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REGIONAL CENTRE FOR THE PROMOTION OF
ENVIRONMENTAL PLANNING AND APPLIED STUDIES (PEPAS)

REPORT

REGIONAL WORKSHOP ON HEALTH AND TECHNICAL ASPECTS OF NIGHTSOIL AND WASTEWATER USE

Kuala Lumpur, Malaysia

24 - 28 September 1990

Kuala Lumpur, Malaysia

November 1990

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REPORT
REGIONAL WORKSHOP ON HEALTH AND TECHNICAL ASPECTS OF NIGHTSOIL AND WASTEWATER USE

Convened by the

WHO WESTERN PACIFIC REGIONAL CENTRE
FOR THE PROMOTION OF ENVIRONMENTAL PLANNING
AND APPLIED STUDIES
(PEPAS)

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NOTE

The views expressed in this report are those of the participants in the workshop and do not necessarily reflect the policies of the World Health Organization.

This report has been prepared by the WHO Western Pacific Regional Centre for the Promotion of Environmental Planning and Applied Studies (PEPAS) for governments of Member States in the Region and for the participants in the Regional Workshop on Health and Technical Aspects of Nightsoil and Wastewater Use held in Kuala Lumpur, Malaysia, from 24 to 28 September 1990.

CONTENTS

1. INTRODUCTION

The Regional Workshop on Health and Technical Aspects of Nightsoil and Wastewater Use was held at the WHO Western Pacific Regional Centre for the Promotion of Environmental Planning and Applied Studies (PEPAS) on the campus of the University of Agriculture, Malaysia (Universiti Pertanian Malaysia), Serdang, Selangor, Malaysia, from 24 to 28 September 1990.

The workshop was sponsored by WHO Headquarters and attended by twelve participants from seven countries and areas in the Western Pacific Region. In addition, one representative from the UNDP/World Bank Regional Office for Water and Sanitation, and three observers from concerned agencies of Malaysia also attended the workshop.

A list of the participants, representative, observers and secretariat members is presented in Annex 1.

2. OPENING SESSION

Following brief introductory remarks by Dr P. Guo, Director, PEPAS, Dr L.R. Verstuyft, the WHO Representative for Brunei Darussalam, Malaysia and Singapore, delivered the opening address on behalf of Dr S.T. Han, Regional Director, WHO Regional Office for the Western Pacific. The address stressed the importance of the workshop objectives and expressed the hope that it would provide a suitable forum for the review of nightsoil and wastewater treatment and use in relation to the health needs of the Region. The full text of the address is attached as Annex 2.

In his message, Prof. Dr Syed Jalaludin, Deputy Vice- Chancellor, University of Agriculture, Malaysia, welcomed the participants, representative and observers to the University campus and expressed his own interest in the subject matter of the workshop.

3. OBJECTIVES

The broad objectives of the workshop were to disseminate the information contained in the WHO document "Health Guidelines for the Use of Wastewater in Agriculture and Aquaculture" and to discuss health risks associated with the use of nightsoil and wastewater and ways of minimizing these risks.

The five main objectives of the workshop were:

(a) to introduce to participants the technical information contained in the new WHO guidelines;

(b) to review and evaluate current practices in the treatment and use of nightsoil and wastewater in rural and urban areas, particularly in relation to the transmission of diarrhoeal and other diseases;

(c) to exchange information on environmental, institutional, public health, sociocultural and economic aspects of nightsoil and wastewater use in the countries and areas of the Region;

(d) to identify health research needed to complement existing knowledge in the area of nightsoil and wastewater use; and

(e) to promote integrated approaches (such as wastewater treatment, crop restriction, application methods and human exposure control) to optimize nightsoil and wastewater use and to improve health protection for the groups at risk.

4. WORKSHOP PROGRAMME

The workshop agenda and list of documents distributed during the workshop including working papers and country reports, are attached as Annexes 3 and 4 respectively. Copies of the documents are available on request from PEPAS.

