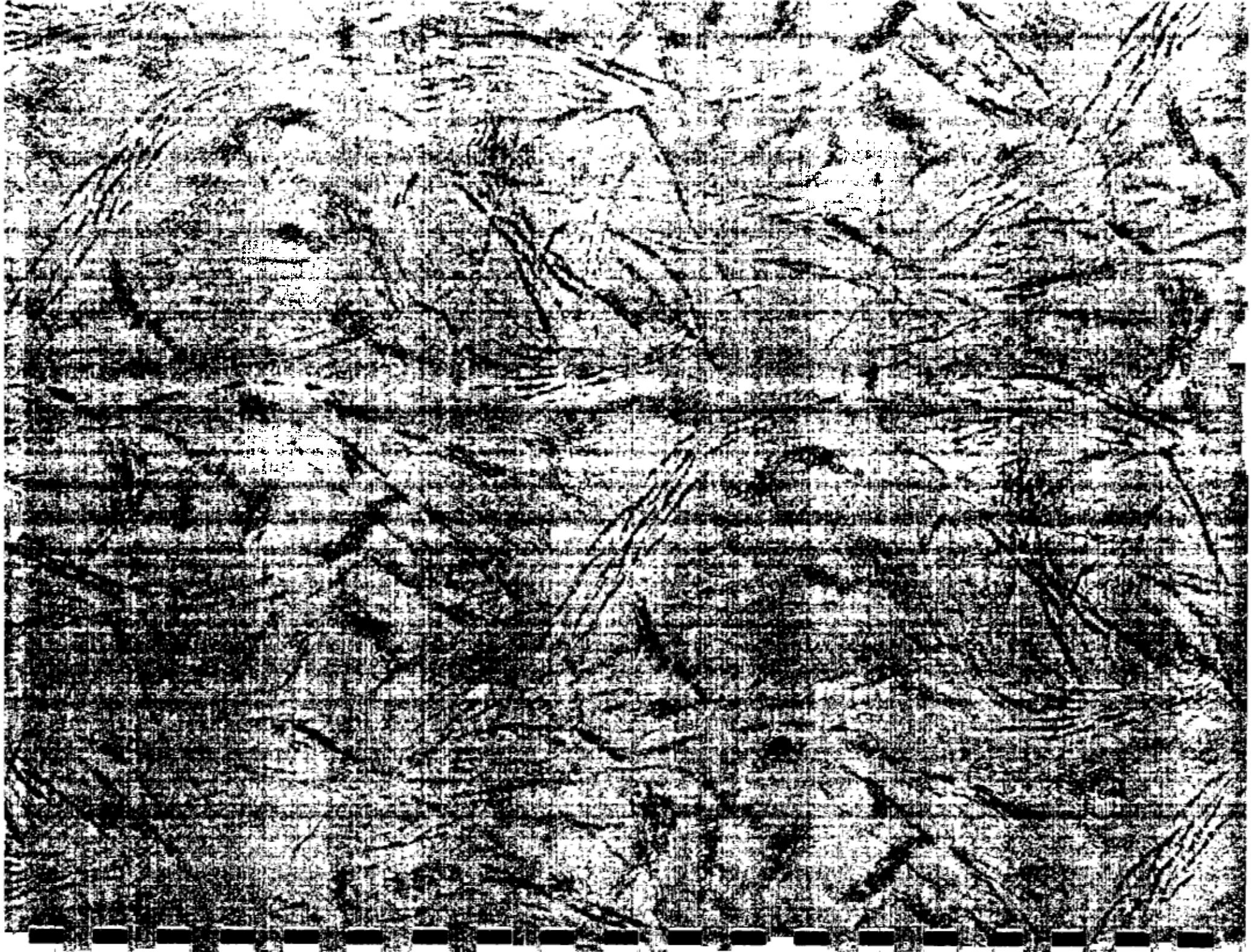
RWSGEAP: Environmental Sanitation Study

China: Nightsoil Management Improvement Study in Hubei

July 1995

UNDP-World Bank Water and Sanitation Program



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(Executing Agency: The World Bank)

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4 July, 1995

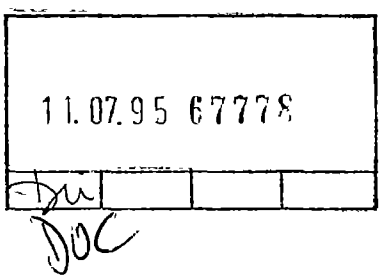
Dear Colleagues,

I am pleased to share with you the findings of an evironmental sanitation study undertaken in 1994. The UNDP/World Bank Water and Sanitation Program in collaboration with International Reference Center for Waste Disposal undertook a study on Nightsoil Management Improvement in Hubei Province, China, as part of a proposed World Bank urban environmental project in the same province.

Pilot technical activities, which is a second part of the Nightsoil Management Improvement Project, is still on-going in Hubei. A separate report will be published early next year when the pilot activities are completed. I welcome any comments you may have on the study findings.

Best regards,

Mary Judd
Acting Regional Manager, RWSGEAP



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China: Nightsoil Management Improvement Study in Hubei

UNDP/World Bank Water and Sanitation Program
in collaboration with
International Reference Center for Waste Disposal

Contents

SUMMARY

The Nightsoil Management Improvement Project, undertaken by the UNDP/World Bank Water and Sanitation Program in collaboration with the International Reference Center for Waste Disposal and Chinese Institutes, is part study and part demonstration activity for improving environmental sanitation in nightsoil management in an urban setting The project results are meant to provide input into the nightsoil component of a proposed World Bank financed project An investment program for the component is also included.

The Hubei Urban Environmental Project (HUEP) is being prepared for partial financing by the World Bank as part of its lending program in a series of environmental projects for China. The Project proposed for FY96 is in the cities of Wuhan, Huangshi, Xiangfan and Yichang in central Hubei Province. The four cities have a combined urban population of about 4.5 million people, ranging from about 3.2 million in Wuhan to about 400,000 in Yichang. The Bank project is focusing on municipal services, such as sewerage and sanitation improvements, night soil management improvements, solid waste management, and industrial pollution control

One component of HUEP aims at improving areas with inadequate sanitation facilities and the unhygienic management and use of human excreta and urine, collectively termed "nightsoil" It is estimated that approximately 30% to 60% of the population in the four cities use public latrines--water flush or dry pit latrines. In the peri-urban areas, dry pit latrines are used by over 70% of the farming households In areas not connected to sewers, the public latrines are periodically emptied by vacuum tankers or other means and the contents hauled to peri-urban farms where farmers use nightsoil as soil conditioner and fertilizer for vegetables, rice plants and/or nutrients in fish ponds; the tankers often bypass the nightsoil treatment tanks

The Nightsoil Management Improvement Study examines the key inter-related aspects of hygiene and epidemiology of the existing practice of nightsoil handling; socio-economic and marketing aspects of nightsoil management and use; and technical options, costs and benefits of improving its management and use.

The demonstration part of the Project consists of several technical pilot activities which are currently being undertaken in three cities The activities include: construction and monitoring of modified septic tanks in both private and public latrines, monitoring of existing septic tanks for comparative purposes, construction and monitoring of modified nightsoil storage tanks; and setting up a pilot plant for co-composting of nightsoil and solid waste The pilot activities will be carefully monitored (through 1995) and refinements made; the information and improved capacity to undertake such activities will provide input to the proposed HUEP

The objectives of the pilot and demonstration activities are to evaluate the treatment efficiency of properly designed and operated conventional Chinese septic tanks and to test the potential for improving the treatment efficiency of septic tanks through innovative and low cost modifications in their design and operation. The modified systems include the anaerobic baffled reactor (tested in Huangshi) and the anaerobic filter (tested in Yichang) These two systems have the advantage over conventional septic tanks in that there is much better contact between the fine and dissolved organic matter in the wastewater and the anaerobic bacteria Therefore, a much higher efficiency with regard to the removal of BOD can be expected compared to conventional septic tanks

The purpose of the nightsoil storage tank activity is to attempt to provide some treatment to the nightsoil to reduce the pathogen content as well as provide a more useful fertilizer by obtaining a better digested nightsoil The tank is built to provide easier access and loading of the semi treated nightsoil by farmers at the tank outlet.

Co-composting of nightsoil and solid waste has never been tried in any of the project cities If this process can be shown to be technically feasible, it will have significant benefits in providing a treatment option for nightsoil and earning income from sale of the compost to farmers This activity will try a small capacity treatment plant based on the aerated pile method for composting.

Findings from the hygiene study indicate a weak hygiene education and sanitation promotion program and limited practice of proper sanitary behavior. People have some knowledge of the relationship between proper hygiene behavior and disease prevention but this linkage is not fully understood and key behaviors are not well practised Sanitation facilities are not adequate and there is demand from users for improvements The continued demand for nightsoil in the peri-urban areas means that improvements in physical facilities and sanitation service will have to take this demand into account.

Findings of the epidemiological study show a high prevalence of enteric-related diseases, similar to studies in other Chinese cities. Statistical analysis provides clear correlation between several key factors--such as, the lack of proper hygiene behavior, unsafe food hygiene practices, and environmental risk factors--and the increased risk of contracting excreta-related diseases. Lack of exposure to hygiene education in school shows a highly significant correlation

The high risk groups who stood a greater chance of contracting diseases are a) farmers, who were significantly less exposed to health education and more exposed to untreated nightsoil handling; b) sanitary workers, and c) young children under 10 years old

The main conclusions to be drawn from the results of the market survey are that there is still a strong preference by farmers for nightsoil as fertilizer and that they are willing to pay for good quality nightsoil Farmers' access to nightsoil are affected by the decreasing supply due to conversion of dry latrines to water flush types and the lack of transportation.

The review of the health data and findings from the various study components--hygiene, epidemiology, market analysis and technical pilot activities--clearly identified the need for a coordinated approach based on technical improvements, better management practices, better information and education in the sanitation aspects of nightsoil and related aspects for the improvement of the health and welfare of the people in the project cities Improvements are recommended in the following areas:

- improvements in sanitation physical facilities;
- improvements in sanitation service, including the treatment of nightsoil,
- promotion of better hygiene practices through an improved hygiene and sanitation promotion program;
- improvements in the management of nightsoil; and
- other identified areas, including privatization

Improvements in physical facilities will require parallel improvements in nightsoil management and, for maximum health impact, these will require improvements in related hygiene behaviors through an improved hygiene education program Provincial and city health authorities need to develop an appropriate and effective hygiene education program, especially for the identified high risk groups such as farmers, nightsoil workers, young children and consumers living in unsafe areas

The recommendations put forth in the nightsoil management improvement study report complements the improvements proposed by the sewerage and sanitation component of HUEP. They are intended to provide additional improvements not only to assist the nightsoil and septic tank sludge use in agriculture and

aquaculture but also to provide improvements in areas which are not covered under the sewerage plans, these areas are mainly in the low income and poorer sections of the city

The total cost of the investment program for the three cities of Huangshi, Xiangfan and Yichang is RMB 18 9 million, Wuhan which prepared its own investment has a figure of RMB 9.9 bringing the total cost for the nightsoil management component in HUEP to RMB 28 8 million or equivalent US$ 3.35 million (December 1994 prices) As much as possible, the cities want to use their own resources and not the loan for this component

The various findings of the overall study have been integrated in Part 1 of the report. Part 2 contains the investment program. The individual studies are included as annexes. A separate report will be produced on the technical pilot activities when the demonstration is over at the end of 1995. A Chinese version of this report is also available.

Glossary

BOD	Biochemical Oxygen Demand (a measure of biological pollutant loading)
COD	Chemical Oxygen Demand (a measure of organic and inorganic pollutant loading)
Effluent	Wastewater flowing out of a receptacle or other location
ESB	Environmental Sanitation Bureau
HPIHE	Hubei Provincial Institute for Health Education
HUEP	Hubei Urban Environmental Project
Influent	Wastewater flowing into a receptacle or other location
IRCWD	International Reference Center for Waste Disposal
Mu	Chinese measure of area (= 666 square meters)
Nightsoil	Human excreta and urine, collectively termed "nightsoil"
PPHCC	Provincial Patriotic Health Campaign Committee
RMB	Renminbi - unit of Chinese currency
RWSGEAP	Regional Water and Sanitation Group for East Asia and the Pacific, one of the five regional groups of the UNDP/World Bank Water and Sanitation Program executed by the World Bank
UNICEF	United Nations Children's Fund
STI	Swiss Tropical Institute

Part 1. Nightsoil Management Improvement Study

1. Introduction

HUEP Urban Environmental Project

A proposed Urban Environmental Project for Hubei Province in China is being prepared for partial financing by the World Bank as part of its lending program in a series of environmental projects for China. The Project proposed for FY96 is in the central province of Hubei and will concentrate in the capital city Wuhan and three large secondary cities of Huangshi, Xiangfan and Yichang. The four cities have a combined urban population of about 4 5 million people, ranging from about 3 2 million in Wuhan to about 400,000 in Yichang. This does not include the "floating" (non-registered) population which would add another 10 to 20% to the urban core The Bank project is focusing on **municipal services**, such as sewerage and sanitation improvements, nightsoil management improvements, solid waste management, and industrial pollution control.

One component of the Hubei Urban Environmental Project (HUEP) aims at improving the unhygienic collection, treatment, disposal and use of human excreta and urine, collectively termed "nightsoil" It was estimated that in the urban centers of the above cities, approximately 30 to 60% of the population used public latrines--water flush or dry pit latrines. In areas not connected to sewers, the public latrines are periodically emptied by vacuum tankers or other means and the contents hauled to suburban farms where farmers use nightsoil as soil conditioner and fertilizer for vegetables, rice plants and/or nutrients in fish ponds, the tankers often bypass the nightsoil treatment tanks.

It is likely that in the long run the Chinese cities will aim for a full-fledged sewer system for the inner city population However, in the immediate and intermediate future, improvements to the current scheme, including alternative low cost technologies, will be required Given the apparent well-functioning economic cycle, consisting of an incentive-based interaction between the inner city and the suburban areas, any improvement or alternatives to the current nightsoil collection and disposal system must be carefully studied, so as not to disrupt this delicate cycle. Any potential alternative, therefore, will have to be reviewed in the context of the local socio-economic environment and existing health situation. Hence, the rationale for the Nightsoil Management Improvement Study and Pilot Activities undertaken by the UNDP/World Bank Water and Sanitation Program in collaboration with the International Reference Center for Waste Disposal with funding from the Swiss Development Corporation for technical pilot activities.

Scope of Work

The Nightsoil Management Improvement Study is a learning opportunity and will have significance for other environmental sanitation projects in China and elsewhere (e g , Vietnam) The approach used in the study consists of several stages: a) a review, assessment and analysis of current practices related to nightsoil handling; b) a demonstration and field test of activities to check and/or confirm a number of issues which may not be answered by a desk analysis, and c) preparation of recommendations for nightsoil management improvement including a program of investments for HUEP and a hygiene education program for nightsoil handlers and other high risks groups.

The study looks at the following key inter-related aspects:

1. Hygiene and epidemiology of the existing practice of nightsoil handling.

2. Socio-economic and marketing aspects of nightsoil collection, treatment, disposal and use

3 Technical options, costs and benefits of improving nightsoil collection, treatment, disposal and use

At the end of the study, the various findings and conclusions are integrated and a set of recommendations developed for HUEP regarding appropriate health protection strategies and actions to include components on improvement of physical facilities, fecal sludge treatment, hygiene education and management improvements.

In addition to the above studies several technical pilot activities are currently being undertaken in three cities These activities are construction and monitoring of

modified septic tanks in both private and public latrines, monitoring of existing septic tanks for comparative purposes, construction and monitoring of modified nightsoil storage tanks, and setting up a pilot plant for co-composting of nightsoil and solid waste. The pilot activities will be carefully monitored (through 1995) and refinements made; the information and improved capacity to undertake such activities will provide input to the proposed HUEP.

The Nightsoil Management Improvement Study commenced in mid-March 1994 with the aid of national consultants, supported by experts from various organizations, under the coordination of UNDP/World Bank Water and Sanitation Program (RWSGEAP).[1] The study covered the four project cities of Wuhan, Huangshi, Xiangfan and Yichang. The various components of the study were undertaken in 1994 with two major periods of field interviews conducted in May and September 1994 Due to various setbacks and delays, the technical pilot activities have just begun with construction expected to take one to two months, February-March 1995, and monitoring of all facilities to be completed by February 1996.

The overall recommendations of this study will be incorporated into proposals for project investment, to be supported by the project's World Bank loan. Investments will be mainly for physical implementation items (improvement to public latrines, sludge collection vehicles, improvements to septic tanks, etc.), but will include recommendations for support to and implementation of hygiene and sanitation promotion and better management of nightsoil operations.

Current Situation

Data for sewerage service/coverage has been difficult to collect and what has been collected may not entirely reflect the real situation. The data collected thus far in the four project cities indicate the following sewerage coverage: 47% in Xiangfan, 66% in Huangshi, 67% in Wuhan, and 50% in Yichang. Sewerage coverage is mainly concentrated in the central core areas of the cities. This means that a range of about 25% to 53% of the urban population in the four cities does not have sewerage service and are not connected to sewers. They are served mainly by septic tanks and/or use dry private/public latrines If the non-registered "floating" population are to be included in the statistics the proportion of urban population not served by sewers would be larger

Furthermore from estimates carried out and discussions with the project cities indicate that there is still a considerable proportion of people living in the urban areas of the cities without adequate sanitation service who rely on public latrines, dry latriness or very basic sanitation as their only means of sanitation disposal In the three project cities of Huangshi, Xiangfan and Yichang, it is estimated that perhaps 17% of the urban population may be in this category.

Of the four cities, two cities--Xiangfan and Yichang--have no wastewater treatment plants The other two cities--Wuhan and Huangshi--have one partially functioning treatment plant each All the four cities discharge most or all of their untreated wastewater into the Yangtze River Each of the three cities of Huangshi, Xiangfan and Yichang produce an average of 700 to 800 tons of nightsoil daily while Wuhan reports figures of 5,000 to 7,000 tons of nightsoil production daily. For more information on the cities, see Annex 1.

The existing nightsoil management system generally consists of collection of septic tank latrine wastes and dry latrine nightsoil by the Sanitation Bureaus of each city, and retention storage in containers or discharging into the sewers In some cases, the Sanitation Bureaus perform septic tank cleaning operations on a call basis by residents, usually for septic tanks at buildings, which are overflowing or not operating properly. The wastes, sometimes treated and more often not, are either collected by private individuals (farmers) or transported by the Sanitation Bureaus' vacuum tank trucks to the fields to be used for fertilizer and for which a fee is charged

[1] The study team was made up of the following experts. National. Prof Jin Rulin (engineer) from the Wuhan Urban Construction Institute, Li Jun (engineer) from Huangshi Environmental Protection Agency, Gao Shuisheng (economist) from Hubei Environmental Protection Agency, and Prof Zhang Shaoqing (epidemiologist), Dr Li Hanfang (health specialist) and Dr. Cheng Feng (epidemiologist) from Hubei Academy of Medical Sciences, Lu Zuxun from Tongji Medical University, and Dr Li Yuesheng (epidemiologist) from Hunan Institute of Parasitic Diseases International Roland Schertenleib from International Reference Center for Waste Disposal; Dr Marcel Tanner and Dr Daniel Mausezahl from Swiss Tropical Institute, Peter Barker from WEDC Loughbourough University, Terence Sketchell from EDU International, and Vladimir Lipsky and Mary Judd from UNDP/WORLD BANK Water and Sanitation Program

The **major problems in the non-sewerage sanitation service areas** have been identified as follows:

1 improper septic tank designs,

2 septic tanks not built to meet existing regulations;

3. irregular emptying and therefore overloading of septic tanks,

4 inadequate treatment stages of the septic tank waste, improper designs of storage tanks for untreated nightsoil which meet the 30 days retention time requirement, and

5 general pollution of the non-sewered areas from the discharge of septic tank effluent

Sludge from septic tanks and fresh nightsoil from dry latrines are often used by agriculture and aquaculture farmers without any treatment. Although no health statistics are known at this point with regard to nematode morbidity, the above arrangement implies a considerable health hazard, especially when fresh nightsoil from dry latrines is being used. Dry latrines, both private and public, are often improperly designed and operated in an unsanitary manner resulting in general public health hazards

2. Hygiene Study

Objectives

Nightsoil has traditionally been used for cultivation in China, especially of fruits and vegetables. The tradition continues today though perhaps with an increasing shift to chemical fertilizer due to the decrease in supply of nightsoil In the cities visited, nightsoil demand is still strong because of the extensive cultivation of vegetables at the periphery of the city. Many farmers feel that "vegetables taste better using nightsoil than chemical fertilizer." The demand for vegetables and other food crops will grow significantly in the coming years due to the rapid growth of the cities which have recorded growth rates of 6 to 8 percent per year

The Chinese who were interviewed perceive nightsoil as "dirty" but the fresh feces of children under two years old is believed to be cleaner than the others Most discussants acknowledged that improper handling of nightsoil can caused diarrhea but they did not view it as a "real" disease but only as a symptom of improper food handling by street vendors As a result, they did not see the need to improve their own hygiene behavior but advocated stricter controls for management of the food services outside the homes.

The objectives for the hygiene study are to

a review relevant publications and documentation on nightsoil and the current hygiene education program in work units, communities and schools in Hubei Province, particularly in the four project cities;

b. assess the knowledge and practices/behavior, through a survey, of community members with regards to hygiene and the nightsoil environment; and

c to undertake an indepth and qualitative study for additional information

Methodology

The methodology for the study consisted of a desk review, field surveys and focus group discussions of a total of 485 randomly selected respondents (385 for survey questionnaires and 100 for focus group discussions in Hangkou and Wuchang Districts of Wuhan). The key findings from the hygiene study are listed below.

Key Findings

1. Education and hygiene knowledge:

- No significant correlation was found between education and knowledge about health and hygiene. However, there were more farmers (13 percent) with no formal education than the non-farming groups (5 percent and below).

2. Inadequate sanitary facilities:

- Lack of proper water supply and sanitation facilities, particularly for farmer households where 35 percent of farmer households did not have access to pipe water and 72 percent still used dry pit latrines

- Residents in the urban areas who still use dry public latrines expressed a demand for the water flush type and were willing to pay for their use.

- Some school facilities need to be improved In an extreme case, 3,000 middle school students had access to one old public latrine without water for hand washing

3. Limited knowledge about proper hygiene behavior:

- There was only partial knowledge of key sanitary behaviors. In fact, respondents did not see the need to improve their own hygiene behavior but advocated stricter controls for management of the food services outside the homes which they assumed to be the main cause of diarrhea

- General lack of awareness of what to do when diarrhea occurred, especially among farmer households where 65 percent reported doing nothing when their children had diarrhea (54 and 53 percent were reported for the worker and professional households respectively)

- Limited exposure to hygiene education in schools In fact, the epidemiological study reports that less than 25 percent of the respondents were ever exposed to health education in schools.

4. Some practice of proper hygiene behavior but inadequate practice of key ones:

- There was generally good practice of several proper hygiene behaviors where more than half the respondents kept flies from food, covered water jars, kept house and yard surroundings clean.

- Many households did not maintain their latrines properly with 58 percent for farmer households and 40 percent for worker and professional households.

- Washing hands after defecation was not well practised

- Hand washing was mainly with water only and not with soap which was reported practised by around 20 percent of the respondents

5. General hygiene education curriculum:

- Health education is implemented by the Hubei Provincial Institute for Health Education (HPIHE) together with the following institutions schools, hospital, work units, anti-epidemic stations, mass media, and special health units. In general, water and sanitation related diseases do not have a high priority even though they are included in the health education syllabus.

- Health messages contained in the primers are more extensive than intensive; the messages do not go beyond a list of "dos" and "don'ts".

- Primary school curriculum focuses on personal hygiene, diseases and their prevention High school curriculum focuses on nutrition and general health aspects.

- Regarding sanitation, there is little or no teaching about safe water, proper excreta disposal, proper drainage, and disease transmission routes and control

- Health education approaches and materials are very didactic in nature; health education teachers have little training, minimal teaching tools and educational materials to assist them in the classrooms

6. Use of nightsoil in agriculture:

- Nightsoil was widely used in agriculture by 61 percent of the farmers interviewed

- The same farmers and several more reported using chemical fertilizer to supplement nightsoil

- Seventy percent of farmers who use nightsoil used untreated nightsoil.

- More than half the respondents said they preferred to use chemical fertilizer due to the current difficulty of obtaining nightsoil and also because of the ease of using the former. However, the high cost of chemical fertilizer kept the use down

- There was a higher preference for nightsoil by farmers if it was of good quality (i.e., not watery sludge), easily available and transported to or closer to their farms.

Findings from the hygiene study indicate a weak hygiene education and sanitation promotion program and limited practice of proper sanitary behavior People had some knowledge of the relationship between proper hygiene behavior and disease

prevention but it was not fully understood and key behaviors were not well practised Sanitation facilities were not adequate and there was demand from users for improvements The continued demand for nightsoil in the peri-urban areas means that improvements in physical facilities and sanitation service will have to take this demand into account For more details on the hygiene study, refer to Annex 2.

3. Epidemiological Study

Objectives

The epidemiological study establishes the background incidence of excreta related disease and assesses increased health risks of urban and rural population groups. Specifically, the study objectives are to. a) assess the practice of **untreated nightsoil** management with regard to transmission of excreta-related disease; b) estimate the health risks using a case-control approach and their public health relevance, and c) determine which risk factors play a role in disease transmission

Methodology

The following methodology was adopted to meet the objectives of the epidemiological study:

a. Routine health statistics from Anti-Epidemic Stations in the four project cities were reviewed to establish general morbidity rates of communicable diseases related to nightsoil management: hepatitis, dysentery and typhoid. Existing literature was reviewed to determine existing evidence linking nightsoil use with enteric diseases For helminthiasis as specific nightsoil-related disease, the available local literature was consolidated

b Based on the review on the communicable disease statistics, an assessment of risk factors in the general urban population was undertaken for hepatitis and dysentery. For this purpose, sick individuals (referred to as cases) suffering from a disease were chosen. For each case, a sympton free (healthy individual of similar age and sex (referred to as control) were identified. In total, 452 subjects were interviewed and the responses of the cases compared with those of the controls

c A cross-sectional morbidity survey on helminth infections was conducted in two farming communities--vegetable farmers (511 subjects) utilizing nightsoil and rice farmers (438 subjects) applying chemical fertilizer. Information was gathered by obtaining one fecal sample from each study subject which was analyzed by Kato-Katz method for helminth eggs.

d. An assessment of health risks based on occupational exposure to nightsoil was accomplished by surveying vegetable farmers and urban consumers using dysentery as the health outcome indicator. Total sample size was 361 respondents.

Findings Based on Existing Data

Existing Literature[2]

A report from the Shanghai Environment Project (1992, ref 9) showed a substantial difference in morbidity rates between rural vegetable farming areas and urban settings over a twelve-year period in Shanghai and Fengxian County. Incidence rates of dysentery in 1981 indicated a rural and urban ratio of 5:1 in Shanghai. Incidence rates decreased significantly over the study period, however, differing morbidity rates still prevailed (2·1 in 1989). In Fengxian County, dysentery incidence fluctuated around 3:1 indicating rural/urban differences in morbidity. Hepatitis rates were similar for rural and urban settings of Shanghai. The rural/urban difference in hepatitis morbidity (230 vs $100/10^5$ in Shanghai and Fengxian) is explained by the more urbanized, densely populated Shanghai where person-to-person contact is the primary vector Incidence rates of typhoid exhibited the same pattern in Fengxian County.

A two year study in four Chinese provinces (1991, ref 8) showed the prevalence of parasitosis among the agricultural population. In Dalian 93 percent of the population was affected in areas with untreated nightsoil use and 40 percent where treated nightsoil was used. In Henan, these figures were 55 and 23% percent respectively. For pond workers exposed to untreated nightsoil, the study demonstrated higher helminth infection rates. A comparison of sanitary and water work personnel indicated higher prevalence of helminth, salmonella and hepatitis infection for the sanitary workers. Cheng (1990, ref 6) reported that

[2] All references are found in Annex 3 - Epidemiological Study Report

infection rates for ascaris and hookworm in nightsoil workers were 72 and 28 percent respectively, which was much higher than 29 and 2 percent in other workers

The results of a 1986 national helminth survey by the Local Governmental Department of Public Health show that intestinal parasitoses present a major public health problem In Hubei province 14 different species were described. In all cities infection rates were extremely high around 40 percent. Infection rates for vegetable farmers were above 50 percent indicating a clear occupational health risk.

Routine Health Status Data

Yearly morbidity rates for hepatitis from 1991 to 1993 for Wuhan, Huangshi, and Xiangfan ranged from 183-209/10^5 describing a constant situation. For Yichang, hepatitis maximum morbidity was 2120/10^5 in 1991 which still indicates 200 percent greater morbidity rate over the yearly mean for all four cities. Hepatitis peak incidence varied. January to May were the peak months in Huangshi, Yichang and Xiangfan and September for Wuhan

Yearly morbidity rates for dysentery from 1991 to 1993 showed a constant reduction for all project cities by more than 50 percent in the three years. Prevalence rates for Yichang were again above the all-cities average in all years Monthly morbidity rates indicate a peak in August in all project cities which coincides with the hottest summer temperatures in 1993.

Typhoid was not an important disease in the project cities as the incidence rates in the project cities were quite low

The high morbidity rates for Yichang were explained by local staff as caused by the absence of a good water supply system for sanitation service and a recent increase of the floating population However, quality control of routine data collection effects the accuracy of the data Varying standards between the district reporting systems may be pertinent.

Findings Based on a Case Study of Dysentery and Hepatitis in Urban Wuhan

The case study was accomplished by interviewing a sample of urban residents in two communities in Wuhan For both diseases age, wealth and educational levels were similar The main factors which increased risks are listed below. Increased risk is defined as the increased likelihood of contracting a disease

The data presented in the table below highlights several key factors which increase the risk of excreta-related diseases. These are hygiene behavior, food hygiene and consumption habits, environment and hygiene education.

- *Hygiene Behavior.* The lack of hand washing, particularly after defecation, before cooking and eating posed significant health risks to people. If the behavior was analyzed by occupation, groups that were directly exposed to nightsoil, like farmers and fishermen, demonstrated a 3 times higher chance of getting hepatitis than was found for the rest of the study population

Risk Factors of Excreta-Related Diseases

Factors	Hepatitis Risk	Dysentery Risk
Lack of hand washing:		
- after defecation	3.2	5 6
- after work	2 6	1 4
- before eating	5 6	4 8
- before cooking	5 6	2 8
- farmers/fishermen	3 0	
Defecation habits outside latrine:		
- children's feces	4 4	–
- in yard or field	–	2 7
Lack of food hygiene:		
- uncovered food	10 8	8 6
- unclean kitchens	2.0	5 5
- consuming left-overs	2 4	16 1
- raw or uncleaned veg	–	11
- fresh milk, rarely cooked fish, meat	2	2 8
- street vendors food	–	1 8
- veg from open places	3.6	2.8
- unboiled water	3.0	4.9
Unsafe environment		
- children's play within public area	3.6	–
- flies in the homes	1 8	1.8
Lack of hygiene education in school	5.6	7 0

See Tables 15-16 in Annex 3 for more details.

- *Food Hygiene and Consumption* Unsafe practices in food hygiene and consumption habits indicated significant health risks for the population, particularly as related to hepatitis and dysentery. The danger in eating left-overs and food that was left uncovered could be attributed to unsafe food storage practices, particularly during warm

summer months Drinking unboiled water and buying vegetables from open markets were also risky.

- *Environment.* Hepatitis and dysentery cases reported problems with flies in their household significantly more often than controls. Also, children under the age of 13 years were found to have a higher hepatitis infection risk if they played near ponds, garbage heaps, and vegetable gardens; these were areas that were more likely to be contaminated with nightsoil.

- *Hygiene Education* A striking result of the risk factor assessment indicated that the lack of exposure to health and hygiene education during schooling was associated with highly significant 5.6 times for contracting hepatitis A and 7 times for dysentery The respondents in the case study group had less exposure to hygiene education than the healthy control group

Findings Based on a Case Study of Dysentery in Urban Consumers and Peri-urban Farmer Communities

The population sample was chosen from Hongshan District in Wuhan where records indicate a high incidence of dysentery and the presence of a sufficient number of farming households Differences in the educational level were more evident between the two groups: no formal education for 13 percent of the farmers and 2 percent for the consumers, and university level education for 2 percent of the farmers and 52 percent of the consumers.

This study had limitations in size, diagnosis of illness and time constraints The disease surveillance records of dysentery cases of those engaged in agriculture was limited so statistical significance could not be ascertained but differences were apparent.

- *Hygiene Behavior.* In both groups, lack of washing hands after work increased the risk for dysentery by 2 and 2.7 times, respectively.

- *Consumption.* For the consumer population, the consumption of raw vegetable increased the risk for a dysentery attack by 1 8 times. For the farmers, the consumption of unboiled water increased the risk 3 5-fold

  If the consumption-related risk factors were pooled vegetable farmers were 1 9 times more at risk; the consumers exhibited a 1.5 fold likelihood for disease, respectively.

Findings Based on Cross-Sectional Morbidity Survey of Helminth Infections in Farmers

This survey was conducted in two suburban villages, one with vegetable farmer households using nightsoil and the other with rice farmer households using chemical fertilizer.

- Nightsoil. Specific health risks attributable to the direct exposure to nightsoil were found for population groups that are occupationally exposed to nightsoil.

  a. There was a considerably higher prevalence of helminth infections in the nightsoil-using community considering all ages (25 vs 19 percent, representing 95% of 1002 persons tested).

  b. In the same group of nightsoil users the prevalence of infection was significantly higher in the age strata 31 - 60 years that represents the majority of people working in the fields (25 vs 17 percent).

- *Vulnerable Group.* Helminth infection occurred significantly more often in children below 10 years of age (35 vs 21 percent in adults). This was found to be similar in both communities where the younger age groups were more susceptible and showed a higher cumulative exposure risk than adults.

Findings of the epidemiological study show a high prevalence of enteric-related diseases, similar to other studies in similar Chinese cities. Statistical analysis provided clear correlation between several key factors--such as, the lack of proper hygiene behavior, unsafe food hygiene practices, and environmental risk factors--and the increased risk of contracting excreta-related diseases. Lack of exposure to hygiene education in school showed a highly significant correlation.

The high risk groups who stood a greater chance of contracting diseases were: a) farmers, who were significantly less exposed to health education and more exposed to untreated nightsoil handling; b) sanitary workers; and c) young children under 10 years old Refer to Annex 3 for detailed information and statistical analysis on the epidemiological study

4. Economic and Market Study

Initial Assessment

In the first phase of this study, an overall assessment was made of the economic and market aspect of nightsoil use in each project city. Data was collected and information obtained from discussions with city officials regarding the nature and methods of collection, storage, transport and the use of nightsoil and septic tank sludges for agricultural purposes. This assessment was carried out to obtain knowledge of the basic economic aspects, cost factors and general operations and nightsoil usage by farmers, as well as to understand the main issues and constraints relating to nightsoil use.

Following this initial assessment recommendations were made for a more detailed sample survey of farmers on specific issues found in the initial assessment. The survey focused on farmers in the suburban areas of two project cities

The results and analysis of this economic assessment and farmer surveys were used as inputs to develop the proposals in the investment program and to provide recommendations for improvement to the nightsoil operations.

City Market Situation

The main trend is that of a marked reduction in nightsoil sales since 1992. This is in contrast to rapid sales in growth immediately prior to this period. The cities' program for conversion from dry to wet latrines accelerated over the same period. These conversions resulted in a change in the quality of nightsoil as perceived by farmers, that the available nightsoil is wet material which has several disadvantages from their point of view. These disadvantages are:

a. It is viewed as being less nutritious to plants.

b. It is heavy, difficult to transport and requires a larger investment in storage facilities at the farm

c. Its wetness means that most farmers do not have suitable transportation of their own Moreover, the city has only four vehicles with a total of 16 tons of carrying capacity. The constancy of sales by city truck appears to be at least in part due to the constraint imposed by transport.

d. It is claimed that wet material has more foreign bodies, eg. plastic and paper.

e. Control of the dilution is under farmer control for the dry material but not the available wet material

Nevertheless it was found that nightsoil is still sold to farmers, indicating a potential for market sales.

Identified Problems

The main problems regarding market and sale of nightsoil are:

a. The change in the perceived quality of nightsoil consequent upon the conversion to wet latrines has reduced demand for the available product. The possibility for full cost recovery of station operating costs is not high. Nevertheless improved cost recovery could be achieved through a mixture of increasing revenue and reducing costs. It is important to realize that the latter is a potentially powerful component of cost recovery.

b. It should be recognized that in the absence of finding an adequate market outlet for nightsoil, the authorities will still have to bear the costs of safely disposing of this material.

Market Survey

To evaluate in more detail the potential for market and economic aspects for continuation of nightsoil use, it was recommended in the first phase of this study that further surveys be carried out. Sample surveys of farmers were carried out in the second phase of the study in two cities--Wuhan (60 farmers) and Huangshi (20 farmers) The survey locations in the cities were chosen to represent typical suburban vegetable farming areas, with questions covering the following topics.

- cultivation areas and crop type, farm income
- whether nightsoil used or not, including reasons
- quantity of nightsoil used
- preference for nightsoil and/or chemical fertilizers
- specific uses of nightsoil and chemical fertilizers
- when chemical fertilizers/nightsoil used
- total spending on chemical fertilizers/nightsoil

- amount farmers are willing to pay for nightsoil
- preferences for treating nightsoil
- farmers' source of knowledge for fertilizers and nightsoil
- farmers' suggestions for improvements to nightsoil operations

Results of this survey were then used to establish whether nightsoil is in demand at present and whether it indicates the demand will remain in the future. Results of other aspects--such as preferences for nightsoil treatment, preference of either nightsoil or chemical fertilizer, reasons for using on not using nightsoil, amount spent and willingness to pay for nightsoil, farmers suggestions for improvement to the nightsoil operations--were used in the general economic and financial analysis for the investment program items.

Results of the Market Survey

The market survey provides a number of clear results regarding the use of nightsoil in vegetable farming in the suburban areas in the two project cities. The main conclusions to be drawn from the results of the farmer surveys are

- there is preference to continue to use nightsoil but the nightsoil should be "dry" and not "wet";
- there is a strong preference to use nightsoil even though chemical fertilizers are also used;
- there has been a reduction in supply of nightsoil by city authorities, thereby reducing the availability of nightsoil;
- main characteristics sought by farmers in nightsoil (apart from nutritional value) are low cost, ease of transport and delivery to farm;
- amount spent on nightsoil per year is around RMB 600 per farmer for nightsoil and RMB 1,100 for chemical fertilizer,
- both nightsoil and chemical fertilizers are used throughout the year with a peak season in spring (March) and a low season in winter (January),
- there is a high willingness to pay for nightsoil, but this is only for good "fresh" nightsoil (up to RMB 21 per ton) or treated nightsoil (up to RMB 25 per ton) For nightsoil and solid waste co-compost willingness is higher - at RMB 50 to 55 per ton;
- there is a lack of good sources of information for both nightsoil and chemical fertilizer; and
- among the main requirements suggested by farmers to improve the nightsoil operations are for the City Sanitation Department to provide good and inexpensive nightsoil, including transport facilities.

Detailed results and analysis are given in Annex 4 of the report.

5. Technical Pilot Activities

Objectives

A number of technical improvements for septic tanks, nightsoil storage tanks and nightsoil treatment are being tested to assess and demonstrate the appropriate technical parameters for wastewater and nightsoil treatment processes. These activities are intended to provide improved design parameters and operating methods which will then be applied to refine the technical designs of the project investment items. The pilot activities are being undertaken in two project cities, Yichang and Huangshi, and will be carried out for a period of approximately 10-12 months (February/March -December 1995). Based on the pilot activity results, recommendations for any necessary improvements to the designs and operation can be incorporated into the specific project investment items for the nightsoil component.

The pilot activity designs and construction have been completed, testing and monitoring have commenced. The activities are being implemented by the Sanitation Department in each city and technical advice is provided by the UNDP/World Bank Water and Sanitation Program and IRCWD.

Septic Tanks

The pilot activities for the septic tank improvement will test and monitor several aspects of the septic tank treatment and design process, including the following.

- design criteria used in the Chinese septic tank design, particularly the three compartment tank design; and
- methods of improving the efficiency of septic tank.

A number of common faults in septic tank operation have been noted in the project cities. These are.

- overloading, whereby solids do not settle out sufficiently and are not digested sufficiently, infrequent de-sludging, resulting in reduced volumes in the tank thereby impeding the digestion process, and
- poor maintenance resulting in broken or missing inlets and outlets allowing untreated discharge to flow into streets.

The objective of this set of activities is to improve the septic tank design and provide more appropriate septic tanks to deal with the situations for which these tanks are commonly used in the project cities, and possibly on a wider geographic basis Septic tanks at both residential buildings as well at public latrines are being tested.

Nightsoil Storage Tanks

The project cities have used nightsoil storage tanks to supply nightsoil to the farming community. However, the storage tanks are not operational for various reasons The purpose of this activity is to improve the design and provide technical improvements to enable storage tanks to provide some treatment to the nightsoil and sludge in order to reduce the pathogen content. The tank will also be built to provide easier access and loading of the semi treated nightsoil by farmers at the tank outlet

Co-composting

There is a major problem in finding safe outlets for disposal of nightsoil. The objective is to develop a technically viable method of co-composting suited to the conditions in the project cities, ie., for the types of solid waste and nightsoil and sludge wastes being generated in those cities Although it is known that there have been numerous attempts at co-composting and not all successful, it is considered that by having a this co-composting pilot activity it will provide an opportunity to develop a technically feasible method while at the same time appropriate to the Hubei urban situations and conditions. Co-composting will have the additional advantage of reducing the need for separated (and potentially expensive) treatment of nightsoil and septic tank sludges

Pilot Activities Undertaken

A number of pilot activities have been allocated to the project cities of Yichang and Huangshi. The activities undertaken are.

Septic Tanks:

ACTIVITY No 1: Monitor only - Standard Chinese 3 Chamber Septic Tank at Residential Building

ACTIVITY No 2: Construct and Monitor - Septic Tank with Anaerobic Filter at Residential Building (tank based on Chinese standard design)

ACTIVITY No. 3 Construct and Monitor - Septic Tank with Anaerobic Filter at Residential Building (modified design)

ACTIVITY No. 4· Monitor only - Standard Chinese 3 Chamber Septic Tank at Public Latrine

ACTIVITY No. 5: Construct and Monitor - Septic Tank with Baffled Reactor at Public Latrine

ACTIVITY No. 6: Construct and Monitor - Septic Tank with Anaerobic Filter at Public Latrine

These septic tank activities are intended to test improvements to the existing Chinese 3 chamber septic tank design and also to provide a more efficient design for a septic tank with higher BOD removal rates than a typical design. Such an improved design could be used to serve several apartment or residential buildings which do not have access to sewerage or adequate drainage disposal and could significantly improve the sanitation situation in local sanitation areas Improvements to be tried include the addition of anaerobic filter and baffled reactor. Two existing operational septic tanks (one at a public latrine and one at an apartment building) will also be monitored and will be used as the base case with which to measure the propose improvements and efficiencies.

Nightsoil Storage Tank

ACTIVITY No. 8. Construct and Monitor - Nightsoil Storage Tank

One operating segment of a storage tank will be built and tested - to measure the extent of digestion and removal of pathogens as well

Co-Composting

ACTIVITY No. 9: Construct and Monitor - Co-composting Treatment (Nightsoil & Solid Waste)

The co-composting method will involve a small treatment plant based on the aerated pile method for composting of nightsoil, septic tank sludge and solid waste. It will measure and provide guidance on the following.

- appropriate mix ratios of nightsoil to solid waste;
- range of water content of the solid waste required;
- size and type of pile for satisfactory composting;
- amount of separation of non useful material required to achieve a useful compost;
- any requirements for post compost separation; and
- weather and climate influences (such as rainfall and ambient temperature)

Tests will be carried out on the final compost for coliform and parasite counts (ie., measure safe levels of nightsoil) and also on the organic nutrient quantities to measure its value as a fertilizer.

Detailed descriptions and background of the pilot activity items are found in Annex 5

6. Conclusions and Recommendations for Nightsoil Management Improvement

The review of the health data and findings from the various study components--hygiene, epidemiology, market analysis and technical pilot activities--clearly identified the need for a coordinated approach based on technical improvements, better management practices, better information and education in the sanitation aspects of nightsoil and related aspects for the improvement of the health and welfare of the people in the project cities Improvements are recommended in the following areas:

1. Improvements in sanitation physical facilities

2 Improvements in sanitation service, including the treatment of nightsoil

3 Promotion of better hygiene practices through an improved hygiene and sanitation promotion program

4. Improvements in the management of nightsoil

5. Other identified areas, including privatization

Improvements in physical facilities will require parallel improvements in nightsoil management and, for maximum health impact, these will require improvements in related hygiene behaviors through an improved hygiene education program. Provincial and city health authorities need to develop an appropriate and effective hygiene education program, especially for the identified high risk groups such as farmers, nightsoil workers, young children and consumers living in unsafe areas.

The recommendations proposed here have taken into account the findings from the four integrated studies as a whole. Which agency will undertake what part of the recommended activities will be up to the municipalities themselves. However, these recommendations have been proposed with maximum health benefits in mind. The items to be included in the final investment program under HUEP will be based on environmental considerations and on discussions between the cities and the World Bank.

The nightsoil management improvement program is part of the larger **Sewerage and Sanitation Improvement Component** of HUEP which looks at investments in trunk and secondary sewer systems, pumping facilities and wastewater treatment facilities in the four project cities. An urban sewerage and sanitation strategy for the project cities needs to have long-term planning and staged development over a period over a number of years, eg., 15 to 20 years for reasons of limited financial resources, economic development and changes due population growth. While trunk and some secondary sewers can be constructed for city centers in HUEP, many of the older inner core of the city and peripheral areas will not be covered immediately. The development of these areas will have to be phased over a period of several years. However, in the immediate and intermediate future, improvements to the current situation, including alternative low cost technologies, will be required

The recommendations put forth in the nightsoil management improvement study report complements the improvements proposed by the sewerage and sanitation component and provides services to a needy and unserved part of the population Present proposals for sewerage improvements under the HUEP project will provide improvements mainly to trunk and main lines Funds within the HUEP project will not be

sufficient to cover construction and installation of tertiary distributions, house connections, and full treatment facilities Even with the large investments to be provided under this project, it is anticipated that a significant proportion of the urban residents will not be able to have complete sewerage facilities With the anticipated growth and development in the cities, unless additional funding is provided, many residents will remain without adequate sanitation facilities. Proposals included in the nightsoil component are intended to provide additional improvements not only to assist the nightsoil and septic tank sludge use in agriculture and aquaculture, but to provide improvements in areas which are not covered under the sewerage improvements, which in the main are in the low income and poorer areas of the city.

1. Improvements in Sanitation Facilities

Conclusion. Existing sanitation coverage is still inadequate in many areas Many areas are not served by sewerage systems and may not be covered in future proposals by the cities. Numerous residents, particularly in those living in older buildings, do not have private facilities and rely on public latrines In other areas, where buildings do have private latrine facilities, not all have adequate discharge outlets either to sewerage or reasonable drainage system, resulting in unsanitary conditions around buildings. In the peri-urban farming areas, there is a lack of water supply and sanitation facilities. It has been observed that some school sanitation facilities also need improvement

Septic tanks are the main form of primary treatment for wastewater discharges from buildings and households But septic tanks often do not function properly due to overloading, inadequate maintenance and improper poor design and construction

In all project cities nightsoil storage tanks were constructed to be used as a transfer point for nightsoil collection from both public latrines and septic tank de-sludging operations; farmers could then obtain nightsoil to be used as fertilizer. However most of these tanks are not operational due to a number of reasons, including improper design and inconvenient locations for the farming community. Nightsoil and septic tank sludge is often collected by farmers in a fresh state with a high risk of contamination by pathogens and coliform.
From the field investigations it has been found that the public generally is willing to pay to use public latrines, but with proper facilities of running water and flush latrines

Recommendation. Improvements are required to the sanitation facilities both to increase access to adequate sanitation services as well as to improve the nightsoil operations for agricultural uses. Increasing access to sanitation facilities would require the provision of new facilities as well as improving the design and construction of the existing facilities, such as:

- conversion of dry to water flush public latrines;
- improved septic tank designs;
- provision of equipment for septic tank de-sludging;
- construction of more efficient septic tanks to serve several buildings in specific local areas; and
- investigation of lower cost sewers to assess their suitability in the project cities.

Improvements to the collection, transport, storage and distribution of nightsoil and septic tank sludge for use as fertilizer in agriculture would require the following:

- improved nightsoil storage tank design and location;
- more vehicle resources for transport of nightsoil, and
- provide treatment to the nightsoil used for fertilizer to reduce harmful pathogens.

From the market survey results, most vegetable farmers interviewed stated that they are now using less nightsoil than before. The reasons given included a reduction in the supply of nightsoil by the city authorities and lack of transport facilities. However they would still prefer to use nightsoil (in many cases in preference to chemical fertilizer) if there was sufficient amount of available nightsoil and a more convenient arrangement for collection and transport of nightsoil

Improved water supply and sanitation facilities for people living in the peri-urban areas are required, especially where there are farms growing food for the city center. The improvements should take into account farmers' need for nightsoil in cultivation. This could mean improved and safe designs for dry latrines and treatment options. Improvements in these facilities would greatly benefit the women in providing them easy access to safe facilities and decrease their time in having to care for sick children and other members of the household.

The technical pilot activities will test a number of septic tanks, storage tanks and nightsoil treatment

designs, which can be applied to provide some of the technical improvements to a number of these facilities in the proposed project implementation program. For more detail on the technical pilot activities currently being implemented in two project cities, Yichang and Huangshi, refer to Annex 5

2. Improvements in Sanitation Service

Conclusion. As discussed in the previous section A, there is inadequate service coverage for sanitation in the project cities. In addition, existing servicing of septic tank cleaning is irregular or, at times, not at all. The cities do not have adequate resources for maintenance of their vehicles and equipment. There are very few means of treating nightsoil before the nightsoil or septic tank sludge is collected by farmers. Existing controls on waste disposal do not appear to be implemented well The cities do not have sufficient resources to provide adequate septic tank de-sludging services

Recommendation It is recommended that increasing the service coverage, particularly in the areas without sewerage and reticulated drainage, can be achieved by the provision of a number of facilities as discussed in the previous section A, and in addition with the following service improvements:

- improvement to the maintenance and cleaning of septic tanks for both public latrines as well individual buildings,
- use of more efficient septic tanks to serve areas without sewerage or drainage facilities;
- improvement to maintenance of service vehicles for collection of nightsoil;
- better and more systematic control on polluting wastewater discharges.
- stricter control on septic tank design and operation at buildings and public latrines;
- construction of more public latrines;
- more sanitary disposal of nightsoil; and
- develop more efficient and workable methods of disposal of wastes and effluents, including co-composting, possibility of collection and utilization of waste gases, safe means of storing nightsoil and septic sludges.

3. Improvements in Hygiene and Sanitation Promotion

Conclusion. Findings from the hygiene study indicate a weak hygiene education program and limited practice of proper sanitary behavior People had some knowledge of the relationship between proper hygiene behavior and disease prevention but it was not fully understood and key behaviors were not well practised. Statistical analysis from the epidemiological study provided clear correlation between several key factors--such as, the lack of proper hygiene behavior, unsafe food hygiene practices, environmental risk factors, and nightsoil handling--and the increased risk of contracting excreta-related diseases. Lack of exposure to hygiene education in school showed a highly significant correlation with health risks.

Recommendation. The study team strongly recommends improvements in the hygiene education program for the project cities and their environs as well as continuous health impact assessment to provide continuous feedback into the hygiene education program as well as other sanitation improvements.

The city health authorities together with the sanitation bureaus should develop an appropriate and effective Hygiene and Sanitation Promotion Program focusing on **improving key sanitary behaviors while improving latrine facilities** for high risk populations. Certain population groups and the schools, particularly primary schools, should be the main targets for the program. The main objective of a sanitation promotion program is to improve human health. It should include the dual component of providing hygienic latrines for the safe deposit of excreta and hygiene promotion. Hygiene promotion would be focused on three key sanitary behaviors which interrupt disease transmission. Techniques for hygiene promotion will involve the participation of the community as much as possible. Appropriate channels of communication will be identified, such as community venues, schools, work units, local health posts, radio, TV, and printed material.

In addition and as support to the above interventions, there should be a **Monitoring and Evaluation Component** of the health impact of the proposed improvement activities in all four project cities to: (i) assess the effectiveness of the proposed nightsoil management improvements; and (ii) validate the program's health outcome. This could be accomplished by:

- a continuous monitoring of selected infectious diseases' morbidity as well as behavioral changes through the existing district and village/community-based routine operations; and

– – conducting one case-control study in each city in selected high risk areas covered by the nightsoil management improvement interventions and within selected population strata.

Monitoring and evaluation activities can be initiated after the hygiene and sanitation promotion interventions have been in place and after a major portion of other nightsoil management improvements have been implemented

Details of and investment for the Hygiene and Sanitation Promotion Program can be found in Appendix 6, Part 2 of the report.

4. Improvements in Nightsoil Management

Conclusion There is inadequate management of the nightsoil and sanitation facilities, the main aspects noted in this study are:

- revenue from public latrines and septic tank de-sludging operations does not appear to be fully recovered;
- there is inadequate and irregular surveillance and monitoring of revenue collection;
- there is lack of supervision (and education) for sanitary units in hygienic work methods; and
- insufficient allocation of sufficient resources (plus vehicles/equipment) with a need for a need for better and more convenient nightsoil supply for farmers, including transport of nightsoil.

The market survey carried out of farmers in Wuhan and Huangshi has found that farmers are willing to pay for treated nightsoil and composted nightsoil. This factor suggests that there is potential for revenue and income generation to the cities by provision of improved and better service of nightsoil supply.

The market survey also found that vegetable farmers in the peri-urban areas of the cities recognize the need to use treated (rather than fresh nightsoil) to reduce the harmful pathogen content, it also found that lack of facilities for transport of nightsoil is a problem There is a need for the city authorities to improve the treatment (such as in nightsoil storage tanks, additional treatment facilities) and the supply of nightsoil to the peripheral farming areas of the city.

Recommendation Management and operation of a number of aspects of sanitation facilities, nightsoil operations, revenue and income management, could be improved in the project cities to provide a more efficient service and improve the sanitation and hygiene situation in the urban residential as well as peri-urban farming areas. Recommended improvements include:

- more efficient and effective administration and management of septic tank cleaning, which will require rigorous enforcement of existing legislation controlling septage dumping;
- improve collection, treatment, and sale of nightsoil;
- more regular surveillance and monitoring of nightsoil operations, latrine use, and septic tank operations;
- improve supervision (and education) for sanitary units
- allocation of sufficient resources (plus vehicles/equipment) will need to be supported by a well managed vehicle servicing operation; and
- improve collection of user fees and revenues from public latrines, sale of nightsoil, and septic tank cleaning.

5. Improvements in Other Areas/Services

Conclusion. The study findings also indicated several additional areas for improvement. These include:

- with the cities' limited resources there is potential for privatization of several of the operations, including septic tank cleaning, and transport of nightsoil (perhaps similar to privatization of solid waste collection and transport);

- in view of the prevalent use of nightsoil as a fertilizer for vegetable growing, the sale of vegetables bought at markets may contain harmful pathogens from nightsoil application; and

- there is an unaccounted for "floating" (non-registered) population which would add another 10 to 20% to the urban core of cities; these people rely on public latrines for all their sanitary needs.

Recommendation. Recommendations by the study team are:

- Privatization of septic tank cleaning operations should be considered as a viable option to supplement the cities' sanitation service This should be in the form of a public service supported by adequate (and improved) controls and regulations on septic tank construction, operation,

as well as on unauthorized and unsanitary discharge of wastes from buildings and public latrines Privatization could be considered for transport and collection of septic tank sludges (this is a common practice in other countries) as well the possibility of treating the nightsoil and sludges on a commercial basis.

- Controls for the sale and public handling of food should be strengthened and/or implemented more rigorously particularly for the products derived from nightsoil fertilization.

- While improving public facilities would benefit the non-registered population, there is also a need for a sewerage/sanitation plan to anticipate even larger influx of the floating population due to the disruption and resettlement of over 1 million people around the Three Gorges Dam; especially in Yichang and Wuhan

The above proposed improvements should be coordinated with other agencies, such as the Provincial Patriotic Health Campaign Committee (PPHCC), HPIHE, UNICEF and others who are working in the same sector. UNICEF is starting a health education program in a few counties in selected provinces focusing specifically on mothers Hubei is one of the selected provinces and UNICEF is working with HPIHE to implement the program The city sanitation bureaus should hold discussions with UNICEF and HPIHE to expand the program to the four project cities.

Due to the limitation of financial resources and the need for a staged development, the study team recommends the following items for the investment program under HUEP: a) new public latrines and conversion of dry to wet public latrines; b) improvements to nightsoil storage tanks; c) nightsoil and sludge treatment; d) construction of improved storage tanks to serve critical local areas; e) purchase of vacuum trucks and improvements in maintenance of existing vacuum trucks and transport vehicles, including workshop space, f) institutional and staff resource development for improved nightsoil management; and g) improvement in hygiene and sanitation promotion for sanitary workers, farmers who use nightsoil, and residents who live in areas with dry private and public latrines.

Based on the results of the study findings and discussions with the project cities, proposals for investment items have been developed for the three project cities of Huangshi, Xiangfan and Yichang (refer Part 2 of the report). Proposals for Wuhan have been prepared additionally by Wuhan City Administration and are incorporated into the World Bank's project preparation. These investment proposals, if implemented will provide significant improvements to the cities' sanitation and nightsoil management operations, and improve the health and hygiene of nightsoil exposure groups (farmers, sanitation workers, etc.) as well as raise the sanitation service levels, particularly in the low income areas of the cities and in areas with limited sanitation facilities.

The total cost (current costs) of the investment program for the three cities is RMB 18 9 million or equivalent US$ 2.2 million; (Huangshi RMB 10.3 million, Xiangfan RMB 1.7 million and Yichang RMB 5.7 million, plus RMB 1.2 million for health education and sanitation promotion). As Wuhan has prepared an investment of RMB 9.9, the total cost for the nightsoil management component then is RMB 28.8 million or equivalent US$ 3 35 million (December 1994 prices). Project costs and details are given in Part 2 of the report, Table 1 and Appendix 3.

Recommendations that are made but not prioritized for the investment program should not be ignored but should be implemented at a later stage or by other departments. For example, hygiene and sanitation promotion for other high risk groups like food vendors, young children and those in schools should be the responsibility of the health departments. Production of quality nightsoil for sale to farmers could be implemented on a trial basis by the private sector (which could include local and community groups like a farmers' cooperative). The small bore sewer system option could be implemented as a trial in a later period.

Part 2. HUEP Nightsoil Investment Program

1. City Profile and Nightsoil Management System

Introduction

The Nightsoil Management Improvement Study prepared an investment program for the three project cities--Huangshi, Xiangfan and Yichang--as part of the Hubei Urban Environmental Project (HUEP). Investment proposals for Wuhan have been prepared separately by the Wuhan City Administration and are included in HUEP

The study has assessed various aspects of nightsoil practice--epidemiological, hygiene, economic and social--and these are reported in the subsequent sections of this report Part 2 of this report sets out proposals for investment items to be included in the HUEP based on the recommendations from this study for improvement to nightsoil management and operation. Financial analysis of these investment proposals is included for. Huangshi, Xiangfan and Yichang.

Use of Nightsoil as Fertilizer

The use of nightsoil for agricultural/aquacultural purposes is still commonly practiced in the peri-urban and nearby rural areas in the project cities. Nightsoil finds its use as a fertilizer primarily for vegetable and aquacultural farming

The results of field investigations carried out in this study indicate that although there has been a diminishing use of nightsoil by the farming community in the peri-urban areas of the project cities, there is still a relatively high demand for it A significant majority of farmers interviewed stated that although they use chemical fertilizers they would generally prefer treated nightsoil (i e made safe from harmful bacteria).

Furthermore, epidemiological field surveys carried out as part of this study indicate that there are health risks associated with handling untreated nightsoil which affect the nightsoil exposure group (farmers, fishermen, sanitation workers) who have higher incidences of nightsoil related diseases (such as diarrhea, dysentery and hepatitis A).

Aims of the Nightsoil Investment Program

The preliminary investment proposals developed at this stage of the study have the following broad aims:

- To improve health and hygiene, particularly for the nightsoil exposure groups by reducing the health risk associated with handling nightsoil. This supports the local concept that nightsoil is a valuable resource for farming which is still in demand today.

- To improve sanitation services, particularly for the lower income communities who lack adequate sanitation facilities. There is still a significant proportion of the population in the urban areas with very limited sanitation facilities. Many residents rely on very basic facilities, those who do not have latrines in their dwellings rely on public latrines as the only means of sanitation disposal. Improvements to the municipal nightsoil operations (removal of nightsoil wastes from public latrines, cleaning of septic tanks, disposal of septage wastes, etc.) are also required to increase the sanitation services, particularly to the low income communities.

- To improve management of municipal nightsoil operations.

