UNEP

IETC
International
Environmental
Technology
Centre

Workbook for Training in Adopting, Applying and Operating Environmentally Sound Technologies (ESTs)

Regional Workshop

Implemented 8-13 December 1997 in Perth Australia,
in collaboration with Murdoch University

WORKBOOK FOR
TRAINING IN
ADOPTING, APPLYING AND OPERATING
ENVIRONMENTALLY SOUND TECHNOLOGIES (ESTS)

Regional Workshop

implemented 8-13 December 1997 in Perth,
Australia by UNEP IETC in collaboration with
Murdoch University

UNEP International Environmental Technology Centre

Osaka/Shiga, 1998

IETC Report Series – Issue 6
ISBN 92-807-1478-0

Preface

International Environmental Technology Centre (IETC) is a unit of the United Nations Environment Programme (UNEP). Its role is to promote the adoption and use of environmentally sound technologies (ESTs) for the management of urban and freshwater basin environmental issues in developing countries and economic transitioning countries. ESTs are recognised as critical to countries'success in achieving sustainable development.

One of the Centre's activities is to enhance the capacity of the decision/policy makers to make sensible decisions on technologies. Adopting, applying and operating ESTs are key issues to policy-making and technology choices/practices for integrated environmental management approaches.

The regional workshop for Asia/Pacific on adopting, applying and promoting of environmentally sound technologies, organised by the IETC in collaboration with Murdoch University of Australia from 8 to 13 December at Perth, Australia, was a response to this need. It was a follow-up to the global workshop in Dresden, Germany, 1996 and brought together 30 participants from 19 countries. The program combined proactive sessions, exercises, small group works, and field trips to build individual and institutional capacities: it focussed on priority issues such as freshwater resources, water supply, technology transfer, waste management and city planning.

The training was targeted at the needs of national/local government, and civil-society decision-makers in the area of technology implementation/regulation, as well as at those with responsibilities involving environmental issues.

This publication contains session outlines including presentations and reports, and information related to the workshop. As such it is a valuable source document for all who are involved in working towards sustainable development.

John Whitelaw
Director

December 1998

TABLE OF CONTENTS

Introduction

This workshop was organised in Perth, Australia, from 8 to 13 December 1997 in collaboration with Murdoch University as part of IETC's capacity building activities on adopting, applying and operating Environmentally Sound Technologies (ESTs). It followed the global workshop held in Dresden, 2-10 September 1996. The workshop was regional, bringing together 30 participants from 19 countries in Asia and the Pacific region, all of whom eagerly met together in 19 sessions including four field trips. The sessions included 1) reports from delegates and industry presentations; 2) lectures and discussions on sustainable development and technology choices, fresh water resource, water supply, permaculture, technology transfer, solid waste, waste assessment, next steps in local sustainability, and urban management; 3) presentation on IETC's information system; and 4) training course design.

SESSION 1

Lecture I:

Sustainable Development and Technology Choice

Dr. Kuruvilla Mathew and Martin Anda, Murdoch University

Sustainable Development & Technology Choice

Martin Anda, Kuruvilla Mathew & Michael Penberthy
Institute for Environmental Science, Murdoch University
Perth, Western Australia

1.1 The Concept of Sustainable Development

In recent years, the pursuit of Sustainable Development has become a goal common to environmentalists, economists, development theorists, governments, and even many industrialists. This broad-based concern for both environment and development is part of a second wave of modern environmentalism (Beder 1993, p.xi).

The first wave of modern environmentalism peaked in the 1960's and early 1970's. During these years a significant number of scientists began to express their concern for environmental issues such as the effects of pollution and the depletion of non-renewable natural resources. There was also a rapid increase in public concern for the welfare of the natural environment. Nature conservation organisations expanded their interests to include environmental issues, and new organisations and societies were formed specifically to draw attention to environmental issues (eg. Greenpeace formed in 1971).

Environmentalism in the 1960's and early 1970's was different to environmentalism today in that it had very little support from mainstream economists and industrialists. It was also much more antagonistic towards industry, and the western capitalist ideal of pursuing never-ending economic growth. First wave environmentalists voiced concern that population growth and the growth of industry could not be sustained indefinitely. Many argued that a global ecological crisis was imminent, and the pursuit of economic and industrial development was held to be responsible (eg. Meadows *et al.* 1972). At the time, governments were reluctant to acknowledge the presence of global environmental problems, or to recognise the possibility of a global ecological crisis. However, many governments in wealthier nations (including Australia) responded to community pressure and introduced clean air acts, clean water acts, and other forms of environmental legislation.

The first wave of modern environmentalism lost its momentum in the late 1970's and early 1980's, largely because a number of writers began to argue that a global environmental crisis was just doomsday fantasy (see Beder 1993, Adams 1990). These views were quite popular amongst some leading members of the governments of affluent industrialised nations. Governments which had previously responded to community pressure to place environmental restrictions on industry, bowed to growing pressure from both industry and the public for economic growth. Governments became less enthusiastic about getting involved in the introduction of new environmental legislation, and in some cases they became reluctant to enforce existing legislation.

The second wave of modern environmentalism began in the late 1980's. One of the events that helped this second wave along was the emergence of convincing scientific evidence about the build-up of greenhouse gases in the atmosphere, and convincing evidence that the ozone layer was being depleted. Another significant event was the release of The Brundtland Report[1] in 1987 by the United Nations World Commission on Environment and Development. In the Brundtland Report the World Commission argued that the world was in urgent need of both environmental protection *and* economic development. Thus, it proclaimed, sustainable forms of economic development needed to be encouraged. The World Commission defined Sustainable Development as:

---

[1]The Brundtland Report was entitled "Our Common Future" but it is commonly referred to as the *Brundtland Report* after the World Commission's chairperson Gro Harlem Brundtland.

"development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

The Brundtland Report was not the first publication to suggest that development needed to be sustainable, or the first to give a definition of sustainable development[2] However, it was much more influential than previous documents because the timing of its release, and also because of the prominent position of its authors in the international political arena. At the time of the release of the Brundtland Report Sustainable Development was approved in the UN General Assembly and also accepted as a national goal by the governments of 100 nations (Beder 1993, p. xiii).

Critics of the Brundtland Report have argued that the Brundtland Report's definition of Sustainable Development is very loose, and that this has allowed different interest groups to interpret the definition in ways that suit their own specific goals. They argue that whilst interest groups may all agree that the environment must be protected, they often have different ideas about which bits of the environment should be protected, different ideas about how it should be protected, and different ideas about what development is. In other words, although interest groups may all agree that the pursuit of Sustainable Development is important and necessary, they often disagree about how it should be pursued.

This became very apparent in 1990 when the Australian Commonwealth Government set up a number of working groups to formulate a National Strategy for Ecologically Sustainable Development. The working groups were to study how Sustainable Development could be applied to nine industry sectors that were thought to have a significant impact on natural resources. These sectors were: agriculture; energy use; energy production; transport; mining; fisheries; forest use; tourism; manufacturing.

The working group members consisted of representatives from government, industry, unions, consumer/social welfare organisations, and conservation groups. Summaries of the working group's findings were released in 1992. Some representatives from conservation and environmental organisations were not satisfied by the way the working groups operated. They felt that intersectorial issues (the issues that crossed sector boundaries) were not dealt with properly. Other environmentalists argued that contentious issues and recommendations were left out in the effort to reach consensus, and that the policy options and recommendations that appeared in the final reports were conservative and aimed at slow incremental change rather than the more radical dramatic change which they felt was necessary.

Environmentalists have levelled similar criticism at the United Nations Conference on Environment and Development which was held in Rio de Janeiro in June 1992. Agenda 21, a program of environmental action for the 21st Century which the UN hopes will be undertaken by all nations, was criticised as being weak and without strong statements on important but contentious issues such as the role of trans national corporations, population control, and consumption in affluent nations.

The Brundtland Report's version of Sustainable Development, which is the basis of the Australian Commonwealth Government's National Strategy, has also been criticised by those in the field of Development Studies. Some writers specialising in development issues have argued that the Brundtland Report is essentially just a reformed, greener version of "developmentalism"[3]. They argue that the Brundtland Report looks at the environment from

---

[2]Other writers and committees had given definitions for Sustainable Development years earlier e.g. the UN Conference on the Human Environment held in Stockholm in 1972, and the World Conservation Strategy published in 1980.

[3]The term "developmentalism" is used to describe the view that all countries should progress down the (linear) path towards modernisation, and that progress down that path can be measured in terms of economic growth and the rate at which modern technology is adopted.

the perspective of affluent industrialised nations (which they refer to as the *core*). Sustainable Development, in their opinion, *should* look at the environment from the perspective of poor Third World communities (the *periphery*). Thus, rather than primarily focusing on reducing the environmental impact of existing economic practices, affluent industrialised nations should look at changing existing economic practices in order to ensure that the poor have a secure and sustainable livelihood (Adams 1990, p.5, 198; Chambers 1987).

Zethoven (1991) defined three positions present in the Sustainable Development debate: shallow, intermediate and deep sustainable development. The first assumed that natural and human-made assets could be substituted while the other two couldn't. The Business Council of Australia and the Australian Government, for example, fitted the 'shallow' position with their continued support for indiscriminate economic growth even with the loss of "unimportant species". The ecologically sustainable development package brokered by the Australian Government between industry and the mainstream conservation organisations on this shallow basis resulted in Greenpeace walking out of these negotiations (Beder, 1994). The Brundtland Report espoused an 'intermediate' position which would accommodate growth in developing countries to achieve a *sustainable livelihood security* while growth in the industrialised world was to be curbed. Many environmentalists fit the 'deep' position of sustainable development and interestingly this is perhaps the position applicable to Fourth World communities. Within a framework of 'deep' sustainable development local communities, for example, remote indigenous communities, are able to undertake limited and finite growth to remedy the disadvantage they suffer within an industrialised nation.

Beder (1994, p39) called for a 'third wave' of environmentalism which would "transcend both the protest [first wave] and consensus [second wave] approaches of recent decades."

1.2 Discussion on Issues Affecting Sustainable Development

(a) To what extent is the natural environment considered in planning for sustainable development?

(b) How are the poor catered for in developing countries when planning for sustainable development?

(c) What sort of lifestyle do we need and how does that differ from the sort of lifestyle we want? We may want to ensure that future generations have the resources to meet their needs but how do we know what they will need? Or even what they will want? Should there be upper and lower limits on living standards?

(d) What is development? Is it the process of becoming industrialised and a user of high technology? Can it be measured in economic growth and technology transfer? Is it something that the modern 'north' must help the primitive 'south' do? Is it perhaps something that the North could learn from the South, or is it something that we must do together?

(e) Give examples of the way desire for sustainable development is transforming the economic development practices of business enterprises.

1.3 References on Sustainable Development

Adams, W.M. (1990) **Green development: Environment and sustainability in the Third World.** Routledge, London pp 14-65.

Adams, W.M. (1993) **Sustainable Development & the Greening of Development Theory**, in F.J. Schuurman (ed), Beyond the Impasse, Zed Books, pp207-222.

Beder, S. (1993) **The Nature of Sustainable Development.** Scribe Publications, Newham, Australia. pp 3-8.

Beder S (1994), **Revoltin' Developments: The politics of sustainable development**, Arena Magazine, June/July, pp37-39.
Bookchin, M. (1983) An open letter to the ecological movement. **RAIN**, Oct/Nov.
Brundtland, H. (1987) **Our common future**. Oxford University Press, Oxford (for the World Commission on Environment and Development). pp 45-65
Chambers, R. (1987) **Sustainable Rural Livelihoods: A Strategy for People, Environment and Development**. Overview paper for Only One Earth; Conference on Sustainable Development, IIED, London, 1987
Commonwealth of Australia (1992) **National strategy for Ecologically Sustainable Development**. December, AGPS, Canberra. pp. 6-19 (Introduction)
Meadows, D., Randers, J., Behrens, W.W. (1972) **The Limits to Growth**. Universe Books, New York.
Sachs, W. (1992) Whose environment? **New Internationalist** 232, 20-22.
World Commission on Environment & Development (1995), **Towards Sustainable Development**, in Conca *et. al.* (eds), Green Planet Blues, Westview Press, pp211-221.
Zethoven I (1991), *Sustainable Development - a critique of perspectives*, in Immigration, Population and Sustainable Environment, Smith J W (ed), Flinders University Press, Adelaide.

2.1 Technology for Sustainable Development

As explored in the previous section, there are a range of physical and social factors which are going to determine whether economic activities are sustainable or not. An important element in these physical and social dimensions of sustainability is the *choice of technology* and whether or not the technology is appropriate in a given set of circumstances.
The concept of *Appropriate Technology* (AT) was first synthesised by E.F. Schumacher and expounded in his landmark work **Small is Beautiful**. A definition of AT which accords closely with Schumacher's original ideas is that of: "*a technology tailored to fit the psychosocial and biophysical context prevailing in a particular location and period*" (Willoughby, 1990).

As with sustainable development, the subject of AT is an enormous one in itself. The term AT has been widely and loosely used to cover a multitude of concepts depending on the particular emphasis and agenda of the author. Some have referred to it in a derogatory way, calling it a "bandwagon" term covering everything from philosophical approaches to technology, ideologies, political-economic critiques, social movements, economic development strategies, particular types of technical hardware, and 'anti-technology' activities (see Willoughby, 1990, pp16-17). Despite these criticisms, the idea of AT remains central in the pursuit of sustainable development in affluent and less affluent countries, and is a key concept in the evolution of new environmental technologies.

The most comprehensive discussion of the philosophical issues concerning AT can be found in Willoughby (1990). What is important to recognise here is that:

- it is indeed possible to choose technologies which are inappropriate in the prevailing physical and social circumstances (many examples are provided in the essential readings), and;
- it has become crucial to give a great deal more thought to the appropriateness of technologies because:
  - (a) if this is not done then even the technical task to which the technology is directed will not be accomplished and
  - (b) particular technologies bring with them underlying structures and assumptions which may be destructive to the society in which they are introduced.

Thus, if development is to become more sustainable, it is important to assess technologies on a number of different criteria before adopting them. These criteria cover the technical, social and economic requirements of the specific situation. This applies as much to so-called 'environmental technologies', as it does to more mainstream technological approaches.

2.2 References on Technology Choice

Azelvandre, J.P., (1994) Technology Choices for A Sustainable Future: Some Conditions and Criteria for Appropriate Technology. **Ecotech '94 Papers and Discussions.**

McRobie G (1991), Ideas into Action - the early years, **Appropriate Technology**, 18, 2: 1-4, IT Publications, London.

Mitchell, R.J. (1980) **Experiences in appropriate technology**. The Canadian Hunger Foundation, Ottawa, Canada.

Sachs, W. (1992) Technology as a Trojan horse. **New Internationalist** 232, 12-14

Smillie I (1991), **Mastering the Machine: Poverty, aid & technology**, IT Publications, London.

Willoughby, K. (1990) **Technology choice: A critique of the appropriate technology movement.** Westview Press, Intermediate Technologies Publications, London.

2.3 Discussion of Issues Affecting Technology Choice

(a) Give your own definition of Appropriate Technology.

(b) Explain why technologies can not be considered to be neutral or value free in the way they interact with society.

(c) List what you consider to be the major factors that must be fulfilled for a technology to be considered appropriate for a given situation.

(d) Discuss the technical, organisational and cultural factors affecting water supply & sewerage systems in a town of a developing country. Do the value systems of the society from where the proposed technology comes from need to be considered? Why?

SESSION 2

Lecture II:

An Introduction to Practical ESTs for Sustainable Development of Freshwater Resources

Mr. Masahiro Yoshioka, UNEP IETC/ILEC

An introduction to Practical ESTs for Sustainable Development of Freshwater Resources

Masahiro Yoshioka
Cooperation Staff
UNEP IETC/ILEC (International Lake Environment Committee Foundation)

SESSION INFORMATION

This session is scheduled for a total of 90 minutes and the task of this session is to discuss some aspects of ESTs for sustainable development of freshwater resources. In detail, the session is divided into two parts:

(a) What are the practical ESTs for sustainable development of freshwater resources? And, what are the roles of modern technologies in evolving into a more integrated system?

(b) How to make up for gaps between two scenarios (*"pictures"*). One is the current status (*"on-the-way picture"*) and the other ongoing planning (*"should-be picture"*). This part will be followed by asking the participants to identify some EST needs for environment management and its capacity-building.

"SESSION 2 EXTRA (Supplement)" is prepared as an introduction to freshwater resource issues for reference.

LECTURE NOTES (Summary)

The availability of water is a fundamental requirement, as well as limiting factor, for socioeconomic development. Without sufficient quantities of water fit for human use, a region simply cannot develop to any significant degree. Water is essential to human health, to socioeconomic development. Yet the supply of water on this planet is fixed. Moreover, we continue to make available supplies of water unit for human consumption through industrial contamination, agricultural runoff, urban sewage discharge and sediment by poor logging practices. In some respects, water resources are like mirrors. They reflect disturbing symptoms in our society and unwise environmental practices.

Practical ESTs

It is well accepted that the most practical ESTs for sustainable development of water resources, for the time being, should be based on reducing wasteful water uses and adopting of efficient technologies for augmenting water supply and for water consumption. To this end, IETC has, in cooperation with UNEP Freshwater Unit, recently undertaken an analysis of technologies for augmenting freshwater production which will be published in a series of six regional respect. Many of the ESTs based on this principle are not necessarily state-of-art or advanced technologies, but include traditional but improved, adjusted and organized technologies which would put substantive support into sustainable human activities in most cases.

"HANDOUT 1" is an excerpt from a draft *"Source Book of Alternative Technologies for Freshwater Augmentation in Latin America and the Caribbean"* compiled by Dr. Kirk P. Rodgers, Director, Department of Regional Development and Environment, Organization of American States (OAS), Washington, D.C., USA. The table will give us good examples of practical technology profiles in augmenting freshwater.

Among those technologies, *"Rainwater Harvesting in Roof Catchments"* is one of the most widely used and practical ones, although roof catchment systems have declined in some countries. But the systems have been and will have been one of the practical survival ones in a coming water scarcity era. Even this most popular technology which has been practiced for more than 4,000 years worldwide has to be improved and adjusted itself to new circumstances. In this context, practical ESTs will call for lots of in-depth investigations in developing the sustainability of them. They have really a wide range of aspects in adopting, applying and operating to be considered.

"HANDOUT 2" is an excerpt from a draft *"Source Book of Alternative Technologies for Freshwater Augmentation in Asia"* prepared by Danish Hydraulic Institute. The tables of contents of Part-B and Part-C for the draft source book will help give rough pictures of practical freshwater augmentation technologies.

"HANDOUT 3" is an excerpt from a draft *"Source Book of Alternative Technologies for Freshwater Augmentation in Small Islands States"* compiled by the South Pacific Applied Geoscience Commission (SOPAC). The table summarizes information from the technology profiles in Small Islands Developing Countries.

Roles of Modern Technologies

Of course, some of modern technologies have been developed and tested for practical operations with good outputs. *"Satellite Remote Sensing"* is such a case. Satellite data with well-done analyses and syntheses is providing valuable information on surface water management, irrigation potential, ground water potential, water-quality assessment, snow and ice cover, environmental impact of river valley projects, mitigation of water-induced disasters and in particular integrated resources management in conjunction with geographic information systems. Future satellite systems with better than 10 meter spatial resolution will no doubt provide valuable information in better understanding the hydrological cycle and the dynamics of water resources for sustainable development. But, without well organized traditional ESTs both in terms of soft and hard systems, such a high technology will not be optimally utilized by technicians and managers. Technology and knowledge which have to be imported without adjustable infrastructures often make importers more dependent.

Although this is a reality in nine cases out of ten, there is an exceptional idea that access and adherence to a high technology will possibly give a chance to review and improve the traditional systems.

Whether information technology will be the great equalizer or the great divider has been hotly debated since the advent of the computer. Fortunately, innovations are helping some countries leapfrog over the information gap. Wireless technology, for instance, is allowing developing countries to improve and expand their telecommunications industries without having to raise the enormous capital for infrastructure required by port telecommunications systems. Although the disparities in countries' access to information and technology are still vast, the competition that drives technology forward, and costs down, may help bridge the information gap.

In developed countries, various types of pollution have occurred sequentially with the result that most developed countries have successfully dealt with major surface water pollution.
In contrast, developing countries are facing all these issues simultaneously due to their rapid industrialization, urbanization and transboundary adverse effects caused by globalization of socio-economic situations. New approaches which would allow us to jump over the lack of EST infrastructures and bring the new stimulus of capacity-building are strongly desired, although it will require new strategy for the availability and effectiveness.

"HANDOUT 4" is a publication of *"UNEP Environment Library No 14,"* entitled *"WATER QUALITY OF WORLD RIVER BASINS,"* in which the conceptual evolution of major water quality issues is figured on page six.

Two Pictures

Whenever a business plan is developed, the current status (*"on-the-way picture"*) is reviewed as well as the objectives of the plan discussed (*"should-be picture"*). Gaps between the two scenarios are the basis on which on-going planning should be done. Various kinds of information on the present state of things, probable trends in the near future, similar cases for reference in other places are regarded to have effective forward planning.

"HANDOUT 5" is a poster entitled *"Healthy Lakes Need Wise Lake and Watershed Management"* published from the Terrene Institute, USA as a cooperative product with U.S. EPA.

"HANDOUT 6" is a brochure prepared for handouting on the occasion of the "6th International Conference on the Conservation and Management of Lakes," 23-27 October 1995, Tsukuba, Japan. It illustrates: a) 6 major problems regarding lake/reservoir management, and b) Restoration measures for lakes and reservoirs.

IDENTIFICATION

This part will be devoted for each participant to consider his or her (and/or his or her team/institution/organization's) present status of affairs to get involved in planning and implementing ESTs transfer for his or her communities, municipalities, country and region from three aspects of consideration as follows:

(1) *Demand-side* ; we have to identify correct demands for ESTs.
(2) *Supply-side* ; we have to ascertain correct technologies and skills we can offer.
(3) *Study-side* ; we have to explore right ways to strengthen our capacity-building in both sides of demand and supply as well as to bridge gaps between the two sides.

"HANDOUT 7" is a sheet to write down those identifying items and to consider effective linkages among those items so as to result in a fresh impetus to capacity-building and target-building.

EXTRA (Supplement)

I. Paper Structure

The task of this paper is to discuss some aspects of ESTs for sustainable management of freshwater resources. The management of freshwater resources requires investment in economic infrastructure. This point has been recognized as a principle of "Sustainable Development" since the "World Commission on Environment and Development" Report in 1984.

Water resources development contributes to economic productivity and social well-being. All social and economic activities rely heavily on the supply and quality of freshwater. But as populations and economic activities grow, many countries are rapidly reaching conditions in water scarcity or facing limits to economic development. The holistic management of freshwater as a finite and vulnerable resource within the framework of national economic and social policy is of paramount importance for action in the 1990s and beyond. Effective implementation and coordination mechanisms are required.

Therefore, in order to ensure both the protection of freshwater resources and progressive economic development, we need renewed and innovative efforts toward transfer of ESTs. This is particularly true in the case of developing countries and countries with economies in transition, which are presently facing rapid growth rates to the extent that their natural environments are too often compromised.

II. Goal and Objective

The report of the UNEP/ILEC joint project "Survey of the State of World Lakes" identifies six major problems that are confronting the world's lakes and reservoir, as follows: 1) Lowering of water level, 2) *Rapid siltation*, 3) *Acidification*, 4) *Toxic contamination*, 5) *Eutrophication*, and 6) *Extermination of ecosystems and biota.* These problems are common to rivers and ground water as freshwater resources. In view of the growing importance of lakes and reservoirs as sources of freshwater, these problems represent a serious ecological disaster, comparable in importance to the destruction of tropical forests and desertification. The resultant deterioration of water quality and aquatic ecosystems as well as the decreasing amount of available freshwater is a global environmental problem in the sense that is taking place simultaneously over much of the world.

The conditions under which lake conservation is pursued in one country are not necessarily the same as in another. Nevertheless, the substantial experience and technical skills in managing lakes and reservoirs in one nation can, if used appropriately, contribute important lessons for lake and reservoir conservation in others. Assessment and monitoring, reserve selection and management, training methodologies, and cooperative management of international freshwater resources are but a few of the specific areas where transfer of experience and technology should be explored.

The UNEP IETC exists specifically to facilitate this kind of technology transfer.

III. Extent of the Water Crisis

The water crisis, which many countries are facing at present, and which more and more countries will face in the early part of the 21st century, can be attributed to the effect of the following six direct but interrelated tendencies.

First, throughout history, global water requirements have increased steadily. This trend will extend into the 21st century for two reasons. One is higher population and another is increasing per capita demand due to changing lifestyles and rising standard of living. Per capita use today is nearly 50 percent higher than it was in 1950.

Second, the amount of freshwater available to any country on a long-term basis is limited. Since nearly all the easily available sources of water have already been developed, or are in the process of development, the unit cost of providing water in the future will be substantially higher.

Third, the competition for water for agricultural, industrial and environmental requirements will continue to increase. For example, globally agricultural water use has declined from 90 percent of all water requirements in 1900 to about 62 percent at present. During the same period, industrial water use has increased from 6 to 24 percent. This trend will continue into 21st century. In addition, ecosystem water requirements would be an increasingly important factor in the future, which is likely to further intensify the conflict between various uses.

Fourth, as human activities increase, more and more waste products like sewage, industrial effluents and agricultural chemicals are contaminating water sources. These contaminants are seriously affecting water quality, increasing the costs of providing water for other productive uses including domestic purposes and further impacting ecosystem health.

Fifth, environmental and social considerations will significantly delay project implementation in the future and more so than in the past.

Sixth, water resources are especially vulnerable to the effects of climate change. Climate change caused by global warming is likely to trigger wider changes in temperature and precipitation. In a warmer world we will need more water to drink and to irrigate. In the UK, for instance, a one-degree centigrade temperature rise would increase demand for irrigation water by more than 25 percent.

The above six reasons mean that the existing water management practices need to be improved substantially within a short period to avoid disaster on a global scale within the next decade. While it may be possible to solve the technical aspects of the problems within this period, political, social, environmental and institutional problems would be very difficult to resolve. These aspects will be the most difficult challenge facing the water management profession in the 21st century.

While every one supports the concept of water development and ecosystems management, there is unfortunately no general agreement on what this means, or more importantly how this can be achieved. The question is no longer whether environmentally sound water development is desirable but rather how do we make it a functional part of integrated economic development. To date global discussions on sustainability and environmental considerations for freshwater development have been centered on what it comprises. We need to devise a holistic process that is intrinsically sustainable from the very beginning of the planning process.

IV. Major Themes in Water Resource Management

The International Conference on Water and the Environment (ICWE) held in Dublin in January 1992 produced "The Dublin Statement," which should enable countries to tackle the water resources problems on a wide range of fronts. The seven items among "The Action Agenda" described in the Statement indicate concrete targets to tackle in a sustainable development of water resources.

First: Alleviation of poverty and disease;
At the start of the 1990s, more than a quarter of the world's population still lacked basic human needs of sufficient food, a clean water supply and hygienic means of sanitation.

Second: Protection against natural disasters;
Lack of preparedness, often made worse by lack of data, means that droughts and floods take a huge toll in deaths, misery and economic loss. Economic losses from natural disasters, including floods and droughts, increased three-fold between the 1960s and the 1990s. Development is being set back for years in some developing countries, because investments have not been made in basic data collection and disaster preparedness.

Third: Water conservation and reuse;
Current patterns of water use are unsustainable. There is great scope for water savings in agriculture, industry and domestic water supplies. Irrigated agriculture accounts for about 80% of water withdrawals in the world. In many irrigation schemes, up to 60% of this water is lost before it is applied. More efficient irrigation practices will lead to substantial freshwater savings. On average, 36% of the water produced by urban water utilities in developing countries is "unaccounted for"; lost in antiquated distribution systems. Combined savings in agriculture, industry and domestic water supplies could significantly put off investment in costly new water-resource development systems and have enormous impact on the sustainability of future supply.

Fourth: Sustainable urban development;
As water scarcity and pollution force development of ever more distant water sources, reasonable costs of meeting fresh demands are growing rapidly; threatening the sustainability of urban development. Residual contamination of land and water can no longer be seen as a reasonable trade-off for the jobs and prosperity brought by industrial growth.

Fifth: Agricultural production and rural water supply;
Achieving food security is a high priority in many countries. However agriculture must not only provide food for rising populations, but also conserve water for other uses. The challenge is to develop and apply water-saving technologies and management methods, and, through capacity building, enable communities to introduce incentives for the rural population to adopt new approaches, for both rained and irrigated agriculture. The rural population must also have better access to a potable water supply and to sanitation services.

Sixth: Protecting aquatic ecosystems;
Water is a vital part of the environment and a home for many forms of life on which the well-being of humans ultimately depends. Disruption of flows has reduced the productivity of many such ecosystems, devastated the fisheries, agriculture and grazing sections and marginalized rural communities which rely on these. Various kinds of pollution, including transboundary pollution, exacerbate these problems, degrade water supplies in-turn requiring more expensive water treatment, destroy aquatic fauna, and deny recreation opportunities. Integrated management of water basins provides the opportunity to safeguard aquatic ecosystems, and make their benefits available to society on a sustainable basis.

Seventh: Resolving water conflicts;
The effective integrated planning and development of transboundary river or lake basins require integrated management endorsed by all affected governments and backed by international agreements. The essential functions of international basin organizations are include; reconciling and harmonizing of countries concerned, monitoring water quality and quantity, development of concerted action programs, exchange of information, and enforcing agreements. With the exception of the Antarctic, 47% of terrestrial land occupies international river or lake basins. 44 countries are such ones of which more than 80% of the territories spread out in international river basins. In excess of 200 rivers and lakes share more than two countries. Numbers of rivers or lakes shared by more than three countries number 58.

V. Tackling the Problems

Key words which are described in the above statement and which would suggest concrete actions and measurements to put into programs for sustainable development, are as follows:

- preparedness for protection against natural disasters
- water savings
- efficient practices of water uses
- water reuse
- prevention of water leaks
- cost policies of water supply
- institutional frameworks for reduction of pollutants
- integrated management of watersheds
- international cooperation

We have to note that several of these are non-structural measurements to which must be given priority in new programs of water resource development. Pollution prevention and efficient water uses are top priorities in a broad sense of water resource development at present. We must reduce wasteful water uses and adopt efficient technologies for water supply and consumption. Conservation, efficiency, recycling, and reuse and the application of many simple and traditional technologies can generate a new supply large enough to get us through many of the shortages on the horizon. And this might able to buy time to bring consumption and population growth down to sustainable levels, while scientists continue to work at the broad issue of climate change mitigation.

VI. Two Aspects of Capacity-Building

Chapter 34 of Agenda 21 stresses importance of capacity building regarding EST transfer and makes fundamental recommendations of basis for action. ESTs have two principal aspects in addressing action plans for the capacity building. One is "hardware capacity", the other is "software capacity." *"Hardware capacity"* is for technologies to deal with actual technical installations such as process and product technologies, pollution treatment technologies, monitoring technologies and so on. *"Software capacity"* is for technologies to cope with management of the complexities of hard and soft technologies such as management and assessment of technology, Environmental Risk assessment, government capacity for policy making and environmental permitting processes, training and education and so on. Without "software" applications, hardware technologies are unsustainable. In a similar manner, without "hardware" investments, concrete progress of environmental improvement has no future. Thus the two types of capacity have a close link to EST transfer and development. Their complementary work should foster "Environmentally Sound Technology Infrastructure" (here abbreviated to *"ESTIN"*) to help ensure the sustainability of software and hardware investments.

VII. Barriers to EST Transfer

In the process of transferring ESTs or adopting current technologies, we commonly face barriers such as knowledge barriers, technology barriers, economic barriers, social barriers and political barriers.

- Knowledge barriers:
  - Inadequate understanding of transfer process.
  - Limited knowledge of alternative technological solutions.
- Technology barriers:
  - Application of inappropriate technology.
  - Knock-on effects of technologies.
- Economic barriers:
  - Seeking the cheapest solution probably in the short term.
  - Difficulty in funding process.
  - Difficulty in selling, long-term, more costly solution.
- Social barriers:
  - Anti-technology concept.
  - Failure to reflect social aspects of technological solution in decision process.
- Political barriers:
  - Avoiding consideration of the controversial aspects of the technology transfer decision-making process.

It might strike everyone that nearly every conference, expert meeting and seminar on environmental related issues tends to discuss barriers to environmental management and technology transfer: old barriers, new barriers, barriers to this and barriers to that. It is, no doubt, very important to understand the problems facing our progress. Without addressing these issues, we are in danger of making and repeating mistakes that could be avoided. However, we must not fall into the trap of concentrating all our efforts on identifying problems. Otherwise, we are apt to fall victim to the problem of over-analyzing the situation and not taking action on it. What is needed from us are bold steps in the direction of overcoming technology transfer barriers, taken with the knowledge and information we have available. This workshop will serve as a pilot facilitator in getting into such steps.

VIII. UNEP IETC's Strategies and Projects

In seeking to contribute to solving these problems, UNEP IETC has developed a program strategy that concentrates on three main sub-issues:

1) improving access to information on ESTs;
2) fostering technology cooperation, partnerships, and transfer; and
3) capacity building.

Of course as a single international center, we cannot attempt to overcome all of the individual barriers encountered at every stage of the technology transfer process. However, by setting these three sub-issues as our goals, we are attempting to address important parts of barriers in some manner.

In order to improve access to information on ESTs, our Centre:

1. has integrated three electronic database - **EST Information Sources**, **EST Related Organizations** and **Technologies** - into one, **"Searchable EST Directory"**, assisted by the new information collection and dissemination tool, **"maESTro"**.
2. **has published and will continue to publish its quarterly newsletter, "IETC's INSIGHT".**
3. has put the **IETC Homepage** online.
4. has published **International Source Book on Environmentally Sound Technologies for Municipal Solid Waste Management**.
5. will publish **Source Books of Alternative Technologies for Freshwater Augmentation in Six Regions**.
6. publishes a **Technical Publication Series** on sectoral issues.

To the end of fostering technology cooperation, partnerships, and transfer, the UNEP IETC:

1. has been extensively involved in the UNCHS's **Sustainable Cities Programme**. Presently Shenyang and Wuhan, China, and Katowice, Poland are the foci of activities.
2. has been involved in a **Diagnostic Study for Lake Erhai**, China, to contribute to investment planning for regional sustainable development.

3. organized **International Shiga Forum on Technology for Water Management - Soft Options or Hard Choices** in Japan.
4. will conduct selected **case studies on barriers** to EST transfer.
5. will set up **basic research guidelines** for best practices in implementing urban sewage programs.

And finally, to assist in capacity building, UNEP IETC has:

1. hosted an **Expert Meeting on Training Needs Assessment** in Japan in June 1995.
2. held **Pilot Training Workshop on Environmental Technology Assessment (EnTA)** in Malaysia in November 1995.
3. held an **Environmental Risk Assessment (EnRA) Workshop** in Poland in April 1996.
4. held **Pilot Training Workshop on Adopting, Applying and Operating ESTs for Urban and Lake/Reservoirs Management** in Germany in September 1996.
5. held **Workshop on Environmental Technology Assessment (EnTA) in Sub-Saharan Africa** in South Africa in November 1996.
6. held **Symposium on Management of Earthquake Wastes** in Japan in June 1995.
7. held **National Workshop on Environmental Risk Assessment for Sustainable Cities** in China in May 1997.
8. held **National Workshop on Environmental Technology Assessment for Sustainable Cities** in China in May in 1997.

IX. Practical ESTs

As noted earlier, it is well accepted that the most practical ESTs for sustainable development of water resources, for the time being, should be based on reducing wasteful water uses and adopting of efficient technologies for augmenting water supply and for water consumption. To this end, IETC has recently undertaken an analysis of technologies for augmenting freshwater production which will be published in a series of six regional respect late this year. Many of the ESTs based on this principle are not necessarily state-of-the-art or advanced technologies, but include traditional but improved, adjusted and organized technologies which would put substantive support into sustainable human activities in most cases.

Of course, some of modern technologies have been developed and tested for practical operations with good outputs. "Satellite Remote Sensing" is such a case. Satellite data with well-done analyses and syntheses is providing valuable information on surface water management, irrigation potential, ground water potential, water-quality assessment, snow and ice cover, environmental impact of river valley projects, mitigation of water-induced disasters and in particular integrated resources management in conjunction with geographic information systems. Future satellite systems with better than 10 meter spatial resolution will no doubt provide valuable information in better understanding the hydrological cycle and the dynamics of water resources for sustainable development. But, without well organized traditional ESTs both in terms of soft and hard systems, such a high technology will not be optimally utilized by technicians and managers.

Although this is a reality in nine cases out of ten, there is an exceptional idea that access and adherence to a high technology will possibly give a chance to review and improve the traditional systems. There are millions of farmers, foresters, fishermen, planners, local governments, businesses, non-governmental organizations, students and common citizens with practical problems where suitable remote-sensed images would be a real help in support of environmental management. Even illiterate people can understand pictures and identify their own lands and resources from them. Remote sensed images of various environmental parameters should become as familiar as the daily weather map, forming public opinion on environmental issues and motivating necessary changes in behavior. This approach would allow us to jump over the lack of scientific capacity in developing countries, and bring the benefits of remote sensing directly to the users where it can make the most difference. It will require new strategy for the availability and distribution of imagery, and extensive capacity building exercises.

X. Two Pictures

Whenever a business plan is developed, the current status is reviewed as well as the objectives of the plan discussed. Gaps between the two scenarios are the basis on which on-going planning should be done. Various kinds of information on the present state of things, probable trends in the near future, similar cases for reference in other places are regarded to have effective forward planning.

Since the viability of most water resources depend on the natural and social characteristics of the regions in which they are found, central government programs which are excessively "top-down" or so "comprehensive" often make a poor fit in local communities do little to improve integrated water resource management. Big national projects for water resources development, for instance, big dam construction should take a "*technocratic*" approach. The technocratic approach starts with a recognition and analysis of the problems and, after a review of all feasible alternatives, selects a well-specified optimal solution. In this process sophisticated feasibility or simulation studies are employed. Against this, community-based projects should take a "incremental"' approach. The incremental approach, in contrast, makes an assumption that there is no obvious decision which can be made objectively on a long-term basis. Rather, a continuous stream of minor decisions is made, thus providing opportunities for changes in policy as the situation develops. In practice, the validity of the incremental approach depends on the size and complexity of the programs concerned. The incremental approach is defined as one which is human in scale, understandable and manageable by local government, one which suits the lifestyle and respects the vulnerability of the region concerned, and one which concerns itself with 'how to operate or manage' rather than "how to build equipment." As for even a big project, parts of it might have to be broken down into some sub-programs in which the incremental approach is preferable to the technocratic one to get steady progress.

How to foster "ESTIN" (Environmentally Sound Technology Infrastructure) is also an important work to be taken into consideration when we engage ourselves in planning EST transfer and implementing it. Putting a EST transfer program into ESTIN-minded practice will foster the capacity of stakeholders for adapting themselves to positive action, consequently generating improvement in communities, regions, and organizations concerned in integrated water resource management.

References

Shimazu, Y., "The soft approach to watershed management," WATER RESOURCES DEVELOPMENT, Vol. 4, No 4, Dec. 1988.

Biswas, A. K., 'Sustainable Water Development and Ecosystems Management', Extended Summary for a Lecture ,1 November 1995, in Japan.

PANOS's Newspegs: 'Third World Faces Added Burden of Climate Change', 5 February 1996

The Dublin Statement and Report of The Conference, "International Conference on Water and the Environment --- Development issues for the 21st century," 26-31 January 1992, Dublin, Ireland.

Barrett, B., Memorandum on Barriers to EST Transfer, 11 April 1995.

El-Habib, H. N., 'Barriers to the Transfer of Environmentally Sound Technologies', Workshop on Transfer of Climate Technologies and Activities Implemented Jointly, 19-21 June 1996, Osaka, Japan.

Kitawaki, H., "INTEP's Past and Future --- What INTEP wishes to contribute," INTEP (International Environmental Planning Center) Newsletter, No 9, January 1996.

Manikiam, B., "Satellite Remote Sensing for Water Resources Development," Asia-Pacific Environment Newsletter, Vol. 1, No 2, 1995.

Postel, S., "Facing Water Scarcity," State of the World 1993, by Brown, L. R. et al.

Dowdeswell, E., "Statement at the 26th International Symposium on Remote Sensing of the Environment," 25 March 1996, Vancouver, Canada.

World Bank, "Global Group Seeks Ways to Narrow Info Gap," World Bank News, Vol. XVI, No.25, July 10, 1997, p.4.

SESSION 3

Reports from Delegates I:

Mr. Pak Sokharavuth, Cambodia
Mr. E. Ratukalou, Fiji
Mr. C. D. Serra, French Polynesia
Mr. S. K. P. Parekh, India

Lecture III:

Sustainable Water Technologies
Microbial Tests for Drinking Water Quality: On-Site Methods

Environment condition in Phnom Penh Cambodia

Pak Sokharavuth
Department Poll ution Control
Ministry of Environment
Cambodia

Background

Cambodia has a total land area of 181.035km², situated in Southeast Asia. The maximum extent is about 580Km from east to west and 450Km from north to south. It is bordered by Vietnam to the East and southeast, by Lao to the North and by Thailand to the North and west.

According to the 1996 census, the country Population was estimated to be 9 million, Buddhism is the National religion which is respected and practiced by more than 95% of population.

Between 80 - 85% of the labor force is engaged in agriculture on over 2 million hectares. Rice is the dominant crop, grows in 65% of the nations farms. The fishing, forestry, trade and manufacturing industries including import and export activities also contribute to the economic growth of the country. Energy consumption in Cambodia mainly comprises fossil fuels such as gasoline, diesel, fuel, and oil. All petroleum products are imported from Asian countries. For electric energy production the country depends its power from fossil fuel and powered plants.

1/ Status of Water Pollution

Development in towns and cities in general, and in Phnom Penh in particular, is in fact the major source that releases polluted waters into the Mekong River. These chemically as well as biologically polluted waters increase on a basis due to demographic growth is closely related to development.

Investments in any shape form of manufacturing such as the establishment of new factories, the reconditioning of the old ones etc., always regard the waterways as prime locations. Used waters and chemical wastes (Zn, Pb, Hg, Cr, Cd, As, Mn, Ti, S04, Cn etc.,) are directly discharged into the rivers and subsequently make river water almost unusable. The alcohol distillery at Russey Keo, for instance, has released into Tonel Sap River high level of acidity which has greatly increased the water temperature which harmful to aquatic life.

In farming sector, the use of illegally imported pesticides, for example the products worldwide banned coupled with no adequate training and no protection gear, has become a national concern for the farmers' health in recent years. Worse still, the use of not properly labeled chemical fertilizers gives not only the adverse result, but also irreversibly alters chemical and, by the process, agricultural properties of farming land.

Mining is another cause of concern as it generally affects the waterways too. The extraction and trading in full force of gem stones in Pailin, for instance, has made the great Tonle Sap Lake and some of its confluences from the south shallower in a speed never seen before. This must have been largely contributing to unusually devastating floods in areas surrounding the Lake in the last six years or so. In sea beds off the Sihanoukvill coastline, there have been petroleum exploration activities for quite some time, and petroleum exploitation will eventuate in near future. This will certainly affect water quality as well as biodiversity and will pollute beaches in that area.

The irrational and rapid deforestation in the last fifteen years is not only the crucial factor of soil erosion and degradation, but it changes the geography of waterways itself. Thus it has forever altered the ecosystem of all aquatic life in the whole country.

The destruction at the same speed of mangrove forests in coastal regions in exchange for lucrative prawn farming business threatens the very surviving of these typical forests which play a major role in softening monsoon storms before they reach Cambodia's inland, let alone the obvious pollution of sea water and the change of soil properties in coastal areas.

The transportation by waterways, either the transportation of petrol or that of passengers, ends up as usual in the discharge of such chemical wastes as used lubricants and water into the stream, needless to mention the devastating effects of oil spills that occurred from time to time by either fire accidents on or oil leaks from cargo ships.

The inappropriate burial or dumping of toxic wastes has severely polluted subterranean water sources and subsequently affected the health of people normally using well water for consumption.

2/ status of Waste Management

Everything we produce always leave waste ·wastes may be toxic or hazardous substances or sources of diseases. However, the cost of cleaning services in cities are very high. For the moment, the food wastes, mud, sewage, papers, plastics, glass, engine oils and chemical substances that are produced in citizen's houses, workplaces and construction sites have not been managed to be thrown out by the kind.

Even though the Kingdom of Cambodia is a progressing country, there are 66 factories and 1282 handiworks in Phnom Penh. Therefore, control of wastes disposal for some factories should performed, for example for factories of:

- tire production
- tire repair
- shoes production
- paint
- compressed air
- phosphate fertilizers
- batteries
- rubber tubing
- soap
- mechanics
- paper
- construction materials.

The domestic wastes are also a big problem. There is over a million individuals in the city of Phnom Penh, including the tourists and foreign residents. The total domestic wastes for the city amounts to 1800 cubic meters per day which represent an average of 0.5tons of waste per person per year.

After the civil war, the city lacked the machines and garbage trucks. Fortunately, 24 garbage trucks were donated to the city by friend countries. However, these is presently a lack of spare parts for these trucks. The garbage trucks usually make four trips a days between Phnom Penh and the dump site located 10 Km away from the city. There are 678 persons employed for the removal of domestic wastes. However, the problems of domestic waste are still very obvious in Phnom Penh.

3/ Status of Air Pollution

In Cambodia, as in other countries, Socio - economic development will certainly lead to increasing levels of air pollutants. High concentrations of sulphur dioxide Nitrogen oxide, Carbon monoxide, hydrocarbon, lead and dust are emitted from the major sources such as motor - vehicles, powered plants, factories boats and generators. The ministry of Environment of Cambodia has concentrated its attention on the problem of Air pollution in Phnom Penh City, because of the national economic development has been occurred there. The problem of air pollution in Phnom Penh began 4 years ago when Cambodia's economic development got underway, but it is not as severe as in other countries.

-Air pollution by vehicles and fuel station.

Air pollution by vehicles in Cambodia is not yet a big problem but if we look at Phnom Penh City, we can see that Air has been polluted by various vehicles and fuel stations. Most vehicles and motorcycles are second hand imported from neighboring countries. At present, there is a concern with the rapidly increasing number of vehicles in the city and the frequent traffic jams. The old vehicles generally have greater emissions then the new ones. The lack of appropriate controls in the petroleum sector also is a factor in air pollution. Fuel station are improperly built and emit volatile organic carbons such as benzene and other. Some illicit traffickers continue to import low quality gasoline which contains highly - toxic substances. Governmental agencies have taken measures to control these activities but was not able to stop them yet.

-Air Pollution by generators:

The electric power supply in Cambodia is not yet adequate by 1979 most of the electric power plants were broken down and the number of factories, handicrafts, hotels guest houses, restaurants, businesses, of offices, private houses have greatly increased from year to year.

Today 1996, the electricity supply was improved, but is still not yet adequate, so the generator are widely used which lead Air and noise pollution, the result we have received a lot of complaint about pollution from the exhaust and soot of generators. The Ministry of Environment has responded their problems by assigning specialists to deal and educate the generator owner.

-Industrial air pollution:

Cambodia is not a heavily industrialized country. During the period 1960-70, Cambodia developed some industrial capacity principally in Phnom Penh. However, the technology utilized was not very modern and nobody was paid attention to environmental considerations such as on environmental impact assessment.

Early this year the industrial base in Cambodia was estimated at about 80 factories. By comparison to neighboring countries, most of Cambodia's industries are small and medium scale because the country still is rebuilding its basic infrastructure which were destroyed by two decades of civil war. Therefore the industrial air pollution in Cambodia is lower.