The country reports were presented during the first two days of the workshop. A field visit to two palm oil estates was carried out on the third day.

On the fourth day, the participants were divided into two groups to discuss the following topics:

(a) health and technical aspects of nightsoil and wastewater use; and

(b) research needs in nightsoil and wastewater use and treatment.

On the fifth day, the participants were asked to prepare an action plan that each of them would expect to carry out in his/her country, reflecting the objectives of the workshop. The findings of each group discussion were presented and reviewed in the last session of the workshop.

During the workshop, two videos were shown to the participants: the first about wastewater stabilization ponds; and the second about the use of fish in pollution detection.

5. PRESENTATION OF PAPERS AND DISCUSSIONS

5.1 Papers presented by the secretariat

The first paper was presented by Dr I. Hespanhol, staff member from WHO Headquarters. He reviewed the WHO health guidelines for the use of wastewater in agriculture and aquaculture and highlighted the following points:

(a) the history and existing practices of wastewater use in the world;

(b) benefits of wastewater reuse in agriculture;

(c) public health aspects;

(d) effluent quality microbial guidelines;

(e) technical aspects - measures for health protection; and

(f) integration of various measures for health protection.

The second paper titled Overall considerations and decision sequence for wastewater treatment, was presented by Dr Saqer Al-Salem, consultant. He mentioned the coverage of water supply and sanitation in EMRO and WPRO, and the criteria for setting the priority of selecting projects according to their importance to health, and decision sequence for wastewater and sludge treatment.

The third paper in the same session on Guidelines for the safe use of wastewater and excreta in agriculture and aquaculture was presented by Dr Niu Shiru, temporary adviser. The paper outlines the historical background of the existing guidelines used for nightsoil and wastewater in agriculture and aquaculture according to epidemiological knowledge reached.

On the second day, Dr Niu presented a paper titled Trends in wastewater and excreta use in agriculture and aquaculture. He described the existing practice in using nightsoil as a fertilizer in the Region.

The second presentation was given by Dr Saqer titled Design, operation and maintenance of wastewater stabilization ponds.

In the second session of the same day, Dr Hespanhol presented a paper titled Economic aspects of wastewater use. He emphasized the importance of the economic value of wastewater as a substitution of fresh water and fertilizers.

The next topic by Dr Niu was on Development of biogas technology in excreta treatment. He described in detail the different kinds of biogas digestors used in China for treatment of nightsoil and gas production, and he gave figures on the performance of thermophilic and mesophilic biogas digestors in the removal of pathogens and the effects in the improvement of sanitation.

The last presentation in this session was given by Dr Saqer titled On-site sewage disposal system in rural areas. He described in detail the different kinds of pit latrines used in EMRO, and the problems associated with their performance.

On Thursday morning, 27 September 1990, Dr Niu presented a paper on anaerobic and aerobic processes used in wastewater/excreta treatment for aquaculture in China. He described an experimental pilot scheme for treating nightsoil by anaerobic digestion and a combination of waste stabilization ponds, and the final effluent used to raise fish.

The second presentation was given by Dr Saqer titled Compliance of different wastewater systems with WHO guidelines for use in unrestricted irrigation. He explained that from the studies made of various wastewater treatment plants, it was found that waste stabilization ponds achieved 100% removal of nematode eggs, and reduced the faecal coliform to less than 1 000/100 ml. In contrast, conventional treatment with extended aeration failed to achieve the WHO guidelines for nematode eggs removal, while the trickling filter achieved complete removal of nematode eggs.

The third presentation was given by Dr Niu on Control measures for the use of human wastes. In his presentation, he explored the different ways of protecting the

consumers and workers, and also explained various methods that can be integrated to ensure health protection.

During this session, Mr Fisher, Sanitary Engineer, PEPAS, chaired a discussion on health research needs in the field of nightsoil and wastewater treatment and their application and health aspects related to their use.

The last presentation was given by Dr Saqer titled Wastewater treatment and reuse - a case study. In his presentation, he described the various treatments used and their performance in Jordan, the ways of using the final effluent and the regulations covering the use of effluent.