The proposed investment program will provide significant improvements to the municipal facilities and substantially achieve the above objectives

Municipal Nightsoil Operations

The need for improved municipal nightsoil operations stems from two principal factors; (a) the absence of suitable latrine facilities in many areas, particularly in the older buildings, and (b) the non-existence of piped sewerage or properly constructed disposal facilities (such as septic tanks). Even where acceptable septic tank facilities do exist there remains the need for these to be routinely emptied and their contents safely disposed of

Present investment proposals are substantially geared towards improving health and the environment by addressing the more critical deficiencies in the present process and providing alternative technologies aimed at rendering waste materials safer and less harmful to local environments. However, they also include the first steps towards reinforcing the link between the piped conveyance of effluents and their safe disposal. In addition, the movement away from dry latrines is a further step in emphasizing the link between clean water inputs and dirty water outputs.

With the high rate of urbanization the tendency in the present urban development is that areas without adequate service coverage remain unserved particularly in the densely built up areas which increases the demand on already inadequate services in those areas. From the financial and cost recovery viewpoint it would make a great deal of sense to bring the nightsoil activity within the responsibilities of proposed new wastewater companies from the outset. As new user charges are established for the mainstream activities so the present charges related to nightsoil could be kept under review and the equity of their continued application regularly reviewed as the integration of the sewerage/dirty water/effluent activities proceeds.

Existing Situation

The nightsoil operations and resources in each city consist of a formal system of service provided by the municipality and an informal nightsoil collection by farmers. The resources of the city (formal) nightsoil operations are described below

Huangshi. The Huangshi Sanitation Bureau has a resource of 4 vacuum trucks but only two are operational Many farmers also transport sludge from latrines to farms using their own resources and hand carts

There are 110 public latrines (70 water flush type and 40 dry) They are located throughout the city There is one nightsoil storage tank (approximately 1,000 cu.m.) but is not in current use, although the tank appears to be in good condition Sludge from latrine septic tanks is transported and disposed into the drainage and sewerage system, while some nightsoil is also taken by farmers (using hand carts) directly from both public and private latrines

Total nightsoil waste generated in the city is in the order of 650 tons per day Approximately 110 to 120 tons per day of this are in public latrines of which sludge waste generated in septic tanks of public latrines is approximately 35 to 40 tons per day In addition, sludge from other septic tanks (eg. not connected to sewerage system) would generate approximately another 100 to 150 tons per day.

Xiangfan. The Xiangfan Sanitation Bureau has a resource of 6 vacuum trucks (5 ton capacity) as well 18 hand carts which are used to clean sludge from public latrine septic tanks, as well as to clean household septic tanks on demand. There are 167 public latrines (134 water flush type and 33 dry). They are located throughout the city and the sludge from the septic tanks is trucked to various areas as well as collected by farmers in the farming areas around the city.

There are two nightsoil storage tanks (1,200 cu.m.) located in the urban areas of the city but not readily accessible to the farming community. The storage tanks do not appear to be operational In addition to the municipal service, some farmers collect nightsoil directly from both public and private latrines.

It is estimated that by the year 2000, assuming that all dry public latrines will be converted to flush type there will be approximately 1,200 tons of waste generated in the city, of which sludge will account for nearly 200 tons, with approximately 40 tons from public latrines.

Yichang. The Yichang Sanitation Bureau has a resource of 2 small vacuum trucks as well as about 100 hand carts which are used to clean sludge from public latrine septic tanks, as well as to clean household septic tanks, the latter on a demand and fee basis. The majority of the nightsoil equipment used is for collection of nightsoil from public latrines. There are 128 public latrines (84 water flush type and 44 dry). They are located throughout the city. Nightsoil from dry latrines is trucked to various areas and collected by farmers in the farming areas around the city. There is one nightsoil storage tank (50 cu.m.) located at the solid waste dump site but the storage tank is not operational; the tank was constructed for trial purposes but due to construction contractual difficulties, the tank is not yet in use.

The sludge waste is transported and disposed into the sewerage system and some nightsoil is sold or made available to farmers In addition to the municipal service, some farmers, using hand carts, collect nightsoil directly from both public and private latrines.

It is estimated that there are approximately 1,000 septic tanks with approximately 1,200 tons per day of waste generated in the city by the year 2000. On the

assumption that all the dry public latrines will be converted to the water flush type, there will still be a significant requirement for removal of septic tank sludge form public latrines It has been estimated that waste sludge generated in all septic tanks in the city will be approximately 170 to 180 tons per day by the year 2000 and about 250 tons per day by the year 2010. Out of this total amount, approximately 30 to 35 tons/day will be from public latrines by the year 2000 and 40 tons/day by 2010 It is obvious that the city's present resource of 2 vacuum trucks will need to be significantly increased to provide the future septic tank cleaning service and sludge disposal

Wuhan. The municipal system includes the operation and maintenance of the public latrines (total 977 of which 804 are water flush type), 6 transfer stations (underground storage tanks ranging in size from 800 to 1,000 cu.m. capacity), and 68 vacuum tankers (three and five ton capacity) Hand carts are no longer used for collection of nightsoil. Figures supplied by the municipality indicate that 5,000 to 7,000 tons of nightsoil are collected daily, although this appears to be excessive. In addition farmers take nightsoil directly from storage tanks or public latrines, and in some cases, nightsoil collection vehicles distribute untreated nightsoil directly to farmers, bypassing the nightsoil storage tanks Generally, Wuhan has a combined sewerage and drainage system in all of its seven urban districts, but there are still many areas with poor sanitation service conditions.

Issues in Nightsoil Operations

This study has found that nightsoil is still in significant demand by the agricultural community in the peri-urban city areas. However, its use as agricultural fertilizer in the semi urban and near city areas has diminished over recent years due to·

- expansion of city and urban development, reducing farmland adjacent to the city;
- conversion of dry latrines to water flush latrines, (farmers preference is to use "dry"[1] nightsoil);
- availability of chemical fertilizers as alternate fertilizers,
- a smaller agricultural labor force; and
- lack of transportation

Furthermore, there is a significant proportion of the urban population living without adequate sanitation facilities; estimates indicate approximately 17% of the urban population (Appendix 1) The projected and planned improvements to the cities' water borne sewerage systems, are unlikely to provide necessary improvements in sanitation service to all residents presently without adequate sanitation facilities.

The main issues which have been identified in this study regarding management of the city nightsoil system are:

1. Nightsoil is often collected by farmers in its fresh state without adequate removal of harmful bacteria and pathogens, prior to handling.

2. There are still many urban residential areas without adequate sanitation facilities. Many residents even in areas within the sewered areas are without proper drainage and sanitation disposal facilities, relying on shared latrines or public latrines.

3. Septic tanks are the main form of sewerage waste treatment in all the project cities, but are not always functioning properly, due to overloading, inadequate maintenance and infrequent sludge removal.

4. The cities' resources for collection, disposal and maintenance of public latrines and septic tanks is very limited.

5. Although nightsoil exposure groups (farmers, fishermen, sanitation workers) recognize untreated nightsoil as being harmful, there is still the general lack of adequate hygienic practices in handling and use of nightsoil.

Improvements to the present nightsoil management and operations are required for the following reasons:

1. *Health and Hygiene Improvement*: Improve the health and environmental sanitation of the area for consumers, farmers and nightsoil workers.

2. *Nightsoil as Fertilizer*: Continue and support the use of nightsoil as traditional agricultural fertilizer resource.

3. *Provision of Basic Sanitation Facilities.* Raise the sanitation service levels of a significant proportion of the population without proper sanitation facilities who rely on dry and unsanitary latrines in the urban area, and those who do not have latrines

[1] Dry nightsoil is referred to the waste obtained from non water flush type latrines (i e both feces and urine)

in their houses and rely primarily on public latrines.

2. Technical Options and Other Improvements

Project Preparation

Proposals for improvements have been developed by the study team based on the data and analysis of existing and projected situations. Discussions were held with each city, notably the Sanitation Bureaus (who are the primary government agency for the sanitation and nightsoil service in each city).

Each project city had previously prepared its own (broad) plans for development and improvements, which have been reported to the World Bank project preparation missions, with the intention of seeking funding assistance for their programs Each city's program must be submitted to the higher city authorities for approval, including to the City Planning and Finance Departments and City Project Office, before a commitment by the city for its proposed plans is made. During preparation of the proposals for improvements, the study team held discussions with the Sanitation Bureaus, Construction Commissions, project offices, and based the required improvements on the cities' proposals

Technical Options

The proposed sanitation improvement options considered for an investment program include.

1 public latrines (conversion from dry to water flush latrines as well as construction of new latrines),

2. nightsoil storage tanks;

3. vehicles for sludge and nightsoil waste transport (vacuum trucks) and garage space and minor equipment,

4. nightsoil and sludge treatment,

5. construction of improved septic tanks to serve local areas;

6. lower cost water borne (small bore) sewers;

7. health and sanitation promotion program to improve hygiene behaviors; and

8. institutional and staff resource development.

These items have been assessed on a needs basis. However the total program in each city has been evaluated on a financial affordability basis and not all items are included in each city's program due to financial limitations. Each of the option is discussed in greater detail below.

1. Public Latrines.

Due to the relatively large number of residents still relying on public latrines (including dry latrines) as their only sanitation facility, one of the highest priorities is in conversion of dry public latrines to water flush type, including provision and/or improvement of septic tanks and effluent disposal. **The most urgent and first stage priority is for the conversion of dry latrines located in the central urban areas.**

In addition, the financial analysis in this study has shown that there is a potential revenue source (which is not being fully realized) from public latrines. In view of the cities' proposals to continue to provide new public latrines as part of the future development of the city, it is appropriate to provide a small number of new latrines within this investment program, and develop a better financial management system to recoup some of the operational expenses.

2. Nightsoil Storage Tanks

The present system in each of the four project cities includes a number of nightsoil storage tanks which are used for emptying sludge wastes from public latrines (and some private septic tanks). The storage tanks are designed as holding tanks to allow sludge to digest and make treated waste available to farms.

In practice however **the existing storage tanks are not operated adequately** and for several reasons, farmers are unable to obtain safe treated wastes. The reasons include:

- nightsoil and sludge from septic tanks have been diluted as public latrines have been converted to flush latrines;

- there is no control on collection from the tanks; sludge is collected as a slurry and combined with both the liquid and sludge wastes and there is little

time for the digestion process to take place properly; and

- the tanks are located primarily in urban areas and are too distant from the farming areas

To provide improvements so that wastes are both treated safely and are of suitable organic nutrients, it is proposed that nightsoil storage tanks be modified and collection from the tanks controlled to allow digestion and treatment to proceed The storage tanks should be located close to the farming areas for more convenient transport to the farms The proposed storage tank design is based on a compartmental arrangement. Each compartment in the tank will hold one week supply of sludge/nightsoil which will be left to digest for one month. Removal (i e., use by farmers) will be allowed only after the one month digestion period has elapsed The proposed pilot activities (refer Annex 5), which is part of this study, are attempting to define the optimum digestion period.

3. Vehicles for Nightsoil/Sludge Collection

Due to the fact that the majority of septic tanks are not connected to a water borne sewerage or drainage system, removal of septic sludge from both public and private septic tanks and nightsoil storage tanks is by vacuum trucks and disposed to various outlets. Vehicle resources are extremely limited and in poor working condition Existing vehicle resources are inadequate to transport the sludge volumes generated from public latrines and cannot provide adequate disposal service for any additional sludge removal and septic tank cleaning required from private locations.

4. Nightsoil and Sludge Treatment

Under the existing sanitation system, not all nightsoil and septic tank sludge wastes can be used as agricultural fertilizer. There may not be sufficient demand and cost of transportation may be too high in some areas. Consequently to maintain a collection and disposal service, facilities should be provided for discharging the wastes Only small volumes of sludge wastes can be disposed into the piped sewerage/drainage system in view of the high content of harmful bacteria and pathogens in the sludge wastes.

There are several options to provide additional treatment capacity for septic sludges, including:

- additional treatment at (future) sewerage treatment plants,
- co-composting facilities with solid waste to reuse the wastes with potential income generation through sale of compost; and
- treating in nightsoil storage tanks.

It is understood that the proposals within HUEP may not include sewage treatment, although this does not mean that sewage treatment in the future will not be provided. In view of the long lead up time for any future treatment plants (particularly secondary and tertiary treatment), co-composting can provide a means of disposing safely of some of the nightsoil and sludge wastes as well as provide a useful agricultural fertilizer. Even though the revenue from sale of compost is unlikely to cover all costs of co-composting operations, it could recover some costs and at the same time provide a reusable resource In addition it also reduces the need (and capital expense) of any future sludge treatment at the sewerage treatment plants.

Previous attempts at co-composting have been attempted in several of the project cities on a very limited scale but without success. At this stage of the co-composting development technology, there is little evidence at present of successful co-composting operations in China as whole. The proposed pilot activities undertaken in this project will be able to provide technical solutions and more accurate parameters for the co-composting process suited to the type and composition of the nightsoil and solid waste in the project cities. Furthermore, the findings of this study indicate that there is a market demand for co-composted material in the peri-urban areas of the cities, suggesting that co-composting may be a viable and useful option.

5. Improvements to Septic Tanks and Local Treatment

Many buildings have improper wastewater disposal facilities; wastes are often discharged into open drains or into open areas adjacent to buildings, creating unhygienic situations. This applies particularly to the older areas, where water borne sewerage and drainage systems have not been provided.

A simple system of collection leading to a communal septic tank capable of providing relatively clean effluent could provide significant sanitation improvements to these areas. Costs of providing such a system could be shared by the city and local residents, the latter being responsible for the latrine connections from the buildings to the pipe system plus labor for the pipe installations, while the city would provide the collection pipe materials and costs of constructing the septic tank. The improved septic tank

required would have a capacity to treat volumes serving resident populations in the order of 500 to 1,000 persons and could reduce BOD by as much as 70% from the influent BOD loading Effluents with such a reduced septage content could be discharged into open drains providing significantly improved sanitation. To provide this level of treatment and maintain economic sizes of tanks, the septic tanks need to be provided with an additional treatment stage, such as baffled reactors or anaerobic filters (refer Figure 1 and 2). The pilot activities (refer Annex 5) include the construction and monitoring of these types of septic tanks to test and improve their design and operations

6. Lower Cost Water Borne Systems

In areas which may be difficult to service a sewerage system, one option may be to provide a small bore sewer system by converting the septic tanks to the holding tanks and discharging into the pipe system. A number of areas appear suitable for this, including in Huangshi where the hilly terrain makes it difficult to interconnect sewerage distribution network system. However, in view of the financial limitations on the total costs of the investment in each city, this item is seen as a lower order priority and has not been included in the program at this stage. Furthermore, in discussions with the City Sanitation Bureaus, there appears to be a reluctance to accept the degree of maintenance required for this system, particularly maintaining the holding tanks.

7. Hygiene and Sanitation Promotion Programs

The study findings (refer Annex 2) indicate that in communities involved in handling untreated nightsoil there is a need for improved hygiene practices to reduce the incidence of disease. The details of a hygiene and sanitation promotion program are given in Part 2 Appendix 6).

8. Institutional Development

The proposed investment items will require improved management as well as additional resources (both labor and equipment) to operate and maintain. Additional funds will need to be provided for operation and maintenance of the new and additional equipment and facilities, including supervisory checking, control of both construction and operation of facilities, and management tasks

Required Improvements

To provide the above improvements, the following specific items and their (approximate) priority of needs are:

Huangshi

1. Conversion of Dry to Wet Public Latrines. Basic improvements to the unsanitary conditions at dry public latrines is considered a high priority and accords with the city's development plans. It is understood that Huangshi have attempted to carry out this conversion but due to limited finances only a few latrines have been converted each year. There remain 40 dry public latrines in the urban area of Huangshi, but due to limitation of local counterpart funds it is proposed to convert only half of these remaining latrines (i.e., 20 latrines) in the proposed project. The priority will be in the center of the urban areas and areas with poor sanitation service.

2. Vacuum Tankers. The projected volume of nightsoil sludge generated is approximately 80 to 90 tons per day, including 40 tons per day from public latrines. Based on a minimum of two septic tank cleaning trips per day per truck, and allowing for additional private and other demand, there is a requirement for 8 trucks with 5 tons and 4 trucks with 2 tons capacity (the 2 ton trucks are needed in more constricted areas and for smaller loads).

The existing garage at the Sanitation Bureau's vehicle depot is very small and will not be able to provide sufficient space or equipment facilities for the additional new vehicles. Funds are proposed to cover additional garage space (including for land acquisition) and minor repair and service equipment.

3. Provision of Nightsoil Storage Tanks. Treatment (i.e., digestion) of nightsoil should be provided in locations where it may be used conveniently by farmers. Discussions with the Sanitation Bureau indicated that there is a need for a conveniently located storage tank. However due to limitation of funds, the city officials indicated that they prefer to rehabilitate the existing storage tank on their own rather than include it in the investment proposal.

4. Septic Tank Improvements. Total number of septic tanks in Huangshi is estimated to be approximately 1,200 by the year 2000. Similar to Yichang and Xiangfan, it is recommended that septic tanks at public places (schools, public areas, etc.) should be improved where they are functioning inadequately. A nominal number of 10 septic tanks is proposed.

5 Nightsoil Treatment. It is recognized that not all nightsoil can, or will be, utilized in agriculture. With the proposed sewerage system to be implemented in Huangshi, the nightsoil collection should be taken to a sewage treatment plant rather than be disposed into

sewers or drains For this, an additional nightsoil treatment facility could be added and provided in the proposed sewage treatment plant. Treatment capacity required for the balance of the nightsoil volume generated but not disposed to farms and other means is estimated to be 40 tons per day.

Discussions with the city authorities indicated that they would like to provide a nightsoil and solid waste co-composting plant but it does not rank high in this investment proposal. They are, however, undertaking the pilot activity of co-composting (refer Annex 5 - pilot activity number 9 for Huangshi) and with further insight into its process and results they will develop their own treatment at a later stage

Xiangfan

1 Conversion of Dry to Wet Public Latrines. Similar to Huangshi, the first priority is seen to be the conversion of all the 34 dry to wet public latrines in the urban areas, with the highest priority being in areas where these are used by residents without private latrine facilities. This is in accordance with Xiangfan's own development plans as well the study team's assessment of the lack of adequate sanitation facilities in many urban areas.

Based on financial considerations, it is considered that Xiangfan's local counterpart funding will not be able to sustain a large or significant nightsoil program and, consequently, only 20 latrine conversions are proposed for Xiangfan's nightsoil program.

The study team has found that there is a need for other items for the investment program, including vacuum tankers, nightsoil storage tanks, septic tank improvements, nightsoil treatment The city officials indicated that these items could not be considered at this stage in view of the financial limitations largely due to difficulties of providing the matching local counterpart funding. Consequently they are not included in the program.

In view of the fact that Xiangfan has proposals for a sewerage treatment plant in the near future, it is appropriate that additional sludge treatment capacity be provided at the treatment plant for disposal and treatment of septic tank sludge.

Xiangfan had proposals of its own for treatment of nightsoil (co-composting) as part of its own development program. This may now be delayed, but not necessarily ruled out in the future.

Yichang

1. Conversion of Dry to Wet Public Latrines. Among the highest priorities is conversion of all the dry to wet public latrines (total 40). The city's own proposals include the conversion of all public latrines This is considered by the city authorities a high priority in view of the anticipated growth in the city's population as well as the "floating population" due to the Three Gorges Dam project and Yichang's tourism potential. However, the present project proposals will be limited to 20 latrine conversions due to financial limitations.

2. Vacuum Tankers. To provide transport facility for a projected volume of nightsoil sludge of approximately 80 to 90 tons per day, including 35 tons per day from public latrines, the total transport facility required is based on assuming two septic tank cleaning trips per day It is recommended that trucks be used exclusively for the latrine operation and the hand carts be slowly phased out. Total truck capacity requirement would be 40 to 50 tons per day. To allow for some additional private septic tank cleaning capacity, total requirement would be 4 trucks x 5 tons, plus 6 trucks x 2 tons capacity. The 2 ton capacity trucks can be used in narrow and congested areas. Based on a financial assessment it is considered that half of this amount could justified for the investment program and consequently proposals will be for 2 x 5 ton and 3 x 2 ton vehicles.

3. Provision of Nightsoil Storage Tanks Treatment (i.e., digestion) of nightsoil should be provided in areas where it may be used conveniently by farmers. It is recommended that one storage tank be provided in areas to serve the agricultural district - in the south of the city along the Yangtze River bank and east of the central city areas Approximately half of the daily demand of 40 tons of nightsoil and septic tank sludge (total 20 tons) is to be included in this proposal, i.e. approximately 600 cu.m. capacity tank will be required based on one month storage of the septic wastes.

4. Nightsoil Treatment. With the proposed sewerage system to be implemented in Yichang, the nightsoil collection could be taken to a sewerage treatment plant rather than be disposed into sewers or drains. However, since sewerage treatment is unlikely to be provided in the near future, emphasis should be placed on treating nightsoil and sludge and providing it for agricultural use. A treatment capacity for co-composting of 20 tons per day is proposed. It is also proposed that nightsoil co-composting could provide treated nightsoil to serve some of the agricultural demand for fertilizer and compost

3. Project Costs and Implementation

Nightsoil Component Project Costs

The total estimated cost of the nightsoil component in Huangshi, Xiangfan and Yichang is RMB 18.9 million (US$ 2.2 million)[2] Of this sum, approximately RMB 16.8 million (US$ 1.93 million) is estimated to be local costs and RMB 2.1 million (US$ 0 24 million) to be direct or indirect foreign exchange costs. Base costs are presented at December 1994 prices. A physical contingency of 15 per cent has been added to all costs. Design, supervision and management costs have been included based upon 12 per cent of the cost of civil works but not land Inclusion of the latter would tend to distort the relative provision between those elements requiring new sites and those where existing sites can be utilized No provision has been included for construction management as the component generally involves only small scale, low technology, construction

Price contingencies have been calculated on the basis of 2.2 per cent per annum for foreign costs and the following--1995 (14%), 1996 (10.6%), 1997 (8.5%), 1998 (7%), 1999 (6.5%) and thereafter (6 2%)--for local costs for all construction activity, including land acquisition. The Health Education component has been projected using the forecast general price escalation provision of 1995 (9%), 1996 (8%), 1997 (7.2%), 1998 and 1999 (6.5%) and 2000 (6%). These are in line with current Bank guidelines but look optimistic when compared with present performance and future Government projections.

It is understood that the Government of the Republic of China has indicated that it does not wish to avail itself of the facility to capitalize interest during the construction period A similar assumption has been made in relation to funds onlent. Accordingly no interest during construction has been included in the project cost table.

The estimated cost for the overall nightsoil component is summarized in Table 1. The rate of exchange used to convert local costs to US dollars is RMB 8.7 per US $1. Details of the proposed investment in each city are shown in Appendices 3-1, 3-2 and 3-3 and are consolidated for the three cities in Appendix 3-4. Appendix 3 also contains details of the estimated year by year disbursements for the individual elements of each city's physical action program. Additionally a breakdown of the cost of the proposals related to Health Education is provided in Appendix 6-2.

Implementation and Procurement

With the exception of preliminary design expenditure, investment is programmed to commence in 1996 and continue until the year 2000. As this design expenditure can be regarded as forming part of the local counterpart funding it is not anticipated that the presently proposed package will generate the need for any retroactive funding

The project items are to be implemented over the HUEP's five year period (1996 to 2000) Among the earliest items for implementation will be latrine conversion to be implemented in the first three years (in line with the Provincial Government's requirement to phase out dry public latrines in the next three years).

Nightsoil treatment (co-composting) plant and nightsoil storage tanks will also be implemented in the initial stages (first or second year) to achieve early benefit to the whole nightsoil operations. Items of a more general nature, such as vacuum trucks, improved septic tanks, public latrines, will be spread out over the five year period.

Contract Packaging

Implementation of the nightsoil component items will include detail engineering design, and contract document (for construction) preparation, physical construction and supervision, procurement of vehicles, as well as the preparation, implementation and monitoring of a hygiene and sanitation promotion program.

Detail Design and Contract Documents

Project detail design and contract tender document preparation is to be included in the scope of work of the second round of the project's consultancy work (presently planned in the 1995 year schedule). For the first year program of construction (planned start in 1996), tender documents and contract letting procedures must be completed prior to that start date.

[2] It is understood that Wuhan is proposing an investment program of their own at a cost of approximately RMB 9.9 million (US$ 1 1 million) which will be funded from their own sources and Wuhan will not seek World Bank financing for its nightsoil component

TABLE 1

HUBEI URBAN ENVIRONMENTAL PROJECT- NIGHTSOIL COMPONENT
OVERALL PROJECT COST SUMMARY

Item	(RMB Thousand) Foreign	Local	Total	($ Thousand) Foreign	Local	Total	Forex %
I. Base Costs							
PHYSICAL INFRASTRUCTURE							
Land Acquisition		322.00	322.00		37 01	37.01	0%
Civil Works	449 00	5,334.00	5,782.00	51.61	613 10	664 71	8%
Plant and Equipment	126 10	761.30	887.40	14 49	87 51	102.00	14%
Vehicles	826 50	3,314.50	4,141 00	95.00	380 98	475.98	20%
Design, Supervision and Management		749.30	749.30		86 13	86 13	0%
Sub Total	1,401 60	10,481.10	11,881 70	161 10	1,204 72	1,365.83	12%
HEALTH EDUCATION							
Hygiene/Sanitation Promotion		850.00	850 00		97.70	97.70	0%
Sub Total - Base Costs	1,401 60	11,331.10	12,731.70	161 10	1,302.43	1,463.53	11%
II. Contingencies							
(a) Physical Contingencies	210 00	1,699.00	1,909.00	24.14	195.29	219 43	11%
(b) Price Contingencies	532.00	3,780 00	4,312 00	61 15	434.48	495.63	12%
Sub Total - Contingencies	742 00	5,479 00	6,221.00	85.29	629.77	715.06	12%
III. Interest During Construction							
Total PROJECT COST	2,143.60	16,810 10	18,952.70	246 39	1,932 20	2,178 59	11%

Exchange rate 8 70

Physical implementation works will include:

- civil works (LCB), and
- vehicle and equipment procurement.

Civil Works. This will include the construction of the following items:

- latrine conversion (septic tank installation and discharge pipework, provision of plumbing and water supply, modification and improvement of architectural and furnishing items);
- -new public latrines,
- -improved septic tanks;
- -nightsoil treatment facility;
- -nightsoil storage tank, and
- -vehicle garage /workshop improvements.

It is proposed that the civil works contracts be made as one contract for each year in each city. That is, a total of 13 civil works contracts for the three cities of Huangshi (5), Xiangfan (3) and Yichang (5) The value of each contract is within the LCB range of contracts for civil works. Construction of the nightsoil component items involves relatively straightforward techniques and is within the capacity of local contractors.

Vehicle and Equipment. Items will include procurement of vacuum trucks (de-sludging trucks), as well as procurement of minor vehicle servicing equipment

Hygiene and Sanitation Promotion and Monitoring Program

Hygiene education and promotion program is proposed for the four project cities. The program is considered to be of more general benefit to the public, not only to the nightsoil exposure groups, and can therefore be applied to a wider community, not only in the project cities but on a provincial basis at a later stage It is therefore appropriate to have execution of the hygiene and sanitation program by a central provincial authority such as the Hubei Provincial Institute of Health Education (HPIHE) in collaboration with the City Sanitation Bureaus (refer Appendix 6). Monitoring and evaluation of the hygiene program's results can be carried out by a qualified institution such as the Hubei Academy of Medical Sciences and also in conjunction with the City Sanitation Bureaus. Design of the program (preparation of specific topics, preparation of graphic material and literature, and printing) is to begin in the first year of the project, with implementation (training of trainers and field workers, distribution of material), in the following second and third years, followed by monitoring and evaluation thereafter.

The contract packages proposed will be

Item	No	Value per Contract (RMB million)	Type
Design/Tender Docs.	1	—	2nd Consultancy Project Prep'n.
Civil Works	13	<2 0	LCB
Vehicles/Equip.	5	1.0 to 1 5	DC or IC
Hygiene/Sanit. Promotion	1	1.2	by Provincial Institute + ESB's

Land Acquisition

Some land acquisition will be required for the construction of new public latrines, nightsoil storage tank and vehicle garaging. However the areas required for each item are small; they can be located with some flexibility to avoid major land acquisition problems. Although actual locations have not yet been selected, it is not anticipated that any resettlement will be involved.

4. Financial and Economic Evaluation

Introduction

The main benefits to be achieved from the proposals for the nightsoil component are improvement in health and environmental conditions, and are directed particularly towards the lower-income communities. The economic benefits, include improved health and thus less call on medical services, improved productivity resulting from less lost time due to illness, improved amenity and increased land values resulting from a reduction in pollution. While such benefits can clearly be identified, quantification of their value is difficult. However the proposals will also include financial impacts (latrine user fees, charges for septic tank cleaning, and income and expenditure. This chapter outlines the financial impacts and analysis of the investment proposals

Financial Status of Cities

Based upon historical data provided by each of the project cities for the period 1991 to 1994, cash flow statements have been prepared. These are attached as Appendix 1 The nightsoil activity, both existing and proposed is small in the context of overall city activity. Evaluation of the past management of the nightsoil service would appear to indicate that not only is there scope for operational improvements but little effort has been made to optimize on the financial management of the service, and hence minimize on the costs to be borne by general city revenues. The analysis which follows focuses on three aspects:

- status of each city's finances in the historic perspective;
- basis upon which future projections have been made; and
- assumptions and methodology adopted in preparing total value of the proposed nightsoil component

Historic Perspective

During the study's evaluation and assessment of the city and particularly City Sanitation Bureaus finances, two factors became apparent. First, there was limited availability of data through which to validate the apparent financial status of the cities, and second, the practice of significant "off-budget" activity is taking place, which limits the conclusions that can be drawn from the data provided. Notwithstanding these limitations, however, a number of observations can be made.

Through the period 1991 to 1994 both Huangshi and Yichang appear to have been running an annual deficit. In Huangshi growth in income has been of the order of 7% while expenditure has escalated at around 15% per annum. Xiangfan exhibits the reverse characteristics with income growing by almost 17% per annum and expenditure increasing at less than 4% per annum. Yichang, during this period has maintained greater equilibrium but remained in deficit in 1993 and budgeted for a deficit in the 1994 figures. Allowing expenditure to increase significantly in advance of income clearly cannot continue in other than the short term Local government revenues have increased much slower than personal incomes or personal savings in the recent past and there is evidence to suggest that a review of the sources of revenue available to municipal government and the efficiency of their administration is required

Forward Projections

Given the relatively short profile of past activity there are few guidelines to indicate reasonable assumptions on which to base future projections. Clearly taxes and charges need to be escalated at or above the forecast rate of inflation if even the status quo is to be maintained. The growth in city populations will in many cases increase the tax base, either directly or indirectly. Equally any increase in expenditures in excess of those predicted for income will accelerate the worsening financial picture.

Forward projections have been made of the "without project situation". In each city the base year (1994) situation has generally been preserved by increasing both income and expenditure (1996 onwards) by assumed rates of inflation together with a growth factor for each city. Not surprisingly those in deficit in 1994 remain so, while Xiangfan continues to make modest surpluses Taxes and charges (items 2 to 6 in Appendix 1) have generally remained neutral in their overall impact and have not been included in the process outlined above. They have been increased in line with past profiles or retained at much the same figure as in the base year. They are not in any event significant in overall terms.

The Nightsoil Component

The "with project" situation has been projected based on the following assumptions and criteria

It has been assumed that the necessary equity will be provided out of recurrent revenues and accrued balances. A loan/equity split of 50/50 has been adopted, the equity being drawn from the cities general revenues. Subsidiary loan terms of a 15 year loan, including a five year grace period, an interest rate of 7.09 % per annum. Commitment charges of 0.75% on the undrawn balance of the loan and the foreign exchange risk, simulated by using a deflator of 60% of the inflation differential have been allowed for. Provision has been made for incremental operating costs calculated in relation to each particular element, eg, latrines, vehicles, etc. (refer details in Appendix 4).

The relative small size of the nightsoil component in the context of overall city scale activity has been referred to earlier It has been suggested by various city and project officials that capital receipts from the sale of land may be available to partially or wholly defray the cost of the counterpart funding requirements

Project revenues are shown based upon an assessment of what might reasonably be recovered, even within the limitations of the present tariff rates. It should be stressed that these are substantially in excess of what is currently being collected and accounted for. Project revenues have been assumed to increase in line with the general rate of inflation but one to two years deferred. A fuller discussion on the issue of charges and revenue generation is provided later in this chapter.

It will be seen that **projected revenues could meet a major proportion of operating costs** and would, if subjected to only modest improvements over the medium term, fully recover such costs. Using Huangshi as an example, in the year 2001 situation about 50% of operating costs will being recovered (RMB 1.43 million compared with RMB 2.96 million). If increases in revenues (such as through better management and more efficient application of user charges) could result in 10 per cent per annum increase on both new and existing assets, then operating costs will be recovered in about five years Given the nature of the service and its focus on the poorer sections of the community it would seem acceptable that the balance of the cost (debt charges) should be met from general city revenues.

Co-Composting Production

The Project includes proposals to establish co-composting production in Yichang using a blend of nightsoil and solid waste. A preliminary review of the economics of this activity at varying levels of production has been carried out and compared with data derived from a survey of potential users. Details of the estimated costs are shown in Appendix 5. The potential users survey carried out, indicated a willingness to purchase compost, of a suitable quality, at between RMB 40 and RMB 50 per ton which is more than the operating and establishment costs. Although we can assume that there may be other factors which will reduce the financial viability (such as smaller market for co-compost at various times of the year) it can be seen that the operation has the potential for reasonable financial returns. Since previous experience with composting of solid waste in other countries and other cities in China indicated it is difficult to produce a financially viable operation, we should apply some caution to the financial projections.

The aim in this project should not be pure financial gain, rather it should aim to reduce the amount of harmful nightsoil and sludge to be disposed (and a potential cost of such disposal) and at the same time provide a useful fertilizer for which perhaps some costs of the co-composting operations can be recovered. Then from this perspective the co-composting proposals can be considered to be economically viable.

Nightsoil Storage Tanks

The project contains proposals to establish nightsoil tanks in order to retain sludge for a period (approximately one month), before making it available to farmers. If supported by measures to restrict access to untreated nightsoil it should significantly reduce the risks inherent in handling raw nightsoil. If historic costs only are recovered and demand is sufficient to absorb all of the supply available a break-even charge of approximately RMB 13 would be required (see Appendix 5 for details). If a replacement cost basis was adopted this figure would increase to around RMB 17 per ton. The economic and market survey (Annex 4) carried out in Wuhan and Huangshi indicated a relatively robust demand for the product, particularly if delivered to the point of use A sale price of between RMB 25 and RMB 30 per ton would appear feasible.

Income and Expenditure of City Sanitation Bureaus/Departments

Sanitation Bureaus/Departments generally form only a part of larger operating units. Accordingly little financial insight can be gained from the review of published data. Efforts have been made to identify and analyze historic cost data for sanitation, the results of which are shown in Appendix 2. The most salient features to emerge are briefly discussed below.

Income

Latrine charges produce only a fraction of the revenue that might be expected. There may be several reasons for this Not all latrines apply charges, eg., for dry latrines and for public latrines in some poorer areas where they are used as a sole source of sanitation facility for residents. There were no specific figures available from the cities, however, it is estimated that perhaps only one third to one half of the public latrines apply user charges. Latrine revenues are contracted to attendants for payment of a monthly figure to the Sanitation Bureau. However, little knowledge of the potential of many individual locations is held by those accepting bids It is believed that attendants are in some cases in receipt of incomes well in excess of that necessary to secure performance of the service.

Septic tank emptying fees feature in some cities while not in others. This could be a result of the way income is classified but is more likely to indicate that the service is not provided, or it is provided but not charged for

Expenditure

The items included in expenditure are not necessarily indicative of the real costs of providing the service. In Huangshi the cost of water, up to a ceiling figure, is not borne by the sanitation department whereas in Xiangfan the cost of water constitutes by far the largest single cost and appears excessive. Differing policies and standards related to the employment of latrine staff are pursued with the result that cross city comparisons cannot be made easily

Capital Expenditure

Although a policy of conversion from dry to wet latrines is being followed in each city this is probably the only consistent aspect of the profile of capital investment. In other respects, particularly in regard to vehicle purchase and replacement, spasmodic investment only is made. The most regular source of capital for investment is indicated as being budgetary allocations although Xiangfan did receive a substantial injection of funds from the Special Fund.

Conclusion

Based on the financial data and information obtained, and discussions with the City Sanitation Bureaus and Finance Departments, improved control over franchising out the management of latrines, a clearer policy in relation to the provision of septic tank emptying services and improved cost control in relation to expenditure could go a long way towards recovering the cost of the sanitation service.

Least Cost Solutions

One of the requirements stated in this World Bank's project preparation is to propose least cost options to serve as many beneficiaries. Proposals in the nightsoil component are typically based upon inexpensive, effective and technically feasible options available to the solution of specific conditions Latrine conversion rather than new construction forms the major part of the provision made for latrine facilities. Sunk costs are therefore utilized in expanding and upgrading the required level of provision Locational considerations determine the need to construct new facilities in a few key areas. A range of septic tank options is proposed relative to given ground and local conditions, the least expensive suitable option being intended for use as appropriate. Furthermore, areas selected for the construction of local treatment facilities will be limited to those outside the catchment of existing and proposed main sewerage networks, thus ensuring the maximum economic life for such facilities. The recycling of nightsoil and its subsequent re-use by farmers seeks to introduce only the minimum standard of improvements required in order to secure adequate safeguards to health. Finally the composting components will be guided by the findings of a pilot project intended to demonstrate and validate the minimum levels of treatment necessary.

Household and Individual Affordability

Public Latrines

All project cities apply fees for selected public latrines. However, the fee charges vary according to several considerations. Typically in low income areas where public latrines are the only sanitation disposal facility for residents in a neighborhood area, no charges are levied. Similarly for dry latrines where service provided is of low standard, fees are not applied. In other areas such as commercial, and public use areas, fees are generally RMB 0.2 per visit and in some few cases where service is of a high standard (such as Class 1 latrines) fees are RMB 0.3 per visit. Furthermore the use of free latrines at the workplace, schools, etc., and in house means of providing temporary sanitation facilities, requiring only disposal facilities at intervals, ameliorates the demand for the use of public latrines to a considerable degree Even at these modest charges it cannot be considered that using public latrines as sole means of sanitary facility is affordable to the lower income community (for a family of four persons, it would represent almost 5% of an estimated monthly income of RMB 500).

Charges levied for public latrines would therefore be viewed from a provision of a public facility to be provided at communal places and areas of public congregation, commercial centers, etc. Data obtained from the cities does not provide details of how much users of public latrines might spend based on present charges, but experience in operating the latrines indicates that charges levied are based on charges which the public at large is prepared to pay.

The main question of affordability and income is therefore more in the way of better and more efficient operation and contracting arrangements, to improve the cities income.

Sale of Nightsoil and Compost

The affordability of both treated nightsoil and compost appears to have been substantiated by the results of the survey of some 60 farmers and smallholders, carried out as part of this study (refer Annex 4). Although many farmers responded that they would prefer to obtain good inexpensive nightsoil, majority responses indicate a willingness to pay around RMB 20 per ton for good "fresh" nightsoil, up to RMB 25 per ton for treated nightsoil and for treated co-compost up to RMB 50 per ton. These results suggest a willingness to pay for a suitable nightsoil product. The results of the market survey indicate that in the peri-urban areas of the project cities, which contain many vegetable farms, there is a substantial market for treated nightsoil, including co-composted nightsoil. Even though the market survey was based on a relatively small sample, the significant positive response would indicate that the results can be extrapolated to other vegetable growing and farming areas in other parts the project cities.

The continued availability of unofficial supplies of nightsoil would clearly erode the ability to maximize supplies as well as reducing the sought after improvement in health. Steps should therefore be taken to reinforce the control of this aspect. Delivery to the point of use has been incorporated in the estimates of cost used to verify affordability. The survey results indicated that transportation difficulties were a constraint to increased sales. The tanker capacity provided for in the investment items should minimize this constraint in the future and facilitate sales growth

5. Institutional Arrangements

Existing Institutional Arrangements

The institutional structure and responsibilities for city sanitation, including nightsoil operations is similar in all the project cities (refer Appendices 7-1, 7-3 and 7-5 for overall city structure in the city sanitation operations) In each city the responsibility for sanitation work - wastewater, solid waste, street cleaning, nightsoil operations is under a Construction Commission or Bureau Below the Construction Commission, there are agencies responsible for specific sanitation aspects, which are described below. Each city has a specific city HUEP project office which is ultimately responsible to the city mayor although in practice a deputy mayor is typically assigned the prime responsibility for project approval. For solid waste and wastewater operations, separate autonomous companies are proposed to be established (and several have been established) to operate on commercial principles

Huangshi

In Huangshi responsibility for wastewater construction and maintenance is within the Public Works and Gardens Bureau and, in addition, the Huangshi Drainage Company (also under the Public Works and Gardens) has been established to develop the project's (and future) wastewater programs and to be responsible for all wastewater systems in Huangshi. Solid waste (including street cleaning) and nightsoil operations are within the Environmental Sanitation Bureau. Only in Huangshi are the sanitation operations at a bureau level. Nightsoil operations are primarily those of public latrine operations (including construction, operation and maintenance), maintenance of septic tanks (although this is limited in scope due to the bureau's small resources and mostly cleaning of septic sludges), maintenance of nightsoil storage tank (although it is now non operational), occasional transport of nightsoil and septic sludge to farmers.

Within the Sanitation Bureau the somewhat tenuous link between the solid waste/street sweeping function and that of nightsoil collection is already recognized through a sub division of these functions.

Xiangfan

Under the Construction Commission there is an Environmental Sanitation Department responsible for solid waste and nightsoil operations and an Urban Construction Bureau has responsibilities for wastewater construction and maintenance and other activities (water supply, gas, etc.) The newly proposed Xiangfan Municipal Urban Sewerage Administration Company is being established under the Construction Bureau The establishment of a solid waste company (to operate commercially and authorized to collect fees) is presently being considered and will be responsible for all solid waste services except street cleaning.

The Sanitation Management Office oversees present activities from collection through primary treatment and subsequent disposal.

Yichang

Nightsoil and solid waste collection are currently administered by the Environmental Sanitation Division of the Public Utilities Bureau Proposals for new Sewage Company and Solid Waste Disposal Company have apparently been shelved for the time being

Levels of staffing and the organizational arrangements at the Sanitation Department/Bureau level are shown for each city in Appendices 7-2, 7-4, and 7-6.

Main Issues and Findings

The main points revealed by a review of the organizational arrangements and main issues requiring attention and further improvement, in terms of better management are

Staff numbers in the three cities appear to be adequate for the present work responsibilities of maintenance and cleaning However the staff levels are geared mainly towards maintenance of public latrines, and transport operations The wider nightsoil operations covering collection and transport of nightsoil, servicing storage tanks, septic tank de-sludging, do not appear to have the same resource levels. The project's proposals for additional vehicles and facilities, would need additional staff and operating facilities.

The Sanitation Departments/Bureaus do not have a close link to the sewerage and wastewater service. There is a need to provide for more coordination and linkage, particularly for the septic tank cleaning, nightsoil and septic tank sludge disposal and treatment operations.

There is little evidence of any formal control or inspection on collection and use of nightsoil or sludge from septic wastes by private individuals for fertilizer use. In view of the study's preliminary findings that use of untreated nightsoil/sludge has a negative impact on health and hygiene, a major finding is that there is a need for more and better inspection and control of nightsoil use, and to promote the use of treated rather than fresh nightsoil for agricultural uses. This would lead to an added responsibility within Sanitation Departments for inspection and control processes.

Guidelines for the Modification of Institutional Arrangements

There is no model for the administration of environmental services in nightsoil operation and management, such as there are for everyday services of water supply, sewage collection and treatment, solid waste management

Nightsoil operations in the urban context are seen as being of a "temporary" nature, as increasing urbanization and development of water borne wastewater disposal gradually squeeze out the simple sanitation service based on nightsoil collection and disposal. The increasing linkage between nightsoil collection and increasing service provided by sewerage and drainage networks is compatible with the early association of the management of these functions.

Furthermore both solid waste and nightsoil operations rely on the truck transport facility for collection and disposal and this creates an operational link between solid waste and nightsoil. Vehicle operation, maintenance and repair would almost certainly be better provided through central workshop facilities for both solid waste and nightsoil.

There are, therefore, good arguments for institutional arrangements for nightsoil to be linked to both solid waste as well as wastewater operations and management.

However, given that in all project cities the size of the nightsoil operations (even after the proposed project is implemented) are relatively minor compared to wastewater and even solid waste, it is not considered appropriate, in the immediate stages, to consider any major modifications to the institutional arrangements such as recommending a shift of responsibilities for nightsoil operations away from the existing Sanitation Departments/Bureaus.

Broad Recommendations

The proposed project items will incur a need for additional staffing and resources. However, in addition, two broad directions for recommendation are given at this stage of the study regarding the institutional arrangements and management. These are described below.

Closer Linkage to Sewerage/Wastewater Activities

Where the nightsoil activity is currently managed separately from the wastewater activity serious, consideration should be given to integration of institutions responsible for these linked activities, ultimately phasing out the former institutions and providing a comprehensive wastewater conveyance and disposal system. In the present situation where nightsoil operations consist of both public latrine, septic tank maintenance as well as collection, storage and delivery of nightsoil to farmers, then the present responsibility arrangement (i.e. Sanitation Bureaus responsible for all nightsoil operations) should remain. **However as the nightsoil operations of nightsoil collection, etc., are gradually phased out (which will**

occur with increasing urban development and conversion of dry to water flush type public latrines) then the nightsoil management activity should in the future be placed under the same control as wastewater services.

Septic Tank De-sludging and Potential for Privatization

As discussed in earlier sections there is a need to improve and increase the capacity of the septic tank cleaning service A large majority of residents rely on septic tanks for disposal of wastewater. In many cases septic tanks are not functioning effectively due to overloading, lack of maintenance and regular sludge cleaning, resulting in septic tanks not providing any treatment to the waste effluents. In areas where septic tanks are not connected to the sewerage system or regular underground drainage, wastes are often discharged into open drains and streets creating unsanitary conditions These problems have been highlighted in this report (refer Annex 1)

The Sanitation Departments/Bureaus are ill equipped to provide the necessary services to maintain and clean septic tanks as required Improvements to the septic maintenance operations will require not only an increase in Sanitation Departments' resources but must be accompanied by regulatory, and inspection arrangements as well as mandatory maintenance by the public for all private septic tanks In this respect it is appropriate to consider privatization aspects for septic tank cleaning for each city in the future to improve efficiency of operations, thereby reducing the burden on the cities' limited resources.

Although municipal building and hygiene controls on septic tanks and their operations are in place, they do not appear to be followed, or the controls and regulations are not strong enough to restrict improper and unhygienic discharge of wastewater.

For privatization to be effective these legal and supervisory controls must be in place and must be followed. In the project cities as stated above although various regulations and controls exist they must be strengthened to provide the following minimum and effective controls:

- *Legal Provisions.* To enable satisfactory standards of hygiene to be observed, adequate and enforced legal provisions should be clearly enacted and publicized, including designation of ownership, responsibility for septic tanks, degree of sanitation levels tolerable in a community.

- *Compliance with Building Codes.* The municipality should have both the authority and resources to check and control construction of septic tanks and drainage systems to the required standards for buildings.

- *Hygiene Monitoring.* Regular monitoring and recording of septic tanks and drainage systems to check effluent and discharges for compliance with bacteriological and chemical standards. To ensure a fair approach to residents, the hygiene monitoring should be carried out by an agency different to the one responsible for enforcing the provisions. A common system in other countries is for the Health Departments to monitor and report sanitation misdemeanors, who will report their findings to the Wastewater or Sanitation Department; it will be the responsibility of the wastewater or sanitation department to enforce corrective measures on the public.

If this control and supervision is improved and implemented, there is considerable potential to promote a private septic tank cleaning and sludge removal system for each of the project cities, which could follow similar and successful practices in other countries and cities where municipal authorities contract out septic tank cleaning operations.

HUBEI ENVIRONMENTAL PROJECT

PROJECTED CASH FLOW STATEMENT

TOWN HUANGSHI

(YUAN '10,000)

	1991 (Actual)	1992 (Actual)	1993 (Actual)	1994 (Budget)	1995	1996	1997	1998	1999	2000	2001
INCOME											
1 COMMERCIAL AND INDUSTRIAL TAXES											
Production and value added tax	21,876	23,350	24,151	25,420	29,848	33,818	37,619	41,460	45,266	49,421	53,958
Sales tax	5,095	5,634	6,789	4,140	4,861	5,508	6,127	6,752	7,372	8,049	8,788
Urban construction and Maintenance tax	2,073	2,471	3,046	2,430	2,853	3,233	3,596	3,963	4,327	4,724	5,158
Other taxes and Charges	2,829	3,368	4,660	5,880	6,904	7,823	8,702	9,590	10,471	11,432	12,481
Sub-Total	31,873	34,823	38,646	37,870	44,467	50,381	56,044	61,766	67,436	73,627	80,386
2. AGRICULTURAL TAX	524	568	624	1,229	1,250	1,275	1,300	2,500	2,600	2,700	4,000
3 LAND USE TAX	217	81	230	209	200	200	200	200	200	200	200
4 TAX AND PROFITS-STATE OWNED ENTERPRISES	3,239	3,757	2,831	3,535	3,340	3,340	3,340	3,340	3,340	3,340	3,340
5. SUBSIDIES TO STATE ENTERPRISES	(5,377)	(5,501)	(6,454)	(5,695)	(5,757)	(5,757)	(5,757)	(5,757)	(5,757)	(5,757)	(5,757)
6 OTHER INCOME	1,260	1,315	1,458	1,780	1,958	2,115	2,284	2,467	2,664	2,877	3,107
7. PROJECT REVENUES						10	22	47	76	102	143
Sub-Total	(137)	220	(1,311)	1,058	991	1,183	1,388	2,796	3,122	3,462	5,033
Total Revenue-Own Sources	31,736	35,043	37,335	38,928	45,458	51,564	57,432	64,562	70,559	77,089	85,418
GOVERNMENT GRANTS,LOANS AND OTHER											
Provincial Government	3,408	3,658	3,508	3,508	3,500	3,500	3,500	3,500	3,500	3,500	3,500
Other	402	616	510		550	550	550	550	550	550	550
Project Loan						145	175	178	100	76	
Sub-Total	3,810	4,274	4,018	3,508	4,050	4,195	4,225	4,228	4,150	4,126	4,050
Grand Total-Revenue	35,546	39,317	41,353	42,436	49,508	55,758	61,657	68,791	74,708	81,215	89,468
EXPENDITURE											
RECURRENT											
State owned Enterprises	484	880	642	1,625 }							
Scientific Projects	162	393	289	184 }							
Direct Fund for Agriculture	1,146	927	1,334	1,300 }							
Forestry, Industry,Transport	1,171	1,245	1,455	885 }							
Science - Other Departments	495	560	772	768 }							
Culture , Education and Public Health	5,825	6,811	7,713	13,528 }							
Youth Employment	46	34	37	}	67,136	76,065	84,642	94,223	104,008	113,802	124,547
Welfare	398	424	536	546 }							
Price Subsidies	866	553	30	}							
City Maintenance	2,022	1,847	2,695	2,499 }							
Payments to higher authorities	20,275	21,722	22,478	23,541 }							
Other costs (incl Sewage costs)	4,453	5,752	8,060	12,300 }							
Project Operating Costs						24	60	150	225	273	290
Sub-Total	37,343	41,148	46,041	57,176	67,136	76,089	84,702	94,373	104,233	114,075	124,837
Debt Charges											
Debt Charges-Existing											
Debt Charges-Project (Incl Commitment Chgs)						10	20	31	40	46	114
Provision for foreign exchange risk						1	3	6	10	13	38
Total Recurrent Expenditure	37,343	41,148	46,041	57,176	67,136	76,100	84,725	94,410	104,283	114,134	124,989
CAPITAL EXPENDITURE											
Development (non-project)						Included above					
Development-Project						269	350	357	199	153	
Other											
Total Expenditure	37,343	41,148	46,041	57,176	67,136	76,369	85,074	94,767	104,482	114,287	124,989
Balance In Year	(1,797)	(1,831)	(4,688)	(14,740)	(17,628)	(20,631)	(23,417)	(25,976)	(29,774)	(33,072)	(35,521)
Balance Brought forward	(784)	(2,581)	(4,412)	(9,100)	(23,840)	(41,468)	(62,099)	(85,516)	(111,492)	(141,266)	(174,338)
Balance Carried Forward	(2,581)	(4,412)	(9,100)	(23,840)	(41,468)	(62,099)	(85,516)	(111,492)	(141,266)	(174,338)	(209,859)
Ratios											
Debt service/Own Sources	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.1%	0.2%
Debt service/Total Revenues	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.1%	0.2%
Local Rev./Total Rev (excl Capital)	90.3%	90.5%	91.4%	91.7%	92.9%	93.6%	94.3%	94.9%	95.3%	95.7%	96.1%

HUBEI ENVIRONMENTAL PROJECT

PROJECTED CASH FLOW STATEMENT

TOWN XIANGFAN

(YUAN '10,000)

INCOME	1991 (Actual)	1992 (Actual)	1993 (Actual)	1994 (Budget)	1995	1996	1997	1998	1999	2000	2001
1 COMMERCIAL AND INDUSTRIAL TAXES											
Production and value added tax	37,612	43,665	56,135	61,749	71,925	82,282	91,531	100,876	110,137	120,247	131,266
Sales tax	12,676	16,102	19,422	21,364	24,885	28,468	31,668	34,901	38,105	41,603	45,423
Urban construction and Maintenance tax	3,292	3,774	4,744	5,218	6,078	6,953	7,735	8,524	9,307	10,161	11,094
Other taxes	3,935	3,593	4,222	4 644	5,409	6,188	6,884	7,587	8,283	9,044	9,874
Sub-Total	57,715	67,134	84,523	92,975	108,297	123,892	137,818	151,889	165,832	181,056	197,676
2. AGRICULTURAL TAX	4,394	6,198	6,059	6,665	7,398	8,212	9,115	10,118	11,231	12,466	13,838
3. LAND USE TAX	265	427	604	664	650	650	650	650	650	650	650
4. TAX AND PROFITS-STATE OWNED ENTERPRISES	7,247	6,606	6,417	7,059	5,829	5,829	5,829	5,829	5,829	5,829	5,829
5. SUBSIDIES TO STATE ENTERPRISES	(7,625)	(7,234)	(5,803)	(5,223)	(5,000)	(5,000)	(5,000)	(5,000)	(5,000)	(5,000)	(5,000)
6. OTHER INCOME	5,045	5,334	5,623	6,185	5,500	5,500	5,500	5,500	5,500	5,500	5,500
7 PROJECT REVENUES						5	11	23	50	75	103
Sub-Total	9,326	11,331	12,900	15,350	14,377	15,196	16,105	17,120	18,260	19,520	20,919
Total Revenue-Own Sources	67,041	78,465	97,423	108,325	122,674	139,088	153,923	169,009	184,092	200,576	218,596
GOVERNMENT GRANTS AND OTHER											
Provincial Government											
Other											
Project Loan						70	240	93	23	8	
Sub-Total	0	0	0	0	0	70	240	93	23	8	0
BALANCE BROUGHT FORWARD (previous years)											
Grand Total-Revenue	67,041	78,465	97,423	108,325	122,674	139,158	154,163	169,102	184,115	200,584	218,596
EXPENDITURE											
RECURRENT											
State owned Enterprises	2,108	1,546	1,959	2,155 }							
Scientific Projects	204	532	493	542 }							
Direct Fund for Agriculture	4,923	5,915	6,067	6,674 }							
Forestry, Industry, Transport	4,341	4,403	4,989	5,466 }							
Science - Other Departments	1,795	16,522	20,003	22,003 }							
Culture, Education and Public Health	20,207	24 396	29,351	32,286	106,715	122,082	135,804	149,669	163,409	178,410	194,788
Youth Employment	66	62	90	99 }							
Welfare	2,237	2,371	2,753	3,028 }							
Price Subsidies	4,213	2,230	1,840	1,656 }							
City Maintenance	3,362	3,458	4,227	4,650 }							
Payments to higher authorities				}							
Other costs (incl Sewage costs)	16,047	6,867	10,409	11,450 }							
Project Operating Costs						14	64	125	181	206	218
Sub-Total	61,525	68,302	82,161	90,009	106,715	122,082	135,804	149,669	163,409	178,410	194,788
Debt Charges											
Debt Charges-Existing											
Debt Charges-Project (incl. Commitment Chgs)						5	15	26	30	31	73
Provision for foreign exchange risk						1	2	5	7	9	24
Total Recurrent Expenditure	61,525	68,302	82,161	90,009	106,715	122,088	135,821	149,700	163,446	178,450	194,886
CAPITAL EXPENDITURE											
Development (non-project)						included above					
Development-Project						140	461	166	45	16	
Other											
Total Expenditure	61,525	68,302	82,161	90,009	106,715	122,228	136,302	149,866	163,491	178,465	194,886
Balance in Year	5,516	10,163	15,262	18,316	15,960	16,930	17,861	19,216	20,624	22,118	23,710
Balance Brought forward	0	5,516	15,679	30,941	49,257	65,217	82,147	100,008	119,224	139,848	161,966
Balance Carried Forward	5,516	15,679	30,941	49,257	65,217	82,147	100,009	119,224	139,848	161,966	185,676
Ratios											
Debt service/Own Sources	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Debt service/Total Revenues	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

HUBEI ENVIRONMENTAL PROJECT

PROJECTED CASH FLOW STATEMENT

TOWN: YICHANG CITY

(YUAN '10,000)

INCOME	1991 (Actual)	1992 (Actual)	1993 (Actual)	1994 (Budget)	1995	1996	1997	1998	1999	2000	2001
1. COMMERCIAL AND INDUSTRIAL TAXES											
Production and value added tax	33,327	38,336	48,215	65,585	77,010	87,252	97,059	108,969	116,789	127,510	139,216
Sales tax	14,569	16,062	20,964	9,000	10,568	11,973	13,319	14,679	16,027	17,498	19,104
Urban construction and Maintenance tax	3,726	4,267	5,221	5,721	6,718	7,611	8,467	9,331	10,188	11,123	12,144
Other taxes	5,049	4,818	5,607	6,100	7,163	8,115	9,027	9,949	10,862	11,860	12,948
Sub-Total	56,671	63,483	80,007	86,406	101,458	114,952	127,872	140,928	153,865	167,990	183,412
2. AGRICULTURAL TAX	2,865	3,366	3,469	3,733	3,994	4,274	4,573	4,893	5,236	5,602	5,994
3. LAND USE TAX	351	410	789	853	1,024	1,228	1,474	1,769	2,123	2,547	3,056
4 TAX AND PROFITS-STATE OWNED ENTERPRISES	4,345	4,550	3,799	4,104	4,200	4,200	4,200	4,200	4,200	4,200	4,200
5. SUBSIDIES TO STATE ENTERPRISES	(5,229)	(5,432)	(5,459)	(5,200)	(5,200)	(5,200)	(5,200)	(5,200)	(5,200)	(5,200)	(5,200)
6 OTHER INCOME	2,848	3,178	3,965	3,600	3,816	4,045	4,288	4,545	4,818	5,107	5,413
7. PROJECT REVENUES						5	11	29	50	68	104
Sub-Total	5,180	6,072	6,563	7,090	7,834	8,552	9,346	10,236	11,226	12,324	13,568
Total Revenue-Own Sources	61,851	69,555	86,570	93,496	109,292	123,504	137,218	151,164	165,092	180,314	196,980
GOVERNMENT GRANTS AND OTHER											
Provincial Government	14,872	15,173	13,799								
Other	1,401	26,807	5,702								
Project Loan						148	248	132	73	41	
Sub-Total	16,273	41,980	19,501	0	0	148	248	132	73	41	0
BALANCE BROUGHT FORWARD (previous years)	(2,548)			148	248	132	73	41	0		
Grand Total-Revenue	79,124	111,535	106,071	93,496	109,292	123,652	137,466	151,297	165,164	180,355	196,980
EXPENDITURE											
RECURRENT											
State owned Enterprises	7,282	8,203	9,772	11,025 }							
Scientific Projects	298	324	468	470 }							
Direct Fund for Agriculture	6,051	6,795	6,815	7,000 }							
Forestry, Industry,Transport	4,031	3,993	5,357	5,500 }							
Science - Other Departments	1,795	3,207	4,259	4,000 }							
Culture , Education and Public Health	18,102	21,621	27,721	33,000	116,276	131,741	146,549	161,511	176,338	192,526	210,200
Youth Employment	99	119	76	70 }							
Welfare	2,126	2,004	2,445	2,700 }							
Price Subsidies	3,586	2,442	1,772	1,600 }							
City Maintenance	3,507	3,487	3,892	3,800 }							
Payments to higher authorities	18,018	18,763	20,643	}							
Other costs (incl. Sewage costs)	15,426	18,873	27,083	29,861 }							
Project Operating Costs						16	100	154	263	302	321
Sub-Total	80,321	89,831	110,303	99,026	116,276	131,741	146,549	161,511	176,338	192,526	210,200
Debt Charges											
Debt Charges-Existing											
Debt Charges-Project (Incl Commitment Chgs)						10	22	34	41	45	109
Provision for foreign exchange risk						1	3	7	10	13	36
Total Recurrent Expenditure	80,321	89 831	110,303	99,026	116,276	131,752	146,574	161,552	176,389	192,584	210,345
CAPITAL EXPENDITURE											
Development (non-project)						Included above					
Development-Project						297	497	265	146	81	
Other											
Total Expenditure	80,321	89,831	110,303	99,026	116,276	132,048	147,071	161,817	176,534	192,665	210,345
Balance in Year	(2,197)	21,704	(4,232)	(5,530)	(6,984)	(8,396)	(9,605)	(10,520)	(11,370)	(12,310)	(13,365)
Balance Brought forward	0	(2,197)	19,507	15,275	9,745	2,761	(5,635)	(15,240)	(25,760)	(37,130)	(49,440)
Balance Carried Forward	(2,197)	19,507	15,275	9 745	2,761	(5,635)	(15,240)	(25,760)	(37,130)	(49,440)	(62,805)
Ratios											
Debt service/Own Sources	0.0%	0.0%	0.0%	0 0%	0.0%	0.0%	0.0%	0 0%	0.0%	0 0%	0.1%
Debt service/Total Revenues	0.0%	0 0%	0 0%	0 0%	0 0%	0.0%	0.0%	0.0%	0 0%	0 0%	0.1%
Local Rev./Total Rev (excl Capital)	79 2%	62.4%	81.6%	100 0%	100 0%	100.0%	100 0%	100 0%	100 0%	100.0%	100 0%