However, we presently pay attention on rapid increasing of handiwork in urban and rural areas and not separated zone, These are improperly built and lack equipment to control air pollution.

-Air pollution by dust:

The lack of management of building construction and construction material transportation have made the city roads completely by dusty. Also wastes frequently are thrown on the road sides and in the rainy season these wastes could be flow with the rain water into the sewer, this causes the sewers overflow. The sewage contain various microbes, and the dry sludge along the road then get into the air cause eye disease and respiratory problems especially asthma, Dust also is generated by the fact that some road are not yet repaired, and more are not yet paved because of lack funds.

- ***Acid deposition:***

Most acid deposition comes from the exhaust of vehicles, factories, power plants and generator. Today have 47,061 vehicles, 170,472 motorcycles in Cambodia and 3 power plants in Phnom Penh. The emission of vehicles, motorcycles, Factories, power plants, handicrafts etc, in this year concentrated about 1,000 Tons of suspended particulate mater 7,700 tons of SO_2, 4,400 tons of NO_X, 2,300 tons of HC and 52,000 tons of CO, these toxic gases reacted with atmospheric moisture, they can return to Earth as acidic deposition in areas far from or nearby the sources depending on the type of toxic gases.

The Ministry of Environment is divided into 5 department:

Air pollution control is carried out by Department of Pollution Control which has the following responsible:

- Organize policy and plans to promote and conserve national environmental quality.
- Prepare Draft Air, water, and soil quality sub - degree and Air, water quality standard.
- Prepare reports on the status of pollution of the country.
- Monitor sources of air pollution.
- Provide environmental education programs to other governmental office and private sectors.
- Apply sampling methods to manage and promote the air, water quality. Today Department of Pollution Control are difficult to implement the above task because
- Lack of information on resources required for effective management and enforcement.
- Lack of Monitoring Program
- Lack of expertise in management and control.
- Lack of financial resources for monitoring.
- Lack of equipment for controlling.
- Lack of definition of roles, responsibility and relationships between institution.

+ Human resources:

- Lack of qualified teaching staff
- Lack of Technical Language skills
- Lack of Management
- Limited fund to support educational activities
- Lack of experience

Recommendation:

- Development of Air water Pollution Control sub - degree
- Clear definition of roles, responsibilities and relationship among institutions responsible for air quality management.
- Provision of necessary equipment and financial resources for monitoring and enforcement
- Provision of short term overseas training activities for existing staff to upgrade research and management skills.
- Provide technical assistance and appropriate financial support for the Development and Implementation of Air water and soil quality management plan.

Environment Conditions of Suva and Greater Suva Region

E. Ratukalou
Suva City Council
Suva, Fiji

1. Introduction

1.1 Locality

Suva is both Fiji's largest and administrative capital in Fiji. The city is on the southeastern tip of the island of Vitilevu (which is the largest of the Fiji Islands). Geographically, Suva is located on latitude 15 deg. South and lies just west of the 180 deg. Meridian.

Consequently the country enjoys tropical climate. Suva is a sea port, and because of the geographic position it lies on the direct ocean routes, between Panama Canal, the west coast of North America and the southern hemisphere ports in Australia and New Zealand.

Historically Suva came into existence as a sea port for ships sailing between the countries or between pacific islands.

1.2 Population Growth

Suva became capital in 1880.

By 1946 the population of Suva had grown to 25,500. In the early 1,950's the township received the status of a city and the population surpassed 35,000.

At the time of the 1966 census the city population exceeded 54,000. This represented a growth of 45% within the preceding two decades.

From 1976 to 1996 the growth rate had leveled off to 10%. The population at the 1996 census recorded the population at 96,000. However in combining the city and peri-urban population the number stands at around 185,000.

2. Environmental Conditions

2.1 Air Quality

As similar in many overseas cities Suva's air quality is being affected to some degree through growth of heavy manufacturing industries and increase in pollution created by vehicle emission. At the present time pollution is concentrated in isolated centres however the rates of increase has to be monitored/controlled immediately.

2.2 Water Quality

Suva has a relative abundance of annual rainfall, perennial rivers, good surface drainage and numerous springs ensures there is no fundamental problem in obtaining domestic water supplies.

Waste water treatment including sewerage wastes discharged into septic tank or ii-into sewerage system. At least 60% of dwelling are connected to sewer main whilst 40% discharged into septic tank.

The central government who is responsible for the sewer treatment in Fiji is currently undertaking major projects in the sewer development in Suva City and suburbs. One of the major problem is the overloading of treatment plants, which results in discharging of affluents into creeks without being properly treated.

2.3 Solid Waste Management

Suva City operates its own dump site located on the outskirt of the city. The site has been in operation for over 50 years. The growth of the city and its peri-urban areas has increased the volume of garbage and refuse tremendously. The current mode of solid waste disposal is by open dumping utilising, only one D6 bulldozer to bury the waste.

There are a number of public nuisances originating from this dump such as offensive smell, dust emission, pollution of marine ecosystem by heavy metal leachates e.g. mercury, iron and other toxic chemicals such as arsenic.

3. Assessment of the Problems and Solutions

The lack of control of waste disposal and pollution is currently a serious environmental issue and one that will inevitably increase unless effective measures are introduced.

The main areas of concern are:

* the poor standard of municipal waste management,
* the lack of any 'hazardous waste" facility in the country;
* the ability of existing polluters do so without any obvious constraint; and
* the inadequate level of pollution monitoring.

3.1 National Waste Management Strategy

Two options could be considered for the administration of pollution control and waste management:

* Local Authorities develop their own management capabilities under the standards/monitoring directions of a unit within the DOE.
* A Waste Management Authority is set up to administer waste disposal and pollution control on a national basis.

The weak link here is the variable level of assistance which Government might provide. LAs cannot be expected to develop their capabilities and undertake the management functions in the absence of realistic levels of financial assistance from Government. Levels of assistance would be a clear indication of Government's commitment to the issue.

Government should also facilitate the revenue (rates) earning capacity of the local authorities.

Vitally important would be the need for 'call-in' powers for Government to take over management of local authorities' waste management activities, if required.

3.2 Duties

In this option Government's duties would be:

- to set design and management standards for municipal waste dumps and hazardous waste facilities;

- in conjunction with local authorities draw up monitoring programmes for municipal waste dumps and hazardous waste facilities;

- spot check the monitoring programmes to be undertaken by local authorities;

- provide adequate levels of financial assistance and facilitate LAs increasing their revenue generating capacity;

- invoke call-in powers if required and then undertake management at the expense of the local authorities.

3.3 Waste Management Authority

The alternative option would be the institution of a statutory Waste Management Authority (WMA).
The WMA would have officers stationed in the Local Authorities and who would act in a similar manner to the existing Health of Officers.

3.4 Duties of the Waste Management Authority

The WMA would have the following duties:

In conjunction with the Local Authorities manage the municipal waste sites and hazardous waste facilities to the standards set by the Department of the Environment.

Introduce revenue earning and cost-recovery measures (polluter pays principle, recycling etc.) To ensure that waste management and pollution control is adequately financed.

3.5 Advantages/Disadvantages of a Waste Management Authority

The advantages of \WMA would be:

single authority responsible for all waste management (including pollution);
- revenue earning capacity;
- no expansion of the civil service.

The disadvantages of a WMA would be:

waste management is removed from being a local issue;
revenue earning potential may not be sufficient to cover costs necessitating continued (Government resource allocation which questions the need for a WMA;
shared responsibility with Local Authorities;

Because Fiji s waste and pollution management is in need of a completely new direction the feasibility of the WMA should be thoroughly evaluated in a priority project of the Natural Environment Strategy (Project.)

3.5.1 Recommendations

1. Waste management and pollution control become the responsibility of the Ministry of Planning and Environment.

2. A comprehensive National Waste Management Strategy be commissioned to provide a practical plan following consultation and a detailed evaluation of the legislative, administrative, managerial, financial and time frame issues.

3.5.2 Ports Authority of Fiji

Under its 1990 Act, the Ports Authority of Fiji is currently the sole industrial and urban pollution monitoring agency. PAF's monitoring is confined to designated port areas where it is attempting to enforce its own standards. This is a remarkable development and deserves every encouragement. However, conceptually it appears quite inappropriate.

PAF is an GOF-owned corporation which is expected to be run at a profit, with a proportion of its profit being returned to Government. To undertake its pollution control mandate, PAF will have to either

- receive funds from Government to cover its pollution management costs; or
- increase its revenue to cover pollution management costs by charging its customers.

Since PAF's customers (port users) are not the major polluter (although ship's discharges and fuel leakages are a small source of normal pollution in port areas) charging them to raise revenue for pollution management is misguided. It should be expected too, that in times of poor profitability, then revenue and (cost considerations in PAF's management will; certainly prevail to the detriment of pollution control.

This is not to say that PAF should not undertake the monitoring and/or enforcement, but PAF needs to come under the mantle of national standards and local authority management. Specifically they need a revenue mechanism to undertake the work which is independent of their other operations.

3.5.3 Vehicle Emissions

In metropolitan environments, where there are large numbers of vehicles, one of the most serious forms of pollution originates from vehicle emissions. These emissions contain sulphur dioxide nitrous oxides and a variety of solid dust particles. In addition, in countries such as p iii where leaded petrol only is used, the lead is absorbed by people through inhalation and through contact with contaminated dust. It also finds its way through wash down and run off into coastal creeks and waters where it accumulates and can be assimilated into the food chain. This is a significant and serious form of pollution.

Fiji's vehicle emission regulation is not enforced and the prevalence of smoky emissions is clearly visible to all who travel or live by Fiji's roads.

3.5.4 Recommendations

1. A programme for conversion to unleaded or very low leaded petrol be introduced as soon as possible, with financial inducements being offered for quick compliance.

2. The existing vehicle emission regulation be enforced on an ongoing basis and strengthened by the inclusion of regulatory standards.

References - The Environment Strategy Fiji 1993.

Environmental Issues of the Papeete Urban Zone Tahiti - French Polynesia

Claude SERRA, Delegation for environment,
B.P. 4562 Papeete Tahiti, French Polynesia
Tel : (689) 43 24 09 Fax : (689) 41 92 52

The urban zone of Tahiti includes the city of Papeete and the surrounding cities of Pirae, Arue, Faaa and Punaauia that represents 65.4 % of the total population (total : 223,000) concentrated on 1% of the total area of French Polynesia (total area : 3,430km², 120 islands on 2,500,000 km² of ocean).

The economical resources of these islands are now tourism, pearl farms, and fishing. Most of the environmental issues are on the rivers and the reefs by anthropic influence, as all the islands are small and most of them are circled by lagoons.

Environmental conditions

Air Quality

Air quality is good except in the city of Papeete and surrounding areas where the pollution is due mostly to vehicles (major part of diesel powered engines). Pollution peaks in CO and NOx averages the rates measured in Paris, Phoenix or Los Angeles in small parts of the city. But this pollution is temporary as the tradewinds clean up the air.

Waste water treatment.

Due to high water using and careless treatment in individual housing, a large part of the littoral pollution in Tahiti is coming from waste water. The waste water treatment plants are private, small ones, sized for a small input of waste and, due to their undersizing, present very often malfunctionements, an important source of pollution.

Solid waste disposals,

Since 1997, after a waste treatment plant by cremation which failed because of high air pollution that caused social problems (opposition of the population) and was closed by the environment minister, there where no solution except waste disposals, only one of them was authorised by the environment administration. Then, many problems where caused by « wild waste disposals » scattered all around the islands in valleys or rivers. A waste disposal management plan is now on study and a new modern waste disposal (landfill) has been adopted by the government of French Polynesia.

Land use and land degradation

One of the most important issues for the lagoons in South Pacific islands is the siltation due to land reclamation and clearance for building. The aggravation of this issue is due to geological parameters (erodability of the weathering cover : ferralitic soils, high slopes averaging 70 to 90 %) and meteorological parameters (high tropical rainfalls, 2000 to 10000 mm per year).

Social conditions

Recent studies shows that 1 % of the total area of Polynesia is occupied by 65.4% of the population. Considering the high natural slopes of the island of Tahiti and the lack of space in the littoral plain, this induces high concentrations of population with all the correlated problems we can find in other countries.

Assessments of problems and solutions :

Air quality

An engineering study is initiated to evaluate the data and factors of air pollution in urban zones.

The minister of environment and the delegation for environment will try to promote the LPG fuel instead of the diesel for trucks and buses operating in urban zone. If the LPG is convenient in terms of price and maintenance, it should maybe useful to provide financial support for the equipement of trucks with LPG powered engines (i.e. custom facilities etc.).

Waste water treatment

A project of a main sewer associated with a sewage treatment exists for several years, a first stage will be done in 1998 in the city of Punaauaia, west side of the urban zone, the other cities will follow in the future.

Solid waste management

In correlation with the settlement of a modern landfill it will be usefull to promote the preselection of domestic wastes by population. This can be done with popular education in relation with associations, churches, schools, local authorities with the support of media.

The main issue in the identification of landfill sites in French Polynesia is the N.I.M.B.Y.phenomenon wich is a real obstacle considering the small area of our islands. In opposition, the export of selected wastes for recycling is not economicaly possible because of the available bulk and the prices of shipping. This can be done only for several materials such as aluminium, copper.

Land use, land and lagoon degradations

The assembly of French Polynesia adopted in 1995 a law on environmental impact assessments, some others regulations have to be done to regulate the land clearances, reclamations on lagoons, coral dredging (which is now forbidden but still used in some islands) and technical assistance is available in administration for helping the builders in order to avoid major risks for the environment such as booklets, studies, and advices.

Even the delegation for environnement is only 12 years old and a lot of regulations, since its creation have been taken by the local authorities, the increasing of population in urban zone, the lack of urban management plans, a certain anarchy in small house buildings (without authorisations), and the lack of space for human settlements induces neighbouring conflicts, especially concerning environment problems.

Environmental Scenario and Urban Waste Water Management of Mumbai

K. P. Parekh, Executive Engineer (Environment), Bombay sewage Disposal Project, Bandra Outfall Site, Mumbai 400 050 India

1. Introduction

The original city of Mumbai consisted of seven islands separated by shallow creeks. These islands were linked progressively by causeways and the areas which were gradually reclaimed. The commercial and the industrial prosperity of Mumbai dates back to 1860 when the railways opened up and the port of Mumbai developed when the Suez Canal commissioned in 1869. The Britishers started organizing the civic life by forming the Municipal Corporation in 1872 and enacting the Bombay Municipal Corporation Act in 1883.

Mumbai today is the nerve center of trade, commerce and industry in India. The 1991 census indicated the population of 9.81 millions. One would not be surprised if the population crosses the limit of 12.5 millions by the year 2000.

Mumbai is surrounded by sea on three sides and a river on North East side. It is situated almost half way on the western coast of Indian subcontinent. It covers an area of 438 sq.km. The topography of Mumbai has now imposed serious limitations on any further developments.

The phenomenon growth of population, increasing industrial activities, generation of tremendous vehicular traffic and development of slums have created social, economical, technological and environmental problems. The all concerned have started acting to fight back the growing menace of pollution.

2. Environmental Scenario of Mumbai

2.1 Defining Environment

The Environment can be defined as the one's surrounding. To an Environmental Engineer, the word Environment may take global dimension. The global environment consists of the atmosphere, the hydrosphere and the lithosphere in which the life sustaining resources of the earth are contained. The non living things i.e. air, water, soil, climate, heat, light & radiation form the physical environment whereas the living organisms including the man, animals & plants form biological environment. There is also a concept of psycho-social environment which is the background of varied social, economic and cultural context of different countries, their status and value system.

The above system of environment has operated for millions of years with tremendous sustaining and assimilating capacity to absorb waste products in gaseous, liquids, solids and biological forms. However, the system capacity is not infinite and it has shown signs of stress during recent times.

2.2 Topography & Climatory

Mumbai is situated almost half way on the western coast of Indian subcontinent. The geographical latitude and longitude are 19 N and 73 E respectively. It is surrounded by sea on three sides and river flowing on North-East side. The climate of Bombay is fairly equiable. May is the healthiest month from pollution angle as the temperature change is minimum. Prevailing direction of normal wind during the year is West-North-West. There are little fluctuations in wind velocity. In wet season the velocity increases which is maximum in July. The climatory turbulence and wind velocity determine the extent of dispersion of pollution.

2.3 Profile of Environmental Pollution

2.3.1 Air Quality

Long range effect of air pollution in the atmosphere can not be neglected. Air pollution can cause death, reduce visibility and bring about huge economical losses. It can imbalance the oxygen proportion, decrease the global temperature and cause green house effect or even deplete the Ozone layers threatening the ultra-violet radiation on the earth.

Greater Mumbai enjoys unique position in India. It has become a focal point of industrialization and commercialization. It has almost 35000 factories, 66 textile mills, 256 chemical industries, 180 hazardous industries and over 7.5 lac vehicles which emit almost 2000 tonnes of pollutants daily. These pollutants have registered tremendous impact on the environment. Average ambient air quality shows predominance of suspended dust at 300 u gm/cum and SO_2 at 61 ugm/cum on 24 hour basis. H_2S is 6 ugm/cum and NO_X is 43 ugm/cum on annual basis. However, figures differ much for different zones categorized on the basis of intensity of pollution.

2.3.2 Water Pollution

Water pollution is a serious problem eversince the sewage and industrial efffluents are discharged into the water bodies. Water borne diseases are caused by the presence of infective agent or aquatic host in water. The hazardous of toxic chemicals on human health are due to detergent solvents, cyanides, heavy metals, organic acids, dyes and pigments.

Mumbai discharges almost 2500 Mld. of sewage into the sea/creeks. Preliminary and primary treatment is given to sewage before disposal. However, many stretches of the creek and coast present very poor water quality as regards to DO, BOD and high bacterial density.

2.3.3 Solid Waste Disposal

Solid waste encompasses the heterogeneous mass of throwaways from residence and commercial activities, which is declared useless or unwanted. Solid waste mixed with hazardous waste pose a substantial danger to human, plant and animal life. Mumbai disposes more than 3500 tonnes of solid waste daily. The sanitary landfill method is utilized for controlled disposal of solid waste. The aspects of site selection, collection and transport, control of landfill gases and leachate are considered in solid waste disposal and management. Mechanical volume reduction by the compactors is also utilized for efficient disposal. In past, methods of composting and incineration on pilot basis are tried and installed. Vermiculture

Biotechnology (earthworm) may also find its way in near future. Besides, direct pollution of land by pathogenic organisms is caused by digested sewage sludge and animal dead bodies. Besides all above forms of pollution, Mumbai has registered much higher levels of background noise due to railways, heavy traffic and aircrafts.

3 Environmental crisis m the urban context and control strategies

3.1 The Crisis

During last two centuries, the increasing population and technological progress has deteriorated the environment very badly. It has also threatened the exhaustion of basic raw materials and natural resources. The tremendous impact is seen through changes in energy pattern, radiation levels and presence of toxic chemicals into the air, water and soil.

Eventually big price has to be paid even today to bring atmospheric and water pollution under control. There can be no return to the past in relation with nature. Also technological progress and economic development can not be haulted. The man therefore continues to intrude into nature's kingdom. But this intrusion has to be cautious, scientifically, economically and socially justified and it has to be planned and regularised centrally.

3.2 The Control Strategies

Environmental crisis has led to growing concern among the people, the scientists, the engineers and the industries. The sevearity of the problem can be reduced by adopting following strategies:

1. Social strategies:
   To create public awareness by way of training, seminars, publicity through media and dialogues.
   To create confidence and to encourage cleaner living.
2. Statutory strategies:
   To decide about environmental policies and to enact laws for control.
3. Administrative Strategies:
   To implement, monitor and control the environmental policy and laws and bye laws.
   To welcome and adopt the latest technology available.

4. Urban Waste Water Management

4.1 Bombay Sewage Disposal Project

The first modern sewerage system was built in Germany in 1842 by an innovative English engineer named Lindley. Mumbai was not an exception. First water supply was brought to the city in 1860 and in 1868 Capt. Tullock strongly recommended separate sewerage system for disposal of domestic waste. After the IInd World War and Independence, the Mumbai city experienced tremendous growth. The sewerage system was therefore, enhanced from time to time.

Since last two decade the Corporation of Mumbai is implementing integrated Water Supply and Sewerage Project with the assistance from International Development Association/International Bank for Reconstruction and Development. The Phase I and Phase

II are completed till 1988. The present sewage network consists of almost 1381 km. of main sewer lines, 51 number of pumping stations and 3 major Waste Water Treatment Facility works. Bombay Sewage Disposal Project under Phase III is under construction which will be largely completed by 2005. It will raise the total water supply to 2900 Mld. and add 2 major ocean sewage disposal outfalls and 2 mechanical aerated laoons.

Mumbai being coastal city, the Environmental Impact Assessment Studies have suggested ocean disposal in the west coast and through aerated lagoons disposal into the east creeks. For this purpose, the sewerage system is divided into 7 zones. Marine outfall of 1.1 km. length with steel pipe of 1.2 dia. is constructed under the sea and commissioned in Colaba zone. At Worli and Bandra zones, a 3 km. long, 3.5 m. dia. R.C.C. tunnel at a depth of 65 m. with risers and diffusers at the end is being constructed separately. Aerated lagoons of 5.5 m. depth on eastern side are under construction which shall provide almost 75% 90% BOD removal with about 1.5 days of retention time. The preliminary treatment of screening and aerated degritting will be imparted to the sewage before disposal. It would also accomplish some biological treatment thereby reducing organic loads. The estimated dry weather flow capacity for the year 2005 of Worli & Bandra outfalls is 757 Mld & 797 Mld respectively & that of Ghatkopar & Bhandup lagoons is 285 Mld & 280 Mld respectively.

The Waste Water Management plan also proposes to carry out feasibility studies for a time horizon of 2025. It would estimate the flows, suggest modifications to the existing system to keep pace with technology and prepare cost estimates.

4.2 The Environmental Mitigation and Motoring

The environmental assessment for BSDP was carried out by National Environmental and Engineering Research Institute, a Government of India Undertaking. The EA procedures, the first of its kind, are introduced in BSDP works and form regular part of project execution. The EMM is categorized as under:

1. Weekly monitoring reports on EMP formats, for all work sites and quarry Inspection, follow-up and monitoring actions and monthly review meetings.

2. Project/study works related to environmental matters

3. Public awareness campaign and Citizens' Advisory Committee

4. Reporting and Management Information System

5. Environmental Performance Monitoring Indicators

The daily and weekly environmental mitigation actions are designed separately for each site. The site engineers carry out such environmental mitigation measures and note in the EMP formats. The Environmental Officer and his section keep control by way of regular inspection, follow-ups and personal dialogues. The specific problems are routed through problemsheets and correspondence.

The regular monthly review meetings on Environmental Monitoring actions are taken at all sites. Various issues are sorted out across the conference. A short and concised reporting system is devised in the form of minutes and actions to be taken thereupon.

Various projects and studies related to environmental matters are undertaken. Such works include plantation of mangroves on the disturbed areas; Bombay Coastal Water Quality Modelling study; Green Belt development; Ambient air quality monitoring; Noise level monitoring; survey of coastal areas of Mumbai for mangrove re-plantation. The BCWQS would develop hydrodynamic and water quality computational models of sewage dilution and dispersion. It would help to decide the receiving body standards for sewage disposal through deep sea marine outfalls.

The Citizens' Advisory Committee has been formulated with the prominent members of the city for their observation and guidance on EMM and overall project. Similarly, a public awareness compaign is organised from time to time along the community particularly the fishermen who are concerned in such project. A positive and corrective approach is adhered to on the basis of various discussions and dialogues during such compaign. Public consultation and participation has left little scope for any kind of misconcept or ignorance.

A Management Information System has been implemented to facilitate the flow of environmental information and data. The MIS basically consists of a reporting system to the EMM cell by the various agencies working on the project. The data on ambient air quality of all the sites and also noise monitoring information is computerised. Necessary chartings have been developed to compare the data with available standards. Such computerised data base would help to estimate the change in profile before and during the project implementation.

The Environmental performance monitoring indicators are introduced to measure the performance. One of such indicators is the record of the complaints received from the public which is very much effective indicator for the project implementation. The second indicator records the aggregate compliance of all environmental parameters such as air, noise, dust etc. These are monitored at sites and expressed as overall percentage of parameters meeting the set standards and limits.

The International Organisation for Standards offers guidance for use under ISO 14001 to evaluate any Environment Management System. International Standards covering environmental management are intended to provide organisations with the elements of an effective EMS which can be integrated with other management requirements. ISO 14001 certification requires clear environmental policy followed by planning, implementation, monitoring, corrective action and lastly management review popularly known as Plan-Do-Check-Act cycle. Many organisations undertake environmental "reviews" and "audits" to assess their environmental performance. These "audits" are not sufficient for one time review but should assure to meet its legal and policy requirements continuously. DET NORSKE VERITAS (DNV) UK are the certification bodies for ISO 9000 / ISO 14001 on EMS.

The environmental performance monitoring indicators are only a step forward towards such advanced certification.

4.3 Standards and Legislation

4.3.1 Air Quality Criteria and Standards

It was the 1972 United Nations Conference on Human Environment in Stockholm that set the ball rolling for many countries of the world to adopt standards and legislation for the protection of the environment and to establish an administrative mechanism for its implementation.

Air Quality Standards express public policy, hence require actions. They are evolved differently in different countries depending upon exposure conditions, socio-economic situations and importance of other health related problems. Air quality standards, therefore, reflect what a country can do or afford to do.

Air quality standards are categorized as primary standards and secondary standards. Primary standards define level of air quality that is able to protect public health with adequate margin of safety. Secondary standards are those which protect public welfare from known or anticipated adverse effect of the pollutants. Emission standards establish emission levels for specific group of emitters. It can be national or local on the basis of required ambient air quality, emission inventory and air pollution surveys.

4.3.2 Water Quality Standards

Water quality standards are the set of parameters to define water quality. They are usually based on the water quality of the stream and specify the quality of the effluent discharged. However, there are two schools of thought in the United States for rigid protection. One group prefers effluent standards and the other prefers stream standards. Stream standards system is based on establishing standards of the quality of stream and regulating any discharge into it. It prevents the excessive pollution load into the stream regardless of the type of the industry. The loading is limited to what the stream can assimilate. In India however, the effluent standards are followed.

The water quality standards for receiving body as sea through deep marine outfalls depend upon the use of designated water. While it may be easier to meet the requirements of BOD, suspended solids by way of preliminary treatment, it is quite difficult to meet the standards of bacterial quality. The indicator organism may be feacal coliform that suggests that the water may be contaminated with sewage. However, the best dilution and diffusion depending upon hydrographic and climatory conditions of receiving waters can achieve the suggested norms.

4.3.3. Legislation

United Nations conference on Human Environment in Stockholm 1972 stressed the need of appropriate legislation which should be directed towards control of sources of pollution, institution of town planning, zoning of industry and use of proper fuels. Accordingly, "water (Prevention and Control of Pollution) Act, 1974" was enacted to check and prevent water pollution. A Central Board was established for monitoring and detecting pollution of water bodies. "Water (Prevention and Control of Pollution) Cess Act, 1977." was enacted to promote recycling and reuse of waste. "Air (Prevention and Control of Pollution) Act, 1981." was enacted to control air pollution. A fourth act called "the Environmental (Protection) Act, 1986." has been promulgated for improving and protecting the environment.

4.3.4 Towards the solution – When all means are justified

At the turn of the century, the people will need sustantial land, food, water and energy. The pollution problems would therefore follow. The eminent Soviet chemist Alexender Nesmgyanov was once asked, "What is your attitute towards air and water purification?" He replied, " It is negative attitude. We should not purify air and water. It is far more important not to pollute them." Hence waste free production should be the principle in 21St Century. For that, all means scientific or technological, social or political, economical or non-economical are justified.

Oceanographic & Water Quality Modeling Studies at Mumbai

The National Environmental Engineering Research Institute, a Govt. of India organization is currently carrying out the above studies.

Objective of the Study

a) To develop integrated hydrodynamic and water quality computational model. The model covers region extending upto 15 kms. into the sea and 25 kms. along the coast of Mumbai. The model will provide total coliform concentrations at the coast.

b) To conduct bathymetric, tidal and current observation with hydrodynamic model for monsoon and non-monsoon conditions.

c) To estimate dispersion coefficients, coliform decay, BOD and Ammonia removal rate for non-monsoon condition.

d) To evaluate least cost options for coastal water quality management treatment and marine outfalls at Worli and Bandra.

Present Environmental Quality

The present waste water discharges on the west coast have created many critical zones where water quality is impaired in terms of physico-chemical and bacterial attributes. High level of pollutants are witnessed during the ebb tide compared to flood tide. The D.O. levels shows that about 5 Km. of the West Coast is highly polluted. The other 8 Km. stretch of the coast shows moderate depletion of the D.O. The other parameters such as B.O.D. and Nutrients are moderate at most of the region. The sediment quality did not show any significant accumulation in the polluted region. The inorganic pollution such as metals in either the marine water or sediments on the west coast is insignificant. The Bacterial contamination range from 104-105 counts/100ml.

The BCWQM study shows that, for the same conditions of dilution and location of outfall, monsoon patches are smaller than non-monsoon results. The rapid dilution is due to strong surface currents in monsoon. The patches shift further away from the shore as the length of outfall increases.

Waste Water Quality Standards

Presently no standards exist for discharge from deep marine outfall into the receiving water body. However, IS-7967-1976 suggests receiving body water quality tolerances for bathing, fishing etc. as under:

1. Colour: -	No noticeable colour, no odour
2. Floating Materials: -	Not visible

3. Suspended Solids: -	Not visible
4. pH: -	6.5 to 8.5
5. Free Ammonia as N: -	1.2 mg/l
6. Phenolic Compound: -	0.1 mg/l
7. D.O.: -	More than 3 mg/l
8. B.O.D. at 200, 5 days: -	5.00 mg/l
9. Coliforms: -	MPN 1000/100ml

However marine coastal discharge values are as under:

1. BOD: -	100 mg/l
2. COD: -	250 mg/l
3. Free NH3: -	5 mg/l
4. Residual Cl: -	1.00 mg/l
5. Temperature: -	450 maximum

The BCWQM study will help in deciding the receiving water body standards depending upon different categories of designated use of water.

Determination of existing water quality study alongwith west coast sew beaches

It is essential to establish the efficacy of the outfalls during operation in terms of the water quality after they are constructed. Hence, it is decided to establish the existing water quality status along west coast and beaches as well as sea fronts of Mumbai. The existing water quality conditions of coastal areas near the proposed outfalls extending within 4 Kms. wide band from the low water line and 5 Kms. from the shore would be established. Existing status of the water quality at 1 Km., 3Km. and 5Km. line from the shore starting from Colaba to Mudh will be covered. Grid of total 10Km. x 5Km. covering an area around Worli and Bandra shall be studied critically to determine the existing water quality in terms of total coliforms, feacal coliforms, BOD, DO, Ammonia, Phytoplankton, Zooplankton and any other relevant parameters. This will provide background data on present status of water environment.

After the construction of outfalls and its operation, post commissioning studies regarding the water quality shall be initiated. Critical sampling points shall be identified to carry out the said studies.

With the above studies it will be possible to find out the changes in water quality before and after commissioning of the outfalls. This would help in working out the further options as regards to additional treatment facilities and/or extension of the outfalls as may be necessary at that stage.

Disposal and Treatment Alternatives

1. Land Disposal:-	Effluent Irrigation
2. Dilution:-	Sea Outfall
3. Conventional treatment: -	Primary/secondary treatment like activated sludge plant/ trickling filters, anaerobic digestion.
4. Natural oxidation: -	Oxidation pond, aearated lagoons

Land treatment requires large and porous open land, low rainfall, low water table, natural river not in the vicinity and finally irrigation water scarcely available.

The dilution in natural water with self purification like marine disposal requires favourable hydrography and sea currents. The water not to be used for navigation or water supply and acquatic life not to be damaged. Sea water contains less D.O. It normally contains other dissolved matters and hence its capacity to absorb sewage is not high. Sewage may chemically react with dissolved matters and milky appearance may emerge. The lighter and warmer sewage may float on surface, giving rise to sleek. However infinite dilution favours the marine disposal. The disposal has to be deep in sea, quite below sea level and outfall to be placed on firm rocky bed.

The conventional treatment methods are decades old in Mumbai. They are slowly phased out in view of the current project. However, anaerobic digestion treatment is continuing at one of the treatment plants from the academic interest point of view and sewage gas generation.

Aerated lagoons are simple, low power cost and symbiosis treatment process. The aerobic conditions are maintained by aeration by mechanical means. This treatment facility is under construction for disposal of sewage into the creek on east side of Mumbai.

Aerated Lagoons at Versova

Aerated lagoons are earthen basins generally 2.5 to 5.0 m deep, provided with mechanical aerators installed on floats or fixed columns. Raw sewage is fed from one end into the lagoon after preliminary treatment and leaves from the other end after a desired period of aeration. Depending upon the power input per unit lagoon volume and the provision or otherwise of a recirculation arrangement, the solids in the system either settle, flow through or build-up. BOD removal efficiency in aerated lagoons could vary over a wide range between 50 to 98 percent. Also, effluent from lagoons with or without recycle could significantly differ in ammonia and nitrate concentrations. Wide range of coliform removal is also observed subject to the lagoon design.

Environmental Repercussions

The impact of aerated lagoon effluents on the receiving water body is governed by the available dilution and assimilative capacity. For effluent characteristics described above, approximately 12 times dilution would be necessary to bring down the BOD and ammonia levels sufficiently to avoid an adverse depletion of dissolved oxygen. A few hours of travel/residence time before the effluent reaches the sensitive locations, however, will be necessary for bacterial concentration to decay to a level of about 1000/100 ml which is considered safe for bathing. For discharge of effluents into creeks, available dilution at the low tide slack period could be of overriding importance as during the flood tide cycle pollutants are pushed into upper regions of the creek and may cause significant dissolved oxygen depletion. In the absence of adequate dilution, bacterial contamination of water and sediments may also occur in the water body.

The impact of lagoon effluents on the receiving waters, however, is closely linked with the performance of the aerated lagoons. Inadequate lagoon performance can also lead to odour problem due to formation and dispersion of hydrogen sulphide. Another aspect of lagoon operation is periodic desluging of facultative lagoons. Adequate measures are also necessary for proper disposal of sludge to safeguard against ground water contamination due to formation of leachates at the sludge disposal sites.

Environmental repercussions may also arise due to the civil works activity during the construction of the lagoons. These impacts are primarily air and noise pollution at the construction and quarrying sites due to material hauling and operation of construction machinery.

Details of Aerated Lagoons Versova

Waste water from Versova Drainage zone is treated biologically and discharged in aerated lagoons in Versova. Pre-treatment consists of screening and grit removal with screenings and grit to be hauled off to a dump or for land filling. Stabilised sludge from lagoons is removed at 10 year intervals and is to be used for land filling.

The aerated lagoons are 4 metres deep, provided with mechanical aerators installed on floats. They are facultative aerobic, two streams of three cells of retention time 1.4d, 1.8d, and 1.1d respectively. In the first cell, BOD is expected to be reduced by 65 - 72% but all suspended solids remain and go to the 2nd cell where mainly suspended solids settling and digestion would occur. The last cell would allow further settlement and subsequent reduction of total BOD.

Sustainable Water Technologies

Dr Kuruvilla Mathew
Research Fellow, Institute for Environmental Science
Murdoch University

Introduction

Water is the most fundamental of resources. It is essential for all forms of life and is involved in most forms of human production systems. Water also has recreational, emotional and religious significance in many cultures. Yet we continue to undervalue the significance of our water environments and reduce the quality of our water resources on an unprecedented scale around the world. The potential for marked global climate change threatens the hydrological patterns of the world. The world's water resources are threatened on many levels (oceans, rivers, lakes, estuaries, groundwater mounds), and from many different activities (urban development, industrial processes, bad agricultural practices and so on). As a result, pressure for new approaches to water management and water technologies is constantly growing, and with this, new technologies and water management methods are emerging.

The relationship between "water technologies" and economic and social development is complex. However, its significance is most easily understood by the fact that the most effective and beneficial way of improving the health and nutritional status of the world's poor is not provision of more food supplies, but provision of adequate water supplies and sanitary conditions. Achieving this would reduce the extent of manageable water borne diseases, thus improving the nutritional status of people living in marginal conditions, without requiring major agricultural productivity increases or excessive food aid. In this context, it is easy to see that achieving a basic level of human dignity and well-being is closely linked to the sensible application of water science and engineering.

The relationship between water technologies and environmental quality is also complex. Effectively, all forms of "development" change the natural water cycle, affecting surface drainage patterns, groundwater recharge patterns, water quality and water dependent flora and fauna (ie development = landscape change = water cycle change). For example, if one considers the typical suburban street, its storm water drainage system illustrates a technology or an applied form of engineering which has been developed to achieve certain objectives, mainly flood management and traffic safety. Traditionally however, little thought has been given to the consequences of urban stormwater pollution on urban water environments, eg the pollutant load of outflows into local wetlands due to residues washed off road surfaces and fertilisers from lawns and gardens.

"Water technologies", in all their forms can thus be seen as the interface between the natural water cycle and the human water use (or abuse) cycle. These technologies are not isolated but form systems of artifacts and people who manage and manipulate the system and the interface with the natural water cycle. In developing sustainable solutions to the water problems of society or your own home, you need to be aware of the current diverse and fragmented nature of water resource management and regulation and how water technologies are applied and modified.

The two lectures in this section of the course will introduce and outline some of the emerging ideas and solutions in the areas water supply, water efficiency, wastewater and urban stormwater management.

But remember water is more than a resource and water technologies are more than simple devices, as this poem by Kenneth Boulding illustrates: -

Water

Water is far from a simple commodity,
Water's a sociological oddity,
Water's a pasture for science to forage in,
Water's a mark of dubious origin,
Water's a link with a distant futurity,
Water's a symbol of ritual purity,
Water is politics, water is religion,
Water is just about anyone's pigeon,
Water is frightening, water's endearing,
Water's a lot more than mere engineering.
Water is tragic, water is comical,
Water is far from the Pure Economical.
So studies of water, though free of aridity,
Are apt to produce a good deal of turbidity.

Boulding, K. (1964) The economist and the engineer: economic dynamics of water resource development. In S.C Smith and E.N. Castles (Eds.).

This part of the workshop hopes to clear a little of the turbidity.

Topic for workshop

(1) The water supply test kit developed by the Remote Area Developments Group will be demonstrated (see the paper by Pillai *et al*, 1997).
(2) The solar-powered reverse osmosis desalination unit developed by RADG will be developed (see the Solarflow brochure).

Questions

(1) In no more than three paragraphs, describe the urban water system, its problems and some ideal solutions.
(2) More dams and bore fields or greater water efficiency: What are the trade-offs?
(3) What factors should be taken into account if you were asked to develop a total water cycle management strategy for an urban development?

References

CEPA (1993) **Urban stormwater: A resource too valuable to waste.** National Capital Printers, Canberra.

Dziegielewski, B. and Baumann, D. (1992) Tapping alternatives: The benefits of managing urban water demands. **Environment** 34 (9), 7-11 and 35-41.

Newman, P. and Mouritz, M. (1992) The urban/greenfields and rural planning context. **Managing stormwater: the untapped resource.** Workshop Proceedings, Environmental Technologies Committee Research Report No. 3. DITAC, Canberra.

Niemczynowicz, J. (1992) Water management and urban development: A call for realistic alternatives for the future. **Impact of Science on Society** 42 (2), No 166, 131-147.

Peace, F. (1991) Ancient lessons from arid lands. **New Scientist** 7, December 1991.

Pillai J, Mathew K, Gibbs R, Gawthorne T, & Ho G (1997), **Microbial Tests for Drinking Water Quality: On-Site Methods**.

Postel, S. (1992) **Last oasis: Facing water scarcity.** Norton and Co. New York.

Thomas, J.F. and McLeod, P. B. **Australian research priorities in the urban water services utilities area.** Division of Water Resources, CSIRO, Water Resources Series No. 9.

Microbial Tests for Drinking Water Quality: On-Site Methods

J. Pillai, K. Mathew, R. Gibbs, T. Gawthorne and G. E. Ho

1. Introduction

Microbial contamination occurs when faecal materials enter a drinking water source through sewage or run off water. Testing for the microbial water quality is an essential part of ensuring that drinking water is safe to drink. In remote areas and in developing countries microbial contamination gets noticed only when there is a disease outbreak. Waterborne diseases spread faster than any others affecting the entire community. An important part of solving this global problem is the regular assessment of drinking water quality and immediate remedial measures if any contamination is noticed. However in developing countries throughout the world, testing can not be carried out frequently because of distance from the laboratories, high costs involved and the level of expertise required for water testing. Therefore an adequate, simple and inexpensive field test is an immediate requisite. This paper explains how a suitable on-site field test could be made for testing the microbial quality of water.

2. Microbial indicators of water pollution

It is impossible to test water for each and every pathogens. There are many different pathogens which may be present in water. Testing for all of them would be too expensive and tests are not available for some pathogens. Water is therefore tested for suitable bacterial indicators of faecal pollution. Bacterial indicators are organisms that do not necessarily cause disease, but are always observed in predictable numbers when pathogens are present. They should be specific to faecal contamination and able to resist water treatment and disinfection process to the same or a slightly greater extent than the pathogens. An indicator organism should also be able to be detected by simple and rapid methods.

Coliform bacteria have been used as indicators for bacterial pollution since the early part of this century. Mostly nonpathogenic, they are present in the intestine of warm blooded animals and man and leave the body in the faeces. This has led to the use of coliform bacteria as indicators of faecal pollution in water. The method was adopted because it had proved difficult to culture and identify many specific human intestinal pathogens and was much easier to demonstrate the presence of non - pathogenic intestinal bacteria such as *Escherichia coli*. Other coliforms include *Citrobacter*, *Enterobacter* and *Klebsiella* species. According to the 'Guidelines for Drinking Water Quality' in Australia (NHMRC & ARMCANZ, 1996), potable water should be routinely monitored for the presence of total coliforms, thermotolerant coliforms or *E. coli*. The frequency of the test depends on the quality of water tested, the use of water sources, the treatment the water receives, the size and complexity of the distribution system, the previous history of water quality and the size of the population supplied with the water. If there are less than 1000 people using the system, water should be tested once a month and if there are more than 100 000 people water should be tested at least 13 times a month.

Although total coliform, and *E coli* counts perform as indicators of faecal pollution in warm waters, they are not exclusive to faeces and may also originate from soil, vegetation and sediments. Coliform organisms have also been noticed to multiply in receiving waters. Also pathogens have been found in the absence of indicator bacteria. Iveson and Fleay (1991) observed *Salmonella* sp in reptile and bird faeces in the absence of faecal coliform organisms. A spatially variable correlation between these indicator organisms and Salmonellae was also reported (Morinigo *et al.*, 1990).

3. Methods to analyse bacterial pollution

The standard methods (WHO, 1993) to assess the water quality by detecting coliforms are the Membrane Filtration (MF), the Most Probable Number (MPN) or the Multiple Tube Fermentation (MTF), the Presence - Absence (P/A) test and the Enzyme Detection Method (EDM). The P/A test and the EDM can indicate the presence or absence of both the total coliforms and faecal coliforms whereas separate tests are required with the traditional MF and MPN methods. The DelAgua Water Testing Kit developed by the University of Surrey works on the basis of MF to detect the number of coliforms in the sample. The EDM has more significance in remote areas since its principle is used in the comparatively simple microbial water testing kits such as the Colilert and the Colisure.

The Enzyme Detection Method was derived from the technology originally designed to identify microbes on the basis of their constituent enzymes (Edberg and Edberg, 1988). Enumeration of indicator bacteria based on enzyme reaction had the advantage of being more specific and more rapid than traditional culture methods (Feng and Hartman, 1982). A selective and differential medium for the simultaneous detection of both total coliform and *E. coli* in water samples is employed. The two active substrates, the chromogenic, o-nitro-phenyl B-D-galactopyranoside (ONPG) and the flurogenic, 4-methylumbelliferylB-D-glucuronide (MUG), are combined simultaneously to detect total coliform and *E. coli*. *E. coli* produces enzyme B-glucoronidase that hydrolyses MUG to form a fluorescent compound, which can be detected by a long wave UV lamp. The medium can be used in either Multiple Tube Fermentation (MPN) or Presence/Absence (P/A) configurations. The Colilert and Colisure are on-site bacterial tests based on this method.

3.1. The Colisure Test:

The Colisure is a simple and effective method for simultaneously enumerating both total coliforms and *E. coli*. The procedure involves the addition of water sample to the Colisure powder, mixing to dissolve and incubate to a maximum of 24 hours. The presence of total coliforms is indicated by the change of colour from yellow to red which is more easily noticeable than the Colilert method. The presence of *E. coli* is noticed by the presence of green fluorescence under W light. The Colisure test is marketed by the Millipore Corporation.

The Colilert has the same procedure as the Colisure. The difference is the end point where the colour change from clear to yellow for the presence of total coliforms or *E. coli* which is not as clear as the Colisure end point.

All these methods detect only the coliform bacteria whereas there is a need for a separate test for the pathogens such as Salmonella. The standard test for detecting *Salmonella sp* is a four staged procedure which take 96 hours for confirmation. In Western Australia, 30% of all

Salmonella has been identified in the absence of the coliforms (Peterson and Schorsch, 1980). At present there are no portable kit that can detect *Salmonella* A field test or method to assess the presence of both the indicators and the pathogens would be highly suitable in this situation.

3.2. Hydrogen Sulphide Paper Strip Method (H_2S Method).

The H_2S paper strip method was developed by Manja *et al.*, (1982) based on the observation that the presence of coliforms in water was often associated with H_2S producing organisms and enteric bacteria such as *Salmonella, Proteus, Citrobacter* and some strains of *Klebsiella* were found to produce H_2S (Allen and Geldreich, 1975). The project was funded by the International Development and Research Centre (IDRC), Ottawa, Canada and the H_2S method was first tested during an epidemic of hepatitis A infection in Gwalior, India.

Evaluation of the H_2S method has been conducted in different countries in tropical, subtropical and temperate climates. The H_2S method was used to test the water distribution system in India (Manja *et al.*, 1982), the tap water in the city of Lima, Peru (Ratto *et al.*, 1989), distribution systems in Banjaramasin, Indonesia (Kromoredjo and Fujioka, 1991), disinfected and non disinfected drinking water systems in Brazil (Martins and Pellizari, 1990) and in Chile (Castillo *et al.*, 1994, *Martins et al.*, 1996), the natural water sources in India (Venkobachar *et al.*, 1994), household water sources and drinking water in Malaysia (Desmarchelier *et al.*, 1992), drinking water in Thailand (Hewison *et al.*, 1988; Sivaborvorn and Dutka, 1989) and surface and well water samples in the United States (Grant and Ziel, 1996).

Preparation of H_2S paper strip medium

A concentrated medium was prepared by dissolving the following chemicals in 50 ml water (Manja et al., 1982)

Peptone	- 20 g
Di Potassium Hydrogen Phosphate	- 1.5 g
Ferric ammonium citrate	- 0.75 g
Sodium thiosulphate	- 1 g
Teepol	- 1 ml

Aliquots of 1 ml of the above medium were absorbed in folded tissue paper (80 cm^2) which was then placed in McCartney bottles, sterilised and dried at 50 degree centigrade under sterile conditions. Treated in this way the medium has an unlimited shelf life. Water sample (20mL) was then poured into bottle and allowed to stand at ambient temperature. Faecal pollution was indicated if the contents of the bottle turned black, in which case the water was graded unfit for drinking.

