CHAPTER 1

INTRODUCTION

1.1 Background and Rationale

For centuries, schistosomiasis has caused suffering and premature death among people living along the Chang Jiang (Yangtze River) and in other endemic areas of China. People spoke of "villages without villagers" because many had left or were dead in the epidemic villages of China (Chen, 1989). More than 100 million people were at risk before national schistosomiasis control started in 1955. Continued efforts over four decades have led to a 90% reduction in the number of infected persons. *Schistosoma japonicum* was eradicated from one third of the original endemic area, it is controlled in another third, but remains an important public health risk in the remaining area (Chen, 1989). The integration of control measures and parallel, complimentary, coordinated scientific research have been cited among the major elements that contributed to the success of the programme (WHO, 1988; Zhang, 1990). The strategies used in the eradication campaign have been described in detail by Zhang (1982) and Yuan (1992). They consisted of the eradication of intermediate snail hosts through environmental modification and molluscicide, combined with large scale chemotherapy for humans and cattle as well as the provision of safe water, sanitation, personal protection and health education.

Schistosomiasis, caused by *Schistosoma japonicum* used to be one of the most important health problems in the south of China. About 100 million people are at risk of infection. The infection led among to enlargement and congestion of liver and spleen resulting in disability and death. It was also a serious disease for principal animal reservoirs, such as cattle, pig and other domestic animals. The disease was particularly difficult to control since the intermediate hosts of *S. japonicum* are amphibious snails that do not live in water all the time. Rice growing, cattle herding on seasonally flooded marshlands in lakes, fishing and harvesting of grass along rivers and lakes lead to intense water contact.

From the 1950s until the early 1980s, both snail control and chemotherapy were integral components of the control strategy. After praziquantel became available for large-scale use, it became possible that mass chemotherapy could be used in the population.

Although remarkable progress has been made in the control of schistosomiasis, China is still facing important challenges to achieve control in the remaining endemic areas. In the remaining endemic areas the epidemiological situation has been changing and in some areas the prevalence is going up. Acute schistosomiasis is now reported from cities in the lake region and in other rural areas; about 95% of cases are distributed in marshland regions (Wang, 1989 and Yuan, 1992).

The main problems of control schistosomiasis in lake and marshland areas of China are:

1) Schistosomiasis is a major health problem in south China. About 40 million people live in the schistosomiasis risk areas, 1.5 million people are infected with schistosomiasis and 60,000 people have severe clinical schistosomiasis.

2) The lake and marshland region is the main epidemic area of schistosomiasis in China, because 85% of persons with schistosomiasis lived in marshlands and 95% of snail ridden areas distribute in the lake and marshland region.

3) The population density is high and their agriculture and daily activities force people into contact with the infected water.

4) Biological factors give difficulties for control of schistosomiasis in this region, because the main infection sources are from domestic animals in this area and the amphibious intermedical host-snail is very difficulty to control.

5) Marshland regions are poor economic zones and the resources for the control of schistosomiasis are very limited.

Schistosomiasis is a severe disease and how to control schistosomiasis is a major health problem in marshland areas of China. The most common control approaches that we have used in those areas are chemotherapy, molluscicide and environmental change.

Thus, it is the focal point of this study to find out which of these three approaches is the most cost-effective one in controlling the *schistosomiasis japonicum* in the marshland areas of south of China.

1.2 Literature Review

1.2.1 Control Strategy

Schistosomiasis results from heavy infection with schistosome trematode worms, and in particular from the eggs laid in the human body by female. The disease affects 74 countries, in which-according to 1984 estimates- some 200 million people are infected. Of course, some 20 million suffer clinical morbidity or disability. The disease kills few people, but its sapping chronic effects, very high prevalence, and association with agricultural and economic water development projects, make it a problem of great public health importance (TDR/WHO 1995). Tanner (1989) pointed that the transmission dynamics of schistosomes are complex and involve four phases (man-water-freshwater snail-water) that are subject to ecological and biological factors influence, and to environmental and socio-economic factors that determine the behavior of human populations. Consequently, epidemiological patterns vary between countries, within countries and prevalence and mortality pattern is highly heterogeneous in different communities.