NIGHT SOIL ACTIVITY
(RMBx10,000)

CITY..... **HUANGSHI**

ANALYSIS OF INCOME AND EXPENDITURE

	1991 (ACTUAL)	1992 (ACTUAL)	1993 (ACTUAL)	1994 (BUDGET)
INCOME				
LATRINE CHARGES	0.8	3.0	6.0	8.0
SALE OF NIGHT SOIL }	10.0	10.5	11.0	13.0
FEES-EMPTYING SEPTIC TANKS }				
OTHER INCOME	0.0	0.0	0.0	0.0
1. TOTAL INCOME	10.8	13.5	17.0	21.0
EXPENDITURE				
SALARIES AND WAGES				
-Latrine staff	4.0	4.0	4.5	5.0
-Drivers	2.4	3.0	3.0	3.0
-Other	0.5	0.7	1.0	1.0
SUB-TOTAL	**6.9**	**7.7**	**8.5**	**9.0**
OTHER OPERATING COSTS				
VEHICLES				
-Fuel	1.5	2.5	2.8	3.0
-Repairs and maintenance				
-Other	1.0	1.5	2.0	2.5
SUB-TOTAL	**2.5**	**4.0**	**4.8**	**5.5**
WATER CHARGES				
ELECTRICITY				
OFFICE ADMINISTRATION				
OTHER	2.7	3.7	7.1	6.0
2 TOTAL OPERATING COSTS	**12.1**	**15.4**	**20.4**	**20.5**
CAPITAL INVESTMENT				
LATRINES	20.0	30.0	60.0	60.0
VEHICLES AND EQUIPMENT	8.0		8.5	
OTHER				
3. TOTAL CAPITAL INVESTMENT	**28.0**	**30.0**	**68.5**	**60.0**
4. TOTAL EXPENDITURE (2+3)	**40.1**	**45.4**	**88.9**	**80.5**
5. EXCESS EXPENDITURE OVER INCOME (4-1)	29.3	31.9	71.9	59.5
FUNDED BY:-				
SPECIAL FUND				
BUDGETARY ALLOCATIONS	29.3	31.9	71.9	59.5
OTHER (specify)				

NIGHT SOIL ACTIVITY
(RMBx10,000)

APPENDIX 2
Page 2

CITY..... **XIANGFAN**

ANALYSIS OF INCOME AND EXPENDITURE

	1991 (ACTUAL)	1992 (ACTUAL)	1993 (ACTUAL)	1994 (BUDGET)
INCOME				
LATRINE CHARGES		1.0	8.0	8.0
SALE OF NIGHT SOIL	2.0	2.5	5.0	5.0
FEES-EMPTYING SEPTIC TANKS }				
OTHER INCOME }	1.0	2.0	5.0	5.0
1. TOTAL INCOME	3.0	5.5	18.0	18.0
EXPENDITURE				
SALARIES AND WAGES				
-Latrine staff	17.8	47.6	52.4	66.7
-Drivers	2.2	2.4	2.6	3.3
-Other				
SUB-TOTAL	**20.0**	**50.0**	**55.0**	**70.0**
OTHER OPERATING COSTS				
VEHICLES				
-Fuel	4.6	4.8	5.0	5.2
-Repairs and maintenance				
-Other	3.0	3.0	4.0	4.0
SUB-TOTAL	**7.6**	**7.8**	**9.0**	**9.2**
WATER CHARGES	50.0	130.0	130.0	140.0
ELECTRICITY	1.0	2.5	2.7	2.7
OFFICE ADMINISTRATION	1.0	3.0	3.0	3.0
OTHER	5.0	10.0	12.0	14.0
2 TOTAL OPERATING COSTS	**84.6**	**203.3**	**211.7**	**238.9**
CAPITAL INVESTMENT				
LATRINES	432.0	37.0	14.0	
VEHICLES AND EQUIPMENT	6.0			
OTHER				
3. TOTAL CAPITAL INVESTMENT	**438.0**	**37.0**	**14.0**	**0.0**
4. TOTAL EXPENDITURE (2+3)	**522.6**	**240.3**	**225.7**	**238.9**
5. EXCESS EXPENDITURE OVER INCOME (4-1)	519.6	234.8	207.7	220.9
FUNDED BY:-				
SPECIAL FUND	390.0			
BUDGETARY ALLOCATIONS	129.6	234.8	193.7	220.9
OTHER (specify)			14.0	

NIGHT SOIL ACTIVITY
(RMBx10,000)

CITY..... **YICHANG**

ANALYSIS OF INCOME AND EXPENDITURE

	1991 (ACTUAL)	1992 (ACTUAL)	1993 (ACTUAL)	1994 (BUDGET)
INCOME				
LATRINE CHARGES	N/A		1.5	3.0
SALE OF NIGHT SOIL				
FEES-EMPTYING SEPTIC TANKS	5.0	5.5	4.8	7.0
OTHER INCOME				
1. TOTAL INCOME	5.0	5.5	6.3	10.0
EXPENDITURE				
SALARIES AND WAGES				
-Latrine staff	6.4	7.5	8.5	11.9
-Drivers	0.8	1.0	1.0	1.4
-Other	N/A			
SUB-TOTAL	**7.2**	**8.5**	**9.5**	**13.3**
OTHER OPERATING COSTS				
VEHICLES				
-Fuel	0.4	0.5	0.5	0.7
-Repairs and maintenance	0.3	0.3	0.5	0.8
-Other	N/A			
SUB-TOTAL	**0.7**	**0.8**	**1.0**	**1.5**
WATER CHARGES	8.0	9.0	11.8	14.4
ELECTRICITY	0.2	0.2	0.2	0.3
OFFICE ADMINISTRATION	0.3	0.4	0.5	0.6
OTHER				
2 TOTAL OPERATING COSTS	**16.4**	**18.9**	**23.0**	**30.1**
CAPITAL INVESTMENT				
LATRINES	5.0	20.0	20.0	20.0
VEHICLES AND EQUIPMENT				
OTHER				
3. TOTAL CAPITAL INVESTMENT	**5.0**	**20.0**	**20.0**	**20.0**
4. TOTAL EXPENDITURE (2+3)	**21.4**	**38.9**	**43.0**	**50.1**
5. EXCESS EXPENDITURE OVER INCOME (4-1)	16.4	33.4	36.7	40.1
FUNDED BY:-				
SPECIAL FUND				
BUDGETARY ALLOCATIONS	16.4	33.4	36.7	40.1
OTHER (specify)				

HUBEI URBAN ENVIRONMENTAL PROJECT
NIGHTSOIL MANAGEMENT IMPROVEMENT COMPONENT

SUMMARY OF PROJECT COSTS - FOREIGN/LOCAL
(RMB x 1,000)

APPENDIX 3-1

	TOTAL 3 CITIES			HUANGSHI			XIANGFAN			YICHANG		
	Total	Foreign	Local	Total	Foreign	Local	Total	Foreign	Local	Total	Foreign	Local
1 CIVIL WORKS												
Labour	1,463	33	1,431	731	-	731	289		289	443	33	411
Materials	4,319	416	3,903	2,005	214	1,790	822	90	732	1,492	111	1,381
2. MATERIALS & EQUIP.												
Plant	888	126	761	500	95	405	-	-	-	388	31	356
Equipment	-	-	-	-	-	-	-	-	-	-	-	-
Vehicles	4,141	827	3,314	3,008	602	2,406	-	-	-	1,133	225	908
Materials	-	-	-	-	-	-	-	-	-	-	-	-
3 LAND ACQUISITION	323	-	323	228	-	228	-	-	-	95	-	95
4. DESIGN SUP'N & MGMT.	749	-	749	441	-	441	76		76	232		232
5 HYGIENE/SANIT PROM'N	850	-	850	-	-	-	-	-	-	-	-	-
TOTAL BASE COST	12,732	1,401	11,331	6,913	911	6,002	1,187	90	1,097	3,783	400	3,383
PHYSICAL CONTINGENCIES	1,909	210	1,699	1,037	137	900	178	14	165	567	60	508
TOTAL CONSTANT PRICES	14,641	1,611	13,030	7,949	1,047	6,902	1,365	104	1,261	4,350	460	3,891
PRICE CONTINGENCIES	4,312	532	3,780	2,361	311	2,050	382	29	353	1,310	139	1,172
TOTAL CURRENT PRICES	18,953	2,143	16,810	10,311	1,358	8,952	1,747	133	1,614	5,661	598	5,062

HUEP - NIGHTSOIL COMPONENT
INVESTMENT PROGRAM

APPENDIX 3 - 2

CITY: HUANGSHI

	UNIT	1996	1997	1998	1999	2000	TOTAL
PHYSICAL INVESTMENTS:							
1. Latrine Conversion	No.	6	7	7	0	0	20
2. New Latrines							0
- Class 2	No.	1	1	1	1	1	5
- Class 3	No.	1	1	1	1	1	5
3. Improved Septic Tanks	No.	2	2	2	2	2	10
4. N/S Storage Tanks	Cu.m.	0	0	0	0	0	0
5. Treatment Night Soil	No.	0	0	0	0	0	0
6. Low Cost Sewers	Km.	0	0	0	0	0	0
7. Vacuum Trucks							
- 5 Ton	No.	1	2	2	2	1	8
- 2 Ton	No	1	1	1	1	0	4
- Garage / Equip	No.	1					1
8 Hygiene/Sanitation Promotio							

HUBEI URBAN ENVIRONMENTAL PROJECT- NIGHTSOIL COMPONENT APPENDIX 3 - 3

ESTIMATED CAPITAL COST (RMB) **CITY: HUANGSHI**

ITEM	TOTAL	FOREIGN	LOCAL	1995	1996	1997	1998	1999	2000
A LATRINE CONVERSION									
Civil Works-Labour	307,840	-	307,840	-	92,352	107,744	107,744	-	-
Civil Works-Materials	876,160	91,997	784,163	-	262,848	306,656	306,656	-	-
Design,Supervision and Management	152,736	-	152,736	17,760	47,952	49,728	37,296	-	-
Sub-Project Cost	1,336,736	91,997	1,244,739	17,760	403,152	464,128	451,696	-	-
B 1 NEW LATRINES (CLASS 2)									
Land Acquisition	54,000	-	54,000	-	-	9,000	18,000	18,000	9,000
Civil Works-Labour	165,600	-	165,600	-	-	27,600	55,200	55,200	27,600
Civil Works-Materials	554,400	55,440	498,960	-	-	92,400	184,800	184,800	92,400
Design,Supervision and Management	86,400	-	86,400	-	3,600	18,000	28,800	25,200	10,800
Sub-Project Cost	860,400	55,440	804,960	-	3,600	147,000	286,800	283,200	139,800
B.2. NEW LATRINES (CLASS 3)									
Land Acquisition	54,000	-	54,000	-	9,000	9,000	18,000	9,000	9,000
Civil Works-Labour	108,000	-	108,000	-	18,000	18,000	36,000	18,000	18,000
Civil Works-Materials	324,000	37,908	286,092	-	54,000	54,000	108,000	54,000	54,000
Design,Supervision and Management	51,840	-	51,840	2,160	8,640	10,800	15,120	8,640	6,480
Sub-Project Cost	537,840	38,880	498,960	2,160	89,640	91,800	177,120	89,640	87,480
C. IMPROVED SEPTIC TANKS	-	-	-						
D. NIGHT STORAGE TANKS	-	-	-						
E. NIGHT SOIL TREATMENT	-	-	-						
F. VEHICLES, PLANT, EQUIP, ETC.									
Land Acquisition	120,000	-	120,000	-	120,000	-	-	-	-
Civil Works-Labour	150,000	-	150,000	-	150,000	-	-	-	-
Civil Works-Materials	250,000	28,750	221,250	-	250,000	-	-	-	-
Equipment	500,000	95,000	405,000	-	200,000	300,000	-	-	-
Vehicles	3,008,000	601,600	2,406,400	-	466,000	466,000	752,000	752,000	572,000
Design,Supervision and Management	150,000	-	150,000	70,000	80,000	-	-	-	-
Sub-Project Cost	3,198,600	614,236	2,584,364	3,900	652,700	466,000	752,000	752,000	572,000
G. HYGIENE/SAN EDUC	-	-	-	-	-	-	-	-	-
TOTAL LAND ACQUISITION	228,000	-	228,000	-	129,000	18,000	36,000	27,000	18,000
TOTAL CIVIL WORKS	2,736,000	214,095	2,521,905	-	827,200	606,400	798,400	312,000	192,000
TOTAL EQUIPMENT	500,000	95,000	405,000	-	200,000	300,000	-	-	-
TOTAL VEHICLES	3,008,000	601,600	2,406,400	-	466,000	466,000	752,000	752,000	572,000
TOTAL DESIGN AND SUPERVISION	440,976	-	440,976	89,920	140,192	78,528	81,216	33,840	17,280
TOTAL HYGIENE/SAN PROMOTION	-	-	-	-	-	-	-	-	-
BASE COST	6,912,976	910,695	6,002,281	89,920	1,762,392	1,468,928	1,667,616	1,124,840	799,280
PHYSICAL CONTINGENCIES	1,036,946	136,604	900,342						
BASE COST + PHYSICAL CONTINGENCIES	7,949,922	1,047,299	6,902,623						
PRICE CONTINGENCY	2,361,127	311,048	2,050,079						
TOTAL PROJECT COST (Current Prices)	10,311,049	1,358,347	8,952,703						

HUBEI URBAN ENVIRONMENTAL PROJECT- NIGHTSOIL COMPONENT APPENDIX 3 - 4

ESTIMATED CAPITAL COST (RMB)

CITY: XIANGFAN

ITEM	TOTAL	FOREIGN	LOCAL	1995	1996	1997	1998	1999	2000
A LATRINE CONVERSION (x 20)									
Land Acquisition	-	-	-	-	-	-	-	-	-
Civil Works-Labour	288,834	-	288,834	-	96,278	96,278	96,278	-	-
Civil Works-Materials	822,066	90,428	731,638	-	274,022	274,022	274,022	-	-
Equipment	-	-	-	-	-	-	-	-	-
Design,Supervision	76,109	-	76,109	11,109	20,000	25,000	20,000	-	-
Sub-Project Cost	1,187,009	90,428	1,096,581	11,109	390,300	395,300	390,300	-	-
B. NEW LATRINES	-	-	-						
C. IMPROVED SEPTIC TANKS	-	-	-						
D NIGHT STORAGE TANKS	-	-	-						
E NIGHT SOIL TREATMENT	-	-	-						
F. VEHICLES, PLANT, EQUIP.	-	-	-						
G. HYGIENE/SANITATION PROM'N									
BASE COST	1,187,009	90,428	1,096,581						
PHYSICAL CONTINGENCIES	178,051	13,564	164,487						
BASE COST + PHYSICAL CONTINGENCIES	1,365,060	103,992	1,261,068						
PRICE CONTINGENCY	382,217	29,118	353,099						
TOTAL PROJECT COST (Current Prices)	1,747,277	133,110	1,614,167						

HUEP - NIGHTSOIL COMPONENT APPENDIX 3 - 5
INVESTMENT PROGRAM

CITY: YICHANG

	UNIT	1996	1997	1998	1999	2000	TOTAL
PHYSICAL INVESTMENTS:							
1. Latrine Conversion	No	6	7	7	0	0	20
2. New Latrines							0
- Class 2	No.	0	0	0	0	0	0
- Class 3	No	0	0	0	0	0	0
3 Improved Septic Tanks	No	0	0	0	0	0	0
4. N/S Storage Tanks	Cu m	600	0	0	0	0	600
5 Treatment Night Soil	No	0	1	0	0	0	1
6. Low Cost Sewers	Km	0	0	0	0	0	0
7 Vacuum Trucks							
- 5 Ton	No.	0	1	0	1	0	2
- 2 Ton	No	1	0	1	0	1	3
8 Hygiene/Sanitation Pro							

HUBEI URBAN ENVIRONMENTAL PROJECT- NIGHTSOIL COMPONENT APPENDIX 3 - 6

ESTIMATED CAPITAL COST (RMB) **CITY: YICHANG**

ITEM	TOTAL	FOREIGN	LOCAL	1995	1996	1997	1998	1999	2000
A LATRINE CONVERSION									
Civil Works-Labour	338,624	24,608	314,016	-	107,744	115,440	115,440	-	-
Civil Works-Materials	963,776	70,038	893,738	-	306,656	328,560	328,560	-	-
Design, Superv. & Mmgt	156,288	-	156,288	12,432	50,616	53,280	39,960	-	-
Sub-Project Cost	1,458,688	106,003	1,352,685	12,432	465,016	497,280	483,960	-	-
B NEW LATRINES									
C. IMPROVED SEPTIC TANKS	-	-	-	-	-	-	-	-	-
D. NIGHT STORAGE TANKS									
Land Acquisition	50,000	-	50,000	-	50,000	-	-	-	-
Civil Works-Labour	51,000	3,706	47,294	-	51,000	-	-	-	-
Civil Works-Materials	179,608	13,052	166,556	-	179,608	-	-	-	-
Design, Superv & Mmgt	27,632	-	27,632	6,908	20,724	-	-	-	-
Sub-Project Cost	308,240	22,400	285,840	6,908	301,332	-	-	-	-
E. NIGHT SOIL TREATMENT									
Land Acquisition	44,500	-	44,500	-	-	44,500	-	-	-
Civil Works-Labour	27,000	2,174	24,827	-	-	27,000	-	-	-
Civil Works-Materials	235,697	18,974	216,723	-	-	235,697	-	-	-
Plant and Equipment	387,500	31,194	356,306	-	-	387,500	-	-	-
Design, Superv. & Mmgt	31,524	-	31,524	-	7,881	23,643	-	-	-
Sub-Project Cost	726,221	58,461	667,760	-	7,881	718,340	-	-	-
F. VEHICLES, PLANT,EQUIPMENT ETC.									
Civil Works-Labour	26,600	2,128	24,472	-	26,600	-	-	-	-
Civil Works-Materials	113,400	9,072	104,328	-	113,400	-	-	-	-
Vehicles	1,133,000	224,901	908,100	-	183,000	288,000	188,000	186,000	288,000
Design, Superv & Mmgt	16,800	-	16,800	4,200	12,600	-	-	-	-
Sub-Project Cost	1,289,800	236,101	1,053,700	4,200	335,600	288,000	188,000	186,000	288,000
G. HYGIENE/SAN EDUC									
TOTAL LAND ACQUISITION	94,500	-	94,500	-	50,000	44,500	-	-	-
TOTAL CIVIL WORKS	1,935,705	143,751	1,791,954	-	785,008	706,697	444,000	-	-
TOTAL EQUIPMENT	387,500	31,194	356,306	-	-	387,500	-	-	-
TOTAL VEHICLES	1,133,000	224,901	908,100	-	183,000	288,000	188,000	288,000	188,000
TOTAL DESIGN AND SUPERVISION	232,244	-	232,244	23,540	91,821	76,923	39,960	-	-
TOTAL HYGIENE/SANITATION PROM'N	-	-	-	-	-	-	-	-	-
BASE COST	3,782,949	399,845	3,383,104	23,540	1,109,829	1,503,620	671,960	288,000	188,000
PHYSICAL CONTINGENCIES	567,442	59,977	507,466						
BASE COST + PHYSICAL CONTINGENCIES	4,350,391	459,822	3,890,569						
PRICE CONTINGENCY	1,310,338	138,498	1,171,839						
TOTAL PROJECT COST (Current Prices)	5,660,729	598,320	5,062,409						

AVERAGE INCREMENTAL COSTS

Appendix 4

COMPONENT	NUMBER OF BENEFICIARIES	AVERAGE INCREMENTAL COST
	No.	RMB.
LATRINE CONVERSION	117,000	73.92
LATRINE CLASS 1	8,000	184.80
2	8,000	295.68
3	11,000	177.41
IMPROVED SEPTIC TANKS	7,500	59.14
N/S STORAGE TANKS	60,000	369.60
LOCAL TREATMENT	2,500	1,300.99
	214,000	

COSTS OF CO-COMPOSTING

Item	Unit	Production -Tons per Day 150	100	75	50
Capital Investment	RMB'000	1280	970	770	570
Capitalized (15yrs.)	RMB/ton	3.74	4.25	4.50	5.00
O & M Costs *	RMB/Yr.	187	146	112	64
	RMB/ton	4.16	4.87	4.98	5.60
Total cost per ton		7.90	9.12	9.48	10.60
Storage, Sales Admin. and Other costs	RMB/ton	3.10	3.18	3.22	3.40
Total Cost	RMB/ton	11.00	12.30	12.70	14.00
Assume losses (25%)	RMB/ton	14.67	16.40	16.93	18.67

* Assumes production on 300 days per year.

COST OF NIGHTSOIL TREATMENT AND TRANSPORTATION

	Unit	RMB
Additional transport to tank farm	per ton	6.28
Storage (capital cost)	per ton	3.24
(operation)	per ton	0.97
Delivery	per ton	2.09
		12.58

Appendix 6.1

CHINA
HUBEI URBAN ENVIRONMENTAL PROJECT
TERMS OF REFERENCE FOR TECHNICAL ASSISTANCE PACKAGE C
HYGIENE/SANITATION PROMOTION & TRAINING PROGRAM

Background

1. The Hubei Urban Environmental Project (HUEP) is part of a phased development program of Hubei Province to improve environmental conditions and management. The principle objective of the project is to provide sustainable environmental setting for the longer term economic and social development of the Province, while providing a competitive framework for industrial growth.

2. HUEP is being supported by the World Bank and bilateral donor agencies. The project is in the provincial capital city of Wuhan and three large secondary cities of Huangshi, Xiangfan and Yichang, whose combined urban population is 4.5 million of which Wuhan has 3.5 million. The project cost is estimated to be in the order of US$ 300 million and the components of the project include wastewater collection and treatment, industrial pollution control, solid waste management, nightsoil management, water quality improvement, and institutional development and technical assistance for local staff and officials.

3. All the four project cities are heavily industrialized. The cities are located along major river systems which receive much of the cities' untreated wastes. A major focus of the project is the improvement of health and hygiene of the urban population through improved wastewater collection and disposal, better solid waste management facilities, improvements in domestic and public latrine facilities and improved nightsoil practices.

Nightsoil Management Improvement Study

4. In all the project cities, nightsoil (both dry latrine nightsoil and septic tank sludge) is being re-used for agriculture as a fertilizer, and to a much lesser extent in aquatic cultivation. This follows Chinese traditional practices where human (and animal) wastes are considered a resource which can be used beneficially in agriculture/aquaculture and, even in some instances, for scientific and medicinal purposes. While these practices have been carried on for many centuries in China, the present management practices of nightsoil in the existing dense urban living conditions in the project cities has increased the potential detrimental risks to peoples' health.

5. As part of the project preparation in the wastewater component, a Nightsoil Management Improvement Study was undertaken by UNDP/World Bank Water and Sanitation Program to assess current nightsoil management practices in the project cities and to prepare recommendations for improvements. The study investigated a number of inter-related aspects of existing nightsoil collection, treatment, disposal and use:

a. hygiene and epidemiological aspects;
b. economic and marketing aspects; and
c. technical options for improvements.

6. The study has produced a final report which recommends a number of improvements for nightsoil management practices, including improvements of the following: physical sanitation facilities, sanitation services, treatment of nightsoil, nightsoil management and ***better hygiene practices through an improved hygiene and sanitation promotion program***.

Hygiene and Sanitation Promotion Program

Objective

7. The objective of the Hygiene and Sanitation Promotion Program is to improve the health welfare of people in the project cities through the promotion of better hygiene behaviors as related to nightsoil handling. There are two components in this program:

a. hygiene education and information dissemination
b. monitoring and evaluation

Scope of Work Part 1 - Hygiene Education and Information Dissemination

8. Hygiene education and information dissemination will be carried out in the four project cities of Wuhan, Huangshi, Xiangfan and Yichang and will focus on three key sanitary behaviors which interrupt excreta-related disease transmission:

a. sanitary disposal of feces;
b. hand washing (especially after defecation and handling excreta, before preparing food and before eating); and
c. maintaining drinking water free from fecal contamination.

9. The activities would be targeted to high risk groups and high risk areas, and shall include (but not be limited to):

a. peri-urban farmers and their families;
b. families with children under 5 years in high risk areas;
c. sanitary workers, public latrine attendants and cleaners, and others engaged in handling nightsoil; and
d. primary school children.

10. Techniques for hygiene promotion will involve the participation of the community as much as possible. Messages based upon people's beliefs, perceptions, current practices and needs will be developed. For use within the community only, messages should be developed by community members. For wider use outside the community, messages should be developed using social marketing techniques where both communication experts and users are involved.

11. Appropriate channels of communication will be identified. Within communities, suitable methods of face-to-face communication, local dramas and shows will be used. For wider dissemination, messages will be channelled through schools (formal and informal curriculum such as comic books and games), work units, local health posts, radio, TV, and printed material.

12. It is recommended that hygiene promotion component be implemented in collaboration with the City Sanitation Bureaus and the Hubei Provincial Institute for Health Education.

13. The Consultant shall undertake the following activities for the assignment of this component:

a. Design: The program will commence with a preparation and design phase in which an outline plan will be developed based on the recommendations of the Nightsoil Management Improvement Study, particularly the Hygiene and Epidemiological aspects, as well as a needs assessment of the targeted areas. The outline design will indicate the beneficiaries to be targeted, locations, time schedule, resources required (both manpower and physical resources), and outputs to be achieved. The design plan will indicate participatory methodology to be used, indicative training material, types of

printed literature, and broadcast material. A report of the proposed plan will be produced.

b. Acceptance of Design Plan: The design plan will be discussed with the each project city, including Sanitation Bureaus and Health Departments. The design shall be accepted by the Provincial Health Bureau and each project city Sanitation Bureau and the HUEPO.

c. Training: Training will be provided for the following persons to implement the hygiene and sanitation promotion program:

- 10 trainers (4 in Wuhan and 2 in each project city);
- 20 assistants (8 in Wuhan and 4 in each project city);
- school teachers (6); and
- community leaders (6) and village administrators (12) in all four project cities).

The training will cover the following topics:

- hygiene and epidemiological aspects of disease transmission related to nightsoil, and key ways to break the transmission routes;
- participatory training methodology;
- community needs assessment;
- communication skills; and
- monitoring and evaluation.

Training will include the preparation and production of training tools and materials in adequate quantities.

d. Graphics and Printing: Based on the design plan, brochures, pamphlets and posters will be designed using professional graphic artists, photographers and draft persons. These will be printed and made available for distribution.

e. Broadcasting Material: Suitable programs and scripts will be prepared for broadcasting through media channels: radio, TV, public exhibitions and shows (including in schools) and public lectures.

(The programs for d) and e) will indicate methods of dissemination, locations, and schedules. A report of the materials produced, schedules and targeted audience will be produced).

f. Dissemination: The program will carry out dissemination of the designed materials as planned above.

While dissemination is proposed only in the four project cities, it is considered appropriate that if the dissemination can also reach a wider (but similar category) audience without additional resources, then it should be disseminated accordingly.

Scope of Work Part 2 - Monitoring and Evaluation

14. The specific objectives of the monitoring and evaluation component are to: (a) provide feedback into the hygiene and sanitation promotion program; (b) assess the effectiveness of the proposed nightsoil management improvements; and (c) validate the program's health outcome. They will be accomplished by a twofold approach:

a. a continuous monitoring using the existing routine disease surveillance system for infectious diseases to estimate dysentery and hepatitis morbidity on district and community level; and

b. The undertaking of a community-based strata case-control study for each project city of a selected population strata and areas covered by the nightsoil management improvement interventions. The studies will accomplish the following: (i) assess changes in the health risk pattern associated with the practices of nightsoil management; (ii) assess morbidity patterns from helminth infections; and (iii) provide comparative data for the evaluation of routine data from the disease surveillance system.

15. It is recommended that the monitoring and evaluation component be implemented in collaboration with the City Sanitation Bureaus and the Hubei Academy of Medical Sciences.

16. The Consultant shall undertake the following activities for the assignment of this component:

a. Design: A plan for monitoring and evaluation will be developed for the four project cities. The plan will be prepared with consultation of the Anti Epidemic Stations, Sanitation Bureaus and Health Departments of each project city. The plan will be agreed to by the respective departments and HUEPO. A report will be prepared outlining the proposals.

b. Testing: A routine and continuous program of testing will be carried out based on sample populations both in the recipient areas of the nightsoil management improvement program as well other selected areas consisting of similar nightsoil exposure groups. Testing will be for incidences of infectious diseases to estimate dysentery and hepatitis morbidity as well as individual field testing (stool sampling). The sample ratios should be of a significant level to provide statistically conclusive results.

c. Monitoring: This will be carried out using field sampling of community based case control study for each project city with nightsoil management improvement program.

d. Analyses and Reporting: Analyses of the tests will be carried out and the results will be reported on a regular basis. Reports will be submitted to the HUEPO and the City Sanitation Bureaus as well as the Health Departments of each project city. Reports will be provided on a 6 monthly basis.

Timetable and Reports

17. The work will be carried out commencing with the Hygiene Education and Information Dissemination component in Year 2 of HUEP for two years; the Monitoring and Evaluation component will begin in Year 3 and continue until the completion of HUEP (presently scheduled for five years implementation from 1996 to 2000).

18. The following reports shall be provided under this assignment and submitted to the project cities and HUEPO:

	Reports/Outputs	Due Date (months after commencement)
a.	Hygiene Education/Information Dissemination	(Year 2)
	i. Design Plan	3
	ii. Promotion Literature & Materials	9
	iii. Mid-term Training Report	15
	iv. Training Tools & Materials	18
	v. Final Training Report (including evaluation on effectiveness of training)	24
b.	Monitoring and Evaluation	(Year 3)
	i. Monitoring & Evaluation Plan	3
	ii. Testing Results/Analysis (every 6 months)	9, 15, 21, 27, 33
	iii. Case Control Study Report	30
	iv. Final Report (including evaluation on effectiveness of nightsoil management improvement interventions)	36

Expected Level of Effort

19. The expected level of effort by the Consultant to address the scope of work outlined in this assignment is approximately 80 person months of local specialists--65 person months for hygiene education/information and 15 months for M&E. The local specialists should have the following appropriate qualifications: extensive experience in providing health and hygiene information programs to large communities and general public; have adequate and qualified senior staff in fields of medicine and hygiene, community work, participatory training; and the preparation and production of literature, brochures, booklets, presentation of programs through shows, exhibitions. In addition, the M&E specialists should have experience in testing for helminth, parasites and bacteria; experience in sampling populations for testing and monitoring of diseases; and have sufficient laboratory and equipment facilities to carry out laboratory and field tests.

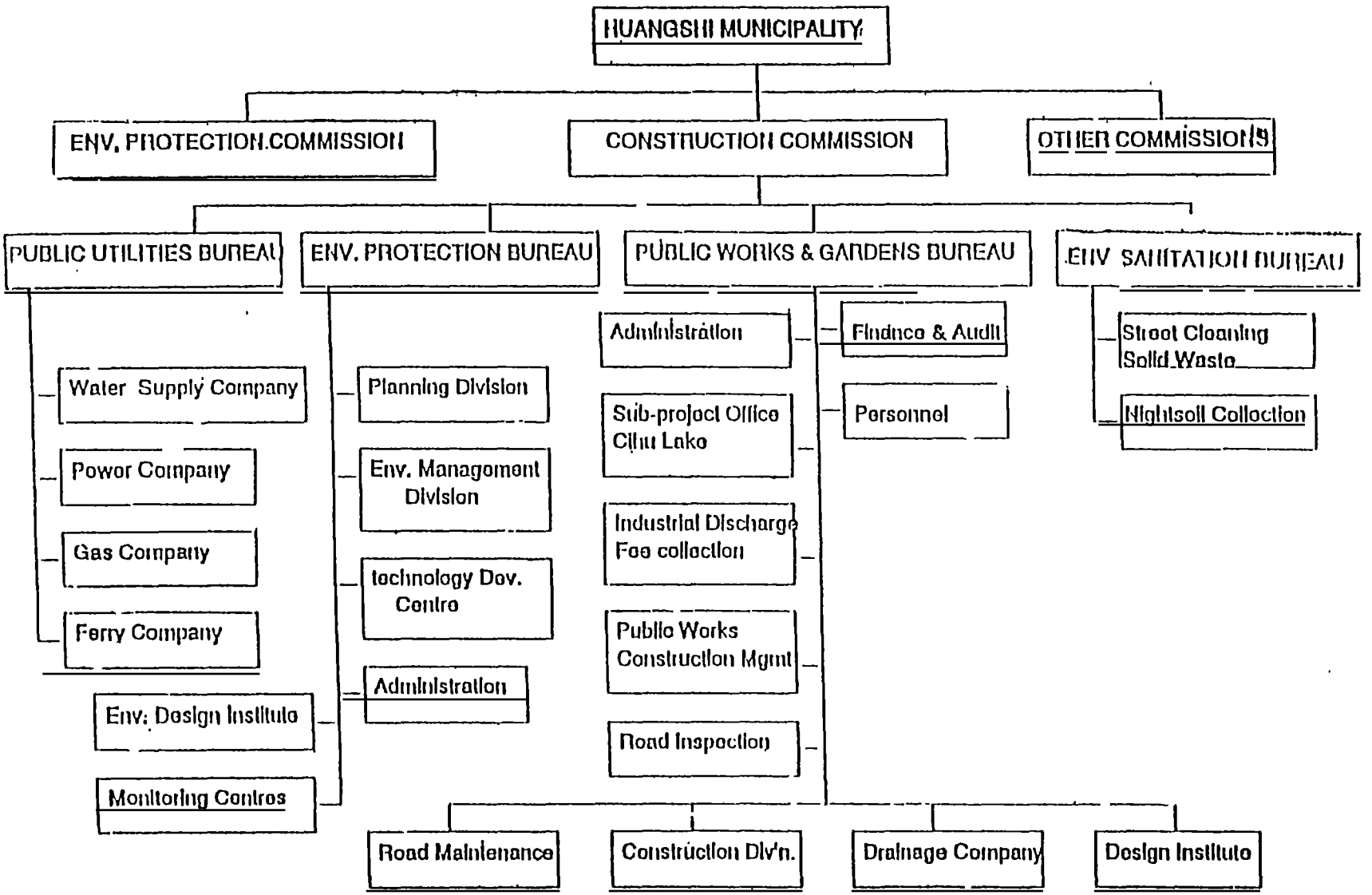
Estimated Budget

20. The estimated budget for the Hygiene and Sanitation Promotion Program is shown below. All facilities and laboratory equipment required for the implementation of the components in accordance with the terms of reference will be provided by the Consultant. Both the project cities and HUEPO will provide all due assistance in obtaining clearances and approvals to enable the Consultant to perform the tasks.

HUBEI URBAN ENVIRONMENTAL PROJECT
HYGIENE & SANITATION PROMOTION PROGRAM

ESTIMATED BUDGET (RMB) (1994 prices)

No.	Items	No. Persons	No. Weeks	Unit Rate (RMB)	Sub Total (RMB)	TOTAL (RMB)
A.	**HYGIENE & INFORMATION**					
1	TRAINING COURSES:					
1a)	Training of Trainers					
	(4 in Wuhan, 2 in each of other 3 cities	10	4	1,500	60,000	
1b)	Assistants, Support Staff, Etc.					
	- Wuhan	8	4	1,200	38,400	
	- Huangshi	4	4	1,200	19,200	
	- Xiangfan	4	4	1,200	19,200	
	- Yichang	4	4	1,200	19,200	
1c)	School Program					
	- teacher training	6	4	1,200	28,800	
1d)	Community Leader Training					
	- provincial administration	6	4	1,200	28,800	
	- urban/peri-urban levels	12	4	1,200	57,600	
	- admin/support				5,000	
1e)	Communication/Office Supplies				15,000	
1f)	Transport/Perdiems				25,000	
						316,200
2	DESIGN EDUCATION MATERIALS					
2a)	Designers/ drafts persons	3	15	1,200	54,000	
2b)	Supplies, graphics, etc.			20,000	20,000	
						74,000
3	PRODUCTION OF MATERIALS					
3a)	Brochures					
	- 3 brochures: schools x 20,000			1.5	90,000	
	- 3 brochures· general x 20,000			1.5	90,000	
3b)	Pamphlets					
	- 4 pamphlets: farm/agric x 10,000			2.25	90,000	
3c)	Posters					
	- 5 posters x 200			10	10,000	
3d)	Radio/TV Advertising			50	50,000	
3e)	Sanitation Bureau's Info. Material				5,000	
						335,000
	SUB-TOTAL					725,200
B.	**MONITORING & EVALUATION**					
4a)	Monitoring Program & Case Study	5	12	1,200	72,000	
4b)	Monitoring Testing				15,000	
4c)	Communication/Office Supplies				13,500	
4d)	Transport/Perdiems				24,000	
	SUB-TOTAL					124,500
	TOTAL		80 mos			**849,700**



ADMINISTRATIVE ORGANISATION CHART
HUANGSHI CITY

Appendix 7-1

HUANGSHI CITY GOVERNMENT

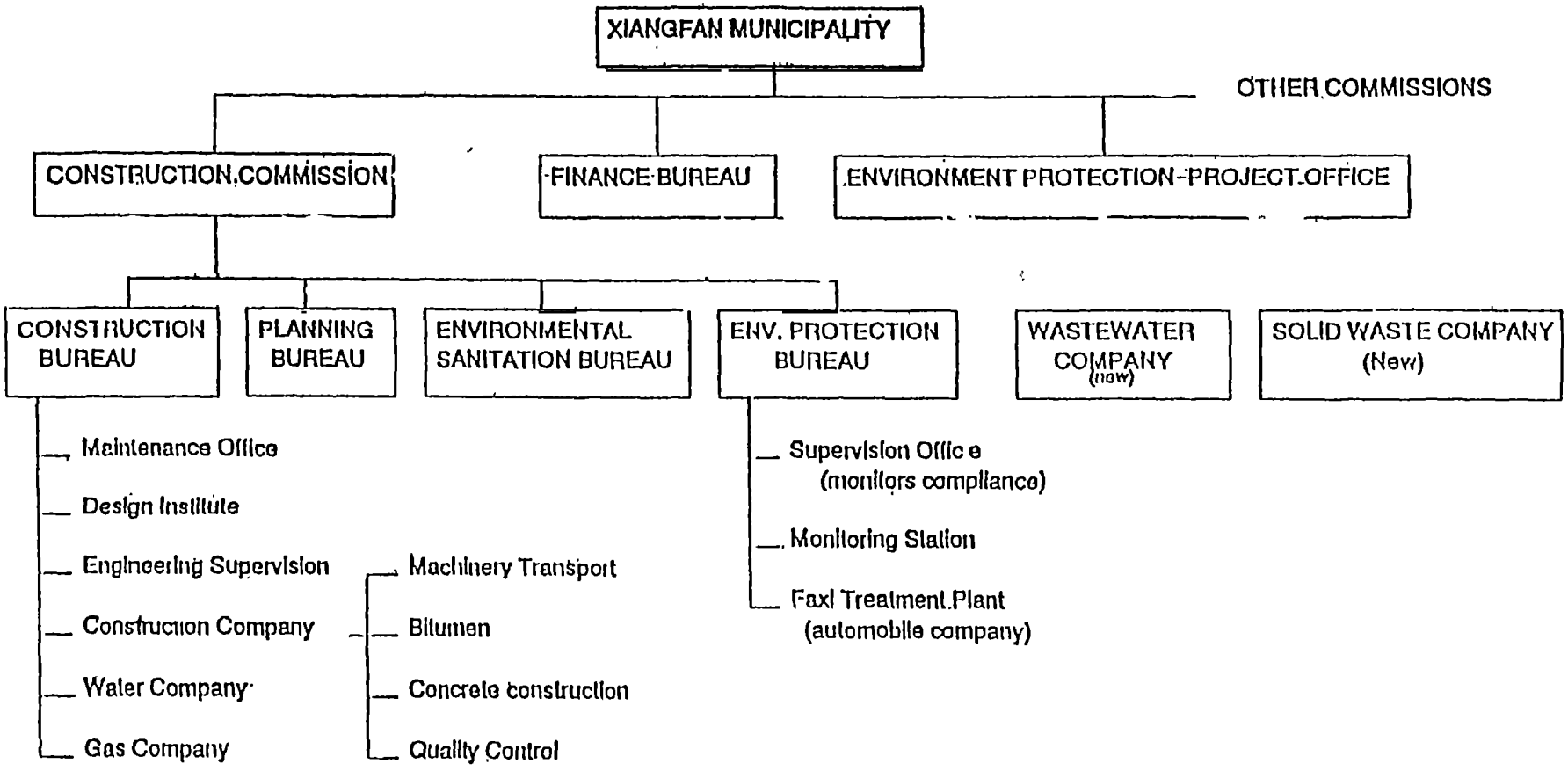
URBAN CONSTRUCTION COM'N.

ADMIN of URBAN SANIT'N.
(Leaders=5; Secretaray=1; Engineers=15;
Technicians=25; Drivers=2)

DISTRICT SHIHUA SANIT. TEAM	DISTRICT SHENYANG SANIT. TEAM	DISTRICT CHENCHAWAN SANIT. TEAM	MACHINERY STATION

SECTION:				
- Env Sanit'n	10	12	12	
- Management	8	10	10	
- Finance	6	8	7	
- Cleaning	45	48	51	
- Latrine	35	36	36	
- Others	3	5	4	
Total Staff =	107	119	120	25

HUANGSHI SANITATION BUREAU
ORGANIZATION & STAFFING LEVELS



Appendix 7-3

ADMINISTRATIVE ORGANISATION CHART
XIANGFAN CITY

XIANGFAN CITY GOVERNMENT

URBAN CONSTRUCTION COMMISSION

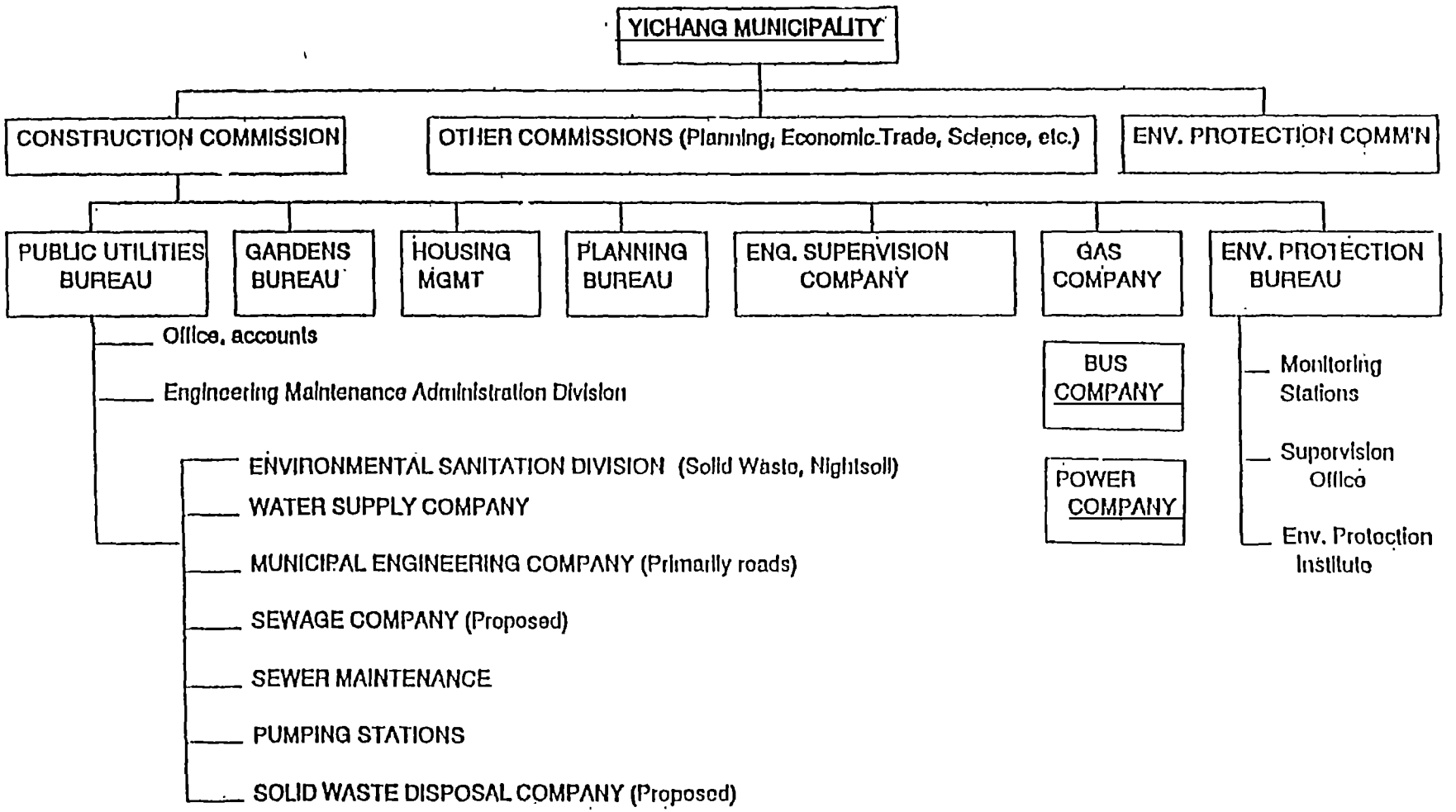
ENVIRON. SANITATION DIV'N

(Leaders=6; Engineers=7; Technicians=15)

	LOGISTIC	CLEAN & TRANSPORT TEAM	LATRINE MANAG'T	CLEANING & MANAG'T	MAINTEN'CE	SOLID WASTE	ADMIN.
Staff:							
Permanent:	48	48	128	100			
Temporary:	120	100	100	775			
Total:	168	148	228	875	11	13	70

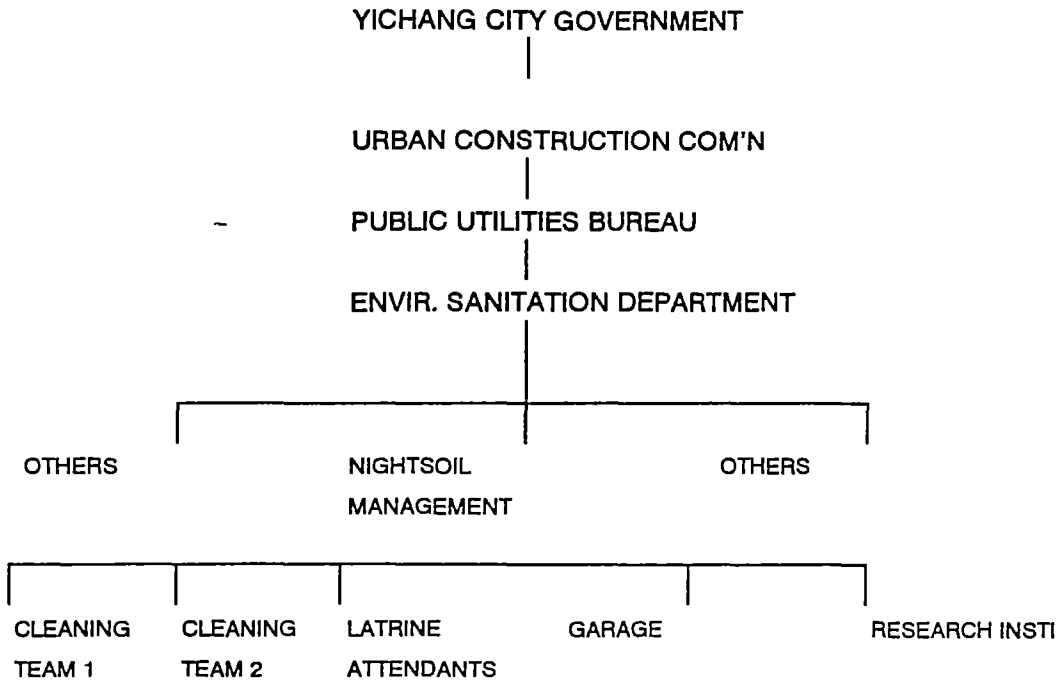
(Sanit. Section)
(Equip Section)
(Finance Section)
(Security Section)
(Retired Staff Sect)
(Research Section)
(Party Office)
(Clinic)

XIANGFAN SANITATION DIVISION
ORGANISATION & STAFFING LEVELS



Appendix 7-5

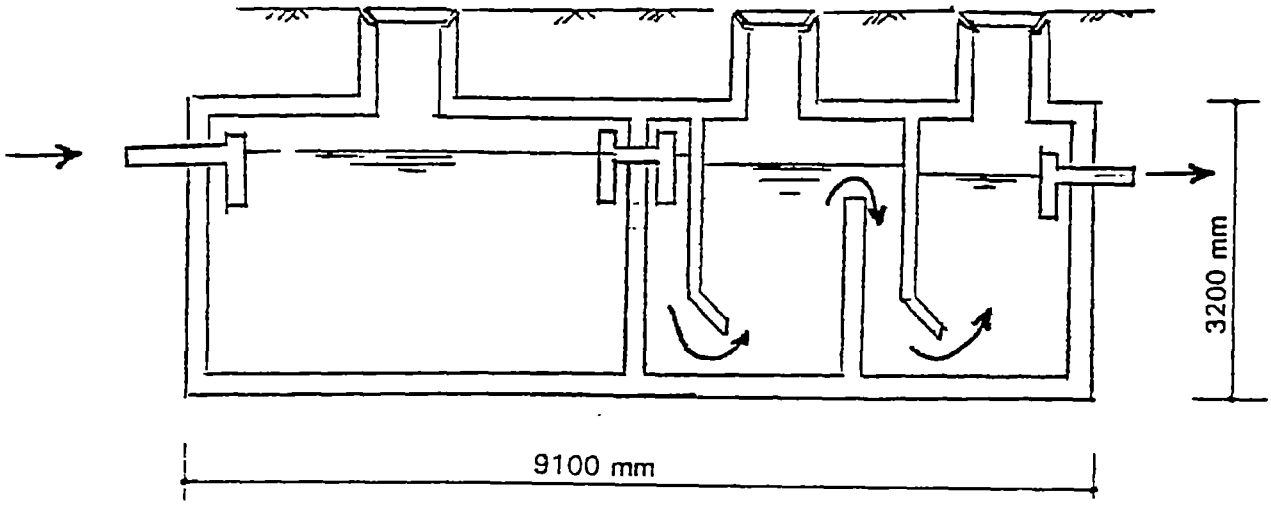
ADMINISTRATIVE ORGANISATION CHART
YICHANG CITY

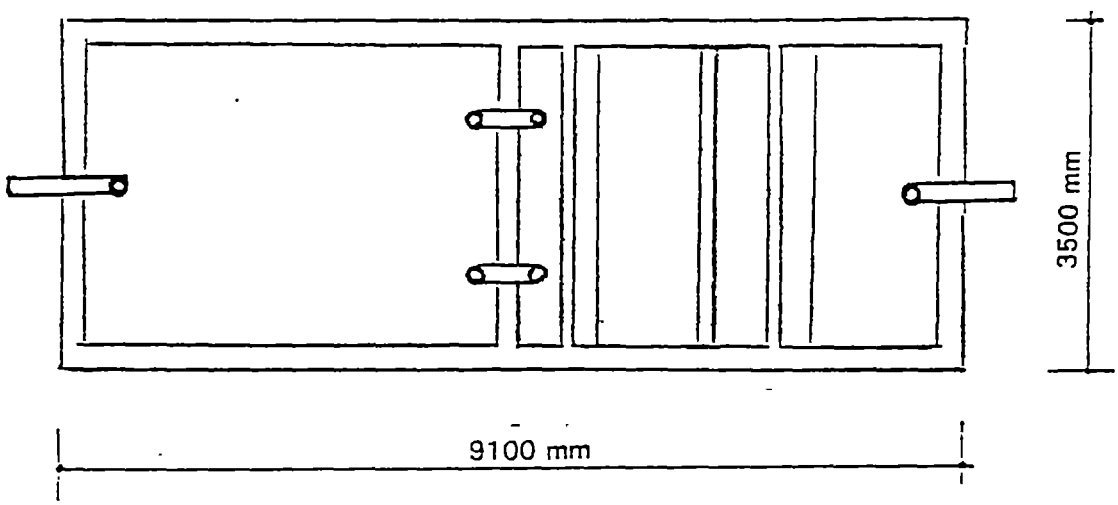


Total Staff:

Leaders (4); Engineers (2); Technicians (15)	
Maintenance Staff =	38
Trades/ Repairmen =	56
Part Time Trades =	8
Workers =	114
Guards =	2
Sub Total	239
Other Part Time Workers	417
Total Staff	656

YICHANG SANITATION DIVISION
ORGANIZATION & STAFFING LEVELS

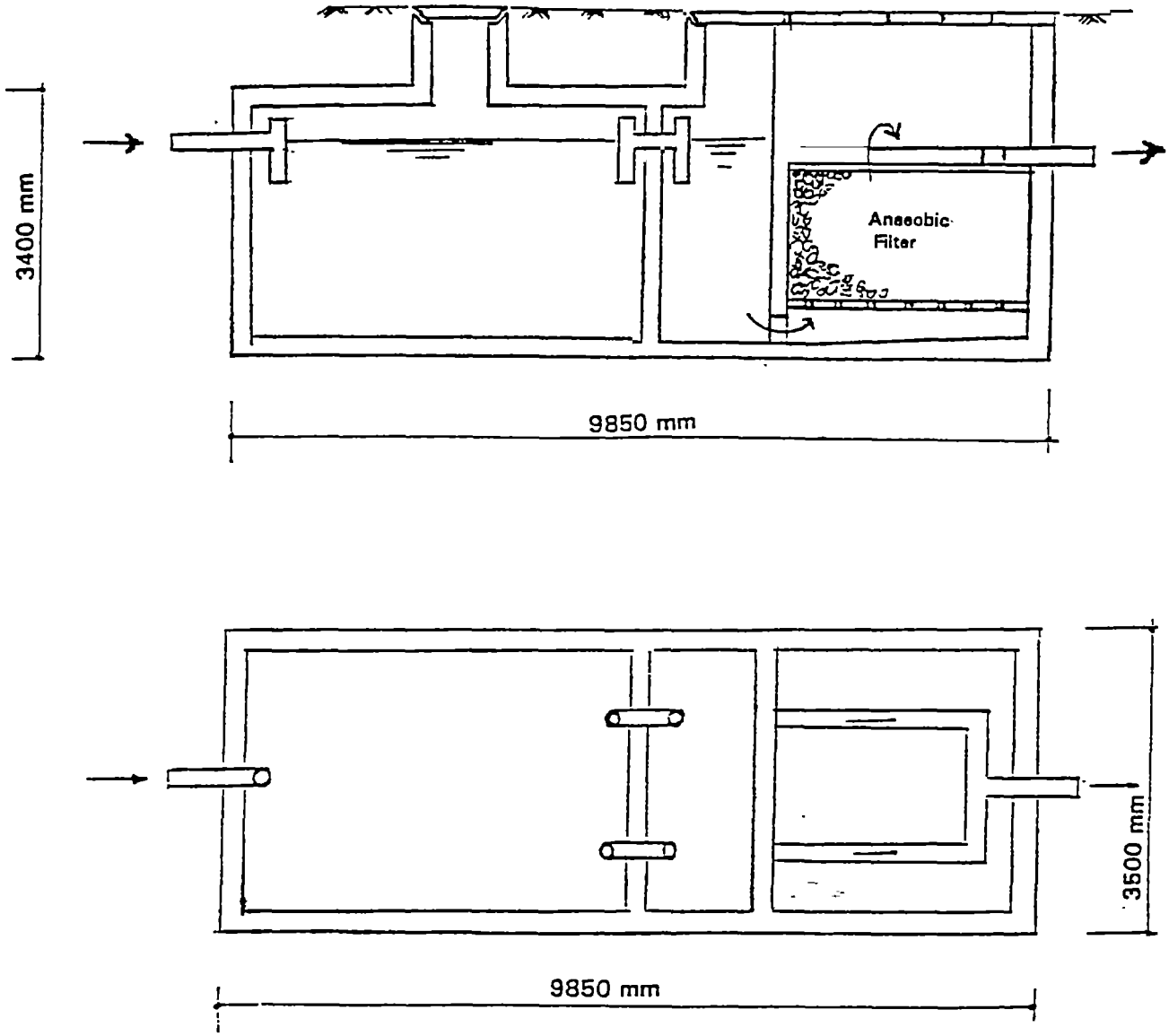




IMPROVED SEPTIC TANK

(BAFFLED REACTOR) TYPE 1

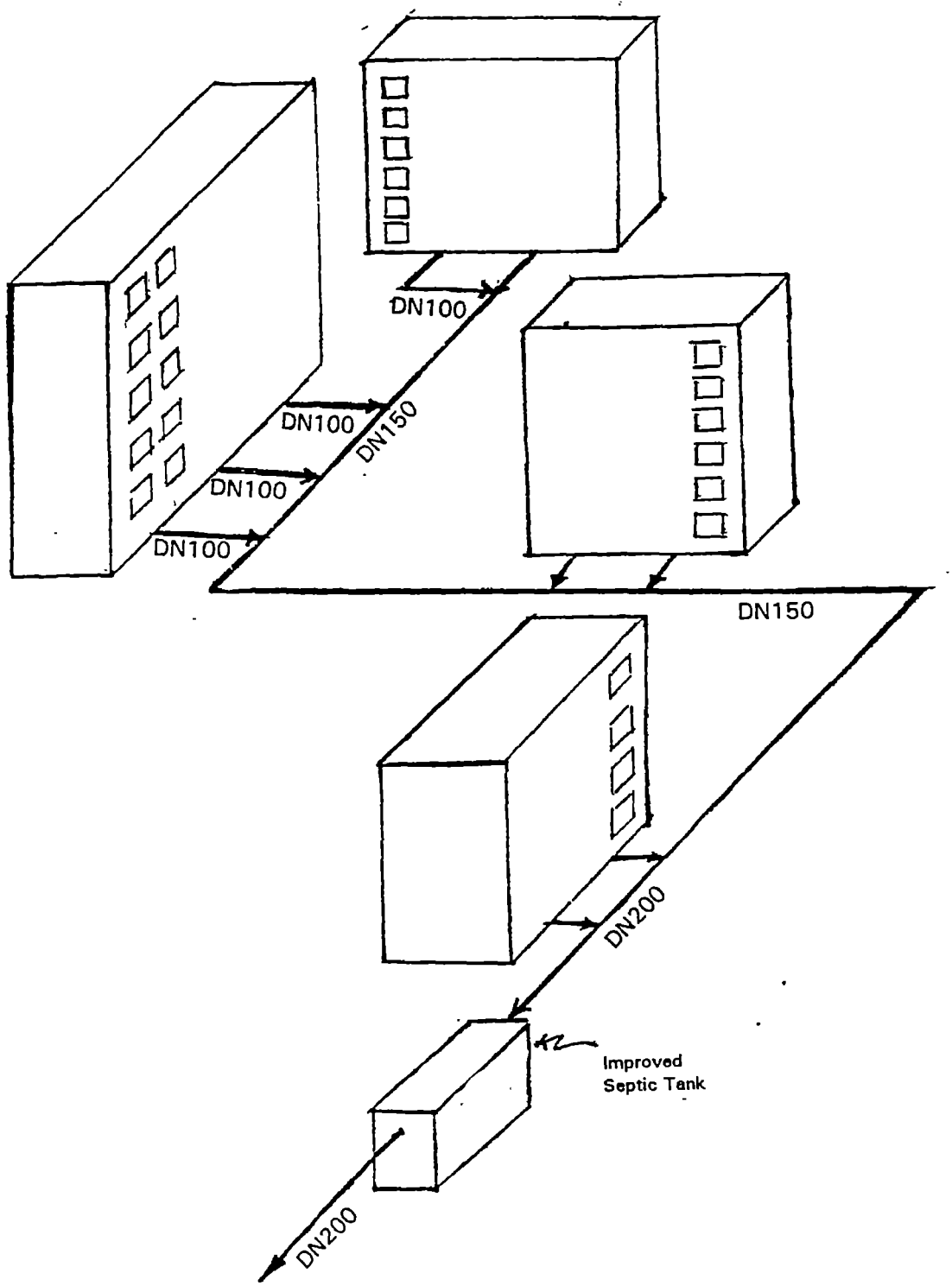
Figure 1



IMPROVED SEPTIC TANK TYPE 2

(ANAEROBIC REACTOR)