Principle of H_2S method

H_2S producing bacteria utilises sodium thiosulphate as a sulphur source. The thiosulphate is reduced to sulphide which reacts with ferric ammonium citrate to form a precipitate of iron sulphide which is black in colour. Iron sulphide may not form under acidic conditions. Peptone acts as a major source of nutrients and the medium does not contain any inhibitors or suppressing agents.

Agreement of the results of H_2S method with the standard tests

When considering the percentage of agreement of the results of H_2S method with the MPN method, Manja *et al.* (1982) obtained 88.34% for total coliforms whereas Castillo *et al.*(1994) and Venkobachar *et al.*(1994) reported an agreement between 81-85% and 87-91% respectively. A correlation of 83% for faecal coliforms and 96% for total coliforms was observed by Kasper *et al.*(1992). Martins and Pellizari (1990) observed approximately 70 - 90% agreement between the MPN test and H_2S method for faecal coliforms in raw and treated waters in Brazil. Sivaborvorn in the AIDAB project report (Hewison *et al.*, 1988) stated that the H_2S method gave 79.9 and 82.8% agreement for total coliforms and faecal coliform respectively. In highly polluted water, the agreement was even higher *ie.*84.6 and 87.8% for total coliforms and faecal coliform respectively. However Grant and Ziel (1996) observed an agreement ranging from 92.9-98.9% for total coliforms and 85.7-94.4% for faecal coliforms.

Effectiveness of H_2S method in reporting Salmonella

H_2S production was also associated with Salmonellae (Cowan *et al.*, 1974) and Salmonellae sp was also isolated from the H_2S positive tests (Castillo *et al.*, 1994; Manja *et al.*, 1982). Gawthorne *et al.* (1996) tested the suitability of the H_2S method to indicate *Salmonella* in drinking water. Pillai *et al.* (1997) observed that *S. typhimurium* could be detected at a temperature range of 14 – 44°C. The incubation period increase with the decrease in concentration. The main problem in using this method to indicate the presence of salmonella was because only 92% of *Salmonella* sp. produced H_2S (Jay and Davey, 1989). According to Morinigo *et al.*(1992) the microorganism most closely related to *Salmonella* was *C. perfringens* and the ability of the H_2S method to confirm the presence of *C. perfringens* (Grant and Ziel, 1996) will indirectly indicate the presence of *salmonella*. Incubation at 37°C produced faster detection of *salmonella* than at room temperature and the end result could be obtained m 24 hours.

4. Conclusions

The coliform tests such as the MF and MPN tests can efficiently detect coliforms, but the lengthy procedure and the need for two separate tests for faecal coliforms and total coliforms is a draw back.

The commercial kits were found to be as equally effective as the MF and MPN tests with an added advantage of detecting total coliforms and *E. coli*. The Colilert, Colisure and the H_2S bottles are on-site testing methods which are very simple and do not require technically trained personnel. Local people who have no experience in water testing could be trained to conduct the test.

As Colisure is a commercial kit it is expensive for routine analysis. H_2S bottles could be prepared in any laboratory so it is economical compared to all other tests in terms of cost of reagents, transportation and storage.

The incubation period is very critical for Colisure and therefore require incubators at 35°C whereas the H_2S bottles could be incubated at room temperature varying from 22 to 44°C.

The Colisure chemicals should be stored at 4-8°C while the H_2S medium has an indefinite shelf life at room temperature. The H_2S bottle requires only minimal laboratory support such as refrigeration, incubation and power supply. It was possible to conduct the test even when no laboratory facilities are available at the site.

Colisure give 100 percent correlation with the presence of total coliforms and *E. coli* whereas the H_2S method gives only 70 - 80% correlation. The H_2S method could reveal the presence of coliphages, *Clostridium* Sp and *Salmonella* Sp. which are also indicators of faecal pollution.

5. References

Allen, M. J. and Geldrich, E. E.(1975). Bacteriological criteria for ground water quality. *Ground Water*, **13:** 5-52.

Castillo, G., Duarte, R., Ruiz, Z., Marucic, M. T., Honorato, B., Mercado, R., Coloma, V., Lorca, V., Martins, M. T. and Dutka, B. J. (1994). Evaluation of disinfected and untreated drinking water supplies in Chile by the H_2S paper strip test. *Water Research.* **28:** 1765- 1770

Cowan, S. T(1974). *Cowan and Steels's Manual for the identification of Medical Bacteria*, Cambridge University, London.

Desmarchelier, P., Lew, P., Caique, W., Knight, S., Toodayan, W., Isa, A.R. and Barnesn A.(1992). An evaluation of the H_2S water screening test and coliform counts for water quality assessment in rural Malaysia. *Trans. Royal Society of Tropical Medical Hygiene*, **86:** 448-450.

Edberg, S. C. and Edberg, M. M (1988). A defined substrate technology for the enumeration of microbial indicators of environmental pollution, *Yale J. Biol.* **61:** 389-399.

Feng, P. C. S. and Hartman, P. A(1982) Fluorogenic assays for immediate confirmation of E. coli. *Applied and Environmental Microbiology*, **43:** 1320-1329.

Gawthorne, T., Gibbs, R. A., Mathew, K. and Ho, G. E..(1996). H_2S papers as presumptive tests for *Salmonella* contamination in tropical drinking water. *Wat. Sci. Tech.,* **34 (7-8):** 187 - 194

Grant, M. A. and Ziel, C. A (1996). Evaluation of a simple screening test for faecal pollution in water. *Journal of Water SRT-Aqua.,* **45(1):** 13-18.

Hewison, K., Mack, K. F. and Sivaborvorn, K (1988). Thai Australian Northeast Village Water Resource Project, Report No. 47. *Evaluation of a H_2S Screening Test.*

Iveson, J. B. and Fleay, B. J. (1991). Serovars of Salmonella isolated from humans, animals, waters and effluent in natural and disturbed environments in Western Australia. *Proceedings of the 14 th Federal Convention, Australian Water and Wastewater.* **2:.** 435-441.

Jay, L. S and Davey, J..(1989). *Salmonella: characteristics, identification and enumeration. In:* Buckle, K. A., Davey, J., Eyles, M. J., Hocking, A. D, Newton, G. and Stuttard, E. J.(eds), Foodborne microorganisms of Public Health Significance. pp 51-82, Australian Institute of Food Science and Technology (NSW branch) Food Microbiology Group, Australia.

Kasper, P., Guillen, I. Rivelli, D., Meza, T. Velazquez, H., Mino, D., Pozolli, L, Nunez, C., Zoulek, G. (1992). Evaluation of a simple screening test for the quality of drinking water systems. *Tropical Medical Parasitology*, **43:** 124-127.

Kromoredjo, P. and Fujioka, R. S.(1991). Evaluating three simple methods to assess the microbial quality of drinking water in Indonesia. *Environmental Technology and Water Quality,*. **6:** 259-270.

Manja, K. S., Maurya, M. S and Rao, K. M. (1982). A simple field test for the detection of faecal pollution in drinking water. *Bulletin of the World Health Organisation*. **60:** 797-801.

Martins, M. T., Castillo, G. and Dutka, B. J.(1996). Evaluation of drinking water treatment plant efficiency in microorganism removal by the coliphage, total coliform and H_2S strip tests. *In: IAWQ conference on Health Related Microbiology, Wat. Sci. Tech.* **35 (11 - 12):** 403 - 409

Martins, M. T. and Pellizari, V. H.(1990). Evaluation of coliphage test and other simple microbiological methods for the examination of drinking water and classification of water sources. In: Dutka B. J. and El-Sharaawi A. H. (eds) *The use of simple inexpensive microbial water quality tests.* IDRC Report, 1990, 79-92.

Morinigo, M. A, Cornax, R., Munoz, M. A, Romero, P. and Borrego, J. J. (1990). Relationships between Salmonella spp. and indicator microorganisms in polluted natural waters, *Water Research*, **24:** 117-120.

Morinigo, M. A, Munoz, M. A, Cornax, R., Martinez-Manzanares, E and Borrego, J. J.(1992). Presence of indicators and Salmonella in natural waters affected by outfall wastewater discharges. Marine Disposal Systems., *Water Science Technology*, **25(9):** 1-8.

NHMRC (National Health and Medical Research Council)(1997). Guidelines for drinking water Quality in Australia, Canberra Publishing and Printing, and Canberra.

Peterson, D. J. and Schorsch, I. (1980). The microbiological surveillance of drinking water in Western Australia, *WA Health Surveyor* **2** June, 7-11.

Pillai, J., Mathew, K., Gibbs, R. and Ho, G. E. (1997) Bacteriological water testing by H_2S Method. *Proceedings of the 23 rd WEDC Conference on Water and Sanitation for all: Partnerships and Innovations*, Durban, South Africa, 289 - 292

Ratto, A., Dutka, B. J., Vega, C., Lopez, C. and El-Shaarawi, A. H. (1989). Potable water assessed by coliphage and bacterial tests. *Water Research*. **23:** 253-255.

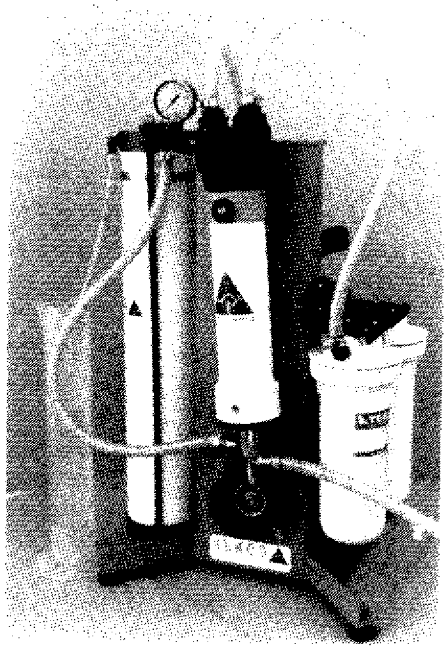
Sivaborvorn, K and Dutka, B. J.(1989). Coliphage presence in various types of potable water in Thailand. *Water Pollut. Res. J. Can.* **24(4):** 583-588.

Venkobachar, C., Kumar, D., Talreja, K., Kumar, A. and Iyengar, L. (1994). Assessment of bacteriological water quality using a modified H_2S strip test. *J. Water. SRT-Aqua.,* **43(6):** 311-314.

WHO (1993). *Guidelines for drinking water quality,* Second edition, Vol. I Recommendations, WHO, Geneva.

SOLARFLOW

SOLAR POWERED BRACKISH WATER PURIFIER



WEIGHT (PACKED)
57KG

DIMENSIONS (PACKED)
0.55 x 0.58 x 0.76 = 0.24cu.m

- Reverse Osmosis process separates dissolved salts and water-borne particles including pathogens.
- Produces up to 400 litres* of high quality drinking water per day.
- Powered directly from safe, low-voltage photovoltaic panels. No batteries needed.
- Compact rugged construction for easy transport.
- Low maintenance and easily serviced.
- Developed in collaboration with Murdoch University, Western Australia

G.P. & G.F. HILL PTY. LTD. ACN 008 969 104
29 OWEN ROAD, KELMSCOTT, PERTH, WESTERN AUSTRALIA 6111
TEL: (08) 9399 5265 FAX: (08) 9497 1335
INTERNATIONAL TEL: 61.8.9399.5265 FAX: 61.8.9497.1335

APPLICATIONS

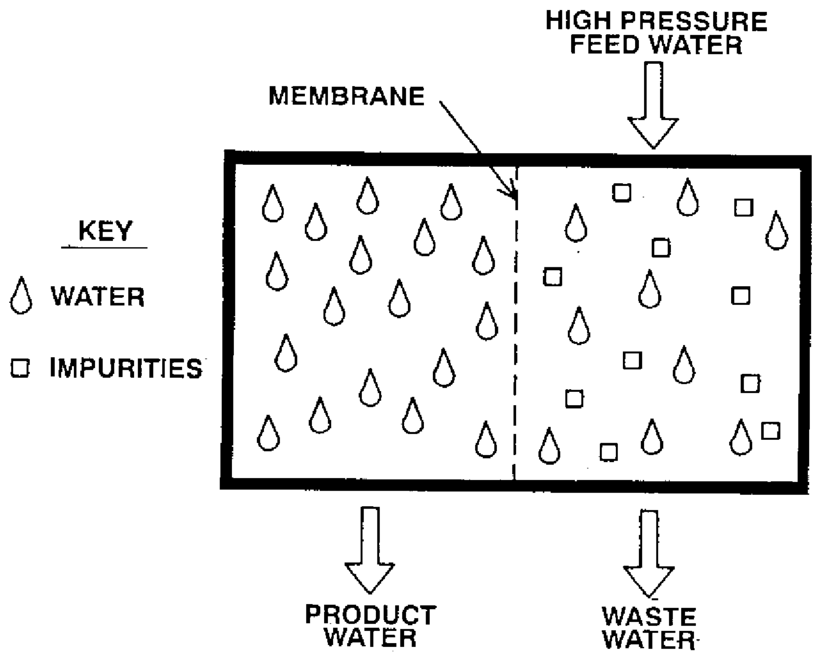
Providing high quality drinking water for:

- Small isolated communities
- Remote medical outposts
- Areas where potable water has been contaminated with salt or there is a risk of water - borne bacteria.

WHAT IS REVERSE OSMOSIS (R.O)

Osmosis is a naturally occurring phenomenon. Simply, if two salt solutions are separated by a membrane, water will pass from the more dilute side to the more concentrated side of the membrane.

Reverse osmosis is a process whereby high purity water can be produced by reversing this natural 'osmotic force' of a solution by pressurising the water to be treated . High quality water will then permeate though the membrane leaving the salts and other impurities behind.



THE PROCESS OF REVERSE OSMOSIS.

HOW THE UNIT OPERATES

A positive displacement piston pump, forces the pre-filtered raw water through a specially designed spiral membrane, housed in a corrosion proof cylinder. Approximately 10% of the pumped water is purified leaving the remaining water to constantly flush the membrane which minimises contaminant build-up. The waste water which is still pressurised, is then used to pump more water through the system via a unique energy recovery system. This system makes the unit self-starting and self-regulating at all operational speeds from sunrise to sunset.

Since the total dissolved solid (TDS) concentration of the waste water is only raised by approximately 10%, the water may still be used for other purposes.

* (Flow is dependent on water quality & solar input)

SESSION 4

Field Visit:

Chemistry Centre (WA), 125 Hay Street, East Perth

CHEMISTRY CENTRE (WA)

125 Hay Street East Perth
Western Australia 6004

"Chemistry Working For The Community"

CHEMISTRY CENTRE

Contact: The Director
Telephone: 61 8 9222 3177 **Facsimile:** 61 8 9325 7767
e-mail: chemist@dme.wa.gov.au

Background Information

The Chemistry Centre (WA) is a wholly Western Australian state government owned organisation which operates on a fully commercial basis.

Types of Work

- contract analytical and investigative work
- applied research in chemical and related scientific problems
- technical training – on-site and at the Chemistry Centre in Perth
- specialist investigations for government, industry and the general public.

Major Clients

- Government agencies with environmental, health, crime fighting, resource development and occupational health responsibilities
- Mining companies - gold, alumina, mineral sands, iron ore
- Contract research agencies – product/process development and control
- Members of the general public

We have undertaken **educational and technical advisory work** in South East Asia.

Accreditation by External Quality Accreditation Authorities

- Accreditation for an extensive range of chemical tests with the National Association of Testing Authorities (NATA), Australia, registration No. 8.
- Accredited by NATA for quality systems accreditation to Australian and International Standards AS/NZS ISO 9001:1994 - Registration No 6712.
- Regular participation in NATA and other professionally organised proficiency test programmes for the range of tests relevant to our accreditations.

EXTERNAL ACCREDITATION & PROFICIENCY TESTING –
ESSENTIAL QA ASPECTS OF LABORATORY OPERATIONS.

Technical Training and Educational Services

The Chemistry Centre can provide contract services for training chemists, technicians and occupational hygienists. Sampling, analysis, use of instrumentation, laboratory design and setup, site assessment and general laboratory testing are the main areas covered.

Scientific Capability

The Chemistry Centre has an excellent **staff and technology base**. Our staff includes over 50 professionally qualified scientists. These include chemists, biochemists and mineralogists. Many have published in the literature, some have lectured at tertiary institutions.

Major Instrumentation

- Inductively coupled plasma atomic emission spectroscopy (ICP-AES)
- Inductively coupled plasma mass spectroscopy (ICP-MS)
- Atomic absorption spectroscopy - flame, electrothermal and vapour generation
- Scanning electron microscopy (SEM)
- X-ray fluorescence spectroscopy (XRF)
- X-ray diffraction (XRD)
- Fourier Transform Infra Red spectroscopy (FTIR)
- Gas chromatography (GC), range of detection systems
- High performance liquid chromatography (HPLC), range of detection systems
- Gas chromatography - mass spectrometry (GC-MS), quadrapole and ion trap systems
- "Air Saturn" specialised GC-MS system for detection of organic components in gases
- Substantial range of optical microscopy equipment

This range of instrumentation is supported by all normal laboratory techniques and enables us to address complex problems with investigation of <u>solids, waters, sediments, dusts, gases, fumes, asbestos, chemicals, biota and virtually any sample matrix.</u>

Typical Problems Investigated

- Chemical spills in the environment – pesticides, cleaning chemicals
- Chemical residues in foodstuffs – heavy metals, pesticides
- Water testing and advice on treatment options to improve quality
- Mining and industrial effluents – monitoring and cleanup advice
- Hazardous waste treatment and disposal options
- Speciation of meat and seafood products – types of meats and species present
- Forensic and criminal investigations including blood alcohol levels and drugs
- Biological monitoring of people for exposure to chemicals
- Occupational hygiene testing, assessment of workplace environments
- Workplace drug testing
- Agricultural and environmental research
- Testing of gases and atmospheric discharges for pollutants

Key Contacts

Work Area	Contact	Telephone	Facsimile
Foods, agriculture, biochemistry	Neil Rothnie	61 8 9222 3038	61 8 9 325 7767
Environment, wastes, waters	Doug Ingraham	61 8 9222 3017	61 8 9 325 7767
Forensic, drugs	Neil Campbell	61 8 9222 3470	61 8 9 325 7767

SESSION 5

Industry Presentations I:

1. Process and Pollution Control Pty Ltd
2. BioMAX Pty Ltd
3. Environmental Solutions International

BATTLING THE BAD BUG

Angus Mac Dougall (1)
Damon Greenwood (1)
Helen Stratton (2)

(1) Process Pollution Control P/L
PO Box 42
KEDRON 4021 AUSTRALIA

(2) Griffith University
Department of Environmental Engineering
NATHAN AUSTRALIA

BACKGROUND

The paper presents a Wastewater Engineer's interpretation of the veterinary and medical profession's research into a major health risk namely *"CRYPTOSPORIDIUM"* that exists in underdeveloped areas.

The process described uses Solar Energy to Pasteurise a gravity or pumped water stream and is 99.999% effective in inactivating disease causing bacteria, viruses and most other fecal pathogens. In recent trials at Hawaii University, primary sewerage effluents were disinfected and achieved excellent results including seeded viral and salmonella streams.

Large cities and densely populated areas generally have state of the art wastewater treatment, but recent outbreaks of *Cryptosporidiosis* in the US and UK bring into question the security of water treatment plant's disinfection processes, but more importantly highlights the need to understand why the *"Cryptosporidium"* problem must be solved.

ABSTRACT

Population growth with in developing countries have resulted in contamination and depletion of existing water supplies. This coupled with the spread of waterborne diseases suggest that there is a need for more effective disinfectant or minimum water treatment that will give clean and efficient resources. The use of chemicals to treat drinking water is expensive and can result in by-products that may be carcinogenic and have negative environmental effects. During this century the use of chlorine in water treatment has eliminated typhoid fever and other waterborne diseases, however viruses and protozoa's such as *Giardia* sp. and *Cryptosporidium* sp. are resistant to chlorine and are now considered the major cause of waterborne disease. Boiling water will render such parasites non-infective but requires the use of valuable resources such as wood and other fuels, contributes to deforestation and adds to the production of so called greenhouse gases.

The paper looks at solar energy to produce a pasteurisation process that will provide drinking water to remote communities and developing countries. The system can operate on very poor quality waters. It consists of simple components with only one moving part and uses sunlight as the sole energy source.

"CRYPTOSPORIDIUM" - THE NEW BUG ON THE BLOCK

Crypto has now emerged, as possibly the major cause for diarrhea and gastric attacks attributed to E-coli and other fecal pathogens. First discovered in mice (1) Tyzzer in 1907 in humans in 1976 (2) This first case was a 3 year old child in rural Tennessee who had severe Gastroenteritis for 2 weeks.

Then it's fatal effects on AIDS patients was discovered in 1980 (3) by Tzipori when only 30 papers (4) on Crypto had been published. From 1980 to 1991 the papers published exceeded 950.

From the recorded papers referred to in the 1991 review of Crypto (4) we now find that most water journals have at least one Crypto article per issue.

From the first water outbreak in 1984 from a well, 1986,87 saw river water outbreaks (5) then airborne droplets were responsible during a severe diarrhoeal attack where attendants inhaled oocysts and became infected (1).

This normally waterborne disease gained extreme prominence with a massive outbreak in Milwaukee (5) where 403,000 people were reportedly affected or at risk and 104 deaths were attributed to *Crypto*.

Then followed 72 cases in 1995 in Florida and this year in the U.K. 2 outbreaks saw 'boil water' notices.

RESEARCH SUMMARY

The time scale following shows research into Cryptosporidium worldwide.

1907	First discovered in mice (Tyzzer)
1976	First discovered in humans (J.A. Nime et al)
1980	AIDS/ immunocompromised association discovered (Tzipori), total of 30 Cryptosporidium papers in circulation.
1991	Total of 950+ papers in circulation reported (Current & Garcia)
1984	First well water outbreak
1986	13,000 people affected, 54% of population in city of Carollton, Georgia (Current & Garcia)
1987	First river water outbreak
1988	First infection from inhalation of airborne droplets recorded. (Tzipori)
1987-91	*Cryptosporidium* recognised as the cause of Traveler's Diarrhoea (Current & Garcia) in their paper used about references even one (1) from North Queensland.
1992	Multiple municipal water supply outbreaks (Current & Garcia)
1993	Largest US outbreak in Milwaukee 403,000 reported cases, 104 deaths
1995	Alachua County Florida, 72 reported cases of *Cryptosporidiosis* (Andrew Wright)
1997	Three valleys, UK, boil water notice given after 300 cases of *Cryptosporidiosis* (A Wright)
1997	Bedfordshire UK, boil water notice given after 10 cases of Cryptosporidiosis (A Wright)
1997	Australian research into Solar Inactivation of *Cryptosporidium*

CRYPTOSPORIDIUM TESTING & IDENTIFICATION TIMELINE:

1993	15 different staining techniques in operation (Flanigan & Soave)
1993	Light & electron microscopy discovers thin and thick walled oocysts. (Flanigan & Soave)
1994	Mouse assay proving pasteurisation efficiency (R. Fayer)
1994	Warning on identification and interference in yeast, vegetable and mineral content waters (R. Fayer)
1997	"Non-red" staining is not necessarily "non-dead" (F. Rynne)

CRYPTOSPORIDIUM - THE PROBLEM

The identification of *Cryptosporidium* in water streams for both supply to treatment plants and treated water has been extremely difficult. There is a need for continued research for a low cost method to establish the degree of risk, i.e. to detect periods of seasonal or specific event hazard in the water supply catchment and storage. Then an effective quality assurance system plus monitoring the treatment plants performance will reduce the risks associated with *Cryptosporidium*.

However the following research highlights the difficulty in detecting the presence, then viability (i.e.; alive or dead) of the discovered organisms.

UNSAFE DRINKING WATER, THE MAJOR CHALLENGE WE FACE TODAY

Unsafe drinking water is the leading health challenge in the world today

- One billion people do not have access to safe drinking water.
- 80% of all diseases in developing countries are transmitted through water.
- Human feces pollutes water sources used for drinking and washing.
- 900 million cases of diarrhoea
- Four million children die every year - 34,000 per day, 1 every 10 seconds.
- Even in major cities, water can be unsafe and is boiled to prevent illness.
- Boiling unsafe water is an effective preventative measure for those that can afford it. Boiling consumes scarce natural resources and can contribute to de-forestation and air pollution.
- Contaminated water places a tremendous burden on the lives and health of the world's poorest people.
- It causes needless misery and death where the struggle for life is the hardest.

YOUR NEEDS AND CONSTRAINTS

SIMPLE LOW COST METHOD OF DISINFECTION

There is now a simple, low cost and effective solution to disinfect water.

- Disinfecting water no longer requires electricity, pumping systems, chemicals or boiling.
- Now water can be made safe to drink by using only the heat of the sun through the process of Pasteurisation.
- Pasteurisation has proven to be 99.999% effective for inactivating disease-causing bacteria, viruses and micro-organisms, even sewage laden water is completely disinfected.
- Pasteurisation does not eliminate chemical pollutants. SWS has taken pasteurisation one step further by utilising the heat from solar thermal energy to disinfect water.

The benefits of solar pasteurisation include:

- Saving shrinking natural resources - the world's forests
- Preventing soil erosion
- Reducing air pollution

Time and money spent gathering wood can be channeled into more productive activities with positive economic benefits for individuals and communities.

FINANCIAL BENEFITS

The financial benefits to communities are:

- Healthier children and older people.
- No chemical usage except for storage and reticulation, but a low level of chlorine only to prevent re-contamination.

- Poor quality river, bore water or roof collected rain water can be turned into Safe Water.
- Expensive pumping and centralised filtration & treatment plants can be planned for the future, and local treatment and pasteurisation carried out at the village/ hospital/ school/ health clinic/ or mine site etc.
- Commercial application - bottled or barrels of water can be sold.
- Tourism expanded - provision of safe water will encourage tourism with obvious financial benefits to the community.

CONCLUSION 1

Results to date have confirmed the results obtained in the University of Hawaii study for usual fecal and viral pathogens and indicators.

Our next steps are to perfect a viability procedure that is fool proof and definitive. We believe that the staining and fluorescing procedures need penetration into the shell of the oocyst. Thick and thin walled oocysts obviously will not stain and fluoresce equally so that viability tests appears to be dependent on the chemical degradation of the shell either from disinfectant, centrifuging, scrapping or naturally in bile conditions experienced in the body during diarrhoeal events.

Similarly we believe that boiling or par boiling in the pasteurisation process need not puncture or cause cracking in the outer shell, to allow the antibody or alternative stain to indicate viability of the Sporozoites that excyst (breakout) and start the replication process (refer P. O. Donoghue's life cycle diagrams)

Excystation of treated oocysts will be carried out to prove conclusively that pasteurisation will work on highly contaminated effluent waters and further research with natural streams and bore water is justified.

CONCLUSION 2

THE NEED CONFIRMED

The following figures are estimates of the extent of this problem in Australia:

1) 154 000 people living in communities of between 30 and 1000 are without a reticulated water supply,
2) 35 000 are served by schemes with severe capacity problems,
3) 14 000 are served by schemes with insufficient capacity to meet peak day water needs,
4) 29 000 have schemes with severe physical problems, and
5) 82 000 are served by schemes needing treatment for physical problems in order to meet NHMRC guidelines 1987 (Samra 1989).

The need confirmed above shows that there is definitely room for health improvements in remote communities in Australia, so we ask the age old question: What cost for quality of life?

REFERENCES

1) Tyzzer E.E, 1907. "A Sporozoan found in Peptic Glands of the Common Mouse" *Proceedings of the Society for Experimental Biology & Medicine* **5,** 12-13.

2) Nime F.A. *et al,* 1976. "Acute Enterocolitis in a Human Being Infected With the Protozoan *Cryptosporidium*" *Gastroenterology*

3) Tzipori, S., 1988 "Cryptosporidiosis in Perspective" p.82 "Advances in Parasitology", Vol 27, pp 63-129

4) Current, W.L. & Garcia L.S., 1991. Cryptosporidiosis Clinical Microbiological Reviews July 1991, pp 325-358.

5) Ford, T.E.& Colwell, R.R., 1996. "A Global Decline in Microbiological Safety of Water: A Call for Action" *American Academy of Microbiology Report*

6) MacDougall, A.A., Greenwood, D.H. & Stratton, H., 1997. "Australian Research Into Solar Inactivation of *Cryptosporidium*" Poster Paper Handout at UNEP Conference, 4-5th December.

7) Flanigan, T.P. & Soave, R., 1993. Cryptosporidiosis Progrees in Clinical Journals **3,** pp. 1-20

BioMAX™ Wastewater Recycling Systems

John Holbrook, Ray Durrant and Rajendra G Kurup
BioMAX Pty Ltd, Suite 1/231 Balcatta Road,
Balcatta, Western Australia 6021
Tel: (61) (08) 9345 3071 Fax: (61) (08) 9345 3171

INTRODUCTION

Of the many advances made in technology over the last 200 years, among the most important are the developments made in the treatment and distribution of water supplies and the treatment and disposal of wastewater. Disinfection of water supplies and appropriate wastewater treatment have been the major factors in the control of epidemics such as typhoid and cholera which have previously swept through communities. Emphasis is now being directed towards the need to treat wastewater adequately to reduce its environmental impact.

Domestic wastewater is typically 99.97% pure water. Unfortunately the contaminants which make up the remaining 0.03% are capable of causing serious disease and environmental degradation. These contaminants include body wastes such as fecal matter and urine, which may contain pathogenic (disease causing) organisms and other organic wastes which upon uncontrolled biological breakdown may result in septic conditions. Discharge of inadequately treated wastewater to natural waters can seriously affect aquatic life through reduction in oxygen levels and toxicity from the presence of ammonia and algal blooms which are promoted by the nutrients such as nitrogen and phosphorus in the wastewater.

The strength of wastewater is often defined by its 5 day biochemical oxygen demand (BOD_5) and total suspended solids (SS). The BOD_5 is the amount of dissolved oxygen used by bacteria over a 5 day period in the biological breakdown of the organic matter. A typical domestic wastewater has a BOD_5 of between 250 - 350 mg/L. The SS are normally also in the same range.

The first formal method used for treatment was to distribute the wastewater over suitable soils and to collect the effluent by underdrains. This method is known as a "sewage farm" as the resulting vegetation growth is often used as animal fodder. Although capable of producing a good quality effluent, the amount of land required was substantial and sewage farms soon lost popularity in favour of more compact methods.

Modern biological treatment involves enhancing the processes which take place in nature. Activated sludge treatment and trickling filter are widely used methods for large scale wastewater treatment plants at a municipal level, where sewer network exists. However, for remote areas and locations where sewer network is not practical, onsite treatment systems are employed.

Septic tanks systems and simple leach pit disposal methods have been considered to be the options for onsite wastewater treatment systems in many countries. However, because of the ground water pollution associated with such systems, environmental protection agencies or other concerned departments in many countries have made very high standards for onsite disposal systems.

Biomax wastewater treatment plants are onsite treatment systems, that are factory assembled reinforced concrete or fibreglass plants with capacities ranging from 10 to 60 population equivalent. BioMax wastewater treatment systems utilise anaerobic and aerobic methods to meet the standard discharge criteria for BOD_5 and Suspended solids of 20 mg/L and 30 mg/L. This is followed by chlorination to reduce the Fecal coliform count too less than 10 per 100 mL. The final effluent is often used to irrigate surface coverage such as small shrubs or ground cover.

PROCESS DESCRIPTION

The BioMAX wastewater treatment system incorporates five principal chambers;

a) Anaerobic chamber - primary settlement and anaerobic treatment
b) Aeration chamber - aerobic treatment
c) Clarification chamber - sludge settlement and removal
d) Disinfection chamber - contact time with chlorine
e) Pumpout chamber - discharge to effluent disposal (irrigation) area

a) ANAEROBIC CHAMBER

Wastewater is received into the anaerobic chamber. Approximately 30 - 50% of the suspended solids settle out in this chamber where they undergo anaerobic digestion. In addition, settled sludge and skimmed material returned from the clarification chamber are further digested in this chamber. The plant is sized to enable these microorganisms to maintain a sufficient population naturally without the need for the addition of proprietry biological products.

b) AERATION CHAMBER

The partially treated wastewater flows from the anaerobic chamber to the aeration chamber. Air is introduced by means of compressors and diffusers, maintaining aerobic conditions. The oxygen enriched effluent flows about a submerged media where beneficial bacteria thrive. The media has a discreet flow pattern with a large surface area and is self cleansing. A biological film with bacteria and other microorganisms forms on this media. These microorganisms utilise the dissolved and colloidal organic matter as food. The air pattern causes the liquid in the chamber to pass through the media in a discreet flow pattern and to have intimate contact with the microorganisms.

The BioMAX aeration system differs from ordinary suspended growth systems in that both sub-surface anaerobic and surface aerobic micro-organisms grow on the submerged media. This allows anaerobic bacterial action to continuously reduce the media growth, thereby reducing the biological sludge accumulation. Nevertheless, as the thickening of material on the media occurs, some sloughing off due to fluid movement will take place.

The two compartment design of the aerobic chamber ensures that no short-circuiting can occur, preventing partially treated wastewater passing to the clarification chamber. The diffused aeration system allows the air to be introduced below the media. It also allows adjustment of the air to provide most aeration at the head of the chamber, where the highest loading occurs - in accordance with modern "tapered aeration" principles. Basically the reaction in the aerobic chamber converts the dissolved and non-settleable (colloidal) solids into carbon dioxide and a biological floc, which, under quiescent conditions, will settle.

c) CLARIFICATION CHAMBER

Following aeration, the wastewater, along with the excess sludge, flows to the clarification chamber where the sludge settles under quiescent conditions. Settled sludge from the bottom of the chamber and floating material are returned to the anaerobic chamber. The return is effected by an air lift pump, capable of automatic and continuous operation. From the clarification chamber the effluent is drawn off at below surface level and flows through the automatic gravity chlorinator to the disinfection chamber.

The return of sludge to the anaerobic chamber provides a continuous supply of "food" to the plant and ensures a "healthy" system during periods of zero flow or extended vacancy of the property.

d) DISINFECTION CHAMBER

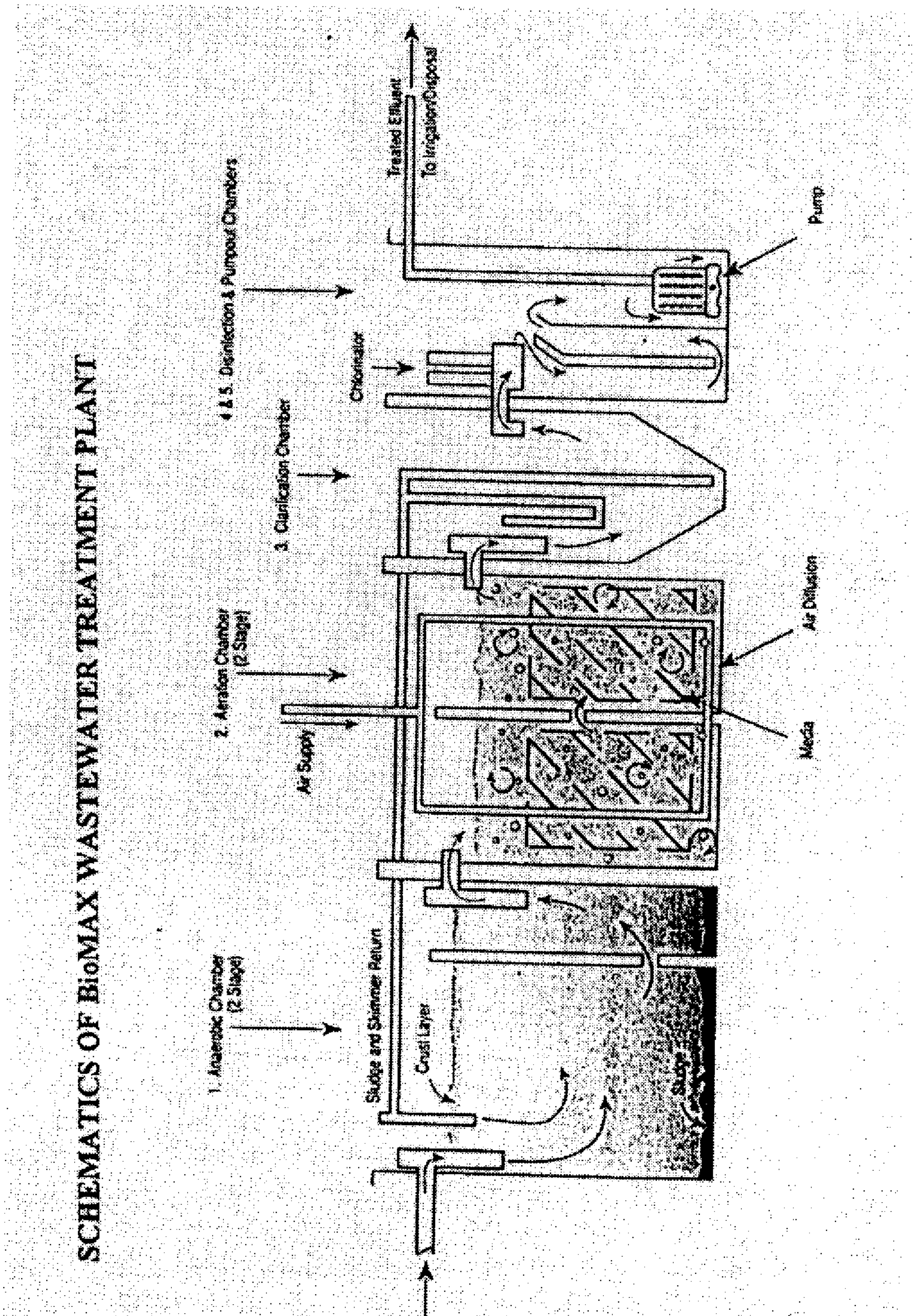
The discharge from the clarification chamber passes through an automatic gravity chlorinator en route to the disinfection chamber. The chlorinator is calibrated for above normal water usage. The chlorinator is stocked with sufficient chlorine to last for double the normal interval between the three monthly servicing.

The disinfection chamber is designed to provide a minimum of 30 minutes contact time between the effluent and chlorine to ensure achievement of bacterial die-off.

e) PUMPOUT CHAMBER

After disinfection, the treated effluent enters the pumpout chamber. The submersible pump in this chamber is automatically controlled by a level switch.

SCHEMATICS OF BioMAX WASTEWATER TREATMENT PLANT



OPERATION AND MAINTENANCE

The system has two mechanical moving items of equipment, two compressors and a submersible pump. They are protected by a 10 amp circuit breaker in the electrical control box, which is located in the compressor housing, in addition to the circuit breaker on the main switchboard. The electrical control box also has a 2 amp glass fuse for protection of the alarm circuit. The alarm circuit detects loss of air pressure (potentially compressor failure) and high water level in the plant (potentially pump failure).

In brief the operating requirements are:-

Daily -	Attend alarm calls (if any)
Monthly -	Replenish chlorinator with chlorine tablets
Quarterly -	Clean compressor filter elements
	Check alarm operation
	Check and adjust aeration system
Bi-annually -	Replace compressor filter elements
Periodically -	Desludge anaerobic chamber

Alarms
The alarm plate contains two visual indicators (LED's) and an audible alarm. Air system malfunction is indicated by the lighting up of the LED marked "AIR" and sounding of the audible alarm. A high water level in the pumpout chamber is indicated by the LED marked "WATER". The audible alarm also sounds. A switch on the alarm plate allows the audible alarm to be muted after a fault has been noted and corrective action commenced.

FINAL EFFLUENT QUALITY

The treated effluent from this system meets the stringent standards set down by the Health Department of Western Australia for above and below ground disposal of wastewater on passive landscaped and garden areas.

BOD_5	Not greater than 20 mg/L
SS	Not greater than 30 mg/L
Free chlorine	Not less than 0.5 mg/L at maximum flow
Fecal coliforms	No more than 10 fecal coliform organisms per 100 mL

CONCLUSION

We have already installed about 2000 BioMAX systems of different capacities in different countries, including Australia, South Africa, Indonesia and Malaysia. Some of the plants were constructed for camp sites, hotels, factories and mining sites. The successful performance of these plants has proven that BioMAX wastewater treatment plants are a better solution for onsite treatment of wastewater, and it is environmentally friendly as treated water is recycled for irrigation.

"LET'S TALK ABOUT YOUR ENVIRONMENT" AN INTRODUCTION TO ENVIRONMENTAL SOLUTIONS INTERNATIONAL LTD

ROBERT HEILBRONN
ENVIRONMENTAL SOLUTIONS INTERNATIONAL LTD
PO BOX 1495
OSBORNE PARK WA 6916

1. INTRODUCTION TO ENVIRONMENTAL SOLUTIONS INTERNATIONAL LTD

1.1 Technologies

Environmental Solutions International Ltd (ESI) supplies advanced waste management technologies and provides solutions for the treatment, recycling and management of wastewater and organic sludges.

Between 1974-1985, ESI traded as a private company in Australia. Since 1985, ESI has operated as a public company listed on the Australian Stock Exchange. In 1987/88, ESI commenced development and commercialisation of its environmental technologies and has, since then, secured significant orders.

ESI is fortunate in having a management team which represents a wide cross-section of industry and commerce as well as the waste management industry.

A key aspect of ESI's business is to provide processes that fully optimise the generation and recycling of treatment by-products. In many areas, improved cost efficiency and greater environmental "friendliness" is achieved by incorporating fuel and energy recycling into treatment systems, as well as extracting and processing useful, marketable by-products.

ESI's core technologies are:-

ESI SBR - **Sequencing Batch Reactor** for treatment of **domestic sewage** and low strength organic wastewaters such as:-

- Paper pulp waste
- Landfill leachate
- Food processing wastewater
- Textile wastewater
- Fruit Juice wastewater
- Dairy plant wastewater
- Hospital wastewaters
- Alcohol and perfume wastes

Biological Nutrient Removal is a significant feature of **ESI SBR.**

HYBRACTOR - **Hybrid High Rate Anaerobic System** for treatment of high strength organic wastewaters such as:-

- Abattoir effluent
- Brewery wastewater
- Beverage industry waste
- Wine industry effluent
- Pharmaceutical Industry Wastewater
- Alcohol distillery wastewater
- Pulp and paper wastewater

ENERSLUDGE - Cost effective resource recovery – sludge management technology. A particular feature is the ability to produce high calorific value fuel oil from organic sludge.

ESI has been awarded the two largest Design and Construct SBR contracts let in Australia in the past two years.

A consortium of ESI and Allied Constructions was awarded a contract worth in excess of $20 million for a 60,000 person SBR plant at Winmalee by the Sydney Water Corporation.

This has since been followed up by a $9 million order for a 40,000 ep SBR plant at Caboolture in Queensland based on our SBR technology and a 15,000 ep SBR plant augmentation for the Dalby Town Council where we are acting both as consultant and principal supplier.

In the past 18 months, ESI and its contracting partners have been awarded $50 million worth of orders for the treatment of sewage and sludge generated from 400,000 people.

We would point out that ESI is not simply an engineering consultancy, but a successful design and construct contractor with its own in-house process design expertise. Few companies, if any in Australia can make a similar claim. Therefore, our company structure is one suited for the dynamics of a tough contracting environment and not a traditional consultancy structure.

ESI has significant knowledge of SBR plant installations. Of particular interest is the SBR plant installed at Rottnest Island, Western Australia. This facility services a resort complex on an island near Perth and is closely monitored by regulatory authorities. The Rottnest Island SBR plant is consistently achieving biological nitrogen and phosphorus removal with average effluent N and P values of 4.5 and 0.6 mg/l respectively and BOD values of < 10 mg/l. Discharge is to sea and low nutrient concentrations ensure that algal blooms cannot proliferate in the receiving waters. Treated effluent from the Rottnest Island plant is utilised for irrigating the local sports field and golf course.

In addition to the SBR process which has achieved significant sales in the past 24 months, ESI has developed the high rate anaerobic reactor (HYBRACTOR).

Our engineers developed the concept for the HYBRACTOR in 1988, after an extensive review of worldwide design practices. A pilot demonstration plant was designed, constructed and operated for 12 months at the Western Australia Meat Commission (WAMC), with financial support from the WA State Government, under the Western Australian Research and Development (WARD) scheme.

The HYBRACTOR won the 1992 WA Industry and Export Award in the R&D category and a 30 m^3 HYBRACTOR is currently installed in a bakers yeast recycling factory in Indonesia. Operation is controlled from our Perth offices.

Full scale operating installations are at Matilda Bay Brewery and Spearwood Centralised Wastewater treatment facility with the most recent project operating at Leiner Davis Gelatin in Beaudesert, Queensland.

Our most recent order is for the retrofit of an existing UASB plant to a HYBRACTOR system for a candy factory in the Philippines.

ESI's commitment to remain at the leading edge of waste treatment technologies has resulted in a $22 million order for the world's first ENERSLUDGE™ plant. The plant will produce diesel oil from sewage sludge in much the same way as nature produces oil; however, the process is completed in 30 minutes instead of millions of years. About 300 litres of oil will be produced from each tonne of sludge and will be used on site to produce electrical power.

1.2 Staff

ESI staff have been involved in numerous wastewater technology development, demonstration and commercialisation programs as well as direct contract management.

For example, *Trevor Bridle* was responsible for the process design, commissioning and operation of the world's first industrial wastewater nutrient control facility which was commissioned by Du Pont in Canada in 1973. This predenitrification/nitrification facility, treating 4 ML/d of wastewater was successfully designed on the basis of results from laboratory and pilot scale test units.

Mark Newland was involved in the start up, commissioning and troubleshooting of the NZ Synthetic Fuels wastewater treatment plant in Montunui/New Plymouth, New Zealand. The NZSF facility was the first commercial plant to convert natural gas to liquid hydrocarbons and thus the wastewater treatment plant was also unique.

John Jennings was the Project Engineer for the design of a 100,000 ep IDAL plant at Quakers Hill and was appointed the Project Manager for the design and construction of the 120,000 ep Bendigo SBR sewage treatment works.

Mal Peters was the Engineering Manager for the 120,000 ep Bendigo SBR Sewage Treatment Works and was responsible for design approval, staff training, commissioning and operation of the plant.

2. SEQUENCING BATCH REACTOR (SBR)

2.1 Introduction

We recommend the **ESI SBR** system for treatment of domestic and low strength or pre-treated industrial wastewaters.

ESI SBR wastewater technology is a simple 2 basin arrangement where all the process of:-

Carbonaceous treatment
Nitrification
Denitrification
Phosphorus release
Phosphorus uptake and
Biomass selection

are all performed in a single reactor. The conventional plant zones to create anaerobic, anoxic and aerobic zones and clarification are created in this single basin by interruption or adjustment to flow and aeration. The process described below is typical. Operating costs are far less than competitor systems.

2.2 Process

The **ESI SBR** process is a variable volume activated sludge system which operates as a Sequencing Batch Reactor. A typical **ESI SBR** plant consists of two process basins with an influent reaction zone and air diffuser system to provide aeration and mixing of the biomass. Rotating out-of-basin surface skimmers fitted with positive floating scum barriers completely replace conventional clarifiers. Recycle and sludge wasting are provided by use of simple in-basin submersible pumps. A process control centre controls the air-on/air-off sequences, settling time, effluent decanting and flow distribution.

The aeration is controlled by the process control centre via input to a variable speed controller on the positive displacement blowers.

The process design is for a short sludge age and further stabilisation of sludge is undertaken by utilising a separate aerobic digester.

This sludge digestion basin is intermittently aerated and, with decanting, the settled sludge is able to be concentrated up to 2.0-3.5% depending on operator's needs.