5.2 Country reports

Seven country reports were presented by the participants.

The first report was submitted by one of the Chinese participants. The report showed that the coverage of water supply and sewage systems in urban area has reached 85% and 40% respectively. It described the current practices in nightsoil and wastewater treatment in urban and rural areas and institutional framework, and gave information on the performance of biogas digestors, double pit latrines and septic tanks.

The country report of Japan discussed policy, management and practice of nightsoil and wastewater treatment and use, and the regulations covering the use of reclaimed water for restoration of rivers and recreation.

The country report of Lao People's Democratic Republic covered current nightsoil and wastewater treatment and use in rural and urban areas, and pointed out that the people do not like to use pit latrines and ventilated improved pit latrines, because in the rainy season the pits are flooded with water and they are breeding grounds for mosquitos.

In Malaysia, 4.9% of the population have central sewage systems, 34% and 42% of the population are using individual septic tanks and pour flush latrines respectively, but the remaining 19.1% are still using simple pits or overhanging latrines. The incidence of water-borne diseases has decreased sharply between 1976-1989 due to high coverage of adequate excreta disposal.

About 37% of the population in the Philippines depend on water from open dug wells, rainwater cisterns, lakes and streams, a number of which are doubtful in quality. Most of the population depend on on-site nightsoil disposal and septic tanks which drain directly into river and creeks. Water-borne diseases are wide spread.

In Republic of Korea, legislation specifies that nightsoil applied to crops and vegetables is restricted to sludge from nightsoil treatment plants, digested nightsoil and composted nightsoil. The report gave information on the prevalence of diseases related to the use of nightsoil, such as roundworm, hookworm, liver-fluke and diarrhoea.

The country report of Viet Nam described the types of latrines used in Viet Nam and indicated that there was a reduction of diarrhoeal morbidity between 1980-1989 because of the promotion of latrines in rural areas. The composting vault should be retained at least 2-3 months before emptying, but this is not normally done.

6. FIELD VISIT

A field visit to two oil palm estates was conducted on Wednesday, 26 September.

The first place visited was the Guthrie Estates palm oil mill in Ladang Bukit Talang, to view the stabilization ponds system used for wastewater treatment. The effluent is improved to a condition within the requirement of the Department of Environment, Malaysia, for the land application of palm oil mill effluent, and is used as a fertilizer by feeding it into irrigation ditches between rows of immature trees. With effluent application, yields are increased with no adverse effect on palm growth. Monitoring on well water quality indicated negligible impact on environmental quality.

The second place was the Sime Darby Plantations, where the wastes generated from palm oil processes are being used to produce biogas by anaerobic digestion. The raw effluent with a 5-day biochemical oxygen demand (BOD_5) of 30 000 to 35 000/100 ml is put into an anaerobic digestor for 9-13 days. The byproduct of 65% methane and 35% carbon monoxide is tapped, collected in tanks, stored under pressure, and then used to generate power for mills or sold to a nearby ceramic factory for heating purposes.

7. FINDINGS OF GROUP DISCUSSIONS

The following findings were the results of group discussions:

(1) Issues and problems related to nightsoil and wastewater use in the Region.

a. Lack of skilled manpower (technicians and engineers);

b. Lack of financing to implement projects in water supply and adequate sanitation to satisfy the basic needs of health protection;

c. Insufficient transfer of information concerning hygiene practices to rural areas where the health standard is low;

d. Low priority generally given to environmental management and enforcement; and

e. As the economy improves, the community tends to consume more resources to generate more wastes, and to reduce its use of nightsoil and wastewater.