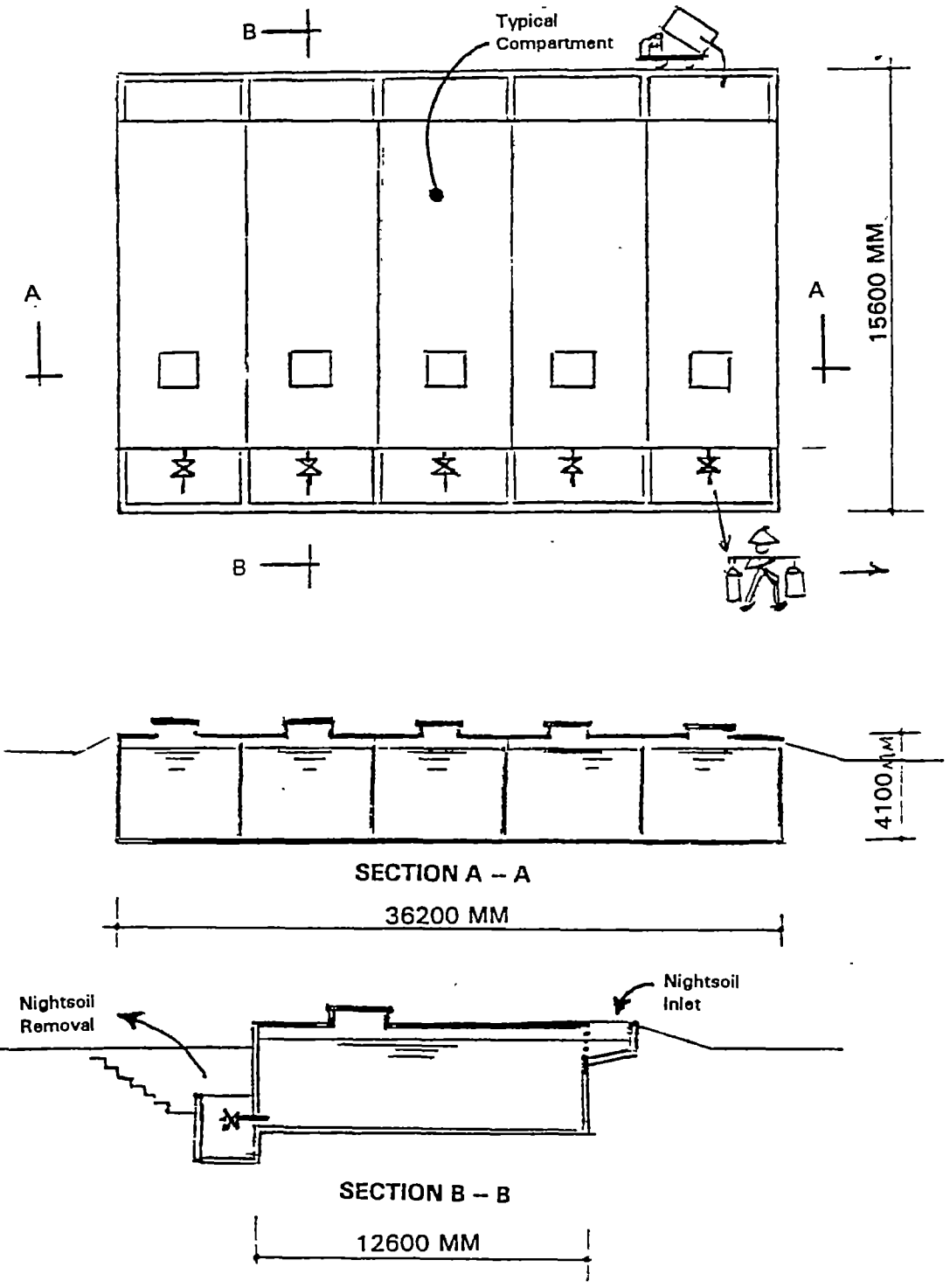
Figure 2



LOCAL AREA TREATMENT

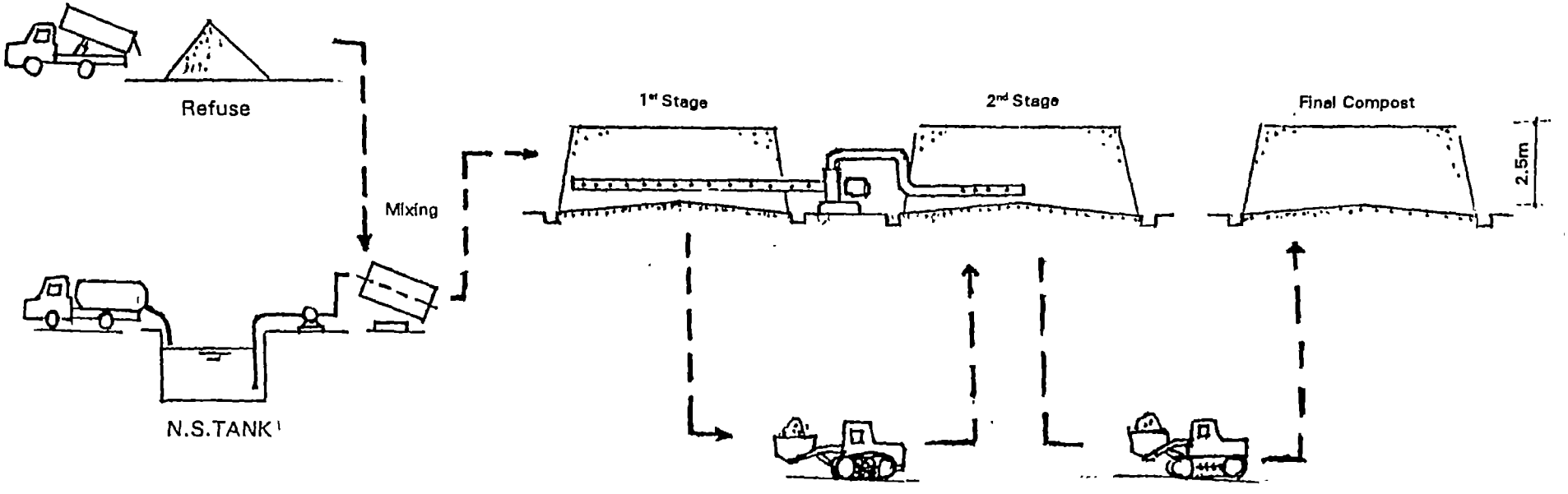
IMPROVED SEPTIC TANK

Figure 3



NIGHTSOIL STORAGE TANK

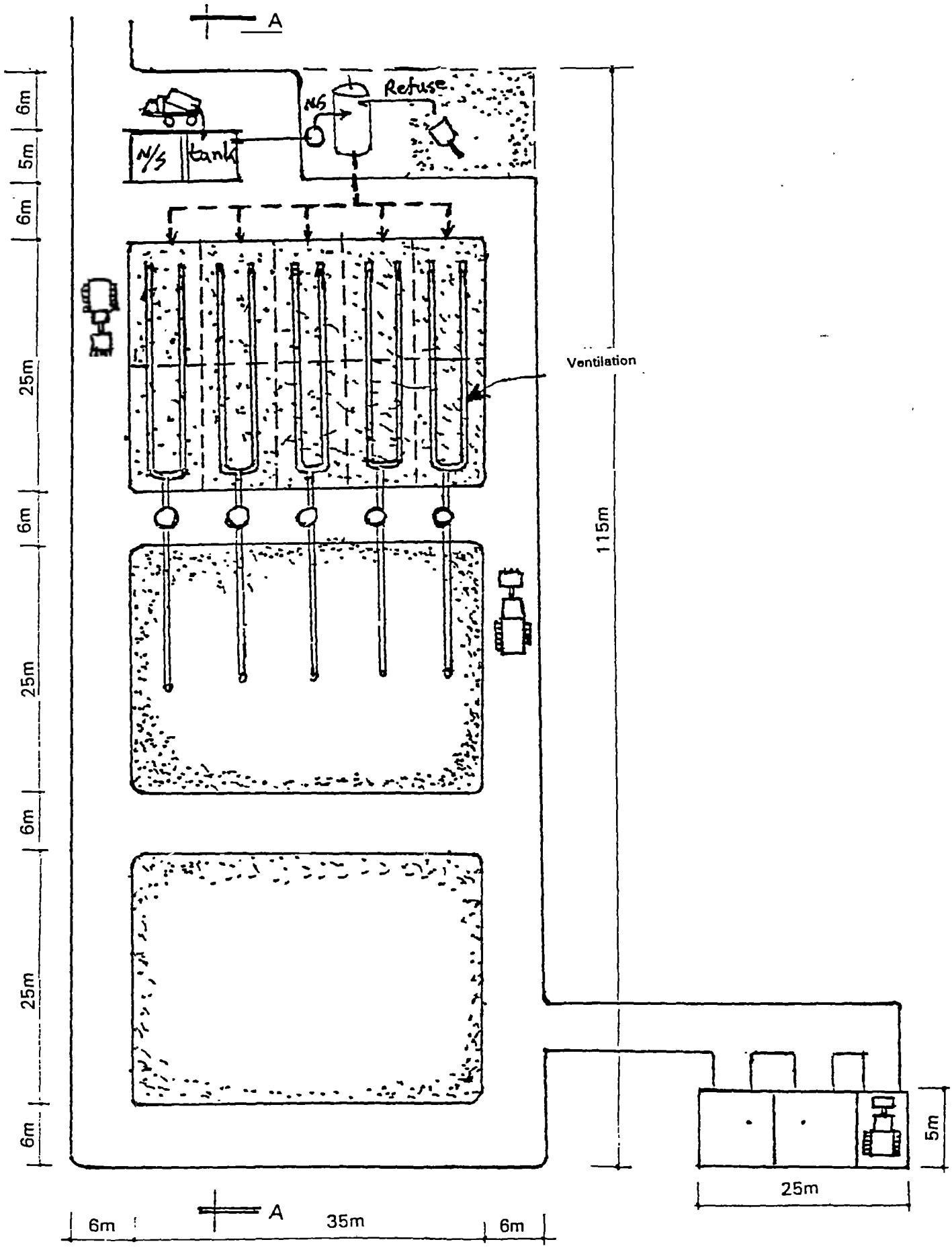
Figure 4



CO-COMPOSTING PLANT

(ELEVATION)

Figure 5 - 1



CO-COMPOSTING PLANT

(PLAN)

Figure 5 - 2

Annex 1

Provincial and City Profile

UNDP/World Bank Water and Sanitation Program
RWSGEAP

Contents

Hubei Province

1. Province Overview

Hubei Province is situated in the central part of the People's Republic of China The name of the province, Hubei meaning north of the lake, is derived from its location to the north of the Dongting Lake in the middle reaches of the Yangtze River. Directly under the Hubei Provincial Government there are eight cities and six prefectures, an autonomous region and a forest region, Shennogjia Forest Region These cities and prefectures again exercise authority over 48 counties and 22 cities at county level

The eastern, western and northern parts of Hubei Province are mountainous areas while the central part is low lying land. Of the total land area, 11% is mountainous, 36% is hilly and 20% is low plains. The Yangtze River cuts through the Wushan Mountains in West Hubei, creating the magnificent "Three Gorges". The Jianghan Plain in central south Hubei is one of China's bases for grain and cotton production. The hilly southeastern area and the mountainous area as well are important areas for Hubei's native and special local products

Hubei's climate is subtropical monsoonal, and enjoys plenty of sunlight and heat The annual frost-free period lasts for 230 to 300 days; the annual rainfall is between 800 and 1,600 mm; and the annual mean temperature is between 13 and 18 C The highest temperatures (38.2 C) occur in August, and the lowest in December. The over one thousand lakes dotting the land of Hubei constitute a significant base for freshwater aquatic products Thus, the province is well- known as the "province of a thousand lakes" and a "land of fish and rice".

Hubei ranks ninth among Chinese provinces and autonomous regions in population terms (54.4 million in 1990) and in aggregate GNP terms (RMB Y79 billion in 1990) but only 14th in GNP/capita terms with RMB Y1,460/capita The Hubei economy is dominated by Wuhan Municipality which accounted for almost 23% of gross provincial output value in 1991

Although a rural province, industry accounts for 65% of Hubei's gross output value, coming mainly from state owned enterprises which employ two thirds of industrial workers, chiefly in heavy industries (55%), notably iron and steel, cement and chemicals. Non-state (collective owned) industrial enterprise is relatively well represented in Hubei and accounts for more than 30% of employment in nearly 16,000 enterprises Manufacturing includes a wide variety of light industry, chemicals, paper and, more recently, automobiles and high-tech industry such as fiber optics and other communications technology.

Table 1
Hubei - Major Cities by Non-Agricultural Population (1993)

City	Total Population ('000)	Non-Agric Population ('000)	Ave Pop Growth 1980-88 (%)
Wuhan	6,840	3,810	7 7
Huangshi	1,370	570	3.0
Xiangfan	6,750	580	5 6
Yichang	3,920	420	4 6
Shashi		261	4 2
Shiyan		260	4.6
Xiantao		240	9.3
Qianjiang		191	n/a
Honghu		191	n/a
Erzhou	950	300	15.1

n/a not available

The rural character of Hubei is reflected in its low level of urbanization. In 1988 the registered non-agricultural population of Hubei was only 7.5 million or 14.7% of the total population but has been growing at 8% per year on average since 1980.[1] Hubei's list of 29 cities of prefectural or county rank is headed by Wuhan, the provincial capital, with a non-agricultural population of 3.3 million in 1988 or 43% of the total

[1] Urban administrative districts take in much rural area as well. The registered urban district population in Hubei including registered agricultural workers is 20.3 million (39% of total) However, the built-up urban area is typically 10-15% of the total urban district area. Many registered agricultural workers do in fact live and work in urban areas as contract laborers The exact number of urban dwellers is not known but is understated by the non-agricultural population statistics.

population. The majority of Hubei's cities are to be found close to the Yangtze River which has served as a major transport artery between Sichuan and Shanghai for centuries.

2. City Overview

Wuhan

Wuhan is a major industrial center as well as a key national transportation hub and important educational center. It is located along the flood plains of the Yangtze River and has a total population of 6.84 million (12.3% of the provincial total), of which 3.8 million (7 urban districts, 2 suburban districts) can be considered to be living in urban areas Yearly population growth is 7.7%. The urban 'built up' area is 187 km2, indicating a low average population of 172 persons/ha. According to official city statistics, literacy rate is 85% of the total population

GNP in the city proper was RMB Y3,356/capita in 1988. The city is comparatively well provided with urban services Water supply service is reported available to 92 5% of the population. Paved roads make up under 10% of the city area and traffic congestion is evident There appears to be little recent investment by the Wuhan Municipal Government in public waste management

The city has a combined sewerage and drainage system with a daily sewage flow estimated at 1 1 million m3/day. of which only a very small part is treated by one sewage treatment plant Only residents living in the inner core of the city are connected to the sewerage system. It is reported there are a total 977 public latrines with 804 of the water flush type and 173 dry latrines It is estimated that 2 million people use public latrines each day and many of the city population are proper without sanitation services.

Huangshi

Huangshi is a fast growing port and new industrial town located on the Yangtze River and has a population of 1.37 million of which 570,000 are considered urban residents. The municipality recorded a GNP of RMB Y2 9 billion in 1991 reflecting an average of only RMB Y2,180/capita Huangshi has grown around a large lake (Ci Hu, 8 km2). The lake, which receives untreated wastewater discharges from industry and domestic sources, is used for fishing, recreational and water supply purposes The city has a combined sewerage/drainage system although the wastes are untreated and discharged into the Ci Lake and Yangtze River. Several industrial factories have their own wastewater disposal facilities.

Xiangfan

Xiangfan is located on the Han River with a total population of 6.75 million of which 580,000 are urban residents; the urban area covers the two adjacent districts on opposite sides of the river. Literacy rate of the population is over 90% The city has an urban per capita income of RMB Y1,774 per annum There is a combined sewerage and drainage system serving an estimated 340,000 residents. The untreated sewage is pumped directly into the Han River. Many city residents live without adequate sanitation service in the older areas of the city

Yichang

Yichang is a new industrial and tourist city located along the upper reaches of Yangtze River and has a total population 490,000 of which 420,000 live in the urban areas. Literacy rate is over 90% in urban area. The city has an annual per capita income of RMB Y1,600 for the urban area Yichang is known as "the Gateway to the Three Gorges" and is a strategic passage between Sichuan and Hubei provinces. It is estimated that 200,000 tourists visit this city every year. This city has a total 127 public latrines with 82 water flushed type and 45 dry latrines. A large part of the city is covered by a combined sewerage system which was completed in 1990.

3. Overall Sewerage Coverage

Data for sewerage service/coverage has been difficult to collect and analyze; what has been collected may not entirely reflect the real situation in the cities. The data collected thus far in the four project cities indicate the following sewerage coverage: 47% in Xiangfan, 66% in Huangshi, 67% in Wuhan, and 75% in Yichang. Sewerage coverage is mainly concentrated in the central core areas of the cities This means that a range of about 25% to 53% of the urban population in the four cities do not have sewerage service and are not connected to sewers. They are served mainly by septic tanks and/or use dry private/public latrines If the non-registered "floating" population are to be included in the statistics the proportion of urban population not

served by sewers would be larger as they form between 10 to 20% of the urban population

Of the four cities, two cities--Xiangfan and Yichang--have no wastewater treatment plants. The other two cities--Wuhan and Huangshi--have one partially functioning treatment plant each. All the four cities discharge most or all of their untreated wastewater into the Yangtze River. Each of the three cities of Huangshi, Xiangfan and Yichang produce an average of 700 to 800 tons of nightsoil daily while Wuhan reports figures of 5,000 to 7,000 tons of nightsoil production daily

Estimates of the levels of sanitation service indicate that the majority of residents in the urban areas of the project cities rely on septic tanks as the main means of sanitation disposal and treatment of kitchen and latrine wastewater. Service coverage for three project cities have been estimated based on area covered by existing sewerage/drainage pipelines as well as estimates of the population living in those areas with a direct connection to a sewerage line. In areas outside of the sewered parts of the city, the main sanitation service is septic tanks which may be connected to a stormwater or other drain. In some areas, particularly in the older parts of the city, there are buildings without septic tanks and other buildings without their own latrines. These estimates have been discussed with the project cities but, in view of the fact that no definite data exists, the figures given below are only estimated indications of the service level situation.

Table 2: Sanitation Service Coverage in 1993 ('000)

Type of Service	Huangshi Pop	(%)	Yichang Pop	(%)	Xiangfan Pop	(%)
Sewer w/ direct sewer connection	131	(23)	192	(50)	160	(32)
Septic tank only	292	(51)	101	(27)	204	(41)
No sewer or septic tank	147	(26)	90	(23)	136	(27)
Total Population	570	(100)	383	(100)	500	(100)

Out of the total population without direct sewer or septic tank connections (approximately 500,000 out of a total urban population in the three cities of 1.45 million), not all would be classified as having inadequate sanitation facilities Perhaps half of this unserved population, i e , about 17% of the total urban population can be classified as having no latrine facilities in their houses or buildings and have to rely on either public latrines, dry latrines, or neighboring facilities Although these figures are indicative estimates only, they do show that there is a significant proportion of the population without adequate sanitation facilities

The existing nightsoil management system generally consists of collection of septic tank latrine wastes and dry latrine nightsoil by the Sanitation Bureaus of each city, and storing in storage containers or discharging into the sewerage systems. In some cases, the Sanitation Bureaus perform septic tank cleaning operations on a call basis by residents, usually for septic tanks at buildings which are overflowing or not operating properly The wastes, sometimes treated and more often not, are either collected by private individuals (farmers) or transported by the Sanitation Bureaus' vacuum tank trucks to the fields to be used for fertilizer and for which a fee is charged.

The **major problems in the non-sewerage sanitation service areas** have been identified as follows: improper septic tank designs; septic tanks not built to meet existing regulations; irregular emptying and therefore overloading of septic tanks; inadequate treatment stages of the septic tank waste, improper designs of storage tanks for untreated nightsoil which meet the 30 days retention time requirement; and general pollution of the non-sewered areas from the discharge of septic tank effluent.

Sludge from septic tanks and fresh nightsoil from dry latrines are often used by agriculture and aquaculture farmers without any treatment. Although no health statistics are known at this point with regard to nematode morbidity, the above arrangement implies a considerable health hazard, especially when fresh nightsoil from dry latrines is being used. Dry latrines, both private and public, are often improperly designed and operated in an unsanitary manner resulting in general public health hazards.

4. Institutional Responsibilities

There are many government agencies with responsibilities for sanitation. In Wuhan, there are. (a) the Provincial Environmental Protection Agency; (b) the Provincial Construction Commission; and (c) the Provincial Department of Public Health which includes an Epidemic Prevention Station. There is also the Provincial Patriotic Health Campaign Committee,

mainly responsible for promoting policies on health education and monitoring of public places to ensure sanitary conditions. Each of the major cities has an Urban Construction Agency, an Urban Environmental Protection Bureau and Municipal Public Health Department There is usually also at the city level a Municipal Patriotic Health Campaign Committee Office. The institutions at the urban level generally report to the City Commission which is under the City Council They receive technical directives from government departments at the national and provincial level, but there is generally little enforcement and monitoring

The agencies directly involved in urban sanitation are the Environmental Sanitation Bureaus (ESB) which are under the jurisdiction of the Urban Construction Agency, and the Public Health Department which is mainly in charge of monitoring epidemiological data and carrying out health and hygiene promotion programs. While the Urban Construction Agency is responsible for the city's sewerage network, the ESB deals with all nightsoil activities, domestic waste collection and street sweeping.

With the increasing conversion of dry public latrines to the water-flush type, the need for close cooperation and interaction between Urban Construction Agency and ESB becomes important. It was found that communication between the two agencies is lacking. For example, during the initial process of preparing project proposals for the World Bank project, neither ESB nor the Public Health Department were consulted. Furthermore, the ESB seem to be largely out of touch with the people they serve. For example, there is no clear understanding of the demand for nightsoil, or of the number of people who use public latrines on a daily basis, or of what happens with the "unaccounted-for" daily nightsoil which is not collected by the ESB.

Annex 2

Hygiene Study Report

UNDP/World Bank Water and Sanitation Program
RWSGEAP
Hubei Academy of Medical Sciences

Contents

Hygiene Study Report

1. Introduction

Scope of Work

The Hygiene Study is part of the Nightsoil Management Improvement Study which is related to a component of the Hubei Urban Environmental Project (HUEP).[1] The overall nightsoil study's approach is to: a) review, assess and analyze current practices related to nightsoil handling; b) carry out demonstration and field testing activities to check and/or confirm a number of issues which may not be answered by a desk analysis; and c) prepare recommendations for nightsoil management improvement including a program of investments for HUEP and a hygiene education program for nightsoil handlers and other high risks groups.

The Nightsoil Management Improvement Study looks at the following key inter-related aspects:

1. Hygiene and epidemiological studies of the existing practice of nightsoil handling.

2. Socio-economic and marketing aspects of nightsoil collection, treatment, disposal and use.

3. Technical options, costs and benefits of improving nightsoil collection, treatment, disposal and use.

In addition to the above study several technical pilot activities are currently being undertaken in three cities. These activities are: construction and monitoring of modified septic tanks in both private and public latrines; construction and monitoring of modified nightsoil storage tanks; and setting up a pilot plant for co-composting of nightsoil and solid waste.

The pilot activities will be carefully monitored (through 1995) and refinements made; the information and improved capacity to undertake such activities will provide input to the proposed HUEP.

The Hygiene Study was undertaken in close collaboration with the Hubei Academy of Medical Sciences.

Objectives

The specific objectives for the hygiene component of the study are to:

a. review relevant publications and documentation on nightsoil and the current hygiene education program and implementation schedule in work units, communities and schools in Hubei Province, particularly in the four cities;

b. assess the amount of knowledge and practices/behavior, through a survey, of community members with regards to hygiene and the nightsoil environment in a sample of locations in the four cities;

c. undertake an indepth and qualitative study as in (b); and

d. provide recommendations for provincial and city officials of an appropriate hygiene education program for farmers, nightsoil workers and children to accompany the proposed nightsoil management component of the Hubei Urban Environmental Project.

2. Review of Health Services and Nightsoil Regulations

Chinese Health Care System

Health care in China, with its goal of promoting mental and physical health for all Chinese nationalities and of raising the level of health for all people, forms an important component of the country's social welfare. As 80 percent of the population live in the rural areas, rural health

services have consistently been the focal point of such work. The National Government placed the emphasis of health work on disease prevention. "The prevention first, treatment combined with Chinese traditional medicine and western medicine" policy was applied for forty years.

The health care system in China must be seen in the context of the country's sociopolitical system. The organization of the country's economy, particularly at the grassroots level, influences both the organization and financing of health care in the rural areas. The emphasis on self-reliance and the mobilization of the masses through the Patriotic Health Campaigns, in operation since 1952, have made community participation and involvement a way of life. Within this system, health is seen as an integrated part of the socioeconomic life of the community.

The Government at every level has a special administrative office which is responsible for communicating and cooperating with Government leaders, the various departments and general health campaigns. In terms of the health system, the Ministry of Public Health is the national health policy maker. The health bureaus carry out decisions for local health problems. The Academy of Preventive Medicine provides technical guidance for disease control. The provincial anti-epidemic stations are responsible for planning health programs, while the county anti-epidemic stations and the township health units carry out the actual implementation of such plans.

National Health Care Services

Health care in China, with its goal of improving the level of health for all people, especially in the promotion of mental and physical fitness, forms an important component of the country's social welfare. As 80% of the population live in the rural areas, rural health services have consistently been the focal point of such work. The national government placed the emphasis of health work on disease prevention first and treatment second; this policy has been applied for the past forty years.

The health care system in China must be seen in the context of the country's sociopolitical system. The organization of the country's economy, particularly at the grassroots level, influences both the organization and financing of health care in the rural areas. The emphasis on self-reliance and the mobilization of the masses through the Patriotic Health Campaigns, in operation since 1952, have made community participation and involvement a way of life. Within this system, health is seen as an integrated part of the socioeconomic life of the community.

The national organization structure of health care is coordinated through a special administrative office which is found at every level of government. This office is responsible for communicating and cooperating with local government leaders and the different departments. The Ministry of Public Health is the national health policy maker. The health bureaus carry plan and implement activities for local health problems. The Academy of Preventive Medicine provides technical guidance for disease control. The Provincial Anti-Epidemic Stations are responsible for planning activities for epidemic control, while the County Anti-Epidemic Stations and the Township Health Units carry out the actual implementation of such plans.

City Health Care Services

The City Government has attached great importance to the health service. At present, one of the objectives for social development of local authorities is to implement health care, to improve rural health conditions and to upgrade the health of farmers so as to achieve the strategic goal of health for all by the year 2000, set by WHO. The city health systems have developed, with initiatives from the states, collectives and community, and through the combined efforts of health professionals and part-time workers.

The health network has different levels, consisting of city, district (county) and community (villages), to provide health service to the people. The health services at the district and community level are the force in primary health care, performing the actual function of medical care, community health and disease control. This system has adopted various

practices, such as health insurance, cooperative medical service, contractual services for disease prevention or child immunization, to effectively ensure the provision of health.

Each city has the same systems. There are general hospitals, district hospitals, private clinics and disease control organizations or anti-epidemic stations. The Anti-Epidemic Station is in charge of disease prevention. It was reported that there were a total 10,472 of health units with a health staff of 267,548 in 1990 in Hubei Province, of which 120 anti-epidemic units with 7,602 health staff were involved in preventive medicine. On average, 2.86 medical doctors serve a population of one thousand inhabitants. Payment for medical care is regulated at provincial and county level. In Hubei Province payment for health services was introduced 1987 with only government staff, workers and students above high school level receiving free medical care.

Nightsoil Regulations

A review of the publications and documentation on nightsoil indicates that there is an increasing number of legislation and regulations regarding the improvement of nightsoil management in China. A few of the more important ones will be briefly quoted below.

- Item 2 of Section 2 of "Infectious Diseases Prevention Law of the People's Republic of China" (published on February 21, 1989):

  "All local authorities should construct and improve public sanitation facilities in a planned way, properly treat waste water, solid waste and nightsoil and improve drinking water conditions."

- Item 10 of Section 2 of "Implementation Regulation of Infectious Diseases Prevention Law of the People's Republic of China" (published on December 6, 1991):

  "Cities should follow the standards of urban sanitation facilities implementation regulation to build public latrines, dustbins, nightsoil treatment facilities and waste water, rain water drainage and treatment systems and other sanitation facilities."

  "The countryside should gradually renovate latrines, treat nightsoil properly, strengthen the management of public and domestic water supply, develop necessary sanitation management rules, forbid the presence of waste water pond, nightsoil pit and other polluting resources near areas of drinking water resources, forbid washing nightsoil containers and transport equipment near drinking water resources".

- "Nightsoil Treatment Standards" (GB 7959-87) published by the Ministry of Public Health states that *nightsoil should achieve specific sanitary criteria after treatment.*

Hubei Province and the four project cities of Wuhan, Huangshi, Yichang and Xiangfan have no special department to enforce the regulations of nightsoil collection and usage. The Provincial Health Bureau has developed a booklet on the design of the selected three septic tanks latrine and distributed to the whole province.

Review of Hygiene Education

Health education in Hubei is the coordinated and guided by the Hubei Provincial Institute of Health Education (HPIHE). Health education is considered an important part of preventive medicine. At present, there are 10 health education institutes at provincial, municipal and county levels in the province. Among the four project cities, only Wuhan has a HPIHE.

HPIHEs are in charge of health demonstration activities in the countryside, schools, factories and hospitals. They conduct health education consultancies, provide lectures, workshops and health education and scientific promotional exhibitions, develop all kinds of promotional

materials, and publish the periodical "Hubei Health Weekly" and "Wuhan Health Newsletter". HPIHE together the following institutions implement health education activities with varying degrees of frequency and intensity.

Schools. Hubei Province has gradually been improving its health education program in schools which was only institutionalized in 1992. In July 1994, it reproduced and improved on an eight volume set of Health Education Primers which were based on an original five volume set. The eight primers are meant for first year of primary school to the third year of middle school, averaging about one primer per grade per year. Health education classes are 30 minutes each at the frequency of one class per week.

The health messages contained in the primers appear to be more extensive than intensive. The curriculum for primary school focuses on personal hygiene, diseases and their prevention. The messages urge the children to be clean, to wash their hands before eating and after defecation, to eat properly washed and cooked food, etc. However, the messages appear not to go beyond a list of "dos" and "don'ts". The curriculum for high school focuses on nutrition and general health aspects.

Hospitals. There is one full time health education staff in each hospital who is responsible for providing advice to in-patients and out-patients. Posters are displayed regularly.

Work Units. Each unit provides health education to its own members with regards to occupational health and work safety within its own discipline. The service provided is irregular.

Anti-Epidemic Stations. The stations prepare a regular paper "Hubei Health Weekly" which is distributed to all hospitals, local clinics, town centers and villages. The paper is also available for sale to the public. The HPIHE provides direct health education to the public only in times of disease outbreaks.

Mass Media. Health messages are shown on television irregularly and briefly; in 1993 only three of these advertisements were shown and for 3 to 5 minutes each. However, there is a regular weekly half hour program on issues like the dangers of smoking, AIDS and general health. Similarly, radio has a regular daily health broadcast of 15 minutes duration. Hygiene and sanitation are infrequently discussed in these programs.

Special Programs. a) National Health Campaigns are carried out during special health days (eg., Worlds AIDS Day); b) Disease Control Programs are launched infrequently; and c) Aid Organizations - UNICEF is starting a provincial health education known as "Life Knowledge" for mothers. It is a pilot activity and will target a few counties in selected provinces, Hubei being one of them. This will include family health and hygiene and diarrheal prevention for infants and children under five years old.

In general, water and sanitation related diseases do not have a high priority even though they are included in the health education syllabus. On the topic of sanitation in the school syllabus, there is little or no teaching about safe water, proper excreta disposal, proper drainage, and disease transmission routes and control. Health education approaches and materials are very didactic in nature. In addition, health education teachers have little training, minimal teaching tools and aids to assist them in the classroom.

3. Hygiene Study

Hygiene Survey and Interviews

An extensive hygiene survey and a limited number of indepth focused group interviews were carried out in Wuhan during the study. The main objective of the survey was to determine the amount of knowledge and practices/behavior of community members with regard to proper hygiene in connection with nightsoil handling. It was also envisioned that the survey data could be used at a later stage in the HUEP project as a baseline for evaluation.

Good hygiene behavior is broadly defined as a wide range of actions that promote health and keep the person's surroundings clean, especially in order to prevent illness or the spread of water and sanitation-related diseases. These diseases include various types of diarrhea, worm infestations, skin and eye infections and vector-borne diseases. The variables for the survey

focused on diarrhea and selected hygiene behavior.

The survey questionnaire was developed based on the three key sanitary behaviors which interrupt disease transmission. These key behaviors are:

a. sanitary disposal of feces;

b. hand washing (especially after defecation and cleaning babies' bottoms, before preparing food, and before eating; and

c. maintaining drinking water free from fecal contamination; and

Methodology

The study team was comprised of international and national consultants. Dr. Li Hangfan of the Hubei Academy of Medical Sciences/Hubei Provincial Anti-Epidemic Station was responsible for assisting with the hygiene component. Due to time constraints, only two districts in Wuhan have been surveyed--Hangkou and Wuchang Districts. The survey was conducted by members of the Anti-Epidemic Station under the guidance of Dr. Li. Data was coded and entered into the computer under the coordination of Dr. Cheng Feng of Hubei Academy of Medical Sciences using the EPI INFO software developed by the Center for Disease Control, Atlanta and WHO. Mary Judd, with the assistance of the national consultants, analyzed and wrote this report.

It was decided from the beginning that the epidemiological study and the hygiene survey would focus on the same two locations so that the information could be used for a richer analysis of both studies. The communities of Qiaokou in Hangkou District and Hongshan in Wuchang District were randomly selected from a combined total of 30 communities. These communities are located at the periphery of Wuhan. Within the two communities of Qiaokou and Hongshan, 400 households were randomly selected for the survey from a combined total of 500 households. Of the 400 surveys only 385 were entered into the database as 15 were not valid.

The focused group discussions were also held in Wuchang District. City residents (consumers) and suburban residents (farmers) were the two major categories of participants which totaled 100. The discussions were held with five different age/gender groups within each category (see Attachment 2)

The information presented below is from the survey data of a randomly selected general population. The analysis, therefore, is also general and only broad relationships can be made at this phase. The more indepth and qualitative information of the next phase will be able to provide more specific relationships and patterns which will be useful for developing a hygiene education program.

Survey Group

The composition of the sample of 385 persons (199 respondents from Hangkou District; and 186 from Wuchang District) interviewed in the hygiene survey is presented below as well conditions of water supply and sanitation facilities for their households.

Table 1a: Occupation of Respondents

Occupation	Qiakou (Hangkou District)		
	Women	Men	Total
Worker	20	20	40
Farmer	34	63	97
Professional	28	30	58
Not Working	1	3	4
TOTAL	83	116	199

Table 1b: Occupation of Respondents

Occupation	Hongshan (Wuchang District)		
	Women	Men	Total
Worker	21	19	40
Farmer	35	51	86
Professional	25	33	58
Not Working	1	1	2
TOTAL	82	104	186

Survey respondents were grouped into three main occupational categories: worker, farmer, and professional. The last category is made up of mainly cadres, intellectuals, and medical staff. Women made up 43% and men 57% of the total respondents. The educational breakdown of the respondents, as shown in Table 2, indicate a relatively educated group where more than three quarter (76%) of them have secondary school education. The high educated level is also similar among the epidemiological study respondents.

Table 2: Educational Level of Respondent by Gender

Education	Women	Men	Total	%
No Education	11	25	36	9
Primary	19	39	58	15
Junior High	56	63	119	31
Senior High	56	48	104	27
College	23	45	68	18
TOTAL	165	220	385	100

Some differences in educational level appear when viewed from an occupational perspective. More farmers report no formal education than workers or professionals. The professional group had the most number of respondents with secondary education and above (91%), followed by workers (80%) and by farmers (62%). In fact, the professional group as expected had the most number of respondents with a college education. This pattern is also similar for the epidemiological study respondents.

Table 3: Educational Level of Respondents by Occupation
(in percentage)

Education	Worker	Farmer	Prof.	Total
No Education	2	13	5	9
Primary	9	25	4	15
Junior High	47	36	14	31
Senior High	33	17	38	27
College	9	9	39	18
TOTAL	21	48	31	100

4. Study Findings

Water and Sanitation Facilities

Lack of proper water supply and sanitation facilities for farmer households. The data on drinking water sources and sanitation facilities in the study locations reveal a lack of proper facilities, particularly for the farmer households. Figure 1 shows that 35 percent farmer households used water sources other than house and/or public taps with a corresponding figure of about 12 percent for the other households. Of these households, 26 percent still obtained water from rivers and springs compared to about 10 percent for the other two groups of households.

Over 70 percent of all groups of households have private latrines as shown in Figure 2 with the remaining households using public latrines. Private latrines are divided into two types: 1) water flushed ones which are generally located within an apartment building or house; and 2) dry pit latrines which are built separate to the residence. Public latrines are also divided into

water flushed and dry pit latrines. More information on the different types of latrines is provided in the endnote.[2]

In the survey, farmer households in general used dry pit latrines more than the other households, 72 percent as compared to about 40 percent (see Figure 3). The breakdown of dry pit latrines for farmers were: 88 percent of private latrines and 55 percent of public latrines. Among the complaints reported by respondents who use the dry pit latrines were bad odors, flies and uncollected nightsoil, especially during the non-planting season. A few respondents who use water flushed or wet latrines complained of occasional non-functioning of the flush system or of blocked sewers.

In informal discussions, non-farming city respondents who still use dry public latrines had expressed the desire for improved water flush latrines and were willing to pay for their use. Farming respondents continued to prefer the dry latrines because of their use of the collected nightsoil for agriculture. However, they welcomed improvements for the latrines.

Figure 1: Type of Water Source

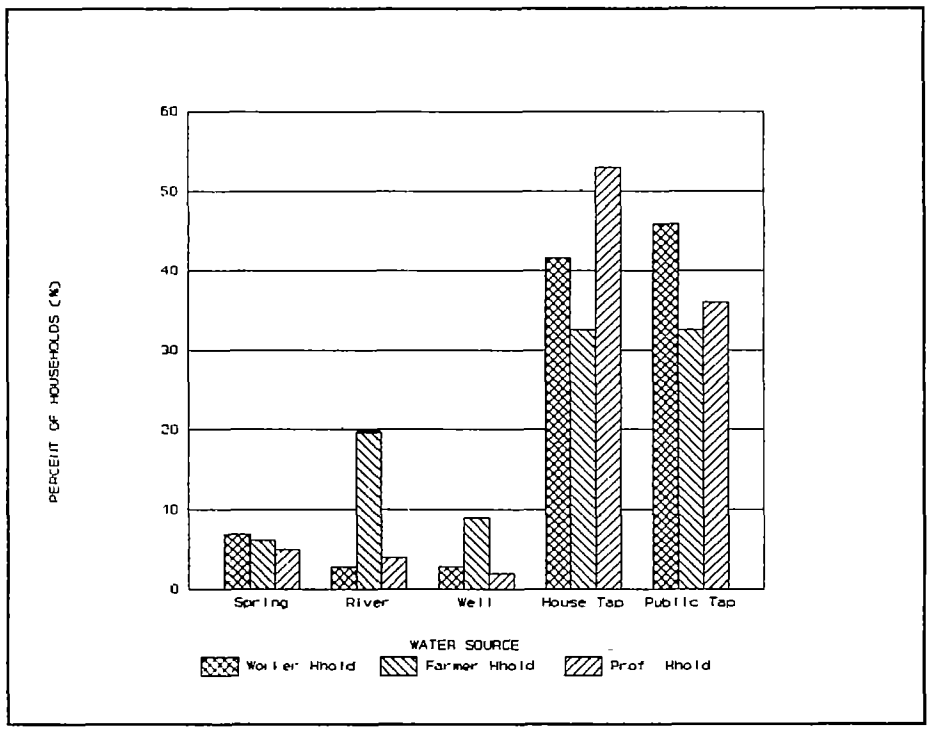


Figure 2: Private/Public Latrines

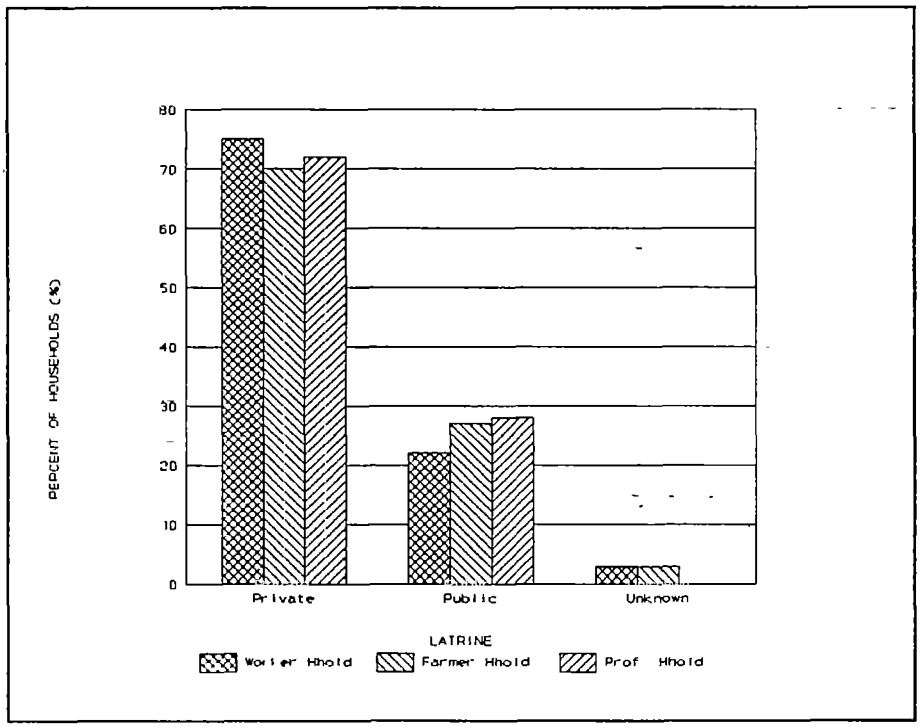


Figure 3: Wet/Dry Latrines

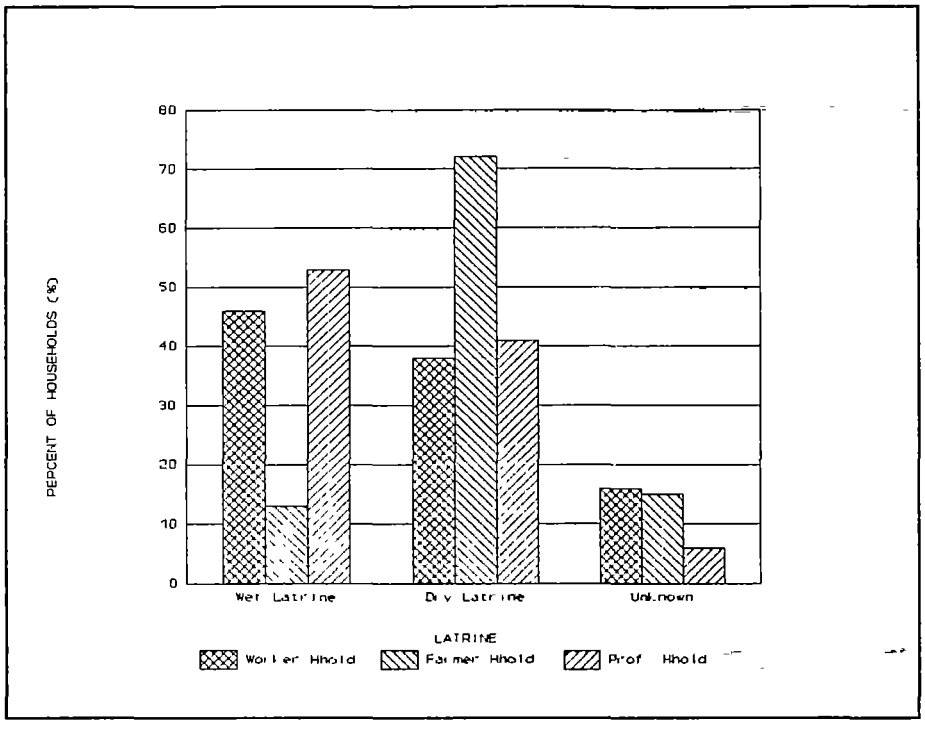
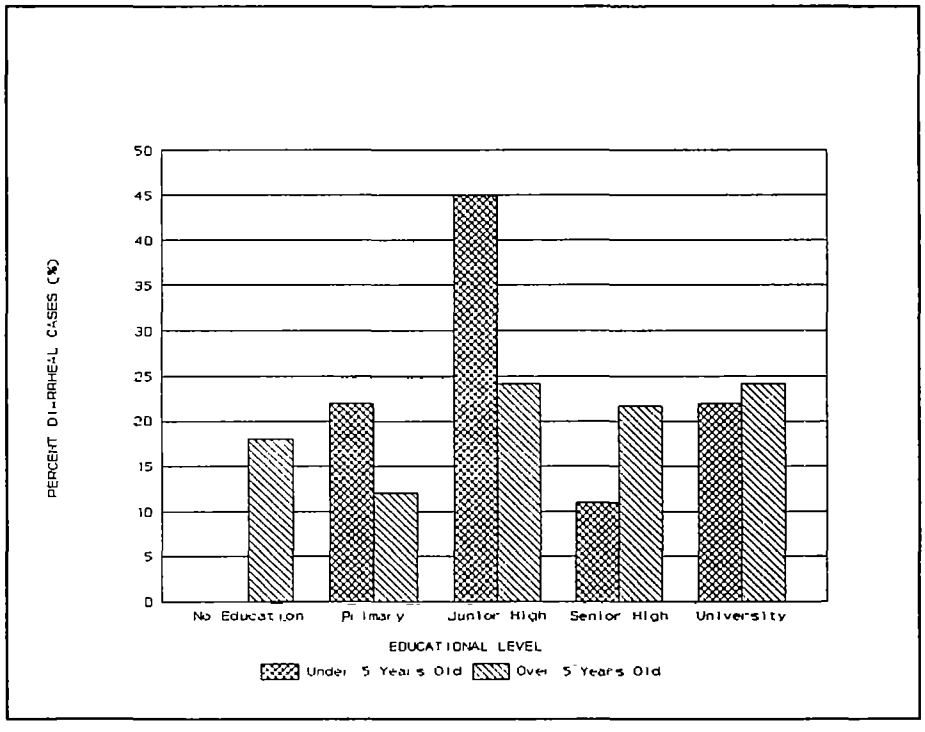


Figure 4: Educational Level of Respondents and Diarrheal Cases



Some school facilities need to be improved. Observation of a city's middle high school during a focus group discussion show that improvements need to be made in the schools's water and sanitation facilities. The school has an enrollment of 3,000 students and equipped with four public latrines. Only one latrine is near the classroom and most used by the students. The facility is old and water is not available for hand washing after defecation. The interviewer reported that the lack of improvement of the latrine was not a financial problem but more one of the lack of awareness of a health hazard.

Hygiene Knowledge

The following sections examines the hygiene knowledge and practice of key sanitary behaviors of the respondents. It is appropriate at this point to say a few words about the focus group discussants' cultural perception of nightsoil. Nightsoil is generally considered "dirty" but the fresh feces of children under two years old are believed to be cleaner than the rest.

Most discussants acknowledged that improper handling of nightsoil can caused diarrhea but they did not view it as a "real" disease but only as a symptom of improper food handling by street vendors. As a result, they did not see the need to improve their own hygiene behavior but advocated stricter controls for management of the food services outside the homes.

As mentioned above, the people interviewed in the survey had relatively high educational levels. A comparison was undertaken to see if there was any correlation between education and diarrheal cases reported in the sample households, ie., the higher the educational level the lower the number of diarrheal cases. Diarrhea was selected as a basis for analysis because it is one of the main sanitation-related diseases. Safe excreta disposal is one of the primary barriers to the transmission of diarrhea as it helps to prevent the disease organisms from getting into the environment.

No significant correlation between levels of education and the number of diarrheal cases. Figure 4 indicates that there does not appear to be any significant correlation between levels of education and the number of diarrheal cases reported for the households.

Diarrheal incidences in the last two weeks prior to the survey occurred across the various levels of educated households. In fact, there were more cases reported in the households where the respondents had secondary education than those with primary school education and/or no education. Diarrheal cases (12 cases) among children under 5 years old were highest in the households where respondents had junior high education.

Partial knowledge of key sanitary behaviors. The survey examined respondents' knowledge and practice of key hygiene behaviors. The question was asked about what can be done to prevent diarrhea. The answers are indicated in Figure 5. The information indicates that over 70 percent of those interviewed in both worker and farmer households have prioritized one of the key hygiene behaviors--hand washing--as a prevention for diarrhea. Over 90% in the professional households listed hand washing as an important diarrheal prevention behavior. About 20 percent and below of the remaining households listed covering of food as an important behavior and only a handful of households mentioned the proper storage of water as important.

From the information above, it can be inferred that the respondents have partial but not full knowledge of key sanitary behaviors and that there is a lack of awareness of the danger of diarrheal disease, especially to young children. This limited knowledge can be attributed to a large part to the limited exposure of people to hygiene education.

Figure 5: Knowledge of Diarrheal Prevention

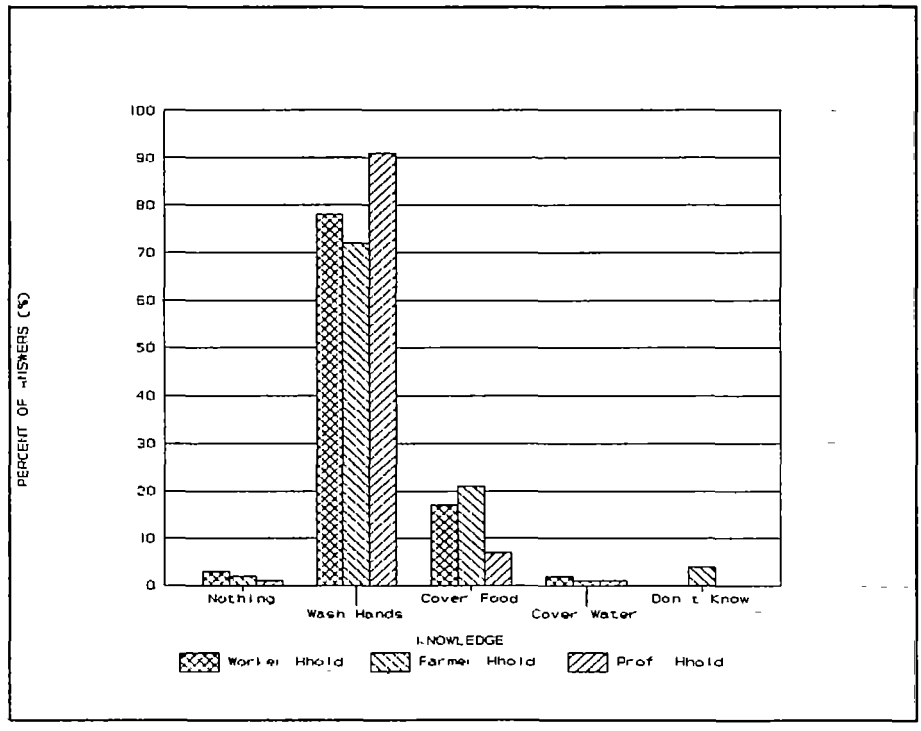


Figure 6: Remedy for Diarrheal Prevention

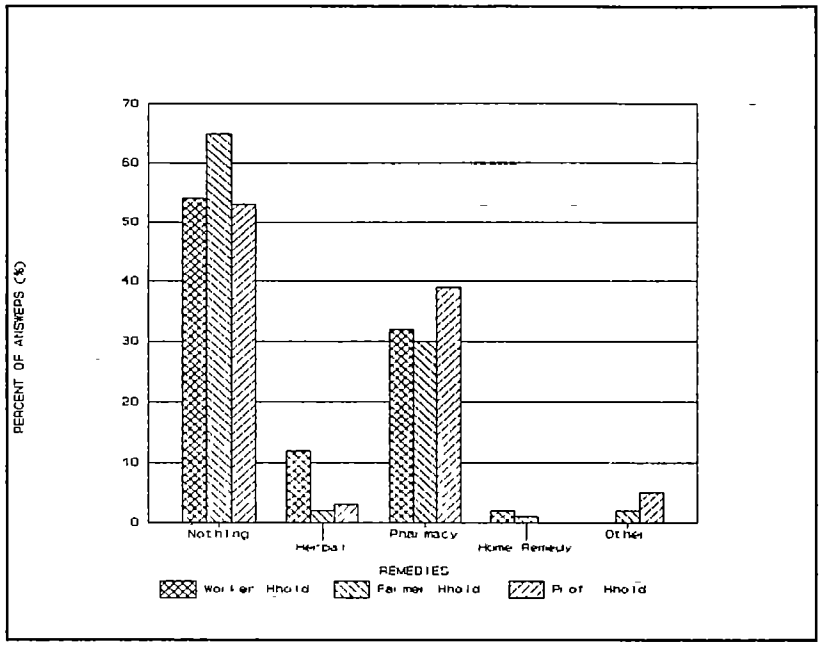
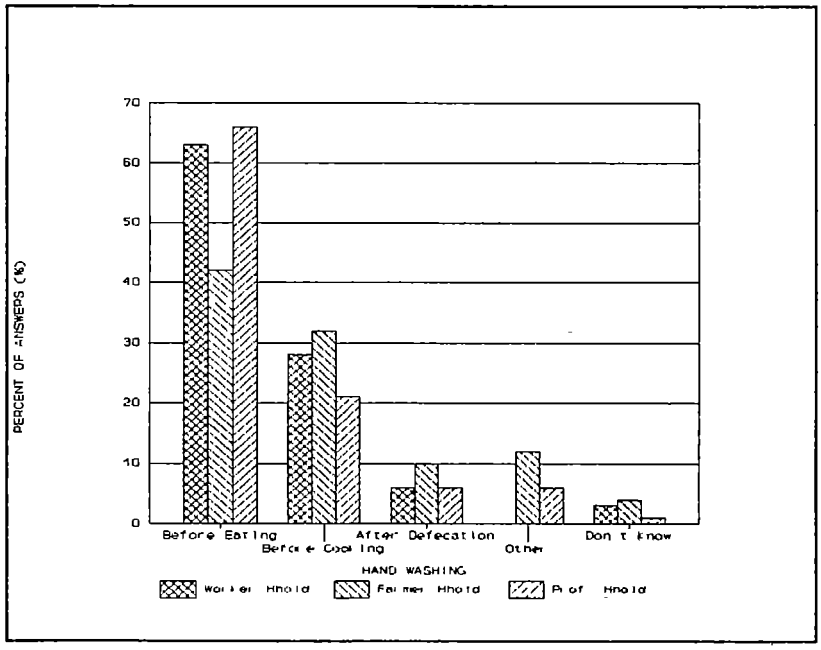


Figure 7: Hand Washing Practice (a)



Data from the epidemiological study confirms this point by reporting that 34 percent of farmer respondents and 11 percent of consumer respondents had never been exposed to health education (refer Annex 3). Those that had exposure reported that it was minimal. Exposure to health education from schools were reported by less than a quarter of the respondents. The epidemiological study also found that people without exposure to health education in their lives had a significantly higher chance to contract infectious diseases, e.g., 5.6 times higher for hepatitis and 7 times higher for dysentery.

Hygiene Practices

Remedy for Diarrhea

General lack of awareness of what to do when diarrhea occurs. Figure 6 relates to the question of what was done the last time the respondent's child had diarrhea. An overwhelming majority in both the worker and professional households (54 and 53 percent respectively) and the farmer households (65 percent) did nothing with the much higher number among the farmer. About one third of the respondents (32 percent workers, 39 percent professionals and 30 percent farmers) went to the pharmacy for a cure. Some households also used herbal cures. The small range of differences for each behavior among the different categories of households indicate that there is a general lack of awareness of what to do when diarrhea attacks their children. These initial findings indicate that there is a need to provide more information on diarrheal prevention and what to do when it occurs.

Hand Washing

Washing hands after defecation not well practised. Several questions were asked about the actual practice of hand washing, eg., when do the respondents wash their hands and how do they do it. Figure 7 illustrates that many respondents reported washing their hands before eating (63 percent for those from the worker households, 42 percent from the farmer households, and 66 percent from the professional households) and before cooking (29 percent, 32 percent and 21 percent from the respective households). Washing hands after defecation did not appear to be practised by the majority of the respondents. Those who did comprised about 10% and below of the respondents (6, 10 and 6 percent from the respective household categories).

The vast difference in washing hands before eating and after defecation cannot be explained by the degree of availability of piped water services because, eg., over 89 percent of the respondents in the professional group have piped water facilities (53 percent have household taps and 36 percent use public taps) and while 66 percent of them wash their hands before eating only 6% wash their hands after defecation. Nor can the discrepancy be explained by educational and occupational factors. The most probable explanation is the lack of awareness of proper hygiene behavior in this case.

Hand washing with water only. How people wash their hands is also an important indicator of good practice. Figure 8 shows that 80 to 83 percent of those interviewed used water only while 17 to 20 percent used both soap and water.