Typically, the **ESI SBR** process will produce an effluent with less than:-

10 mg/L	BOD
10 mg/L	TSS
1 mg/L	NH_3-N

2.3 Nutrient Removal

Nitrogen removal is a prime objective of many facilities and the **ESI SBR** provides a large degree of N & P removal at secondary treatment cost.

2.3.1 Biological Selector

A BioSelector is provided at the front of each aeration basin to ensure that soluble biodegradable substrate is removed from the feed before it enters the completely mixed basin. A high So/Xo ratio is provided for at all times in this selector thereby providing a competitive advantage to organisms that either provide good settling characteristics or are able to bio-accumulate phosphorus or both.

This BioSelector is critical to the process as it ensures the promotion of a sludge that settles well. Typical operating SVI's for **ESI SBR** plants are in the order of 50 – 60 m^3/kg. Continuous plants are not able to achieve such a low SVI.

Effluent quality reflects this SVI with a typical 10:10 effluent. The BioSelector alternates between anoxic and anaerobic conditions depending on whether or not the aeration cycle is on. It therefore provides a role in the denitrification and P-release mechanisms.

2.3.2 Oxygen Utilisation

During the aeration period, continuous monitoring of oxygen utilisation is used to control the aeration intensity. The **ESI SBR** system is unique in its successful measure of oxygen utilisation. The aeration intensity is adjusted to follow a pre-determined algorithm programmed into the control centre. This control of aeration has several advantages:-

- Allows **efficiency of aeration** by maintaining the maximum driving force attained by using a low dissolved oxygen level.

- Provides adequate oxygen as measured by the biomass but not excessive oxygen, **thereby saving power**.

- Enables **co-current nitrification/denitrification** by not over-aerating.

- Allows a high intensity aeration to be provided at the end of the aeration cycle thereby **avoiding bulking problems** associated with poor aeration or high unaerated mass fraction.

The aeration control therefore provides significant advances over conventional DO control.

It allows a simple, reliable, automatic control that enhances biological nutrient removal making it a reliable, predictable process instead of the variable, unreliable process it is in a continuous plant.

Not only is Biological Nutrient Removal therefore enhanced, it is also made simple and reliable without the need of sophisticated measurements, controls or high technical staffing requirements.

Typically TN and TP concentrations of 5 mg/l and < 1 mg/l respectively, would be expected with the ESI SBR process.

2.4 Comparison with Other Processes

The **ESI SBR** system is unique in that it is able to achieve so much in a single basin. It is the simplicity of the ESI process, its enhanced performance and reliability that gives ESI the comfort to offer this as a solution to many clients and as a demonstration of the advantages of Australian technology over its foreign competitors. Other continuous processes are similar to each other in offering complex flow sheets that are expensive to build, expensive and difficult to operate.

Biological Nutrient Removal was introduced, at a high standard, to Australia by Mr. Mal Peters of ESI with his early work at Bendigo (Vic). This was a state-of-the-art continuous process and in order to meet the standards required this already complex process requires further design and control inputs. Both Mal Peters and the design/construction/ commissioning manager of Sinclair Knight Consultants for the Bendigo project (Mr. John Jennings) now work for ESI in offering alternate systems to the normal continuous process.

The intermittent system developed in Australia, enhanced by nutrient removal requirement in the USA, and backed by ESI is the most cost-effective, quality solution to wastewater treatment.

3. THE HYBRACTOR TECHNOLOGY

3.1 Anaerobic Treatment Fundamentals

Anaerobic effluent treatment involves the conversion of organic pollutants into methane and carbon dioxide by naturally occurring microorganisms in the absence of oxygen. Complex organics are broken down into simple acids (such as acetic and propionic) by a mixture of specialised bacteria. These acids then form a substrate for methanogenic bacteria responsible for further degradation and the generation of useful methane biogas.

Traditionally, anaerobic digestion has been employed in the stabilisation of sewage sludges and farm manures. Large "digesters" with long hydraulic retention times of 20-25 days have been used.

Increased trade waste charges for effluent disposal have given fresh impetus to the development of profitable methods of biological pretreatment of industrial wastewater. The most recent developments are **high rate anaerobic processes** for treatment of high strength effluents. These processes operate with short hydraulic residence times (often less than 20 hours) and high organic loadings, thus reducing reactor size, land area requirement and capital costs.

Features of the anaerobic process which make it more cost effective than other processes for industrial wastewater pretreatment include:-

- Low operating and maintenance costs
- Energy recovery in the form of methane gas

- Low production of excess (stabilised) sludge
- Odourless operation

3.2 Anaerobic Reactor Designs

The inherent principle in design of anaerobic bioreactors is the establishment of effective contact between the microbial solids and the organic pollutants present in the effluent. High rate systems aim to widen the gap between solids residence time and hydraulic residence time within the reactor. The choice of systems has ranged from suspended bed systems (upflow anaerobic sludge blankets or UASB's) to fixed film technologies (anaerobic filters and hybrid systems).

Hybrid reactors combine suspended bed and fixed film systems in the one unit. This complimentary design exploits the best features of both technologies and overcomes their individual limitations.

Hybrid systems have the greatest industrial potential and are rapidly becoming established as the most dependable, cost effective and stable process. In addition, they are being used to revamp existing UASB and anaerobic filter plants because of this enhanced stability and improved retention of the anaerobic microorganisms within the reactor. The flexibility and robustness offered by this process have eliminated many of the early problems associated with anaerobic waste treatment.

3.3 The HYBRACTOR - Hybrid High Rate Anaerobic Reactor

ESI's HYBRACTOR contains a suspended bed of flocculant microorganisms. An array of injector ports provide even feed distribution from the bottom of the reactor and maintain the flocs in suspension with an upflow of effluent. Gentle hydraulic mixing aids release of gas bubbles from the active biomass. Results on a variety of wastes have shown that very high biomass concentrations can be achieved in this lower section. Harder to degrade suspended solids and oil and grease emulsions in the effluent are tapped within this bed and broken down.

Packing material in the upper section of the reactor provides a high surface area for microorganism attachment. Microorganisms grow as a "biofilm" on all exposed surfaces of the packing where they consume soluble pollutants in the effluent as it sweeps upward. This attached biofilm greatly enhances reactor stability. The rigid packing material has been specifically designed to prevent plugging and has proven itself in many large scale applications over several years. Solids carryover from the HYBRACTOR is very low, generally 100 ppm or less, as the packing acts like an internal settling device and also fosters excellent gas disentrainment. These are major advantages over competitors (such as UASB reactors) which do not remove suspended solids and during upsets, can suffer from severe carryover problems.

Biogas is collected from the headspace of the reactor and removed for use in steam generation or other heating equipment. The biogas generally has a methane content of 70%, the reminder being carbon dioxide.

Reactor size is determined by the organic loading rate that can be achieved (in kg COD/m^3/day). This is related to effluent type and strength and can range from as low as 5 kg

$COD/m^3/day$ for hard to degrade wastes such as oils and fats to over 20 kg $COD/m^3/day$ for simple sugars. Operating temperatures are generally between 20 °C and 40 °C. COD and BOD, removal depends on loading rate and there is generally a trade off between capital cost (ie. reactor volume) and percent removal. Nevertheless **80-90% BOD_5 removal is targeted.**

The HYBRACTOR is patent protected.

3.4 Where is the ESI HYBRACTOR Applicable?

Many industries generate effluents that are appropriate for high rate anaerobic treatment. Effluents with BOD_5 greater than 1000 mg/L are particularly suitable and there is not really any upper limit. If discharge is to sewer, considerable savings can be achieved in trade waste fees. In other situations environmentally damaging discharge to receiving waters can be prevented. Plant fuel costs can be offset through off site generation of methane gas. Often segregation of high and low strength waste streams within the plant can enhance treatment options.

Anaerobic wastewater treatment has been demonstrated throughout the world in industries such as:-

- Dairies
- Distilleries
- Abattoirs and Meat Processors
- Vegetable Processors
- Pharmaceutical
- Breweries & Wineries
- Food and Soft Drink Plants
- Pulp and Paper
- Fish Processing
- Tanneries

The HYBRACTOR is suitable for treatment of wastewaters from all of these industries.

4. THE ENERSLUDGE PROCESS: AN ENERGY AND COST EFFICIENT SLUDGE MANAGEMENT SYSTEM

4.1 Introduction

Increasingly stringent agricultural reuse standards, banning of ocean disposal and strict landfill criteria are forcing wastewater treatment plant operators around the world to seriously evaluate alternate thermal-based sludge management systems. Historically, agricultural use of sludge was regarded as the only viable reuse option. However, recent advances in thermal based technologies have clearly demonstrated their ability to recover resources and energy and are now viable sludge reuse options.

To be publicly and environmentally acceptable, sludge management technologies of the future will need, at minimum, to offer the following:-

1. Maximum flexibility of operations and byproduct marketing.
2. Demonstrated resource and/or energy recovery.
3. Minimisation of volume of byproducts requiring transport off site.
4. Compliance with worldwide environmental/health standards.
5. Benefit derived from sludge reuse must outweigh the environmental impact from recovery/reuse.

6. Value of recovered resources must outweigh the total resources invested.

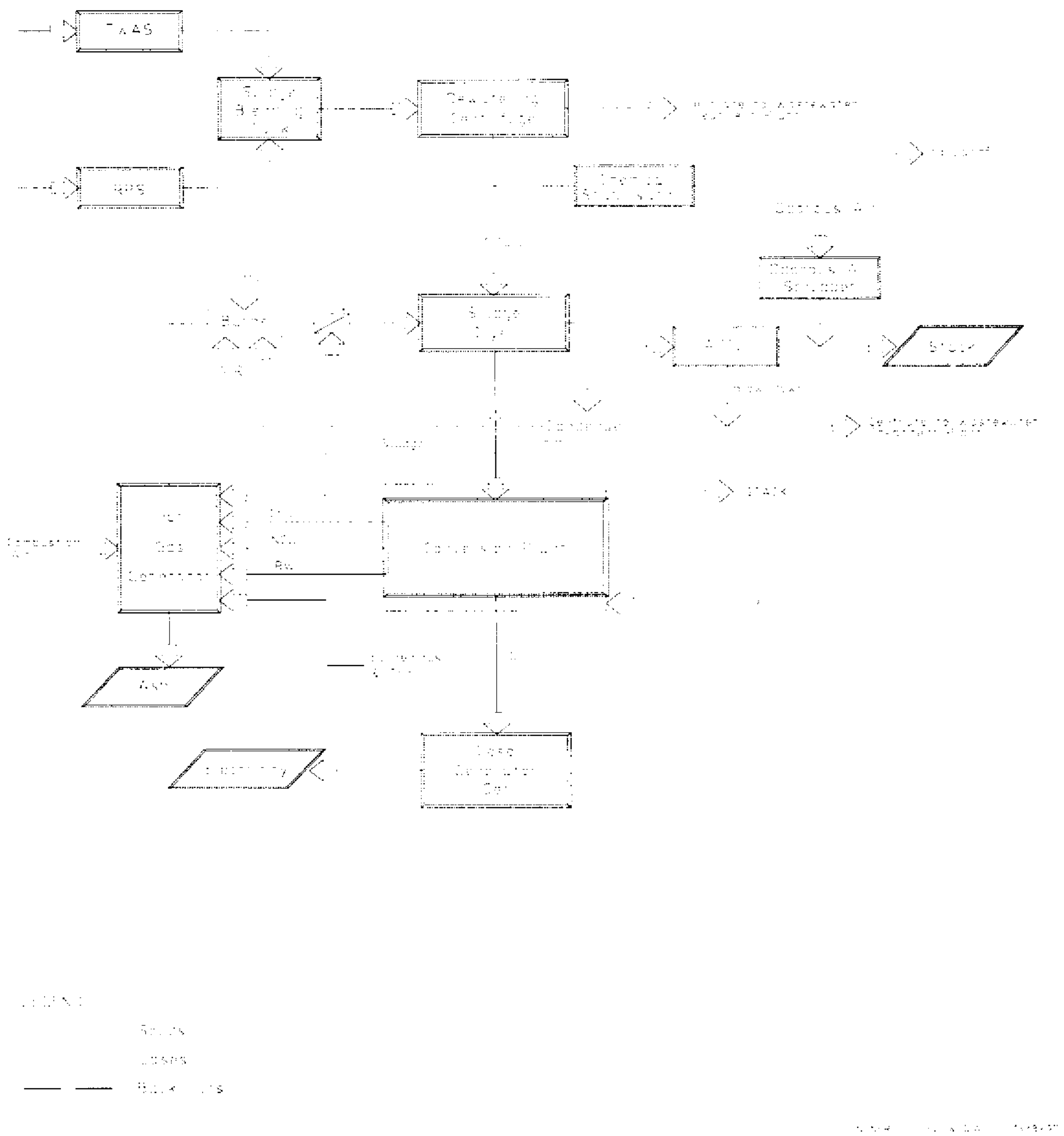
The ENERSLUDGE process is one technology that meets these objectives. The Water Corporation of Western Australia awarded a contract to the ESI-Clough Joint Venture, in November 1996, to build and operate the world's first commercial ENERSLUDGE plant at their Subiaco Wastewater Treatment Plant. The ability of the process to meet the above objectives, including investment in the technology by the Energy and Research Development Corporation, were instrumental in the Water Corporation's decision making processes.

4.2 Technology Description

The ENERSLUDGE process mimics nature by thermochemically converting sludges to oil, char, gas and reaction water. The process has been demonstrated on municipal, pulp and paper, tannery and woolscouring sludges. Sludge conversion takes place in a dual reactor system at essentially atmospheric pressure, in the absence of oxygen, at 450 °C. Alumino-silicates and heavy metals, present in the sludge catalyse the vapour phase conversion reactions. The oil produced is similar in nature to a middle distillate fuel and can be used to fuel both internal and external combustion engines. Furthermore, the oil has oleophillic properties and can be used as a specialty chemical, such as an Anti-Stripping Agent (ASA), used in the manufacture of asphalt cement.

The process requires that sludge is dried prior to processing in the conversion reactor and the typical process flowsheet for an integrated plant is shown in Figure 1. As can be seen, the low grade fuels produced, namely char, gas and reaction water are combusted to provide the energy needed for drying the sludge. Alternative process configurations are possible, dependent on sludge quality and environmental constraints.

Figure 1: Process Flowsheet



4.3 Technology Attributes

The process offers demonstrable energy and resource recovery, environmental and economic benefits as outlined below:-

4.3.1 Energy and Resource Recovery

The process can be configured to recover the following reusable products from sludge:-

i) A dried sludge product for agricultural/fuel use.
ii) Oil for use as a fuel or specialty chemical.
iii) Char for use as a fuel/adsorbent.
iv) Activated char for use as an industrial adsorbent.
v) Ash for use in concrete mixes.

This diversity of product ranges offers plant operators significant flexibility to ensure maximum product reuse. Plant operating strategies can be tailored to meet product market demands.

Typical product data for raw municipal sludge are shown in Table 1 below:-

Table 1: Typical Product Data for Raw Sludges

Product	Yield (%)	% of Sludge Energy
Oil	30	60
Char	50	32
Gas	10	5
Reaction Water	10	3

As can be seen, oil is the major energy product, containing about 60% of the raw sludge energy. In the normal process flowsheet (Figure 1) the low grade fuels (char, gas, water) are combusted onsite to generate the energy required to dry the sludge. Consequently, the oil can be regarded as the "exportable" or "nett" energy from the process.

In this integrated mode of operation, the end products of the process are oil and ash from combustion to the char. Testing has shown that the ash can be used as a replacement for sand in concrete mixes.

The examples of energy and resource recovery using the process show true "beneficial reuse" of sludge. Contrary to the widely held belief, agricultural reuse of sludge can often not be "beneficial" as generally believed. When considering the beneficial reuse criteria of:-

- i) Resource Recovery
- ii) Health Protection
- iii) Benefit versus Total Impact, and
- iv) Recovered versus Invested Resources,

it has been shown that this process performs significantly better than most agricultural-based reuse options.

4.3.2 Environmental Impact

Sewage sludge, having a very high surface area, adsorbs most of the intractable contaminants in sewage. Thus sludge is contaminated not only with human pathogens and viruses but also heavy metals and chlorinated organics such as pesticides, PCBs and dioxins, the legacy of human civilisation. It is the accumulation of these contaminants in the food chain that have led to the development of increasingly stringent sludge reuse and disposal guidelines. These standards are likely to become even more stringent due to the recent USEPA reassessment of dioxins concluding that impact on the human reproductive and immune systems was greater than previously estimated.

These trends have resulted in increased use of incineration for ultimate sludge treatment. Incineration significantly reduces the volume of sludge requiring disposal and also the negative impact of human viruses and pathogens. Furthermore, incineration also immobilises most of the heavy metals, making them unavailable for uptake by plants, animals and humans. It does however, significantly increase air pollution compared to other treatment systems. However, since sludge incinerators are not designed to be toxic waste incinerators, the organochlorine components in sludge will not be completely destroyed and some will be emitted in the flue gas.

In contrast, this process overcomes all of these problems, thus providing an environmentally superior sludge disposal technique. Specifically, the process has been demonstrated to destroy organochlorine compounds present in sewage sludge via reductive dehalogenation reactions. This unique environmental benefit allows the technology to meet stringent air emission standards without expensive air pollution control equipment. In a similar vein, the process immobilises all the heavy metals in sludge, making them unavailable for leaching and transport up the food chain.

In the conversion reactor all the metals, with the exception of mercury, are retained in the char. Mercury is reduced in the reactor and recovered for reuse or treatment and disposal leaving the products essentially mercury free. Upon combustion the metals are retained in the ash and converted to non-leachable oxides and silicates. Furthermore, since no organochlorines are fed to the combustor, operation can be optimised (low temperature) to minimise metal emissions. This overcomes the current dichotomy between organochlorine destruction and metal volatilisation in sludge incinerators. Metal emissions are thus maintained well within the most stringent worldwide emission criteria without the need of costly air pollution control equipment such as activated carbon filters.

4.3.3 Economic Benefits

Independent costings of various sludge management options have shown that this process potentially offers significant economic benefits. The fact that the Water Corporation of Western Australia chose this management option rather than upgraded anaerobic digestion/energy recovery does demonstrate its potential economic advantages. A significant economic attribute of the technology is that the sludge is "destroyed" in the process and hence there are no contingent liabilities with respect to the long term concerns regarding sludge disposal to land.

4.4 The Subiaco ENERSLUDGE Plant

The ENERSLUDGE facility is designed to process raw primary sludge (RPS), thickened excess activated sludge (TEAS) and grit and screenings from the Subiaco WWTP, with a capacity to treat all the material produced in the year 2040, estimated at 33 dry tonnes per day (tpd). Laboratory scale sludge conversion trials were conducted to obtain process design data for the full scale plant. A summary of these design data are shown in Table 2 below.

Table 2: Plant Process Design Data

Product	Yield (%)	Gross Calorific Value (MJ/kg)
Oil	34	32
Char	43	16
Gas (NCG)	12	19
Reaction Water (RW)	11	3

As can be seen, the conversion process transforms sludge into four products, each with positive fuel value. The conversion process operates at essentially 100% efficiency.

Raw primary sludge and TEAS are blended prior to being dewatered to 28% TS using a solid bowl decanter centrifuge (Figure 1). A back up chemical stabilisation facility (RDP) is provided to stabilise the raw sludge for landfill disposal, during thermal plant downtime. Under normal operating conditions, dewatered sludge is dried in a flue gas dryer producing a granulated dry sludge product at 95% TS. The dryer operates with a closed loop of recirculating drying air, which passes through a condenser to remove the water evaporated from the sludge. The drying air is reheated to 450 °C in a heat exchanger which is heated by hot gas at 1000 °C from the Hot Gas Generator (HGG). The HGG provides about 95% of the energy required for sludge drying with a small amount of LPG combusted for "top-up" and control purposes. Exhaust gas from the heat exchanger, at 200 °C, is cleaned in a two stage air pollution control device (APCD) to remove particulates and acidic gases. The plant exhaust is designed to meet the stringent TA Luft 17BimSchV emission standard. Condensate from the drying circuit and centrate from the centrifuge are piped to the sewage treatment inlet works.

Dried sludge at 95% TS is metered to the patented sludge conversion system which comprises a dual stage reactor system. In the first reactor, dried sludge is heated to 450 °C in the absence of oxygen to generate char and a raw conversion gas. This gas is condensed, the oil separated and reinjected into the second reactor where it is contacted with char at 450 °C to facilitate the catalysed thermo-chemical conversion reactions. The refined vapours are again condensed in a second condenser and the oil and water separated in a coalescing plate separator. The oil is finally polished in a disc centrifuge to remove small water droplets and fine particulates. The reactor is heated indirectly via LPG.

The low-grade conversion fuels, namely char, NCG and RW are combusted in the fluid bed HGG to provide the energy needed for drying the sludge. The HGG also combusts grit and screenings from the WWTP. To minimise volatilisation of heavy metals and sulphur present in the char, the bed temperature is maintained at <850^0C. The free board temperature is increased to 1050^0C via combustion of the NCG. Fly ash is removed from the hot flue gas prior to use in the dryer heat exchanger. The HGG is also designed to combust dried sludge. This allows the plant to be operated as an autogeneous sludge drying facility during times when the conversion system is down.

The refined oil produced is then available for use on site to generate electricity, for sale as a fuel or for sale as a specialty chemical, such as Anti-Stripping Agent (ASA), which is used in asphalt cement. All three options for oil use will be evaluated at the Subiaco WWTP.

A summary of plant inputs and outputs, at the 2040 design rates, is shown in Table 3 below. If the oil is combusted in the engine, 1.1 MW of power will be produced.

Table 3: Plant Inputs/Outputs for the Year 2040

Product	Plant Input (tpd)	Plant Output (tpd)
RPS + TEAS	25.38	
Grit and Screenings	5.9	
Oil		8.2
Ash		4.4

4.5 Summary and Conclusions

The ENERSLUDGE plant will provide a cost effective long term solution for the management of sludge at the Subiaco WWTP. Particularly, this facility will provide the following benefits:-

i) Control of odours from the sludge management plant.
ii) Compliance with all environmental/emission limits.
iii) Provision of maximum flexibility with respect to saleable byproducts. The following byproducts can be produced:-

- dried sludge
- activated char
- oil for use as a fuel
- oil for use as a specialty product
- ash for use as a building materia

iv) Provision of true resource recovery, with about 50% of the sludge energy being available for sale or the production/sale of other marketable products.
v) Minimisation of greenhouse and other gaseous emissions.

SESSION 6

Reports from Delegates II:

Mr. Tun Than Tun, Myanmar
Mr. R. Shrestha, Nepal
Ms. Sereana Kubuabola, Fiji

Lecture IV:

Permaculture - A Sustainable Urban Agriculture

Martin Anda

Environmental Conditions of Yangon City

TUN THAN TUN
Head of Coordination Department
Yangon City Development Committee
City Hall, 420/450, Maha-Bandoola street
Yangon, Myanmar
Tel. 951- 283219 Fax. 951 -289705

Introduction:-

Myanmar formally known as Burma is situated at the east of India and Bangladesh, south of China and west of Laos and Thailand. Yangon, the capital of Myanmar, is situated in the delta of the Irrawaddy River, the main part of the city lying in the area between Yangon River and the Pazundaung Creek above the confluence of these two rivers and the Bago River.

Yangon is a city of 3.5 million population (approximately 5 million including floating population) The city has grown rapidly in recent years and new suburban satellite townships have been developed to accommodate the increasing population and to resettle inhabitants from the congested inner areas.

The city has retained many of the qualities and feature of the bygone era and is devoid of many of the problems and difficulties that beset many modern cities. Yangon is endowed with two picturesque lakes: Kandawgyi (formerly Royal Lake) near the city's center, and Inya Lake (formerly Victoria Lake) four miles to the north. The central area, located close to the river, is still dominated by somewhat dilapidated colonial-style buildings and broad tree lined streets: this area contains most government offices, shopping, the port, and business and commercial activities.

The city has historically grown northwards from the central area and development has been severely constrained by the Hlaing (Yangon) River and Pazundaung Creek. The area of the city has expanded from around 33 square mile in 1920, to over 80 sq miles in 1974 and 133 sq miles in 1985. Following the change in government in 1988, the city area has been further extended to 223.217 sq miles, by the inclusion of substantial additional areas to the west of the Hlaing (Yangon) River and east of Pazundaung Creek. However, the most area of Yangon City is covered by the various kinds of trees.

Environmental Conditions:-

Air quality:

Yangon is geographically situated in a region that is influenced directly by the southwest monsoon in rainy season. The city has an average rainfall in excess of 100 inches (2540 mm). There are three industrial zones, already set up and some production activities are starting now. However, the pollutants emitted by these factories are significantly low and most of the factories taking energy from electricity provided by government and a few factories using rice husk for heating their boiler such as; distilleries, rice mill etc. According to the "Yangon Transportation Systems Management Study Report", there was only 77,000 (seventy seven thousand) vehicles in (1988) registered in Yangon and increased to 122000 (one hundred and twenty two thousand) vehicle in 1992. It can be assumed that approximately over 300000 (three hundred thousand) vehicles being utilized in transportation system in the city (including, private, government and institution). Other transportation such as trains, boats, air planes relatively lower than other cities. Electric power generating by fossil fuel and refuse burning have not been practiced in the city. Due to lower amount of air pollution sources and meteorological advantage, Yangon air quality is still below 50 psi.

Water quality:

Water supply to Yangon City is conveyed by the main trunk lines (66, 56 and 42 inches) from 3 reservoirs, which are surrounded by restricted catchment areas, can be kept out of contamination and analysis the drinking water quality periodically. Two industrial zone established on the bank of Hlaing (Yangon) river, discharged their effluent without treatment in to the river. Hlaing river has minimum flow of fresh and tidal water about 91,000 cuft second in May (summer) and maximum flow of 210,000 cuft per second in rainy season. Furthermore, Yangon sewerage system discharges 15 mgd. (27 cuft per second) into Hlaing river. The total effluent discharge of the factories to the river from the two industrial zones are not available but the industrialisation of these zone has been stepped up only in late 1990 so the extent of industrial pollution has thus for been minimal. As a result of low polluted effluent and the high assimilative capacity of Yangon River, the quality of Yangon River can be assumed under control.

Wastewater treatment and disposal:

The existing sewer system serves an area of approximately 9 sq.km (3.5 sq mls). It was first installed in 1888 to serve a population of about 40,000 with gravity sewer for 22 groups of city blocks each served by a shone pneumatic ejector pumping station and then expanded to cover a total of 39 groups of city blocks in 1928.

The discharge of wastewater from the ejectors are collected through a network of cast iron pressure mains and are discharged into the Yangon river without any treatment. The rest of the city area depend either on common or individual septic tanks or on other forms of onsite disposal systems such as pit privy.

Solid waste management:

The pollution Control and the cleaning Department of Yangon City Development Committee is responsible for solid waste collection and disposal. Daily general amount is about 2000 tons within city area. However, only 65% of solid waste are able to collect and dispose by one hundred and eighty vehicles and 3500 of labour force. Due to constraint of financial and mechanical equipment, the proper sanitary landfill disposal has not been fully practiced yet but considerable success have been attained by using partial sanitary landfill method.

Land uses:

The land use has been divided into following classifications: - residential, commercial, mixed residential and commercial, industrial, constitutional and openspaces (park and play ground), administration, financial zones garden and rice fields. Land use planning is organized systematically by Human settlement and Housing Dept.

Land degradation:

The tropical monsoon climate, topography, natural vegetation and human activities highly influence the soil status. There is no evidence of soil erosion in Yangon.

Social condition- In socioeconomic terms, Myanmar ranks 133rd out of 174 countries in the 1996 Human Development Index of the United Nations Development Programme. However, with the advance of the market oriented system increased urbanisation and industrials action give opportunities to seek more jobs and to promote the living standard of Yangon citizens. In addition, many hospitals and health clinics have been increased to provide adequate health care. This has reduced mortality at all ages and extend the life expectancy of the citizen of Yangon.

Assessment of the problems and solutions:

In the mean time, the air quality of Yangon City is quite cleaner and fresher than neighbouring countries. Nevertheless, industrialization of electricity demand of on site power generation and the emission of the rapid development industries can rise the environmental problem such as air pollution and water pollution due to lack of air emission standard and effluent standard and properly designated institutional authority and legal mechanism to control the environmental pollution from industrial process. Furthermore, the three industrial zones already set up in Yangon City have proper infrastructure such as concrete roads, electricity but there are no proper hydralic grade line sewer system to discharge to the disposal. So the effluent from distilleries, tanneries, food processing, pulp and paper factories have the lowest dissolved oxygen levels, colour and were anaerobic during the summer season. As a result, there are unacceptable odour and unsightly sludge. Water and excreta related discuses can be transmitted from improper septic tanks, pit latrines and direct disposal to the Yangon River.

Conclusion:

Environmental infrastructural services should also be planned right from the beginning. This would prevent many pollution problem from ever getting out of the hand. Prevention of problems is certainly a much cheaper solution than the remedy and to correct pollution problems after they have occurred. Without a long term perspective with regard to environmental related issues, it is almost impossible to maintain affective environmental management and sustainable development. This is because when environmental management system lag behind economic development, the consequences can be severe. Myanmar is at the early part of the growth curve, could, in our planning, set out to avoid the mistakes made by others and capitalize on the lessons learnt by neighbouring cities.

Recommendation:

Urgent establishment of properly designated institutional authority and legal mechanism are required for effective control of the environmental pollution. National air emission and effluent standards should be established depending on the economic growth of Yangon.

Enact clear water and air law for water and air pollution prevention and control.

Some of the tasks but not the least which require the immediate attention of the Pollution Control Authority are listed below:

(a) Regular control of the water quality supplied to Yangon.
(b) Control of smoke emission from factories.
(c) Control of smoke emission from vehicles.
(d) Control of liquid wastes discharged by the factories.
(e) Solid wastes should be properly covered by soil.
(f) Sewerage system and proper treatment plant should replace the existing septic tanks to minimize the eminent subsoil pollution.
(g) Regular monitoring of the quality of water in the Rivers of the city.

Promote air and water pollution monitoring network, create fixed sites of continuous monitoring stations at the likely polluted sites, establish laboratories and prepare and disseminate reports on air and water quality of urban and industrial areas periodically.
Due to high investment requirement for monitoring facilities, financial assistance from the international organizations, developed countries and NGO should be sought.
Promote training and human resources development of technical personnel on air and water pollution control and cleaner technological processes.
To reduce vehicular pollution, regulate the import of polluted second hand vehicles and engines and liberalize the import of cleaner and new vehicles and engines. Limit the nos of vehicles and start plan to introduce Mass Rapid Transportation.
Promote the technologies transfer of cleaner production industries.
Promote achieve the accessibility of environmental and social education from primary school through a dulhood to all group of people.
Promote awareness both in the population at large and in the public sector of environment problems and issues to garner their full support and collaboration.

References.

Report 1. Master Sewerage Plan for Rangoon, Burma; Metcalf & Eddy Engineers 1965.
2. Yangon Infrastructure and Environmental Services, Myanma General Consultants, 1993.
3. Myanmar Agenda 21 (Final Draft) National Commission for Environmental Affairs, Yangon 1997.
4. Yangon Transportation Systems Management Study Report, United Nation Development Programme Yangon Transportation Systems Management Study. Traffic & Transport Consultants in association with Asia Engineering Consultants Corp. Ltd. 1994.

ENVIRONMENTAL CONDITIONS OF KATHMANDU METROPOLITAN CITY

Mr. Roshan R. Shrestha
Environmentalist & Advisor to Mayor
Kathmandu Metropolitan City Office
P. O. Box: 8416, Kathmandu
Tel: 977 1 272110, Fax: 977 1 270 334
Email: kmcadv@mos.com.np

INTRODUCTION:

Kathmandu Valley lies in the Lesser Himalayas of Central Nepal. It is 26 km in east west direction and 20 km wide in north-south direction. This valley is almost a circular bowl-shaped and surrounded on all sides (except the narrow gap in the south) by the mountains which have a height of about 2,122 m on average.

Average annual rainfall varies from 1245mm to 2984 mm around the valley. About 80 % of the total rain occur during the main rainy season from June to September. On an average, the Kathmandu Valley has warm temperature climate. Winter (December to February) is cool with mean temperature of about 11° C. The month of March to November is warm with a mean temperature of about 23 °C.

The urbanization of the valley started in the late 1950's. After 1970 rapid unplanned growth has occurred. Land use in Greater Kathmandu (Kathmandu and Patan Municipalities) has changed dramatically in the last two decades; the urban area has expanded from 24 % of the total area in 1971, this growth has been at the cost of agricultural land (Halcrow Fox and Associates, 1991).

Kathmandu Metropolitan City (KMC) is one of the big cities in the valley and also the kingdom of the country. Patan, Bhaktapur, Thimi and Kirtipur are other four municipalities include in the valley. King Gun Kamdev in 723 A.D built the city of Kathmandu.

Table 1: Some Statistics of Kathmandu Metropolitan City:

Population	: 421,000 (1991 Census)	Built up area	: 2912.4 ha
Annual growth rate	: 6 %	Average Pop - Density	: 87 persons/ha
No. Households	: 81,358	Higher Pop- Density	: 1200 persons/ ha
No. of Houses	: 53,995	Per Capital Income	: Nepal - 180 US $
Area	: 4758.7 ha		: Kathmandu - 200 US $

ENVIRONMENTAL PROBLEMS:

Until the 1970's Kathmandu Valley was seen as the "Shangri-La" of the Himalayan region, and was a major tourist destination. It offered splendid natural beauty, historical and cultural monuments and traditional ways of life, making it a virtual "living museum." Kathmandu Valley is the entry and exit point for about 95 % of 300,000 tourists visiting each year from the only international airport in Nepal is situated here.

Kathmandu valley currently faces a number of serious environmental and ecological challenges. The growing problem of Kathmandu Valley's environmental degradation is one of the important environmental issues addressed in the Nepal Environmental Policy and Action Plan (NEPAP) endorsed in September 1993 by Environmental Protection Council, His

Majesty's Government of Nepal. The major environmental problems evident in the urban areas are physical congestion, water and air pollution, lack of cleanliness, loss of open spaces, and loss of cultural property.

RIVER POLLUTION:

The main river, Bagmati and its tributaries originate on mountain slopes facing the valley and follow a centripetal pattern, eventually converging toward the center of the valley. These formerly clean rivers are now polluted and unfit for human use. Pollutants primarily include untreated sewerage and industrial effluent, and solid waste dumping into the riverbanks. Rivers have become a major depository for urban wastes and the riverbanks are either encroached to build houses or are dumping grounds for solid waste. The river surroundings and the historical and cultural assets on the riverbanks are in bad shape and are being ruined. The rivers after entering into the city area are heavily polluted. It is more critical during dry season, October to June where water volume gets very much less and river turns into sewer canal rather than river.

Table: 1 Quality of the river at a station in city area (Shrestha & Sharma, 1996)

Year	DO mg/l	BOD mg/l	COD mg/l	$N\text{-}NH_3$ mg/l
1988	6.2	10.0	28.8	1.03
1991/92	3.4	20.9	67.3	6.83

The result indicates that the pollution level of the river Bagmati is increasing tremendously within 3 years of time period. Major tributaries of the river like Bishnumati and Dhobikhola are still more polluted than the river Bagmati. BOD and COD level of the tributaries were recorded 22 to 50 mg/l and 65 to 105 mg/l respectively (Shrestha & Sharma, 1996).

Increasing level of the pollution in the Kathmandu city's rivers are mainly due to the discharge of untreated domestic sewerage with 130 to 560 mg/l of BOD, industrial effluent with 455 to 24,257 COD, agricultural run off and solid wastes (Shrestha & Sharma, 1996). It is estimated that about 30 % of the river flow during dry season at Chobhar (the out let of the river from the valley) is nothing but the raw sewage and sludge (Shah, 1995). The studies confirm that municipal sewage is the main source of pollution. Heavy metal concentrations in the rivers are still very low except few points of the rivers where chromium contamination were found due to the effluent from dyeing industries. The riverbanks are free land for illegal squatters, pig farming, vehicle repairing yards and animal slaughtering. All these contribute to the degradation of riverside environment and river water.

Fecal coliform level of the rivers is also very high. It goes up to several millions of fecal coliform bacteria in 100 ml of water. Despite of those mentioned quality of the river, river are still being used by people for bathing, laundry, washing of the vegetables before selling into the market, swimming by children, irrigation, animal watering etc.

DRINKING WATER:

There is water crisis in the valley. The average per capita water availability for household use is around 52 litters per day against the theoretical requirement of 150 liters per day. (which is much lower than of other cities having similar climatic conditions). Table-2 clearly shows the deficit of water in the valley. Due to the leakage and wastage of supplied water, which is about 40 %, shortage of drinking water is getting more serious issue in urban area in Kathmandu valley.

Table: 2 Urban Domestic Demand & Piped Water Supply by Nepal Water Supply Corporation (NWSC)

Year	Urban Population (000)	Theoretical Water Demand		Observed Water Demand		NWSC - System MLD		Available for use
		LCD	MLD	LCD	MLD	Wet season	Annual	
1981	363.5	150	45.4	100	36.4	60.2	50.3	30.2
1991	598.5	150	89.8	100	59.9	90.9	76.0	45.6
1994	1,210	150	181.5	100	121.0	105.3	88.0	52.8
2001	1,578	150	233.7	124	195.7	111.2	93.0	60.5

Source: Shah, 1995

A large number of industries, including hotels, have put immense pressure on water resources, which have already become a scarce commodity in the Valley. The carpet and garment alone employ about 300 to 350,000 people (Three fourth of them are migrants). Wool dyeing and carpet washing consume about 6.6 million liters of water on each operational day which otherwise could have satisfied the water needs of 165,000 people at the current rate of supply. The Star-rated hotels alone use about 2.5 million liters water per day. There are numerous other industrial establishments consuming more than 3.2 million litters per day (Shah, 1995).

Due to shortage in piped water supply, people are more depending on ground water. The present level of ground water abstraction is more than two times the critical abstraction rate, which is 15 million litters per day. For this reason the water level is lowering by a meter every year. People are unknowingly abstracting age old (about 28,000 years) confined ground which is probably non-rechargeable stagnant or "fossil" ground water.

Nepal Water Supply Corporation (NWSC) is the responsible agency for supplying of drinking water to urban areas of the country including Kathmandu Metropolitan City. The supply of water is intermittent, with most of the area being supplied for 2-3 hours/day in wet season. In several areas it is often less than one hour a day and during dry spell, water supply is reduced to even half an hour every alternate day.

Besides the quantity problem, drinking water quality in city is also very poor. Many studies have indicated the public water supply being unsatisfactory in many localities in terms of bacteriological contamination which possess significant risks to the users. Environment & Public Health Organization (ENPHO) a non-governmental organization is monitoring water quality of Kathmandu City water supply since 1988. Report suggests that the bacterial contamination increase as water travel from the water treatment plants to the distribution systems. (Table 3).

Table: 3 Bacteriological Quality of Kathmandu City Water Supply (Shrestha & Sharma, 1996)

	1988 (Total coliform test)	1991-92 (Fecal coliform test)	1995 (Fecal coliform test)
Number of Samples	282	172	228
% of samples without coliform	30	50	49
% of samples with coliform	70	50	51

ENPHO study also pointed out that the water quality often gets high bacterial contamination during rainy season. The result during May 1995 has shown alarming results: 39 out of 42 samples were contaminated with fecal coliform bacteria and almost all samples (98%) had no "free residual chlorine". Only 2.4 % of the samples were satisfactory (1-3 coliform/100 ml), while 14.3 % were suspicious (4-9 counts), 50 % unsatisfactory (10 - 180 counts) and 26.3 % were heavily polluted (over 180 counts).

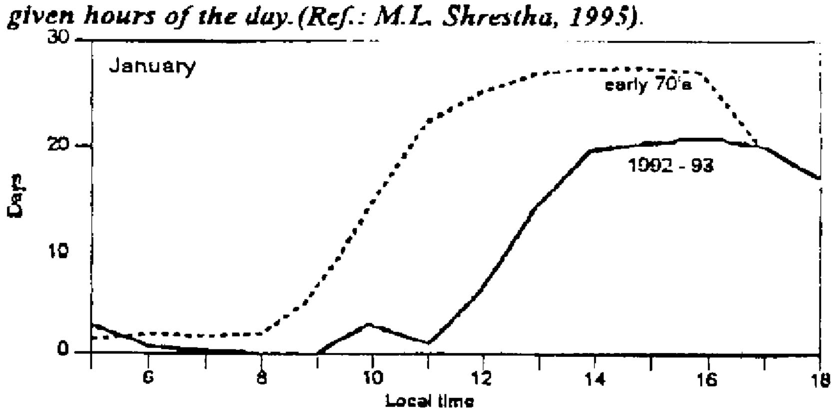
Due to the shortage of water people are also using water from traditional spouts. Historically those spouts were very important and one of the reliable source in former time. Unfortunately, water from those spouts is getting heavily bacterial contamination. Contamination level reached thousands of fecal coliform bacteria per 100 milliliter of water and more worse during rainy season as in city water supply.

Main reason for the degrading quality of city water supply is the distribution network, which are very much complicated and expanded without any plans. The pipes are two old, up to 100 years especially in the city core area and their condition has detonated. In few cases the water pipes are close to sewer lines; resulting and leakage in pipes and low water pressure increase the chance of sewerage contamination in drinking water system. Similarly some of the treatment plants are in very poor condition which needs to be rehabilitated soon.

AIR POLLUTION:

The bowl shaped geographic feature of Kathmandu Valley is surrounded by towering hills, the valley suffers from unusually severe atmospheric inversion. Wind cannot easily sweep air pollutants away. With the growth in the number of vehicles and industrial expansion, the consumption of coal and automotive fuel has increased. Over the period 1980-93, the increase has been about 150 % for gasoline, 175 % for motor diesel, 250 percent for kerosene and 580 % for fuel oil (MEIP, 1996).

Figure 1: No. of days in January with good visibility (>8,000 m) at given hours of the day. (Ref.: M.L. Shrestha, 1995).



Atmospheric visibility data from Kathmandu's airport analyzed onwards from 1970 show that there has been a very substantial decrease in the visibility in the valley since about 1980. (Fig 1). Basically, there have not been any significant trends for temperature over the last 20 years. However, slight warming has been observed during the later 10 years (1983-1992) as compared to the earlier 10 years (1976-1985). The average temperature has increased slightly by 1.5 ^{o}C. This shift can be said to be significant only in that it is indicative of a warming trend caused by escalated vehicular emission, urbanization and loss of green areas in the valley (Shakya, 1994).

Air pollution measurements show that particulate pollution is the most significant problem in Kathmandu Valley. Total Suspended Particulate (TSP) emissions per year amount to 16,500 tons. PM_{10} emissions are 4,700 tons per year. The main sources of particulate pollution are the brick industry (28 % PM_{10}, 31 % TSP); domestic fuel combustion (25 % PM_{10}, 14 % TSP); the Himal Cement Plant (17 % PM_{10}, 36 % TSP); Vehicle exhaust (12 % PM_{10}, 3.5 % TSP) and re-suspension of road dust (9 % PM_{10}, 9 % TSP). WHO air quality guidelines substantially exceeded. There have been measured 24 hours TSP concentrations above 800 υg/m^3, while the WHO AQG is 150 - 230 υg/m^3.

SOLID WASTE PROBLME IN KATHMANDU METROPOLITAN CITY:

The misconception of " I have to throw garbage because it should not be kept inside and since I have elected a body who will look after the cleaning business they will have to pick it up" is the reason of current solid waste problem faced by Kathmandu as a whole.

According to survey result conducted by HFA, PPK & CEMAT (1991), the amount of solid waste produced in Kathmandu was 546 cubic meter per day. Out of which only 50 % of the total waste was managed by KMC in last fiscal year, the rest is left pilled up around all corners of the town, settlement areas and open spaces, without any discrimination. Of the total waste generation, 79% is biodegradable and rest is non-degradable in nature.

KMC with its large number of sweepers, clean the major streets, collects the garbage from containers and transport to the landfill site. At present, waste is not utilized for composting, recycling or biogas production by KMC. Only a few private sector has taken the initiative of waste recycling and composting. There is no any system in the city to separate industrial, hospital and hazardous wastes; they are simply dumped in municipal containers.

STRATEGY OF KATHMANDU METROPOLITAN CITY OFFICE FOR BETTER ENVIRONMENT:

Newly elected Mayor (just before four months) has lot of challenges for the betterment of Kathmandu City. People are expecting lot from him and also getting big support from the people. KMC is also seeking the approval of decentralization act in next coming session since KMC has very less authority in present legislation. Following are some of the strategy & actions already made by KMC especially to control environmental pollution:

River Pollution Control:

To control river pollution, KMC will prohibit solid waste dumping in banks of the rivers. KMC will encourage private and government industries to install wastewater treatment systems to treat industrial effluent. KMC will also provide technical assistants to these industries for the best possible treatment systems according to their needs. KMC will promote low-cost and feasible wastewater treatment systems for small communities. In order to stem erosion along the riverbanks and to improve the overall environment, KMC will plant trees. In order to be successful to prevent river pollution, KMC realizes that it should address to the whole community and make aware to the people about the importance of the rivers.

Drinking Water:

To ensure that people of Kathmandu get clean and sufficient drinking water, KMC is going to tap local water resources in order to increase water volume. For efficient water distribution KMC will put pressure to the concerned governmental lain agencies to rehabilitate existing pipe network and monitor leakage and breakage. To improve water quality KMC will regularly monitor drinking water quality and make people aware and inform the situation to NWSC. And also KMC will work with NWSC, the government, and the public to maintain the quality of drinking water supplying according to the demand. To meet the demand, KMC will put presses to the government to implement Melamchi water project (World Bank funded project).

Air Pollution Control:

In the past years, Kathmandu Valley residents have witnessed a sharp decline in the quality of the air they breathe. KMC realizes the seriousness of this problem and committed to take effective action to improve our air quality. To control vehicular emission and roadside dust are the main sources of air pollution within the city, KMC will focus on limiting the pollution from these sources. As an institute directly responsible to the citizens of Kathmandu, KMC is committed to monitoring Kathmandu's air quality and the performance of relevant agencies in controlling air pollution. KMC will regularly monitor air quality vehicular emission, and fuel being used. KMC will also build linkage between various organizations involved in air pollution control and the general public who are the victims of pollution so as to coordinate efforts and assist in sharing of information. KMC will also implement programs to encourage the use of environmentally friendly transportation such as electric vehicles and bicycles. KMC will be involved in raising awareness among citizens on issues related to air quality and pollution control with the long-term goal of changing people's behavior.

Solid Waste Management:

Keeping the Valley clean and healthy is one of the main functions of KMC. In recent years, rapid population growth and changing consumption have put great pressure on KMC to increase the efficiency of waste management system. To bring the efficiency to the maximum level, KMC will improve the current waste collection system so as to make it more convenient for the citizens as well as waste collectors. KMC will improve its system for equipment, vehicles, and human resource management and provide regular collection from skips. KMC will improve the facilities and operational procedures at transfer stations and a waste management education centers will be opened. Encouraging private sectors, KMC will maximize recycling, incineration, and composting of waste. KMC realizes that cooperation with the government and public are essential for the success of any solid waste management system. In order to do this, KMC will work closely with the center government and make residents of Kathmandu aware on KMC waste management system. We will also gradually privatize waste management services to ensure a clean and healthy Kathmandu.

REFERENCES:

EPC/HMG, 1993 Nepal Environmental Policy and Action Plan: Integrating Environment and Development.
HMG, Environment Protections Council, Kathmandu, Nepal.

Halcrow Fox and Associates, 1991, Kathmandu Valley Urban Development Plans and Programs. Department of
Housing and Urban Development, Kathmandu, Nepal.