There is no doubt on a global scale, both the prevalence and incidence of schistosomiasis are increasing. TDR(1995) reported that there were three principal causes of this increase: the expansion of irrigated agriculture-and with it new ditches, canals and habitats for water snails; the creation of man-made lakes for hydroelectric power; and the lack of sanitation and clean water supplies for the growing population.

The World Health Organization has, from a strategic point of view endorsed a global plan of action to reduce morbidity (WHO, 1985), following the advent of safe and effective oral schistosomicicides. The effective use of specific snail control measures by the application of molluscicides and environmental changes bring about a slow reduction in prevalence and intensity of infection and then of morbidity - the use of chemotherapy, however, has a direct impact on the disease and can quickly reduce its prevalence and intensity, and possibility transmission.

In considering the further role of molluscicides in schistosomiasis control, a WHO Expert Committee (1985), stated that population-based chemotherapy combined with health education and focal and seasonal mollusciciding are likely to be the most important features of schistosomiasis control operations in high priority endemic foci. Webbe and others (1991) pointed that the available data indicate that in many circumstances chemotherapy may be the most cost-effective short-term method of reducing prevalence, incidence and intensity of schistosoma mansoni and haematobium. Experience in use of drugs for large-scale population based chemotherapy or targeted treatments is still, however, limited, and proposed delivery systems have not been fully evaluated. The problems of using chemotherapy as a control methods have certainly been underestimated in many places.

A WHO Expert Committee (1993) reported that the snail control is one of the methods of choice for the control of transmission of schistosomiasis. No new molluscicide of any great significance has been development in the past decade. Niclosamide is the main molluscicide used in the world for control schistosomiasis. While copper sulfate is still used in Egypt, sodium 2,5-dicholorp-4-bromophenol is used in Japan and sodium pentachlorophenate is used in China.

A WHO Expert Committee (1985) reported that the possible role of molluscicides in schistosomiasis control programmes depends on local epidemiological and ecological circumstances, and the human and financial resource available. The relationship between the population dynamics of the intermediate snail hosts and transmission is poorly understood.

Savioli (1989) reported that in all the countries, the potential for further reduction of prevalence and morbidity will be in jeopardy if surveillance and maintenance of intervention are not continued and adapted to changing epidemiological, social and economic conditions. The focal nature of schistosomiasis becomes even more pronounced with the success of control using chemotherapy.

Doumenge (1987) that epidemiological factors must be considered in the assessment of a country's ability to understate control. The epidemiology of schistosomiasis, within a particulate ecosystem, involves the complex interrelationship between people and their environment. However, much epidemiological information is available

that can help countries to implement effective control measures.

A WHO Expert Committee(1993) reported area-wide molluscicide usually associated with large irrigation schemes, is costly and requires knowledge of malacology and skilled personnel as well as considerable logistic means and equipment. Focal molluscicide, in which the important transmission sites in communities where prevalence is high are targeted, is feasible in smaller, circumscribed transmission sites.

A WHO Expert committee(1993) reported most national development policies are implemented through programmes and projects specific to the economic sector responsible. Development projects associated with changes in the local environment often lead to greater disease transmission.

A WHO Expert Committee(1993) reported natural water bodies, such as marshes, ponds and swamps, where snails breed and from where they may infest irrigation schemes and other water projects, can be modified or completely eliminated. Land can be reclaimed for agricultural purposes. In many countries wetlands are now protected and where is a significant risk strict regulations should be applied to limit human settlement in these areas.

Hunter and others(1993) found that in irrigation development selection of technique is the first decision with potentially important health consequences. Where surface irrigation is the technique of choice, design features to reduce the risk of schistosomiasis transmission should be considered. Proper drainage has been effective in reducing transmission of *S. japonicum* in China, Japan and the Philippines.

A WHO Expert Committee (1991) reported in health center with diagnostic facilities, microscopic parasitological confirmation of clinically suspected schistosomiasis is feasible. Parasitological examination requires trained staff using standardized techniques and reporting procedures, and local support services for supplies and equipment need to be in place.

Qurashi (1991) pointed that the treatment of schistosomiasis has been transformed by the introduction of praziquantel, which is effective, generally in a single dose, against all species of parasite. Periodic treatment

is now established as a central component of schistosomiasis control. Various operational approaches are used with the dual objectives of reducing the prevalence and intensity of established infection and decreasing the intensity of transmission. Treatment of a high proportion of the infected individuals in a locality within a short period of the time promotes achievement of two object.