(2) Technical and health aspects of nightsoil and wastewater use.

a. The guidelines provided by WHO could be individually adapted for each country bearing in mind that the situation in each country is different;

b. A code of practice for using nightsoil and wastewater in agriculture and aquaculture should be formulated to suit the social, cultural and economical backgrounds, etc., in each country. As an

example, if fish raised in wastewater ponds are not accepted by the people, it may be promoted as animal food;

c. There is a need to coordinate the exchange of information in this Region as research findings and experiences from within the Region is more relevant;

d. Researchers in this Region should also make greater efforts to have their findings and experience published (in English) so that it can benefit more people;

PEPAS should take up the responsibility of information exchange; and

e. Many countries put more emphasis on water supply rather than on sanitation. It is necessary to make governments realise the importance of sanitation in order that any project on beneficial use of nightsoil and wastewater can run smoothly.

8. RECOMMENDATIONS

Based on the above findings the participants made the following recommendations:

(1) Each country in the Region which has no standards/guidelines for the use of nightsoil and wastewater in agriculture and aquaculture should set such standards/guidelines, taking into consideration hygiene practices, health standards and water-borne diseases prevalence in each country. These standards/guidelines can be developed on the base of WHO guidelines.

(2) Where the final effluent standards are adopted, it is essential to take into consideration the health parameters (F.C., nematode eggs) parallel to other parameters traditionally used for wastewater treatment, such as BOD_5, Suspended Solids.

(3) A pilot project for research and training in the use of nightsoil for agriculture and aquaculture should be carried out in one of the developing countries to serve as a model centre for the Region.

(4) Several methods for the detection of helminth eggs have been proposed to date. However, as they are not completely satisfactory, there is a need to develop and improve low-cost, reliable egg-detection methods which have a high degree of sensitivity. Further investigations are also required to facilitate the determination of egg viability in order to develop analytical methods which will be suitable for routine application.

(5) Research should be directed towards existing as well as new nightsoil and wastewater treatment technology, and the following areas should receive special attention:

- waste stabilization ponds
- land-saving options, such as deep ponds
- direct coagulation - flocculation of nightsoil and wastewater (for intestinal nematode removal)
- filtration of effluents from primary or secondary nightsoil

and wastewater treatment plants (for nematode removal)
- horizontal and up-flow vertical roughing filters as post-treatment for nematodes removal.

(6) There is a need to identify the more suitable types of crops and species of fish suitable for the purpose of agriculture and aquaculture using nightsoil and wastewater treatment in the Region, especially for the types eaten raw.

(7) It would be beneficial to hold similar workshops in each concerned country in the Region to promote the WHO guidelines at the national level. PEPAS could collaborate in holding these workshops.

9. ACTION PLANS BY THE PARTICIPANTS

The following are the main activities that the participants expect to pursue on their return to their respective countries as a result of the workshop:

(1) China

- Setting guidelines/standards for nightsoil use in agriculture.
- Collecting background and epidemiological data of nightsoil use in aquaculture.
- Establishing appropriate nightsoil treatment demonstration facilities for public participation.

(2) Viet Nam

- Giving more attention to the importance of nightsoil and wastewater treatment.
- Carrying out a pilot project to demonstrate nightsoil and wastewater treatment.

(3) Laos

- Holding training courses on low-cost water supply and nightsoil treatment systems for different levels.
- Organizing a joint committee between the Ministry of Public Health and local governments to create laws and regulations for nightsoil and wastewater management.

(4) Japan

- Extracting and consolidating useful information for setting guidelines on reclaimed wastewater reuse.
- Introducing the small-scale on-site wastewater treatment unit "Joukasou" to the countries of the Region.

(5) Malaysia

- Raising the importance of issuing a regulation for safe disposal of septage and exploring the feasibility of cultivating fish in ponds as animal food.

(6) Philippines

- Disseminating WHO guidelines to people concerned and emphasizing the importance of water supply and sanitation projects for health promotion.