HFA, PPK & CEMAT 1991, Kathmandu Valley Urban Development Plans and Programs: Concept plan for
Kathmandu Historic Area. HMG /ADB, Kathmandu

MEIP, 1996, Urban Air Quality Management Strategy in Asia URBAIR, Kathmandu Valley Report. Metropolitan
Environmental Improvement Program, A World Bank Initiative.

Shrestha, R. R and Sharma, S. 1996, Trend of Degrading Water Quality of The Bagmati River (1988 - 1995).,
Bagmati Environmental Seminar, March 11, 1996. Water Induced Disaster Prevention Technical Center,
Ministry of Water Resources / HMG - Nepal.

Shrestha, R. R. and Sharma, S., 1996, Bacteriological Quality of Drinking Water in Kathmandu and Patan City
(Research conducted by ENPHO and DiSvi - 1988 - 1995), National Conference on Environmental Sanitation & Water Supply, March 22 - 24, 1996. DWSS & NEA.

Shah, S. G., 1995, Regulating Growth: Kathmandu Valley, Main Report, IUCN - Nepal.

Shakya, D. M., 1994, Climatic Data at Khumaltar. In: Annual Report 1992 - 1993. Agronomy Division, NARC.
September-1994, Lalitpur, Nepal

Wastewater Treatment and Disposal in Suva Urban and Peri-urban Areas

Sereana Kubuabola (Ms.)
Institute of Applied Sciences
University of the South Pacific
P O Box 1168, Suva, FIJI
Tel: (679) 212 245 Fax: (679) 300 373
e-mail: Kubuabola_S@usp.ac.fj

Introduction

Fiji consists of 300 islands scattered over 1.3 million square kilometres of the South Pacific Ocean. Only 100 of these islands are inhabited. The two largest islands Viti Levu, where about 75% of the total population reside, and Vanua Levu, comprise 87 % of total land area.

Suva, the capital of Fiji and where the main seat of administration sits is located on the South East Coast of Viti Levu. Out of a total population of 772,665, Suva hosts some 167,421 people (1996 Census). This is an increase or 18.5% from 1986 but migration to urban areas is still increasing. This paper will attempt to illustrate the means by which Suva and its peri-urban areas deal with their wastewater.

Environmental Conditions

According to the 1995 statistics the Public Sewerage Systems servicing the area of study operate as such:

Outfall		Capacity Equiv No. of Persons	No. of Connections	Population Estimated
Sea	Kinoya STP	60,000	11,000	85,000
River	Raiwaqa STP	15,000	2,138	15,000
River	Wailada STP	1,000	(not avail)	500

The figures indicate that:
1) The system at Kinoya is overloaded
2) About 60% of the population are using the systems

Out of 40% of the population about 1-2% live in squatter settlements which do not have proper disposal systems while the rest are serviced by septic tanks. From some water quality monitoring carried out by the Institute around the Suva Port, levels of faecal coliform in the river draining densely populated and unsewered areas are extremely high, especially during periods of heavy rainfall when septic tank effluent and sewage effillent from pit latrines get washed into creeks and rivers.

The Public Works Department (PWD) has standards on Trade Waste which unfortunately it is not able to enforce since it has not been legislated. However, it has encouraged industries to put into place monitoring programmes for their discharges. In a survey carried out in

1991, on point sources of Industrial pollution entering the port waters of Suva, twenty-three out of thirty nine industries surveyed discharge directly into port waters, into a river which drains into port waters, or into storm water drains. The situation has not changed.

Data gathered indicated that organic effluents gave elevated levels of Biological Oxygen Demand ranging from.200 to 1200 mg/L and more often the effluents were directed to storm water drains discharging into the river. Effluent from one steel company rendered safe levels of Fe, Mn, Cu, Pb, Zn, Cd, Cr but a previous survey had stated that effluent from this company as well as others discharging effluents which are likely to contain metals pose problems to the health of people dependent on the marine environment, close to the industrial area, for a food source. Waste and grease is another problem that has been highlighted.

Conclusion

There is now an increasing concern for the state of pollution in the waterways around Suva and the peri-urban localities caused by uncontrolled discharges. Most important sources of pollution are sewage and industrial effluents with sewage pollution being the most prevalent - surveys have shown faecal coliform counts for Suva's port waters exceed recommended international standards by up to 10,000 fold.

Recommendations

1. There needs to be a regular monitoring of waterways in the city and peri-urban areas to determine trends and levell of pollutants being discharged into them.
2. There should be compulsory connection to the sewerage systems by industries so that monitoring can be effective.
3. Efforts must be made to discourage squatter settlements.
4. Septic tanks should be dispensed off in favour of sewering.
5. There needs to be active campaign on polluter awareness.

References

1. Cripps. Ken (1992). Survey of the point sources of Industrial Pollution entering the Port Waters of Suva. Engineering Dept., Ports Authority of Fiji, Suva.
2. The National Environment Strategy, Fiji. Compiled by Dick Watling (1993).
3. Tamata, B.R., Lloyd, C.R., Green D. (1993). Water Quality in the Ports of Fiji. IAS Environmental Report No. 67.
4. IAS Analytical Results - Effluent Monitoring 1996-1997,

The author would also like to gratefully acknowledge assistance given by officers of the Sewerage Department (PWD) and Bureau of Statistics, Fiji.

Permaculture - A sustainable urban agriculture

Martin Anda
Environmental Technology Centre, Institute for Environmental Science
Murdoch University

Introduction

What is permaculture and why do we need it?

In the past, many communities deployed a range of building and agricultural techniques to provide their basic shelter and food needs which were more environmentally-sound than what we generally see today in advanced industrial societies. Many individuals were 'generalists' rather than specialists or experts in one particular field. Since the onset of industrialisation, specialisation of individuals and groups has arisen, alienating many from the means of production, extensive community interaction and group decision-making. Agriculture has become mechanised and dependent on fossil fuels, leading to the raising of hybridised monocrops in sterile, degraded soils of limited life expectancy.

In the city, the motor car dominates our culture both behaviourally and environmentally, to the extent that up to 70% of urban space in some areas such as city centres, can be dedicated to roads and car-related facilities. Our wastes frequently pollute surface and ground waters, soil and atmosphere, instead of being productively recycled and reused.

Permaculture is one part of what must be a broad-based attempt to close the cycle, helping to bring people back together to gain more control over their lives in an ecologically-sound manner. Permaculture has been described as "a permanent, self-sustaining system of agriculture, adaptable to both rural and urban situations and designed to produce an efficient, low maintenance, optimally productive integration of trees, plants, animals, structures and human activities within specific environments. The goal is ecological stability and diversity in a system designed for conservation of soil, water, energy and all other natural resources. It is common-sense design inspired by ecology." (Crystal Waters Community Co-op Ltd).

The essential message of permaculture is this: that along with other larger changes, permaculture can help us to continue to meet the basic necessities of human life as derived from plants, animals and other natural resources, without the environmental degradation, resource wastage and large scale, highly vulnerable monocultures, which characterise so much of today's animal husbandry and agricultural practices. And in terms of cities, permaculture can be one element in a whole suite of changes that will contribute to more sustainable patterns of urban settlement and a better quality of urban life.

In recent years, with a continuing rise in awareness about environmental issues, as well as considerable publicity surrounding the founder of Permaculture, Australian Bill Mollison, the permaculture movement has gained major popularity around the world, reminiscent of the 1960's back-to-the-land movement. Permaculture has become particularly popular in Perth where there are now numerous locally-based groups as well as the Permaculture Association of Western Australia. There are an increasing number of experienced individuals offering educational courses out of TAFE colleges, permaculture nurseries, community centres, as well as their own farms and houses.

Here at Murdoch University there is an on-campus permaculture club based at the Environmental Technology Centre called MUPETS (Murdoch University Permaculture & Environmental Technology Society). MUPETS offers Introductory and Design Certificate courses as well as a range of other energy-efficiency, waste management, landcare and permaculture-related courses. The 1.7 hectare Environmental Technology Centre is located in the southeast corner of the campus, south of the Energy Research Institute (MUERI) and south of the proposed United Nations Centre for the Application of Solar Energy (CASE). All are part of the new Enterprise Park. The Environmental Technology Centre is landscaped on permaculture principles to display renewable energy devices, sustainable sewerage, water conservation, energy-efficient housing, waste management technologies, etc.

Permaculture in the city

The growing popularity of permaculture is one of many responses to the fundamental problems of suburban sprawl in Australian cities. These problems are making themselves more evident each year in the destruction of prime market garden land on the urban fringe, the bulldozing of thousands of hectares of native bush and the lack of wildlife corridors through existing and new urban development. Suburban development practices are leading to more and more constraints on urban growth, such as unwanted impacts on Perth's groundwater mounds, a resource essential to the provision of safe drinking water to urban residents.

Questioning of the viability and sustainability of suburban sprawl is on the rise as more areas are covered over with low-density housing and bitumen for roads (roads alone typically occupy some 28-30% of the land area of modern subdivisions). Permaculture has a role to play in finding solutions to these problems, because it is possible to practice its principles even on the balcony of an apartment in the central city of Sydney or on a postage stamp sized rear yard of a terrace house in inner Melbourne.

However, applying permaculture ideas in cities requires a warning. Where permaculture will not tend to be helpful in the city, is if it is seen as a way of giving large numbers of people a big block of land on the urban fringe to grow their own food and rear their own animals, i.e. if it is seen as being a totally privatised pursuit, needing comparatively large areas of private land for each household. This will tend to spread the city, creating similar problems to traditional low density suburban sprawl, with everyone needing to own two or more cars, drive long distances to major destinations around the city without any viable public transport system, while generating a big demand for petrol and high production of automotive emissions.

Where permaculture can be constructive in our cities is where it can be integrated into a philosophy of more compact urban design and housing and efficient use of land, such that it will provide more greenery and a closer, more practical and useful relationship with nature right in the city (i.e. the idea of an 'urban village' - see next section). Permaculture can be more effectively practiced on an urban commons within a communal framework, with individuals sharing and pooling their skills, rather than on a privatised basis. Such land use has been referred to as a Community Garden. For example, Vancouver in British Columbia has many high density housing developments built as housing cooperatives and surrounded by extensive gardens and other horticultural activities which could use permaculture techniques. The houses are designed on passive and active solar design principles and are located in good proximity to other urban activities, accessible by foot, bicycle and public transport. These qualities are what many people are seeking on a suburban block of land, but in too many cases it is not what is achieved - cars are the only viable form of transport, there is little contact with nature, the land is wasted and it needs large quantities of water and other resources to maintain it.

To secure land in urban areas through local government authorities for community gardens is very difficult even though it is surprisingly abundant - there are often degraded pieces of land, excessively sized carparks, under-utilised public open space, and large road verges. However, even after the land is secured, the community mobilised, the permaculture education and design conducted, and the gardens established - there is still the vital ingredient for longer term success. How to sustain community involvement, how to continue ongoing development and maintenance. A permaculture landscape is not created in its establishment. Its productivity only develops with time and continued efforts to ensure the systems designed for reach maturity: windbreaks, soil building, the seven-layered food forest, crop rotation beds, correctly pruned fruit trees, replacement of inappropriate species, losses and vandalism, and so on. To some extent a polyculture food garden, with a Zone 2 focus, will maintain productivity with minimal care. However, to maximise productivity the ongoing efforts of volunteers and other workers is essential. But the work is no longer hard once the initial preparations and establishment is complete. To sustain community involvement is the key and this is perhaps where permaculture is not dissimilar to other community development projects. Many techniques can be deployed by the core enthusiasts, facilitators, educators or activists: communal busy bees, on-site social events and courses, public artworks, on-site cultural events, newsletters, local advertising, local doorknocks, regular meetings, networking with other like-minded groups, and for the most energetic extending permaculture gardening services to people in their homes in need. A combination of a number of these are necessary to sustain the enthusiasm any community group and the community garden it maintains. Of course the ultimate motivator is the beauty, health, vigor and productivity of the landscape itself.

Vermiculture - an element of permaculture

Vermiculture biotechnology can be used for processing domestic refuse after removal of solid, inorganic recyclables. Composting toilets can incorporate vermiculture. Agricultural wastes, manures and food processing wastes can all be processed by worms. Sewage effluent can be treated by means of vermifiltration with agricultural/horticultural reuse of the clean water. The wet composting domestic wastewater treatment unit developed by Dowmus Pty Ltd is a good example of an environmental technology that incorporates the principles of vermiculture. It is said that environmental destruction commenced with the invention of the plough. However, western agriculture can be begin to be converted to a more sustainable form through a combination of addition of vermicastings from the above waste treatment processes, introduction of worms to currently sterile soils and termination of destructive tillage. Worms themselves can be used for recreational fishing, commercial aquaculture feedstock, etc. The combination on the one site of a vermiculture facility for processing domestic organic wastes, aquaculture ponds relying on worms for protein inputs to the fish and crayfish culture, and a community garden producing carbohydrates from tree crops for the latter as well as food for people, is a proposal worth trialling in the contemporary urban setting. It has successful precedents in the chinampa systems of Mexico City (Tenoxtitlan) and the dyke-pond farming of China.

Workshop Discussion Questions

(1) Describe the current activities that you carry out at home, if any, that demonstrate elements of permaculture and contribute to sustainable urban living.
(2) What factors would you consider in a permaculture design for your home?
(3) Briefly relate the eleven principles of permaculture (Mollison, 1991) to a Community Garden. List the series of steps necessary to organise a Community Garden in your neighbourhood.
(4) Relate the principles of permaculture to the nutrient cycles. How can their closure be maintained to maximise productivity and avoid pollution of the environment?
(5) Describe how you would approach the application of permaculture principles to a sedentary developing community in a remote arid region.

References

Anda M, Stocker L & Carr B (1994), **Urban landcare for sustainable food production,** Conference Proceedings, A Vision for a Greener City: The role of vegetation in urban environments, October 1-4, Greening Australia, Perth.
Bennett, Peter (1989), **Australia and New Zealand Organic Gardening**, Child & Associates, French's Forest. (Y635.9870994 BEN)
Cleveland DA & Soleri D (1991), **Food from Dryland Gardens: An ecological, nutritional and social approach to small-scale household food production, Centre** for Food, People and Environment; 344 South Third Avenue, Tucson, Arizona, USA.

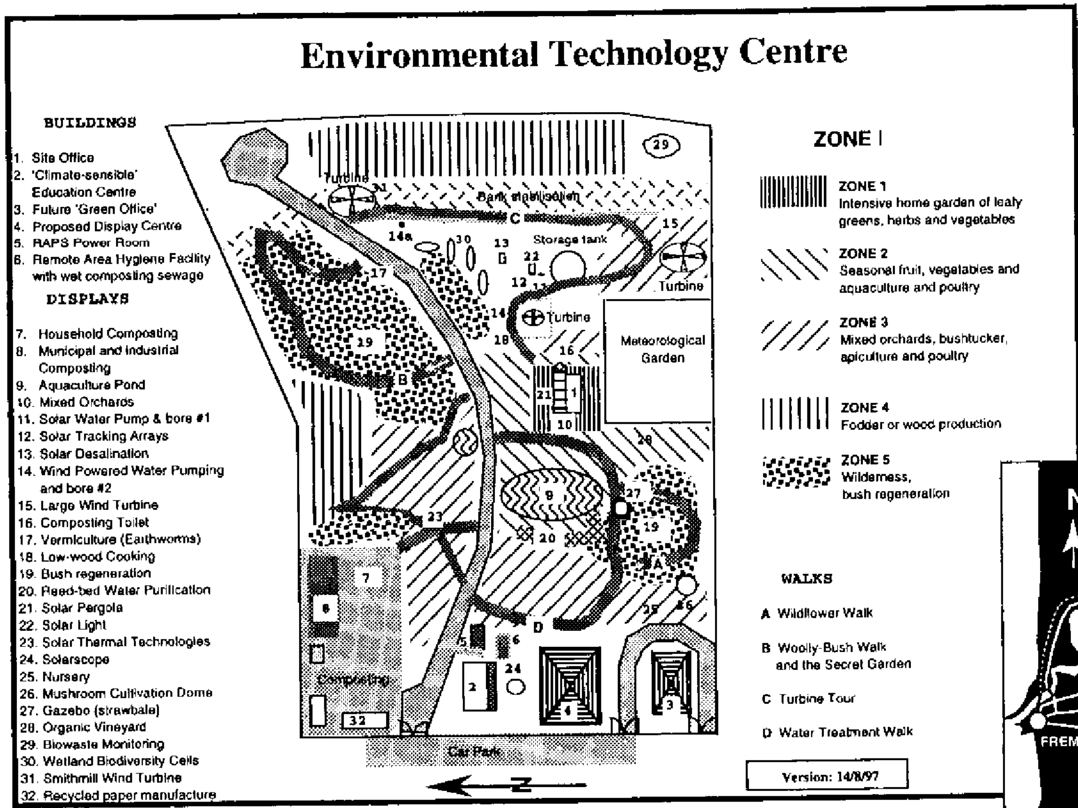
Collins, P. (1992) Permaculture House and Garden. **Soft Technology**, 40, 15-20 Alternative Technology Association, Melbourne.
Conacher J (1988), **Small-Scale Farming and Horticulture: Some theories and strategies for organic growers,** Organic Growers Association WA (Inc.), PO Box 213, Wembley WA 6014.
Eliott, C. (1983), **Growing in the city: Employment, education and recreation in Australian city farms and community farms**, Social Impact Publications, Sydney, pp4-8.
Fukuoka, M. (1978) **The one-straw revolution: an introduction to natural farming.** Rodale Press, Emmaus. (X631.58 F961)
Handreck, K.A. and Lee, K.E. (1978) **Earthworms - for gardeners and fishermen**. CSIRO (PX 595.146 H236).
Hardman L (1997), **Urban Permaculture Solutions** Part I: Selected articles from Permaculture International Journal, Permaculture International, Lismore.
Kennedy, Declan (1991), **Permaculture and the Sustainable City**, Ekistics, 348, May/June.
Kourik R (1986), **Designing and Maintaining Your Edible Landscape - Naturally,** Metamorphic press, Santa Rosa, CA.
Mollison, Bill & Holmgren, David (1978) **Permaculture one: a perennial agricultural system for human settlement**. Corgi, Melbourne. (X338.10994 M726)
Mollison, Bill (1979) **Permaculture two: practical design for town and country in permanent agriculture**. Corgi, Melbourne. (X338.10994 M726)
Mollison, Bill (1988) **Permaculture: a designers manual**, Tagari, NSW, Chapter 14.2, pp 519-530. (Y631.584 MOL)
Mollison, B.C. (1991), **Introduction to Permaculture**, Tagari Publications, Tyalgum, NSW, pp 9 - 15.
Murphy D (1993), **Earthworms in Australia**, Hyland House, Melbourne.
Newman, P. (1991), **Sustainable settlements: Restoring the commons**. Habitat Australia, August, pp 18-21.
Romanowski, Nick (1992), **Water and Wetland Plants for Southern Australia**, Lothian Books, Melbourne.
Smit, Jac & Nasr, Joe (1992), **Urban Agriculture for Sustainable Cities: Using wastes and idle land and water bodies as resources**, Environment & Urbanisation, Vol 4, No 2, October.
Smit, Jac; Ratta, Anna & Nasr, Joe (1996), **Urban Agriculture: Food, jobs & sustainable cities**, Publication Series for Habitat II, Volume One, United Nations Development Programme, New York.

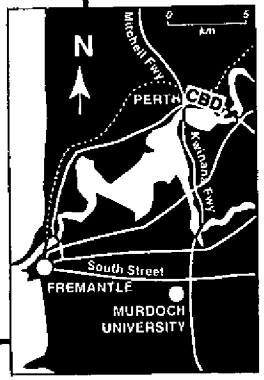
SESSION 7&8

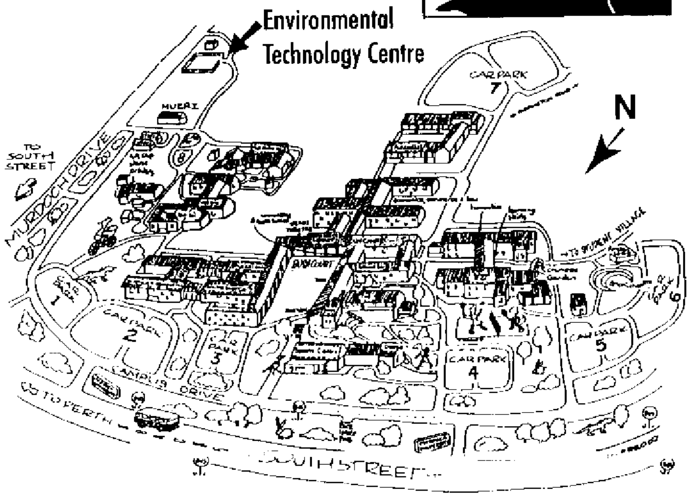
Field Visit:

1. Permaculture landscape at the Environmental Technology Centre on campus (ETC)

2. Demonstration and discussion of technologies at the ETC







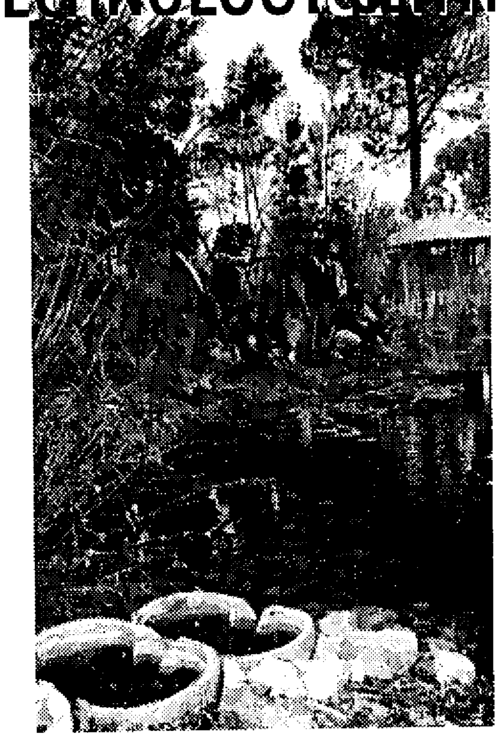
For further information contact:

Stewart Dallas (Centre Manager)
School of Environmental Science
Murdoch University, Murdoch WA 6150
Tel (08) 9360 6414, 9360 6123 Fax (08) 9310 4997
Email: dallas@essun1.murdoch.edu.au

For Tours of the Centre contact:

Leslie Longwood
Phone/Fax (08) 9360 6457
Email: longwood@essun1.murdoch.edu.au

THE ENVIRONMENTAL TECHNOLOGY CENTRE



INSTITUTE FOR ENVIRONMENTAL SCIENCE

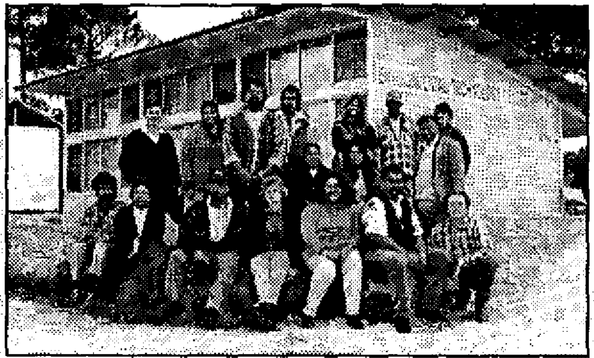
MURDOCH UNIVERSITY
PERTH, WESTERN AUSTRALIA

THE ENVIRONMENTAL TECHNOLOGY CENTRE

The Centre, with an area of 1.7 hectares, serves as a research, learning and demonstration site for a range of operating sustainable technologies including climate-sensible buildings, renewable energy systems for power supply and water pumping, aquaculture systems and organic waste management facilities. The whole site is landscaped on permaculture and bush regeneration principles.The Remote Area Developments Group at Murdoch University established the Environmental Technology Centre on campus to educate and inform the public about energy conservation, renewable energy sources and approaches to environmentally sustainable living. The Centre incorporates both research and display facilities and promotes Appropriate Technology and environmentally sustainable technology to students, industry and the community.

Displays include:

- ♦ A solar passive seminar facility powered by on-site renewable energy systems.
- ♦ Solar-powered desalination equipment.
- ♦ A remote area power system (RAPS).
- ♦ Examples of renewable energy sources.
- ♦ Environmentally-friendly wastewater and sanitation facilities.
- ♦ Composting, vermiculture and organic gardening.
- ♦ RADG technologies for remote communities.
- ♦ Environmentally-friendly building materials and construction techniques.
- ♦ Recycled paper manufacture.


A solar passive seminar facility powered by on-site renewable energy systems

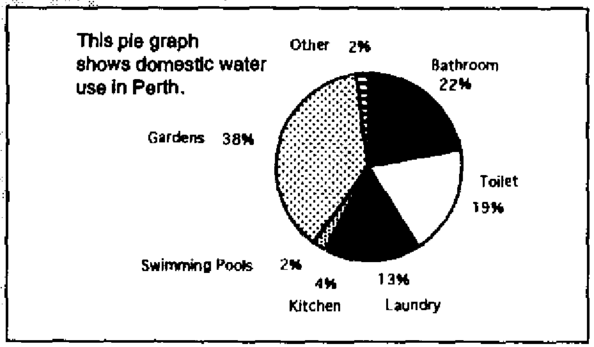
Environmentally Sustainable Technology

The term "Appropriate Technology" or AT has traditionally applied to simple, low cost, reliable, robust systems that can be built, serviced and repaired locally and which are largely independent of outside supply. With an emphasis on local sustainability AT is increasingly equated with Environmentally Sustainable Technology (EST).

The Remote Area Developments Group

The Remote Area Developments Group (RADG) of the Institute for Environmental Science was established to develop appropriate technologies to improve living conditions in remote Aboriginal communities. With growing public awareness of the need for sustainable development, ESTs are also applicable to urban and rural populations interested in a more environmentally responsible lifestyle.

For Example: How can we improve our water use?



The Centre's Aims

Research and Development

The Centre hosts students' project work and research. It is open to local industry wishing to monitor and test their products within the University infrastructure.

Promoting Community Awareness

The Centre offers practical working displays which are clear enough to dispel some of the mystery surrounding this technology while also proving that it can be a viable alternative.

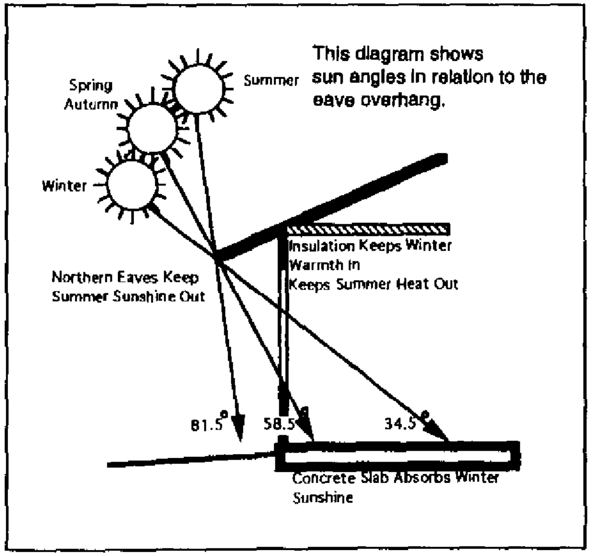
Consultancy Services

Specialists at The Centre are available to provide consultancy services for industry and those seeking further information and advice for their own situations.

Courses

We now offer a broad range of courses throughout the year covering such areas as permaculture, aquaculture, climate sensible housing design, vermiculture, low energy building materials and techniques.

For Example: How can we make use of the Sun's angles?



SESSION 9

Lecture V:

Needs and Conditions of Technology Transfer including Adopting, Applying and Operating ESTs: A Case Presentation and Group Discussion:

Prof. Nobuya Miwa, Osaka Gakuin University

Needs and Conditions of Technology Transfer Including Adopting, Applying and Operating ESTs: A Case Presentation and Group Discussion

Dr. Nobuya Miwa
Associate Professor
Faculty of International Studies
Osaka Gakuin University

SESSION INFORMATION

This session is scheduled for a total of 3.0 hours and includes a small group assignment. In detail, the session is divided into three parts: (a) presentation of cases, (b) discussion of presented cases, and (c) work in small groups.

Subjects of case presentations are adoption, application and operation of technologies (1) in an internal Japanese case by transferring sub-surface dam systems to Miyako Island, and (2) of household sewage treatment technology from Japan to Indonesia. The first case aims to illustrate actual conditions of implementing in remote places of one country state-of-the-art technology which proves to be environmentally sound in central areas of the same country. The second case emphasizes conditions of adopting, applying and operating ESTs imported by a developing country from an industrialized country.

During the work in small regional groups, participants are to identify key environmental problems of their countries and regions including prospective EST solutions. Issues of adopting, applying and operating those ESTs are highlighted. Finally, handouts of group findings are distributed.

LECTURE NOTES

1. Introduction and Objectives

To successful transfer ESTs to developing countries and transition-economy countries, the understanding of national and local needs and conditions is essential. The purpose of this session is to provide participants with an opportunity to understand what kind of ESTs should be selected and what kind of national and local conditions should be considered in adopting, applying and operating ESTs. Case presentation and group discussion (including nominal group technique) will be used as training tools. Through this training session participants are expected to better understand:

1) Key problems related to the environment of large cities and freshwater resources,
2) ESTs needs under national and local conditions,
3) Conditions to be considered for adoption, application and operation of ESTs.

2. Case Presentation and Discussion

Case of ESTs transfer are presented by slides. Information provided through this presentation is: 1) EST implementation under local conditions, and 2) conditions that should be considered in adoption, application and operation of ESTs. After the presentation, participants discuss the case studies. The two cases employed for the demonstration are:

1) Transfer of Sub-surface Dam Technology to Miyako Island in Japan,
2) Technology Transfer of Household Sewage Treatment Systems to Indonesia.

Before dealing with the two cases, a short explanation of what we understand under adopting, applying and operating ESTs should be given. The three steps of implementing technologies are essential during pre- and post-phases of technology transfer.

Adoption
Adoption of ESTs we understand as how to correctly choose most adequate technologies adjusting to national and local conditions.

Application
Application corresponds to the actual setting up of adopted technologies at-site, meeting specific needs of the user.

Operation
Operation means that the technologies will work out well in the medium- and long-term and will be improved in accordance with change of existing conditions.

This attitude towards improvement is very important for self capacity-building. In addition to these three steps, integrated management of the elements is important. The integrative aspect shall reflect the management issue which will consolidate these elements into a holistic mechanism for sustainable development of cities and freshwater resources.

There are conditions to be considered and problems to be tackled in each of above-mentioned phases. For example, during the adoption phase ESTs should be selected from a comprehensive point of view, such as a part of an integrated environmental plan appreciating political, socio-economic and cultural conditions of the country.

For applying ESTs, among others, life style and income level of the population in the user area, natural resources, environmental specifics including risks and other peculiarities of the location are needed to be considered. And during the operation phase, maintenance costs and effort, tool and spare parts supply, energy requirements, organizational and monitoring issues are only a few examples to be examined.

During the case presentation and discussion these conditions for adopting, applying and operating ESTs in local environments will be further reflected. One of the cases deals with sub-surface dam technology transferred by the national government to a local remote island. This case is not a bilateral one, but it shows the one requisites for success of transferring state-of-the-art technology. The other case demonstrates the transfer of a household sewage treatment systems to Indonesia. This case shows the importance of establishing close relationship between supply side and demand side, thus being representative for technology cooperation.

Case 1: Technology Transfer of Sub-Surface Dam Technology to Miyako Island in Japan

Miyako Island is located in the South of the Ryukyu archipelago of Japan, and has an area of 159km2 and a population of approximately 40,000. An experimental sub-surface dam was built by the Japanese national government in 1974 and presently real sub-surface dams are operating.

The reason for the construction of a sub-surface dam is that Miyako Island has a suitable geological condition for construction of underground sub-surface dams and underground water is the only source for all purpose of water use because of the absence of a surface stream. There are many underground valleys in the island and the permeable layer, Ryukyu lime stone layer (thickness from several meters to 100 meters) is on the impermeable bed. There are many faults under the ground, and they form underground valleys. The natural geological condition proved to be suitable for the experiment.

The experiment was successful, and several sub-surface dams were constructed for irrigation of sugar cane fields. The reasons for the success of those dams might be found in the coexistence of:

- Research: a comprehensive and island wide survey of geology and groundwater was conducted by a national research institute.
- High technology: a large general construction company developed the digging technique and a huge computer operated the digging machines. This requires high technology, and there are only three digging machines in Japan.
- Monitoring: after the construction of dams, the water quality in the sub-surface dams has been monitored by governmental research institutions who developed monitoring techniques.
- Finance: construction cost was too high for the local government of such a remote island, but most part of it was covered by the national government as a national project.

Several countries, such as China and India did preliminary research to construct such subsurface dams and requested international assistance. However, several points should be considered in adopting this technology by developing countries:

- Since the level of the involved technology is advanced, it is rather difficult to adopt such technologies in remote areas of developing countries. Thus, engineers, equipments, etc., of the technology exporter should assist in the pre- and post-transfer phases.
- As construction costs are too high for the local government, national and/or international assistance is necessary. Moreover, such technologies should be improved in order to be less expensive. In any case, before adopting these types of technologies, extensive research is required, and after construction, water quality monitoring is needed. It is, therefore, suggested that the institutions in developing countries have research techniques.

- The construction of such dams has significant impacts on the social, economic and environmental systems of the remote location. Environmental Technology Assessment before the construction is necessary.
- After the construction, monitoring of effects on social, economic environmental conditions in the location are necessary.
- Establishment of a new irrigation association is necessary which is much harder than the construction of dams itself. Government and farmers should cooperate with each other and operate the irrigation system successfully.
- Operation cost should be low. In the Miyako case, although the construction cost of the system were fully covered by a national subsidy, operation cost had to be paid by farmers, since the operation costs were too high, owed mainly to electric charges for pumping up groundwater.

<u>Case 2: Technology Transfer of a Household Sewage Transfer System to Indonesia</u>

In an experimental project of installing a Japanese combined private sewage treatment system (Gappei Johkaso) in Indonesia, the transfer of ESTs is demonstrated. The success was provided through long-term partnership among many institutions and agencies of Indonesia and Japan. In addition, the association of companies of private treatment systems devoted herself to transferring technology.

The water condition in rivers in urban areas of Indonesia is critical. Jakarta has rivers with BOD over 90 ppm. The Municipal Agency of Public Health reported that 66% of the wells were contaminated with coliform bacteria. Of the total pollution loading amount, almost 70% has derived from domestic wastewater and 46% of the total pollution loading amount derived from miscellaneous household effluent. Generally speaking, effluent from toilets is treated by cesspool or septic tanks, but in most cases, treated water is discharged underground. Some houses have a toilet above the river and discharge night soil directly. Miscellaneous water is discharged into side gutters without treatment.

In order to mitigate urban pollution problems in Indonesia, a project entitled "Research and Development Project on Building Sanitation" was planned in 1991 by the Ministry of Construction of Japan and relevant organizations. Many organizations of both countries participated in the project, such as the State Ministry of Housing, the Ministry of Public Works, Directorate General of Human Settlement, and the National Urban Development Corporation in Indonesia; the Ministry of Construction, Environmental Agency, Wastewater treatment System Association, and Japan International Cooperation Agency in Japan. Japanese organizations designed, produced, transported and tested private sewage treatment tanks, while Indonesian organizations installed the plants, monitored and analyzed the water quality.

There are two types of sewage treatment systems - public and private systems. Before starting the project, the project team considered which system should be adopted, a public sewage system or the private sewage treatment tank. Both systems have their merit and demerit. Features of the private system are: low costs, short duration of construction, uncomplicated technical knowledge and management systems. Although a public sewage treatment system has the features opposite to those of a private system, it has its merits. It can treat most of household discharge in the area and is especially useful to the area where people are using groundwater from their wells, which is sometimes polluted by toilet discharge. The construction of such a system requires, however, a considerable amount of initial cost and time. For these reasons, the private/public combined sewage treatment system was considered to solve urban water pollution problems at best under discussed conditions.

The project started in 1993. After intensive discussion between the Japanese and the Indonesian side, the Wastewater Treatment System Association produced several types of experimental private combined sewage treatment plants in Japan and shipped them to Indonesia. The social, economical and environmental conditions were fully considered when the plant was planned. Tanks were made of fiber reinforced plastics and one of them was filled with domestic materials, such as coconut shells as a filter. Another type of tank was designed to be operated without electricity. The tanks shipped to Indonesia were installed in several houses and observed in order to test their treatment performance under actual conditions. Water treatment test methods were also transferred. In the initial stage of the tests, Japanese researchers sometimes stayed and taught the test method to the Indonesian researchers. Later on, data were sent to Japan by facsimile in order to check the accuracy of the tests. Japanese staff sometimes visited the site to regulate the projects.

Through the experiment, several problems to be solved while adopting, applying and operating of ESTs were ascertained:

- Private treatment systems are indispensable for households, thus the policy to disseminate the system, standards of installation and structure are required.
- Planning standards of the country should be established based on the natural and social conditions, such as bioremediation capacity under the tropical climate, custom of bathing, pollutant load derived from eating habits, etc.
- Education of residential and sanitary environment is needed to promote the establishment of the system.
- Development of non-electric treatment systems is required because of unstable, expensive power supply. Public maintenance systems, such as collection of sludge by vacuum vehicles and
- Expanding capacities of companies with treatment system engineers are necessary in order to provide stable maintenance service.
- As subsidy systems for installation, operation and maintenance should be considered. Also low-cost systems should be developed.
- A policy that promotes dissemination to people in the upper brackets of income is required. These people can buy the system and the cost of the system becomes lower. Then the system can be disseminated to people in lower brackets.

In order to disseminate this technology in urban areas, the above mentioned problems should be solved. The duration of this experimental project was three years. Long term partnership and collaboration between both exporter and importer of technology are essential for successfully adopting, applying and operating ESTs.

3. Group Discussions

National and local conditions to be considered in adopting, applying and operating ESTs will be identified after the case presentation through discussions in small regional groups. Participants will be assigned to:

(a) List key problems of urban and lake/reservoir environment in their home countries (Participants are requested to cite major environmental problems of their countries.)
(b) Prepare an overview on prospective ESTs to be adopted, applied and operated to mitigate environmental problems listed under (a) above.
(c) Present and discuss group findings.

As training tools, Nominal Group Technique (NGT) will be applied after introducing this method to participants. The work of each regional group of five to six members will be monitored by a discussion leader (facilitator).

Nominal group technique was developed by Andre L. Delbecq and Andrew H. Van de Ven in 1968. Since that time, NGT has gained extensive recognition throughout the world and has been widely applied in health, social-service, education, industrial and governmental organizations.

NGT meetings normally consist of one to five groups of five to nine people each seated around tables open on one end. The open end is used for a flip chart pad on an easel to be used by the leader for the collection and public display of ideas furnished by participants of the group. The leader has markers for writing ideas on the chart pad and masking tape for taping sheets containing ideas on the wall of the room. Participants of each group are provided with pencils and one dozen small writing cards each.

The leader opens the meeting with a statement about the purpose of the meeting, clarification of the importance of each member's contributions and a clear indication of how the meeting's output will be used.

Although a meeting might involve several groups at separate tables, for purposes of illustration, we shall explain the process as if there was one table consisting of between five and nine participants. The process consists of six steps.

Step 1: Silent generation of ideas in writing
Step 2: Round-robin recording of ideas
Step 3: Discussion for clarification
Step 4: Preliminary vote on ideas of importance
Step 5: Discussion of the preliminary vote
Step 6: Final vote

Through the entire process, the role of group facilitator is very important for the success of discussions. Facilitator should exchange information and contents of discussions before and after each discussion session. Prior to group distributions, a rapporteur will be nominated by each group who reports results of group work to the plenary.

4. Conclusions

Case presentations are employed to raise participant's awareness on ESTs transfer, and to identify ESTs that are suitable to mitigate environmental problems of their home countries/regions.

Cases presented in this programme can be easily replaced with other cases which present the process of adopting, applying and operating ESTs. If the venue of a training programme is close to the case area, case presentations with handouts and slides can be replaced by field visits to the area.

Breaking into regional groups as practiced in this programme might be applied in regional or national workshops by breaking into country or local groups. Even in national training activities group can be divided following geological, economic and cultural conditions of various provinces or areas.

SLIDES

HANDOUTS

1. Transfer of Sub-surface Dam Technology within Japan (Final Report)

2. Transfer of Household Sewage Treatment System Technology from Japan to Indonesia (Background Paper)

3. Nominal Group Technique (Briefing Note)

NEEDS AND CONDITIONS OF TECHNOLOGY TRANSFER INCLUDING ADOPTING, APPLYING AND OPERATING ESTs

A CASE PRESENTATION AND GROUP DISCUSSION

Case 1.

Transfer of Sub-surface Dam Technology to Miyako Island in Japan

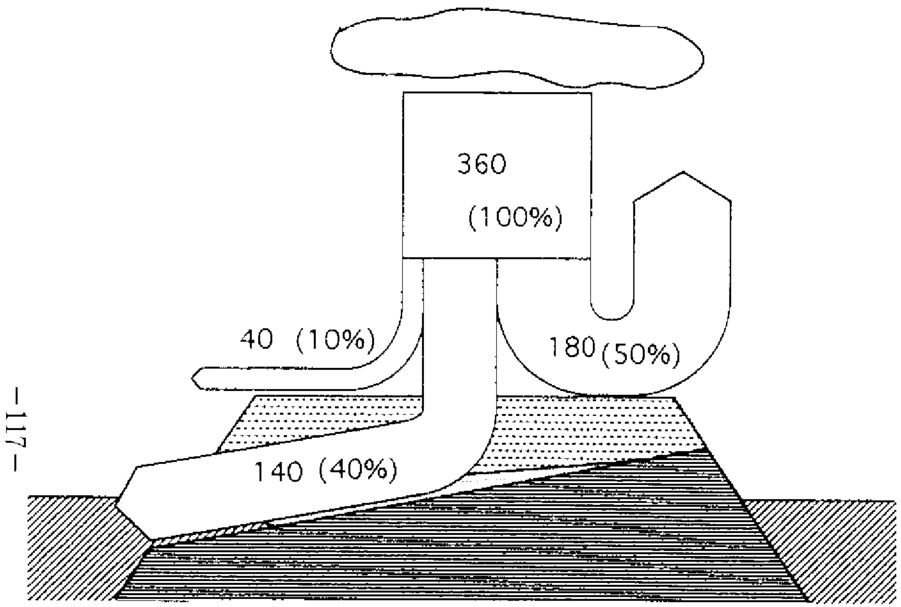
Case 2.

Technology Transfer of Household Sewage Treatment System to Indonesia

NEEDS AND CONDITIONS OF TECHNOLOGY TRANSFER INCLUDING ADOPTING, APPLYING AND OPERATING ESTs

Case 1.

Transfer of Sub-surface Dam Technology to Miyako Island in Japan



Water Balance of Miyako Island

Note: Present water use in Miyako

3.7 million ton/year for drinking water

24 million ton for agriculture

Water resources problem in Miyako Island

Severe natural conditions

Typhoon
- Average number of typhoons is four.
- Wind speed of 85. 3 meter /second was observed in 1966.

Salty wind damage

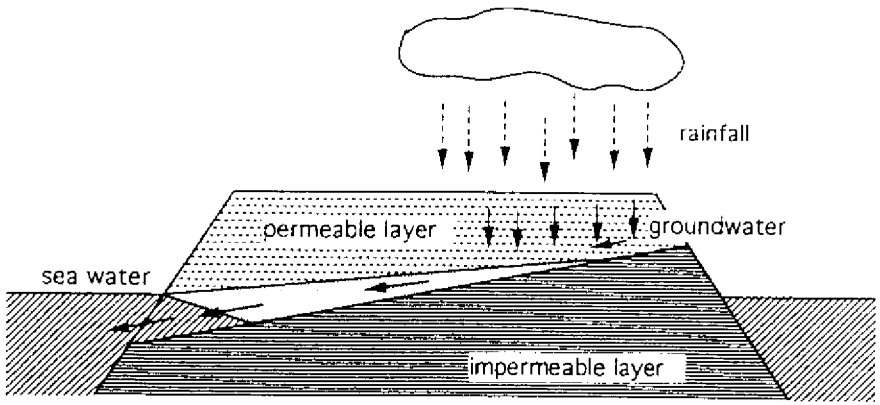
Drought
- Precepitation in half year of 1971 was only 162 mm.

↓

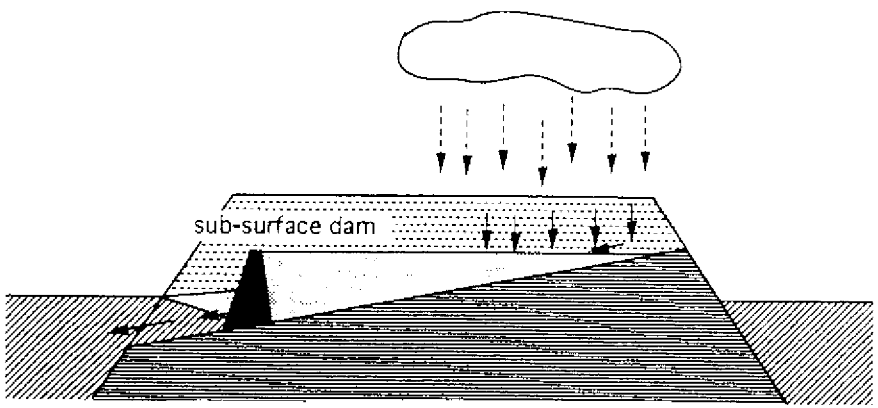
Low production of sugar cane

- 40-60 ton / hectare in Miyako island
- 12ton/hectare in 1971

(80-90 ton /hectare in Hawaii)



Before construction of sub-surface dam



After construction of sub-surface dam

Step of adoption

Alternative Technologies of Water Resources Development

- Dam Construction
- Desalination of Dammed Lake in Bay
- Desalination Plant
- Sub-surface Dam

Construction of Dams

Merit

- Huge amount of water can be stored in one dam.
- Multi purposes (ie, flood control, hydraulic power generation, etc.)

Demerit

- Influence on ecosystem and residents
- Water in dam evaporation under dry conditions
- Sedimentation in dam

Desalination of Dammed Lake in Bay

Merit

- Low construction cost

Demerit

- Eutrophication caused by nutrients from land-based sources
- Change in eco-system in dammed lake
- Change in life style of residents

Desalination Plant

Merit

- The plant can be constructed in any place.
- Quality of desalinated water is very high.

Demerit

- Energy consumption is very large.
- Module of membrane should be changed frequently.
- Maintenance cost is very high.
- Brine from module might damage eco-system in discharge area.