Figure 8: Hand Washing Practice (b)

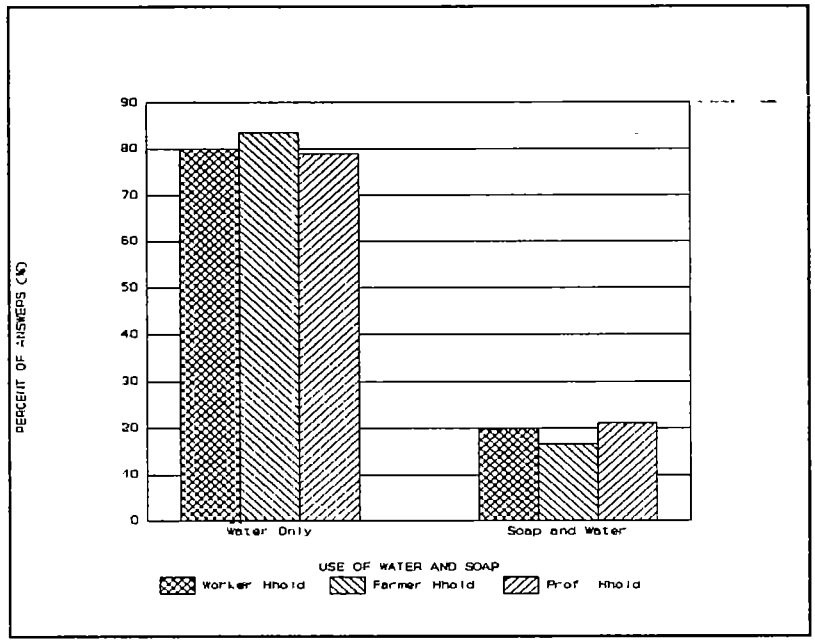


Figure 9: Hygiene Practices

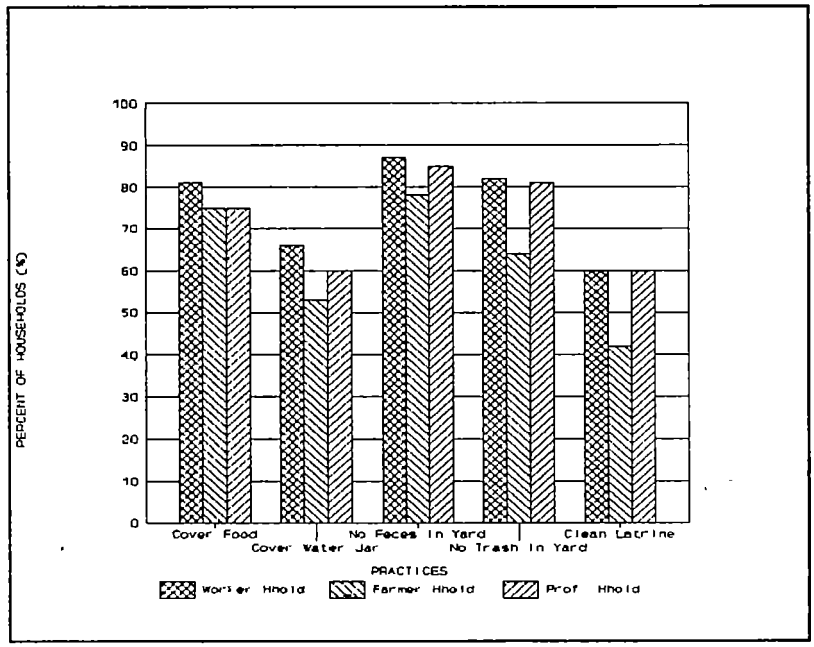


Figure 10: Condition of Latrine Facilities - Clean/Unclean

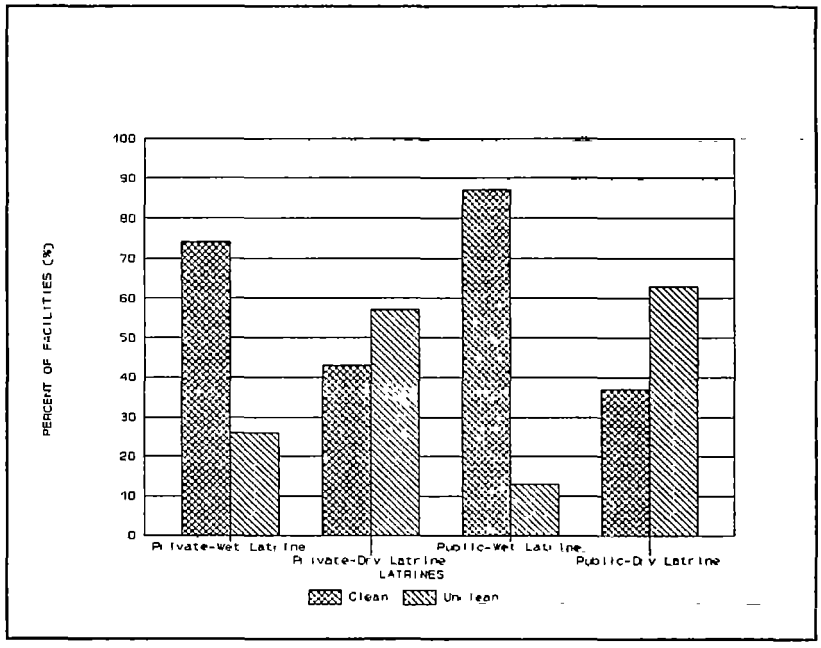
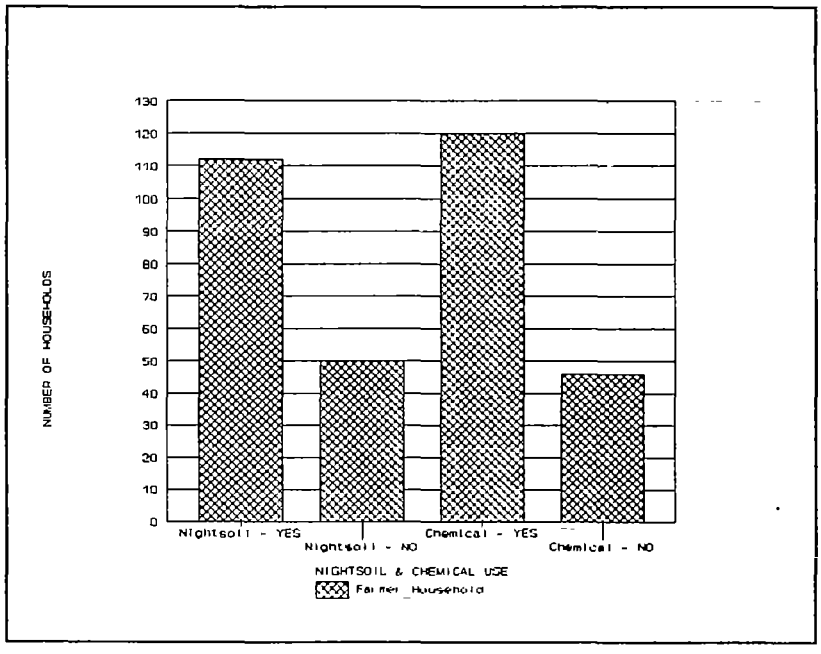


Figure 11: Nightsoil and Chemical Use in Agriculture by Farmers



For each practice the differences among the households are slight. The data indicates that many people practised hand washing but the frequency and method may not be sufficient to ensure the prevention of illness or the spread of diseases, especially diarrhea. The inadequate and/or improper hand washing was found to be highly significant for the increased risks for dysentery and hepatitis (refer to the section of this report on the epidemiology study).

Other Hygiene Practices

Practice of several good hygiene behaviors. It was observed by the interviewers that the households they visited demonstrated other good hygiene practices in several categories as indicated in Figure 9. It was observed in about 75 to 80 percent of all households that food was covered, and about 53 to 65 percent where water jars were covered, with the farmer households exhibiting less care. The good practices indicate that even though they were not prioritized as important (refer Figure 5, people practised them. Over 75 percent in all households demonstrated clean surroundings around the house and in the yards where there were no visible sign of feces or garbage.

Over 50 percent of dry pit latrines are unclean. The cleanliness of the latrines in the households did not score as well. Forty percent of latrines in the worker and professional households and 58 percent in the farmer households were rated not clean by the observers. Figure 10 illustrates the condition among the various types of latrines. In general, water flushed latrines were cleaner than dry pit latrines in both private and public facilities with 74 and 87

percent respectively. Among dry pit latrines 43 percent of private facilities and 37 of public facilities were considered clean. The *data shows that over 72 percent of the farmer households use dry pit latrines* (refer Figure 3). That water flushed public latrines were observed to be cleaner than private latrines may be explained by the fact that many of the public ones have been more recently constructed than the private ones which are in older buildings.

Nightsoil Use[3]

Nightsoil and chemical fertilizer are widely used in agriculture. The survey confirmed the popular notion that nightsoil is still widely used as fertilizer in agriculture in Hubei. In addition, it also indicated the growing preference and use of chemical fertilizer. Figure 11 shows that among the farmer respondents (N = 183) 61 percent said they used nightsoil as fertilizer for their crops. Many of the same farmers and more also used chemical fertilizer as a supplement to nightsoil (65 percent). When asked, more respondents said they preferred to use chemical fertilizer (54 percent) than nightsoil (30 percent).

The main reason for the continued use of nightsoil was due to its relative low cost. The main reasons for the growing preference for chemical fertilizer were because it was easier to use and nightsoil was becoming more difficult to obtain. Similar findings are found in same questions asked in the epidemiological study.

Seventy percent of farmers use untreated nightsoil. Of those who used nightsoil as fertilizer, 70 percent used fresh nightsoil while 30 percent reported using treated nightsoil. The high exposure to untreated nightsoil use together with the low practice of hand washing using soap (refer Figure 7) put this group of people in a health risk situation. The transmission of water and sanitation-related diseases will continue among these households as long as the practice continues.

5. Conclusions

Nightsoil has traditionally been used for cultivation in China, especially of fruits and vegetables. The tradition continues today though perhaps with an increasing shift to chemical fertilizer. In the cities visited, nightsoil demand is still strong because of the extensive cultivation of vegetables at the periphery of the city. Many farmers feel that "vegetables taste better using nightsoil than chemical fertilizer." The demand for vegetables and other food crops will grow significantly in the coming years due to the rapid growth of the cities which have recorded growth rates of 6 to 8 percent per year.

The Chinese who were interviewed perceive nightsoil as "dirty" but they believed that the fresh feces of children under two years old is cleaner than the others. Most discussants acknowledged that improper handling of nightsoil can cause diarrhea but they did not view it as a "real" disease but only as a symptom of improper food handling by street vendors. As a result, they did not see the need to improve their own hygiene behavior but advocated stricter controls for management of the food services outside the homes.

The key findings from the hygiene study are summarized below:

1. **Education and hygiene knowledge:**

   - No significant correlation was found between education and knowledge about health and hygiene. However, there were more farmers (13 percent) with no formal education than the non-farming groups (5 percent and below).

2. **Inadequate sanitary facilities:**

   - Lack of proper water supply and sanitation facilities, particularly for farmer households where 35 percent of farmer households did not have access to pipe water and 72 percent still used dry pit latrines.

   - Residents in the urban areas who still use dry public latrines expressed a demand for the water flush type and were willing to pay for their use.

   - Some school facilities need to be improved. In an extreme case, 3,000 middle school students had access to one old public latrine without water for hand washing.

3. **Limited knowledge about proper hygiene behavior:**

   - There was only partial knowledge of key sanitary behaviors. In fact, respondents did not see the need to improve their own hygiene behavior but advocated stricter controls for management of the food services outside the homes which they assumed to be the main cause of diarrhea.

   - General lack of awareness of what to do when diarrhea occurred, especially among farmer households where 65 percent reported doing nothing when their children had diarrhea (54 and 53 percent were reported for the worker and professional households respectively).

   - Limited exposure to hygiene education in schools. In fact, the epidemiological study reports that less than 25 percent of the respondents were ever exposed to health education in schools.

4. **Some practice of proper hygiene behavior but inadequate practice of key ones:**

   - There was generally good practice of several proper hygiene behaviors where more than half the respondents kept flies from food, covered water jars, kept house and yard surroundings clean.

   - Many households did not maintain their latrines properly with 58 percent for farmer households and 40 percent for worker and professional households.

- Washing hands after defecation was not well practised.

- Hand washing was mainly with water only and not with soap; those who used soap and water constituted about 20 percent of the respondents.

5. General hygiene education curriculum:

- Health education is implemented by the Hubei Provincial Institute for Health Education (HPIHE) together with the following institutions: schools, hospital, work units, anti-epidemic stations, mass media, and special health units. In general, water and sanitation related diseases do not have a high priority even though they are included in the health education syllabus.

- Health messages contained in the primers are more extensive than intensive; the messages do not go beyond a list of "dos" and "don'ts".

- Primary school curriculum focuses on personal hygiene, diseases and their prevention. High school curriculum focuses on nutrition and general health aspects.

- Regarding sanitation, there is little or no teaching about safe water, proper excreta disposal, proper drainage, and disease transmission routes and control.

- Health education approaches and materials are very didactic in nature; health education teachers have little training, minimal teaching tools and educational materials to assist them in the classrooms.

6. Use of nightsoil in agriculture:

- Nightsoil was widely used in agriculture by 61 percent of the farmers interviewed.

- The same farmers and several more reported using chemical fertilizer to supplement nightsoil.

- Seventy percent of farmers who use nightsoil used untreated nightsoil.

- More than half the respondents said they preferred to use chemical fertilizer due to the current difficulty of obtaining nightsoil and also because of the ease of using the former. However, the high cost of chemical fertilizer kept the use down.

- There was a higher preference for nightsoil by farmers if it was of good quality (i.e., not watery sludge), easily available and transported to or closer to their farms.

Findings from the hygiene study indicate a weak hygiene education and sanitation promotion program and limited practice of proper sanitary behavior. People had some knowledge of the relationship between proper hygiene behavior and disease prevention but it was not fully understood and key behaviors were not well practised. Sanitation facilities were not adequate and there was demand from users for improvements. The continued demand for nightsoil in the peri-urban areas means that improvements in physical facilities and sanitation service will have to take this demand into account.

NOTES

1. The hygiene study is complemented by an epidemiological study (Annex 3) with the following objectives: 1) to assess whether the current practice of untreated night soil management leads to excess transmission of excreta-related disease in the group supposedly at risk when compared with the general background level of the diseases in the population; 2) to estimate the health risks associated with night soil management of the population of the urban core using a case-control approach and estimate their public health relevance; and 3) to determine which risk factors play a role in disease transmission in case an excess risk attributable to night soil use would be established.

   Information on the overall health situation in Hubei Province is found in the HUEP Draft Pre-Design Review Report for Wastewater Collection, Treatment and Disposal, September 1994, pp. 10.20-10.25.

2. Private Latrines. All apartment buildings have indoor private latrines connected to septic tanks and eventually to sewers which are discharge untreated into the rivers and lakes. Some of the latrines in older apartments do not work and residents use the public latrines. Discussions with one lady who lived in an old building with non functioning latrines indicated that the latrine was blocked because, as she was told, the pipes were too small. She and her family used the public latrine 100 meters from their apartment and have to pay each time they use it. In another building, only the latrines on the bottom floor did not work. The others on higher floors were functioning.

   Public Latrines. These are divided into a section for men and one for women. In general, the design is simple--each section has three to five open stalls with a trough running through all the stalls. Every 15 to 30 minutes, the caretaker turns on a valve and water rushes out of a 6 to 8 cm diameter pipe to flush out the trough. At night, when the caretaker is not on duty no flushing takes place.

   Several first grade latrines are currently being built and/or planned for the cities. These latrines are built near tourist sites and are similar to western toilets with individual stalls and sit down toilets, cistern flush and wash basins.

   Dry Latrines - Public. There are still many dry public latrines. One such latrine we visited, in a low income area with houses built close together, was filthy and smelly with flies buzzing around. There was an opening about 50 cm square for retrieving of nightsoil by farmers behind the building; it was filthy as well with fecal deposit all around the opening. The closest house was only the width of a narrow lane away. The area has a dense population of over 1000 people served by two public latrines. The area is also served by group taps for water supply.

3. Nightsoil has traditionally been used for cultivation in China, especially of fruits and vegetables. The tradition continues today though perhaps with an increasing shift to chemical fertilizer. In the cities visited, nightsoil demand is still strong because of the extensive cultivation of vegetables at the periphery of the city. Many farmers feel that "vegetables taste better using nightsoil than chemical fertilizer." The demand for vegetables and other food crops will grow significantly in the coming years due to the rapid growth of the cities which have recorded growth rates of 6 to 8 percent per year.

   Farmers do not appear concerned about the use of untreated nightsoil. A farmer expressed the opinion that "the fresher the nightsoil the better." From an agricultural point of view she was correct, however, from a health point of view her belief was highly questionable because of the presence of harmful pathogens. Again, more information is required in the epidemiological area.

   The use of nightsoil will continue not only from the influence of tradition and perhaps cost but also

from existing Government policy of encouraging the use to preserve the fertility of the soil. Farmers are encouraged to mix nightsoil with soil while preparing the land for cultivation. Sometimes, county officials will travel around the area to check that it is done. The access to nightsoil is becoming a problem for farmers because of the lack of transportation to bring nightsoil from the city to the farmers. As a consequence, many are turning to chemical fertilizer.

ATTACHMENT 1

NightSoil Management Improvement Study 6/94

HOUSEHOLD SOCIAL/HEALTH BASELINE

CODE

Community: _____ Household: _____ _____
Interviewer _____ _____
Date of Interview: ____/____/____

A: CENSUS

1. The person being interviewed is: _____
   1. MOTHER
   2. OTHER

2. Sex of the person being interviewed: _____
   1. MALE
   2. FEMALE

3. Age of the person being interviewed: _____

4. Occupation of the person being interviewed: _____
   1. WORKER
   2. FARMER
   3. CADRE
   4. INTELLECTUAL
   5. MEDICAL STAFF
   6. OTHER

5. Years of education of the person being interviewed: _____

6. How many people live in the house? _____

7. How many generations live in the house? _____

8. How many children between 0 and 3 years of age live in the house? _____

9. How many children between 4 and 5 years of age live in the house? _____

10. How many children age 5 years and younger have died in your family? _____

11. Are you currently breastfeeding a child? _____
    0. NO
    1. YES
    9. DOES NOT APPLY

B. MORBIDITY

12. How many of the children age 4 years and younger had diarrhea during the past two weeks? _____

13. How many of the children age 4 years and younger have diarrhea today? _____
    Causes: _____

14. The last time one of your children had diarrhea, what did you give her/him?
    0. NOTHING
    1. HERBAL REMEDY
    2. PHARMACY REMEDY
    3. HOMEMADE SOLUTION
    4. ORAL SOLUTION FROM A PACKET
    5. OTHER

15. Did you continue to breastfeed the child with diarrhea? _____
    0. NO
    1. YES
    9. DOES NOT SUCKLE/DOES NOT APPLY

16. (IF DOES NOT SUCKLE) Do you continue to breastfeed a child who does not take the breast when he has diarrhea? _____
    0. NO
    1. YES
    8. DOES NOT KNOW

17. How many persons age 5 years or older had diarrhea during the past two weeks? _____

18. How many persons age 5 years or older had diarrhea during the past one year? _____

C. HEALTH

19. What can be done to prevent diarrhea? _____
    0. NOTHING
    1. WASH ONE'S HANDS
    2. USE THE LATRINE
    3. COVER FOOD
    4. COVER WATER
    5. KEEP ANIMALS OUTSIDE
    6. DISPOSE OF GARBAGE PROPERLY
    7. OTHER
    8. DOES NOT KNOW

191. How many persons in your family have the habit to eat uncooked vegetables and fish? _____
    0. NO
    1. YES
    2. NUMBER OF PERSONS

20. When do we have to wash our hands? _____
    1. BEFORE EATING
    2. BEFORE COOKING
    3. AFTER USING THE LATRINE
    4. AFTER CHANGING DIAPERS
    5. OTHER
    8. DOES NOT KNOW

21. Where do you get your water for drinking and cooking? _____
    1. NATURAL SPRING OR WELL
    2. RIVER
    3. OWN WELL
    4. FILLS JARS
    5. HOUSEHOLD TAP
    6. PUBLIC TAP
    6. OTHER

22. What is the quality of water used for drinking and cooking?
    1. GOOD
    2. MEDIUM
    3. BAD
    8. DO NOT KNOW

23. (IF TAP) Have you had water at all times during the past two weeks? _____
    0. NO
    1. YES

24. If you are home where do you go to relieve yourself? _____
    1. FIELD
    2. LATRINE
    3. OTHER

25. If you are outside where do you go to relieve yourself? _____
    1. FIELD
    2. LATRINE
    3. OTHER

26. (IF LATRINE) What type of a latrine do you have? _____
    1. PRIVATE
    2. PUBLIC
    3. UNKNOWN

27. (IF LATRINE) Do you have a wet or dry latrine? _____
    1. WET
    2. DRY
    3. UNKNOWN

28. (IF LATRINE) Do the children under age 3 years always use the latrine? _____
    0. NO
    1. YES

29. (IF LATRINE) Do the children between ages 3 and 5 years always use the latrine _____
    0. NO
    1. YES

30. (IF LATRINE) What can be done to prevent the foul odor in the latrine? _____
    0. NOTHING
    1. KEEP IT COVERED
    2. WASH IT
    3. OTHER _____
    8. DOES NOT KNOW

D. HEALTH PROBLEMS/SERVICES

31. Do you know the health staff from the city/municipality? _____
    0. NO (PROCEED TO DEMONSTRATIONS)
    1. YES

32. (IF YES) What is the health staff's name? _____ _____
    0. NO (INCORRECT)
    1. YES (CORRECT)
    8. DOES NOT KNOW

33. In the past four weeks/month, has the health staff visited you? _____
    0. NO
    1. YES

34. Have you ever attended a health meeting at the invitation of the heath staff? _____
    0. NO
    1. YES

35. During the past four weeks, have you attended a health meeting at the invitation of the health staff? _____
    0. NO
    1. YES

36. (IF YES) What was discussed at that meeting? _____
    1. PERSONAL HYGIENE (e.g., washing hands and bathing)
    2. PROPER USE OF LATRINES
    3. CLEAN HOUSE & ENVIRONMENT
    3. OTHER _____

37. What do you think is the most important health problem?

38. What do you think is the most important health problem at your home?

E. NIGHTSOIL USE IN CULTIVATION

39. Do you currently use nightsoil as conditioner for soil? _____
    0. NO
    1. YES

40. Do you currently use nightsoil as fertilizer? (IF NO, GO TO QUESTION 49) _____
    0. NO
    1. YES

41. How many years have you been using nightsoil as fertilizer? _____

42. Which type of nightsoil did you use most last year? _____
    1. FRESH NIGHTSOIL
    2. TREATED NIGHTSOIL
    3. OTHER _____

43. Where did you obtain most of the nightsoil used last year? _____
    1. OWN LATRINE
    2. NEIGHBOR'S LATRINE
    3. NIGHTSOIL VACUUM TRUCK DRIVERS
    4. PUBLIC LATRINES
    5. OTHER _____

44. Last year what months did you need the most amount of nightsoil? _____
    (Use 1 to 12 for months)

45. How much RMB did you pay per truckload of nightsoil last year? _____
    (If not by truckload, state by what amount)

46. How many truckloads of nightsoil did you use last year? _____

47. Was the amount sufficient for your cultivation purposes last year? _____
    0. NO
    1. YES

48. How many fields does your family cultivate? _____

49. Did you use chemical fertilizer last year? _____
    0. NO
    1. YES

50. If you had a choice which type of fertilizer would you use? _____
    1. NIGHTSOIL
    2. CHEMICAL FERTILIZER
    3. OTHER _____

51. Why?
    1. CHEAPER
    2. MORE CONVENIENT
    3. EASILY AVAILABLE
    4. EASIER TO USE
    5. BETTER FOR THE CROPS
    6. BETTER FOR THE SOIL
    7. OTHER _____

F. DEMONSTRATIONS (NB: Not observed properly, therefore not meaningful data for 52-54)

52. Could you please show me how you usually wash your hands? _____
    0. NO
    1. YES

53. **CODES** 0. NO 1. YES
    (IF #52 is YES)
    a) USES RUNNING WATER _____
    b) USES SOAP OR OTHER CLEANSER _____
    c) USES A CLEAN RAG/TOWEL OR AIR DRIES HER HANDS _____

54. Can you ask your child aged 3 to 5 years to show me how he uses the latrine? _____
    0. NO
    1. YES
    9. DOES NOT APPLY

    (If #54 is YES) Does the child use it with ease? _____
    0. NO
    1. YES

G. OBSERVATIONS

OBSERVATION CODE

0. NO	2. WAS NOT OBSERVED
1. YES	9. DOES NOT APPLY

55. HOUSE
    1. Is food covered? _____
    2. Is water which is stored inside the house covered? _____
    3. Is the ground in the house and yard clean and free of excrement? _____
    4. Is the ground in the house and yard clean and free of garbage? _____
    5. Are the animals kept outside the house? _____
    6. Are the animals tied or penned up? _____
    7. Are the mother's hands visibly clean? _____

56. PRIVATE LATRINE
    8. Does the house have a latrine? (If no, proceed to #17 below) _____
    9. Is the latrine enclosed in an outhouse (walls)? _____
    10. Does the latrine have a roof? _____
    11. Does the latrine have a door? _____
    12. Is the door to the latrine closed? _____
    13. Is the latrine (bowl) covered? _____
    14. Is the latrine clean (free of cleaning materials and feces) _____
    15. Does the latrine show signs of use? _____
        - discolored bowl
        - worn bowl
        - some odor
        - floorboard soiled with dirt
        - cleaning materials
    16. Does the latrine have a moderate odor (no strong odor)? _____

57. PUBLIC LATRINE
    17. Do household members use a public latrine? (If no, proceed to #24 below) _____
    18. Does the latrine have a roof? _____
    19. Does the latrine have a door? _____
    20. Is the door to the latrine closed? _____
    21. Is the latrine (squatting) area covered? _____
    22. Is the latrine (squatting) area clean (free of cleaning materials and feces) _____
    23. Does the latrine have a moderate odor (no strong odor)? _____

58. TAP
    24. Does the house have a water tap in the yard? _____
    25. Does water flow from the tap at this time? _____
    26. Does the tap faucet shut off tightly (does not drip)? _____
    27. Once drawn, does the water drain well (no puddles, no mud)? _____

59. CONSTRUCTION MATERIALS FOR THE HOUSE

28. Roof: 1. STRAW _____
2. TILES
3. ROOFING SHEETS
4. OTHER _____

29. Walls: 1. WOOD _____
2. BRICK
3. BLOCK
4. OTHER _____

30. Floor: 1. EARTHEN _____
2. WOOD
3. CEMENT
4. OTHER _____

31. Is the kitchen separate? _____
0. NO
1. YES

60. Does the concrete apartment building have latrines? _____
0. NO
1. YES

OTHER OBSERVATIONS

_____

_____

_____

_____

ATTACHMENT 2

FOCUS GROUP DISCUSSION GUIDELINES

Study Approach

Study areas and population: (the same as for the epidemiological component)

- farmer household
- consumer household

Sample size:

Focus group discussions for each of the above two pop groups and their control groups, ie., four case control groups. Total focus group discussions will be 20 (5 discussion groups x 4 case control groups).

For each group:

- 1 group of mothers with children under 5 years old (10 persons)
- 1 group of fathers with children under 5 years old (10 persons)
- 1 group mixed gender unmarried young adults between ages 20 to 25 (10 persons)
- 1 group mixed gender teenagers ages 15 to 18 years (10 persons)
- 1 group mixed gender older people ages 50-60 (10 persons)

Question Guideline

A focus group discussion is an open discussion amongst a small group of people on a specific subject. In the discussion, the emphasis is on a free exchange of views and experiences. The interviewer's role is to act as a facilitator stimulating the participants to keep discussing the subject, until no new points emerge. Focus groups are especially useful when it comes to investigating what participants think and why participants think as they do. Because of these characteristics, a focus group discussion is a powerful method to explore subjects of interest and to gain a deeper understanding of attitudes, perceptions, beliefs and wishes of the group participants.

A. Cultural Perspectives on Nightsoil

1. Is nightsoil considered clean or dirty?
   When is nightsoil considered clean?
   When is nightsoil considered unclean?
   If nightsoil is unclean, can it be made clean?

2. Can nightsoil cause diseases?
   What types of diseases?
   Does it affect children more than adults? Why?
   Does it affect babies (under 1 year old) more than young children (1 to 5 years old)? Why?

3. How can diseases caused by nightsoil be prevented?
   Where did you learn this?

4. Are vegetables/fruits/fish fertilized by nightsoil better than those fertilized by chemical fertilizer?
   Why?
   How is it better (eg., better for health, better taste, fresher, less poisonous, more nutrition, etc.)?
   What type of fertilized vegetables/fruits/fish do you prefer to eat? Why?

B. Hygiene Behavior and Practice

1. Do you have a latrine in your house?
   At what age do children use the latrine?
   Where do the younger ones go? Do they need to be helped?

2. Do you clean your hands after defecation?
   What do you use to clean your hands?
   Who cleans for the young children?
   If you clean for the young children, do you clean your hands after that?

3. Do you wash your hands before cooking? Before eating?
   What do you use to wash your hands?

4. Do you cover your food?
   Are there flies in your area?
   Is there a link between nightsoil, flies, food and diseases?
   If there is a link, what do you do to keep yourself and your family healthy?

5. Do you eat uncooked vegetables/fruits/fish?
   Do you eat uncooked food often?
   If you eat uncooked food, how do you clean them?
   Have you ever become sick from eating uncooked food?

6. Do you use nightsoil as fertilizer?
   Do you also use chemical fertilizer?
   Which do you prefer? Why?
   Are you able to get sufficient supply of nightsoil for cultivation?
   If not, what is the problem?
   How can it be solved?

C. Physical Facilities

1. What type of water supply system do you have?
   Is it reliable (that is, continuous water flow)?
   Is it sufficient for your household?
   If it is not reliable or sufficient, what is the problem?
   How can it be improved?

2. What type of a latrine do you use (private dry or wet; public dry or wet)?
   Is it clean? Free from odor? Free from flies?
   Does the latrine have easy access to water for hand washing?
   Are you satisfied with the latrine?
   If not, how can it be improved?

Annex 3

Epidemiology Study Report

Swiss Tropical Institute
Hubei Academy of Medical Sciences
for
UNDP/World Bank Water and Sanitation Program

Contents

TABLES.

MAPS

ATTACHMENTS:

Epidemiological Study Report

1. Introduction

Statement of the Problem and the Chinese Context

Human excreta utilization is widely practised in the Asian cultures. In China in particular, reuse of human excrement as nutrients in agriculture and aquaculture is ancient and consistent with local traditions.

Food production initially concentrated in rural areas has increasingly spread into the cities with a growing economical importance. Governmentally supported, the urban food production supplied already in the 1930 big Chinese cities with up to 85% of their vegetable demands applying waste recycling for field fertilization. In Guangzhou, fields fertilized with nightsoil produced up to nine crops per year (IDRC 1993). Such high productivity and concentrated use demands a continuous renewal of the soil fertility. This is traditionally done through recycling of waste, in particular human waste Such fecal sludge is partly still hand-collected from pits or tanks of urban and peri-urban households, storage and conservancy tanks and carted to the fields, sometimes by-passing treatment sites where hazardous pathogens are removed before the fecal sludge are applied on the crops

As human waste is recognized and valued as being highly nutritious it is also widely used in aquaculture, i.e. aquatic-vegetable- and fish farming The use of nightsoil in urban and peri-urban farming and aquaculture poses therefore potential risks not only for the pollution of the water table and available drinking water resources but also for people directly and indirectly involved in the nightsoil handling (occupational risk) as well as urban population who are users and consumers of agro- and fish farming products.

Objectives

The general objectives of the study are[1].

1. To assess whether the current practice of **untreated nightsoil** management leads to excess transmission of excreta-related disease in the group supposedly at risk when compared with the general background level of the diseases in the population

2. To estimate the health risks associated with nightsoil management of the population of the urban core using a case-control approach and estimate their public health relevance.

3 To determine which risk factors play a role in disease transmission in case an excess risk attributable to nightsoil use would be established.

The specific objectives are formulated as:

a. To review the routine health statistics from different levels of the health care delivery system with particular focus on communicable diseases which are likely to be associated with nightsoil management.

b To conduct two case-control studies to assess health risks for hepatitis and dysentery which are associated with the practices of nightsoil management in the general population of urban and peri-urban Wuhan; PR.China.

c. To conduct two case-control studies to assess health risks for dysentery associated with the practices of nightsoil management in two identified high exposure groups, vegetable and

[1] The study was conducted under the collaboration of Daniel Mausezahl from the Swiss Tropical Institute (Department of Health and Epidemiology) and Dr. Cheng Feng and Prof Zhang Shaoqing from Hubei Academy of Medical Sciences. Another collaborator was Dr Li Yuesheng from Hunan Institute of Parasitic Diseases

The report presented here as Annex 3 is an unedited extract from the report as submitted by the above authors in January 1995. The only changes made are as follows (i) the exclusion of certain sections which are to be found elsewhere in other parts of the main report; (ii) the spelling of 'nightsoil', (iii) the substitution of the words 'town' and 'latrines' to 'city' and 'latrine' respectively; and (iv) the numbering system of the different sections. The changes were undertaken for the sake of uniformity with the rest of the full report and for integration as one major study

rice farmers, in urban and peri-urban Wuhan; PR.China.

d To review the current routine health data surveillance system with regards to its potential use in health monitoring, surveillance and evaluation of the HUEP interventions

e. To review and evaluate the current health education activities with respect to a future health and hygiene education intervention focusing on nightsoil related aspects of health and hygiene in the areas covered by the HUEP interventions.

f. To conduct a parasitological survey in two villages of farming communities to investigate possible differences in the infection rates of helminth infections in vegetable farmers using nightsoil fertilization and rice farmers using chemical fertilizers

Methodology

A multi-step approach was adopted to meet the objectives of the epidemiological component of the HUEP nightsoil improvement study:-

1. In a first step the **routine health statistics** were reviewed to describe the general health situation with regards to the morbidity of communicable diseases that are also related to nightsoil management, i e. hepatitis, dysentery and typhoid. For helminthiasis as specific nightsoil-related diseases the available local literature was consolidated.

2. As a further step and based on the findings of the review on the communicable disease statistics, an **assessment of risk factors** for two nightsoil related diseases, hepatitis and dysentery, in the general urban population was undertaken.

3. Dysentery was chosen as nightsoil related health outcome indicator to investigate the health risks in the high exposure groups of vegetable farmer communities and urban consumers.

4 A community-based **cross-sectional morbidity survey** on helminth infections was conducted in two farming communities with a different occupational exposure to nightsoil, i e., vegetable farmers preferring nightsoil fertilization and rice farmers applying chemical fertilizer in the fields.

5. Consequently, and based on the above activities, the current **system of routine health data surveillance** and the current activities with regards to **health and hygiene education** was reviewed in order to provide the planners of the HUEP-project with recommendation to improve, optimize, monitor and evaluate the health situation in relation to the proposed interventions of the nightsoil management component of HUEP.

The study area, its background with regards to the public health care system and the different methodologies adopted are outlined below:-

Review of the Health Situation of Nightsoil-related Communicable Diseases

The Anti-Epidemic Stations in the four project cities are health statistics stations which register only notifiable diseases such as tuberculosis, hepatitis, dysentery and typhoid Those diseases are reported to them by the city health services. Nightsoil specific health indicator diseases such as helminthiases (worm infections) are however not recorded routinely at these stations.

For the purpose of this study, the existing disease registers at the following locations were reviewed for hepatitis, dysentery and typhoid morbidity at the anti-epidemic stations· in all project cities on city level; and in Wuhan on city- and district level.

The study team extracted monthly information for the indicator diseases from the existing records of the stations for the years 1991 to 1993 for all cities. For Wuhan only, data were extracted for all nine districts from their respective anti-epidemic stations All health routine data were extracted at the Anti-Epidemic Stations and computerized directly on site by the study team.

Mapping of disease frequencies for graphical presentation of geographical disease patterns in the region and in the towns. Priority was given to Wuhan for which a district based mapping of morbidity was done.

For the helminth diseases, a literature review was undertaken.

Population based morbidity rates were calculated per 100,000 population. The yearly population figures for all four project cities were taken from official

publications (3,4) Quarterly morbidity rates of hepatitis and dysentery of nine districts of Wuhan for the year 1994 were calculated using population figures from 1993.

The Parasitological Cross-sectional Survey

A community based study was undertaken among residents of two peri-urban farming communities in August/September 1994 in Hongshan District, Wuhan , P.R China Hongshan District consists of six urban and nine rural communities that represent 42% of the total 490,423 inhabitants of the district (3). The latter represent predominantly vegetable and rice farmers who settle in strictly distinct villages within the communities. One vegetable farming village (Qin Ling; N=542) and one rice farming village (Jin Feng; N=460) were randomly selected from lists of all vegetable and rice farmer villages The two villages have similar geographic and economic characteristics.

One fecal sample each was taken from all villagers (Qin Ling, Jin Feng). Fresh stool samples were collected and investigated on the same day using the Kato-Katz method to detect helminth eggs and to estimate semi-quantitatively the intensity of infection (Nr of eggs per gram stool). All villagers with infections were subsequently treated with Albendazole (against *A. lumbricoides, T trichuris, E. vermicularis*: single dose for adults 400mg, children 200mg, against Hookworm: for adults 2 x 400mg (10 days after), children 2 x 200mg (10 days after)

The Determinants of Health Risks

The case-control approach was adopted in two sets of studies to conduct, investigate and compare health risks pattern for

a **two diseases** related to the nightsoil management· dysentery and hepatitis as indicator diseases (two case-control studies); and

b. **two population groups** with different exposure level to nightsoil farmer communities and general urban consumers (two case-control studies with dysentery as health indicator disease)

Design of the Studies. The four case-control studies had the same basic design but differed in the choice of the indicator disease and locality in the city. All studies were conducted in Wuhan only Case selection was done uniquely from the records of the anti-epidemic stations which are local, district-based disease control institutions (cf. Fig 1) A brief summary of the design is presented below:

1. The disease outcome indicators for the two case control studies were hepatitis and dysentery as per the records of the health statistics of the anti epidemic stations

Cases and controls were selected from two districts of Wuhan; one with a high morbidity rate for hepatitis and low morbidity for dysentery; Hongshan District The other district was Qiao Kou with low hepatitis and high dysentery morbidity rates (cf Map 1,2). The districts were selected after the review of the available routine health statistics. The limitation to 2 districts for sampling was due to operational constraints to cover effectively all 9 districts of the city stretching over more than 40 km in diameter.

The sample of cases was randomly selected in a preset procedure from a list of cases obtained from the health statistics register of two districts for the period January - April 1994. Thus, a variation of the exposure due to seasonality could not be considered. A population proportionate random sampling of hepatitis and dysentery cases recorded in the health register was performed to represent the general urban population.

Controls were randomly selected from the neighborhood which excluded households with any family relation to the corresponding case. They needed to be healthy defined as not having suffered from one of the diseases under investigation and/or a combination of certain symptoms. Controls were further sex and age matched to the corresponding case.

2. Two case control studies were conducted one each with vegetable farmers and urban consumers in Hongshan District /Wuhan in July to September 1994. Health outcome indicator for the two studies was dysentery. Cases and controls were selected from Hongshan districts of Wuhan which had been identified during Phase-I as one of Wuhan's districts with a reasonably high morbidity for dysentery and a relatively high proportion of farming households Cases were randomly selected from records of the Hongshan district health statistics register for the period of the peak occurrence of summer dysentery in August/ September 1994 Controls were selected as above.

For all case control studies.

- Sample size was limited to 100 cases with a case control ratio of 1:1 For each disease

outcome there were therefore 200 household interviews to be conducted The sample size was sufficient in order to demonstrate a substantially increased relative risk of disease (if it exists) of 2.5 to 3 on a 10% level of significance and a power of the study of 80%

- A standardized questionnaire in Chinese was administered by trained interviewers to the participants in their own households. Information was collected on sex, age, level of school education, household-related factors (source of drinking water, animals), water and food consumption, perception of hygiene, hygiene behavior, defecation habits and cleanliness, nightsoil use/preference and opinions on nightsoil, health education exposure The questionnaire was complemented with observational data on the household condition and cleanliness and the immediate household environment (cf attachment 3,4).

Data Analysis The analysis of the data provides an estimate for the health risk, the relative risk estimate for the disease. These risk estimates indicate some evidence for the cause of the disease. The 95%-confidence intervals for the risk estimates were calculated For the interpretation· If the range of the 95%-confidence interval excludes 1. a result is statistically significant at the 5% level of significance

In addition, the statistical strength of the association is indicated with the p-value. A p-value below the 5% level of significance ($p<0.05$) is usually regarded as providing good evidence of an association, while results significant at a 1% level (p,0 01) providing strong evidence of an association between each risk factor and the disease.

All quantitative data from the routine health data collection, cross-sectional surveys and case-control studies were analyzed using EPIINFO 5.01 statistical software. Data was partly entered and processed in the field using portable computers All data were entered twice for data entry validation. Graphical display was done using Harvard Graphics 3.0 software. Morbidity frequencies in the four project cities from 1991-1993 are presented by drawing maps.

2. Findings of the Epidemiological Study

Review of the Routine Health Data Situation: Hepatitis, Dysentery, Typhoid and Helminthiasis

The reuse of wastewater in agriculture and aquaculture is associated with a variety of diseases due to the transmission of several bacterial, viral and parasitic pathogens contained in untreated nightsoil in particular. Four types of gastro-intestinal diseases and infections, including bacterial dysentery, typhoid fever, acute hepatitis and helminth infections were reviewed from existing publications and primary data which was collected at the local anti-epidemic stations.

Review of Secondary Data on the Nightsoil-related Health Situation

Acute hepatitis is caused by the infection of hepatitis A. Where environmental sanitation is poor, infection is common and occurs at an early age. Dysentery is an acute bacterial disease involving the large and small intestine, characterized by diarrhea accompanied by fever, nausea, vomiting and cramps. Most of the deaths are in children below 10 years. Typhoid fever is caused by typhoid bacilli, characterized by insidious onset of sustained fever, headache, malaise, rose spots on trunk, non-productive cough, and involvement of the lymphoid tissues Helminth infections occur mainly by the fecal-oral route of ingestion of fertile eggs or penetration through the skin and cause a variety of signs and symptoms ranging from bloody diarrhea, obstruction to pathologies of inner organs. The occurrence of all these four groups of diseases is highly related to the water and sanitation conditions.

A two year study in four Chinese provinces (8) showed that prevalences of parasitosis among agricultural population in Dalian and Henan were 92.7% and 55.2%, respectively, in areas with **untreated** nightsoil use. In contrast, the prevalence rates of parasitic diseases were 40% and 23% of the population of areas where **treated** nightsoil was used. Similarly, for pond workers, the study demonstrated higher helminth infection rates (ascariasis, trichuriasis, clonorchiasis, fasciolopsiasis and schistosomiasis) in those exposed to untreated nightsoil. Lastly, a comparison of sanitary and water work personnel with different occupational exposure to nightsoil indicated higher prevalences for the sanitary workers with regards to parasitic helminth infections (predominantly ascaris infections), salmonella and hepatitis. Cheng (6) reported that

infection rates for ascaris and hookworm in nightsoil workers were 72.2% and 27 8%, respectively, which was much higher than 29 3% and 2.4% in other workers. Duration of exposure to nightsoil was further found to be positively correlated with parasite infection.

A report from the Shanghai Environment Project (9) showed a substantial difference in morbidity rates between rural, vegetable farming areas and urban settings over a twelve years period in Shanghai and Fengxian County. Incidence rates of **dysentery** in 1981 in farming areas of Shanghai were as high as $1700/10^5$, but only $320/10^5$ in urban areas. Although incidence rates decreased significantly over the twelve years period different morbidity rates prevailed (100 *vs* $50/10^5$ in 1989). For Fengxian County dysentery incidence fluctuated around $300/10^5$ in the farming areas and $100/10^5$ in urban settings indicating also a geographical difference in morbidity.

Incidence rates of **typhoid** exhibit the same pattern with differences between vegetable farming and urban areas in both counties and generally higher morbidity rates in Fengxian County.

Hepatitis incidence fluctuated constantly around $230/10^5$ for both, rural and urban settings of Shanghai for the 12 years statistics. In Fengxian hepatitis incidence for both comparison groups decreased remarkably from ~$700/10^5$ to $100/10^5$ in 1986 and remained constant up to 1991. It indicates further a geographical difference in hepatitis morbidity (230 *vs* $100/10^5$ in Shanghai and Fenxian) which is explained by the higher population density in the more urbanized Shanghai County where more frequent person-to-person contact facilitates the spread of the highly contagious disease

Since investigating the distribution of human parasites by Ministry of Public Health (MOPH) in Oct. 1986, the Local Governmental Department of Public Health published the results of this national helminth survey. The results are briefly outlined as follows:

- In China, intestinal parasitoses present a major public health problem with ascariasis being the most prevalent worm infections with hookworm infection and enterobiasis being least frequent (cf Tab 2)
- For the provincial level the results are summarized in Table 3. In Hubei province 14 different species were described with ascariasis being the most prevalent worm infection
- At city level with focus on the project cities the results are summarized in Table 4.

The main findings were that in all cities intestinal parasitoses are important health problems Up to 13 different species of parasites were found. Infection rates were extremely high around 40% in all cities Specific infection rates for vegetable farmers were even higher and above 50% indicating a clear occupational health risk. It was distinguished between vegetable and rice farmers, as the latter use chemical fertilizer rather than nightsoil.

Results of the Routine Health Status Data Review

Hepatitis. Yearly morbidity rates for hepatitis from 1991 to 1993 for the four cities indicate Yichang with significant with 3-4 times higher prevalence rates than the all-cities' yearly averages The yearly averages excluding figures from Yichang, range from 183-$209/10^5$ describing a constant situation. For Yichang hepatitis morbidity decreased by almost 70% in the three year period. (Fig 2, 4 and Maps 3, 4 and 5). In 1993, the mean morbidity rate of hepatitis A in four cities was $306/10^5$ of which the morbidity rate in Yichang was as high as $643/10^5$ indicating a 2-times higher morbidity rate than the yearly mean for all four cities (cf. Fig 2, Map 3). A stratified analysis on seasonality showed that morbidity rates of hepatitis were generally high from January to September with a peak in the second quarter of 1993 ($87/10^5$) average incidence for all cities). However, hepatitis peak incidences varied individually among the four project cities (cf. Tab 5, Fig 3). Monthly morbidity rates of hepatitis A showed that January to May were the peak months in Huangshi, Yichang and Xiangfan and September for Wuhan (Fig 6).

Dysentery. Yearly morbidity rates for dysentery from 1991 to 1993 showed a constant reduction for all project cities by more than 50% in the three years. Prevalence rates for Yichang were above the all-cities average in all years. (Fig 4, 5 and Maps 3, 4 and 5).

The mean morbidity rate in 1993 was $337/10^5$. Yichang figured highest at $694/10^5$ (cf Fig 4). A distinct seasonality for dysentery morbidity was observed for all four cities in the third quarter of the year with an average peak incidence rate of $164/10^5$; city rates ranged from 45-341 $/10^5$ in the third quarter indicating a big individual variance. (Tab 6, Fig 5 and 7). Monthly morbidity rates indicate a peak in August

in all project cities which coincides with the hottest summer temperatures in 1993. (cf Fig 7).

Typhoid. This was not an important disease in the project cities as the incidence rates in the project cities were quite low at 27--32/10^5 (Tab 7, Maps 3, 4 and 5).

For Wuhan only, a district based analysis of hepatitis and dysentery morbidity was undertaken. For both diseases monthly rates from January to March of 1994 from all the nine districts of Wuhan were 43 and 19/10^5, respectively, which represented a small reduction in hepatitis A and a nearly 50% reduction in dysentery, compared with data of the same period for 1993 in Wuhan Morbidity rates for hepatitis and dysentery for the nine districts of Wuhan for the three years 1991-93 are presented in Table 8, 9 and Maps 1 and 2. Constant high rates for hepatitis (around 3-400/10^5) are prevailing in Janghang, Wuchan and Hanyang District With regards to dysentery the nine districts reflect a wide prevalence range (Tab 9). Although a reduction of dysentery morbidity could be observed in all districts form 1991-93 high yearly incidences prevailed in Jianhang and Hanyang above 350 cases per 100,000 population

Discussion of the Routine Health Status Data Review

Existing information reflected a clear difference for nightsoil related infections and diseases such as helminth infections, hepatitis, dysentery and typhoid in different population and occupational groups, as well as geographical locality The studies undertaken and reports available dealt however hardly with general population groups from the urban core and other risk groups such as mothers and children

The information from studies on dysentery in Shanghai are consistent with the findings from other studies, as well as with our findings based on data from the local health statistics from the anti epidemic stations. The routine data which was collected and analyzed for monthly and yearly statistics were also compared with the official statistics of the three infectious diseases from Government sources There was less than 10% error between the two sets of data indicating a high consistency.

Compared with the yearly morbidity rates for hepatitis and dysentery from 1991 to 1993 in the four project cities, it was shown that morbidity rates of hepatitis A in Wuhan and Yichang dropped 20% (305 *vs* 244 /10^5) and 70% (2'120 *vs* 643 /10^5), respectively. However, they increased 17% (203 *vs* 239 /10^5) and 134% (41 *vs* 97 /10^5) in Huangshi and Xiangfan, respectively The latter being a smaller city with a more rural character and a proportion of approximately 30% of population living in rural areas. Morbidity rates of dysentery from 1991 to 1993 dropped 48% (649 *vs* 337 /10^5) This is possible due to the improvement of preventive measures and the recent improvement in the standard of living of the population

Dysentery clearly presents itself as a seasonal disease. The study exhibited a peak morbidity rate of dysentery in the four project cities from July to September, which are the highest temperature months (mean 35.2^{0}C) in Hubei Province. The months from June to September are therefore also suitable for flies breeding. The transmission of dysentery might be mainly by flies due to the environment being polluted. The application of untreated nightsoil on the surface of the soil may, in fact, further increase the problem of flies

Higher morbidity rates for hepatitis in Huangshi, Yichang and Xiangfan were presented from January to March as in Wuhan (cf Fig 3,6). In Hubei Province, the mean temperature in the first quarter of the year is below 10^{0}C which keeps breeding of flies low in spring. So, the approach of transmission of hepatitis may be mainly directly by person-to-person contact The time coincides in fact with the major spring holiday with the Chinese Spring Festival in February. This time is most sociable, as family members, relatives and friends as well as the public comes together providing an increased opportunity for transmission of hepatitis.

For Yichang, prevalence rates were found far above those of the other project cities for hepatitis and dysentery (but not for typhoid). High rates for hepatitis and dysentery in the range of 2000 cases per 100,000 population were also described in other studies (cf Shanghai) which supported the validity of the findings The high morbidity rates for Yichang were explained by medical staff of the local Anti-Epidemic Station by the absence of a good water supply system for sanitation service and a recent increase of floating population. However, it is also worth considering that efficiency and quality control of the routine data collection and registration contributes substantially to the accuracy of the figures obtained. Thus, varying standards between the district based reporting systems may account for the differences. This concludes that a review and validation of the standard procedures of routine health data collection in rural and urban settings is desirable.

Helminth infections are most common in population groups occupationally exposed to nightsoil in agree-

and pisciculture. The literature reviewed does however not describe or reflect the situation for other population and risk groups such as mothers and children. The most prevalent and nationwide parasitic helminth infections are due to *Ascaris lumbricoides.*

Household based investigation rather than risk group oriented exploration of the general health situation would contribute to the validity of the routine health data surveillance system which is highly dependent on accessibility, affordability, quality and attendance of the health service offered

Transmission of intestinal infectious diseases and parasitosis are very closely related to excreta and waste water which contain correspondingly high concentration of excreted pathogens - the bacteria, viruses, protozoa, and helminths (worms) Therefore, the improvement of nightsoil management and treatment is one of the important measures to reduce, prevent and eliminate intestinal infectious diseases.

Conclusions: Health Statistics and Routine Health Status Data Situation

Routine data collected in the current study was coherent with official governmental data.

There were substantial differences in the morbidity of hepatitis, dysentery, typhoid and helminth infections between (i) different population groups occupationally exposed to nightsoil, as well as (ii) geographical locality and (iii) rural and urban settings.

Morbidity rates of dysentery from 1991 to 1993 in the four project cities were reduced by 50% This was possibly due to the improvement of prevention measures and the improvement of living standards in the population since the economical opening of the Chinese market in the last decade.

Hepatitis prevalence remained constant over the three years period for Wuhan, Xiangfan, and Huangshi (average $200/10^5$), but decreased by almost 70% in Yichang.

Morbidity rates of the indicator diseases in Yichang were significantly higher than in Wuhan, Huangshi and Xiangfan The reasons could not be consolidated, Yichang however, has a large rural population and a significant higher agricultural activity than the other cities which could increase all agriculture-related nightsoil management health risks

Dysentery showed a clear seasonal pattern with a peak morbidity rate in July to September in the four project cities which coincides with the highest summer temperatures in the region. These climatic conditions further favor the transmission of dysentery by flies due to a polluted environment and the use of untreated nightsoil.

Transmission of hepatitis A, dysentery and typhoid as well as helminthiasis are very closely related to excreta, wastewater and environmental conditions. Therefore, the improvement of nightsoil management and treatment is a very important measure to reduce, prevent and eliminate such communicable diseases.

Detection of Helminth Infections in Vegetable and Rice Farmers

Demography

Of the total of 1002 inhabitants living in the two study villages of Quin Ling and Jiu Feng, 94 7% were examined indicating a very high overall coverage rate. The age and sex distributions for the two villages were similar (Fig. 8, 9, Tab 10) Approximately 42.3% of all people were in the age group of 21 to 40 years old representing the majority of the working population stratum. Children up to the age of 10 years represented 11.5% (N= 109) of the sample.

Prevalence of Helminth Infections

Four different helminth species were identified (*Ascaris lumbricoides*, *Ancylostoma* (hookworm), *Trichuris trichiura* (whipworm) and *Clonorchis sinensis*). The overall infection rate for both two villages was 22.7% (215/949) (Tab 10) with ascariasis being the predominant infection accounting for 21.9% of all infections (cf. Tab 11). The prevalences in males and females varied not significantly (24.4% *vs* 20.8%). Children below the age of 10 years showed a significantly higher occurrence of helminth infections compared to the age group above 10 years (34.8% *vs* 21.1%) indicating an age dependency of helminth transmission (cf. Fig. 10, Tab 10).

Comparison between the villages revealed a significantly higher prevalence of helminth infections in the nightsoil using community considering all ages (25.3% *vs* 19 6%, $p<0.05$; cf Tab.10). In the same group of nightsoil users the prevalence of infection was significantly higher in the age strata 31 - 60 years that represent the majority of people working in the fields (25.3% *vs* 16 8%). There was no difference observed in the infection rate of children in both, nightsoil and fertilizer using farmer communities.

Discussion and Conclusions

This survey measuring helminth infections as biomedical indicator related to nightsoil handling and hygiene demonstrated a **higher prevalence of infection in the vegetable farming community** (25.3%) which applies nightsoil for crop fertilization and soil conditioning compared to the rice farming community (19 6%) using chemical fertilizers. The association of ascariasis with nightsoil was frequently described in the literature (10,12,13) the high frequency of roundworm infection in this study is further evidence for an excess disease transmission due to the nightsoil exposure in vegetable farmers. The overall prevalence of 22 6% is considerably lower compared to the findings of the national survey on the distribution of human parasites for farming communities in Chaidian/Wuhan area (42 7%). Only one fecal sample per person in study sample was examined in this survey which might explain the differences. The prevalence of helminth infection found can therefore be considered as a rather low estimate of the true prevalence

Helminth infection occurred significantly more often in children below 10 years of age (34 8% vs 21.1% in adults). The younger age groups are usually more susceptible, have a higher exposure due to additional behavioral factors and show therefore a higher cumulative risk exposure than adults. Furthermore, the two farmer communities showed no differences in the infection rates in children. In adults however, the age groups of population strata predominantly working in the fields (31 -60 years), the prevalence of helminth infection varies considerably between nightsoil (vegetable-) and fertilizer (rice-) using farmers with a higher prevalence in vegetable farmers (25.3% *vs* 19.6%).

Therefore, specifically targeted public awareness campaigns should address the high exposure and age groups within the adult population in particular and the age groups children < 15 years in general.

Determinants of the Estimated Health Risks

Risk Factors Associated with Hepatitis and Dysentery in the General Urban Population

For all cases and controls, information on different aspects was recorded which was considered to be risk factors for the acquisition of hepatitis or dysentery. To represent the likelihood of disease in the exposed compared to the unexposed group, the estimated relative risks were calculated

Demographic and Socio-economic Aspects. The study sample for both health outcome diseases consisted of 100 cases and 100 healthy control persons (Tab12). According to the population proportionate sampling 2/3 of the all studies' participants came from Hongshan district and 1/3 from the Giao Kou District.

Age and sex structure for the two studies are presented in Tab 12. For hepatitis as health outcome indicator significantly more male participants 70% (N=140, 95%-confidence limit (CI)= 63.6 - 76.4) were selected in this study sample compared to females 30 % (N=60, CI= 23.6 -36.6). The age structure was normally distributed with 57% of the participants aged 11 to 30 years. Children under the age of 10 represented 17% of the sample (N=34) (Tab 12).

In the dysentery study, equal sex and age distributions were found. The average age of the study sample was 28.5 years and 20% of the participants were children under the age of 10 years.

Educational level of the respondents was found to be similar in cases and controls in both studies with more than 71% of the participants having at least middle school level of schooling (Tab 12) indicating a very high level of schooling education. With regards to the education two findings are worth mentioning.

- Firstly, in the general urban population a very high proportion (more than 35%) of study subjects were university graduates.

- Secondly, between 10 and 20% of the participants had no formal schooling; in the dysentery study the proportion of participants without formal schooling was almost significantly higher than in the hepatitis study (17.3% CI= 12.0 - 22.5 *versus* 9.7% CI= 5.6 - 13.7). Educational level of the parents of children-participants showed no difference between the comparison groups in both studies

With respect to **health and hygiene education** a significant difference between case and control groups regarding the exposure to hygiene education was found in both studies. The hepatitis case group received health education of any kind 5.6 times less often than the healthy control group. In the dysentery study the risk was even 7.0 times higher, suggesting that people without an exposure to health education in their lives were 7 times more likely to contract a dysentery; these findings were statistically highly significant ($p<0.001$). Although a high level of education is achieved, health

and hygiene knowledge did not seem to be incorporated or sustained. 71% of all cases were highly educated (above and including middle school) but the lack of hygiene education remained still significant

The analysis of the occupation of the breadwinner of the household indicated a high proportion of study participants working at governmental institutions; in the hepatitis study 76% and in the dysentery study 58%. We distinguished three occupations in governmental institutions government staff (24% and 28%), factory workers (20% and 30%) and students (32% and 28%). Farmer, fishermen and environmental worker represented 8% (N=15) of the hepatitis study sample and 3.5% in the dysentery sample (Fig. 11, 12)

If the occupation of the breadwinner was grouped into farmer, fishermen or nightsoil worker and then compared to other occupations, a 1 9-fold higher risk for hepatitis was found for the nightsoil exposed group (Tab 13)

Wealth and social-economic status measured as the combined possession of luxury goods (TV, telephone, washing machine and motor-bike, etc.) showed no difference between cases and controls in neither of the studies indicating an equality in wealth (Tab 13). Other indicators such as income, size of the flat and ownership of the flat indicated no difference either.

The study populations in both studies (Hepatitis / Dysentery) appeared to be stable with only little mobility as there were no differences found in the duration of staying in the area. The majority of the population (85% / 58%) stayed in the city for longer than 4 years

The above mentioned indicators illustrate that the two groups which were compared, i.e. the study group of hepatitis/dysentery cases and their healthy controls had similar and comparable characteristics with respect to the measured demographic and socio-economic factors.

Household-related Aspects Household related health risk factors such as the family size and indicators for crowding showed no effect (Tab 13):

- A **family size** of 3 persons in the household was found in more than 41%. More than 50% of the study subjects lived in households with less than three persons. 88% of the participants lived in a household of less than $80m^2$.
- Size (number of rooms) and ownership of the household or flat, the square meters and the **density** (person/m^2) indicator had no correlation with the disease status

This did not differ neither, in the two studies nor between the case and control groups thus, were no risk factor for either disease.

The investigation into the health risk factors with regards to contact with animals showed that no cattle were owned by the suburban farmers, but pigs, chicken and ducks were held by all of them in both studies. Pets, i.e. cats and /or dogs were very rarely kept by only 6% of the samples. Further no animals near or around the living area was observed to be sick or suffering from diarrhea, which would represent a very high risk for infection No difference between the study groups was found. Pets or poultry were reported to never be kept in the living area. Furthermore, no animal near or around the living area was observed to be sick or suffering from diarrhea, which would represent a very high infection risk.

Private toilets existed for 42% in the hepatitis (52%) dysentery (in brackets) study samples; 20% (25%) in case-, 22% (27%) in control households. 94.5% (92%) used a latrine either privately or publicly owned. To give an indication of the public opinion about the cleanliness of public latrines used, 45.7% (38.1%) of public latrine users expressed their concern that the public conveniences were not clean. No difference in this opinion was found in the case and control groups (Tab 13).

A further household related factor presenting a potential health hazard was the presence of **flies** in the household. As other work demonstrated, the subjective perception of the nuisance through flies correlates with increased appearance of the insects. In our study hepatitis and dysentery cases reported problems with flies in their household significantly more often than controls; 1.8 times (2.0, p 0.05) (Tab 13). This gave an indirect indication for a higher flies occurrence in the case households and therefore a potentially higher risk for disease transmission.

The perceived health status of the study subjects at the time of the interview was indicated as normal in 91% of the study subjects.

Social and Behavioral Aspects

Children Children under the age of 13 were found to have a 3.6 higher infection risk for hepatitis if they were playing near a pond, rubbish, in vegetable garden

or with dirt compared to those playing in their own yard (Tab 13). The first mentioned play grounds are most likely to be contaminated with nightsoil.

Behavioral factors. These factors related to household- and person hygiene were found to be strongly and significantly associated with both, hepatitis and dysentery. Hand washing and defection habits were risk factors which were studied in details and which described a significantly increased likelihood for disease up to 5.6 times for those exposed to it:

The lack of **hand washing** as hygiene behavior was associated with hepatitis infection and dysentery in several respects in a statistically significant manner (cf Tab 13):-

- No hand washing after defecation revealed a relative risk estimate of 3 2, suggesting that urban consumers who did not wash their hands after defecation were 3 2 times more likely to develop a hepatitis than those who washed hands A similar risk estimate of 5.6 was described for acquiring a dysentery indicating an even higher likelihood for this disease. All other figures presented should be read as the examples above

Similarly, the relative health risk for the following exposures were estimated to be significantly increased for cases of the two diseases:

- lack of hand washing after work at a 2.6 times and 1 4 times for hepatitis and dysentery, respectively;
- not before eating at 5.6 times and 4 8 times; and
- not before cooking at 5 6 and 2.8 times.

If hand washing after work was analyzed stratified by occupation then omitting hand washing after feeding and handling animals was correlated with a 3 times higher chance for an hepatitis illness for farmers and fishermen. Although statistically not significant this result indicated a high association with particular importance for occupational groups that are directly or indirectly exposed to nightsoil.

Defecation habits and excreta disposal were investigated with particular reference to the disposal of children feces and the use of a latrine when absent from the own home. For hepatitis the disposal of children's feces other than in the latrine was associated significantly with a 4.4 times higher risk ($p < 0.05$). This risk behavior was not associated with dysentery. Conversely, for dysentery only, defecation at places other than the latrine when absent from home, i e. in the garden, yard, in the field, constituted a 2.7 times higher likelihood for the disease as compared to the people using a latrine at any time

Household Environment, Water Use and Food Intake and Consumer Habits. The questionnaires contained a checklisted section for observational notes on the household cleanliness and environment, As a potential source for disease transmission uncovered food was observed to occur 10.8 (8.6) times more often in households of hepatitis and dysentery cases indicating a substantial lack of food hygiene. For both diseases high risks ranging from 2.0 to 5.5-fold increased likelihood were found for the kitchens' cleanliness, open excreta and rubbish disposal around the house (Tab 13).