10. WORKSHOP EVALUATION

Thirteen evaluation questionnaire forms were received, all giving a very high rating on the information gained from the workshop, the methods of discussion and the content of the papers. The forms also showed agreement with the duration and scheduling of different activities of the workshop. The majority of the participants recommended the following working papers for wide distribution:

(1) Health and technical aspects of wastewater in agriculture and aquaculture (Dr I. Hespanhol)

(2) Design, operation and maintenance of wastewater stabilization ponds (Dr Saqer Al-Salem)

(3) On-site sewage disposal system in rural areas (Dr Saqer Al-Salem)

(4) Overall design considerations and decision sequence for wastewater treatment (Dr Saqer Al-Salem)

(5) Development of biogas technology in excreta treatment in China (Dr Niu Shiru)

(6) Anaerobic and aerobic processes used in wastewater/excreta treatment for aquaculture in China (Dr Niu Shiru)

11. CONCLUDING SESSION

Dr P. Guo thanked all the participants, representative, observers, consultant and temporary adviser on behalf of WHO for their active participation and fruitful cooperation in the workshop, which had contributed to its success. Dr Guo especially thanked the WHO Headquarters in Geneva for funding the activity. He encouraged all the participants to transfer the knowledge they gained in this workshop to their own countries, and to use the services and facilities provided by PEPAS. He hoped all the participants will take initiative to dessiminate the WHO guidelines and set similar ones, taking local conditions into consideration, on their return to their respective countries.

In conclusion, he wished everyone a pleasant and safe journey home and declared the workshop closed.

12. ACKNOWLEDGEMENTS

Appreciation is expressed to the authorities of the University of Agriculture, Malaysia, for their assistance and cooperation in holding the workshop. Thanks are also due to the staff of Guthrie Estates and Sime Darby Plantations for their efforts and hospitality during the field trip to their oil palm plantations.

ANNEX 1

LIST OF PARTICIPANTS, REPRESENTATIVE, OBSERVERS AND SECRETARIAT

Participants	Designation and address
1. Dr Xu Guoxiong	Chief Doctor of Public Health Provisional Health and Anti-Epidemic Centre of Henan 47, Wei Wu Road Zhengzhou, Henan People's Republic of China
2. Dr Dong Jicheng	Doctor in charge Office of National Patriotic Health Campaign Committee 44, Hou Hai Bei Yan Beijing People's Republic of China
3. Ms Ling Bo	Associate Researcher Institute of Environmental Health and Engineering 29, Nan Wei Road Beijing 100050 People's Republic of China
4. Dr Kiyoshi Kawamura	Chief, Water Quality Management Office Department of Sanitary Engineering National Institute of Public Health Shiroganedai 4-6-1 Minato-ku, Tokyo 108 Japan
5. Dr Somsy Pasithiphone	Responsable de l'hygiene du ministere de la sante Departement d'hygiene du ministere de la sante Vientiane B.P. 1640 Lao People's Democratic Republic
6. Dr Nouanta Maniphousay	Deputy Director of NIHE/ Project Manager of Water Supply and Environmental Health National Institute for Hygiene and Epidemiology Department of Water Supply and Environmental Health Vientiane Lao People's Democratic Republic

7. Mr Ong Sian	Senior Public Health Engineer Engineering Services Division Ministry of Health 1st Floor, Block E, Jalan Dungun Damansara Heights 50490 Kuala Lumpur Malaysia
8. Mr Joselito M. Riego de Dios	Senior Sanitary Engineer Environmental Health Services Department of Health San Lazaro Compound Sta. Cruz Manila Philippines
9. Mr Sang-Sun Ahn	Deputy Director Industrial Waste Water Division Ministry of Environment 7-16 Shinchun-Dong Songpa-Ku Seoul Republic of Korea
10. Mr Kyong-Ho Kim	Specialist, Engineering Committee Environment Management Corporation 1024-4 Dae Chi-Dong Kangnam-Ku Seoul Republic of Korea
11. Dr (Ms) Le Thi Song Huong	Officer-in-charge Environmental Health Centre of Hygiene and Epidemiology Haiphong City Viet Nam
12. Dr (Ms) Nguyen Thi Mai	Environmental Health Officer National Institute of Hygiene and Public Health Ho Chi Minh City Viet Nam