1.2.2 Cost and Effectiveness Analysis of Schistosomiasis Control

Tanner (1989) point that the scarce resources of many countries endemic for schistosomiasis and the need for optimal allocation of resource require the identification and assessment of the most important schistosomiasis foci and high risk communities. This is of particular importance since it is widely assumed that the chronic nature of schistosomiasis affects labor capacity and thus presents a major obstacle to development in many endemic areas. Despite considerable knowledge of the pathology and clinical manifestations of schistosomiasis, there is a lack of standardized approaches to set a basis for assessment of impact of the disease on well-being and the economy at community level.

Webbe (1991) stated that the cost of the really efficient synthetic molluscicide niclosamide, has steadily risen during the past thirty years since it first became available. It now stands at 35 $ US per kg., depending upon geographical delivery location. Hundreds of metric tons of this compound have been used in the Middle East annually since 1968, and of course, elsewhere to a lesser extent. The flagrant increase in price is due to the world price of hydrocarbons which has inevitably risen and prevented other attempts made to produce cheaper formulations of niclosamide, or resulted in equally costly ones.

About molluscicides Webbe said that area-wide molluscicide is the only practice and scientific approach if transmission is widespread in a watershed or irrigation system. The fact that we now understand far better the degree of focal transmission in no way reduces the logistic problems posed by a vast complex of irrigation channels and drains. In an irrigation system with a high density population, the volume of water treated per capita of population is small, and molluscicide based on controlled water-management and

sound synoptic data is highly cost-effective. In a study in Middle Egypt, the cost of combined molluscicididing and chemotherapy was US $0.76 per person per year and overall prevalence was reduced from 30% to 8.5% (Anon, 1985).

The design of any schistosomiasis control programme entails the selection of one a number of alternative interventions of a combination of several of them: control of snail through molluscicides, chemotherapy, engineering method biological or improved waterlines and sanitation. Despite this diversity, there has been little previous research into contribution was made.

Korte and Mott (1989) stated that schistosomiasis control has a reputation of being very costly. Where an exclusively vertical approach is used during the attack phase, all costs have to be borne by the programme since little or no use is made of the existing infrastructures. Mechanize of maintenance of control for long-term financing should be considered; cost recovery through sale of drugs and diagnostic services may be a viable option. However, with the progressive reduction of drug costs this item is no longer a central issue in the maintenance of control compared to delivery and infrastructure costs. Water development schemes should take into consideration the fact that schistosomiasis usually spreads rapidly and control measures should be initiated early. Part of the investment and the economic return of these development schemes should be allocated for disease control.

Cost-effectiveness analysis is used as a decision making toll to help policy makers and program manager select a future course of action. Although it often is used to evaluate completed programs, the ultimate use this methods should be to help decision makers decide what to do in the future.

Michael (1990) pointed that the a cost analysis is related to a single, common effect which may differ in magnitude between the alternative programme, are usually refereed to as cost-effectiveness analysis. The results of such comparisons may be stated either in terms of cost per unit of effect or in term of effects per unit of cost. The latter is a particularly useful approach when working within a given budget constraint, as long as the alternatives under consider consideration not of radically different scale.

Guyatt and Tanner (1994) pointed that there have been a limited number of the papers about cost effectiveness studies on schistosomiasis control, and have rarely provided an adequate analysis of both cost and effectiveness, nor have they provided clear policy guidance to the health care planners.

Rosenfield and others (1977) early argued that they developed a model of schistosomiasis transmission in Iran in order to simulate the effectiveness of applying different control techniques - molluscicides, engineering methods, chemotherapy, and a combination of controls - subject to a given budget constraint over a seven-year planning horizon. They also indicated a combination of chemotherapy and molluscicide was most-effective where the programme objective was specified in terms of maximizing the reduction in prevalence achieved after seven years. This mix of interventions reduced the prevalence rate from 64% to 20% whereas the next best alternative - chemotherapy - achieved a terminal prevalence rate 60%. However, this measure of effectiveness did not take into account the prevalence reductions achieved during the planning period.