prevalence rate of their neighbours without irrigated tracts (Paulini, Dias, Fiuza, 1967).

Somewhat similar conditions can be observed in the districts of many Brazilian big cities. In Rio de Janeiro, for instance, Jacarepagua District has a great number of farms with irrigated water-crest plantations where active transmission of schistosomiasis takes place.

Caatinga do Moura (Bahia State) - A small rural Community.

Caatinga do Moura is a rural district of Jacobina (Bahia) on the periphery of the São Francisco River Valley. Although the climate is semi-arid, the community has the privilege of a carstic river which springs up in the calcareous soil, flows over a distance of 15 Km and disappears again from the surface.

The diversion of the river water on both sides of the valley allows the perennial irrigation of a 300-500 meter wide tract all along the course of the river. The irrigated land drains back to the river.

The irrigation allows planting and harvesting twice a year. The main crops are beans, rice, corn, garlic, onion and various fruits.

The geographic and climatic conditions of the district create excellent and healthy environment: the community is free of malaria, Chagas's Disease, leishmaniasis which occur in Jacobina. The only public health problem is schistosomiasis which is affecting more than 90 % of the population. The youngest

person found with eggs in the faeces was 2 months old and probably was infected with the bathing water right after the delivery.

The high rate of prevalence is accompanied by high rates of severe cases: 10 - 20 % of the persons show signs of irreversible damage due to the parasitism. It may be said that schistosomiasis is directly or indirectly the main " causa mortis " in Caatinga do Moura.

The river is completely free of snails but the canals of irrigation are supporting large snail populations. About 1-2 % of the collected snails are shedding cercariae of S. mansoni. The chemical composition of the water in the river is almost identical with that of the canals (pH = 7.4 ; total hardness = 300 ppm CaCO₃) the main difference is in the composition of the substratum. The river bed is formed by pebbles, without macroscopic aquatic vegetation, while the canal bed is covered by rotting leaves, fruits and other organic matter.

The factors which determine the high rates of prevalence in Caatinga do Moura are:

- i) the irrigation canals offer almost ideal conditions for snail breeding;
- ii) pollution of the canal water by human excrements,
- iii) frequent and necessary contact of the population with infected water.

Limiting factors of snail breeding

There are three species of planorbid snails involved in the transmission of schistosomiasis in Brazil: Biomphalaria glabrata, B. tenagophila e straminea. The discussion which follows is restricted to these species.

The snails are aquatic and breed in permanent, slow flowing or still water. Outside of the water both snails and eggs loose water, and may die although resistance to desiccation may develop in the snail in certain temporary habitats. Water temperature should be between 15 - 30°C, Salinity is tolerated up to 0.1 % (1000 ppm). Snails are much dependent on dissolved oxygen (50 % of saturation of oxygen, or more) and do not tolerate high turbidity of water.

These snails exhibit rheotropism and tend to migrate upstream, but are not able to withstand the hydrodynamic pressure of a flow of 45 cm/sec or more which then carries them downstream. In an analogue manner, strong or constant waves in lakes or water reservoirs restrict snail breeding to calm and shallow beaches.

Few dissolved inorganic salts are toxic to snails. 0.1 ppm of copper or 0.5 ppm of lithium in the water inhibit the colonization of snails.

Some synthetic organic compounds (molluscicides) kill the snails at a concentration of 1 ppm or even less (Pentachlor-phenol, Nicloseamid, Tritylmorpholin).

There are some natural enemies of the schistosoma-bearing snails Tilapia sp. and aquatic snails (Marisa sp., Pomacea sp), among others have been recommended and tested in the laboratory and in the field. For a detailed account see Ferguson (1976).

Shistosomiasis Control in Irrigation Systems.

An irrigation system is more than an interconnected set of canals and ditches with the appropriate control devices. An irrigation system represents a new social organization in a given eco-system. This organization has its own characteristic structure involving planning, administration, production, commercialization etc.

On the other hand, schistosomiasis is more than an isolated sanitary problem. Schistosomiasis is **manifestation** of a system made up of the aquatic subsystem of the snail and the socio-economic and cultural subsystem of the man. The manifestation of schistosomiasis becomes evident in the well known "circulus viciosus" : Poverty-Disease-Low Productivity-Subnutrition- Low income- Early death-Poverty.

The interaction of the systems needs more than isolated, fragmented control methods. The control should be planned on a broad base involving the whole social system. The Control Plan should aim at the gradual and coordinated change (modification) of the social-cultural and sanitary environment (Paulini, 1974).

The characteristics of this system-approach are:

- i) the process is ~~controlled~~ and any deviations from the projections are continuously corrected);
- ii) it is adaptive and changes in the behaviour of the system don't affect the results;
- iii) Learning and innovative, by incorporating own and/or new experiences into the control process.

Some programme objectives may be mentioned for a General Plan, observing however, that the list is far from being complete:

- 1) overhead and/or drip irrigation wherever possible;
- ii) underground drains instead of open ones;
- iii) increase of water velocity above 60 cm/s,
- iv) night-storage reservoirs stocked w/ fish and Marisa or Pomacea,
- v) Siting houses of farmers 100 m or more away from canals,
- vi) Forming groups of houses and provide them with safe water and sewage disposal;

- vii) providing continuous health education;
- ix) molluscicide application in problem areas.

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