A private tap was indicated to be the drinking water source in 44% (52%) of all participants (88/200 and 104/200) 43 5% (47.5%) use public taps, whereas only 5 5% (1%) use handpumps or protected wells This indicates that the majority of the people use safe water sources for their drinking water. However, the consumption of unboiled water was associated with a significantly increased infection risk at 3 times for hepatitis and 4 9 times for dysentery in cases compared to healthy control persons. This illustrated not only one of the classical infection routes for both diseases, but pinpointed also possible environmental pollution of drinking water sources. None of the participants reported using unprotected sources such as open wells, rivers or ponds regularly

Transient factors such as eating out or visiting neighbors combined with food intake was not related to the disease However, eating left over food of the last days was associated with a 2.4 higher risk for contracting hepatitis and 16.1-fold chance to acquire a dysentery in comparison of the control groups not eating left over food. The consumption of food from the street seller exhibited a non significant 1.8 fold risk for dysentery. Likewise, the consumption of fresh milk ice cream, fish or rarely cooked meat, described 2 to 2 8 times higher risks which were however, not significantly correlate with the diseases. For dysentery only, the consumption of raw or uncooked vegetable was found to be associated with a very high 11-fold risk indicating the classical fecal-oral infection route via contaminated crops.

The sources from where vegetables were bought was found to be a strong and significant risk factor for

hepatitis (cf. Tab 13). The odds ratio of 3.6 was found describing a 3 6 times higher risk to contract hepatitis when vegetables were bought from other sources than the supermarket or shop These other high risk places were visited by - 11% from the private garden, 2% directly from farmer, 40.5% from the open street markets where the produces are often exposed and stored in an unhygienic environment. Similarly, a 2.8 times higher risk for contracting dysentery was described for the 1.5% of study sample taking vegetables from private gardens, for the 2 5% that bought the from farmers directly and the 51 5% which obtained the produces from the street markets.

Discussion and Conclusions

The obvious majority of males in the study sample which was drawn randomly indicates different explanations; such an effect could be due to different health seeking behavior between of the sexes indicating a gender problem or irregularities in the monitoring and recording of the diseases as was indicated to one of the team members in a anecdotal manner. A validation of the results from the routine health statistics is indicated

The striking difference in the exposure to health education in the study groups could not be explained by other socio-economical factors. This indicated the need for a future health education as a long term recommendation to be targeted at school level and consumer level

Such a preventive measure was also strongly supported by the many behavioral risk factors which were identified which can be easily addressed

- playing with or in a potentially nightsoil contaminated area
- hand washing aspects
- safe disposal of feces
- food consumption and preparation
- consumer habits (buying food from street markets)

The high proportion of educational level (above 71%) in the population indicated high general knowledge but little health knowledge. These circumstances let a targeted health education campaign appear very valuable and promising

Unboiled water as one of the typical sources for infection with hepatitis in the setting of urban Wuhan indicated 3 possible reasons and valid speculations.-

- contamination of drinking water sources
- contamination of agricultural produces
- insufficiently safe food preparation and practices

All reasons were directly or indirectly connected to contamination and application or handling of nightsoil. Further evidence, particularly for the contamination of the vegetables, was given by the 11-fold risk for contracting a dysentery after consumption of raw perishables, as well as the fact that dysentery and hepatitis cases were about 3 times more likely to buy their vegetables from the open street market where only limited quality control on cleanliness on selling conditions is performed

Besides these substantial health risk exposures "outside" the household, the home environment itself presented an important predisposition for disease transmission with regards to an apparent lack of adequate excreta and rubbish disposal around the house. This supported a successful disease transmission. The observed unhygienic conditions in house and kitchen (food on the floor, plates and utensils unwashed), as well as the deficient personal hygiene of the respondents (dirty hands, clothes face), which presented significant 3 to 10-fold higher health risks compared to those not exposed, emphasized the findings.

Measures to improve this situation point towards environmental protection, as well as raising public awareness of possible health risk due to inappropriate food hygiene. This was further supported by the risk factors we identified as being related to unhygienic conditions for food and vegetable sellers on the streets and the apparent low opinion of the cleanliness of public latrines by the majority of users Better maintenance and monitoring of public conveniences is suggested.

Comparing the patterns of health risk factors between hepatitis and dysentery as health outcome indicator diseases related to nightsoil management it became apparent that they differed only slightly; variations occurred however with regards to excreta or nightsoil related risk factors: for hepatitis only, the disposal of children's feces and playing in potentially nightsoil contaminated play grounds such as vegetable gardens, ponds or near rubbish was associated with up to 4 times increased health risks. In general, however, the risk factors which were identified were highly consistent for both diseases strongly indicating similar ways of transmission in the given urban setting

The analysis of the risk factors for hepatitis A and dysentery identified in the City of Wuhan showed patterns of infection risks which were rather indirectly related to nightsoil management The risk factors identified were either related to general behavioral aspects or hygiene knowledge and practice.

However, specific health risks attributable to the direct exposure to nightsoil were found for both, consumers and population groups that are heavily exposed to nightsoil occupationally the group of farmers and fishermen showed such a high exposure which, combined with the established apparent lack of appropriate hygiene behavior, lead to an excess increase of nightsoil related diseases For consumers, health risk factors with direct relation to nightsoil contamination were identified with regards to unsafe sanitation habits and the consumption of agricultural products and their handling.

Further in depth studies are needed to explore and demonstrate the direct association between nightsoil exposure and disease by measuring actual contamination of nightsoil with helminth eggs, the level of exposure and the actual infection status of study subjects

Risk Factors Associated with Dysentery in Urban Consumers and Peri-Urban Farmer Communities

The following study is based on the above presented results on the risk factors analysis for dysentery and hepatitis in general Wuhan population. It was conducted choosing dysentery as indicator disease in two population groups which were found to be differently exposed to nightsoil management and contamination.

Demographic and Socio-economic Aspects. The study sampling scheme and size was as described in 3.3.4 Age and sex structure for the two studies on urban consumers and farmers are presented in Tab 14. An imbalance in the sex structure was found again for the consumer population with significantly more male (64.7%) than female (35.3%) study participants. The age structure was normally distributed with 71.4% of the participants aged 11 to 30 years. Children under the age of 10 represented about 10% of the sample. In the farmer study sample equal sex and age distributions were found with 51 7% of the participants in the age classes from 11 to 30 years There were hardly any children under the age of 10 years represented in this study.

Differences in the educational level of the respondents were apparent between the two study samples and in cases-controls comparison groups.

- Firstly, an average of 12.5% (CI=5.8-19 2) of the farmers had no formal schooling which was significantly more than in the consumer group with an average of 2 1% (CI=0.4-3.8).

- Secondly, high school education was substantially more frequent in the farmers group (80%) as compared to the urban consumer population (39%) Conversely, university level education was significantly more often found in the urban consumer sample, as expected (1.7% *vs* 52%).

The social-economic status, household related factors and other demographical parameters (family size, density indicators, mobility of the population) were not asked in this study as no difference was found in the previous case-control studies (cf section 3.4.3.1). They were therefore considered to be similar for both, the farmer and the urban consumer study groups and were as described in section 3.4.3.1.

Household-related Aspects, Environment, Food Water Intake and Hygiene Behavior. Concerning the use of a latrine 35% of the consumers reported to use a private flushing latrine and another 54% using a public wet latrine indicating an adequate latrine use for the majority of the consumer population. The opinion about the cleanliness of the latrines used was indicated equally as good and clean. In contrast, it was found that the 77% of the farmer group did not know the type of the latrine they used. However, almost 97% of the farmers clearly indicated the state of the latrine they used as dirty. Differences between ill and healthy study participants were not observed.

Within the farmer study, flies were 3.3 times (1/0 3, cf Tab 15) less often perceived as a nuisance in the households of cases. In other words, although flies were present in the home they were not perceived as disturbing. This further indicates that they were possibly not prevented due to an evolved adaptation and acceptance by the people.

The behavioral factors investigated were elevated in both studies In most cases however, they did not show a statistical significant association with the disease. In both, farmers and urban consumers the lack of washing hands after work was found to increase the risk for a dysentery by 2 and 2 7 times, respectively (Tab 15). For farmers specifically, the omission of washing

hands after handling nightsoil was associated with a 2 4 times higher likelihood for getting a dysentery.

The analysis on the food and water consumption did not reveal increased health risks for individual food stuff. Only for the urban consumer population, the consumption of raw vegetable increased the risk for a dysentery attack by 1 8 times. For the farmers, the consumption of unboiled water increased the risk 3.5-fold, although (for both studies) the sources for drinking water were almost exclusively private or public water taps If the consumption-related risk factors were pooled vegetable farmers were 1.9-times more at risk (CI=0.4-10 6); the consumers exhibited a 1.5-fold likelihood for disease (CI=0 7-3.3), respectively.

The agricultural use of nightsoil was elucidated in the farmer study. Of all 95 vegetable farmers 92% (N=87) confirmed that they got in touch with nightsoil regularly. Almost all of them used nightsoil as soil conditioner before the planting (98%) and as fertilizer during the growing of the crops (99%). The group of the farmers that fell ill with a dysentery had used nightsoil for a mean duration of 23.5 years (SE=3.0y) at the time of the interview as compared to the healthy control group that used it for 20 8 years (SE=2.8y), which confirmed the old tradition of nightsoil use

The intensive period of nightsoil handling fell between January and April with a peak use in April and December. The source of the nightsoil was indicated by 95% from the own or the neighbor's latrine; only 5% (4/84) had their nightsoil obtained from public latrines or from the treatment plant. Only 14 9% of the vegetable farmers use nightsoil exclusively, however, 67.6% use more nightsoil than chemical fertilizer

Since the large scale conversion of dry latrines to water flushed ones, more wet and diluted nightsoil, which is voluminous and more difficult to transport, is available and less popular with farmers; this may explain why farmers might increasingly use chemical fertilizers. It might also explain that almost 60% of the farmers in this study indicated a preference for chemical fertilizer as compared to 23.3% expressing a preference for fresh nightsoil (Tab. 16). The majority of 78% reason that chemical fertilizer are more convenient and easier to use. If asked and prompted about their opinion about nightsoil almost all (95%) mentioned that nightsoil is "dirty". Only 3 /86 knew "that one can get sick". No further explanations were given and if prompted for other health knowledge no participant brought nightsoil in connection with intestinal infections, stomach problems, diarrhea or worm infection in particular.

With regards to protecting measures all farmers wore shoes while working and 90% stated taking further additional protecting measures Nonetheless a 2.5 times higher risk for contracting a dysentery was found for farmers that reported not taking any measures (Tab 15). Further, as described above the lack of hand washing after dealing specifically with nightsoil was associated with a 2.4 times higher risk for dysentery.

Discussion and Conclusions

Interestingly, farmers did not report the presence of flies in their household as a constant nuisance. It appeared very likely that the constant presence of flies created a tolerance resulting in a coexistence in which protective measures were not taken any more It highlights a situation in which there is a lack of conceptual knowledge of disease transmission situations may prevail that need urgent attention.

A further indication for a lack of conceptual understanding and health knowledge is given by the fact that farmers were clearly of the opinion that nightsoil is dirty, but apparently did not make the link to health, disease, infection or germ-transmission. The lack of hand washing after work and the handling of nightsoil, as well as a 2.5 times higher health risk resulting from not taking protective measures seemed to further reflected this situation.

The assessment of the nightsoil use by peri-urban vegetable farmers reflected the current practice. The usage patterns of nightsoil in the past were not elucidated. Earlier, before the conversion of dry to wet latrines, the consistency and quality of the nightsoil was better, as perceived by farmers. Today, therefore, their choice to use chemical fertilizer rather than wet nightsoil may well be the better of two unsatisfactory options. The provision of other technical options for sanitation could shift the preference back to the traditional use of nightsoil

The case-control study on peri-urban vegetable farmers and urban consumers had some limitations with regards to operation, sample size and the spectrum of risk factors found, which are discussed in below.

Direct morbidity data and information on the actual health status of the study participants could not be collected in the two studies as they were designed. Stool samples for laboratory investigation on helminth infections could not be collected as envisaged, it was not possible to visit the households twice to bring and

collect stool containers due to operational and time constraints during the interviewing Instead, a separate study on the helminth infection status in farmers was launched and two villages of farming communities were investigated (cf 3 4 3)

The number of dysentery cases who were occupationally engaged in agriculture and who were registered as ill in the records of the disease surveillance stations was limited, thus the initial sample size estimate for the study with farmers was not reached. For that reason the health risk factors found to be associated with the dysentery showed mostly a statistical strength above the 5% level of significance. This does not, however, invalidate the present study as the relative risk estimate is a powerful measure in connection with its confidence interval for the magnitude of the risk. Thus, a risk estimate of a 2.7 times higher likelihood for contracting dysentery for the lack of hand washing after work (as described for the urban consumers) is to be taken serious although the association is statistically not significant, particularly if the true value for the health risk could be as high as 10 (cf Table 15).

3. General Discussion and Conclusions

Food production initially concentrated in rural areas increasingly spread into the cities with a growing economical importance. Urban agriculture produces between 25 and 85% of Chinese cities' vegetable and fruit supplies Located in inner and outer city outskirts, urban agriculture contributes in more than one way to a beneficial urban development in reduced food prices and affordability, as incentive not to migrate to the cities' limited jobs due to assured income and employment. Urban food production constitutes an essential part of the urban ecosystem. However, the health situation for those engaged in agriculture and aquaculture, as well as the consumer population seem to be continuously directly or indirectly exposed to specific health risk factors that are related to the collection, disposal, treatment and reuse of untreated nightsoil.

This consultancy focused at a review of the health status situation with regards to nightsoil-related diseases and a primary assessment of determinants of health risks (i) for dysentery and hepatitis as nightsoil related indicator diseases and (ii) for vegetable and rice farmers and general urban population as two different exposure groups. Other population groups highly exposed to nightsoil management such as sanitation workers or more susceptible for the indicator diseases like children were not investigated specifically due to the small number of cases registered in the routine health status records.

The general the situation of the farmer with regards to health aspects can be summarized as follows

Vegetable farmers, representing a population group ocupationally exposed to nightsoil, have a very high level of general education but show significant lack of exposure to health education. Furthermore, the farmer community were considerably less appreciative of increasing their health and hygiene knowledge as compared to the consumer population. They exhibited more frequently high risk behaviors like the lack of hand washing after the handling of nightsoil or the lack of taking protective measures during work. Further evidence for this deficiency is indicated by the apparent higher morbidity for helminthiasis and dysentery in this nightsoil exposed group. Thus, the triage of high morbidity, lack of exposure paired with low susceptibility for health education and high risk behavior focus on the nightsoil exposed population groups as main target groups for health interventions.

The analysis of the risk factors for hepatitis A and dysentery identified in Wuhan showed patterns of infection risks which were rather indirectly related to nightsoil management, the risk factors identified were either related to general behavioral aspects or hygiene knowledge and practice. However, specific health risks attributable to the direct exposure to nightsoil were found for population groups that are heavily exposed to nightsoil occupationally or as consumers. The occupational group of farmers and fishermen showed such a high exposure which, combined with the established apparent lack of appropriate hygiene behavior, lead to an increase of nightsoil-related diseases. For consumers, health risk factors with direct relation to nightsoil contamination were identified with regards to unsafe sanitation habits and the consumption of agricultural products and their handling

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FIGURES

Fig.1 Organizational Structure of the Health Care System in PR.China

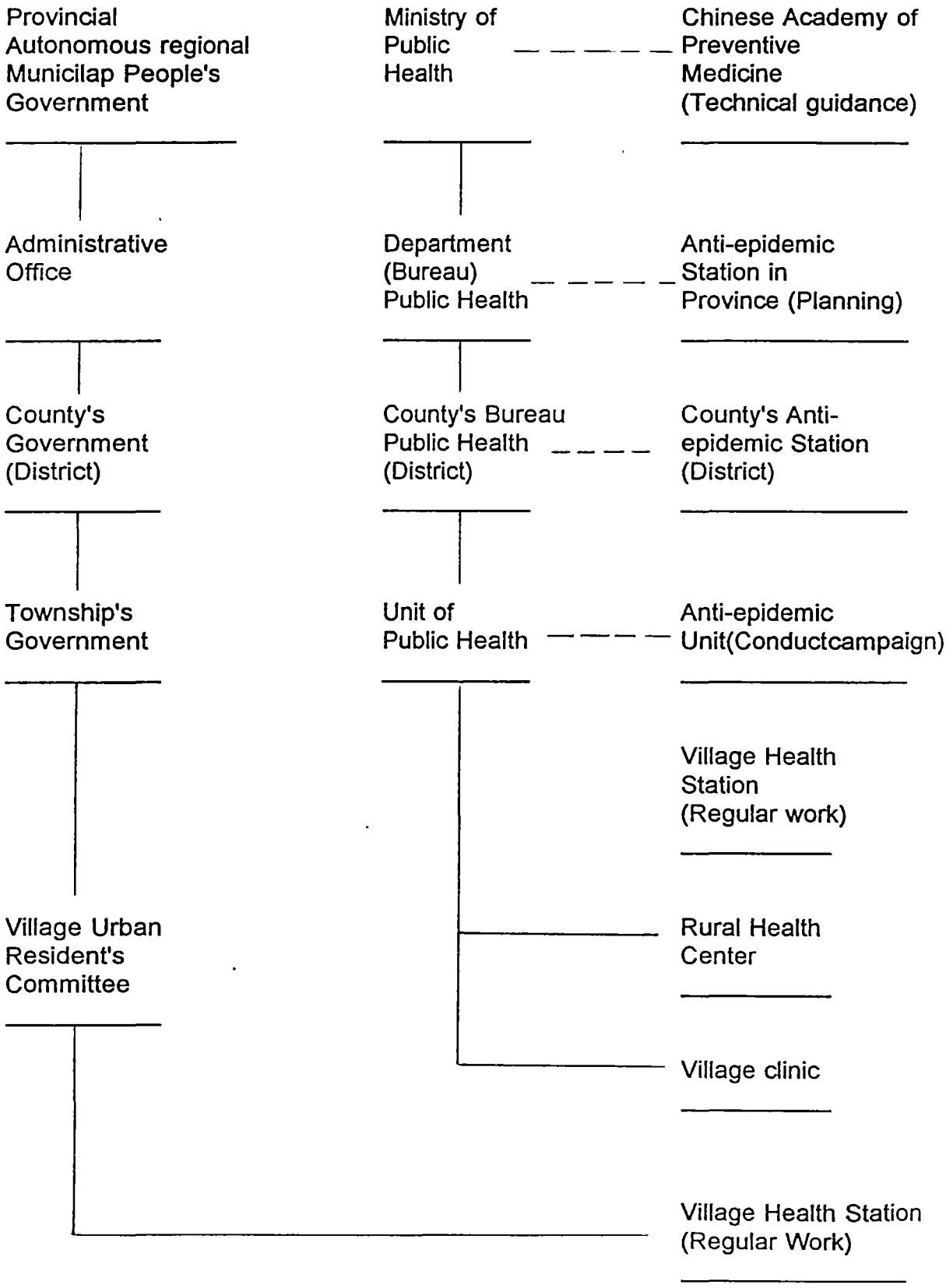
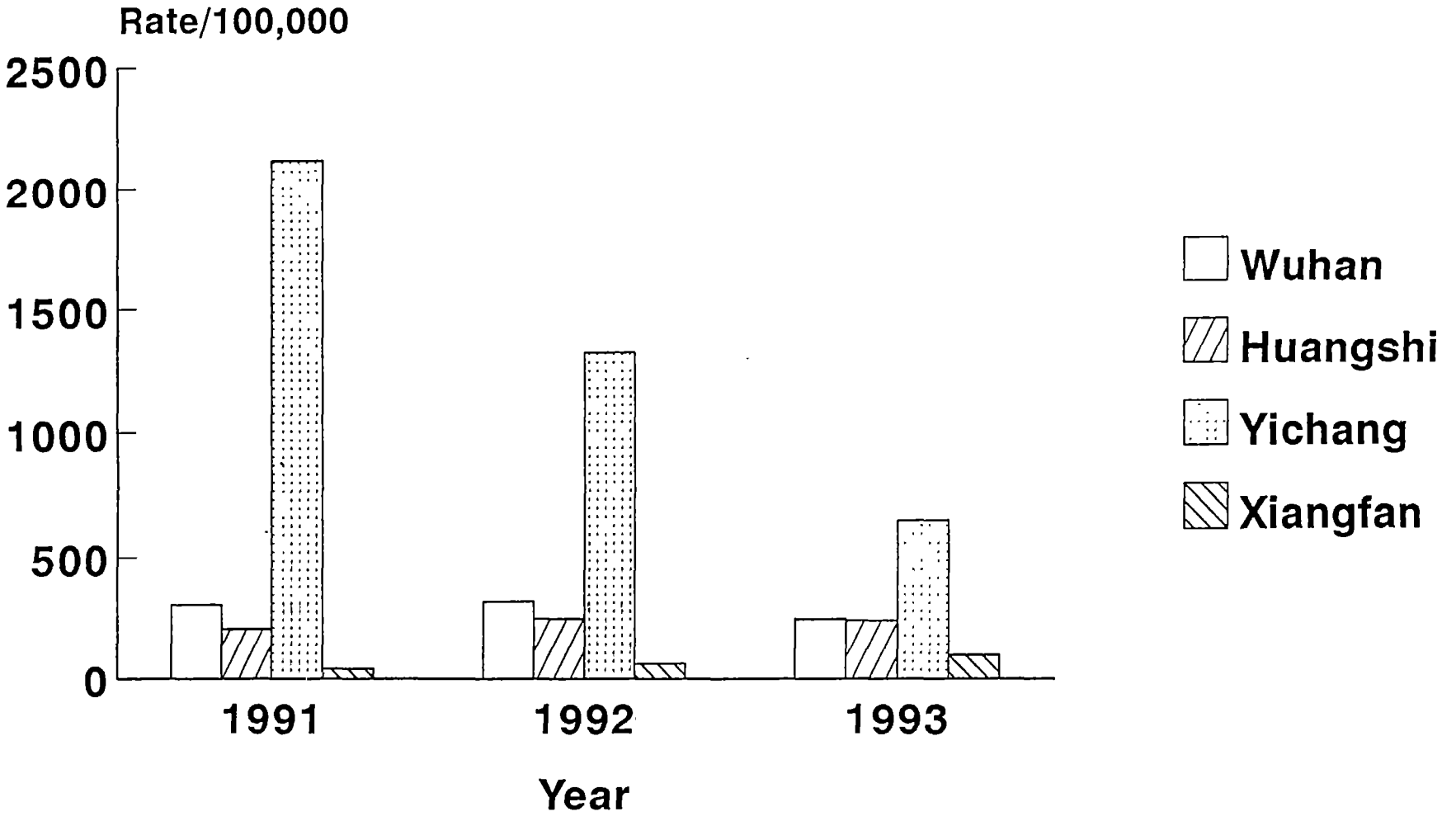
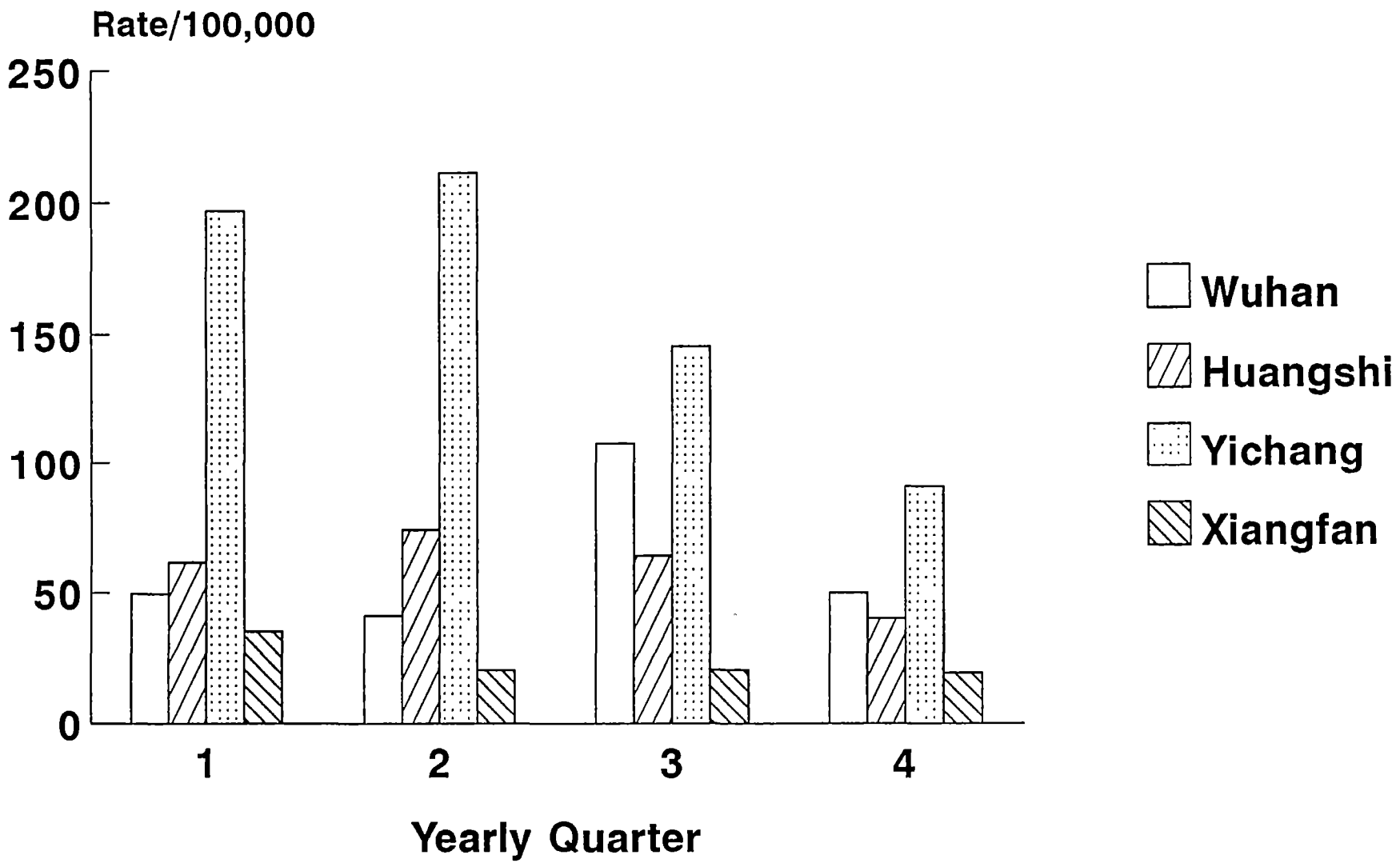


Fig.2: Yearly Morbidity Rates of Hepatitis From 1991-93 in 4 Cities of Hubei Province; P.R.China



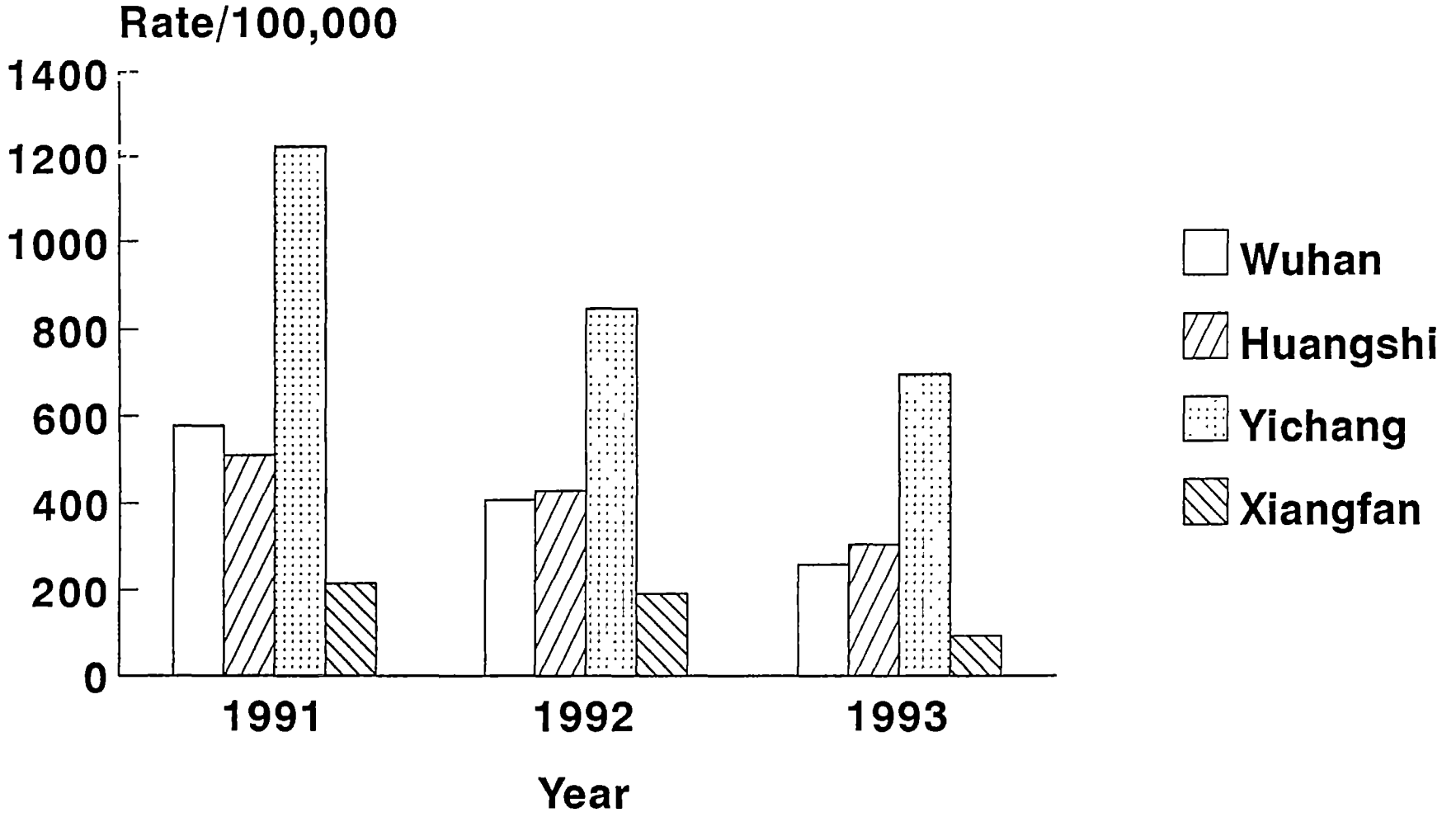
HUEP, May 1994

Fig.3: Quarterly Morbidity Rates of Hepatitis in 4 Cities in 1993; Hubei Province; P.R.China



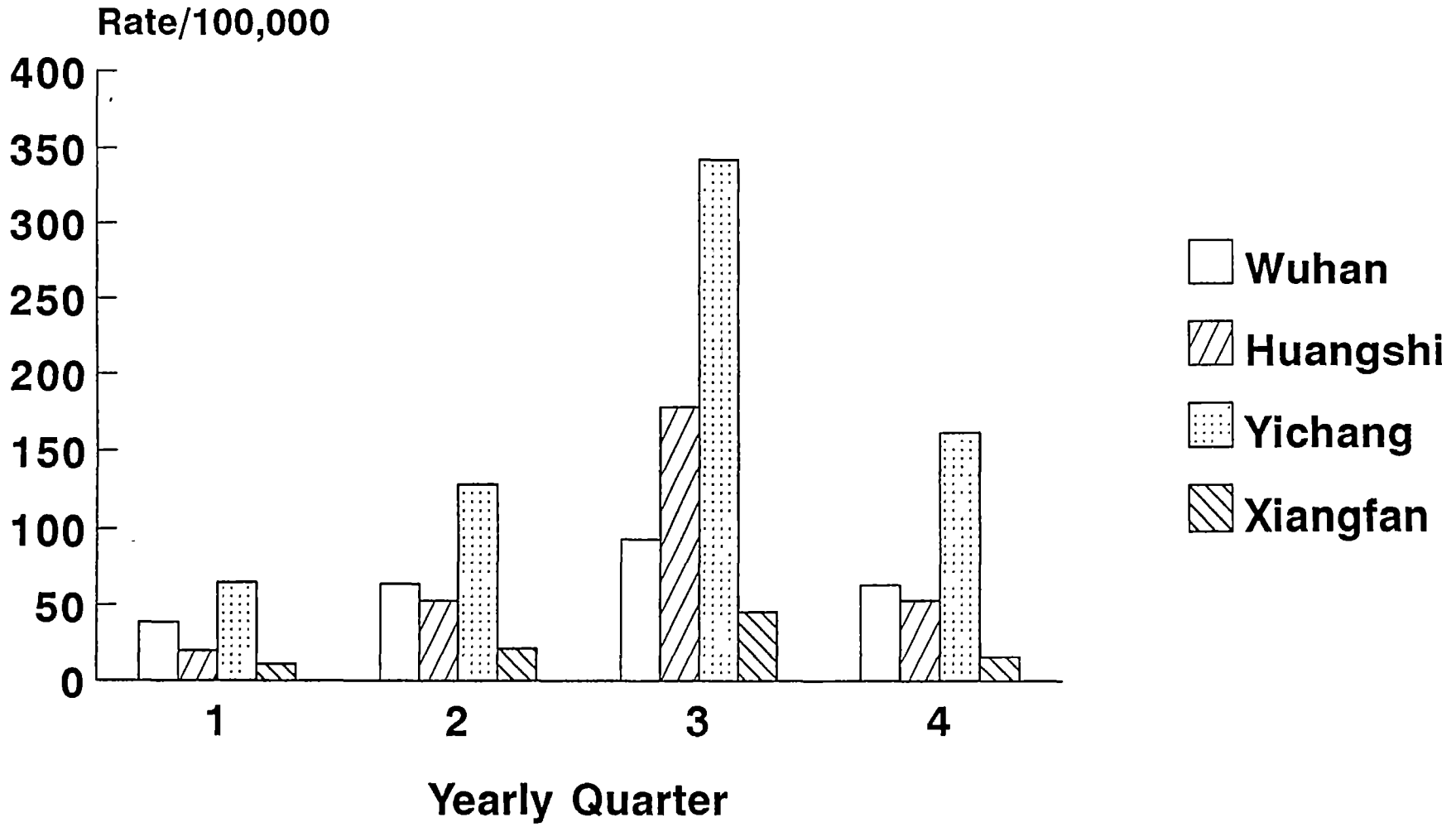
HUEP May 1994

Fig.4 Yearly Morbidity Rate of Dysentery From 1991-93 in 4 Cities of Hubei Province; P.R.China



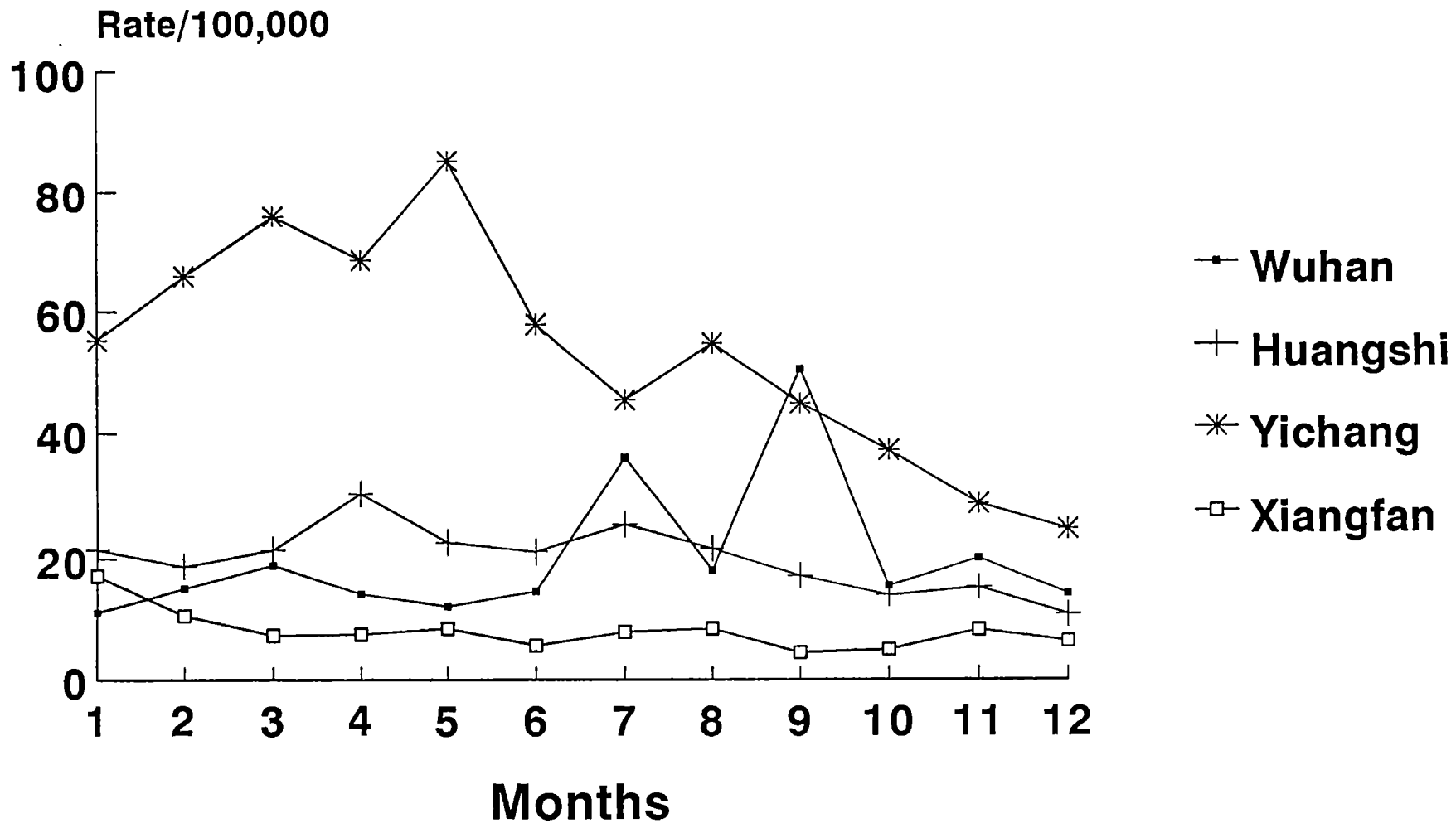
HUEP, May 1994

Fig.5: Quarterly Morbidity Rates of Dysentery in 1993 in 4 Cities of Hubei Province; P.R.China



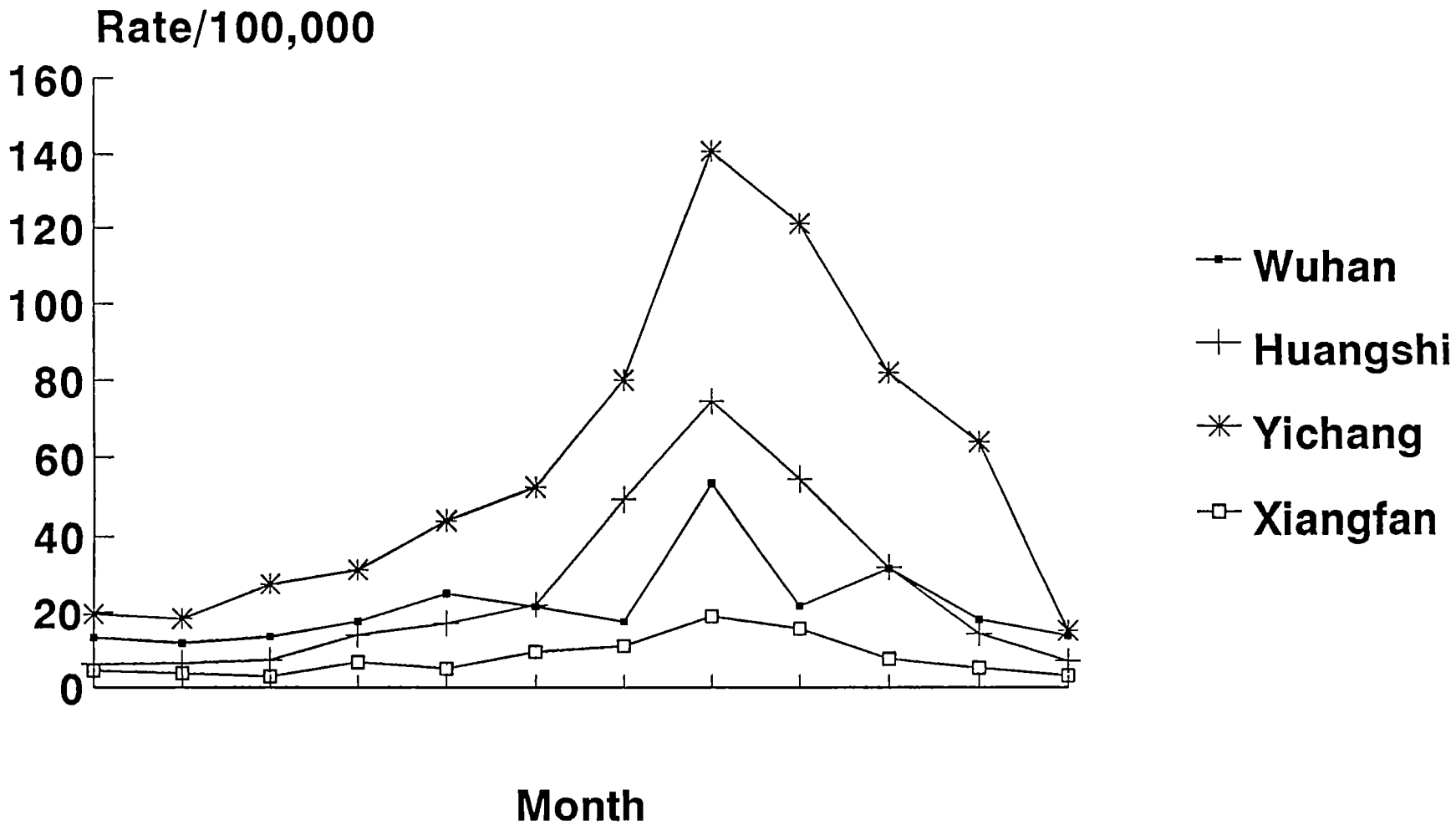
HUEP, May 1994

Fig.6: Monthly Morbidity Rates of Hepatitis in 4 Cities in 1993 in Hubei Province; P.R.China



HUEP, May 1994

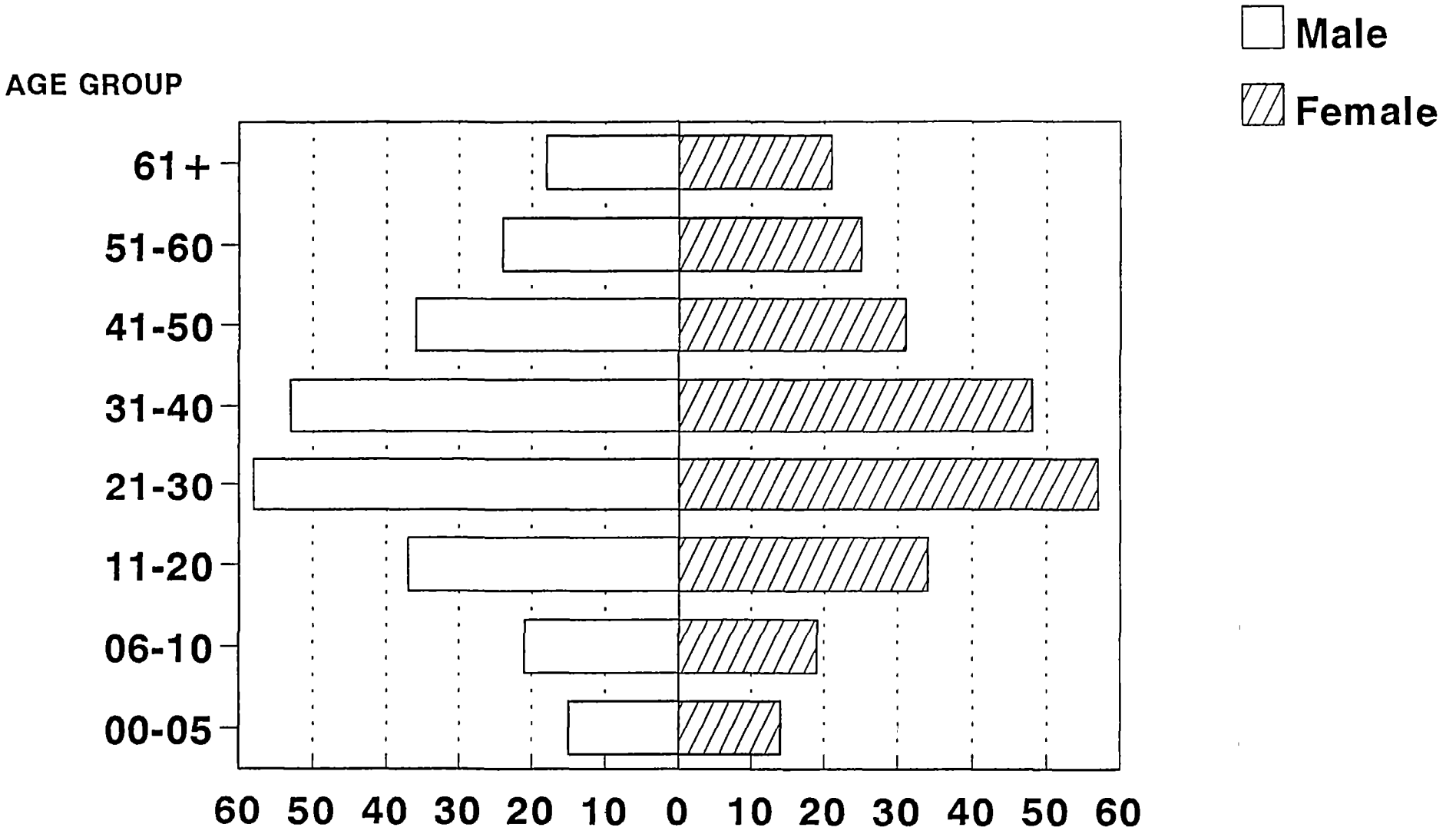
Fig.7: Monthly Morbidity Rates of Dysentery in 4 Cities in 1993 in Hubei Province; P.R.China



HUEP, May 1994

Fig.8: Age and Sex Distribution of a Vegetable Farming Community

Qin Ling Village; Wuhan, P.R.China

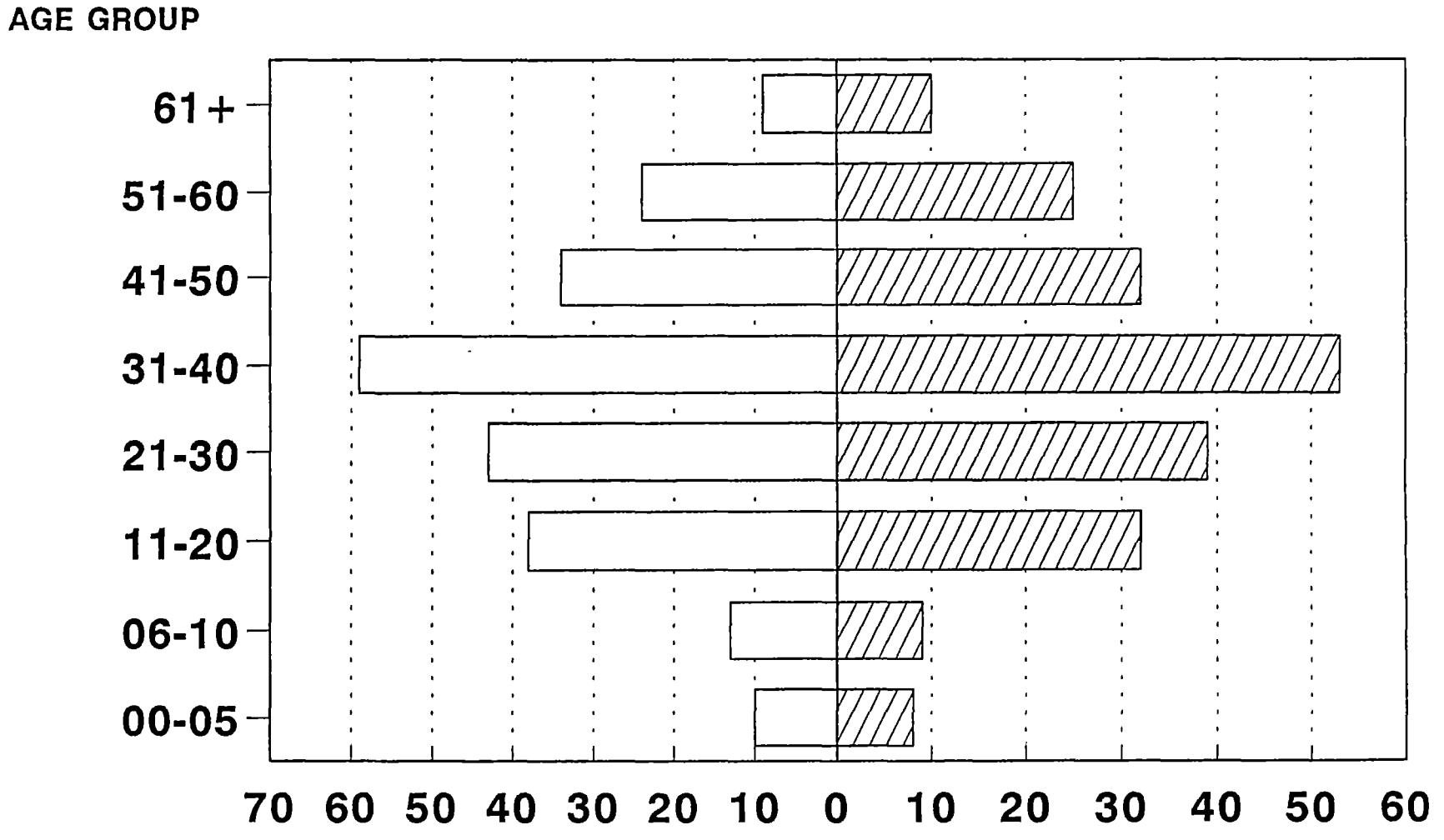


N=511

September 1994

Fig.9: Age and Sex Distribution of a Rice Farming Community

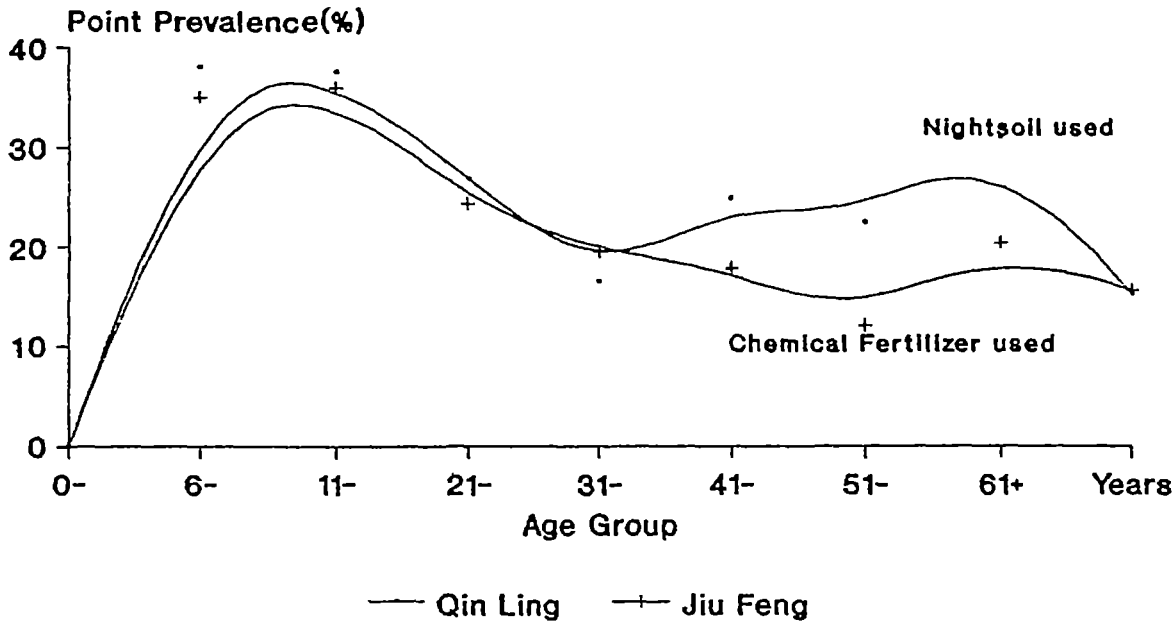
Jiu Feng Village; Wuhan, P.R.China



N=438

September 1994

Fig 10: Age-specific Prevalence of Helminth Infections in Two Farming Communities in Peri-urban Wuhan, P.R.China



Qin Ling:Night-soil using Area
Jiu Feng:Chemical Fertilizer using Area
September 1994

Fig.11: Distribution of the Occupations Among Hepatitis Cases and Controls in Wuhan City; P.R.China

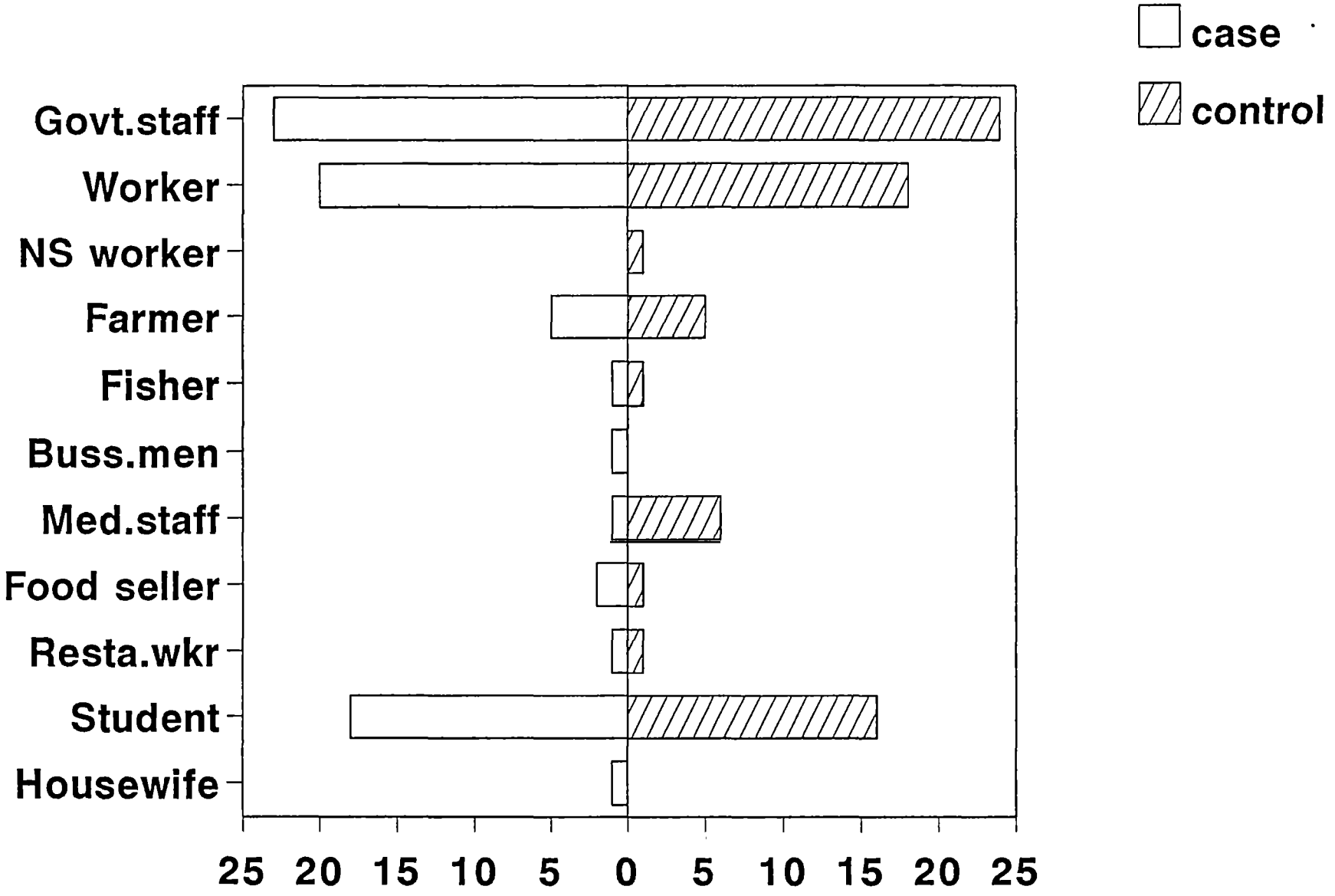


Fig.12: Distribution of Occupations Among Dysentery Cases and Controls in Wuhan City; P.R.China

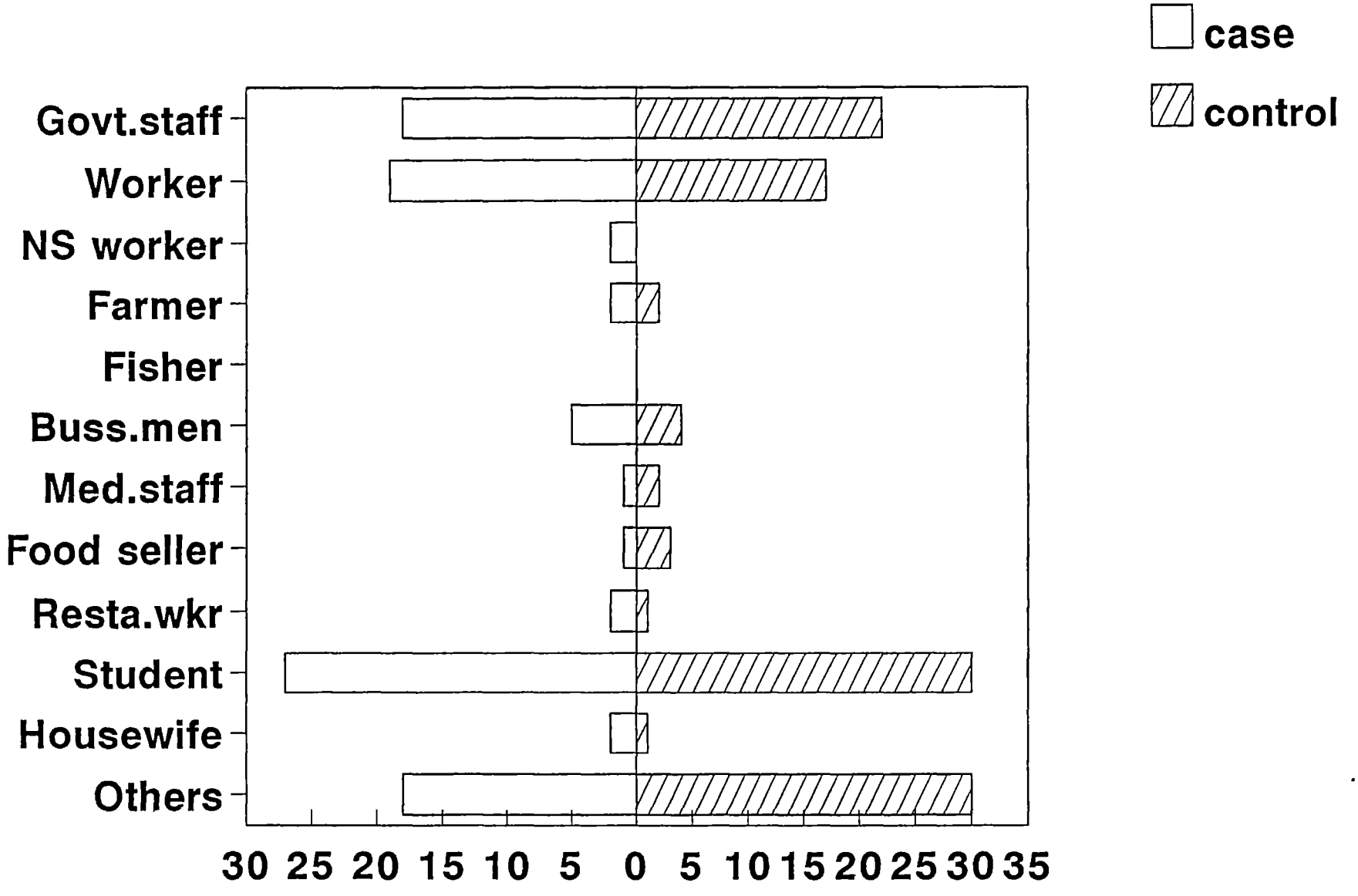


Fig.13: **Comparsion of Health Education Perception & Preference as Perceived By Consumers, Wuhan City, P.R.China**