Representatives/Observers

1. Mr Wilfrido C. Barreiro	Programme Officer UNDP/World Bank Regional Office for Water and Sanitation East Asia and the Pacific RELC Building #08-809 30, Orange Grove Road Singapore 1025

2. Dr Mohd Ismail Yaziz	Lecturer Department of Environmental Science Faculty of Science and Environmental Studies University of Agriculture Malaysia 43400 Serdang Selangor Darul Ehsan Malaysia
3. Mr Hamidon Othman	Public Health Engineer Engineering Services Division Ministry of Health 1st Floor, Block E, Jalan Dungun Damansara Heights 50490 Kuala Lumpur Malaysia
4. Mr Engku Azman T. Mat	Public Health Engineer Technical Unit Local Government Division Ministry of Housing and Local Government Level 4, Block K Damansara Town Centre 50644 Kuala Lumpur Malaysia

Secretariat

1. Dr Paul Guo	Director, PEPAS
2. Mr B.W. Fisher	Sanitary Engineer, PEPAS
3. Dr I. Hespanhol	Sanitary Engineer, WHO Headquarters
4. Dr Saqer Al-Salem*	WHO Consultant
5. Dr Niu Shiru**	WHO Temporary Adviser
6. Ms L.Y. Chan	Administrative Officer, PEPAS
7. Ms Tan Yit May	Special Assistant, PEPAS

* Dr Saqer Al-Salem
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**Dr Niu Shiru
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ANNEX 2

OPENING ADDRESS

On behalf of Dr S.T. Han, WHO's Regional Director for the Western Pacific, I am pleased to welcome you to the five-day Regional Workshop on Health and Technical Aspects of Nightsoil and Wastewater Use. As Dr Han is unable to attend the opening of this workshop today, I wish to take this opportunity to read his message.

The subject of this workshop was first considered in depth by a WHO meeting of experts on the "Reuse of Effluents: Methods of Wastewater Treatment and Health Safeguards" in Geneva from 30 November to 6 December 1971. The meeting noted that the reuse of wastewater for agricultural purposes either in diluted or undiluted forms and without any treatment was an old and common practice. There were 99 references cited on the use of sewage effluents as an agricultural water resource and this was unacceptable from the health point of view. As a result of this meeting, a report (WHO Technical Report Series No. 517) was published in 1973 which contained recommendations that subsequently served as guidelines on wastewater use. Little authoritative information on the health aspects of wastewater use was then available and the recommendations were understandably cautious. However, later reviews of epidemiological data have indicated that the risks involved were not as great as previously thought and the bacteriological standards were unduly restrictive. These considerations led to a second WHO scientific group meeting on the same subject in November 1987. The report from that meeting gave revised health guidelines which aimed at ensuring the protection of the environment and public health. One of the main objectives of this present workshop is to introduce these guidelines to the relevant authorities in our Region.

In the Western Pacific Region, use of nightsoil and wastewater for agriculture and aquaculture is largely confined to the Asian Member States; in many countries of the Pacific area, the practice is disapproved of for cultural reasons. Though sometimes economically attractive, the use of human wastes for agriculture and aquaculture can cause significant health problems. For instance, in some areas where it is practised, over 80% of the population are infected with helminthic diseases. Pathogenic bacteria and toxic chemicals may also pose a grave threat to people who consume crops fertilized or irrigated by insufficiently treated nightsoil and wastewater.

Aquaculture combines the disposal of human wastes with the cultivation of fish, usually in pond systems. At least 100 kilograms of fish per year can be cultivated from a simple fish pond solely fed with excreta from a single family, and this can be an important source of protein and income to the family. However, without proper management, these ponds can contribute to water pollution problems giving rise to disease.

The use of nightsoil for the generation of biogas is common in some parts of China, involving millions of homes. Biogas plants have also been installed with varying success in the Republic of Korea, the Philippines and Viet Nam. However, treatment and disposal of biogas sludge to minimize adverse health risks is a major requirement for these installations.