Sub-surface Dam

Merit

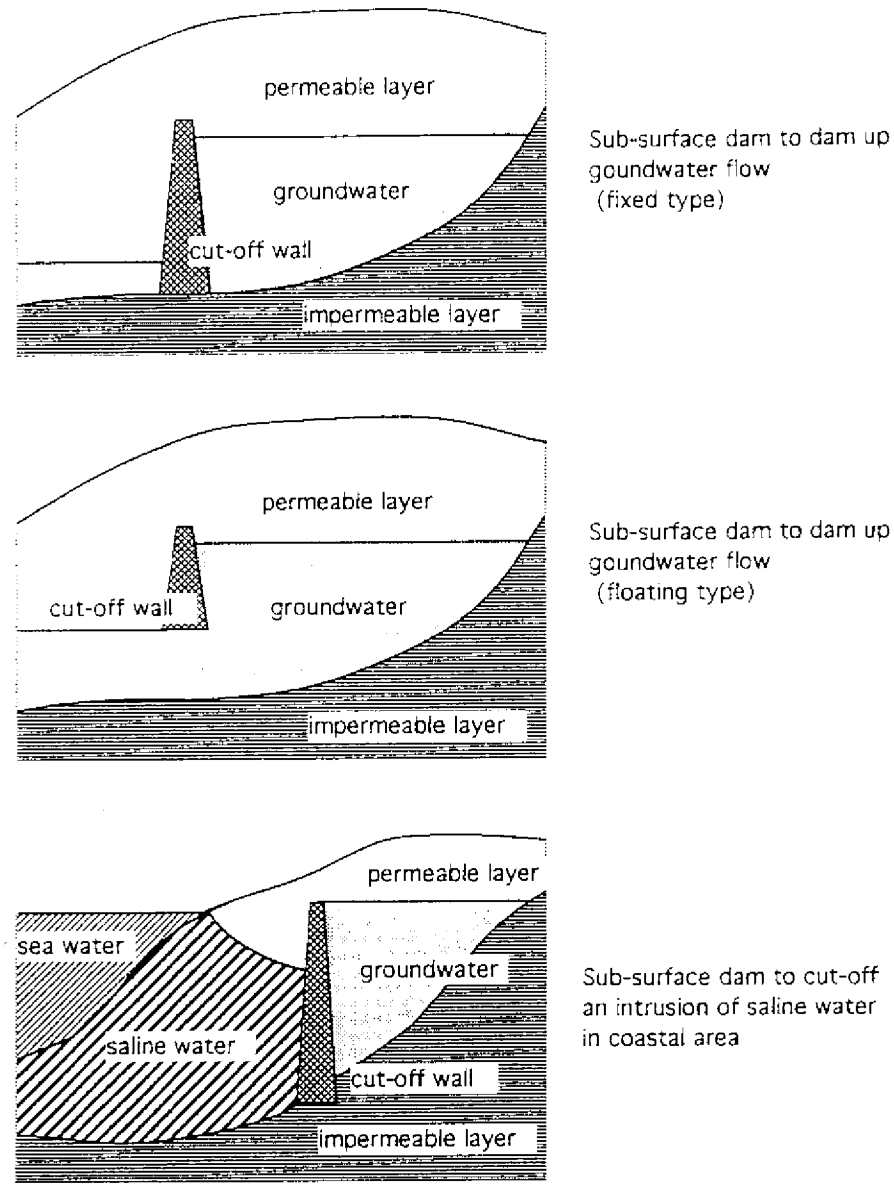
- No submerged land/Land use is not disturbed.
- No sedimentation problem.
- Negligible evaporation from the reservoir.
- Low construction cost.
- Short construction period.
- Non-destructive structure.
- Simple operation.

Demerit

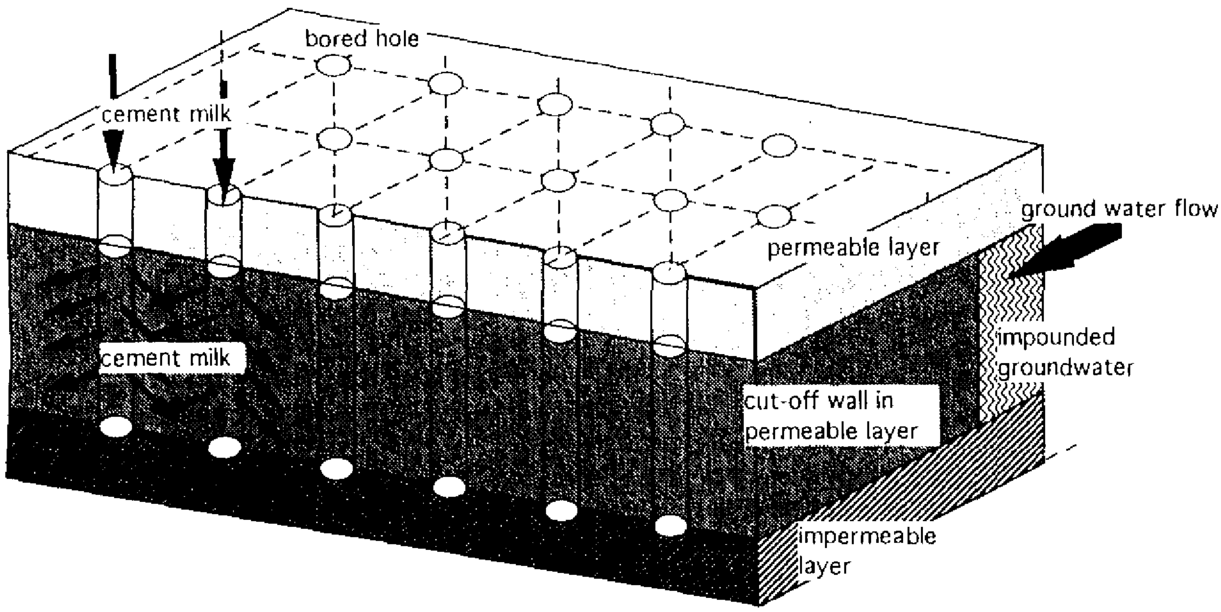
- Geological formation is restricting factor for construction.
- Additional cost for pumping facility.

Requisites for Construction of Sub-surface Dam

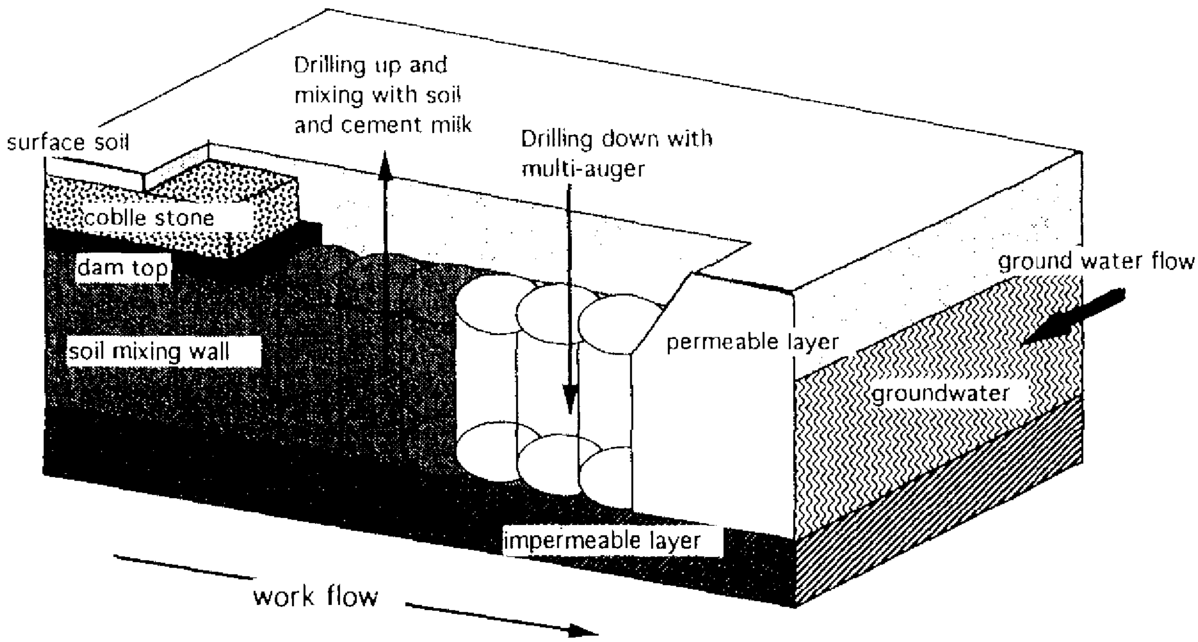
- Permeable layer of certain thickness should exist above the impermeable layer.
- Groundwater recharge area should be large.
- Underground valley which is suitable for construction of cut off wall should exists.



Types of Sub-surface Dam



Sub-surface Dam Constructed with Grouting Method



Sub-surface Dam Constructed with Soil Mixing Wall Method

Feasibility Study of the Experimental Sub-surface Dam (1974-1979)

1974-1976 survey on locational conditions

-geological and hydrological researches of some possible dam sites

-foundamental tests for technical problems in construction of a cut-off wall

-estimation of storage mechanism

1977-1978 construction of cut-off wall

1979-1980 experiment on water intake

-observation on storage condition of groundwater

-test on control of storage water under heavy rain

-water quality control

1981- collecting basic hydrologic data

Minafuku Dam (Experimental sub-surface dam)

Location
Gusukube-cho, Miyako, Okinawa, Japan

Catchment area
1.7 sq. km

Cut-off wall
Hight 16.5 m Length 500 m Thickness 5 m

Method of construction
Grouting method
(injecting cement milk through bore holes)

Storage capacity
Total 700,000 cu. m Available 400,000 cu. m

Water level
6 m up in upstream of the dam (average; 3 m up)

Pumping capacity
4800 cu.m/day (120 ha can be irrigated)

National Land Improvement Project in Miyako Island

Construction work

sub-surface dams : 2 dams (27.2 billion yen)
total storage capacity : 32 million tons

irrigation canal: 135 km
farm ponds : 7
booster pump stations: 8

Beneficiaries :

5685 people
(total irrigated area : 8400 hectare)

Construction cost

national government:
50 billion yen (500 million US dollars)

prefectural government and farmers :
40 billion yen (400 million US dollars)

Problems / step of operation

Economic problem

-pumping cost (electric charges) is high.
10 thousand yen / 1000 sq.m /year
(20 % of net increase of gains)

Social problem

-water utilization association

-water right issues

Environmental problem

-water pollution problem

NEEDS AND CONDITIONS OF TECHNOLOGY TRANSFER INCLUDING ADOPTING, APPLYING AND OPERATING ESTs

Case 2.

Technology Transfer of Household Sewage Treatment System to Indonesia

Project Title

Research and Development Project on Building Sanitation

Objectives of the Project

The objective is to develop an affordable and technologically appropriate on-site individual wastewater treatment systems for Indonesian housing.

Research and development activities of the Project

1. To collect general information about wastewater treatment in Indonesia,
2. To design affordable and technologically appropriate on-site individual wastewater treatment system,
3. To install test plants on the project sites,
4. To evaluate the results of the monitoring, and improve the design based on these results,
5. To examine the applicability of local low cost materials to the test plants.

Problems on Construction of Sewerage System

(1) Construction cost of sewerage system (sewage treatment plant and sewer system) is high.

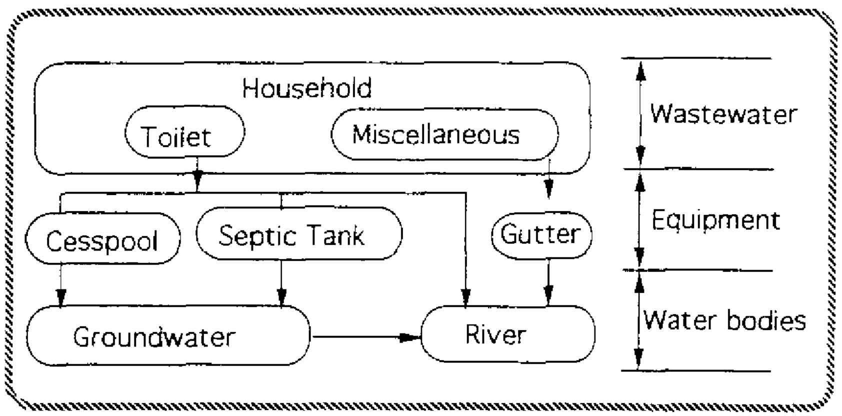
(2) Construction period is long.

(3) Sophisticated technique is necessary for operating the system.

Percentage of Pollution Load in Djakarta city

Source	Percentage of pollution load (%)
Wastewater from household	70
Toilet	24
Miscellaneous	46
Wastewater from urban activities and industries	30
total	100

Wastewater Flow from Household

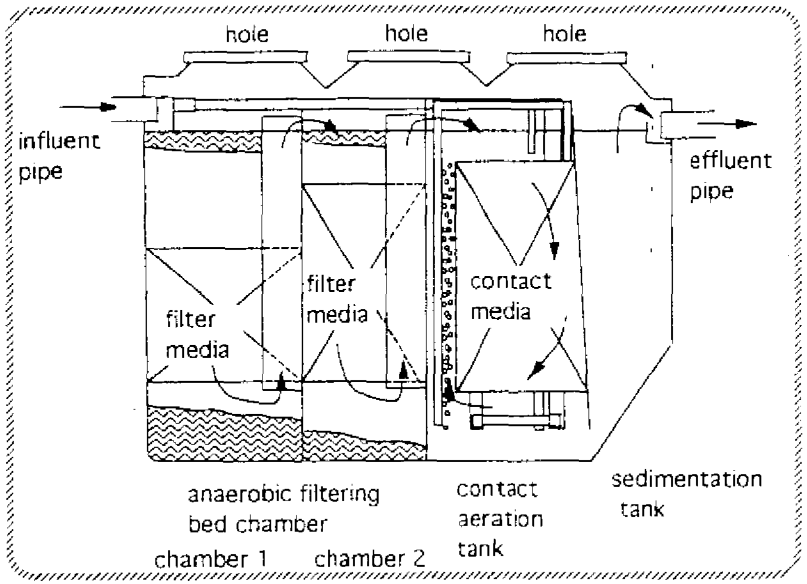


Daily Pollution Load per Capita for Test Plants

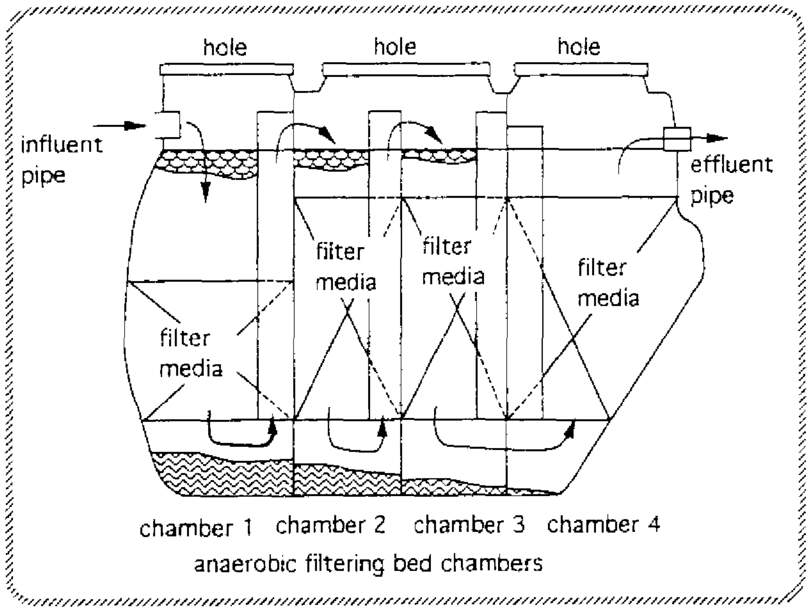
	Water Quantity (liter)	Pollution Load BOD(gramme)
(a) Toilet waste	10 (Pour Flush)	10.5
(b) Kitchen waste	30	
(c) Washing	50	(b)+(c)+(d)= 19.5
(d) Bath and others	70	
Total	160	30

Effluent Condition on BOD

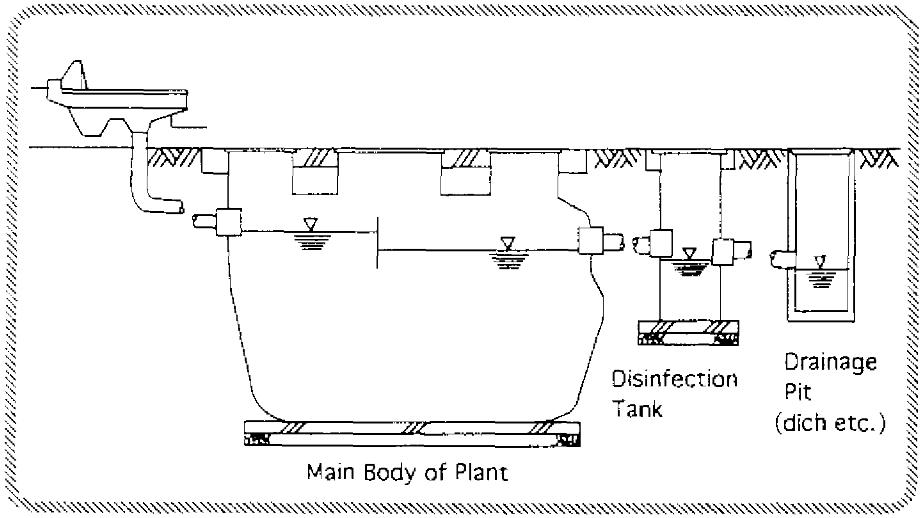
Type of test plant	BOD (mg/liter)
Non-Electric Power Type	50
Electric Power Type	30



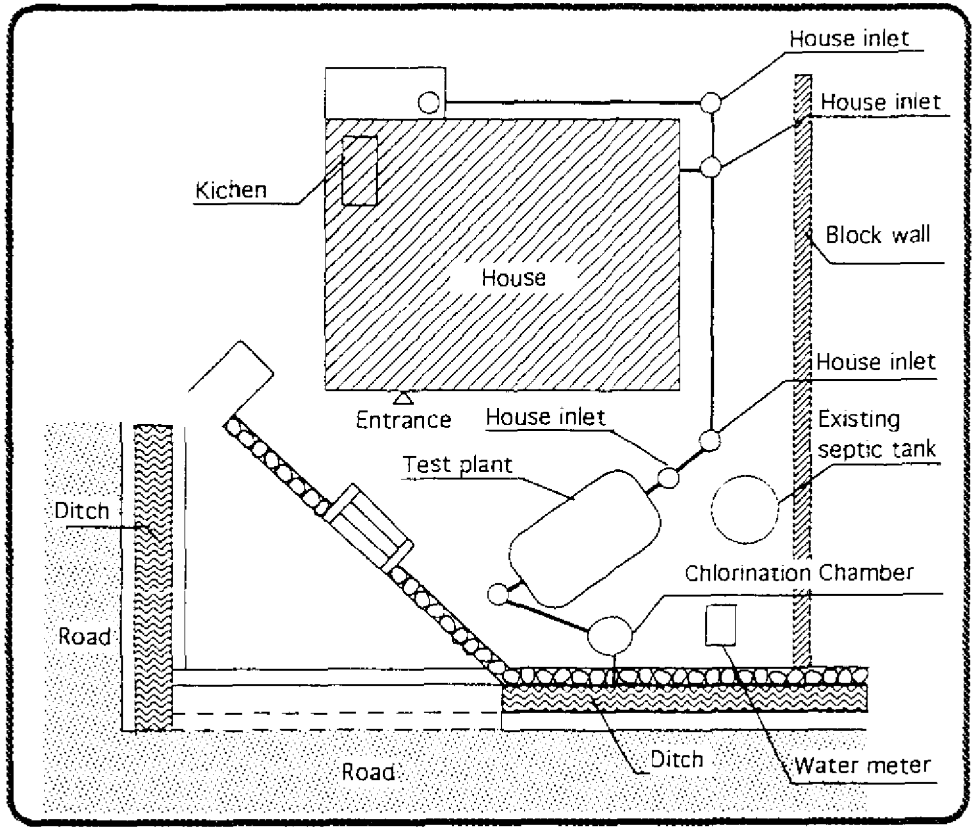
Test Plant (Anaerobic-aerobic biofilm tank)



Test Plant (Anaerobic biofilm tank)



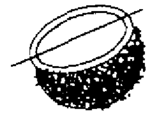
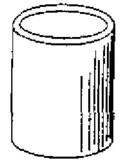
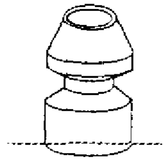
Vertical Layout of Test Plant



House H (Djakarta, Indonesia)

1. Housing
 1) Residents 4 people: 3 adults (1 male1, 2 females), 1 infant
 2) Water source Use of tap water, no use of ground water
2. Basic Items for Design
 1) Number of persons 4 people
 2) Design wastewater flow 160 liter/man day x 4 people = 800 l/day
 3) Inflow BOD rate 30 gramme/man day x 4 people = 150 gramme/day
 4) Inflow water quality (BOD)
 (30g/man day x 1000)/(160 l/man day)= 187.5 mg/liter
 5) Discharge water quality (BOD) 50 mg/liter
 6) Removal rate (187.5- 50)/187.5 x 100 = 73.3 %
3. Treatment Process
 1) Anaerobic treatment (electric power is required.)
 2) Anaerobic filter process
4. Important Issues
 1) All wastewater generated in the house shall be sent into the plant.
 2) Rain water should be prevented from going into the plant.
 3) Existing septic tank should not be used during the test plant operation.

Alternatives of Contact Media

	Material	Size and Shape
First chamber ($0.353\ m^3$)	Coconut husk	Bamboo skewer Outside diameter: about 12 cm 
Second Chamber ($0.434\ m^3$)	Bamboo	Outside diameter: 5-7 cm Length : 5-7 cm 
Third Chamber ($0.434\ m^3$) Forth Chamber ($0.547\ m^3$)	Small plastic bottle	Plastic bottles with bottom cut off 

How to transfer ESTs successfully?

Legal obligation to install household sewage treatment system

mass-producing and reducing cost

Maintenance of the system

Environmetal education

cooperation with NGOs

On-the-job training

based on the needs of the target country

result oriented

Main reasons for successful cooperation

Long international cooperation activities exist between Indonesian and Japanese governments and national organizations.

Engineers in several Japanese national organizations could cooperate each other in Indonesia.

Producers of private sewage treatment plants could participate in the project.

Price of Tank

	Price (Thousand Rupiah)
Septic tank used in houses	250
Proposed fiber reinforced plastic tank	4,500
Maximum price for Indonesian to pay	1,000

Cost of Tanks Using Domestic Materials

	Cost (Thousand Rupiah)	(U.S. Dollar)
(1) Fiber-glass reinforced plastic	4,500	(2,400)
(2) Ferro cement board	1,900	(1,040)
(3) Concrete	2,900	(1,550)
(4) Blocks	1,300	(678)

NEEDS AND CONDITIONS OF TECHNOLOGY TRANSFER INCLUDING ADOPTING, APPLYING AND OPERATING ESTs

NGT(Nominal Group Technique)

NOMINAL GROUP TECHNIQUE (NGT)

Learning Emphasis

Organization Focus

Every partridge knows its way of scratching.

— Kikuyu Proverb

NGT was developed by Andre L. Delbecq and Andrew H. Van de Ven in 1968. Since that time, NGT has gained extensive recognition throughout the world and has been widely applied in health, social-service, education, industrial and governmental organizations.

NGT meetings normally consist of from one to five groups of from five to nine people each seated around tables open on one end. The open end is used for a flip chart pad on an easel to be used by the leader for the collection and public display of ideas furnished by participants of the group. The leader has markers for writing ideas on the chart pad and masking tape for taping sheets containing ideas on the wall of the room.

Participants of each group are provided with pencils and one dozen small writing cards each.

The leader opens the meeting with a statement about the purpose of the meeting, clarification of the importance of each member's contributions and a clear indication of how the meeting's output will be used.

Although a meeting might involve several groups at separate tables, for purposes of illustration, we shall explain the process as if there was one table consisting of between five and nine participants. The process consists of six steps.

Step 1: Silent generation of ideas in writing

The leader reads the nominal question to participants out loud while writing it in plain sight at the top of the pad. Care must be taken by the leader to choose clear and unambiguous wording for the question so as to generate the most specific responses possible. An appropriate question, "How can we make better use of our time at meetings," for example, should produce many useful ideas. This question is far superior to the more general question: "How can our meetings be more productive." The leader then asks participants to write down as many ideas as they can think of in answer to the question. Participants are cautioned by the leader to work silently and independently.

Step 2: Round-robin recording of ideas

Starting at one end of the table, the leader asks a participant to read one of his/her answers out loud. The answer is recorded by the leader on the pad. The next participant is asked for one of his or her answers. This process is continued until every answer of every participant has been recorded. As sheets on the pad are filled the leader tears them off and tapes them to the wall. Participants are encouraged by the leader to "pass" if they have nothing further to offer with the understanding that they may re-enter later with any new ideas that may occur to them. Discussion of ideas and side conversations at the table are strongly discouraged by the leader.

Step 3: Discussion for clarification

The leader explains that the purpose of this step is to ensure that everyone understands what is meant by each idea on the pad. The ideas are taken one at a time as written. Discussion of an item is to focus on understanding, not agreement or disagreement. Participants are told that everyone is responsible for clarifying an idea and not just the person who offered it.

Step 4: Preliminary vote on ideas of importance

The leader asks participants to select five ideas from the list of ideas displayed on the sheets taped to the wall and to write each item down on a separate card. The leader collects the cards and shuffles them to retain anonymity. The leader then tallies the vote and records the results on the flip chart in front of the group.

Step 5: Discussion of the preliminary vote

Participants are told by the leader to examine the voting pattern on the chart and to comment on anything about the pattern that seems unusual, surprising or inconsistent. The leader stresses that the discussion may persuade some participants to change their votes but that no one is being pressured to do so.

Step 6: Final vote

The final vote is simply a repeat of Step 4. It combines individual judgements into a group decision. When it is over, the leader thanks participants for their efforts, repeats what will be done with the meeting output and closes the meeting.

PROS AND CONS OF NGT

Unlike brainstorming, in which participants interact with one another from the start, NGT is designed to let people work in the presence of one another in a structured manner but to write down their ideas independently rather than talk about them. Because of this characteristic, NGT groups have been found to outperform interactive groups consistently in the quality of ideas produced. This seems to be because participants of NGT groups are less subject to being inhibited by one another and are less prone to make premature judgements.

NGT does have some drawbacks. Considerable preparation for NGT meetings is necessary. For this reason, it is less useful as a spontaneous training technique than brainstorming. These drawbacks can be alleviated, however, by leaving out some of the steps described above thereby simplifying the process and saving time.

SUMMARY

Structured techniques for group problem solving like brainstorming and NGT are valuable additions to the trainers repertoire of learning activities. They are particularly useful as a source of creative ideas and to demonstrate the tremendous potential of a group to analyse and remedy its own problems. NGT is more formal and time-consuming than brainstorming but is sometimes preferred by people in training who are uncomfortable with the more spontaneous, interactive methods.

Group Assignment to Session 9 and 10:
NGT(Nominal Group Technique)

Part I: Nominal Questions:

What are the key problems of urban and lake/reservoir environments in your region/country?

1. Each participant notes as many as possible problems individually (without interacting with other members of the group) for about 10 minutes.

2. Reading identified problems to the group
One single, relative specific problem at a time by each participant. Then clockwise to the next one until all problems are gathered.

The group leader takes note of each stated problem on a single card and pins it to the board (use work sheet 1).

3. Out of the list of all stated problems, participants are requested to pick the three most important and write each one down on a card. Cards will be collected by the leader and votes will be gathered. The score will be presented and the three highest priorities named.

Part II: Group Discussion:

Please identify the EST (hard and/or soft technology) which can contribute to mitigate each of the three prioritized problems (use work sheet 2).

Then analyze the identified technologies under the following aspects (use work sheet 3):

(a) Major barriers in the adopting phase and how to overcome these barriers.

(b) ____________ in the application phase ________________.

(c) ____________ in the operation phase ________________.

Group findings will be presented by the rapporteur following a consistent format.

List of Problems

Work Sheet 1 (Session 9 &10)

Group name: ______________________

What are the key problems of urban and lake/reservoir environments in your region/country? Each participant notes as many as possible problems individually and the group leader takes note of all stated problems on this sheet.

Problems and ESTs

Work Sheet 2 (Session 9 &10)

Group name:

Please identify the EST (hard and/or soft technology) which can contribute to mitigate each of the three prioritized problems.

Problem 1

EST

Problem 2

EST

Problem 3

EST

Problems and ESTs

Work Sheet 3 (Session 9 &10)

Group name:

Please analyze the identified ESTs: major barriers in each phase and how to overcome these barriers.

Problem No.

EST

ADOPTING

Barriers

How to overcome

APPLYING

Barriers

How to overcome

OPERATNG

Barriers

How to overcome

Group Works on Session 9&10

Group 1: India, Bangladesh, Sri-Lanka, Nepal, Bhutan, Maldives (SAARC)

Problem 1 Poor drainage and sewer systems

EST
- Well planned sewer and treatment system for larger cities
- Well planned on-site sanitation for medium and small cities/towns

Problem 2 Lack of awareness of environment problems

EST
- Management and planning of environmental education and training

Problem 3 Solid waste water problems

EST
- Appropriate technology for waste minimization, collection, treatment and disposal

Problem 1 *Poor drainage and sewage systems*

EST
- Well planned sewer and treatment system for larger cities
- Well planned on-site sanitation for medium and small cities/towns

ADOPTING

Barriers
- Budget restrictions
- Social problems
- Not well-informed decision making

How to overcome
- Cost recovery (through awareness), cost analysis
- Community policy, aware creation, education
- Full utilization of existing information system and willingness

APPLYING

Barriers
- Lack of local skilled human resources
- Lack of confidence of local small public residence

How to overcome
- Training
- On the job training
- Commonly participation, education

OPERATING

Barriers
- Lack of back-up support system
- Lack of operation/maintenance skill
- Technology

How to overcome
- Well planning and utilizing plan
- Self adoption and application
- Technology monitoring

List of Problems

- deterioration of water quality
- freshwater shortage
- poor drainage and sewer systems
- land management problems
- overextended project implementation (leading of lack of finance)
- solid waste management problems (industrial, hazardous, domestic)
- lack of awareness of environmental problems
- air pollution from industries/traffic
- insufficient traffic management
- ambient noise and thermal pollution
- population density (e.g. through urban migration)
- fragmentation of responsibilities among government agencies
- occupational environmental hazards
- insufficient legislation / reinforcement of laws
- lack of trained human resources
- reverse backflow problem of surface water in coastal areas
- lack of monitoring systems
- poor operation / maintenance of water / sewage treatment facilities
- inadequate research and development
- cost recovery from services provided

Group Works on Session 9&10

Group 2: Cambodia, Myanmar, Thailand, Philippines, and Indonesia

Problem 1 Improper and inefficient wastewater treatment for domestic area

EST
- Appropriate, affordable, adaptable wastewater treatment technology

Problem 2 Solid waste disposal, especially in squatter area

EST
- Integrated solid waste management system (collection, transportation, recycling, reuse, separate)

Problem 3 Technical knowledge on the operation of waste water treatment facility

EST
- On the job training and education
- R&D for transferring imported technology

Problem 1 *Improper and inefficient wastewater treatment for domestic area*

EST Appropriate affordable, adaptable wastewater treatment technology

ADOPTING

Barriers - What in the technology to be adopted.

How to overcome

- Well informed (adv. and disadv.)
- Information generating of the technology
- Matching up demand and supply

APPLYING

Barriers

- Community acceptability
- Available of the site (technically and socially)

How to overcome

- Education
- Involvement (in steps of construction, O/M)
- Demonstration
- Environment subsidy

OPERATING

Barriers - Sustainability and maintenance of the technology

How to overcome

- Training community
- Private sector involvement
- Monitoring
- Budget allocation

List of Problems (Cambodia, Myanmar, Thailand, Philippines, Indonesia)

- improper and inefficient design of wastewater treatment for domestic area
- solid waste disposal, especially in squatter area
- modernization of the sewerage system
- lack of available space for park and recreation and green belt
- groundwater contamination
- technical knowledge on the operation of wastewater treatment facility
- lack of disposal facility
- traffic congestion
- lack of standard and legislation
- lack of ordinance of local government
- air pollution from dust / unpaved road and construction site
- flood and drainage system (poor)
- public awareness and participation
- limited number of technologies for waste utilization
- implementation of rule and regulation
- conflict of interests (general)
- noise pollution (vehicle / generation)
- eutrophication of lake and river
- erosion problem caused by deforestation

Group Works on Session 9&10

Group 3: Pacific

Problem 1 Water related problems (pollution)

EST
- Education and public polluter awareness

Problem 2 Waste problems (rubbish, sewage)

EST
- Composing systems

Problem 3 Lack of legislation of political will enforcement

EST
- Have legislations in place
- Train personnel to enforce legislation.

Problem 1 *Water related problems (pollution)*

EST Education and public awareness

ADOPTING

Barriers
- Lack of financial back up for public participation
- Lack of personal interest in community groups

How to overcome
- Fund raising
- Community meetings

APPLYING

Barriers
- Non availability of local expertise
- Top-down approach
- Cultural sensitivity to issues

How to overcome
- Training-personnel capacity building
- More consultation to involve a wider X-section of the community

OPERATING

Barriers
- Gradual loss of interest in community
- Staff turnover

How to overcome
- Office and public awareness
- Continuous system of campaign
- Incentives

Group Works on Session 9&10

Group 4: China, Korea, Saudi Arabia, Botswana

Problem 1 Water pollution problems

EST

- Domestic wastewater treatment system
- Efficient integrated treatment technology focus on Nutrients (P, N)
- Middle-sized wastewater treatment technologies
- Well-prepared processing of industrial wastewater before joining main sewage line.

Problem 2 Air pollution problems

EST

- Renewable energy technologies (e.g. solar, wind-mill, wave)
- Cleaner production technologies for energy savings
- Technologies for less-polluted emission gas from cars
- Appropriate (not expensive) desulphration technologies for industrial plants.

Problem 3 Solid waste pollution problems

EST

- Recycling technologies for paper, plastics, metals, etc.
- Non-pollution landfill technologies (e.g. safety, order)
- Advanced incineration technologies for energy recovery, low-pollution

Problem 1 *Water Pollution Problems*

EST Efficient integrated treatment technology focus on Nutrients (P, N)

ADOPTING

Barriers
- Lack of local government enforcement
- Change the people's awareness
- Information about the technologies

How to overcome
- By the law/regulation
- International cooperation
- Establish world-wide networks

APPLYING

Barriers
- Financial supports/resources

How to overcome
- 3-5 % of budget

OPERATING

Barriers
- No experiences
- No technological support

How to overcome
- Training program by international cooperation

List of Problems (China, Korea, Saudi Arabia, Botswana)

For wastewater management

- The key problem is eutrophication pollution of the lakes in or around Wuhan, China
- Insufficient sewage treatment facilities including capacity and technologies
- Pollution of the nearby river water and ground water pollution of nutrients
- Water quality is exceed the 5th class of National Standard. This leads to surface water and ground water to be polluted and further more makes water supply shortage
- Water shortage and water pollution by municipal sewage in Beijing city, China
- Because the city located to the coast water table (level of ground water) also in the all city water table mixed with the effluent of portable septic tank.
- Improper sewage collection pipeline system including rainfall sewage separate collection. Same pipelines are leaking insufficient loads for biological treatment of sewage.

For air pollution management

- Air quality moves in the 3rd class of National Standard. The primary reason is energy structure depends on coal burning.
- Air pollution caused by coal-burning and vehicles in Beijing city, China
- Air pollution - Ozone, smog, visibility caused by rapidly increasing automobiles

For solid wastes management

- Too heavily depending on landfill difficulties in security landfill sites
- The problem is burn of solid wastes in landfill that causes by entrance of Yaman people. (poor people)
- Municipal solid wastes control and treatment in Beijing city of China.
- Solid wastes treating facilities is serious lack in Wuhan. This situation has the considerable impacts on the environment around city such as lake water, river and groundwater.

For other environmental problem

- The technological level of my industry remain a low level. This wastes too much resources and give off too much pollutants to control.
- Most industries concentrated in the urban areas and residential areas and industrial areas mixed together.
- Natural environmental destination - Too much development
- Natural calamities: droughts, diseases and desertification
- Poor standard and enforcements
- Urban residents strongly oppose to constructing sewage and night solid treatment facilities nearby
- Lack of good sanitation facilities for the poor sector of the population, for example, use of poor tape of pit latrines in urban areas resulting in small and unhygienic conditions.

SESSION 10

Presentation of UNEP IETC's Technology Information System

C. H. Strohmann

About maESTro:

IETC launched a Searchable Information Directory on ESTs in April 1997. Information and data of this directory is collected and disseminated through a newly developed software tool, "maESTro".

maESTro enables users to manage their information to update it with new data from the Centre and to share it globally, using Email, diskettes and internet. Through its Directory Interchange Format (DIF), maESTro is fully compatible with major international databases such as UNEP's Global Resources Information Database (GRID), NASA, CEOS and NASDA.

The IETC Searchable Technology Directory currently includes:
(a) EST information systems;
(b) institutions worldwide dealing with ESTs; and
(c) an overview on "hard", "soft" and endogenous eco-friendly technologies in IETC's field of activity.

All three areas of maESTro will be continuously amended and updated.

Accuracy and validity of all information collected and disseminated as well as the data stored in the Searchable EST Directory remain under the full responsibility of the original source of information.

maESTro is distributed free of charge both as floppy diskette and CD-ROM. It is also accessible in our homepage at <http://www.unep.or.jp/>. For more information, please visit <http://www.unep.or.jp/maestro/> or send your inquiry to: maESTro@unep.or.jp

SESSION 11

Reports from Delegates III:

Ms A. Siapno, Philippines
Mr. Soo-Hyun Shin, Republic of Korea
Mr. Jayasekara Jayasekar, Sri Lanka

Lecture VI:

Solid Waste Management – Technology Options

Assoc. Prof. Goen Ho

The State of the Environment of Iloilo City

Adeluisa G. Siapno, Ph.D.
Regional Technical Director
Ecosystems Research and Development Service
Department of Environment and Natural Resources (DENR)
Region VI, Iloilo City

Introduction

This paper that I am going to present to you is focused on the air and water quality and solid waste management of Iloilo City, a city located in the Western Visayas region of the Philippines. The first part describes the locality, population, and other background information. The second part discusses the state of the city's environment relative to its air and water quality, solid waste management and other relevant environmental conditions besetting the city.

The last part of the paper identifies the various programs of government, through its implementing arm, the DENR, in addressing the environmental problems discussed in the second part of this paper. One cannot argue to the fact that congestion of people in the city has brought about compounding problems such as pollution, improper garbage disposal, flooding, proliferation of squatter shanties, traffic congestion and increase of communicable disease.

Iloilo's Social Environment

Iloilo City exemplifies a Third World highly urbanized city. It is characterized by a burgeoning population primarily brought about by a high growth rate and massive migration of people from the rural areas.

Based on the 1995 Census of Population, Iloilo City has a total population of 334,539 distributed in 64,811 households crowding over 68.5 square kilometers of land. It comprises six (6) districts, namely: Arevaio, Jaro, Mandurriao, Lapaz, Molo and City Proper, with a total of 180 barangays. The average annual growth rate of the City is 1.6% or 5,000 yearly (1990-1995).

State of the Environment

Air quality

Because of the ever-increasing trend toward industrialization, ambient air quality of Iloilo City has deteriorated. Data revealed that in 1992, the highest level of the total suspended particulate (TSP) was 1,800 micrograms per normal cubic meter. This is seven (7) times the allowable DENR standard of 230 micrograms per normal cubic meter. Particulate matter concentration in the air may be attributed to smoke belching and settled dusts in the streets which become air borne when disturbed by wind action and to loading and unloading of cement and lime products by cargo vessels.

The major sources of air pollution are motor vehicles industries. In Iloilo City, approximately 60% of air pollution is attributed to smoke-belching motor vehicles while the industrial sector contributes approximately 40% of air pollution. Among the pollutants in Iloilo City are carbon monoxide, hydrocarbons and oxides of nitrogen, which mainly come from the combustion of fossil fuels like bunker fuel oil, diesel, gasoline and kerosene for various industries and modes of transportation. If not abated, they will continue to pose significant risks as motor vehicles increase at 11% per year.

Water quality

Water of Iloilo City is quite polluted. The pollution is caused mainly by the households and to a lesser extent by the industrial sector. Approximately 70% of the pollution load come mainly from domestic sources and only 30% from industries. Only about 30-40% of Iloilo City's populace is currently being effectively served by a sewerage system; the rest are dependent on poorly maintained septic tanks. Industries contributing to water pollution are mostly piggeries, coco oil factory, fuel depot, food factories, fishing port, slaughterhouse, weaving mill and motor shops.

Dissolved oxygen (DO) and biological oxygen demand (BOD) levels of inland waters draining towards Iloilo City showed higher concentration levels that exceeded the standards of DENR. BOD tests are used to determine the amount of oxygen that will be required to biologically stabilize the organic matter content. On the other hand, DO indicates the amount of molecular oxygen present in the water. BOD for Class C rivers should have a maximum concentration of 10 mg/liter and 5 mg/liter for Class A rivers while DO level for Class A & C rivers should have a minimum concentration of 5 mg/liter.

There are three (3) rivers that drain into the City, namely: Tigum-Jaro Aganan River, Batiano River, and Iloilo River which traverses the City. The Tigum-Jaro/Aganan River is classified as Class A at its upper reach which is fit for drinking purposes while the lower reach up to its mouth is classified as Class C which is fit for fish propagation.

The Batiano River has no watershed of its own and source its water from the agricultural runoff and tide affected all throughout its entire length. It receives domestic waste, agricultural runoff both from rice lands and fishponds and effluent from one piggery. The entire stretch of the river was classified as Class C.

The Iloilo River, considered by some as just an "arm of the sea", has two (2) major tributaries: the Calajunan Creek which receives waste leachate from Iloilo City garbage disposal site, agricultural runoff and industrial effluent from beverage industry, piggery, fishpond and coconut oil mill; and the Dungon Creek which receives waste from households, piggeries, fuel bulk depot, food processing and oil – from navigational vessels.

Solid waste generation

In 1989, studies showed that solid wastes generated daily within Iloilo City is about 120 cu.m., 67 % of these wastes is collected while the remaining 33% is either left on the streets which poses health hazards, or dumped into storm drains, esteros, canals, creeks, or rivers contributing to flooding problems. Others are burned, thereby creating air pollution, some are recycled by scavengers and sold to traders. Residential wastes account for approximately 70 % of the total solid wastes generated while 30% are generated by industries.

In 1996, data showed that estimated volume of solid wastes generated daily increased drastically to 1,125 cum. which is equivalent to 0.017 cu.m. /household/day. Of this volume, only 430 cu. m. or 38% are collected.

Coast Line

For Western Visayas, Iloilo City has the longest range of coastline. Its southern portion is used for bathing purposes. Food establishment were noted along stretches of Iloilo City coastline from Brgy. San Juan to Punta Villa. It is the recipient of domestic waste, waste from fishing port and oil slick from navigational vessels plying along the area.

Monitoring conducted by the DENR from 1992 to 1996 shows that the Coliform Count from Lau-an Lopez Beach Resort to WESVICO stations had value ranging from 12,956 Most Probable Number (MPN)/100 ml to as high as 2,397,651 MPN/100 ml. This is beyond the limit of set standards at 1,000 MPN/100 ml. This means that the coastline is not fit for bathing purposes.

One of the reasons for the deterioration of the City's water quality is pollution. With the rapid increase of population of the City compounded by an increase in economic activities, pollution will be a growing problem. Sewage, sediments, pesticides, garbage's and industrial effluents accounts for pollution of the City's waters.

Water consumption

Groundwater and surface water are either domestic, industrial, irrigation and power generation purposes. Agriculture continues to be the heaviest water user, accounting for about 60% of total water withdrawals. The quality of water available for irrigation has been relatively good. However, sedimentation of river systems has resulted in the reduced water conveyance capability, thus, causing flashflooding. Another environmental problem which besets Iloilo City is the shortage of water for domestic needs of the ever increasing population of Iloilo City, which the Metro Iloilo Water District (MIWD) can not adequately provide. This problem has been aggravated by the continued destruction of our valuable watersheds and soil erosion. Most of the populace resorted to groundwater extraction or deep-well drilling.

Recommendation

Having discussed briefly the environmental problems, issues and concerns that beset Iloilo City, we are all the more challenged to pursue the policy-based strategy shift which will be community-based and localized in nature. In support to the National thrusts, Local Ordinances may be formulated in line with the following Programs:

- Pollution Control Enforcement and Industrial Waste Minimization;
- Intensive Smoke-Belching Campaign by the LGUs, LTO, PNP and the DENR;
- Building community's capability in solid waste management.

Moreover, the following are some of the recommendations specifically in solid waste management for the City Government of Iloilo to pass an Ordinance on:

1. Requiring households to sort their garbage from their own kitchen and to collect them separately. Instead of investing on expensive incinerators and plants, landfill sites, organic matter generation from biodegradable materials is an economically viable undertaking for the community.

2. School children should be taught how to prepare compost from wastes in their own backyard. They could in turn sell it to prospective buyers.

3. Institutionalize responsibilities of the Local Government Units in the local governance of the Agenda 21 for sustainable development.

4. Putting up of garbage receptacles along busy streets which are color-coded for various kinds of wastes. In this regard, massive education of the populace is needed to enforce segregation coupled with monitoring and penalizing.

Most of all, sustenance of efforts to instill awareness, discipline and change of values is also a must in order to attain the goals and objectives of the DENR. For the past three years, we at DENR have taken great strides. But our feet are planted firmly in our determination to stem the tide.

References

DENR-VI. 1997. A Brief on the State of the Environment of Iloilo City. Unpublished.

Philippine Daily Inquirer. July 29, 1997.

Environmental Conditions of Seoul, Korea

Soo-Hyun Shin, Technology Policy Division, Ministry of Environment,
1 Choongang-dong, Kwacheon, Kyonggi-do, 427-760, Republic of Korea,
Tel: + 822-504-9241, Fax: + 822-504-9280

I. Introduction

A. Geography

Seoul, the capital of Korea, is located in the west-central part of the Korean Peninsula. It is situated in a basin surrounded by mountains such as Mt. Pukan (837m), Mt. Surak (638m), and Mt. Kwanak (629m), which is unfavorable for the diffusion of air pollutants, and therefore, it is vulnerable to air pollution. The Han River flows through the city from east to west into the Yellow Sea. The total area of Seoul is 605 km^2, or 0.6 percent of the entire nation (99,390 km^2).

B. Population and Industry

The population of Seoul is about 10.6 million citizens and it amounts to about one quarter of the whole population (45.3million) of Korea. The population density is 17,491 persons per square kilometer. The trends in industrial composition show that tertiary industries are increasing while primary and secondary industries are decreasing. The major industry in Seoul is tertiary industry, which accounted for 69.7 percent as of 1990. Secondary and primary industries accounted for 29.8 and 0.5 percent respectively.

II. Environmental Conditions

A. Air Quality

There has been a decrease in the average annual concentration of sulfuric gases, carbon monoxide, and dust as a result of the implementation of various measures, such as conversion of fuels and the installation of dust prevention equipment. However, ozone and nitrogen dioxide levels have been on the rise, mainly due to the drastic increase in the number of automobiles.

Table 1 Air Quality Trends in Seoul (annual concentration)

	1990	1991	1992	1993	1994	1995	1996
SO_2(ppm)	0.051	0.043	0.035	0.023	0.019	0.017	0.013
CO(ppm)	2.6	2.2	1.9	1.5	1.5	1.3	1.2
TSP(ug/m^3)	150	121	97	88	77	85	85
O_3 (ppm)	0.009	0.012	0.014	0.013	0.014	0.013	0.015
NO_2(ppm)	0.03	0.033	0.031	0.032	0.032	0.032	0.033

B. Water quality

The Water quality of the Han River and its several tributaries had been damaged by the rapid increase of population and industrial activities. Even though those factors have continued to increase, general water quality in Seoul has improved due to the continued construction of sewage treatment facilities and strengthening of regulations for water contaminants discharge facilities. As shown in the following table, however, the water quality of the Han River upstream has slightly deteriorated.