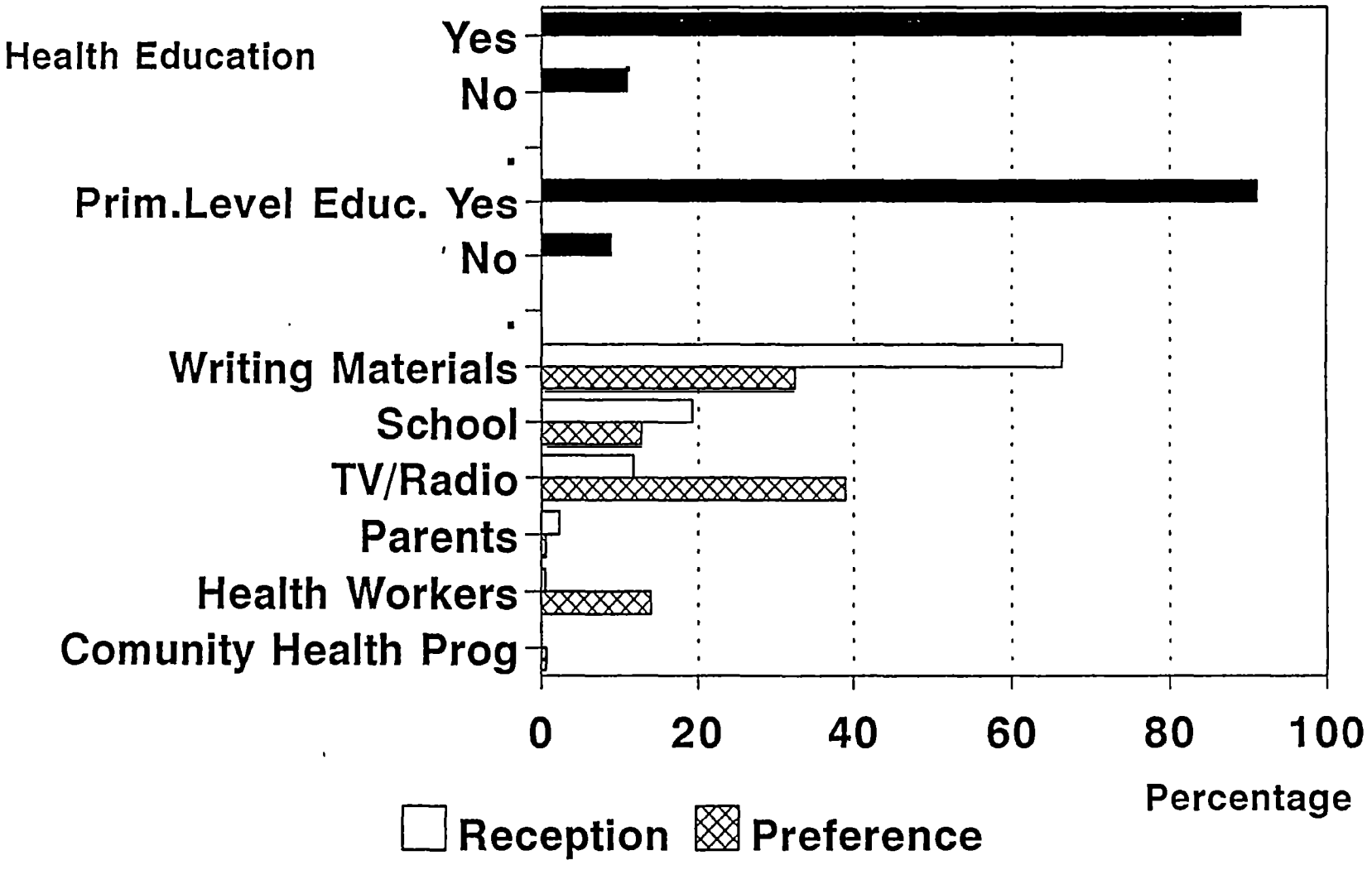


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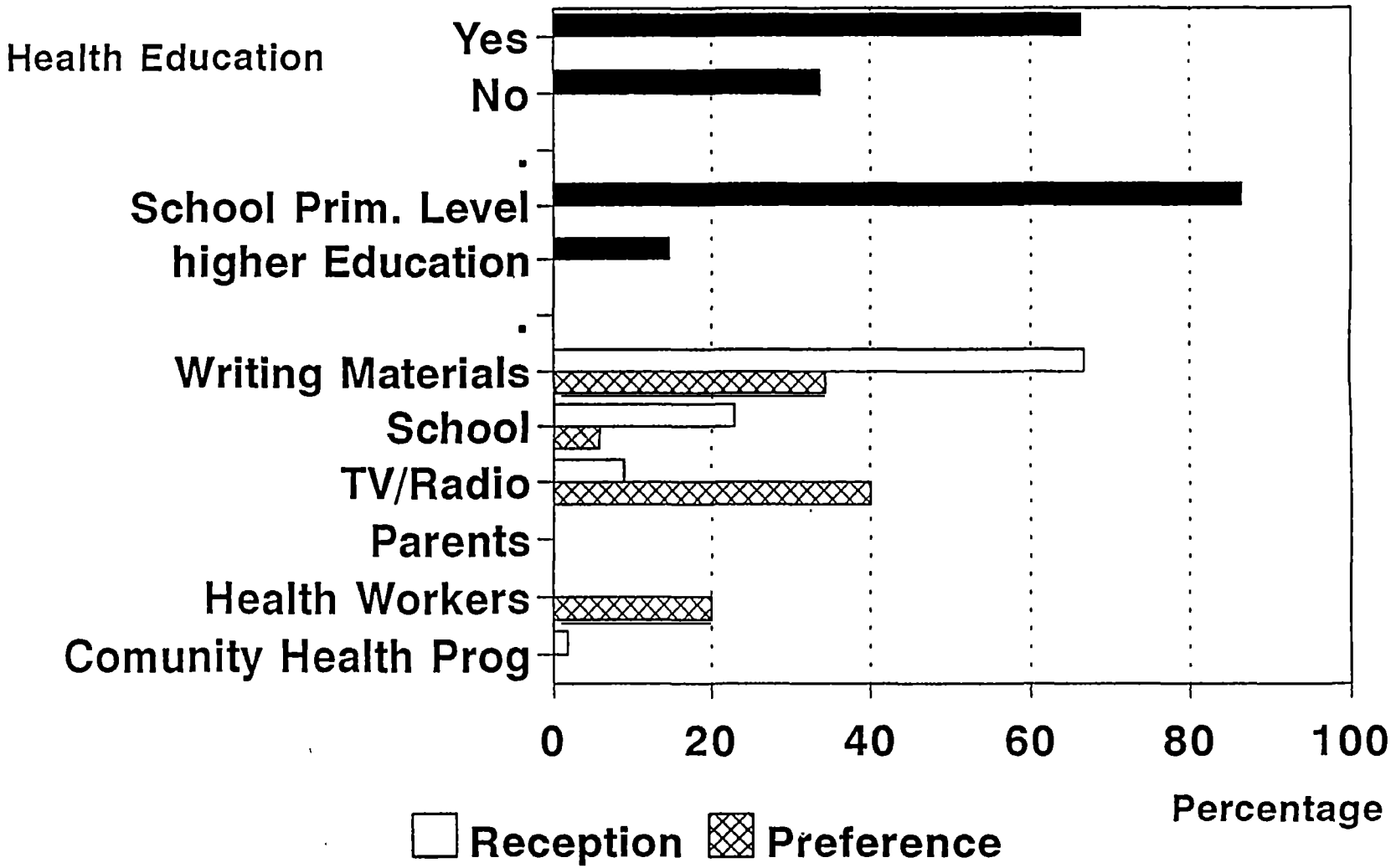
Fig.14: Comparsion of Health Education Perception & Preference as Perceived By Farmers, Wuhan City, P.R.China



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TABLES

Table 1: Populations of 1991-1993 in 100'000 of Four Cities of Hubei Province, PR.China

City	1991	1992	1993
Wuhan	37.9	38.0	38.1
Huangshi	13.3	13.5	13.7
Yichang	4.6	4.8	4.9
Xiangfan	5.4	5.6	5.8
City Summary	**61.2**	**62.1**	**62.6**

Table 2: Results of the National Helminth Survey from 1986 /PR China

Place	Number of Examin.	Ancylo-stoma (%)	Ascaris (%)	Trichuris (%)	Entero-bius (%)
Beijing	13730		30.7	1.2	20.11*
Shanghai	2714	0.7	25.9	44.6	23.7
Tianjing	3016				
Neimeng	505		5.5	2.2	22.9
Shanxi	14133	0.04	25.9	1.36	8.66
Hebei	5898	0.1	28.8	0.4	7.6**
Liaoning	37978		57.5	8.3	14.4
Jilin	501		34.4	1.2	46.0
Heilongjiang	2526		6.5	0.9	
Jiangsu	21102	26.0	44.4	40.8	
Anhui	17611				
Zhejiang	7840	32.4	49.6	25.1	9.0
Jiangxi	52146	17.6	71.1	17.0	19.6
Fujian	4616	40.1	30.6	23.0	
Hunan	34615	30.6	61.1	17	8.9
Henan	85741	15.9	44.6	8.4	21.7
Guangdong	2050	33.9	62.8	46.3	23.6
Guizhou	57892	19.7	72.3	29.9	
Sichan	18468	42.3	66.2	29.5	0.2
Yunnan	1065	69.3	81.9	55.9	12.6
Shannxi	9210		51.6	5.3	
Gansu	28587	0.02	36.0	2.0	12.2
Ningxia	7980		30.8		
Qinghai	878		29.5		
Xinjiang	927		0.9		
Xizang	2534		14.8	2.0	1.9
Hainan	524	34.9	72	7.9	
Guangxi	2616	41.6	66.3	48.0	40.5
Shandong	2860	32.5	31.8	2.8	38.1

Legend: * Peasant 41%, Worker 22.7%., ** Peasant 38.2%, Others 15.3%. *** Minority groups

Table 3: The Infection Situation of Human Parasites in Hubei Province by Region; National Helminth Survey 1986 /PR China

Number of Exam.	JH	SEH	NEH	SWH	NWH	TOTAL
Ascaris lumbricoides	55.24	44.87	12.42	50.23	22.29	39.96
Ancylostoma	13.05	14.80	7.22	8.14	8.9	10.90
Trichuris	32.41	18.55	7.42	11.97	12.82	18.38
Trichostrongylus	0.069	0.24		6	8	0.098
Strongyloides	0.07	-	0.29	0.43	0.27	0.193
Enterobius vermicularis	9.27	9.76	8.75	16.34	19.48	10.49
Fasciolopsis	2.79	1.80	1.39	1.90	0.22	1.774
Clonorchis	0.09	0.30				0.09
Schistosome japonicum	0.014	0.39		4		0.096
Entamoeba histolytica	0.68	0.76	0.65	0.67	0.52	0.663
E. coli	1.89	1.75	1.73	2.46	1.94	1.952
E. Hartmani	0.22	0.21	0.19	0.26	0.25	0.225
Iodamoeba	0.78	0.94	0.80	0.94	0.64	0.824
Giardia lamblia	1.29	1.18	1.36	1.68	1.44	1.374

Table 4: Infection Rates of Human Helminth in 4 Cities

City Name	No.type of Parasites	Infection Rate (IR %)	IR of Veg. Farmer	IR Child (<5yrs)
Wuhan	13	45.5	50.9	15.6
Huangshi	11	38.5	52.9	10.5
Yichang	10	41.7	49.7	8.0
Xianfan	11	42.7	54.5	9.0

Legend: Veg = vegetable

Table 5: **Quaterly Morbidity Rates per 100'000 of Hepatitis in 4 Cities in 1993 of P.R.China**

City	I	II	III	IIII	Yearly Rate
Wuhan	45.93	41.13	107.32	49.80	244.17
Huangshi	61.57	73.83	64.04	40.07	239.49
Yichang	196.96	211.36	145.03	90.26	643.61
Xiangfan	35.17	20.55	20.72	19.52	97.26
Quarterly Summary	**84.91**	**86.71**	**84.28**	**49.91**	**306.13**

Hubei Province; 6.1994

Legend: I, II, .. = yearly quarters

Table 6: **Quarterly Morbidity Rates per 100'000 of Dysentery in 1993 in 4 Cities of P.R.China**

City	I	II	III	IIII	Yearly Summary
Wuhan	38.61	63.99	92.93	63.18	258.01
Huangshi	19.67	52.82	177.78	53.04	303.32
Yichang	65.11	127.38	341.58	160.65	694.72
Xiangfan	11.13	21.06	45.38	15.75	93.32
Quarterly Summary	**36.63**	**66.31**	**164.41**	**73.2**	**337.41**

Hubei Province; 6.1994

Legend: I, II,... = yearly quarters

Table 7: Morbidity of Typhoid per 100'000 from 1991-1993 in Four Cities of PR China

City	1991	1992	1993
Wuhan	NA	NA	NA
Huangshi	33.45	24.24	33.08
Yichang	54.37	44.79	46.20
Xiangfan	2.40	2.47	3.97
TOTAL	**30.61**	**32.01**	**27.75**

Hubei Province; 6.1994

Legend: NA: Data was not available

Table 8: Yearly Morbidity Rates per 100'000 of Hepatitis in 1991-1993 in 9 Districts of Wuhan City, P.R.China

District	1991	1992	1993
Hongshan	94.79	154.79	107.29
Wuchang	425.40	316.62	252.97
Qiaokou	220.53	127.05	210.70
Jianghang	314.00	500.00	374.75
Jiangan	262.41	325.35	341.03
Qinshan	368.11	321.62	209.19
Hanyang	500.86	383.14	242.00
Hanlan	203.00	308.00	180.00
Dongxihu	331.58	387.37	228.95
Yearly Summary	**305.70**	**318.24**	**244.17**

Table 9: Yearly Morbidity Rates per 100'000 of Dysentery in 1991-1993 in 9 Districts of Wuhan City of P.R.China

District	1991	1992	1993
Hongshan	358.75	228.33	165.00
Wuchang	592.84	475.68	222.16
Qiaokou	417.08	264.92	235.44
Jianghang	541.25	497.50	394.25
Jiangan	462.93	373.62	311.38
Qinshan	882.97	652.70	227.03
Hanyang	1204.28	499.71	351.14
Hanlan	264.00	193.00	200.00
Dongxihu	445.26	410.52	210.53
Yearly Summary	**578.58**	**405.79**	**258.01**

Table 10: Helminth Infection Rates in Two Farming Communities using Nightsoil and Chemical Fertilizer in Periurban Wuhan City; P.R.China
- Distribution of Infections by Age and Sex

Age Group		Nightsoil User Qin Ling Village (N = 511)			Chemical Fertilizer Jiu Feng Village (N = 438)		
Years	%infection overall	Male (N)	Female (N)	Rate%	Male (N)	Female (N)	Rate%
00-05	34.0 (16/47)[a]	15	14	38.0	10	8	27.8
06-10	35.5 (22/62)	21	19	37.5	13	9	31.8
11-20	25.5 (36/141)	37	34	26.8	38	32	24.3
21-30	22.8 (45/197)	58	57	16.5	43	39	19.5
31-40	21.1 (45/213)	53	48	24.8	59	53	17.9
41-50	17.3 (23/133)	36	31	22.4	34	32	12.1
51-60	19.4 (19/98)	24	25	31.0	24	25	20.4
61+	15.5 (9/58)	18	21	15.4	9	10	15.8
Total	22.7%	262	249	25.3%* (21.5 - 29.1)	230	208	19.6%* (15 9-23.3)

[a] Number of cases per total number investigated
() 95% confidence limit
* significantly different result: p= 0.048

Table 11: The Infection Rate and Intensity of Helminth by Species in Two Farming Villages, Wuhan 1994

Helminth Species	Overall Infection Rate	Qin Ling (nightsoil users) Total Population = 511		Jiu Feng (chemical fertilizer user) Total population = 438	
	in %	Infection Rate %	Intensity (EPG)	Infection Rate %	Intensity (EPG)
Ascariasis	21.9	24.8	456	18.3	384
Hookworm	4.3	4.9	120	3.7	72
Trichuris	5.6	5.1	72	6.2	72
Clonorchis	0.3	0.6	120	--	--

EPG = eggs per gram stool

Table 12: Percent Distribution of Study Subjects according to Sex, Age and Education:

- **Case-Control Study on Hepatitis and Dysentery in Wuhan City, P.R.China**
- **Qualitative Study with periurban Vegetable Farmers**

	Dysentery		Hepatitis		Veg.Farmer
	Cases (N= 100)	Controls (N= 100)	Cases (N= 100)	Controls (N= 100)	(N= 52)
Sex					
male	51.0	51.0	70.0	70.0	65.4
female	49.0	49.0	30.0	30.0	23.1
Age					
< 10	20.0	20.0	17.0	17.0	0
11-20	20.0	20.0	26.0	24.0	7.7
21-30	18.0	17.0	30.0	33.0	42.3
31-40	17.0	17.0	13.0	12.0	32.7
41+	25.0	26.0	14.0	14.0	13.5
Education *					
no formal schooling	18.2	16.3	9.2	10.1	2.2
primary (5y)	14.1	10.2	15.3	12.1	8.9
middle (7y)	12.1	9.2	16.3	15.2	33.3
high (9y)	18.2	26.5	23.5	22.2	46.7
University	37.4	37.8	35.7	40.4	8.9

* Children <6y excluded

Table 13: **Risk Factors for Dysentery and Hepatitis in the General Population of Wuhan City, P.R.China**

Exposure	Dysentery Nr of Cases	Dysentery Rel.Risk Estimate	Dysentery 95%CI	Hepatitis Nr of Cases	Hepatitis Rel.Risk Estimate	Hepatitis 95%CI	People exposed to the risk factor are x-times more likely for disease.
Socio-economic Factors (y/n)							
Occupation							
Farmer/Fisherman	2/100	1.0	0.1 - 10.3	9/100	1.9	0.5 - 6.8	
Possessions[1]	39/77	0.8	0.4 - 1.5	66/100	1.3	0.4 - 4.7	
Ownership flat	14/100	1.1	0.5 - 2.7	20/100	1.1	0.5 - 2.5	
Nr rooms/flat							
≤3 vs 3+	90/100	0.7	0.2 - 2.1	87/100	0.8	0.3 - 2.1	
Income							
≤800RMB vs 800+	93/100	0.4	0.1 - 2.4	82/100	0.9	0.4 - 2.1	
Household- related Factors (y/n)							
Problems with Flies	49/97	**2.0**	1.1 - 3.6*	56/98	**1.8**	1.0 - 3.4	☜
Illness in the household	6/29	-	-	2/40	0.8	0.1 - 9.4	
Nr pers/household							
≤3 vs 3+	47/100	0.7	0.4 - 1.3	49/100	1.0	0.5 - 1.8	
Duration in area							
≤4y vs 4+	41/100	1.1	0.6 - 2.0	38/100	0.7	0.4 - 1.3	
Consumption- related Factors (y/n)							
Drink unboiled Water	17/100	**4.9**	1.7 - 18.3**	23/100	**3.0**	1.2 - 7.6*	☜
Vegetables bought							
from street vs shop	60/85	**2.7**	1.4 - 5.3**	53/100	**3.4**	1.6 - 7.1***	☜
Eating							
outside	31/100	1.8	0.9 - 3.6	39/100	1.0	0.5 - 1.8	
leftover food	14/100	**16.1**	2.1 - 340.8**	7/100	2.4	0.5 - 12.4	☜
eat streetfood	56/100	1.8	1.0 - 3.2	44/100	1.3	0.7 - 2.4	
raw vegetable	10/100	**11.0**	1.4 - 238.2*	3/100	-	-	☜
raw fish/egg/meat	0/100	-	-	0/100	-	-	
fresh milk	4/100	2.0	0.3 - 16.7	6/100	2.1	0.4 - 10.9	

open icecream	4/100	2.0	0.3 - 16.7	8/100	2.8	0.6 - 14.0	
drink from river/lake/pond	0/100	-	-	0/100	-	-	
Eucation, Hygiene Knowledge & Behaviour (y/n)							
No formal Education	18/99	1.1	0.5 - 2.6	9/98	0.9	0.3 - 2.6	
No Hyg.Education	64/87	**7.0**	3.3 - 14.8***	47/100	**5.6**	2.6 - 11.1***	
Disposal of Child. Faeces							
not in toilet	7/100	1.2	0.3 - 4.2	12/100	**4.4**	1.1 - 19.6*	
Defeaction out of home							
not in toilet	5/100	2.7	0.4 - 20.0	7/100	1.4	0.4 - 5.6*	
No handwashing after							
defeacation	47/100	**5.6**	2.6 - 11.1***	40/100	**3.2**	1.6 - 6.7*	
work	97/100	1.4	0.2 - 7.7	96/100	2.6	0.7 - 11.1	
before eating	39/100	**4.8**	2.1 - 10.0***	35/100	**5.6**	2.7 - 11.1***	
before cooking	70/100	**2.8**	1.4 - 5.3**	77/100	**5.6**	2.3 - 12.5***	
Playing							
in contaminated areas[2]	1/10	-	-	8/16	3.5	0.4 - 34.7	
Perception of cleanleness							
of toilet used: clean vs dirty	76/100	0.5	0.2 - 1.1	72/100	0.9	0.4 - 1.7	
Observational Data (y/n)							
Animals in house	1/97	-	-	6/96	2.0	0.4 - 10.7	
Uncovered food	8/97	**8.6**	1.1 - 190.8*	10/96	**10.8**	1.4 - 234*	
Uncovered drinking water	5/97	1.7	0.3 - 9.4	12/96	1.2	0.5 - 3.2	
Kitchen clean vs dirty[3]	10/97	**5.5**	1.1 - 37.7*	23/82	**3.0**	1.2 - 7.4*	
Excreta or rubbish visible	37/95	**3.7**	1.7 - 7.8***	33/91	2.0	1.0 - 4.1	
Rubbish around house	36/97	**3.5**	1.7 - 7.6***	33/96	1.9	1.0 - 3.9	
Respondents appearence							
dirty hands/clothes/face	15/96	**5.1**	1.3 - 23.0*	14/96	**3.0**	1.0 - 10.2	

[1]Possessions Bike+TV+Tel+ Washing maschine
[2]Playing in contaminated areas (children <13y): vegetable garden, rubbish, pond vs own yard
[3]dirty= food on floor/utensils/plates dirty
p-values Yates corrected: (*): $p \leq 0.05$; (**) $p \leq 0.01$; (***) $p \leq 0.001$

Table 14: Distribution of Study Subjects According to Sex, Age and Education;
- **Case-Control Study on two Nightsoil-exposed Population Groups in Wuhan City, P.R.China**

	Vegetable Farmer		Consumer	
	Cases (N= 45)	Controls (N= 50)	Cases (N= 135)	Controls (N= 131)
Sex				
male	58.8	56.0	63.7	65.7
female	41.2	44.0	36.3	34.3
Age				
≤ 10	2.2	0	10.4	9.2
11-20	13.3	10.3	20.7	21.4
21-30	37.8	42.0	48.9	51.8
31-40	22.2	26.0	8.2	6.9
41+	24.5	22.0	12.8	10.7
Education *				
no formal schooling	15.9	9.1	2.5	1.7
primary (5y)	0	0	0	0
middle (7y)	6.8	6.8	7.4	6.9
high (9y)	75.0	84.1	43.0	35.0
University	2.3	0	47.1	56.4

* Children <6y excluded

Table 15: Risk Factors for Dysentery in Two Nightsoil-exposed Population Group of Wuhan City, P.R.China

	Vegetable Farmer			Consumer			
Exposure	Nr of Cases	Rel.Risk Estimate	95%CI	Nr of Cases	Rel.Risk Estimate	95%CI	People exposed to the risk factor are x-times more likely for disease.
Household- related Factors (y/n)							
Problems with Flies	24/45	0.3	0.1 - 0.9	34/129	1.1	0.6 - 1.9	
Consumption- related Factors (y/n)							
Drink unboilded Water	3/42	**3.5**	0.3 - 91.2	6/124	1.2	0.3 - 4.7	☜
Vegetables bought from street vs shop	0/42	-	-	67/104	1.0	0.6 - 1.9	
Eating							
outside	5/45	0.6	0.2 - 2.1	34/135	1.1	0.6 - 1.9	
leftover food	4/45	1.1	0.2 - 5.8	13/135	0.9	0.4 - 2.1	
eat streetfood	2/45	0.3	0.04- 2.0	18/135	0.8	0.4 - 1.7	
raw vegetable	3/45	0.8	0.1 - 4.7	7/135	**1.8**	0.5 - 7.5	
raw fish/egg/meat	2/45	1.1	0.1 -11.7	2/135	0.7	0.1 - 4.8	
fresh milk	1/45	-	-	0/135	-	-	
open icecream	1/45	-	-	0/135	-	-	
drink from river/lake/pond	2/45	-	-	0/135	-	-	
any of the above	5/45	**1.9**	0.4 - 10.6	22/135	1.5	0.7 - 3.3*	☜
Eucation, Hygiene Knowledge & Behaviour (y/n)							
No formal Education	7/44	**1.9**	0.4 - 8.3	14/132	1.5	0.6 - 4.0	☜
No Hyg.Education	16/45	1.2	0.5 -3.3	16/134	1.2	0.5 - 2.9	
Disposal of Child. Faeces not in toilet	10/17	1.4	0.3 - 7.7	19/39	1.2	0.4 - 3.1	
No handwashing after							
defeacation	37/45	0.8	0.2 - 2.5	92/135	0.8	0.4 - 1.4	
work	43/45	**2.0**	0.3 - 10.0	131/135	**2.7**	0.8 - 10.0	☜
before eating	34/45	1.2	0.4 - 3.3	70/135	1.0	0.6 - 1.7	
before cooking	31/45	0.9	0.4 - 2.5	64/135	0.9	0.6 - 1.4	

Perception of cleanleness of toilet used: clean vs dirty	41/42	1.2	0.0 - 45.3	62/129	0.8	0.5 - 1.4
Observational Data (y/n)						
Household condition animals/open food/ uncovered drinking water	18/45	0.5	0.2 - 1.3	63/135	**1.3**	0.8 - 2.1
Kitchen clean vs dirty[3]	29/42	1.3	0.5 - 3.4	88/119	0.8	0.4 - 1.5
Excreta or rubbish visible	29/42	0.7	0.2 - 1.8	49/129	0.9	0.5 - 1.5
Respondents appearence dirty hands/clothes/face	39/45	0.7	0.2 - 3.0	6/134	1.4	0.4 - 4.7
Agricultural Use of Nightsoil [1] (y/n)						
NS used as soil conditioner	40/45	0.9	0.2 - 3.9			
NS used as fertilizer	41/45	1.1	0.2 - 5.5			
Chemical fertilizer used	29/44	0.3	0.04- 2.1			
No protecting measures during work	8/45	2.5	0.6 - 10.8**			
No handwashing after handling NS	8/30	2.4	0.5 - 11.0***			
Opinion about NS						
No opinion	0/45	-	-			
dirty/diseases	39/45	1.2	0.4 - 4.5			
take measures for disease prevention	36/45	0.9	0.3 - 2.8			

[1] this part only assessed in the group of farmers

NS Nightsoil

* p= 0.32 no significant difference

** p= 0.26 "

*** p= 0.33 "

Table 16: The Use of Nightsoil in Agriculture by Vegetable Farmers of Periurban Wuhan City; P.R.China

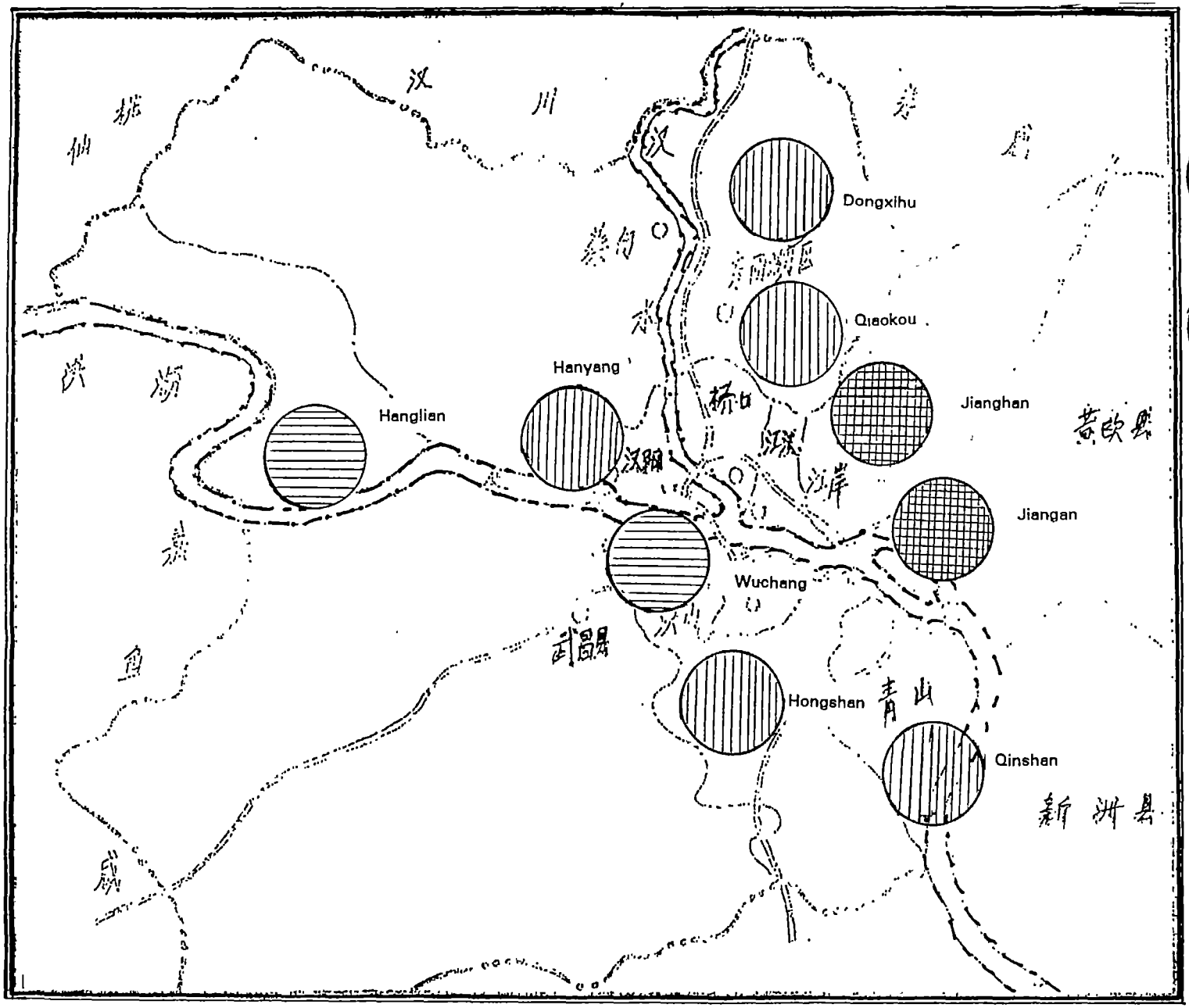
	(N)	(%)			
The Use of Fertilizers (N= 74)					
- Nightsoil only	11	14.9%			
- Chem.Fertilizer	2	2.7%			
- Nightsoil > Chemicals	43	58.1%			
- Chemicals > Nightsoil	11	14.9%			
- Chem. vs Nightsoil; 50:50	7	9.5%			
Source of the Nightsoil (N= 84)					
- from own latrine	74	88.1%			
- from neighbour	6	7.1%			
- from the public toilet	3	3.6%			
- treated NS from the treatm.plant	1	1.1%			
Preference for Fertilizer (N= 73) (N=83)			Reasons for the Preference		
- Fresh nightsoil	17	23.3%	cheaper	10	58.8%
- Treated nightsoil	13	17.8%	cheaper	6	46.2%
- Chemical fertilizer	43	58.9%	easier to use	28	66.7%

MAPS

Morbidity Patterns of Hepatitis A in Nine Districts, Wuhan, P.R. China

(in 1993)

June 10, 1994



Morbidity Rate

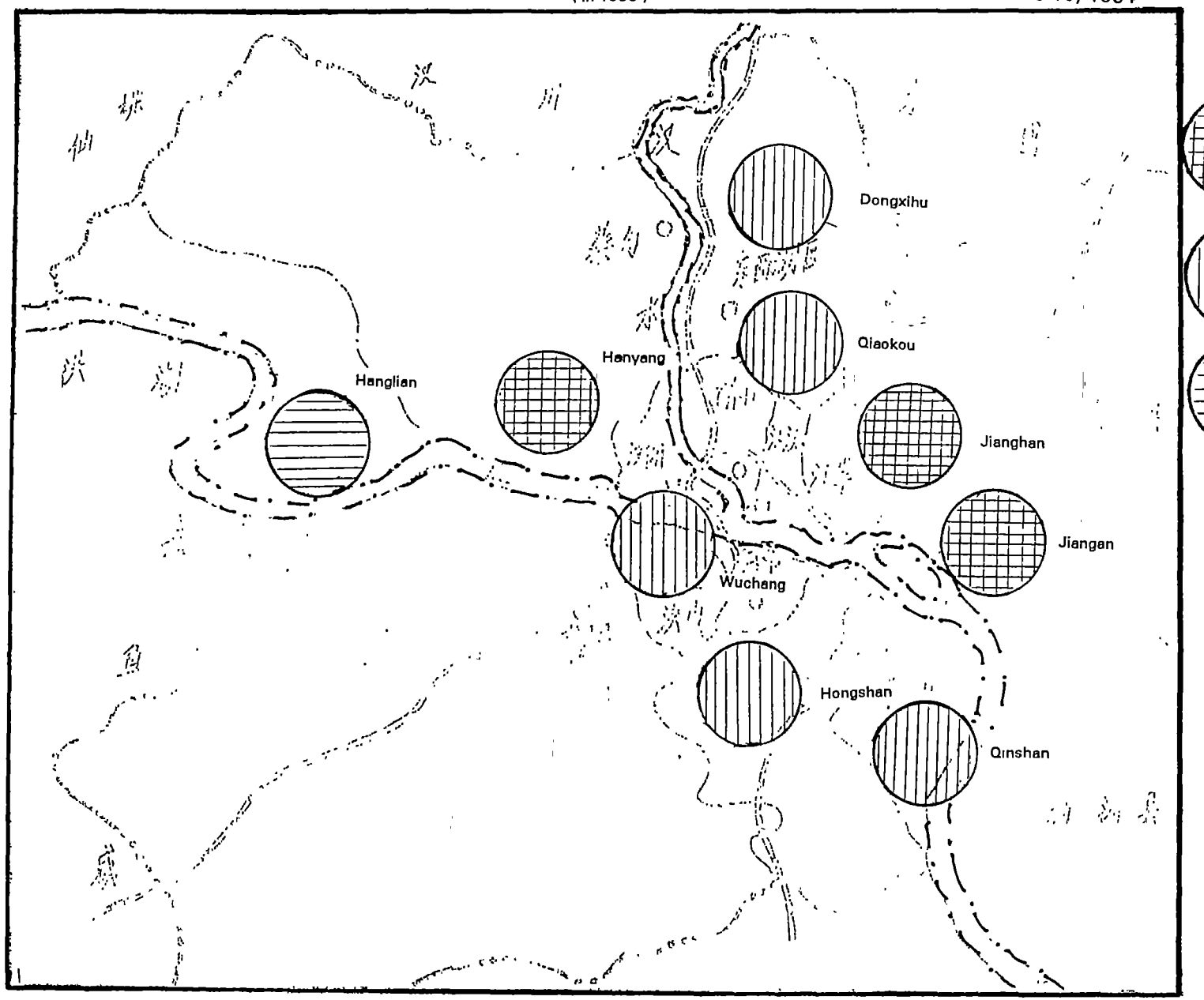
High	300-400/100,00
Medium	201-299/100,00
Low	0 - 200/100,00

Map 1

Morbidity Patterns of Dysentery in Nine Districts, Wuhan, P.R. China

(In 1993)

June 10, 1994



Morbidity Rate

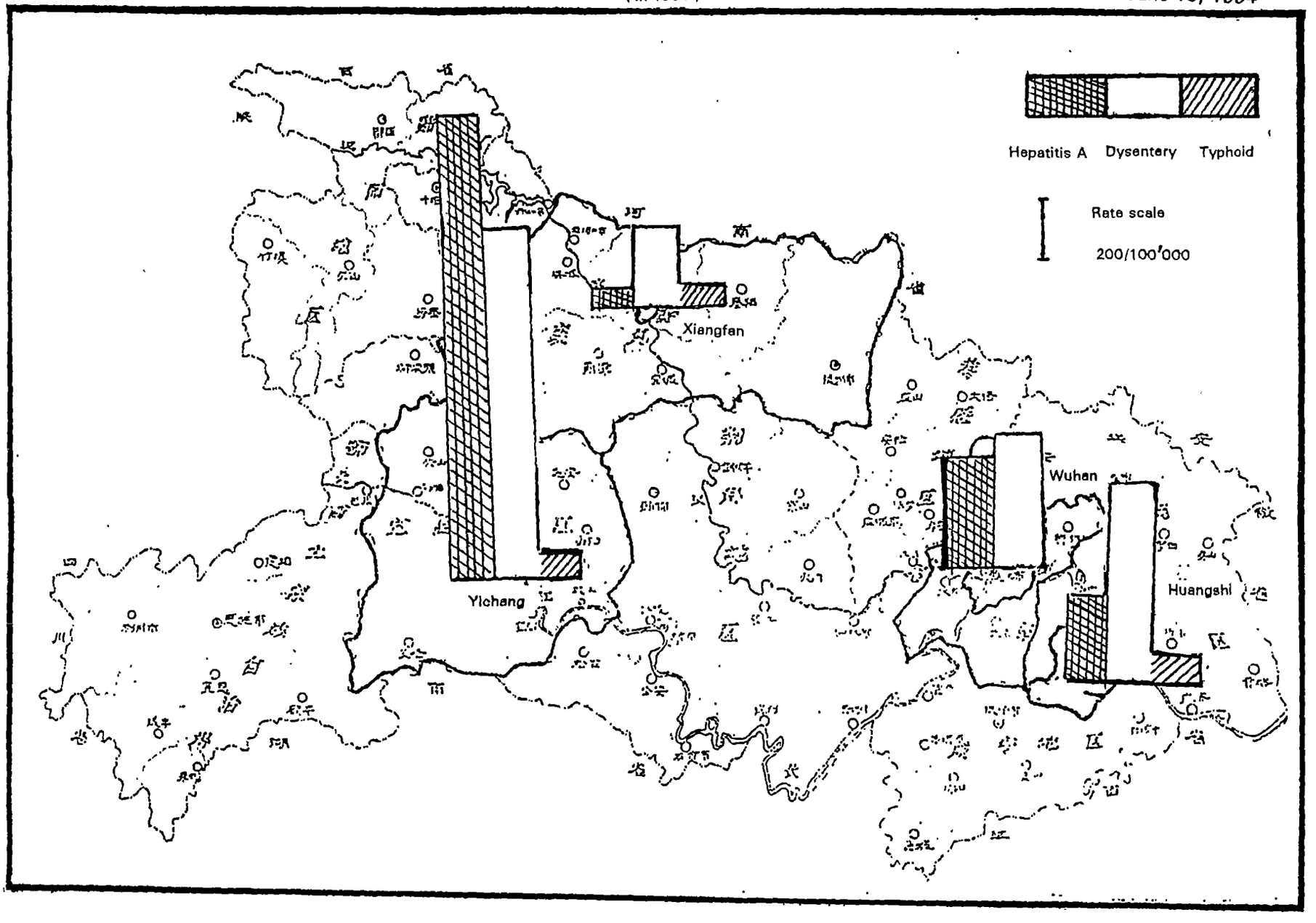
High	300-400/100,00
Medium	201-299/100,00
Low	0 - 200/100,00

Map 2

Morbidity Patterns of Hepatitis A, Dysentery and Typhoid
in the Four Cities, Hubei Province

(in 1991)

June 10, 1994

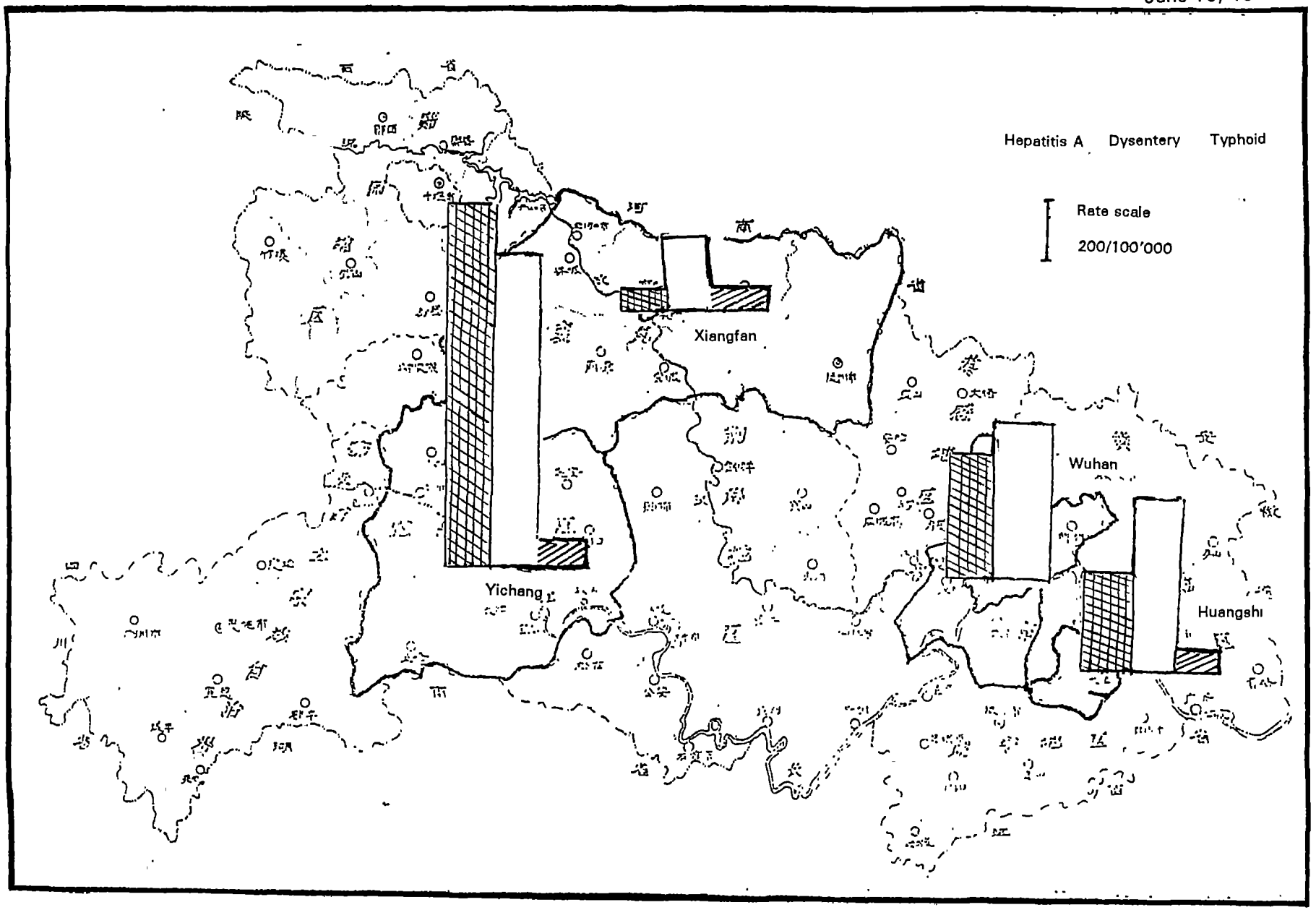


Map 3

Morbidity Patterns of Hepatitis A, Dysentery and Typhoid in the Four Cities, Hubei Province

(In 1992)

June 10, 1994

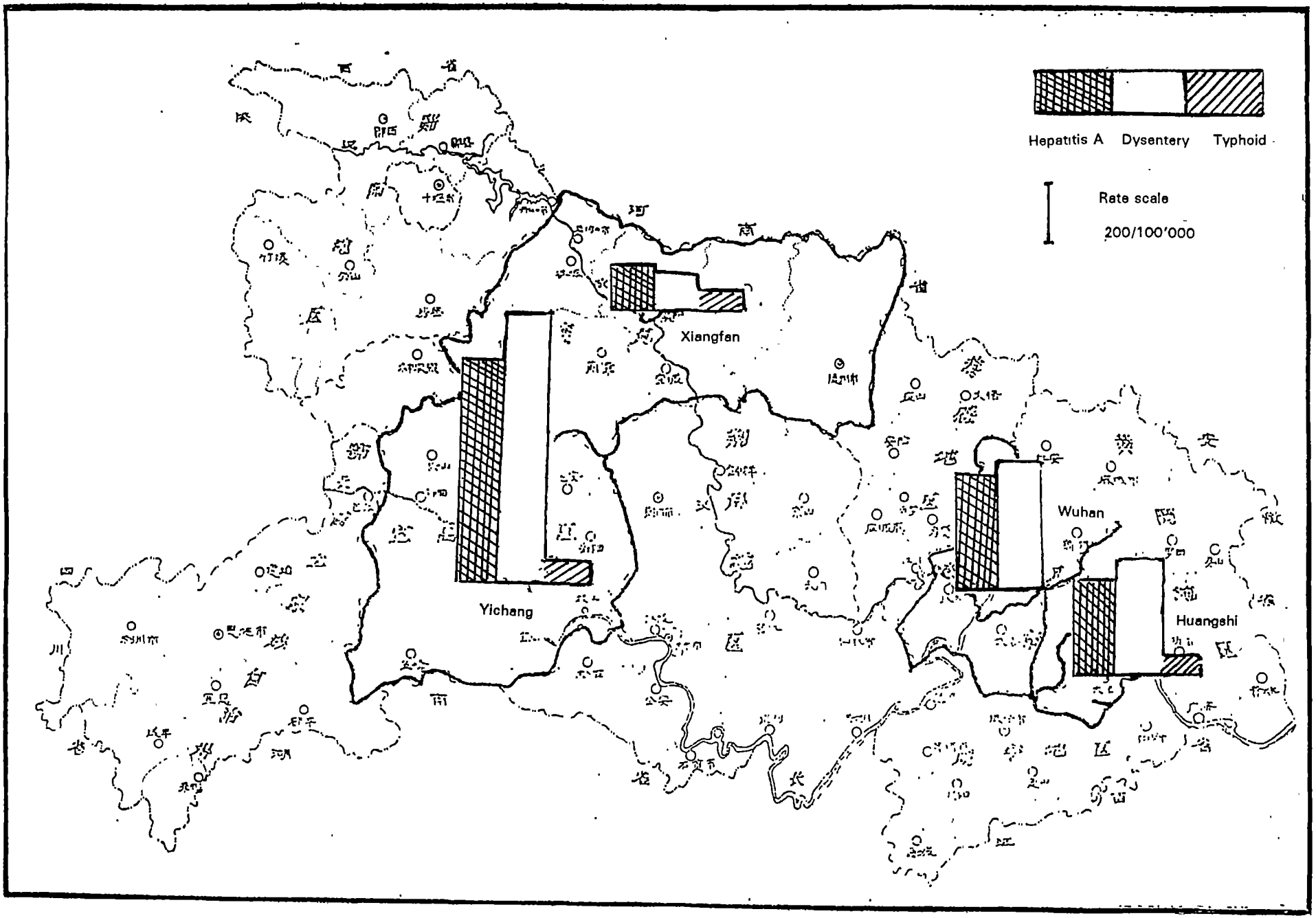


Map 4

Morbidity Patterns of Hepatitis A, Dysentery and Typhoid in the Four Cities, Hubei Province

(In 1993)

June 10, 1994



Map 5

CASE-CONTROL STUDY:Questionnaire for the Hubei Environmental Programme
Epidemiological Component
****

Information for the participant:
A programme on sanitation and health is carried out in collaboration with the Hubei Environment Protection Office.

All data we collect are confidential and are strictly used for the purposes of this project only.

You were randomly chosen from amongst all the people in this town to participate in this project.

We would like to get more detailed background information from you.
Please let me ask you some question and let us fill out this form together. The data we collect is for rthe benefit of all the people in this town. Therefore we like you to give us honest and open answers. For the question we ask there is no right or wrong, so please collaborate with us.
Thank you very much for you kind help.

Part 1: DEMOGRAPHIC DATA

1. **Date of Interview:** ...../...../1994

2. **Name of Interviewer:** ..... Code 1 2 3 4 5

3. **Case or Control**
   Case = 1
   Control = 2

****

4. **Comp. Rec-Number OF CASE AND CORRESPONDING CONTROL** _____

****

5. **Lead disease**_____
   Hepatitis = 1
   Dysentery = 2
   Typhoid = 3

6. **Date of the disease** Year:_____ Month:_____

ADDRESS of Patient:

7. **Town** _____
   Wuhan = 1
   Huangshi = 2
   Xiangfang = 3
   Yichang = 4

8. District _____ Hongshan = 1
Jianghan = 2
Jiangshan = 3
Hanying = 4
Wudiang = 5
Quinshan = 6
Giao Kao = 7
Dongxihu = 8
Chaidian = 9

Communitiy / Street Name .....

Name of Participant: .....

9. Age of the Participant: .....

10. Sex :_____ male.....1
female.....2

11. Education Respondent _____ University = 1
Highschool = 2
Middle School = 3
Primary School = 4
no formal education = 5

(IF PARTICIPANT IS A CHILD GIVE EDUCATION OF MOTHER & FATHER USING SAME CODES AS ABOVE)

12. Education of the MOTHER_____ 1 2 3 4 5

13. Education of the FATHER _____ 1 2 3 4 5

14. Occupation Respondent_____ Government Staff = 1
Worker = 2
Nighsoil management worker = 3
Farmer = 4
Fishermen = 5
Commercial / small business man = 6
Medical staff = 7
Food seller on street = 8
Restaurant worker = 9
student = 10
housewife = 11

others._____

(IF PARTICIPANT = CHILD FILL IN OCCUPATION OF MOTHER AND FATHER USING CODES ABOVE)

15. Occupation MOTHER_____ 1 2 3 4 5 6 7 8 9 10 11

OTHERS _____

16. Occupation FATHER_____ 1 2 3 4 5 6 7 8 9 10 11

OTHERS _____

Part 2: ILLNESS and DISEASE / MORBIDITY

HEALTH STATUS AT PRESENT:

17. Do you feel healthy at the moment?_____ Yes = 1
NO = (cont. below)

18. If NO: Why not (WRITE ANSWER DOWN): _____
_____

19. (NOW ASK SPECIFICALLY): Did you have:_____ diarrhea = 1
abdominal pain = 2
cramps = 3
vomit = 4
feverish = 5
lot of coughing = 6
nausea = 7
see worms in stool = 8

FOR THE CHOICE OF CONTROLS:

HEALTH STATUS IN THE PAST

!!! (LI, Cheng: fill in Mth of illness from the CORRESPONDING CASE) !!!

20. Do you remember being ill in _____ →_____ Yes = 1
No = 2

21. IF YES: (Write down answer): Why were you ill? / suffering from:

_____

_____

22. Which of the following did you have in the last three months:

- Hepatitis _____ = 1
- Dysentery _____ = 2
- Diarrhea (frequent fluid liquid stools) _____ = 3
- Typhoid _____ = 4

23. (Duration Dia) If yes, for how long did it last :

<2d = 1
2-3d = 2
4-5d = 3
1 week = 4
1-2 weeks = 5
more than 2 weeks = 6
came ON and OFF = 7
don't know = 8

24. Ask for both (in 16.): diarrhea and dysentery:

(TICK WHAT IS MENTIONED ; WRITE DOWN ANY OTHER ANSWERS !!!)

25. What did the stool look like, what did it contain? _____ blood = 1
mucus/slimy = 2
smell = 3
watery = 4
worms = 5

OTHERS (Write down): _____

(NOW PROBE AND TICK)

26. Did the stool contain: _____ blood = 1
mucus/slimy = 2
smell = 3
watery = 4
worms = 5

27. Symptoms

- Coughing DRY (more than normal) _____ = 1
- Coughing WET (more than normal) _____ = 2
- Ear infection (ask for children only) _____ = 3
- Fever with a sudden onset _____ = 4
- Vomiting _____ = 5
- Severe stomach cramps _____ = 6
- Sunken eyes _____ = 7

NOW, DECIDE WETHER TO CONTINUE THE INTERVIEW DOING THE FOLLOWING:

1. DISCONTINUE THE INTERVIEW IF PERSON REMEMBERS SUFFERING FROM ANY OF HEPATITIS, DIARRHEA, DYSENTERY OR FROM AT LEAST THREE (3) SYMPTOMS MENTIONED ABOVE.(Question 2.)

2. DISCONTINUE THE INTERVIEW ALSO IF THE PERSON HAS DIARRHOEA AT PRESENT mentioned ABOVE in Question 1.)

If the person is not eligable and you terminate the interview:

_____

THANK YOU VERY MUCH FOR YOUR KIND COOPERATION.
THE INFORMATION YOU GAVE US IS MOST VALUBLE FOR THIS STUDY.
THANK YOU.

_____

28. Was anyone sick in this household in the last three months? _____ Yes = 1
No = 2
dont know = 3

29. What were the person suffering from? _____

_____

30. Was the illness similar to yours _____ Yes = 1
No = 2
don't know = 3
if YES : had diarrhea/dysentery = 4
Hepatitis = 5

Others specify.....

31. Do you remember if ANY OF YOUR FRIENDS WHO IS NOT FROM THIS HOUSEHOLD suffered from an illness when you were sick? _____ Yes = 1
No = 2
don't know = 3

if YES : What did he suffer from? had diarrhea/dysentery = 1
Hepatitis = 2
don't know = 3

Others specify.....

32. How many people stay at this household?_____ < 3 = 2
3
4
5
6
7
8
8 and more = 9

33. How many people live in this household?

Children under 5 = 1 2 3
Children aged 6-17 = 1 2 3
Adults = 1 2 3 4 5

34. How long have you been staying here?_____ less 6 Mth = 1
6 Mth - 1 y = 2
1 - 2 y = 3
2 - 4 y = 4
4 - 8 y = 5
8 - 12 y = 6
more than 12 years = 7

Part 3: GENERAL SOCIO-ECONOMIC STATUS DATA

35. Do you own your house/flat? It does belong to_____ you/private = 1
public/unit = 2

36. How many square meters in your house / flat?_____ <30 = 1
31-50 = 2
51-80 = 3
81-100 = 4
>100 = 5
don't know = 6

37. How many rooms are at your home excluding the kitchen_____ 1
2
3
4
5
6-8 = 6
9-10 = 7
dont know = 8

38. What is the occupation of the bread winner of this house?
(Interviewer: Fill in the occupation of two persons that earn money)

_____ Government Staff = 1
Factory Worker = 2
Nighsoil management worker = 3
Farmer = 4
Fishermen/ Pond worker = 5
Commercial / small business man = 6
Medical staff = 7
Food seller on street = 8
Restaurant worker = 9
student = 10
housewife = 11
parents = 12

Others:_____

39. How much money did you earn in the last month?_____ ≤200 RMB = 1
201-400 RMB = 2
401-600 RMB = 3
601-800 RMB = 4
801-1000 RMB = 5
>1000 RMB = 6
don't know = 7

40. Do you have: POSSESSIONS

Wheelbarrow = 1
Tractor = 2
car = 3
Bike = 4
Motorcycle = 5
COLOR-TV = 6
house telephone = 7
Washing maschine = 8

others /specify)_____

41. Do you have?: DOMESTIC ANIMALS

Cattle = 1
pigs = 2
Sheep/Goat = 3
Poultry (chicken, ducks) = 4
Rabbits = 5
Pigeons = 6
other birds = 7

Other(Specify)_____

42. Do you have: PETS

Cats = 1
Dogs = 2
Cats and dogs = 3
No pets = 4

Other(Specify)_____

43. Do CATS, DOGS or CHICKEN/POULTRY come or sleep sometimes in the living rooms of the house?_____Yes = 1
No = 2
Don't Know = 3

44. Have any of the animals around your home or fields had diarrhoea recently_____Yes = 1

IF YES, specify which:(use codes from Q 41)_____1 2 3 4 5 6 7

No = 2
Don't Know = 3

---Part 4: SOCIAL and BEHAVIOURAL VARIABLES

IF PARTICIPANT IS A CHILD, INTERVIEW THE CHILDS MOTHER:

45. Did you see your child playing recently

in/at the river or pond = 1
at the rubish.pit = 2
in the vegi garden = 3
on the ground in the yard = 4
with dirt = 5
with night soil or manure = 6
Don't know = 7

46. Did the child play with the domestic animal during the past two weeks?_____Yes = 1
No = 2
Don't Know = 3

IF OCCUPATION OF RESPONDENT = FARMER OR FIELD WORKER

47. Do you wear shoes during your work in the fields_____Yes = 1
No = 2
Don't Know = 3

48. Does your child help you with you work ?_____Yes, usually = 1
Yes, sometimes = 2
No = 3
Don't Know = 4

Part 5: HOUSEHOLD FACTORS, WATER USE AND FOOD INTAKE

49. Do you feel you have a problem with flies in this house?_____ Yes = 1
No = 2
don't know = 3

Explain the problem:_____

50. Can you tell us the source of your drinking water for the past 3 months?_____private Tap = 1
Public tap = 2
Well with handpump = 3
Protected well without handpump = 4
Unprotected well = 5
River or stream = 6
Don't know = 7

Other (specify).....

51. do you sometimes drink unboild water ?_____Yes = 1
No = 2
Don't Know = 3

52. Which of the following did you do during the past three weeks ?

eat out of the household with friends/neighbour = 1
eat leftover food of last days = 2
eat food from the street sellers/street cooks = 3
eat fresh, raw/uncooked vegetables = 3
eat raw or rare cooked meat = 4
eat raw fish = 5
eat eggs = 6
drink fresh milk = 7
open ice cream = 8
drank water from river, lake or pond = 9

others, specify:_____

53. Where do you get your vegetables from?_____from own private garden = 1
directly fresh from a farmer = 2
from the open street market = 3
from a shop / supermarket = 4

others, Specify:_____

Part 6: HYGIENE, DEFAECATION, WATER & CLEANLENESS

INTERVIWER MARK WHAT THE RESPONDENT MENTIONS WITHOUT PROBING:

54. When do you wash your hands usually:_____before cooking = 1
before eating = 2
after defecating = 3
after working in the vegetable garden = 4
after feeding / work with the animals = 5
after handling childrens stools = 6

Others: _____

55. Do you use a toilet??_____Yes = 1
No = 2
Don't Know = 3

56. What type of latrine do you use_____wet/flush-toilet PRIVATE = 1
wet/flush latrine PUBLIC = 2
use public toilet = 3
dry latrine = 4
I do not know the type of latrine = 5

Cleanleness of the latrine:

57. Do you think the latrine you use is;-_____clean = 1
dirty = 2
don't know = 3

Do you have any other comments: _____

58. If you are out of your home, where do you defecate?
in toilet = 1
in yard = 2
use bush = 3
in field = 4
In vegetable garden = 5

Others:.....

59. How do you dispose the children's faeces ?_____in toilet = 1
in refuse pit = 2
through in bush = 3
through in a open rubbish pit = 4
use it FRESH and DIRECTLY as fertilizer = 5
I leave it / don't dispose = 6

Others_____

PART 7. NIGHT SOIL USE IN AGRI- AND AQUACULTURE

60. Do you ever get in touch with nightsoil or sludge during your work or your free time?_____Yes = 1
No = 2

IF "NO" GO TO QUESTION .....

61. What do you use nightsoil or sludge for?
as fertilizer, apply it on the surface = 1
as fertilizer, apply it on the surface just before harvesting = 2
as fertilizer, work it in the soil = 3
feeding pigs = 4
feeding fish = 5

(INTERVIEWER RECORD ANSWER)

62. What do you do when you get in contact with night soil?

_____

_____

63. Let me ask you specifically:_____nothing in particular = 1
wash my hands afterwards = 2
wear protecting clothes = 3
wear rubber boots = 4
don't know = 5

others explain: _____

64. When in the last three month did you use the biggest amount of nightsoil?___Jan = 1
Feb = 2
Mar = 3

any other time: _____

65. Where did you get the night soil from in the last three months?
own fresh /untreated night soil = 1
fresh/untreated night soil collected from neighbours / private toilet = 2
from public toilets = 3
Night soil vacuum truck driver = 4
Treated night soil from station = 5

OTHER _____

66. Please tell us when LAST YEAR you needed the biggest amount of night soil?_____

Jan - Mar = 1
Apr - Jun = 2
Jul - Sep = 3
Oct - Dec = 4
don't know = 5

67. What do you pay for night soil

from the public toilets = _____

from private places = _____

from the truck for one load = _____

68. Did you use chemical fertilizer last three months?_____YES = 1
NO = 2
don't know = 3

69. If you had a choice which type of fertilizer would you use?

Night soil = 1
manure from animals = 2
Chemical fertilizer = 3

Other_____

70. Why?_____cheaper = 1
more convenient = 2
easier to use = 3
easily available = 4
better for the crops = 5
better for the soil = 6
safer for health = 7

OTHER _____

71. Do you have any particular opinion about nightsoil?_____Nothing = 1
Its dirty = 2
one can get sick = 3
one can get an intestinal infection/stomach problems = 4
one can get worms = 5

any other opinion: _____

NOW ONE LAST QUESTION:

72. Did you get any hygiene/health education or knowledge?_____Yes = 1
No = 2

IF YES, were from
books = 3
TV / Radio = 4
Health education programme in school = 5
Health education programme in community area = 6

73. Did you hear about Hepatitis, Dysentery or Typhoid before?_____No = 1
Hepatitis = 2
Dysentery = 3
Typhoid = 4

74. Do you have anything to say about the talk we have had, any particular environmental problem ?

IF YES explain the problem: _____

_____

75. Respondent's comments

.....

76. INTERVIEWER'S COMMENTS

.....

_____

THANK YOU VERY MUCH FOR YOUR KIND COOPERATION.

THE INFORMATION YOU GAVE US IS MOST VALUBLE FOR THIS STUDY.

THANK YOU.

_____

PART 7: OBSERVATIONAL DATA

Interviewer must record the following information at the end of the interview.