The use of treated wastewater for groundwater recharge has been successfully carried out in some parts of the world, but this practice is not widespread in countries of the Western Pacific Region.

Wastewater is also used in some cities to replace the urban water supply for industrial use or other non-drinking purposes, although this too is uncommon in the Region.

The epidemiological evidence now available makes it possible to develop more practical guidelines based not on "potential" but on the "actual" health risks involved in nightsoil and wastewater use. The use of integrated approaches, taking into consideration treatment options, crop restriction, methods of application, exposure control and hygiene promotion, can minimize or eliminate these risks.

I hope that this workshop will provide a suitable forum for the review of nightsoil and wastewater treatment and use in relation to the health needs of your countries, and that this will lead to both a safer environment and more efficient management of available resources. I also hope that the research needed to complement existing knowledge in this field can be identified in the workshop. Our organization stands ready to collaborate in such endeavours.

I urge you all to participate fully in the workshop and learn from each other's experience. In closing I wish you a fruitful week of discussions and a pleasant stay in Malaysia.

Thank you.

ANNEX 3

AGENDA

Monday, 24 September 1990

0900 - 0930	Introductory remarks Dr P. Guo, Director, PEPAS Opening speech Dr L.R. Verstuyft, WHO Representative for Brunei Darussalam, Malaysia and Singapore on behalf of the Regional Director Welcome address Professor Dr Syed Jalaludin Syed Salim, Deputy Vice-Chancellor, University of Agriculture, Malaysia
0930 - 1015	Group photograph and coffee/tea break
1015 - 1025	Administrative briefing L.Y. Chan
1025 - 1045	Introduction of consultants, participants and workshop sessions B. Fisher
1045 - 1200	Health and technical aspects of wastewater use in agriculture and aquaculture I. Hespanhol
1200 - 1330	Lunch
1330 - 1500	Country reports
1500 - 1515	Coffee/tea break
1515 - 1615	Overall design considerations and decision sequence for wastewater treatment Saqer Al-Salem
1615 - 1700	Guidelines for the safe use of wastewater and excreta in agriculture and aquaculture Niu Shiru

Tuesday, 25 September 1990

0900 - 0950	Trends in wastewater and excreta use in agriculture and aquaculture Niu Shiru

0950 - 1040	Design, operation and maintenance of wastewater stabilization ponds and visual presentation Saqer Al-Salem
1040 - 1100	Coffee/tea break
1100 - 1200	Group discussions - health aspects
1200 - 1330	Lunch
1330 - 1415	Economic aspects of wastewater use I. Hespanhol
1415 - 1500	Country reports (Cont'd)
1500 - 1515	Coffee/tea break
1515 - 1610	Development of biogas technology in excreta treatment in China Niu Shiru
1610 - 1700	On-site sewage disposal systems in rural areas - a case study Saqer Al-Salem

Wednesday, 26 September 1990

0815 - 1500	Field visit including lunch B. Fisher
1500-1700	Working groups - technical aspects

Thursday, 27 September 1990

0900 - 1000	Anaerobic and aerobic processes used in wastewater/ excreta treatment for aquaculture in China Niu Shiru
1000 - 1020	Coffee/tea break
1020 - 1200	Compliance of different wastewater treatment systems with WHO guidelines for use in unrestricted irrigation Saqer Al-Salem
1200 - 1330	Lunch
1330 - 1430	Control measures for the use of human wastes Niu Shiru
1430 - 1445	Coffee/tea break
1445 - 1530	Health research needs B. Fisher

1530 - 1615	Wastewater treatment and reuse - a case study Saqer Al-Salem
1615 - 1700	Working group - presentations

Friday, 28 September 1990

0900 - 1030	Working group - presentations (Cont'd)
1030 - 1050	Coffee/tea break
1050 - 1200	Discussion of country needs and action plans
1200 - 1330	Lunch
1330 - 1430	Discussion of country needs and action plans (Cont'd)
1430 - 1500	Summary and evaluation of workshop B. Fisher
1500 - 1510	Closing remarks Dr P. Guo
1510 - 1540	Coffee/tea break