Table 2. Water Quality Trends

(BOD standard: ppm)

			1991	1992	1993	1994	1995
The Han River	Upstream	Paldang	1.1	1.1	1.2	1.2	1.3
		Kuui	1.9	1.8	1.9	1.9	2.1
	Midstream		3.9	3.6	3.1	3.3	3.8
	Downstream		4.8	4.3	4.0	4.3	4.4
Tributaries	Chungnangchon		42.6	38.9	24.3	19.7	30.5
	Tanchon		35.9	31.9	26.2	22.4	15.9
	Anyangchon		71.6	52.1	27.7	17.4	13.5

C. Solid Wastes

The amount of waste generation shows different trends according to category. Domestic waste generation is declining from the peak year of 1994, when a volume-based garbage collection fee system was adopted. On the contrary, the amount of waste generated by industries and business is increasing.

Despite the increasing proportion of recycling and incineration, Seoul depends mainly on landfill for waste disposal. Due to the fact that it is practically impossible to secure landfill sites within its jurisdiction, Seoul uses the Kimpo landfill site, which is about 40 km from the center of the city.

Table 3. Domestic Waste Generation and Disposal Trends

(Tons/day, %)

	1994	1995	1996
Total	15,397 (100)	14,102 (100)	13,685 (100)
Landfill	12,144 (78.9)	9,893 (70.2)	9,325 (68.1)
Incineration	94 (0.6)	72 (0.5)	320 (2.4)
Recycling	3,159 (20.5)	4,137 (29.3)	4,040 (29.5)

D. Land Use and the Natural Environment

The natural environment of Seoul is maintained as forest and Green Belt Zones. These areas amount to 159.3 km^2, which accounts for 26.3 percent of the whole Seoul area. "Green Belt", where land use and development are restricted for preserving the environment and preventing disorderly urban development. Due to population increases and various development projects, green spaces such as forest and natural parks decrease. As of 1996, the area of green space per citizen has become merely 14.7 m^2, which is less than half of the 1972 figure of 31.7 m^2.

III. Assessment of the Problems and Solutions

A. Air

One of the critical environmental issues in Seoul is air pollution caused by the increasing number of automobiles. Analyses of the amount of air pollutants and their sources revealed that the total amount of pollutants emitted yearly is on the decline despite a steady increase in total fuel consumption. This can be attributed to the promotion of the efficient use of clean energy sources such as LNG and low-sulfur fuels. However, the proportion of automobile emissions to total air pollutants has increased rapidly from 53% in 1990 to 80.7% in 1995. As a result, ozone, smog, and visibility impairment have become pending problems in Seoul.

Table 4. Trends of Automobiles and Amounts of Air Pollutants Generated (by type of source)

1,000Ton (%)

	1990	1993	1994	1995
Total amount of air pollutants	1,007 (100)	534 (100)	455 (100)	422 (100)
Automobiles	530 (53)	383 (71.6)	351 (77.2)	341 (80.7)
(No. of automobiles (1,000))	1,194	1,751	1,932	2,043
Heating	438 (43)	134 (25)	87 (19.2)	66 (15.5)
Industries	29 (3)	14 (2.6)	12 (2.8)	13 (3)
Power Generation	10 (1)	4 (0.8)	4 (0.8)	3 (0.8)

To solve these problems, more stringent emissions standards and the replacement of diesel powered vehicles to LPG or CNG-using vehicles are necessary. The development of diesel particulate filter traps is also needed. Fuel quality should be improved to contain less sulfur and residual carbon content. Along with these efforts, there should be appropriate policies to slow down the increase in automobiles and to reduce driving distances through taxation and fuel prices.

B. Water

As shown in Table 2, water quality of the Han River upstream is relatively good but it deteriorates downstream as it passes central Seoul. However, while the water quality downstream is improving, it is getting worse upstream, mainly due to increasing livestock wastewater and sewage in the upstream river basin. Because a major drinking water reservoir which supplies drinking water to 18 million residents in the Capital region, including Seoul, is located upstream of Seoul, facilities to treat livestock wastewater and sewage should firstly be expanded. In addition, there should be more stringent restrictions on land use lest additional pollution sources locate in the upstream river basin of the Han River.

C. Solid Waste

With the adoption of the volume-based garbage collection fee system in 1994, per capita waste generation in Seoul is decreasing. As the separate collection of recyclable wastes is increasing, however, the proportion of food wastes has increased to a third of all domestic wastes. Food waste is likely to rot and cause offensive odors and to generate a large volume of leachate when put in landfills. Therefore, it is important to reduce food waste generation and to develop composting technology suitable for Korean food wastes.

Taking into account that securing landfill sites is impossible, Seoul needs to promote the incineration of wastes along with policies for the minimization of waste generation and the maximization of recycling. However, the incineration rate is no more than 2.4 percent and Seoul is confronted with citizens' strong opposition to constructing incinerators in fear of adverse impacts on residents' health. Thus, the expansion of incineration that utilizes environmentally safe incineration technology is desirable.

D. Natural Environment

Population growth and continuous development have caused the decrease in green spaces in Seoul and endangered wildlife species. It is widely accepted that acid rain in Seoul is also destroying ecosystems. To protect the natural environment, therefore, the expansion of designated natural parks as well as environmentally friendly land use are needed. In addition to restrictions on development in the designated zones, efforts to restore damaged natural environments and ecosystems are also important. Some of Seoul's programs to establish ecology parks and to reclaim developed areas through planting trees and the designation of bird sanctuaries exemplify these efforts.

References

Korean Ministry of Environment, *Environmental Protection in Korea*, 1995.

Korean Ministry of Environment, *Environmental Statistics Yearbook*, 1996.

Korean Ministry of Environment, *Environmental White Paper*, 1997.

National Institute of Environmental Research, *Study on Visibility and Smog Phenomena in Seoul Metropolitan Area (III)*, 1996.

National Institute of Environmental Research, *Study on the Water Pollution and Control in the Source Water for the Piped Water Supply in Metropolitan Seoul (II)*, 1996.

Seoul Metropolitan Government, *Environment in Seoul,* 1996, 1997.

Seoul Metropolitan Government, *Environmental Protection in Seoul*, 1997.

Seoul Metropolitan Government, *Seoul Green Vision 21*, 1997.

Seoul Metropolitan Government, *Waste Management in Seoul*, 1997.

An Environmental Profile for Colombo Urban Area

J M L Jayasekara,
National Coordinator, Sustainable City Programme,
Sri Lanka and DY. Director General (Planning & Operations)
Urban Development Authority

Under Sustainable Cities Programme in Sri Lanka the Project Area for the Environmental Profile encompasses three Municipalities namely, Colombo (CMC), Dehiwela-Mt. Lavinia (DMMC) and Kotte (KMC). Although the intensity and complexity of the problems as well as environmental resources and interactions with sector activities are different in each area, it is observed that there had been a great influence (i.e. by way of spill over of activities) extended to the other two MCs by the City of Colombo. Concurrently, it is noted that common situations are emerging in CMC and DMMC, while similar trends are slowly but consistently developing in KMC area also.

Environmental degradation has taken place mostly in the urban underseved settlements, business and commercial areas, harbour and the sea front, transport sector, water bodies and living environment as a whole. One important development is the reduction of agricultural activity and the usage of agricultural lands for alternative uses such as housing, which has degraded the wetlands and water resources, similarly, pollution in the project area has been the result of encroachment and sub standard housing by the sea, especially in DMMC area. The economically viable and valuable land has been put to uses with low return due to this situation, while such settlements, activities and interactions have further degraded the healthy living conditions. Sustainable utilization of resources as against the higher demand for resources does not match in an environment competing for resources. This situation is observed in the whole Project Area. The result has been the degradation of resources, creating environmental hazards (i.e. pollution) detrimental to any human settlement.

The socio-economic impacts of such responses have created other social abuses, resulting in corrupt practices, abuses at administrative and political levels which can be considered as social evils, low educational levels, an untrained labour force in the informal sector of the city, lack of awareness etc. which are anemic to any development effort. This situation, persisting for a long period, will challenge the very sustainability of the city environment in the Project Area.

The emerging evils are showing diverse and complex facets, which cannot be controlled or managed only by enhancing the resource base, wherever possible. It has become imperative to develop institutional capacities, standards of governance, increasing participation and other available or potential solutions, to combat the environmental degradation taken place and might take place. Blaming management in the Project Area rather than nature becomes crucial in such a background.

The major environmental issues / hazards in the Project Area are caused by flooding due to various reasons, loss of habitat for flora and fauna environmental pollution (water, marine, air, coastal, etc.) industrial effluence, inadequate health practices due to weak service infrastructure and congestion related problems which cause air pollution by smoke, dust and other particles etc. Even on these issues the degraded situation would have been reduced if not eliminated, had there been real commitment to manage affairs at all levels.

To address these issues several programmes and projects have been launched by the Government, Local Authorities (LAs), Road Development Authority (RDA), Ministry of Housing & Urban Development (MHUD), etc. Some of these programmes/projects such as the Colombo Environment Improvement Programme (CEIP), Clean Settlements Project (CSP), Metropolitan Environmental Improvement Project (MEIP), Greater Colombo Flood Control and Environmental Improvement Project (GCFCEIP), etc. are donor funded. Some other programmes/projects have been funded by the LAs as well as by the Government, e.g. Urban Development Authority (UDA), National Water Supply & Drainage Board (NWS&DB) etc.

With substantial investments on urban environment when it is revealed that the deterioration of standards continue and complaints on such situations are also reported, to justify the past and present investments for environmental development it becomes necessary to critically look at the reasons for such results also. It is observed that while influencing the natural resource base has been weak, management of natural resources has been even weaker which has resulted in the creation of weak outcomes.

Since the urban environment has several activity sectors which use resources and sometimes cause environmental hazards, an enumeration of the characteristics of the activity, importance, usage of resources, impacts of environmental hazards on activities and the impact of activities on the urban environment were undertaken The main activity sectors in the Project Area are housing, agriculture, fisheries, wetlands, transport and communication, health care, tourism, recreation, industry, trade and commerce, and the affected environmental situation are seen in undeserved settlements - wetlands, water supply/drainage, sewerage and energy supply. Poverty situation in the Project Area, although looks comparatively better when assessed by the number of Samurdhi recipients, may not give the clearest picture, if one believes in better conditions of living as a factor to reckon with for sustainability of cities.

For the activity sectors to be functional, the resources available for the sectors involved in the activity sectors had to be identified. In identifying the resources, the study has looked at resources, characteristics, usage of resources, impact of activities on resources, the significance of resources, competing interests on resources and the management arrangements to deal with conflicts over resources. Since the interactions between the activity sectors and the resource base invariably create environmental hazards, the study has identified those environmental hazards. The main hazards which have been identified are the effluent discharges to inland water bodies/outfalls, public health hazards due to bad sewerage and other weaknesses in service infrastructure service support in the city area, encroachments of environmentally vulnerable lands, noise/air/pollution and those connected with the drainage canal system.

The management setting to address the activity sectors, resource requirements their interactions with the activity sectors and resulting hazards in the Project Area become crucial as several organizations/institutions are involved in the management of the operations. It starts from the central government authorities such as the Presidential Secretariat, Ministry

Offices, Provincial Authorities such as Western Provincial Council and LAs, formal Private Sector, popular or NGO Sector, CBOs etc. who have various roles to play in the management setting at different levels. It encompasses information collection, planning, organizing, staffing, directing, co-ordinating, reviewing funding/budgeting and negotiating for donor assistance.

In the case of management arrangements several weak areas have been identified. Lacking communication between the intra and inter departmental personnel - specially in the MCs weak internal cohesion due to wrong placement of certain functions in the hands personnel who have lesser legal authority to act, resulting conflicts in supervision, weak co-rodination, lacking technical capacities, shortfalls in financing etc. have been the more important. It is therefore quite apparent that the inputs for city development has to have a multi-pronged approach, i.e. technical, human, financial and managerial, if success is to be achieved. Special reference must be made to poverty alleviation, if not undertaken will not bring about sustainability of whatever achievement, through any project/programme. Therefore, non-achievement of required performance will not only affect the sustainability of cities, but even the sustainability of the social fabric of the city. Therefore, the challenge before the authorities is not simple, but crucial and urgent.

Solid Waste Management - Technology Options

Associate Professor Goen Ho
Associate Professor in Environmental Engineering
Institute for Environmental Science,
Murdoch University

Introduction

Solid waste is the term used to denote materials in solid form that are discarded from municipal, agricultural and industrial activities. Solid wastes include garden refuse, foodwaste, paper/cardboard, metals in various forms, plastics, glass and so on. Disposal of these materials currently relies principally on landfilling (i.e. burial) in loose and compacted form and creates environmental problems such as leaching of nutrients and heavy metals into groundwater resources. Other forms of solid waste disposal around the world include incineration and landfill after baling of the wastes. Baling allows for greater volumetric efficiency in the use of scarce landfill sites. These methods however create environmental problems of their own such as air pollution and long term stockpiles of waste which remain essentially unchanged years after disposal and which limit future uses of the land.

To understand why problems are created we need to appreciate the cycles of materials occurring in nature. Understanding these natural cycles also provides the key to overcoming the problems and ensuring long term sustainable uses of these materials.

Foodwaste

As an example of these natural cycles, let us examine the case of foodwaste, something which we cannot avoid producing.

If foodwaste is landfilled, decomposition of the organic substances under conditions devoid of oxygen produces methane, an atmospheric pollutant (methane is much more potent in its Greenhouse effect than carbon dioxide), and a strong leachate, that can contaminate ground and surface water when rainfall percolates through the landfill.

The natural process of cycling of the organic carbon and nutrients in 'foodwaste', taking place on the forest floor for example, does not create pollution. The reason for this is that the amounts that are involved are small compared to the ability of the environment to cycle it. The oxygen requirement is relatively low in comparison to the rate of diffusion of oxygen to the bacteria consuming the foodwaste.

Decomposition of organic waste on a forest floor, furthermore, returns carbon to the atmosphere, produces humus and returns nutrients (nitrogen, phosphorus, potassium, calcium, sulphur, and trace minerals) back to the soil.

Understanding the natural cycles of carbon, nitrogen, phosphorus and other plant and animal nutrients is therefore essential if we want to manage solid waste in a sustainable way. There are two approaches to managing solid waste based on this understanding: (1) Slow down the flow of organic waste so that the ability of nature to cycle it is not exceeded, or (2) create engineered systems to help push the materials along the natural cycles.

Slowing down the production of foodwaste can be achieved by managing food production and marketing efficiently, so that a larger quantity and variety of food products can be generated from the same amount of raw materials, improving food handling to reduce spoiled food, or reducing excess food consumption, thus reducing food production and hence waste.

Composting of foodwaste, on the other hand, is a means of accelerating the natural aerobic decomposition of organic materials to produce humus and return nutrients to the soil. We ensure that oxygen is fully provided to the microorganisms consuming the foodwaste, thus removing the limiting factor in the cycling process.

Other wastes

Foodwaste is an example of waste that is more part of the natural cycles. There are other wastes in this category, but they are now produced in huge quantities, e.g. wastepaper. There are also wastes for which the natural cyclic processes are slow, for example, aluminium. And finally, there are wastes for which the natural cyclic processes are very slow or hardly exist, e.g. waste PCBs (poly-chlorinated biphenyls). Our response, in terms of slowing down or hastening the processes, will depend on our ability to reduce production or create engineered processes to push these materials along the natural cycles.

Bauxite refining residue (red mud)

One particular and unique waste which we will focus on in this section is the residue which results from the refining of bauxite. This is particularly relevant to Perth because of Alcoa's industrial activities on the Swan Coastal Plain and because of the original research which has been conducted at Murdoch University under Alcoa's sponsorship to find a solution to the waste problem, as well as a productive use for the waste materials.

Questions for Discussion

(1) Describe the solid waste disposal in your locality. What are the problems associated with solid waste disposal there?

(2) The hierarchy of solid waste management is:
avoidance;
minimisation;
recycle;
reuse;
treatment;
disposal.
Outline how the hierarchy can be applied in your case. As a particular case assess whether methane production or composting is feasible.

Recommended References

Any text that clearly explains the natural cycles for carbon, nitrogen and phosphorus (e.g. an older text by Clapham, Jr W.B. (1973) Natural ecosystems. McMillan, New York. However, any good text in ecology should have a section on these cycles).

Department of Agriculture (1993). Use of bauxite residue in the Peel-Harvey Coastal Plain catchment. Public Environmental Review.

Ho, G.E., Newman, P.W.G., Mathew, K. and de Potter, H. (1985) Neutralisation of bauxite processing residue with copperas. Paper A8B, presented to Chemeca 85 conference (first page only).

Ho, G.E., Hofstede, H. T. and Qiao, L. (1993) Composting of domestic solid waste. Paper presented at the 10th National Conference on Waste Management, Perth 3-5 March.

SESSION 12

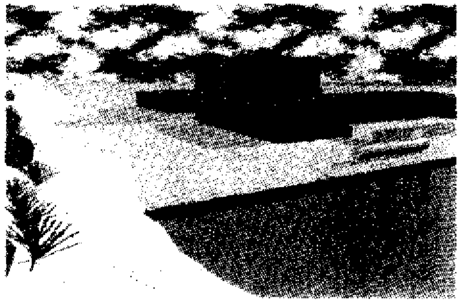
Field Visit:

To landfill gas site

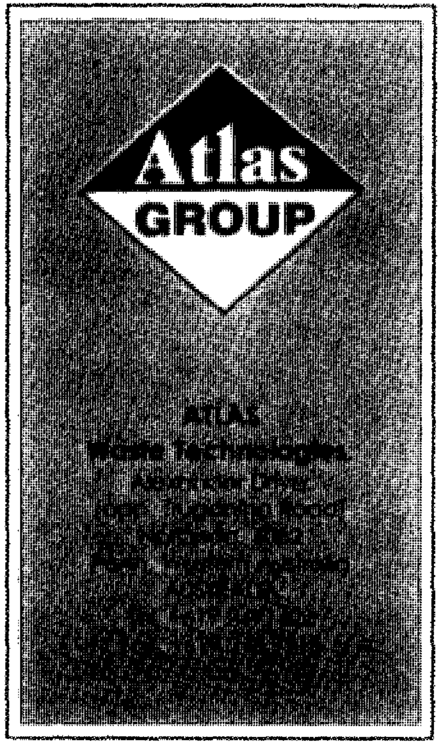
Atlas GROUP ATLAS Group

in association with:

City of Stirling

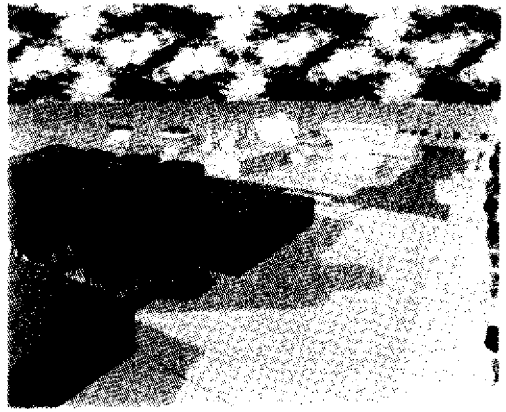


AN AUSTRALIAN FIRST !



SOLID WASTE DIGESTION FACILITY

Atlas GROUP



A WASTE-TO-ENERGY PROJECT

BACKGROUND

[illegible]

THE ATLAS WASTE -TO-ENERGY FACILITY

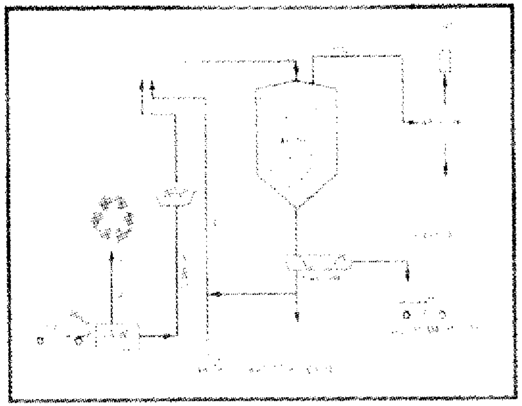
... or on site separation of ... the fermentation of the ... specially designed ... is 25m high with a ... recovered from the ... are shredded and ... Once inside the ... anaerobic bacteria ... material at a ... approximately ... removed ... to ... ... used ...

[illegible]

DIGESTION

The main objective ... treatment of the organic fraction of municipal ... the stabilisation of the biodegradable matter into ... and beneficial products. This can be achieved ... the microbiological processes of digestion.

Digestion (anaerobic fermentation) ... natural process in which microbes convert ... organic matter in the absence of oxygen ... stable end products. In the process ... carbon dioxide are also produced.



THE ADVANTAGES OF ANAEROBIC DIGESTION

Compared to Landfilling

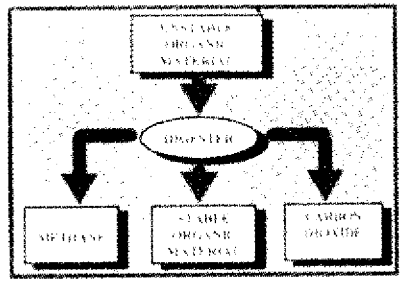
- no methane emissions into the atmosphere, decrease in greenhouse gases.
- limited surface area required.
- no leachate contamination of groundwater.
- landfills have limited use after ..., it can take up to 50 years to stabilise.
- no odour and vermin problems

Compared to Aerobic Composting

- renewable energy production in the form of methane.
- no odour or pest control problem ... digestion occurs inside ... tanks.
- ... area required for ...

Compared to Incineration

- ...
- ...



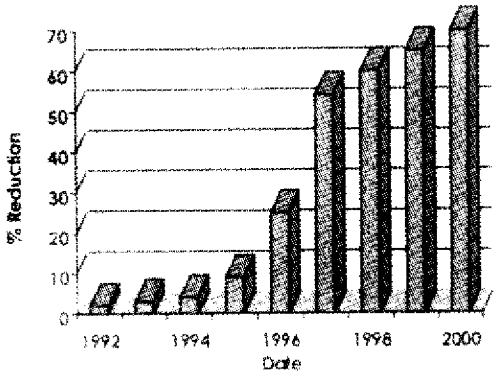
WASTE MINIMISATION

The State Recy... outlined the State ... achieving the ... Government of ... year 2000.

Waste Minimisation Timetable

National target 50% reduction of waste to landfill by the year 2000

As organics compr... domestic waste ... assist the City of ... minimisation ... Minimisation ...



SESSION 13

Lecture VII:

Applying Lifecycle Assessment to Waste Management in Asia

Dr Kanji Tamamushi, Procter & Gamble Far East, Inc.

Applying Lifecycle Assessment to Waste Management in Asia

K. Tamamushi, Ph.D. and R. Aoki-Goldsmith
Professional & Regulatory Services - Environmental Quality,
Procter & Gamble Far East Inc.,
1-17 Koyo-cho, Naka, Higashinada-ku, Kobe, 658 Japan

Peter R. White, Ph.D.
Global Technical Policy Department,
Procter & Gamble, Newcastle Technical Centre, UK.

Abstract

Waste is a by-product of human activity. It contains the same materials as are found in useful products, but it only differs from useful products by its lack of value. Current approaches to waste management rely on legislation, and are often neither cost or environmentally effective. The best alternative approach for improving the environmental performance of solid waste management systems, while keeping them economically affordable and socially acceptable, is via Integrated Solid Waste Management (ISWM). This approach considers the whole waste stream, rather than focusing on a single fraction of the waste stream. Similarly ISWM uses tools such as Life Cycle Inventory (LCI) and economic assessment which take an overall approach, rather than rely on the hierarchy of waste management, which is of little or no value.

This paper shows that many current approaches which focus on recycling of packaging waste are not cost effective. Other options such as composting and/or biogasfication can result in higher diversion levels because it can deal with a large part of the MSW stream. When integrated together, composting, biogasfication and material recycling can provide cost effective ways to manage municipal solid waste.

A computer spreadsheet model developed by P&G allows waste managers and policy makers to carry out an LCI of any solid waste management system and compare the environmental burdens and overall costs of different options. This paper also shows an overview of the solid waste situation in Asian Countries.

Introduction

In line with the overall call for sustainability and sustainable development, there is a need for solid waste management systems to become "more sustainable" in the future. Just as sustainability in general is considered to include environmental, economic and social elements, so solid waste management will become "more sustainable" if it is environmentally improved, economically affordable and socially acceptable.

There are two general requirements for sustainable solid management. There is a need to produce less solid waste in the first place, and then there needs to be an environmentally- and economically-efficient system to manage the solid waste that is still produced. This paper argues that while waste prevention needs to be done on a product-by-product basis, an overall, integrated approach should be taken to manage the solid waste still produced to ensure that genuine environmental improvements occur. Many current approaches to solid waste in general, and to household solid waste in particular, focus on particular fractions of the waste stream, such as packaging, or on one particular treatment method, such as recycling. This approach is likely to result in environmentally- and economically- inefficient systems. This paper proposes that Integrated Solid Waste Management (ISWM), which addresses all of the materials in the waste stream, and uses a range of treatment options, is the most effective way to manage solid waste.

Asia Solid Waste Data

Data on the sources of municipal solid waste (MSW) within a defined geographical area are necessary to design effective collection systems and knowledge of the material composition is essential for effective management and disposal. Although a complete data representing Asia's waste profile is not available, currently available composition of MSW by weight, complied from various sources for Asian countries, is shown in Table 1-3.

Despite the differences in the way data have been compiled, some trends in MSW composition can be seen from Table 1-3. The two major fractions in all countries are paper (including board) and organics (including food) waste. Plastic, glass and metals occur at much lower levels. There is, however, evidence of geographical variability. Although each country has different needs, they are all seeking to develop an efficient system.

Table 1. Asia Solid Waste Data

Country	Population (million)	Total Solid Waste/year (million tons/yr)	MSW (million tons/year)	MSW (kg/capital/yr)
Japan	125	449	50.8	405
China	1,220	NA	NA	NA
Taiwan	21	43.7	9.2	438
Korea	45	53.7	21.1	471
Philippines	67.5			
Metro Manila	8	NA	2.2	278
Singapore	3	2.4	1.03	343
Thailand	58.5	NA	12	204
Bangkok	6.4	NA	2.5	390

Table 3. MSW Disposal

Country	Incineration (%)	Landfill (%)	Composting (%)	Recycling (%)
Japan	71.9	24.6	0.1	3.4
Taiwan	6	83	NA	6
Korea	3.5	81.2	NA	15.3
Philippines	48.8 *(Projected)*	16.3 *(Projected)*	NA	Informal Recycling
Singapore	80	NA	NA	N
Thailand	NA	55 (Sanitary) 25 (Open)	19	Informal Recycling
W. Europe	*27*	*59*	*5*	*12*
USA	*20*	*56.7*	*27.3*	

Italics indicate for comparative reasons.

Integrated Solid Waste Management

Integrated Solid Waste Management (ISWM) is a holistic, flexible approach which integrates waste streams, collection and treatment methods to provide overall environmental benefit, economic optimisation and social acceptability for any region.

ISWM is holistic as it takes an overall approach and seeks to manage the totality of the waste stream. By taking this system-wide approach it is possible to benefit from synergies between different waste management methods and from economies of scale to help optimise the whole system. Splitting solid waste into several different streams and managing each independently can lead to duplication of efforts and redundancies in the system, which will increase both economic costs and environmental burdens.

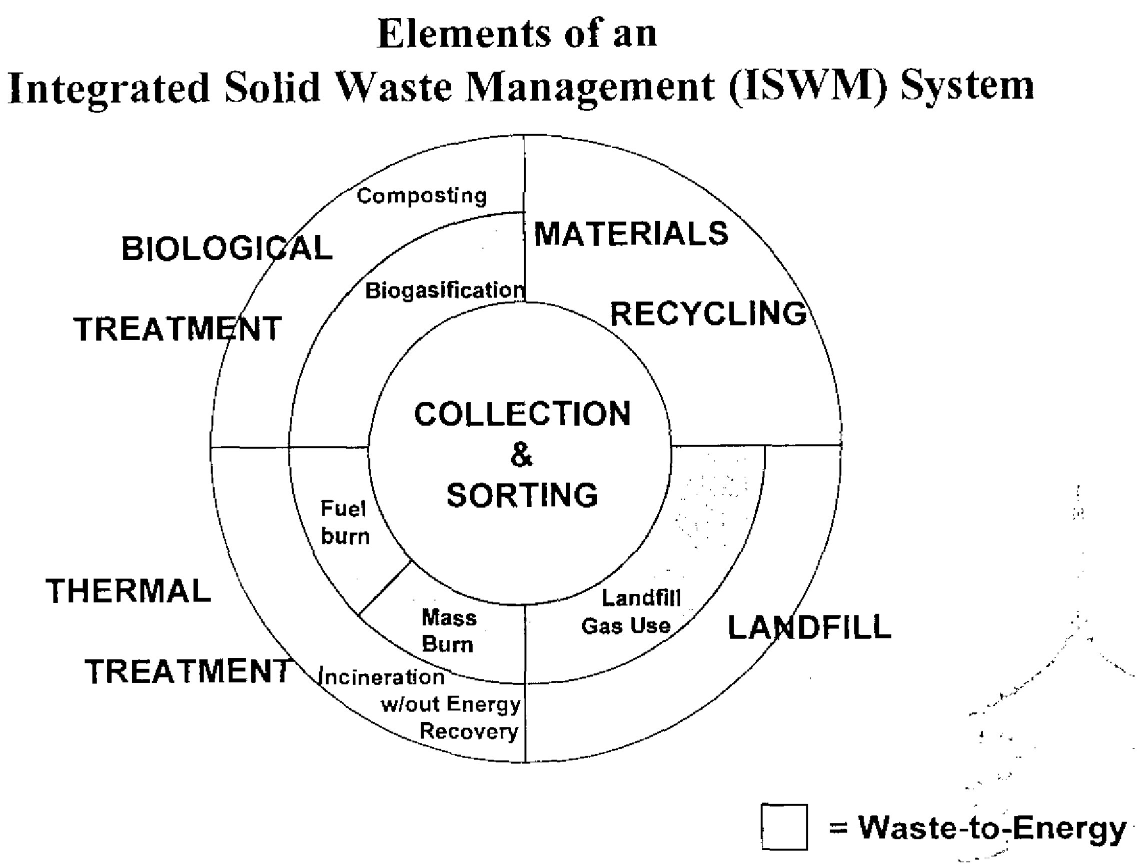
ISWM systems will integrate the management of different materials (such as metals, paper, putrescible wastes), and ideally wastes from different sources (e.g. commercial, household, industrial etc.). ISWM will also manage solid wastes from different product areas (e.g. packaging waste, white goods etc.) since effective management depends more on the materials in the waste, rather than what function was performed by the products before they were discarded.

It is becoming generally accepted that no single treatment method can handle all materials in an effective way. Consequently, ISWM combines a range of treatment methods which can include (following collection and possibly sorting) materials recycling, biological treatment (composting and/or biogasification), thermal treatment (including mass-burn incineration with energy recovery, burning of refuse derived fuel (RDF) or packaging derived fuel (PDF)) and landfilling (Figure 1).

The choice of which treatment options are used in any given ISWM system will depend on local conditions, needs and priorities: in particular the amount and composition of the waste, the pre-existing waste infrastructure, availability of markets for recovered materials and/or energy, and local or regional environmental priorities. Clearly there is no single ISWM solution that will fit all geographies. ISWM is therefore a flexible approach that helps select the optimal solid waste management system on a region-by-region basis.
It needs to be:

- Flexible - to handle changes in the solid waste stream over time
- Region-wide - to support a range of options and benefit from economies of scale
- Market-oriented - to ensure there are outlets for recovered materials, compost and energy

Figure 1. Elements of an Integrated Solid Waste Management (ISWM) system.



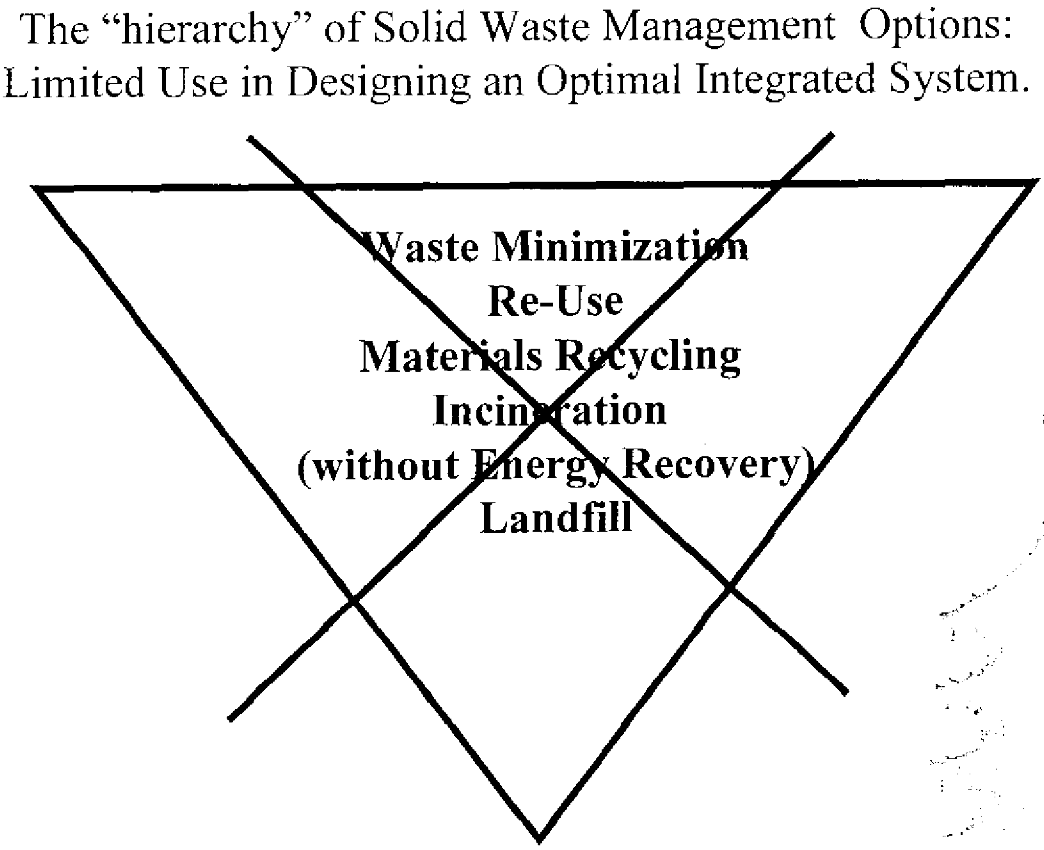
The choice of which options to include in an integrated solid waste management system is NOT based on the much quoted "hierarchy of solid waste management options", however (Figure 2).

The "hierarchy" is of little use in planning ISWM systems since:

- There is little scientific or technical support for the hierarchy.
- The hierarchy is of little use when comparing combinations of options. It does not help decide whether a combination of materials recycling with landfilling is preferable to a combination of composting with incineration of the residues.
- The hierarchy does not address costs. Therefore it cannot assess economic sustainability.

These limitations of the hierarchy are gradually becoming accepted.

Figure 2. The "hierarchy" of solid waste management options: of limited use in designing an optimal integrated system.



Planning Integrated Solid Waste Management Systems

ISWM systems include materials recycling and biological treatment, although ISWM systems can also include waste to energy processes such as incineration with energy recovery or the burning of separated fuel such as refuse derived fuel (RDF) or packaging derived fuel (PDF), and most systems will also include an element of landfilling (Figure 1). The question then arises as to how an ISWM system can be planned to combine the waste management options available, so that overall the system is environmentally sustainable, economically affordable and socially acceptable. It has already been argued that the waste management hierarchy is of little or no value in this process - so what can be used?

In 1995 P&G published a book: Integrated Solid Waste Management: A Life Cycle Inventory 6 which applies the technique of LCI to integrated solid waste management (ISWM) systems. The book contains a computer spreadsheet model that allows waste managers and policy makers to carry out an LCI of any solid waste management system and to compare the environmental burdens and overall costs of different options. It can be used to plan future waste management strategies at the level of a town, city, region or country. It can also be used to identify where the major environmental burdens arise from existing systems, so that improvements can be made.

A diagrammatical representation of the inputs, outputs and boundaries of the LCI model for waste management is shown in Figure 3. Essentially the model considers the overall energy balance, the amounts of useful products (e.g. compost and recovered materials) and the emissions to air, water and land, associated with managing the municipal waste of a given area. It covers the lifecycle of waste, "from dustbin to grave", i.e. from the time the materials are discarded by a householder to the time they become inert landfill material, emissions to air or water, or regain value as useful products. All operations within the waste management system, including the actions of the householder in handling the waste, are included.

Figure 3. The Boundaries for a Life Cycle Inventory of an ISWM system

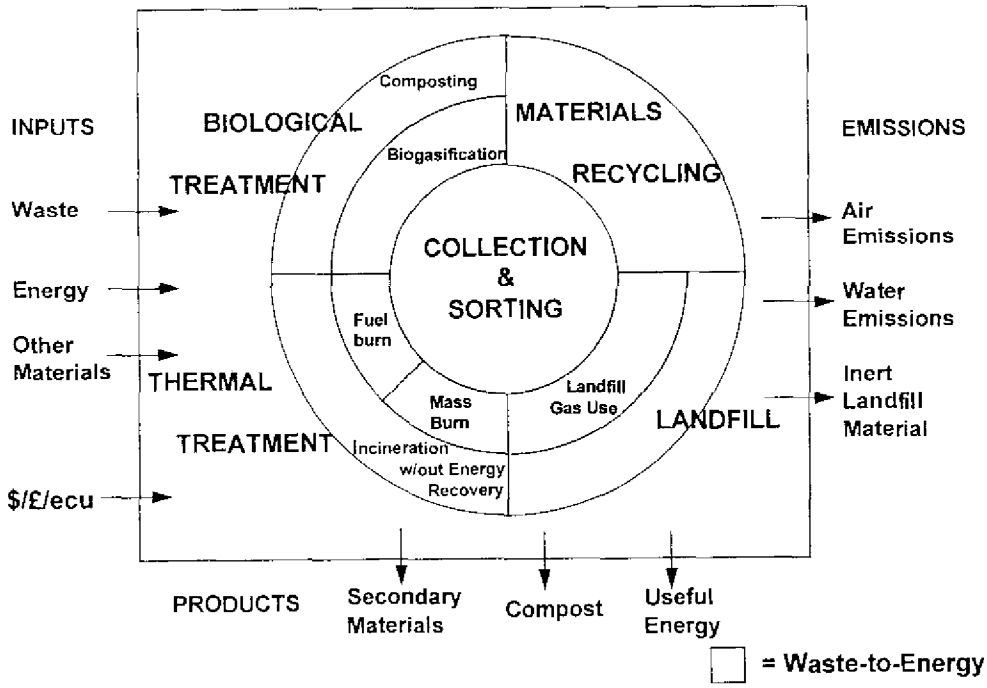


Figure 3. The Boundaries for a Life Cycle Inventory of an ISWM system

Table 2. Composition of MSW

Country	Paper/board (%)	Glass (%)	Metals (%)	Plastic (%)	Organics (%)	Others (%)	Source/ Year
Japan	36.2%	5.25%	3.61%	15.95%	31.13%	7.76%	Yokohama/93
	40.0%	5.7%	4.9%	12.0%	23.8%	13.6%	Tokyo/1993
Taiwan	24.86%	7.69%	7.07%	19.14%	30.79%	10.46%	Taiwan/1994
Korea	21.5%	included in "Others"	5.6%	5.0%	35.3%	(incl. glass) 32.6%	1994
	18.9%		5.0%	4.5%	38.3%	33.4%	1995
China	4.71%	8.24%	2.94%	5.88%	25.88%	11.18%, (water41.76%)	3 sample cities/ 199?
	15-18%	4-5%	3%	13-15%	40-46%	17-22%	
	25-30%	8-10%	5-8%	15-18%	31-37%	13-17%	
Hong Kong	21%	3%	3%	16%	32%	25%	EPD/1994
Philippines	12.9%	3.5%	5.8%	6.9%	35.8%	35.1%	Manila/1991
Singapore	28.3%	4.1%	4.8%	11.8%	44.4%	6.6%	MoE
Malaysia	28.5%	3.9%	5.7%	10.7%	42.7%	8.6%	Estimate based on 20 municipalities
Thailand	18%	3%	3%	15%	40%	21%	Bangkok/90
	14%	5%	2%	21%	15%	34%	Bangkok/92
Indonesia	7.15%	1.03%	2.24%	6.69%	77.38%	7.82%	BAPEDAL/93
India							
Vietnam	2.7%	0.31%	1.02%	0.71%	51.3%	43.8% (31.2%=fraction)	Hanoi
Asia Average	*20.5%*	*4.7%*	*4.2%*	*12.5%*	*37.9%*	*18.7%*	
W. Europe	*28.2%*	*6.4%*	*4.4%*	*7.2%*	*36.4%*	*17.3%*	
U.S.	*35%*	*9%*	*9%*	*7%*	*8%*	*33%*	

Italics indicate for comparative reasons.

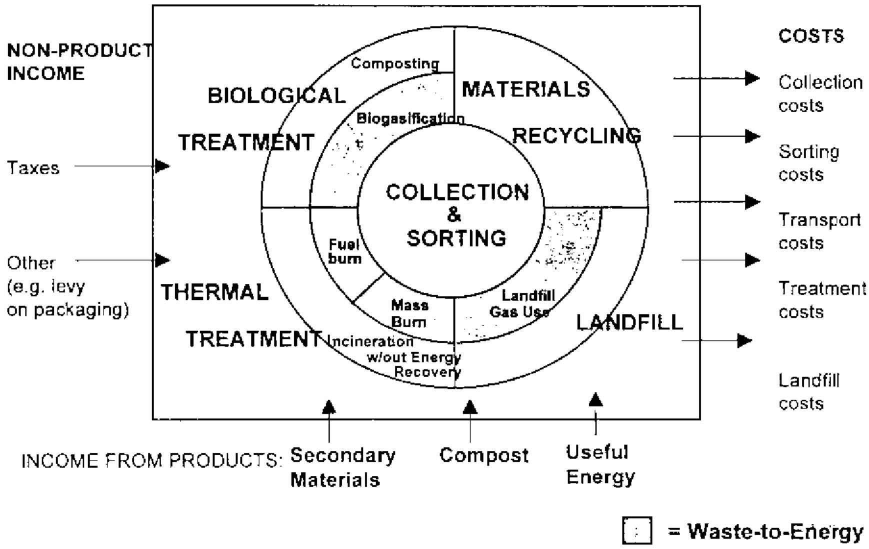
The LCI model can be used to compare different ways of handling municipal solid waste. It considers all of the municipal solid waste generated by an area, rather than individual fractions such as packaging waste, and the many ways that this waste could be managed. It can compare collection from the kerbside, versus bring systems or the use of civic amenity sites; it can involve the use of composting or biogasification for organic materials, the use of a materials recovery facility to separate and process recyclables, the use of thermal treatments such as mass burn incineration, burning refuse-derived fuel (RDF) or packaging-derived fuel (PDF), and the use of landfilling. Composting may be a good technology to use in countries with high organic composition. Any combination of the above treatment methods can be explored in "What if...?" calculations.

For each of these options, it is possible to calculate the overall energy consumption, and emissions to air, water and land associated with managing the waste. Providing that the priorities for environmental improvements have been decided, e.g. conservation of energy, groundwater protection, landfill minimisation etc., the preferred integrated waste management system can then be identified. Note that an LCI will not, by itself, identify which option is "environmentally best" - this will depend on what are considered the most pressing environmental problems in each case.

The system boundaries for the parallel economic lifecycle assessment are shown in Figure 4. Economic outputs of a waste management system include costs for collection, sorting, various forms of treatment, transport and for final disposal to landfill. Revenues produced by the system come from the sales of reclaimed materials, compost and energy. Subtracting the revenues from the costs will give the next cost of operating the system.

The use of LCI for assessing waste management systems is clearly an idea whose time has come. Both the UK Department of the Environment 7 and the U.S. Environmental Protection Agency 8 are currently running similar projects to construct Life Cycle Inventories for comparing waste management options. Since publication, the P&G book and computer model have been used by local, regional and national authorities in Europe and North America to help develop their future waste management strategies. Case studies showing how the model has been used to help plan integrated solid waste management systems are in preparation and will soon be available (e.g. Steele et al., in press). An Asia solid waste case study will be included in the 2nd edition of the P&G book forthcoming.

Figure 4. System boundaries for an overall economic assessment of solid waste.



The P&G model represents no more than a first attempt to take an integrated, systems approach to assessing the environmental and economic performance of solid waste management systems. Other, more sophisticated, models are now becoming available which will develop this approach and technique further. Such improved tools will help develop the Integrated Solid Waste Management Systems of the future, which should be environmentally improved, yet economically affordable and socially acceptable.

In conclusion integrated systems are effective since they combine those waste management options that overall are best suited for a given region, and deal with all materials in municipal solid waste.

References

1. WCED, (1987). Our Common Future. World Commission on Environment and Development, Oxford University Press, 1987.
2. Tanaka, Masaru, (1994) Introduction to Solid Waste (Haikibutsu Gaku Nyumon). Chu-oh-houki Publishing Company. Tokyo.
3. SGS Thailand, (1996) Environmental Market Asia: 1996-1997. Environmental Information Unit, SGS (Thailand) Ltd. Bangkok.
4. Business Opportunities in Waste Management in Eight Asian Countries. (1995) RITE, Singapore and INTEC, Bonn.
5. White, P.R. (1996). So, what is Integrated Waste Management? Warmer Bulletin 49:6. May 1996.
6. White, P.R., Franke, M. and Hindle, P. (1995). Integrated Solid Waste Management: A Lifecycle Inventory. 362pp. Blackie Academic and Professional. Glasgow.
7. Department of the Environment. (1995). Developing Life cycle Inventories for Waste Management. UK Dept of Environment, London. April 1995.
8. Thorneloe, S.A., Friedrich, S., Barlaz, M.A., Ranjithan, R., Weitz, K.A., Kong, E.J., Nishtala, S., Wiles, C., Shepherd, P.B., and Ham, R.K. (1995). Overview of research to conduct life-cycle study to evaluate alternative strategies for integrated waste management. Presented at Solid waste management: thermal treatment and waste-to-energy technologies, Washington D.C. April 1995.

SESSION 14

Lecture VIII:

Sustainable Development and the German Packaging Ordinance: A Case Study

Dr Gerhard Fahrbach, DER GRUNE PUNKT - Society for System Technology, Inc.

Sustainable Development and the German Packaging Ordinance: A Case Study

Dr. Gerhard Fahrbach
Managing Director of Der Grüne Punkt –
Gesellschaft für Systemtechnologie mbH

Sustainable Development - The Rio Legacy
In 1992, the United Nations at their conference in Rio de Janeiro formulated the idea of a "sustainable development" as the maxim for the 21st century. The challenge: Satisfying the ecological, economic and social needs of society without depriving development options of future generations. Two issues are in the center of the discussions on how to sustain our planet: The limited capacity of the environment to handle the impacts we place on it and the limited supply of resources.

Today, our options for easing the burden we are placing on our environment are better than ever before, given the volume of knowledge that has been amassed and the intensive research and development activities that have occurred. Furthermore, increasing globalization allows us to pass national borders in exchanging our experiences and combining our efforts. Because single-handed efforts will not get us very far; sustainable development requires international solutions.

Ecologically sound waste management and recycling today play a major role in reducing the impact on the environment and conserving resources. But following the principles of sustainable development, recycling has to be seen as a "grand picture": It has to be ecologically beneficial and make economic sense. What is therefore needed are waste management and recycling systems which are integrated into a society.

Introducing a Recycling System: The German Packaging Ordinance
This idea of a system plays a very important role in Germany, and I am glad to be here today to introduce you to the German activities in the area of waste management and particularly chemical recycling of plastic packaging. Basically, one could look at what we have been doing in Germany over the past 6 years in terms of a huge project, and I would like to conduct a little case study for you.