77. House located:_____

near lake = 1
near channel = 2
near river = 3
near fish pond = 4
in town = 5
next livestock = 6

others:_____

78. IN THE HOUSE

animals in the house = 1
is food visible and uncoveres = 2
water uncovered in the house = 3

others _____

79. General conditions of the kitchen

Food and other dirt particles on the floor = 1
Unwashed or dirty utensils in kitchen = 2
Unwashed or dirty plates in the kitchen = 3
Unwashed or dirty pots in the kitchen = 4
Flies present in the kitchen = 5
Animals/poultry in the kitchen = 6
all ok = 7

others: _____

80. AROUND HOUSE

excrements visible = 1
is garbadge lying around = 2
all clean = 3

others _____

81. Cleanliness of Respondents _____

all clean = 1
dirty hands = 2
dirty clothes = 3
dirty face = 4

82. ANY OTHER COMMENTS

.....

DYSENTERY CASE-CONTROL STUDY:Questionnaire for the HEP Survey
Epidemiological Component - Phase II

****

Information for the participant:
A programme on sanitation and health is carried out in collaboration with the Hubei Environment Protection Office.

All data we collect are confidential and are strictly used for the purposes of this project only.

You were randomly chosen from amongst all the people in this town to participate in this project.

We would like to get more detailed background information from you. Please let me ask you some question and let us fill out this form together. The data we collect is for the benefit of all the people in this town. Therefore we like you to give us honest and open answers. For the question we ask there is no right or wrong, so please collaborate with us. Thank you very much for you kind help.

Part 1: DEMOGRAPHIC DATA

Date of Interview: ...../...../1994

Name of Interviewer: _____

NAME & ADDRESS of Participant: _____

A1. Case or Control
Case = 1
Control= 2

A2. Comp. Rec-Number OF CASE AND CORRESPONDING CONTROL: _____

A3. Date of disease if case Month/Day/94: _____

A4. DISTRICT code
Farmer area = 1
Urban area = 2

A5. Age of the Participant: Age _____

A6. Sex :
Male = 1
Female = 2

A7. Education Respondent
University = 1
High-school = 2
Middle School = 3
Primary School = 4
No formal education = 5

(IF PARTICIPANT=CHILD GIVE EDUCATION OF MOTHER & FATHER USING A7 CODES)

A8. Education of the MOTHER 1 2 3 4 5

A9. Education of the FATHER 1 2 3 4 5

A10. Occupation Respondent
Government Staff = 1
Worker = 2
Night soil management worker = 3
Farmer = 4
Fishermen = 5
Commercial / small business man = 6
Medical staff = 7
Food seller on street = 8
Restaurant worker = 9
Student = 10
Housewife = 11
(A101) Others:_____

(IF PARTICIPANT=CHILD GIVE OCCU. OF MOTHER & FATHER USING A10 CODES)

A11. Occupation MOTHER 1 2 3 4 5 6 7 8 9 10 11
(A111) Others:_____

A12. Occupation FATHER 1 2 3 4 5 6 7 8 9 10 11
(A121) Others:_____

Part 2: HOUSEHOLD FACTORS, WATER USE AND FOOD INTAKE

B13. Do you have DOMESTIC ANIMALS?
Yes = 1
No = 2

B14. Do CATS, DOGS or CHICKEN/POULTRY come or sleep sometimes in the living rooms of the house?
Yes = 1
No = 2
Don't Know = 3

B15. Do you feel you have a problem with flies in this house?
Yes = 1
No = 2
don't know = 3
(B151)) Explain the problem:_____

B16. Can you tell us the source of your drinking water for the past 3 months?
private Tap = 1
Public tap = 2
Well with handpump = 3
Protected well without handpump = 4
Unprotected well = 5
River or stream = 6
Don't know = 7
(B161) Other (specify):_____

B17. Do you sometimes drink unboiled water?
Yes = 1
No = 2
Don't Know = 3

B18. Which of the following did you do during the past three weeks?
(Using YES=1, NO=2)

(B181)	eat out of the household with friends/neighbour	___
(B182)	eat leftover food of last days	___
(B183)	eat food from the street sellers/street cooks	___
(B184)	eat fresh, raw/uncooked vegetables	___
(B186)	eat raw fish	___
(B187)	eat eggs	___
(B188)	drink fresh milk	___
(B189)	open ice cream	___
(B18A)	drank water from river, lake or pond	___
(B18B)	Others, specify:_____	

B19. Where do you often get your vegetables from?

from own private garden	= 1
directly fresh from a farmer	= 2
from the open street market	= 3
from a shop / supermarket	= 4
(B191) Others, Specify:_____	

Part 3: HYGIENE, DEFECATION & CLEANLINESS

C20. When do you wash your hands usually: (Using YES=1, NO=2)

(C201)	before cooking	___
(C202)	before eating	___
(C203)	after defecating	___
(C204)	after working in the vegetable garden	___
(C205)	after feeding / work with the animals	___
(C206)	after handling children stools	___
(C207)	Others: _____	

C21. Do you use a toilet?

Yes	= 1
No	= 2
Don't Know	= 3

C22. What type of latrine do you use

wet/flush-toilet PRIVATE	= 1
wet/flush latrine PUBLIC	= 2
use public toilet	= 3
dry latrine	= 4
I do not know the type of latrine	= 5

C23. Do you think the latrine you use is;-

clean	= 1
dirty	= 2
don't know	= 3

(C231) Do you have any other comments: _____

C24. How do you often dispose the children's faeces ?

in toilet	= 1
in refuse pit	= 2
through in bush	= 3
through in a open rubbish pit	= 4
use it FRESH and DIRECTLY as fertilizer	= 5
(C241) Others:_____	

C25. Do you wear shoes during your work in the fields?

Yes	= 1
No	= 2
Don't Know	= 3

Part 4. NIGHT SOIL USE IN AGRI- AND AQUACULTURE

D26. Do you ever get in touch with nightsoil or sludge during your work or your free time?

Yes	= 1
No	= 2

IF "NO" GO TO QUESTION E39

D27. Do you use nightsoil as conditioner for soil?

Yes	= 1
No	= 2

D28. Do you use nightsoil as fertilizer?

Yes	= 1
No	= 2

D29. How many years have you been using nightsoil as fertilizer? ____yrs

D30. What do you often do when you get in contact with night soil?

nothing in particular	= 1
wash my hands afterwards	= 2
wear protecting clothes	= 3
wear rubber boots	= 4
don't know	= 5
(D301) Others explain: _____	

D31. Which month do you need the most amount of nightsoil? _____
(Use 1 to 12 for months)

D32. Where did you get the night soil from?

own latrine	= 1
neighbours' latrines	= 2
public toilets	= 3
Night soil vacuum trucks	= 4
Treated night soil from station	= 5
(D321) Other: _____	

D33. Did you use chemical fertilizer?

YES	= 1
NO	= 2
don't know	= 3

D34. In your field work, did you use:

Only night soil	= 1
Only chemical fertilizer	= 2
Night soil > Chemical fertilizer	= 3
Chemical fertilizer > Night soil	= 4
Almost half amount each one	= 5

D35. If you had a choice, which type of fertilizer would you use?

Fresh Night soil	= 1
Treated night soil	= 2
Chemical fertilizer	= 3
(D351) Other: _____	

D36. Why?

cheaper = 1
more convenient = 2
easier to use = 3
easily available = 4
better for the crops = 5
better for the soil = 6
safer for health = 7

(D361) Other: _____

D37. Do you have any particular opinion about nightsoil?

Nothing = 1
its dirty = 2
one can get sick = 3
one can get an intestinal infection/stomach problems = 4
one can get worms = 5

(D371) any other opinion: _____

D38. If you think that night soil can cause some diseases, did you take any preventive measures?

Yes = 1
No = 2

(D381) IF YES, What measures? _____

Part 5: INFORMATION ABOUT HYGIENE EDUCATION

E39. Did you get any hygiene/health education or knowledge?

Yes = 1
No = 2

(E391) IF YES, were from mostly

books, posters = 1
TV / Radio = 2
Health education programme in school = 3
Health education programme in community area = 4
Parents = 5
Health professionals = 6

E40. Are you interested in hygiene/health education program?

Yes = 1
No = 2

(E401) IF YES, Do you think which method is the best? _____
(Using codes of E391)

E41. Do you have anything to say about the talk we have had, any particular environmental problem?
IF YES explain the problem:_____

E42. INTERVIEWER'S COMMENTS: _____

****
THANK YOU VERY MUCH FOR YOUR KIND COOPERATION.
THE INFORMATION YOU GAVE US IS MOST VALUABLE FOR THIS STUDY.
THANK YOU!
****

Part 6: OBSERVATIONAL DATA

Interviewer must record the following information at the end of the interview.

OBS1. House located:

near lake = 1
near channel = 2
near river = 3
near fish pond = 4
in town = 5
next livestock = 6

(OBS11) Others:_____

OBS2. In the house

animals in the house = 1
food is visible and uncovered = 2
water uncovered in the house = 3

(OBS21) Others:_____

OBS3. General conditions of the kitchen

Food and other dirt particles on the floor = 1
Unwashed or dirty utensils in kitchen = 2
Unwashed or dirty plates in the kitchen = 3
Unwashed or dirty pots in the kitchen = 4
Flies present in the kitchen = 5
Animals/poultry in the kitchen = 6
all ok = 7

(OBS31) Others: _____

OBS4. Around house

excrements visible = 1
garbage is lying around = 2
all clean = 3

(OBS41) Others: _____

OBS5. Cleanliness of Respondent

all clean = 1
dirty hands = 2
dirty clothes = 3
dirty face = 4

OBS6. ANY OTHER COMMENTS: _____

Annex 4

Economic and Market Study

UNDP/World Bank Water and Sanitation Program
RWSGEAP

Contents

Economic and Market Study

1. Initial Assessment

Preliminary Assessment of Economic and Market Aspects of Nightsoil Operations

In the first phase of the overall nightsoil study, an overall assessment was made of the economic and market aspects of nightsoil in each project city [1] Data was collected and information obtained from discussions with city officials regarding the nature and methods of collection, storage, transport and use of nightsoil and septic tank sludges for agricultural uses. This assessment was carried out to obtain knowledge of the basic economic aspects, cost factors and general operations and usage by farmers, as well as to understand the main issues and constraints relating to nightsoil use

Following this initial assessment recommendations were made for a more detailed sample survey of farmers, on specific issues found in the initial assessment. The survey focused on farmers in the suburban areas of two project cities--Wuhan and Huangshi.

The results and analyses of this economic assessment and farmer surveys were part of the input used to develop the proposals in the investment program (Refer Part 2) and to provide recommendations for improvement to the nightsoil operations

City Market Situation

All the project cities operate a nightsoil collection and distribution system which serves both to remove nightsoil wastes from public latrines and sludge wastes from building septic tanks as well as provide a source of agricultural fertilizer for farmers Typically farmers and users pay a charge to the municipality for the nightsoil. That is, nightsoil can be considered a marketable item.

Assessment of the sales of nightsoil has been carried out, although it was based on only partial data since not all cities have complete records of nightsoil sales, and not all relevant data was available The main trend is that of a marked reduction in nightsoil sales since 1992. This is in contrast to rapid sales in growth immediately prior to this period. Such a sharp reduction has a negative effect on the finances of the cities and is at first sight surprising given the historic importance attached to nightsoil use in agriculture

Wuhan

Data was obtained for the district of Wuchang, but the figures disguise two facts which become apparent when sales figures are separated into sales to farmers providing own transport and sales by city truck.

Figures in Table 1 show that sales using farmers' own transport have decreased markedly. In 1994 sales by volume and by revenue are only 21.5 % of 1992 sales. By contrast sales by city truck have held constant over the same period. Volume sold in 1994 is only 28.5 % of 1992 peak sales. Sales revenue is down to 31 % of 1994 revenue.

Given the traditional use of nightsoil and the growth in demand prior to 1992 it is unlikely that farmers suddenly rejected the belief of nightsoil benefits. The most likely explanation of the difference between the two types of sales is that the campaign for conversion from dry to wet latrines accelerated over the same period. These conversions resulted in a change in the quality of nightsoil as perceived by farmers; that the available nightsoil is "wet"[2] material which has several disadvantages from their point of view. These are:

a. It is viewed as being less nutritious to plants.

b. It is heavy, difficult to transport and requires a larger investment in storage facilities at the farm.

[1] The economic and market study of nightsoil operations was carried out by the economics team of Mr P Barker - economist (WEDC, Loughbourough University, U K) and Mr. Gao Shuisheng, local consultant from Hubei Environmental Protection Bureau Field market surveys were carried out by Mr Gao Shuisheng, supported by local field surveyors in September and December 1994

[2] "Wet" nightsoil is referred to the latrine waste from a water flush latrine.

c Its wetness means that most farmers do not have suitable own transport. Moreover, the city has only four vehicles with a total of 16 tons of carrying capacity The constancy of sales by city truck appears to be at least in part due to the constraint imposed by transport

d. It is claimed that wet material has more foreign bodies, e.g., plastic and paper.

e Control of the dilution is under the farmers' control for the dry material but not for the wet material

The experience of Wuchang is somewhat similar in other cities The hypothesis is that farmers still value nightsoil but as outlined above, have increasingly rejected the type which is now available.

Xiangfan

Table 2 indicates that nightsoil production has increased with population growth. However sales tonnage and revenue over the period 1990 - 1993 have fallen to about 25% of the previous level.

Again over the period of sales decline there has been a major conversion from dry to wet latrines. Although there is no absolute shortage of nightsoil there is a shortage of the preferred dry material. The higher price in Xiangfan can be attributed to the fact that the price is deregulated and related to cost Transporting the high volume material is expensive for farmers. The price of nightsoil in Wuchang is very much lower than in Xiangfan having been a planning price set many years ago. All the disadvantages of Wuchang's wet material are present in Xiangfan.

It can be similarly suggested that for Xiangfan the demand for the available material has contracted but that the demand for the dry material is still present as evidenced by farmers efforts to procure direct sales in the city.

Xiangfan Sanitation Department officials expressed an interest in the development and application of technologies that would provide dry material. They suggested bio-gas latrines and co-composting as possibilities.

Yichang

There is a long tradition of nightsoil application to farms and orchards in Yichang. However, this is breaking down under recent developments. These include:

a. Farmland on the perimeter of the city is becoming urbanized and the cultivation area reduced. As distances increase, nightsoil prices are inflated by transport costs. This puts a premium on lighter, cheaper to transport material.

b. Conversion to wet latrines has resulted in nightsoil quality reduction, causing a fall in demand.

c Increased work opportunities have caused migration to the city. The number of farmers has decreased and the more able bodied, who would have collected and applied the nightsoil have also decreased.

Despite these factors it is reported that nightsoil is sold at prices between RMB 20 and 30 per ton; this relatively high price indicates a potential for market sales. The proposed plans for Yichang include the use of nightsoil in agriculture as an interim stage with the intention that all nightsoil will be discharged into sewers and treated in a sewerage treatment plant in the future.

Huangshi

In the past the practice has been for farmers to transport the nightsoil from urban areas to farms. Often demand had exceeded supply and usually the material was fresh, untreated material. In recent years delivery has been by truck by the Environmental Sanitation Bureau. The city's plans include the conversion of all dry latrines to flush type. By July 1992, 89 of 105 latrines had been converted, resulting in a reduction of available dry nightsoil to farmers.

The Huangshi Sanitation Bureau has a capacity to collect and transport 24 tons of nightsoil per day of which about 16 tons are distributed to farmers. The rest is discharged into sewers via water flushed latrines. The saleable material was previously taken to a storage tank at Xiaojipu. From here farmers could purchase the nightsoil, thereby obviating the need for polluting carriage through the city. It has been claimed that the Xiaojipu station could treat up to 98.5 % of material. However this facility was built but not used. Sale price at the storage tank was set at RMB 10 per ton which could have generated an income of about RMB 135 per day Assuming sales on 25 days per month this would generate an annual income of RMB 40,000. This would be divided by local arrangement, about RMB 30,000 going to the ESB and the rest to truck drivers providing a supplement to regular wages.

Identified Problems

In summary, the main problems regarding market and sales of nightsoil are.

1. The change in the perceived quality of nightsoil consequent upon the conversion to wet latrines has reduced demand for the available product. There does appear to be a market for a product with the attributes that farmers want. The chief of these seem to be high nutritional value to plants and ease of handling and transportation Unless the authorities can make this kind of product available it is likely that nightsoil sales will further contract and city revenues reduce.

2. The example provided by Xiangfan indicates that at current sales volumes, prices and operating costs, the possibility for full cost recovery of station operating costs is not high. The success of sanitation provision should not be judged on unrealistic targets for cost recovery. In particular, it should be recognized that sanitation benefits are a public good conferring benefits on the whole population. To aim to recover costs predominantly from nightsoil users is both unrealistic and inequitable. Nevertheless improved cost recovery could be achieved through a mixture of increasing revenue and reducing costs. It is important to realize that the latter is a potentially powerful component of cost recovery.

3. It should be recognized that in the absence of finding an adequate market outlet for nightsoil, the authorities will still have to bear the costs of safely disposing of this material.

2. Market Survey

To evaluate in more detail the potential for market and economic aspects for continuation of nightsoil use in more detail, it was recommended in the first phase of this study that further surveys be carried out. These would be surveys of farmers to assess their needs and attitudes, to obtain more information about the pressures on farmers for a drier, more transportable and a better handled product, whether nightsoil is preferable over chemical fertilizer and the willingness to pay for better quality nightsoil.

With respect to the issue of cost recovery, consideration should be given to the longer term potential for private sector participation in the nightsoil sector. Given the constraints on adequate collection and transportation facilities and the preponderance of these functions in nightsoil station costs this might provide a fruitful source of cost savings. On the revenue side attention should be given to the deregulation of prices some of which are low and non-cost related. The real value of revenues have been eroded by failure to match inflation. Such low prices are a deterrent to possible future private participation and capital financing.

Wuhan and Huangshi

Following the recommendations in the first phase, farmer surveys were carried out in two cities -Wuhan and Huangshi. The survey locations in the cities were chosen to represent typical suburban vegetable farming areas. The survey locations were:

> Wuhan: Chaukou, Changan and Dongshi Districts and Wuchang County, Tsang Jian Village and Qingfin Village, Hongshan District.
>
> Huangshi: Yang Ye Village and Hua Hu Village in E Zhou District

A total of 60 farmers were surveyed (40 in Wuhan and 20 in Huangshi) with questions covering the following topics:

- cultivation areas and crop type, farm income
- whether nightsoil used or not, including reasons
- quantity of nightsoil used
- preference for nightsoil and/or chemical fertilizers
- specific uses of nightsoil and fertilizer
- when fertilizers/nightsoil used
- total spending on fertilizers/nightsoil
- amount willing to pay for nightsoil
- preferences for treating nightsoil
- farmers source of knowledge for fertilizers and nightsoil
- farmers' suggestions for improvements to nightsoil operations

Results of this survey were then used to establish whether nightsoil is in demand at present and whether it indicates the demand will remain in the future. Results of other aspects - such as preferences for nightsoil treatment, preference of either nightsoil or chemical fertilizer, reasons for using on not using nightsoil, amount spent and willingness to pay for nightsoil, farmers' suggestions for improvement to the nightsoil operations were used in the general economic

and financial analysis for the investment program items.

Results of the Market Survey

Results of the farmers survey for both Wuhan and Huangshi are given in the tables of this annex. The results are described below:

1. *Farmers' background*

   Generally farmers cultivated small plots, less than 10 mu, with average of about 4 mu (one mu is equal to 666 sq m.). Nearly all farmers were vegetable farmers In Wuhan nearly all farmers used nightsoil now (average use is about 30 tons per year). In Huangshi farmers did not use nightsoil now; the reason for this being that in recent years nightsoil is no longer supplied to this district by the City Sanitation Bureau. This survey therefore represents both farmers who have access to nightsoil and those who do not.

2. *Reasons for using/not using nightsoil*

   In both Wuhan and Huangshi the main replies were that nightsoil was more nutritious for the crops, including being a good soil conditioner. To a lesser extent, lower cost than chemical fertilizer, easier application and better tasting crops were given as secondary reasons.

   The most significant result here is the fact that nightsoil is recognized for its crop nutritional value and is consistent with our understanding of the common agricultural practices in China.

3. *Source of nightsoil*

   In Wuhan farmers obtain most of their nightsoil supplies from the city sanitation trucks and their own latrines, with farmers having to pay for about three quarters of their supplies; average distance traveled is approximately 8 km to obtain supplies. In Huangshi the source is from their own latrines, as apparently the city sanitation trucks do not deliver to the areas or its vicinity.

4. *Changed habits using nightsoil*

   Nearly all farmers in both cities reported that they have changed their means of obtaining and using nightsoil. The main changes included less nightsoil bought from city sources and nearly all reported that the nightsoil was now more wet whereas previously it was dry (and better). Reasons for these changes include more unreliable supply, difficulty with transport and less availability of nightsoil. In Huangshi all farmers reported that it was too expensive to buy now.

5. *Use of chemical fertilizer*

   All farmers reported using chemical fertilizer; main reasons for using chemical fertilizer included easy application, easy transport, nutritious to crops, and some (30% in Wuhan) reported it as being hygienic. In Huangshi the predominant reason given was that nightsoil was not available.

6. *Problems obtaining nightsoil*

   All farmers reported having problems obtaining nightsoil.

7. *Preference for chemical fertilizer or nightsoil*

   Overwhelming response to this question was a preference for nightsoil over chemical fertilizer. Among the reasons for not wishing to use chemical fertilizer were its high cost, more damage to soil, more false products on the market, and crops fertilized by chemical have less taste than if fertilized with nightsoil.

8. *Preferred characteristics*

   Farmers reported the following characteristics which they would like:

   * low cost (88% in Wuhan, 100% Huangshi);
   * direct delivery of supply to farm (70% in Wuhan); and
   * nutritious to plants (50% in Wuhan).

   This indicates that both cost and ease of delivery are major concerns. Although it was expected that the characteristic "nutritious to plants" would have been a major requirement it is felt that the 50% response is rather low for this characteristic, but this result can be interpreted as indicating that perhaps farmers automatically assume fertilizers should be nutritious to plants and the choice should be made from other characteristics

9. *Amount spent on nightsoil/chemical fertilizer*

   Average amount spent by each farmer per year in Wuhan was RMB 600 for nightsoil and RMB 1,184 for chemical fertilizer. In Huangshi average annual spending on chemical fertilizer

was RMB 1,070. This does not indicate a significant difference between spending on nightsoil and chemical fertilizer. Furthermore it should be noted that some of the nightsoil is actually obtained free

10. Seasons for chemical fertilizer/nightsoil use

Both chemical fertilizer and nightsoil are used at similar times of the year. Generally they are used throughout the year but with early spring having maximum application; about 40% of the yearly application is in spring (highest month is March). During the winter months of January and December there is small or virtually no application.

All farmers responded that even if cheap and reliable nightsoil was available they would still continue to use chemical fertilizer as a supplement to nightsoil The main chemical fertilizers used are ammonium nitrate urea and composite fertilizers.

11. Farmers' income and general data on sales

Average annual net income from the sale of crops (after deducting costs) was reported to be RMB 4,950 in Wuhan and RMB 5,400 in Huanghsi, i.e , average of RMB 5,150 per annum. Although nearly all farmers reported this as their only income, it is possible that there may be other non cash income (e.g., breeding their own livestock, etc.)

12. Willingness to pay

Overwhelming majority of farmers are willing to pay for nightsoil; the maximum amount per ton they would pay is around RMB 21 in Wuhan and RMB 25 in Huanghsi for fresh nightsoil; for treated nightsoil, they would be willing to pay RMB 37 and RMB 30 respectively. For treated nightsoil and co-compost the willingness to pay is around RMB 50 to 55 per ton

13. Source of information on nightsoil and chemical fertilizer

There appears to be no single major source of news and information on nightsoil or chemical fertilizers for farmers They rely on friends, neighbors, and radio for their information which is reported to be generally only marginally useful.

14. Farmers' suggestions

The main suggestions from farmers for improvements to the nightsoil operations are:

* provide good and low cost nightsoil;
* transport to be provided by Sanitation Departments (perhaps indicating difficulties of transport by farmers); and
* in Wuhan 42% of farmers would like a nightsoil storage tank (presumably the existing tanks do not serve their purposes adequately)

3. Conclusion

The survey provides a number of clear results regarding the use of nightsoil on vegetable farms in the suburban areas in the two project cities It can also be assumed that since the conditions in these two project cities are similar to the other project cities, that the results can be representative of the project city situations as a whole.

It is recognized that this is a relatively small and limited sample survey but nevertheless, many answers received overwhelming majority responses indicating a clear requirement from the farming community.

The main conclusions to be drawn from the results of the farmer surveys are:

- there is preference to continue to use nightsoil but the nightsoil should be "dry" and not "too wet";
- there is a strong preference to use nightsoil even though chemical fertilizers are also used;
- there has been a reduction in supply of nightsoil by city authorities, reducing availability of nightsoil;
- main characteristics sought in nightsoil (apart from nutritional value) are low cost, ease of transport and delivery to farm;
- amount spent on nightsoil per year is around RMB 600 per farmer for nightsoil and RMB 1,100 for chemical fertilizer;
- both nightsoil and chemical fertilizers are used throughout the year with a peak season in spring;
- there is a high willingness to pay for nightsoil, but this is only for good "fresh" nightsoil (up to RMB 21 per ton) or treated nightsoil (up to RMB 25 per

ton), for nightsoil and solid waste co-compost willingness is higher - at RMB 50 to 55 per ton;

- there is a lack of good sources of information for both nightsoil and chemical fertilizer;
- among the main requirements suggested by farmers to improve the nightsoil operations are for the City Sanitation Department to provide good low cost nightsoil, including transport facilities.

TABLE 1
WUCHANG DISTRICT
Nightsoil Sales and Revenue (1988 - 1994)

Year	Sale (tons)			Revenue (RMB x 10,000)		
	(A)	(B)	Total	(A)	(B)	Total
1988	17,418	3,650	21,068	3.832	1.168	5.000
1989	24,690	3,650	28,340	6.832	1.168	8.000
1990	34,538	4,380	38,918	7.598	1.401	8.999
1991	50,902	4,380	55,282	11.198	1.401	12.599
1992	59,687	5,840	65,527	13.131	1.868	14.999
1993	29,687	5,840	35,527	6.531	1.868	8.399
1994	12,869	5,840	18,709	2.831	1.868	4.699

Note A = sales by farm transport
B = sales by city truck

TABLE 2
XIANGFAN
Nightsoil Production and Sales (1989-1993)

Year	Prod'n (ton x 10,000)	Sales (ton)	Price (RMB/ton) >13 km	Price (RMB/ton) <13 km	Income RMB 10,000
1989	29.73	7,850	10	16	8.0
1990	30.03	7,850	10	16	8.0
1991	30.34	1,906	10	16	5.0
1992	30.57	1,906	10	16	5.0
1993	30.95	2,000	10	16	2.0

(Note : Figures include septic tank sludge from public latrines only.)

ECONOMIC/MARKET SURVEY
NIGHTSOIL USE BY FARMERS

		WUHAN		HUANGSHI	
		TOTAL	AVERAGE	TOTAL	AVERAGE
	CULTIVATION AREA (mu)		4.12		2.52
	" " " " (ha)		0.27		0.16
1	Do you now use N/S ?	Y=39 (97%); N=1 (3%)		N=20 (100%)	
2	? Many truck load/year		13.15		2.80
3	? Capacity of truck (ton)		2.09		0 50
4	? Size of your plot (mu)		4.12		2.52
5	? Your main crop	V=37 (92%); R=3 (8%)		V=20	
6	a) Do you use fresh/treated N/S	TNS =39 (97%)		TNS =20 (100%)	
	b) Do you prefer fresh/ treated N/S	TNS =39 (97%)			
7	Why do you use N/S ?				
	a) fresh	0	0%		
	b) cheap	10	25%		
	c) easily available	19	48%		
	d) easy to apply	0	0%		
	e) hygienic	0	0%		
	f) nutritious for plants	36	90%	20	100%
	g) preferred by customer	20	50%		
	h) other - soil conditioner	38	95%	20	100%
	i) better tasting crops	38	95%		
8	? Total spent RMB/year on N/S		603.41		0
9	? Prop'n of N/S use is free	9	23%	20	100%
10	? Prop'n of N/S use is bought	31	78%		0%
11	Where you get N/S ?				
	a) public latrine	21	53%	0	0%
	b) neighbour's latrine	0	0%	0	0%
	c) city Sanit Bureau truck	36	90%	0	0%
	d) various include city truck	28	70%	0	0%
	e) own latrine			20	100%
12	? Far do you go to get N/S		8.5 km		
13	If you do NOT use N/S why ?				
	a) too fresh				
	b) too expensive				
	c) not available	5			
	d) transport difficulty	5			
	e) difficult to handle /apply				
	f) not hygienic				
	g) not nutritious enough				
	h) not liked by customers				
	i) other	1	3%		

		WUHAN TOTAL	WUHAN AVERAGE	HUANGSHI TOTAL	HUANGSHI AVERAGE
14	Have your N/S habits changed	Y=36 (90%); N=3 (8%)		Y=20 (100%); N=0	
15	If YES, how changed				
	a) from city before now farm	22	55%	0	0%
	b) from farm before now city	8	20%	0	0%
	c) buy more N/S before	27	68%	20	100%
	d) before good dry, now wet no good	8	20%	0	0%
	e) before wet bad, now good dry	34	85%	20	100%
	f) don't buy N/S now	1	3%	20	100%
16	If YES, what is main reason				
	a) too wet	0	0%	0	0%
	b) too expensive	0	0%	20	100%
	c) not available	15	38%	0	0%
	d) unreliable supply	26	65%	20	100%
	e) transport difficulty	23	58%	0	0%
	f) difficult handle/apply	0	0%	0	0%
	g) not hygienic	0	0%	0	0%
	h) not nutritious enough	0	0%	0	0%
	i) not liked by customer	0	0%	0	0%
	j) do not cultivate now	0	0%	0	0%
	k) other	30	75%	0	0%
17	? You use Chemical Fertilizer	Y=39 (98%); N=1 (2%)		Y=20 (100%);	
18	? Main reason for chem fert				
	a) cheap	0	0%	0	0%
	b) easily available	20	50%	0	0%
	c) reliable supply	0	0%	0	0%
	d) easy transport	18	45%	0	0%
	e) easy to apply	39	98%	0	0%
	f) hygienic	12	30%	0	0%
	g) nutritious	35	88%	0	0%
	h) higher yield than N/S	0	0%	0	0%
	i) preferred by customer	0	0%	0	0%
	j) other	0	0%	20	1
19	? RMB spend on Chem Fert/year		1,184.00		1,070.00
20	How far from source Chem Fert (km)				1.5
21	Do you prefer Chem Fert to N/S	Y=1 (2%); N=39 (98%)		Y=0; N=20 (100%)	
22	Main reason NOT use Chem Fert				
	a) prefer N/S	20	50%	20	100%
	b) too expensive	35	88%	20	100%
	c) not available	0	0%	0	0%
	d) unreliable supply	0	0%	0	0%
	e) transport difficulty	0	0%	0	0%
	f) difficult handle/apply	0	0%	0	0%
	g) hygienic	0	0%	0	0%
	h) not nutritious enough	0	0%	0	0%
	i) not liked by customer	18	45%	0	0%
	j) not cultivate now	0	0%	0	0%
	k) Chem Fert. breaks soil	34	85%	20	100%
	l) more false products now	38	95%	0	0%
	m) enough N/S	3	8%	0	0%
	n) crops taste bad	39	98%	0	0%
	o) not easy to store	5	13%	0	0%

		WUHAN TOTAL	WUHAN AVERAGE	HUANGSHI TOTAL	HUANGSHI AVERAGE
23	Which is prefered· CHEM - N/S				
	a) not expensive	39-N/S; 0-Chem		20-N/S; 0-Chem	
	b) availibity	39-Chem; 0-N/S		20-Chem; 0-N/S	
	c) transport	39-Chem; 0-N/S		20-Chem; 0-N/S	
	d) easy applic'n and use	39-Chem; 0-N/S		20-Chem; 0-N/S	
	e) hygienic	39-Chem; 0-N/S		20-Chem; 0-N/S	
	f) nutritious to plants	39-N/S; 0-Chem		20-N/S; 0-Chem	
	g) good soil conditioner	39-N/S; 0-Chem		20-N/S, 0-Chem	
	h) better crop taste	39-N/S; 0-Chem		20-N/S; 0-Chem	
	i) preferred by customers	19-Chem; ? N/S			
	Which is prefered. N/S - TNS	TNS=40 (100%)			
24	Any problem getting right kind of N/S	39	100% problem	Y=20 (100%)	
25	If treated N/S available with characteristics belwo would would you buy N/S				
	a) cheap	33	83%	20	100%
	b) dry and clean	2	5%	0	0%
	c) available in bag	11	28%	0	0%
	d) reliable supply	0	0%	0	0%
	e) delivered to your farm	14	35%	0	0%
	f) odor free & hygienic	0	0%	0	0%
	g) nutritious to plants	40	100%	20	100%
26	If co-composted N/S available with characteristics below would you buy N/S: (20)				
	a) cheap	17	85%		
	b) dry and clean	0	0%		
	c) available in bag	3	15%		
	d) reliable supply	0	0%		
	e) delivered to your farm	14	70%		
	f) odor free & hygienic	1	5%		
	g) nutritious to plants	19	95%		
27	Name 2 of 6 most important				
	a) cheap	32	80%	20	100%
	b) dry and clean	0	0%	0	0%
	c) avalable in bag	0	0%	0	0%
	d) reliable supply	1	3%	0	0%
	e) delivered to your farm	8	20%	0	0%
	f) odor free & hygienic	1	3%	0	0%
	g) nutritious to plants	40	100%	20	100%
28	Now use N/S as Base Fert	40	100%	20	100%
29	Now use N/S for Applic'n.	39	98%	20	100%

		WUHAN TOTAL	WUHAN AVERAGE	HUANGSHI TOTAL	HUANGSHI AVERAGE
30	Which is more nutritious				
	a) fresh N/S	0	0%	0	0%
	b) co-composted N/S	40	100%	20	100%
31	Which is more nutritious				
	a) human N/S	40	100%	20	100%
	b) livestock N/S	0	0%	0	0%
32	? Ratio (%) each month do you use N/S & Chem Fert.				
	- January				0%
	- February				0%
	- March				40%
	- April				5%
	- May				5%
	- June				0%
	- July				10%
	- August				10%
	- September				10%
	- October				10%
	- November				0%
	- December				10%
33	? ratio each season use N/S and Chem Fert				
	- spring				50%
	- summer				20%
	- autumn				20%
	- winter				10%
34	If N/S available, cheap and quality, will you use N/S as main fertilizer	40	100%		
35	And will you continue to use Chem Fert	Y=35 (88%); N=2 (5%)			
36	If N/S becomes more expensive and lesser quality, will you:				
	a) use more Chem Fert	34	85%	20	100%
	b) get fresh N/S	6	15%	0	0%
	c) raise/use livestock	5	13%	20	0%
	d) empty public latrines	8	20%	2	10%
37	? total SALE crops/year (*)				1 00
38	? gross PROFIT crops/year(*)		9.45		11 00
39	? total COST crops cultivation /year (*)		4.45		5.60
40	? net PROFIT crops/year (*)		4.95		5.40

Note (*) costs in RMB x 1,000

		WUHAN TOTAL	WUHAN AVERAGE	HUANGSHI TOTAL	HUANGSHI AVERAGE
41	?far you travel to sell crops		5 33		3.50
42	What transport do you use to sell crops	B=37; PV=2; WK=1		B=20	
43	Who mainly responsible to sell crops	H=34; HW=6; S=1		H=9; S=10	
44	? total HH income RMB/year(*)		5.64		5.45
45	? many people live in your HH		3.79		5.30
46	? you pay for fresh N/S RMB/Truck		471.84		---
47	Are you willing to pay RMB 50 per 5 ton truck for fresh N/S	Y=39; 1=N		Y=20; N=0	
48	Are you willing to pay RMB 75 per 5 ton truck for fresh N/S	Y=39; N=1		Y=20; N=0	
49	? is maximum you are willing to pay per 5 ton fresh N/S		123.25		107 00
50	? much are you paying now for treated N/S /5 ton truck		115.00		---
51	Are you willing to pay RMB 75 per 5 ton truck treated N/S	Y=39; N=?		Y=20; N=0	
52	Are you willing to pay RMB100 per 5 ton truck treated N/S	Y=35, N=4		Y=20, N=0	
53	? is maximum you are willing to pay per 5 ton treated N/S		150.51		188.30
54	? much are you paying for treated compost /ton		---		---
55	Are you willing to pay RMB200 treated N/S/compost per 5 ton	Y=30(88%); N=4(12%)		Y=20; N=0	
56	Are you willing to pay RMB250 treated N/S/compost per 5 ton	Y=13(62%); N=8(38%)		Y=20, N=0	
57	? is maximum you are willing to pay per 5 ton for treated compost/N/S		259.70		287 50
58	Where do you obtain most of information on farming	RF=37, P=2; R=1		RF=16 (80%); B=4 (20%)	
59	How useful is information	U=27 (67%)		U=19 (95%)	
60	Where do you obtain inform'n on N/S	NR=37 (92%)		---	
61	How useful is information	U=36 (90%)		---	
62	Where do you obtain inform'n on chemical fertilizer	RF=25 (62%); NR=13 (32%)		RF=16 (80%); B=4 (20%)	
63	How useful is information	N=20 (50%); U=20 (50%)		U=19 (95%)	

(Note: * In RMB 10,000
(Note: RF=relatives, friends, N=neighbours, B=books)

Annex 5

Technical Pilot Activities

UNDP/World Bank Water and Sanitation Program
RWSGEAP
International Reference Center for Waste Disposal

Contents

Technical Pilot Activities

1. Purpose of Pilot Activities

A number of technical aspects of nightsoil facilities, septic tanks and treatment of nightsoil and septic tank sludges, will be tested to assess and demonstrate the appropriate technical parameters for wastewater and nightsoil treatment processes. These activities are intended to provide improved design parameters and operating methods which will then be applied to refine the technical designs of the project investment items. Furthermore these improvements could then be developed to be used on a wider scale in the province and possibly on a national basis.

In the original schedule of this study it was proposed that the activities would be undertaken in only one or two cities The activities would not be spread throughout all the project cities due to limitation on both budget and logistical constraints, testing and monitoring would be most efficiently carried out by limiting the activities to just one or two cities. The pilot activities are being undertaken in two project cities - Yichang and Huangshi. The selection of the cities was made with the agreement of the HUEPO.

2. Identified Technical Issues and Problems

A number of technical issues and problems have been identified in the project cities and can be categorized as:

A. Existing practices for the removal of excreta from households.
B Existing practices for the treatment/disposal of sludge/nightsoil
C. Identified problems with the existing practices.
D. Identified problem scenarios where answers are needed

A brief outline of the stages, processes and problems involved in sanitation and nightsoil operations for disposal and treatment and reuse of nightsoil are described below

A. Existing practices for the removal of excreta from households

A1 Flush latrine >sewer system

A2 Flush latrine > open drain/creek/river

A3 Flush latrine > septic tank > sewer system

A4 Flush latrine > septic tank > open drain/river/creek

A5 Dry latrine/bucket > open drain/creek/river

A6 Dry latrine/bucket > public latrine septic tank > sewer system

A7 Dry latrine/bucket > public latrine septic tank > open drain/creek/river

A8 Dry latrine/bucket > public latrine storage tank

A9 Dry latrine/bucket > farm/fish pond

B. Existing practices for the treatment/ disposal of sludge/nightsoil

B1 Sludge from septic tanks is collected by municipality > intermediate storage tank > farms

B2 Sludge from septic tanks is collected by municipality > farms

B3 Sludge from septic tanks is collected by municipality > sewer system

B4 Sludge from septic tanks is collected by municipality > mixed with rubbish > landfill

B5 Sludge is collected by informal sector/ farmers > farms

B6 Nightsoil from dry public latrines is collected by municipality > intermediate storage tank > farms

B7 Nightsoil from dry public latrines is collected by municipality > farms

B8 Nightsoil from dry public latrines is collected by farmers > farms

B9 Nightsoil from dry private latrines is collected by farmers > farms

C. Identified problems with the existing practices

A1,2, 5 Lack of any treatment > pollution of river/lake

A3,6 Septic tanks not properly designed and/or overloaded > environment pollution
Septic tanks not operated and maintained (emptied irregularly)

A4,7 Quality of septic tank effluent not adequate for discharge into open drain
Septic tanks not operated and maintained (emptied irregularly)

B1,6 Intermediate storage tank being by-passed
Intermediate storage tank not big enough
Storage tank effluent not adequate for reuse

B1,2, 5 Sludge not suitable for use on farms (too much water/impurities)

B2,5, 7,8,9 Quality of the sludge/nightsoil not adequate for reuse

B3 Pollution of river/lakes

A&B Manual (and unhygienic) handling of nightsoil

D. Identified problem scenarios where answers are needed

D1. In areas sewered or decided to be sewered soon:

D11 Apartment buildings with flush latrines which cannot be connected to the sewer system due to lack of hydraulic gradient.

D12 Apartment buildings with flush latrines and septic tanks which are connected to the sewer system but not functioning properly due to wrong design, overloading and/or lack of maintenance (emptying).

D13 Apartment buildings with flush latrines and regular septic tanks which are not connected to the sewer system and with an effluent which is not adequate for discharging into open drains/creeks/rivers.

D14 Apartment buildings without flush latrines and bringing the excreta to public latrines.

D15 Public latrines with flushing system and septic tanks which are connected to the sewer system but do not function properly due to wrong design, overloading and/or lack of maintenance (emptying).

D16 Public latrines with flushing system and septic tanks which are not connected to the sewer system and the effluent of which is polluting open drains/creeks/rivers.

D17 Dry public latrines with storage tanks.

D18 Dry latrines (public & private) which are not designed properly

D19 Areas which are not connected to the sewer system due to administrative reasons.

D2 In areas which are not sewered:

D21 Apartment buildings with flush latrines and septic tanks which do not function properly due to wrong design, overloading and/or lack of maintenance (emptying).

D22 Apartment buildings with flush latrines and regular septic tanks with an effluent which is not adequate for discharging into open drains/creeks/rivers.

D23 Apartment buildings without flush latrines and bringing the excreta to public latrines.

D24 Public latrines with flushing system and a regular septic tank which is not adequate for discharge into open drains/creeks/rivers.

D25 Dry public latrines with storage tanks.

D26 Dry latrines (public & private) which are not designed properly.

3. Technical Options

The categories below provide technical options for solving the identified problems above and suggestions for pilot and other activities.

E. Technical options for solving the identified problems

F. Suggestions for technical pilot activities

G Suggestions for other activities during the pilot phase

E. Technical options for solving the identified problems

E1 Modifications of the present septic tank design for apartment buildings and public latrines in order to improve:
- the operation and maintenance (regular emptying);
- the quality of the effluent; and
- the safety level of the sludge for reuse.

E2 Treatment of sludge and nightsoil to safe levels through:
- storage (possibly with utilization of biogas); and
- composting together with garbage (co-composting).

E3 Dewatering of the sludge during collection.

E4 Small bore sewer system for connecting non-sewered areas to the main trunk.

F. Suggestions for technical pilot activities

F1 *Monitor existing Chinese septic tank in a building* Monitor the quality of the effluent and the sludge of a septic tank designed according to normal Chinese standard for regular apartment buildings

For proper septic tank operation, de-sludging should be carried out every one to two years The efficiency of pathogen removal is dependent on the retention times and temperature

F2 *Construct modified Chinese septic tank in a building.* Build in an apartment building a septic tank which is designed according to the suggestions of the national consultants and monitor the quality of the effluent and the sludge

Modified 3 chamber septic tank. This is essentially the conventional septic tank but modified to include domestic sullage waste inlet into the third chamber and in addition an improved sludge cleaning action pipe It is also recommended that for ease of de-sludging the septic tank, a separate pipe with an inlet to absorb the sludge at the base of the tank should be provided.

F3 *Construct a septic tank with anaerobic filter.* Build in an apartment building a modified septic tank which has an anaerobic filter in the last compartment and monitor the quality of the effluent and the sludge.

This incorporates a biological filter (materials can be stones or other porous non-organic materials), to provide a final treatment to the septic tank effluent. Anaerobic filter can be used with the anaerobic reactor type septic tanks and the flow can be up or down flow. Upflow action is preferred as this provides a more steady (and with less risk of clogging) and a more convenient outflow to a discharge point.

F4 *Monitor existing Chinese septic tank in a public latrine.* Monitor the quality of the effluent and the sludge of a septic tank designed according to normal Chinese standards for public latrines.

F5 *Construct a septic tank with anaerobic baffled reactor.* Build at a public dry latrine which is converted to a wet latrine with a modified septic tank with baffles and monitor the quality of the effluent and the sludge and measure the gas production.

This process is an improvement to the normal septic tank by increasing the BOD removal rate through a sludge reactor flow process. It is a form of the upflow anaerobic sludge blanket process. Originally this treatment process was

applied to treat high strength industrial wastes, but has been refined and improved to be applied to treat domestic wastes. This process has been tested in several countries for domestic wastes, with BOD removal rates of 60% to 70% having been achieved.

In low to moderate population density areas, with sufficient granular soils, the septic effluent can be discharged into a granular filter bed and percolation medium (sands and loams) This is a common and economical system but care should be taken not to overload the septic tanks and for this reason it is suitable only for low to moderate residential density areas and where there is no likelihood of groundwater contamination.

F6 *Construct modified Chinese septic tank in a public latrine.* Build at a public dry latrine which is converted to a wet latrine a modified septic tank with an anaerobic filter in the last compartment. Monitor the quality of the effluent and the sludge and measure the gas production

F7 *Monitor sludge quality from an existing storage tank* Monitor the quality of the sludge taken out by farmers from a normally operated intermediate storage tank.

F8 *Modify construction of an existing storage tank.* Modify the construction and operation of an existing storage tank (batch operation) and monitor the quality of the sludge taken out by farmers and measure the gas production

The present practice for collecting nightsoil in storage tanks from which sludge can be removed and used as fertilizer indicates that quite often the removal of sludge takes place before the required retention period of 30 days has been reached and sludge in a raw state (with high pathogen content) is then handled by farmers. Simple modifications to the storage tanks to provide batching to ensure a safer sludge for re-use can be made by having two separate tanks or compartments De-sludging or removal of sludge can be allowed from one tank or compartment from which to supply farmers. The other tank or compartment is used to receive the fresh excreta Removal of sludge from this tank should be prohibited. The tank uses can be rotated alternately so that one tank is always used for the safe sludge and waste digestion.

F9 *Set-up a pilot plant for co-composting* Reuse of nightsoil by composting together with solid waste is an efficient means of treating and recycling. The co-composting method uses an aerated composting process. There is a thermal biological reaction in this process which kills off the pathogens and yet leaves enough organic nutrients for the resulting compost to be an effective soil fertilizer and conditioner. Several variations of the process have been tried and carried out successfully in other countries

However the technology of co-composting is not fully developed to provide economical solutions and consequently it is proposed in this project that pilot activities be carried out before any final designs are proposed for investment.

G. Suggestions for other activities during the pilot phase

G1 Initiate trials for dewatering of sludge during collection.

G2 Choose a non-sewered area and conduct an economic comparison (desk study) on the following options:

- wet public latrines with modified septic tanks,
- small bore sewer system with connection to the main sewer system;
- small bore sewer system with decentralized treatment;
- extend regular sewer network, and
- small localized treatment plant

The Small Bore Sewer system is an adaptation of the water-borne sewerage system but has one advantage which enables the use of a more cost effective method as compared to the full bore (i.e, conventional) sewerage system A small "holding tank" is installed at the outlet of the building and before entry into the sewer system This tank settles out solids as well

as grease The effluent from this tank is only liquid. The sewer pipe network can be designed as full flow (not as partial flow condition as for conventional sewers) and the pipes can be designed under hydraulic pressure. This means that these sections of pipes can be laid at minimum cover and not necessarily at the hydraulic gradients This design results in smaller diameter pipes as well as shallower pipe excavation for some lengths of the pipe as compared to conventional sewerage

This system relies on good maintenance of the holding tank as well as the sewer pipes. It has the advantage that it not only reduces pipe costs but also requires less extensive means of sewage treatment process. This system has been used in both developing as well as developed countries and it is considered appropriate to the conditions in Hubei since the practice of using septic tanks for buildings before discharging into the sewer network means that the septic tanks could be converted and act as the holding tanks of the small bore sewer system.

4. Plan of Pilot Activities

Pilot (demonstration) activities will be carried out to test a number of technical and operational parameters and general suitability of a number of proposals for improvements to nightsoil treatment, disposal, septic sludge treatment and disposal. The results of the pilot activities will be incorporated into the detailed design for the appropriate technical designs of nightsoil storage, treatment and septic tanks (for buildings and public latrines) as well as other low cost sanitation options. Because the HUEP will be implemented over several years, lessons learned from the pilot activities can be adopted throughout the project.

Operation and maintenance requirements and costs for the constructed systems will be developed

The results of the activities will be used to refine the design details of the project works program

The following arrangements for construction, testing and monitoring and pilot activities are proposed for construction, testing, monitoring and handover (or even disposal) of each pilot activity:

1 ***Detailed Design of Pilot Activity*** Prepared by the study consultants in close consultation with the project cities, particularly the Sanitation Bureaus, including cost estimates based on agreed standard unit rates for construction

2. ***Available Site.*** Each respective city will provide adequate space for the construction of each pilot activity item. However, as these are pilot activities and not necessarily final usage items the land area requirements are minimal.

3. ***Construction.*** The City Sanitation Bureaus are responsible for the construction which will be based on the agreed costs, and checked by the study consultants.

4. ***Testing and Monitoring of Activities.*** The testing and monitoring of each activity will be by the City Sanitation Bureaus with advice provided by the study team including specialist advice from IRCWD.

The chemical and biological analyses to be carried out will be of the **influent and effluent** for the following parameters.

i) BOD
ii) COD
iii) Suspended Solids
iv) Odor of effluent

and of **sludge** for the following parameters:

i) K/N
ii) Coliforms
iii) Nematode eggs
iv) Helminths eggs

The primary testing parameters will be those used for the agreed acceptable levels for nightsoil use in agriculture/aquaculture, viz.:

i) Intestinal nematodes (arithmetic mean number of eggs per liter)
ii) Fecal Coliforms (geometric mean no. per 100 ml.)

(The nematodes to be tested are ascaris and trichuris species plus hookworm.)

5. ***Funding*** Funding for the pilot activities is from Swiss Development Corporation (grant) funding.

6. ***Handover or Disposal.*** At the completion of the testing and monitoring, each activity item will be handed over to the city.

5. Implementation of Pilot Activities

A number of activities were designed and discussions were held with the project cities After these discussions the finally agreed activities were allocated to the specific project cities of Yichang and Huangshi In Xiangfan one pilot activity was considered (anaerobic treatment with biogas collection septic tank); however the design was proposed by the city but after considering its technical aspects, it was not considered to be sufficiently certain of functioning and would not be suitable as a demonstration item which could be tested and monitored.

These activities are for:

a) conventional and modified septic tanks;

b) nightsoil storage tank; and

c) co-composting.

The pilot activities are summarized in Table 1 and a brief description of the technical requirements and specific objectives for each are described below

Conventional and Modified Septic Tanks

Conventional septic tanks are a major means of primary treatment of the wastewater in each of the project cities However it has been noted that there are a number of deficiencies in their use and operation. Although many buildings have septic tanks, many tanks do not appear to function correctly. Furthermore there is some doubt that the correct design parameters have been used in the design and operation of the tanks, such as hydraulic retention times, sludge accumulation rate and emptying frequency.

The pilot activities proposed for the septic tanks will test and monitor several aspects of the septic tank treatment and design process, including the following:

- design criteria and operational parameters used in the conventional Chinese three compartment septic tank, and
- methods of improving the efficiency of septic tanks through different modifications.

A septic tank is typically designed to act to remove suspended solids and reduce the BOD. According to the literature, removal of SS and BOD in a conventional septic tank is typically between 60% to 80% (SS) and around 30% (BOD), respectively There is also an overall reduction in the number of micro-organisms, however a large number of viruses, bacteria protozoa and helminths can still be present in the effluent, sludge and scum of a septic tank

The following processes are occurring in a conventional septic tank and responsible for the different removal efficiencies:

a) Suspended solids are separated through sedimentation which results in the formation of three distinct layers: a layer of sludge at the bottom, a floating scum on top, and a relatively clear layer of liquid in the middle. Very fine particles initially stay in suspension but later these particles coagulate to form larger particles which may fall or rise depending on their density

b) Organic matter in the sludge, as well as in the scum, is largely degraded by anaerobic bacteria and eventually converted to water, carbon dioxide and methane (biogas).

c) During their retention in the tank, organic materials remaining in the liquid are only partly stabilized by anaerobic bacteria in a process similar to the one described in b).

d) Many kinds of micro organisms grow, reproduce and die in the tank Most are attached to organic matter and separated out with the solids. Some accustomed to living in the human intestine, suffer in the adverse environment of the tank and some are themselves heavy and sink to the sludge layer where they die off depending on the storage time and the temperature.

A minimal hydraulic retention time (before de-sludging) of 12 hours and a sludge and scum accumulation rate of 50 to 70 liters per capita per year are typical design parameters for a conventional septic tank, assuming that the sludge is not removed more than once a year. The sludge accumulation rate as well as the concentration of viable pathogens in the sludge increases significantly with higher de-sludging frequencies.

A number of problems in septic tank design and operation have been identified in the project cities These include.

- hydraulic overloading, whereby solids do not settle out sufficiently and organic matter is digested to a very small extent;
- infrequent de-sludging, resulting in a reduced effective volume and eventually also in hydraulic overloading; and

- poor maintenance resulting in broken or missing inlets and outlets allowing untreated wastewater to flow into streets.

The objectives of the pilot and demonstration activities are to evaluate the treatment efficiency of properly designed and operated conventional Chinese septic tanks and to test the potential for improving the treatment efficiency of septic tanks through innovative and low costs modifications in their design and operation The modified systems include the Anaerobic Baffled Reactor and the Anaerobic Filter. These two systems have the advantage over conventional septic tanks in that there is much better contact between the fine and dissolved organic matter in the wastewater and the anaerobic bacteria. Therefore, a much higher efficiency with regard to the removal of BOD can be expected compared to conventional septic tanks

Since there are differences in the operation of septic tanks for residential buildings and public latrines, the conventional septic tank and the modified systems will be tested in both types of application. In residential buildings there are more pronounced peak daily flows resulting in greater surges of flows which can destabilize the sedimentation and digestion process. Several treatment systems will be constructed and their performance compared with existing septic tanks. Performance will be measured by testing reduction in BOD, COD and SS (i e between influent and effluent), and for coliform and parasite counts in the digested sludge Water consumption, temperature and pH as well as investment and operating costs will be monitored in order to establish the design criteria for the improved systems and to compare their costs with conventional septic tanks

The activities undertaken are

ACTIVITY No. 1 City = Yichang; Monitor only
Standard Chinese 3 Chamber Septic Tank at Residential Building

An existing operational septic tank data residential building (and designed according to standard Chinese designs) is chosen and will be used as a base case against which to measure the performance of the septic tank improvements for residential buildings

ACTIVITY No 2 City = Yichang, Construct and Monitor
Septic Tank with Anaerobic Filter at Residential Building (tank based on Chinese standard design)

It is proposed to test possible improvements to attain higher BOD reduction levels in a standard septic tank, by addition of an anaerobic filter in the last chamber of the tank.

In many areas in the project cities, where piped sewerage systems are not provided, wastewater are discharged into stormwater drains or street drains. In some cases where septic tanks are not fully operational, wastewater discharge directly from buildings into street drains. If higher BOD removal rates can be achieved, such a septic tank could be used to provide partial treatment process in areas with poor sanitation conditions (e.g. areas without sewerage or proper piped drainage for disposal of wastewater). The effluent discharge from such an improved tank, although not totally treated, could be much less harmful, so that it could be discharged into simple covered street drains or even in some cases into open stormwater drains, improving the sanitation in a local area

The septic tank dimensions are designed according to the Chinese standards for sludge volume accumulation; the anaerobic filter design is based on recommendations from IRCWD.

ACTIVITY No. 3 City = Yichang; Construct and Monitor
Septic Tank with Anaerobic Filter at Residential Building (modified design)

This activity is similar to Activity No. 2 but a further modification is made to the first (sedimentation) chamber. It is considered that the Chinese standard design for sludge volume generation may be too conservative and a reduction in the first chamber size is proposed in this activity to test whether a reduced size for the first chamber can be as effective as the standard Chinese design. Accordingly the length of the first chamber in this activity (3) is reduced from 6 to 4 meters.

ACTIVITY No 4 City = Yichang and Huangshi; Monitor only
Standard Chinese 3 Chamber Septic Tank at Public Latrine

This activity is similar to activity No. 1 but it is for a public latrine.

ACTIVITY No 5· City = Huangshi, Construct and Monitor
Septic Tank with Baffled Reactor at Public Latrine

As for activities Nos. 2 and 3, an improvement to the septic tank is proposed - but in this activity the improvement is by using a 2 stage baffled reactor and not an anaerobic filter as in 2 and 3. A comparison will be made between the effectiveness of the two systems - baffled reactor and anaerobic filter.

ACTIVITY No. 6 City = Yichang; Construct and Monitor
Septic Tank with Anaerobic Filter at Public Latrine

As for activities Nos. 2 and 3, the anaerobic filter system will be tested for a public latrine to compare the results with an anaerobic filter tank at a residential building.

Nightsoil Storage Tank

The project cities have used nightsoil storage tanks to supply nightsoil to the farming community. However the storage tanks are not operational for various reasons. Among the main reasons being that nightsoil is too liquid and not so suitable as a fertilizer, difficulty of access for collection and loading of the nightsoil by farmers, location of tanks being too distant form farming areas

The purpose of this nightsoil storage tank activity is to attempt to provide some treatment to the nightsoil to reduce the pathogen content as well as provide a more useful fertilizer by obtaining a more digested nightsoil The tank will also be built to provide easier access and loading of the semi treated nightsoil, by farmers at the tank outlet

ACTIVITY No. 8 City = Yichang; Construct and Monitor
Nightsoil Storage Tank

As this is only a demonstration activity only one typical compartment of the tank is to be built and tested. The test tank will be divided into a number of segments with each segment representing one week of supply of nightsoil Each segment will store the nightsoil for one month period to allow digestion to take place and collection of nightsoil will be made from the respective segment after one month of storage For the prototype, the tank compartment can be replicated for larger storage volumes Tests will be carried out to determine sludge accumulation as well coliform and parasite counts to determine the reduction in harmful pathogens

Co-composting

There is keen interest in the three project cities of Yichang, Huangshi, and Xiangfan for co-composting treatment (nightsoil and solid waste) as a nightsoil and sludge treatment process. Composting (solid waste only) has also been tried in Wuhan, but with limited success

At present there is a major problem in finding safe outlets for disposal of nightsoil It is not intended that the co-composting will provide a financially affordable process; it is doubtful if capital costs can be recovered fully. However if this process can be shown to be technically feasible and at the same time provide some income - ideally to recover operating costs, then it will provide significant benefits to the city administration in its sanitation operations. It will reduce the requirement for additional treatment processes and provide a method for safe disposal of some of the nightsoil and septic tank sludge.

ACTIVITY No. 9 City = Yichang and Huangshi; Construct and Monitor
Co-composting Treatment (nightsoil & solid waste)

This activity will try a small (28 tons nightsoil per month) capacity treatment plant based on the aerated pile method for composting. It is not proposed to provide additional bulking material (such as sawdust, etc.) to the pile. It will measure and provide guidance on the following.

- appropriate mix ratios of nightsoil to solid waste;
- range of water content of the solid waste required;
- size and type of pile for satisfactory composting;
- amount of separation of non useful material required to achieve a useful compost;
- any requirements for post compost separation; and
- weather and climate influences (such as rainfall and ambient temperature)

Tests will be carried out on the final compost for coliform and parasite counts (i e. measure safe levels of

nightsoil) and also on the organic nutrient quantities to measure its value as a fertilizer

Status of Pilot Activity Work and Application of Results

Construction of facilities were completed this month (July 1995); the testing and monitoring have commenced and will be undertaken until December 1995

It is proposed that based on the pilot activity results, recommendations for any necessary improvements to the designs and operation can be incorporated into the specific project investment items for the nightsoil component. Since the planned start of implementation of the project is approximately in the beginning of 1996, there will be adequate time to carry out modifications to the investment program designs as required.

TABLE 1: TECHNICAL PILOT ACTIVITIES

HUBEI PROVINCE, CHINA
RWSG EAP/IRCWD

Activity	City	Apartment Building		Public Latrine		Nightsoil Storage Tank	Co-Composting
		Monitor	Construct & Monitor	Monitor	Construct & Monitor		
1	Yichang	Chinese standard 3 chamber septic tank					
2	Yichang		Chinese standard 3 chamber septic tank w/ anaerobic filter				
3	Yichang		Modified septic tank with anaerobic filter				
4	Yichang Huangshi			Chinese standard septic tank			
5	Huangshi				Modified septic tank with anaerobic baffled reactor		
6	Yichang				Modified septic tank with anaerobic filter		
8	Yichang					Construct modifications to existing tank	
9	Yichang Huangshi						Set up pilot co-composting plant

WP:Pilot.Tab