ANNEX 4

DOCUMENTS DISTRIBUTED DURING THE WORKSHOP

Working papers

WPR/RUD/PEPAS(3)/90.2	HEALTH AND TECHNICAL ASPECTS OF WASTEWATER USE IN AGRICULTURE AND AQUACULTURE By Dr I. Hespanhol
WPR/RUD/PEPAS(3)/90.3	OVERALL DESIGN CONSIDERATION AND DECISION SEQUENCE FOR WASTEWATER TREATMENT By Dr Saqer Al-Salem
WPR/RUD/PEPAS(3)/90.4	GUIDELINES FOR THE SAFE USE OF WASTEWATER AND EXCRETA IN AGRICULTURE AND AQUACULTURE By Dr Niu Shiru
WPR/RUD/PEPAS(3)/90.5	TRENDS IN WASTEWATER AND EXCRETA USE IN AGRICULTURE AND AQUACULTURE By Dr Niu Shiru
WPR/RUD/PEPAS(3)/90.6	DESIGN OPERATION AND MAINTENANCE OF WASTEWATER STABILIZATION PONDS AND VISUAL PRESENTATION By Dr Saqer Al-Salem
WPR/RUD/PEPAS(3)/90.7	ECONOMIC ASPECTS OF WASTEWATER USE By Dr I. Hespanhol
WPR/RUD/PEPAS(3)/90.8	DEVELOPMENT OF BIOGAS TECHNOLOGY IN EXCRETA TREATMENT IN CHINA By Dr Niu Shiru
WPR/RUD/PEPAS(3)/90.9	ON-SITE SEWAGE DISPOSAL SYSTEMS IN RURAL AREAS - A CASE STUDY By Dr Saqer Al-Salem
WPR/RUD/PEPAS(3)/90.10	ANAEROBIC AND AEROBIC PROCESSES USED IN WASTEWATER/EXCRETA TREATMENT FOR AQUACULTURE IN CHINA By Dr Niu Shiru
WPR/RUD/PEPAS(3)/90.11	COMPLIANCE OF DIFFERENT WASTEWATER TREATMENT SYSTEMS WITH WHO GUIDELINES USE IN UNRESTRICTED IRRIGATION By Dr Saqer Al-Salem
WPR/RUD/PEPAS(3)/90.12	CONTROL MEASURES FOR THE USE OF HUMAN WASTES By Dr Niu Shiru
WPR/RUD/PEPAS(3)/90.13	WASTEWATER TREATMENT AND REUSE - A CASE STUDY By Dr Saqer Al-Salem

Country reports

WPR/RUD/PEPAS(3)INFO./1	PEOPLE'S REPUBLIC OF CHINA By Drs Xu Guoxiong and Dong Jicheng and Ms Ling Bo
WPR/RUD/PEPAS(3)INFO./2	JAPAN By Dr Kiyoshi Kawamura
WPR/RUD/PEPAS(3)INFO./3	LAO PEOPLE'S DEMOCRATIC REPUBLIC By Drs Nouanta Maniphousay and Somsy Pasithiphone
WPR/RUD/PEPAS(3)INFO./4	MALAYSIA By Mr Ong Sian
WPR/RUD/PEPAS(3)INFO./5	PHILIPPINES By Mr Joselito M. Riego de Dios
WPR/RUD/PEPAS(3)INFO./6	REPUBLIC OF KOREA By Messrs Ahn Sang-Sun and Kim Kyong-Ho
WPR/RUD/PEPAS(3)INFO./7	SOCIALIST REPUBLIC OF VIET NAM By Drs Le Thi Song Huong and Nguyen Thi Mai

Publications

1. Health guidelines for the use of wastewater in agriculture and aquaculture, Report of a WHO Scientific Group, Technical Report Series 778, Geneva 1989

2. Guidelines for the safe use of wastewater and excreta in agriculture and aquaculture
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Note: Copies of the working papers and country reports are available on request from PEPAS.