So let me start at the beginning of the Dual System in Germany. And paradoxically enough, in the beginning were the limits: Limited resources, limited landfill capacities, a limited potential for plastics in waste-to-energy generation processes, and a very low limit of tolerance in the public with regard to the "disposing" of waste.

The German Packaging Ordinance of 1991 for the first time prescribes the principle of avoiding, reducing and recycling. And what is more important, it holds manufacturers and retailers directly responsible for the disposal of the packaging they have put into circulation. Packaging from households and small businesses is no longer "household waste" as such; it is considered a material that can be recycled and therefore has to be collected separately. The Packaging Ordinance gave industry a choice: Either they had to accept their individual take-back obligation - and collect their used sales packaging themselves - or they had to develop a privately organized system that would do the collection for them. And that is what industry did: Parallel to the municipal waste collection, they organized an additional - a dual - system. In 1991, Duales System Deutschland - DSD - was founded as a private waste management system, responsible for the nationwide collection, sorting, and recycling of post-consumer sales packaging, and releasing companies from their individual take-back obligation. Initially founded by 95 companies from the retail trade and the consumer goods and packaging industries, DSD today has about 600 shareholders.

How the System Works
The services offered by DSD are available to consumers all over Germany. Yellow bags and bins are distributed to households for the collection of light-weight packaging made of plastics, metals and composites. As the first sorting has to be done at home, the success of a dual system heavily depends on the consumer cooperating. Promotional or better, "educational" work is therefore very important. Only if the consumer sees the ecological benefits of a dual system, will he or she participate in the collection.

Waste management companies contracted by DSD collect the packaging either at the curbside or from the containers. These contractors are also responsible for the sorting of the contents of the yellow bag or bin. In over 350 sorting plants, the packaging waste is sorted into five fractions: Plastics, tinplate, aluminum, composite cardboard, and other composites. The waste management companies then forward the sorted packaging to the different industries which guarantee the recycling of their products. While the recycling of aluminum, tinplate and composite sales packaging is handled by industry, DSD is responsible for the collected plastics. An exclusive agent was authorized to coordinate and organize the recycling of these plastics.

Does the system work? It looks like it. Just to give you some figures: Nine out of ten German households participate in the sorting. In 1996, over 5.4 Million tons of post-consumer sales packaging was collected by the Dual System. This corresponds to 86% of all sales packaging brought into circulation. But it's the individual effort that really counts: On average, each citizen collected 71.2 kg of used sales packaging in 1996. Out of the total quantity collected and forwarded to recycling in 1996, the individual figures for the different material fractions were:

- Almost 2.7 million tons for glass
- 1.3 million tons for paper and cardboard
- 535 thousand tons for plastic
- 302 thousand tons for tinplate
- 36 thousand tons for aluminum
- 445 thousand tons for beverage cartons and other composites

With these results, we have also met the quotas of the Packaging Ordinance which since July 1st 1995 require that 80 percent of the sales packaging on the market has had to be collected, and between 80 and 90 percent of this has had to be forwarded for recycling - depending on the material. The incineration of recyclables, by the way, is not permitted in Germany. The collection and recycling services provided by the Dual System are transparent and easy to check: Each year our company submits a detailed mass flow verification to the ministers of the 16 German federal states. This lists the quantities of sales packaging that have been collected, sorted and recycled in the previous year.

Financing

A very important question now is: Who pays for collection and recycling?
The key is the Green Dot trade mark. Mainly those using packaging for their products and - to a limited extent - manufacturers of packaging and retailers pay DSD a license fee for the right to mark their packaging with the Green Dot trade mark. This fee pays for the collection and sorting of sales packaging, and in the case of plastics also for the recycling. The Green Dot as a financing mark shows that manufacturers and retailers are taking their product responsibility seriously and make a financial contribution to packaging recycling. Of course the costs are passed on to the consumer via the product price wherever possible, of course. The license fees are calculated based on the material, the weight of the packaging, and the number of items being circulated in the German market. The fees for the different kinds of packaging thus take into account the actual waste management costs caused by these different kinds of packaging. The license fee for plastic packaging is by far the highest because, unlike with other materials, the costs of preparation and recycling are included in the "Green Dot" fee for plastic packaging, as I mentioned a little while ago.

The Impacts of the Packaging Ordinance

That's the recycling part. But how about avoiding and reducing, the first two principles prescribed by the Packaging Ordinance? We are not only meeting our recycling quotas, but we have also done a lot to avoid packaging in the first place. To reduce license fees industry constantly optimizes packaging and packaging materials. As a result, packaging has changed in Germany. You'd just have to look at German supermarket shelves and you'd see that packaging has become much slimmer and that refill packs are booming. The German Federal Office of the Environment estimates that the amount of sales packaging has dropped by 900.000 tons between 1991 and 1995, - from 7.6 million tons to 6.7 million tons. Re-use is another big issue in Germany: In order to promote reusable packaging for beverages, the German legislator also stipulated in the Packaging Ordinance that the fraction of reusable packaging for beverages may not drop below 72 percent. Otherwise, a deposit may be charged on one-way beverage packaging.

The pioneering work behind us, we can say that what started as a giant experiment in 1991 has turned out a success. Moreover, the recycling achievements in the packaging sector have become a model for an ecologically-oriented economy. "Closing the loop" is the basic concept in this economy. The "Kreislaufwirtschaftsgesetz" – or "Product Recycling and Waste Management Act" -, which came into force last October, is an extension of the Packaging Ordinance. Taking things one step further, this act for the first time makes all branches of industry fully responsible for their products, right through from manufacture to disposal. However important the national implementation of a dual waste management system might be, economies and waste management systems cannot exist nationally. In the long run, "closing the loop" will therefore require international solutions.

With the European Packaging Directive, introduced in December 1994, a major step has been done towards a European solution. This directive stipulates that until the year 2001, all member countries will have to establish collection and recycling systems for packaging material and meet the quotas. To advance the European harmonization and to facilitate international trade, the Dual System is licensing its trademark "The Green Dot". Used as the financing symbol by 7 out 15 EU-member countries already, the green dot can now be found on packaging all over Europe, and maybe one day the DSD-trademark will appear on packaging in Japan, in Korea or China - or the US.

Post-Consumer Plastics

But let me now come to what many of you may be most interested in: Plastics. In every aspect of our lives, plastics play a vital role in advancing technology and increasing quality of life. Plastics are also a very important packaging material. While only 12 weight percent of all packaging is made out of plastics, these 12 % are used to package almost half of all merchandise. Plastics are a packaging wizard. Their versatility makes them the material of choice for the highest packaging standards. But plastics also excel at making the most of our resources. As plastics are used with a maximum efficiency, the positive impact on resource conservation can be felt throughout their life cycle. A German study shows that without plastics packaging, packaging consumption would increase 291 per cent by weight, manufacturing energy would increase by 108 per cent and packaging waste would increase by 158 per cent by volume.

Despite decades of experience with plastics manufacturing and application, the recycling of plastic packaging waste only has a recent history. A few years ago, there were no capacities, no technology, and no markets for secondary products. While paper, glass, and aluminum cans have quite naturally been collected, recycled and traded on established markets for secondary raw materials, plastics were the problem child. The success of a dual waste management system as it is being practiced in Germany will therefore always have to be measured against the efficiency and effectiveness of plastic recycling.

The Traditional Way: Mechanical Recycling

As you have seen just a moment ago, approximately 800,000 tons of plastic packaging were used in Germany in 1996, and out of this total, 535,000 t were forwarded to recycling. The Packaging Ordinance requires that the collected plastic packaging be materially recycled. Initially, material recycling was thought of in terms of mechanical recycling only, meaning plastic packaging was to be processed into granules and back into plastic products. Yet the idea to make a yogurt cup back into a yogurt cup, however tempting it sounded, had to be discarded right away because of the German food law and of course international laws. Furthermore, mechanical recycling processes require pure plastics as input material. In the sorting plant, the plastics collected in the yellow bags or bins are therefore separated into four pure fractions: EPS, bottles, cups and film. However, the sorting into monofractions is only economical up to a certain point. The pure plastics only account for about 40% of the plastic packaging collected by the Dual System in 1996. The major part of the plastics is not further separated but goes into the so-called "mixed fraction". For these mixed plastics, accounting for over 60 % of plastic packaging in 1996, a recycling alternative had to be found.

The New Way: Chemical Recycling

Feedstock recycling or "chemical" recycling, where the plastics are converted into petrochemical base products, offers such an alternative. In the beginning, neither experience nor technology were available to fall back on. One thing, however, was for certain: Mixed plastics have to be properly prepared and converted into a pourable bulk material, easy to store and transport, before they can serve as a feedstock. Together with the chemical industry, who at the time launched the first pilot projects on feedstock recycling techniques, the Dual System developed an appropriate preparation technique. This feedstock preparation is the essential step in the recycling process.

Feedstock Preparation

In the sorting plant, the plastics have to be sorted to a pre-set specification in order to ensure an efficient preparation process. Pressed into bales the mixed plastics are shipped to the plant where they are prepared for feedstock recycling. In a first step, the mixed plastics have to be coarsely shredded to produce a homogeneous material easy to handle in the subsequent processing steps. After shredding, it is important to remove any impurities which have been overlooked in the sorting and which may cause damage to the downstream machinery. Ferrous metals are separated by a magnetic separator. Non-ferrous metals, such as aluminum, are removed by eddy-current separators. Vibrating conveyors and air separators are used to separate other impurities using their different densities. After several shredding and separating steps, the material, which is now largely free of non-plastic components, is compacted. Compacting is an essential step in the preparation. Before the material is compacted, it has a very low density, less than 60 kg per cubic meter. It would be very difficult to handle in subsequent feedstock recycling processes and very expensive to transport. In the compacting process, the material is basically heated up to just below its melting point using either friction or pressure, and then processed into granules of less than 10 mm size. The output product of the preparation process is a homogeneous, pourable bulk material, the so-called a mixed plastics agglomerate. Based on the substantial know how we have collected in Germany, mixed plastics are today processed in 10 preparation plants with a total available capacity of over 387,000 tons per year. The agglomerate can be used in all feedstock recycling processes. It is important to note that all feedstock recyclers receive the same material. Special requests are not granted.

Chemical Recycling

In the hydrogenation process at Kohleöl-Anlage Bottrop, the material is converted into synthetic crude oil, the so-called "Syncrude". In the pyrolysis technique developed by BASF, the plastics are cracked into base chemical components, used, for example, to synthesize new plastics. This technique has been successfully tested in a pilot plant in the past. We are currently determining the possibilities of expanding the production capacities. In the gasification process, the prepared plastics are converted into syngas which can be used in the methanol production. Alternatively, mixed plastic agglomerate can be used in the blast furnace. Here, the plastics injected into the furnace and at a temperature above 2000 ° C are converted into syngas which acts as reducing agent and thus substitutes heavy oil in the production of pig iron from iron ore. Currently, 80,000 tons of agglomerate are processed at Stahlwerke Bremen. Other steel companies are expanding their pilot capacities into a production scale of ten thousands of tons.

For a long time plastic packaging has been considered to be a major problem in the sales packaging sector because of the apparently limited number of recovery and recycling options. Today, the situation has changed dramatically: After 6 years of intensive R & D, we have technologies available which allow us to treat waste plastics as a secondary raw material.

The results of the life-cycle analysis of recycling and recovery of post-consumer plastics packaging, which was performed between January 1994 and July 1995, suggests that, ecologically speaking, mechanical recycling processes are only superior to chemical processes if the post-consumer plastics can be replaced by new plastics on a one-to-one basis. The comparison of chemical and thermal recycling processes revealed that individual techniques differ primarily with regard to the conservation of resources. The study ranks the blast furnace process and the thermolysis process as the top two recycling options. Monocombustion - which, by the way, is not practiced in Germany because the Packaging Ordinance does not allow for thermal recovery - and liquefaction are also ecologically favorable. The combustion with recovery of useful energy and the gasification process, however, are less advantageous options. All of these processes, however, require careful sorting and an appropriate preparation of the waste plastics - and thus represent a considerable technological challenge.

Outlook

To take on this challenge and to meet the increasing international demand for economically efficient and ecologically sound recycling technologies, DSD has recently founded a subsidiary: Der Grüne Punkt - Gesellschaft für Systemtechnologie mbH - SYSTEC. SYSTEC has two missions: First, we will advance the development of economically efficient sorting-, preparation-, and recycling technologies. Second, we are offering to cooperate with both governmental institutions and private organizations in developing waste management and recycling solutions. We have already done our first steps on the international market: A license agreement with Hitachi, the Japanese multinational, has been signed in August. And we are optimistic that cooperation's with other countries will follow soon.

Our mission is to help improve national waste management and recycling standards and thus contribute to a society where "ecologically sound" and "economically efficient" are no contradiction, but go together. We want "sustainable development" to become a 21st-century reality. And we are proud to contribute our share.

SESSION 15

Report from Delegates IV:

Mr. Xiangyang Fang, The Peoples' Republic of China
Mr. Paula Fokikovi Taufa, Tonga
Mr. Laavasa Malua, Western Samoa

Industry Presentations II:

1. Western Wastewater Treatments Pty Ltd
2. Ecomax Waste Management Systems Pty Ltd
3. BSD Consultants

Environmental Conditions of Shenyang City

Fang Xiangyang
Sustainable Shenyang Project
254# Zhengyang Street, Shenhe District,
Shenyang, P. R. China
Tel: 86-24-4844985 Fax: 86-24-4846929
Email:Sepffio@pub.sy.lnpta.net.cn

Good Morning (Afternoon)! Mr. Chairman and all participants:

I am very pleased to have this opportunity, here, to introduce the environmental conditions of my hometown, Shenyang.

Shenyang, the capital city of Liaoning Province, has a jurisdiction over 9 districts, 4 counties. The total area is 13,000 km^2, home to 6.6 million people. The build-up area is 186 km^2, home to 4.689 million people, Shenyang is the political and commercial center of the northeast part of China. There are steel city, Anshan; chemical fiber city, Liaoyang; petrol-chemical city, Fushun; coal and iron city, Benxi; grain city, Tieling; and Dalian and Yingkou in south surrounding Shenyang forming the Liaoning middle area city group, which gives Shenyang a very good superiority to develop its economy.

Shenyang used to be one of the heavy industrial bases of China, set up in the First five-year Plan of the country. Shenyang has complete kinds of industries with machinery as its primary industry; it also has industries of metallurgy, pharmacy, chemical industry, light industry etc. In the past Shenyang, as the national economic base, was grown up with large-scale industrial production, forming an urban structure of "big plants". The large and middle scale state-owned enterprises reached 333, taking one third of all the industries of Liaoning Province. The industrial production was in the conditions of "3 high and 3 low"; i.e. high input, high-energy consumption, high pollution, and low output, low value addition and low benefit. So in the planned economic period, Shenyang was improperly developed into a single production type city, which the characteristics of high concentrated population and industries in central area, with simple function, bad layout, weak infrastructure and heavy structural pollution. This situation gives Shenyang a heavy burden and more difficulties in the transform from the planned economy into market economy. The urban images and environmental quality affected not only on the people's life, but also directly on the opening up to the world of the city. Since reforming and opening to the world, Shenyang Municipality has been highly appreciating the protection of environment and resources and has made a great deal of contributions to this aspect, in the period of setting up socialist market economy, preliminary forming a structure of environmental and economic development coordinately.

In order to protect the environment of Shenyang we implemented integrating reorganization for urban environment—further forming reasonable structures of energy, urban layout, industry and product, enhancing the environmental legislation, which improved our capabilities of pollution control.
Due to our efforts in environmental protection, although the national economic growth rates were increasing at two digits, energy consumption was increasing, population density growing up, auto amount largely increasing, the city's overall environmental quality is still in the comparably steady condition, no deeply deterioration as the economic fast development,

major environmental indexes is remaining steady or less reduced, the overall condition is better than that of the start of 1980's. Compared to the year of 1990, the indexes reflecting the environmental quality have been reduced. Such as, the daily mean value per year for TSP in the air is 0.375mg/m^3, reduce rate 18.48%; SO_2 is 0.099mg/m^3, reduce rate 15.38%; fly dust is 26.99tons/km^2.month, reduced rate 31.65%. the major indexes of air environmental quality have reached at the third class of the National Air Quality Standard (NAQS). The average hypermaganate index in Hunhe River, Shenyang's section, is 10.8mg/l, reduce rate 95.63%. The major water quality indexes are steady or in a better trend. Traffic noise and regional environmental noise are 57.7dB(A) and 57.6dB(A), basically in a steady level.

Nevertheless, we are still facing a serious environmental situation: Environmental pollution and ecological deterioration trend have not been curbed, the overall environmental quality is still in a lower level. The major environmental quality indexes for Hunhe river, Shenyang section, are exceeding the fifth class of National Surface Water Quality Standard, Surface water and ground water were heavily polluted, water resource was heavily wasted, leaving much shortage of water resource. The air quality indexes are moving at the third class of National Air Quality Standard. Exception in industrial area, environmental noise values in other 6 functional area are over national standard in different degree. The reasons for these are as follows: firstly the structural pollution is still existing in Shenyang, the energy structural pollution to the city, majored in coal burning, is the principal reason for air pollution with coal burning type. The unreasonable layout of the city, heavy polluting enterprises concentrated in central area, residential area and industrial area confusing, unreasonable structures of industries and products are also reasons for this. Moreover, the economic development mode is still focus on enlargement, the technologies are still in the 1950's or 1960's level, energy and resources were heavily wasted. Secondly, more history pollution debts, lack of fund, urban infrastructure fragile, the weak capability of integrated reorganization for urban environment, until now there is no any urban wastewater treatment plant in Shenyang city, some of infrastructure are still in a lower level, such as, central heating, gas distributing, traffic lines, which can not meet the needs of the urban environmental protection.

Facing the reality and looking forward to the future, we must adopt macro-regulatory measures for economy and environment, adjust the unreasonable structures, coordinate the development of environment and economy, and firmly take the way to sustainable development.

1. Optimizing the structures--- to increase environmental benefits by achieving the "two fundamental transforms" and structure readjustment.
2. Strengthening environmental management - to increase environmental benefits through the legal system and law enforcement abilities for environmental protection.
3. Developing environmental protection industry and popularizing the comprehensive utilization of waste - to achieve the coordinated development of environment and economy by depending on scientific and technological progresses.
4. Widening the exchanges in environmental protection - to accelerate the pace of opening-up to the outside world and to study thoroughly on sustainable development strategies.

Ladies and gentlemen, We sincerely hope to take intensive and profound discussions and cooperation with international organizations or individuals in the environmental aspect and to turn the sustainable development strategies into reality. Thank you.

Environmental Conditions of Shenyang City

1. Basic Conditions

- **Location:** Locates in the northeast of China, is surrounded by centralized Urban group, and is the political and commercial center of the northeast part of China.
- **Population:** 6,710,000(among them 4,700,000 is urban population).
- **Area:** 13,000Km^2(among them 185Km^2 is urban area).
- **Features:** used to be one of the heavy industrial bases of China with almost all categories of industries, especially machinery as its primary industry, as well as metallurgy, pharmacy, chemical industry and light industry.
- **Economy:** grew rapidly.

2. Review of the Environmental Protection

- Implementing Integrated Reorganization for Urban Environment-- further forming reasonable structures of energy, urban layout, industry and product.
- Enhancing the Capability of Industrial Pollution Control.
- Completing Legal system for Environmental Protection.
- Strengthening the Environmental Management.
- Carrying out Public Education of the Sustainable Development.
- Using the Scitch Achievement to solve environmental issues.
- Widening the international exchanges and cooperation of environment.

3. Environmental change trend and issues

Due to our efforts of Shenyang's Municipal Government in environmental protection, in the conditions of economy rapidly growing up at two digits, energy consumption increasing, population density growing up and auto amount largely increasing, the overall environmental quality is still in the comparably steady condition,. No deeply deterioration occurs as the economic fast development, major environmental indexes remain steady or less reduced, and the overall condition is better than that of the start of 1980's. But Shenyang still faces following serious environmental issues:

- **Air:** the air quality indexes are moving at the third class of National Air Quality Standard, which is the most serious class in NAQS.
- **Water**: surface water and ground water are heavily polluted, and water resource is heavily wasted, leaving much shortage of water resource.
- **Noise:** excepting in industrial area, environmental noise levels in other functional areas are over National Standard.

4. The main reasons of environmental issues

- The structure pollution is still existing.
  - The energy structure majors in coal burning.
  - The heavy polluting enterprises concentrated in central area.
  - The structure of industries and products are unreasonable.
  - The technology of industries is still at the 1950's or 1960's level.
- Lack of fund lead to more and more history debts in pollutant control.
- There are some weak aspects in environmental management.
- The public environmental propaganda need strengthen.

5. Countermeasures

- Optimizing the unreasonable structure.
- Constructing the environmental infrastructure.
- Completing the environmental regulations.
- Developing environmental industry.
- Basing on scitch and public education to enhance the capability of sustainable development.
- Widening the exchange and cooperation in environmental protection.

Environmental Conditions of the Township of Popua Kingdom of Tonga

Mr. Paula Fokikovi Taufa
Terrestrial Conservation Officer
Environment Planning Unit.

Introduction:

Popua is a township close to the city center and it is approximately two kilometers from Nuku'alofa. Nuku'alofa is the capital of the Kingdom of Tonga where most of the work opportunities are centered. A township like Popua is tormenting with natural and anthropogenic activities, which give the area unfavorable, condition to live.

This part of Tongatapu has been examined previously and lately for the unsuitable and unstable manner of the dumping site and other physical conditions. Nuku'alofa the capital of the Kingdom of Tonga has grown rapidly over the last twenty years, because of the influx of people from many islands throughout the Tonga Group, therefore people has to disregard some of the unfavorable condition of this swampy areas, but to start a life in the main island.

Concern for rapid population growth is not limited to the issue of food production. It includes stresses on the States abilities and resources to provide employment, health and social services, adequate and safe drinking water and other essential services.

The township of Popua starts after the hurricane Isaac, in 1982, a consensus drawn by the Minister of Lands, Survey and Natural Resources for the possibility of vacating people from the Sopu area to Popua. It is believed that the Popua site is much sheltered then the Sopu site. During the Hurricane Isaac high waters inundated most of the areas allocated.
During the 1996 Population Census, it was recorded that only 179 numbers of households, with 613 males and 582 females comparing to the 1986 where 93 households, and 334 males and 283 females.

In this paper, I will be talking about Environmental conditions which includes Mangroves destruction, air quality in the township of Popua, waste water treatment and disposal, solid waste management and land-use and land degradation. Secondly is the assessment of the problems and solutions.

Environmental Conditions:

Mangroves destruction:

The Township of Popua located in an area, which was once covered with diversity of mangroves. Mangroves were regarded as wastelands and the nursing ground for many coastal fish are now destroyed. The population of Popua between the year 1986 and the year 1996, is a good indicator of population quietly sprawled in all direction of the newly township. Mangroves here in Tonga are known for breeding ground for mullet and other marine organisms. People of Popua also cut mangroves for house constructions and other purposes.

A number of problems were shown to have originated from human activities in the Popua area. The overall implication is that indiscriminate destruction of mangrove area will persist and continue to increase unless deliberate measures are taken by Government to ensure proper management of the mangroves resources.

Air quality of Popua Township:

The Popua township is almost surrounded by Fanga'uta and Fanga kakau lagoon and the dump site to northern part of the township. The dump is a combination of various refuse and the emanation of the dump is no doubt a problem to the people of the village. Sometime the dump caught on fire and if the wind direction blows from the northern site of the village then the township of Popua will suffer from very dense smoke. The road is also a problem for the quality of air in Popua roads are not tar sealed and this problem is easily recognized in gardens and trees planted in road sites. After heavy rains water logging happens and the green vegetation starts to give unpleasant smell.

Waste water treatment and Disposal:

Popua township is a low-lying and the drainage is a problem in the area. Sanitary Superintendence Regulation provides for regulation of the placement construction and inspection of sanitary facilities and prohibits deposition of human faeces on and ground surface. If any condition is dangerous to health in any town common or public place, notice can be secured to the district officer for a statement. It also in the town Regulation Acts Section 6, requires the unusual inspector of dwelling. If they are in bud repair, badly drained in a filthy condition or unfit to sleep in. The district officer still order the owner to pull them down and rebuild them properly or spread sea sand or gravel around the house.
The only wastewater is that from the flusby of toilet sinks, and bathrooms. The problem arises on heavy rain water tends to inundate toilet and other water collection. The Ministry of Health is responsible for wastewater treatment. Disposed of Waste Water and solid waste can be done by private contractor. At the end, The treatment of Solid Waste and Water Waste has to be done by the Ministry of Health. The wastewater treatment and disposed in the township of Popua is one of the slowest in the Kingdom.

Solid Waste Management:

Solid Waste Disposal and Management is most restricted only for the township of Popua but it is a national issue. There is a Carnage Act and other Health Regulation that can be applied for the Management of Solid Waste. Problem is an area to other Public dumping site and people from other towns tends to unloudle slow of other refuse in some areas of the Popua they have few women groups and youth groups, that have particular concern for solid waste in household. Town officer also plays a major role in the physical appearances of the township of Popua. Town officer supervision roles here is very much needed in such the need to upgrading all arrogance houses that need to be cleaned within the delineate boundary of the Popua township.

Land uses and land degradation:

Popua is a village that has very interesting combination of land uses and the type of land use is the phenomena, that accountable for the degradation of land. Roads are designed in a way to lead water into the lagoon. Type of houses is concrete and the allocated lands are filled with gravels. The rubbish dump is also another factors that cause people to fill there home to the highest that they can go.

Assessment of problems and solutions:

Problems:

1) Mangroves destruction is a major problem in Popua and to find a solution to the problem required intensive planning and funding. Workshop can be organized and other environmental education awareness programs to be ran to ensure that people has the right attitude to mangroves an its important.

   People can be removed from coastal area of Popua to other areas, an action of this kind will tends to give the public a good view of the problems that supposed to take care by the local community.

2) Air quality has been notified as priority areas of concern, considering the proximity of the Popua dumping site, to the community residential areas. Having this problems in minds, the needs to employ a proper mitigation measures is very much needed in here; such as introducing of an innovated technology such as a low cost modernized Incinerator, which may possibly alleviate this problems. Other alternatives, we should think about is the financial resources we might possibly have to facilitate all of these particular needs. Government sector, Public sector, NGO's, Regional & International organizations may well bring forth their attentions regarding this matter.

3) Waste water Treatment & Disposal

   This is one of the major problems faced by the local community of this area, where the needs to find out a suitable Waste water Treatment & Disposal Management plan. A well designed septic and road drainage system may well handle this entire problem. We can also needed here the advised and the support of much local expertise in the field of hydrological architecture and coastal engineering. These alternatives, may further promoted by the pre-formulation and conceptualize of likeable considered project proposals to address the needs for the set up of a suitable coastal integrated management plan for the township of Popua and respective areas.

4) Solid Waste Management

   Considering Solid waste management issue for the township of Popua, the needs to attract the entirely assistance of the whole population of Nuku'alofa is completely regard here. As far as we know that the capacity of the local township solid waste source is most likely to generate from the Nuku'alofa areas.

A mini ingenerator can be installed in the area to burn some of the burnable rubbish. A compose area close to the ingenerator to take care of the organic matter transported to the area.

People of the village can be recruited to do rubbish sortings and other work.

5) Land uses and Land degradation

The solution for the Land use and land degradation is to pass the Land Use and Environmental Planning Act. This is the only way where we can possibly
Managed or make sure that we have something in place to guide the local community land use development needs, and even facilitate the monitoring
Of the target areas land degradation pattern and change, within the specific area of concern.

References

1. Zann, L.P 1984 "Fisheries" in Zann et al
   The Ecology of Fanga'uta, Tongatapu, Tonga. Sea Grant Cooperative Report.

2. Prescott F 1989, *The Management of mangroves Resources in Tonga.*

4. Howard, R 1983 "Technical Report No.32
   Coastal Reclamation Study, Northwest Tongatapu Tonga.

5. Belz, L.H 1985. Nuku'alofa sanitation and Reclamation. Nuku'alofa, Ministry of Health.

6. UN/ESCAP. 1987 "Environmental Management Plan for the Kingdom of Tonga".

Environmental Conditions of Apia

Laavasa Malua
Senior Environment Officer
Department of Lands Surveys and Environment

Introduction:

Apia is the capital and principal port of Samoa. Apia is situated on the north coast of Upolu with a population of around 35,000. By legislation, the Apia Urban area is defined as all the land within a two-mile radius from the three-corner road junction at Taufusi. In more recent times this definition is often exceeded with proposals and services extending further than just the two-mile radius.

The Apia community is not a single municipal entity, rather it comprises a number of traditional villages surrounding and interspersed with freehold lands, commercial and administrative developments. Government offices, most of the country's commercial and industrial enterprises, offices of international organisations, private agencies, the National Hospital, and the major educational institutions are located in Apia.

The Samoan way of life (faa-Samoa) in Apia and uniform all over Samoa, is based on its social institutions (family, village council, women's committee, church) which provide direction for individual or group behaviour and responsibilities as well as overall village organisation. The 'aiga', an extended family group, remains the single most significant social and economic unit. On the first of January 1962 Samoa became the first south Pacific island nation to become independent. A Samoan form of parliamentary government then developed which combined Western practices and Samoan traditional rules. However there are occasions when the village council exercises its governing authority much wider than the western style legislation.

Much of the town is low-lying, being a partially reclaimed swamp, and has a high ground water table, particularly in populated areas close to the main business district. This coastal strip is up to one kilometer wide, and behind it the ground rises towards the central volcanic ranges of the island.

The climate of Samoa is oceanic and mean annual rainfall at Apia is of the order of 2900mm. About 70% of this precipitation occurs in November/April, during the wet season. Winds are generally stronger in the wet season and occasionally in the December-March period, hurricanes do impact on the island causing extensive damage to property. Temperatures are generally in the range of 22 to 32 degrees Celsius. The predominant surface winds are south easterly trades during both dry and wet seasons.

Environmental Conditions

Apia's environment is starting to imitate characteristics of main urban centers in more urbanized countries of the world. There is a consistent breeze blowing into the town given its coastal location, but in the industrial areas, fumes from factories and most imminently the soot from the tar mixing machines at Vaitele industrial area has caused some concern with pollution of the air. Attempts have been made to assess the quality of air in Apia but were conducted mainly on a case by case basis rather than representative research. In addition to the pollution from industries, the increasing number of vehicles which congregate mainly in the urban centre is another source of air pollutants although there has been a recent move unleaded fuel.

In Apia the land is used mainly for commercial, industrial, government offices accommodation, public utilities, monuments and religion, education, recreation, and residential. In 1984 (Sturmms) a survey estimated a breakdown of all these uses as follows:

Use of land	Percentage of total area
Commercial	1.6
Industrial	4.2
Government	0.8
Public Facilities	1.2
Monuments & Religion	3.0
Education	4.7
Health	0.5
Recreation	5.0
Residential	69
Road Reserves	9.0
Total	100

Sewerage

Apia does not have any public sewerage system and the population is served mostly by on-site facilities. The commonly used disposal methods are septic tanks, Treatment Systems (only for major hotels and government complexes) improved ventilation pit latrines and water seal latrines, and pit latrines. Pollution from sewage was calculated by Convard (1992) and has indicated that fresh water resources and marine waters of Apia is immensely threatened. The possibility of pollution is also quite distinct given the unsealed and non-treatment nature of most sewage produce, the high porosity of Samoa's soils, high water table in Apia, and the proximity of buildings and industrial establishments to waterways and the coastal area.

Sewerage Treatment facilities are used by Aggie Greys and Kitano Tusitala hotels. The two government complexes situated on reclaimed land in the middle of town also have treatment plants. All discharge their treated effluent/wastewater into the sea.

Solid Waste

The solid waste generation rate in Apia is about 0.52 kg per person per day (Gangaya, 1994). This figure falls within the range or pattern of solid waste situation in similar developing countries. Putrescibles (food and garden wastes) constitute most of the waste stream with packaging material making up less than 20 percent. While some individuals and companies deliver their own waste to the only designated landfill at Tafaigata (situated in the south western fringes of Apia urban are) at their own expense, the rest is collected free of charge by garbage collection company under contract to the Department of Lands Surveys and Environment. This service is provided daily within the central business area and twice weekly for residential areas. At the municipal landfill, waste is carted and compacted into controlled tip mounds by bulldozer. Unfortunately, only minimal covering of these wastes is possible due to insufficient resources. At most times, the only available machinery (bulldozer) is pressured to fill in for excavation and compacting work.

Not all-solid waste enters the collection system as traditional disposal methods still remain common practice. Leftovers and remains from food preparations are fed to domesticated animals at home. Plant materials not collected by the contractors are either left to rot or buried on family land. Other bulky materials are indiscriminately dumped in neighboring lands and waterways, or used as fill material for reclaiming swampy land. Recyclable wastes (mostly metals and plastics) are re-exported to New Zealand and Australia for recycling.

Assessment of Problems and Solutions

Apia is beginning to experience problems related to the disposal of wastes and the need for urban planning. No planning legislation exits (although legislation is being prepared). Apia exhibits overcrowding, poor segregation of industries and dwellings, traffic congestion and other symptoms of this lack of planning. What is needed therefore is legislation for town planning and urban management. Solid waste disposal is now a growing problem despite insistent public awareness programmes advising people of the danger sand many ill consequences of uncontrolled waste disposal. Even the landfill site at Tafaigata has its own limitations in resources and technology wise. Obviously the management and daily operation of the landfill is very much affected by this lack of government investment in this area. Many have argued that privatising the operation of the landfill to also incorporate an incineration programme could ensure a continuous insertion of funds into the landfill operations.

There is also still evidence that some Apians do not enjoy a consistent service of rubbish collection. This results in many of other municipal rubbish failing to reach the Tafaigata dump. Rather they end up in ditches streams and eventually the coastal area. There is legislation prohibiting the indiscriminate disposal or discharge of waste into Samoan waters but its enforcement is restricted by staff shortages. The fact also that most villages in the Apia urban area are on customary land also means that people can do whatever they prefer on their land as long as it does not affect his or her neighbour.
Industrial activities discharging nutrient-loaded liquid effluent into water resource is also another matter of concern. Likewise are unused facilities where unmonitored obsolete chemicals continue to leak into the nearly marine environment. The disposal of sewage has been well documented and proved to be a major contributor to the pollution of ground water and marine environment in Apia. As there is no municipal sewerage treatment facility, on site facilities easily contaminate the high groundwater table in highly porous soils of the low-lying areas of Apia. A sewerage system is therefore a much-needed solution to this problem.

References.

1. Convard, N. Land Based Pollution Inventory for the South Pacific Region. SPREP, Apia, 1993

2. Department of Lands Surveys & Environment, Government of Western Samoa

3. Gangaya, P. Inia, W. Land Based Pollution Sources of the Marine Environment in Western Samoa, A Case Study, SPREP, Apia, 1994

4. GKW and Government of Western Samoa, Apia Sewerage Project Review of Master Plan 1992, Apia, August 1992

5. GHD (ADB) and Government of Western Samoa, Western Samoa Integrated Urban Development Project, Apia, 1997

6. Peteru, C. Environment Legislation Review, SPREP, Apia, 1993

7. Sturmms M.M, Apia Town Plan - 1984, Government of Western Samoa, unpublished.

8. Western Samoa NEMS Task Team & SPREP, Western Samoa National Environment Management Strategy, SPREP, Apia, 1993

9. Zann, L 1991a, The Inshore Resources of Upolu, Western Samoa: Coastal Inventory and Fisheries Database. Field Report no.5, FAO/UNDP project SAM/89/002, 1991.

AQUARIUS™ Nutrient Removing Aerobic Treatment Unit (ATU)

Graham Ivery
Manager
Sales & Technical Services
Western Wastewater Treatments Pty Ltd
4th Floor, 445 Hay Street, Perth WA 6000
Ph: 61 089 325 8115 Fax: 61 089 3251327

INTRODUCTION

Western Wastewater Treatments Pty Ltd (WWT) was formed in 1985 and has extensive experience in wastewater treatment both domestically and internationally.

In 1991 WWT introduced the domestic (single household) AQUARIUS ATU into Western Australia. The unit underwent a rigorous three month testing program at one of the Water Corporation's wastewater treatment plants. The Kwinana Wastewater Treatment Plant was chosen because the influent to the plant most closely approximated that of domestic sewage. Even so the wastewater stream contained higher than average BOD_5, SS, P and N levels.

Despite these factors, the AQUARIUS unit is the only ATU to meet all the testing parameters. The AQUARIUS ATU was also formally tested for phosphorous removal and informally for nitrogen removal. The AQUARIUS ATU was able to meet the testing criteria of < 1 mg/L TP, and remains the only ATU approved not requiring soil amendment in the irrigation disposal field for P removal.

The results of the nitrogen removal indicated that levels of <10 mg/L of TN can be achieved. Formalisation of this claim is being sought.

The AQUARIUS treatment process can be applied to a wide range of situations from single residential dwellings to commercial installations, motels, grouped housing, industrial units etc.

The treatment plant itself comes in a range of forms which can be adapted to suit the client requirements, site conditions or site location. The unit can come as a single tank configuration or a modular multi tank configuration with the materials of construction either fibreglass, rota moulded plastic, concrete or steel.

The initiative to produce a nutrient removing ATU arose because of the well-known concerns from septic tank effluent and the limitations of the West Australian coastal soils to attenuate nutrients. In addition, other small aerobic treatment units which have replaced septic tanks have shown a limited ability to achieve any noticeable reduction of the pollutant nutrient load (organic nitrogen, ammoniacal nitrogen, nitrates and total phosphorous).

The aim of the AQUARIUS ATU is to provide a method and an apparatus for the treatment of domestic wastewater which will overcome, or will at least partly alleviate the above mentioned problems.

PROCESS DESCRIPTION

The unit consists of four basic components: a pre-treatment unit containing an anaerobic zone and anoxic zone; an aerobic chamber containing two filters, one being an aerobic filter the other a submerged filter with anaerobic and anoxic zones; a stilling zone that acts as the clarifier; and a discharge chamber which houses the chlorination unit if required.

The process includes two recycle streams: 1) recycling a portion of the treated wastewater from the discharge chamber back to the anoxic zone; 2) recycling a part of the wastewater exiting the submerged filter back to the anoxic zone with the remainder of the recycle flow irrigating over the aerobic filter.

Raw wastewater enters the anaerobic chamber. The raw wastewater contains significant quantities of biodegradable organic matter which promotes high rates of anaerobic fermentation. The anaerobic zone will generally remove up to 40% of the organic matter from the raw wastewater and will achieve a degree of organic nitrogen removal and provides conditions to promote a degree of phosphate release.

The partially treated wastewater enters the anoxic zone under gravitational flow. As the biological phosphate removal in the anaerobic zone is not complete, a supplementary chemical phosphate removal process using mineral salts is used in the anoxic chamber. As the recycle water (from the discharge pump) passes through the mineral salts, metal ions are leached into the recycle water such that the metal ions in solution produce insoluble precipitates and complexes to chemically complete the removal of phosphates.

Because the partially treated wastewaters exiting the anaerobic chamber and entering the anoxic chamber are still heavily anaerobic and because the processed discharge water that is recycled to pass through the mineral salts is also not saturated with oxygen, further oxygen may be required within the anoxic chamber to convert the anaerobic wastewaters to anoxic conditions. This is achieved by recycling part of the wastewater from the aerobic filter.

The wastewaters within the anoxic chamber undergo further organic matter reductions, further denitrification, and substantially complete phosphate removal. In this respect the use of a metal salt to chemically assist phosphate removal also assists in the precipitation of organic colloidal suspended matter.

The partially treated wastewaters, containing mainly dissolved organic matter and ammoniacal and organic nitrogen matter then enters the biomass unit (aerobic unit) which contains two filters, an aerobic and a submerged. The wastewater entering the biomass unit combines with the highly oxygenated exit stream from the aerobic filter.

The wastewater passes through the submerged filter where some nitrification and soluble organic matter removal occurs in the upper portion of the filter, and achieves denitrification under anoxic conditions in the lower section of the filter. The aerobic conditions in the upper portion of the filter are maintained by the oxygen supplied in the oxygen rich stream from the upper (aerobic) filter, the amount of dissolved oxygen decreases towards the lower section of the filter to provide anoxic conditions for denitrification.

The aerobic filter achieves removal of soluble organic matter (BOD) and nitrification under aerobic conditions. Nitrification does not normally occur until nearly all the BOD organic matter is removed.

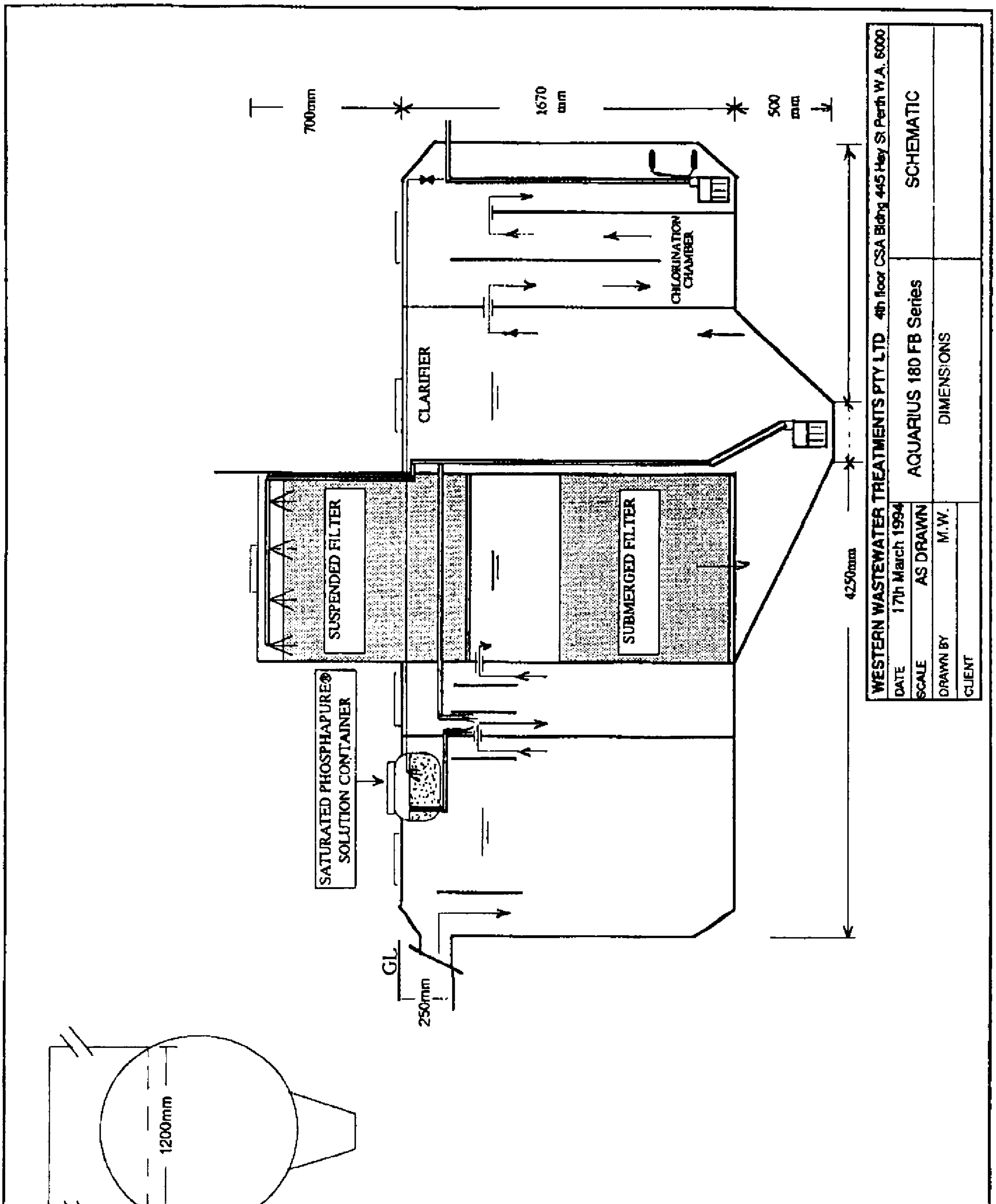
The degree of organic matter removal, denitrification and nitrification, phosphate removal, which is required to produce an effluent suitable for reuse as irrigation water, is achieved by controlling the volume of water recycled through the aerobic filter.

The treated wastewater then enters the clarification chamber where suspended solids are allowed to settle out. The excess sludges and slimes biologically produced in the aerobic zone are transferred by the recycle pump to the anoxic chamber where they are periodically removed with the phosphate precipitates.

Under gravity flow, the treated wastewater then enters the discharge chamber which is suitably sized to ensure there is sufficient retention time (min 30 minutes) for chlorine contact to allow destruction of harmful organisms.

Following disinfection the treated wastewater is then available for discharge to the property under a variety of approved reuse options.

Western Wastewater Treatments PTY LTD have also been successfully involved in the first commercially approved "Grey water" reuse project in Western Australia. This involves the grey water treatment from 6 aged persons dwellings, and recycling part of the treated wastewater back through the toilets. Excess waters bypass the recycle flow and are discharged into garden bed areas. The treatment plant used for this purpose uses essentially the same treatment process as described above.


700mm
1670 mm
500 mm
CLARIFIER
CHLORINATION CHAMBER
SUSPENDED FILTER
SUBMERGED FILTER
SATURATED PHOSPHAPURE® SOLUTION CONTAINER
GL
250mm
4250mm
1200mm
WESTERN WASTEWATER TREATMENTS PTY LTD 4th floor CSA Bldg 445 Hay St Perth W.A. 6000
DATE 17th March 1994
SCALE AS DRAWN
DRAWN BY M.W.
CLIENT
AQUARIUS 180 FB Series
SCHEMATIC
DIMENSIONS

Barriers to Commercialisation of New Environmental Technology

Martin Bowman
Director
Ecomax Waste Management Systems Pty Ltd
PO Box 946, WEST PERTH WA 6872
Tel: (08) 9481 8588 Fax: (08) 9481 8338
E-mail: bbg@wanet.com.au

1.0 INTRODUCTION

The Ecomax Septic System is a small scale high performance sewage treatment system. Its notable features include;

- very efficient phosphorus and nitrogen removal
- high removal of BOD and suspended solids
- disinfection without chemical addition
- heavy metal removal
- gravity driven process
- very long life
- negligible maintenance
- no moving parts

I am not aware of any other commercially viable wastewater treatment system or process which can produce final effluent of comparable quality.

There is significant demand for small scale reliable sewage treatment systems throughout Australia to service individual households and small settlements remote from reticulated sewer systems.

There is also an important environmental management requirement for sewage treatment systems which can remove nutrients, disinfect and are simple and reliable, so as to protect surface water and groundwater from contamination by faecal pathogens and to prevent eutrophication which can result from disposal of poor quality treated effluent.

Although Ecomax Septic System technology can meet these requirements at affordable cost, there has been significant resistance to widescale implementation by State and local government regulators in favour of conventional systems which have a lower performance profile in regard to environmental protection and economics.

In this paper I will describe;

- the technical and commercial history of the technology,
- the economics of treatment using Ecomax compared to conventional nutrient removal costs for larger scale plant, and

- a case history of bureaucratic resistance to use of this new technology, and the environmental and economic costs of this resistance.

I will summarise by putting forward a proposal for a centralised approval system in Australia in order to accelerate realisation of the environmental and economic benefits of new superior technology.

2.0 Description of the technology

The functional elements of an Ecomax Septic System are shown in Figures 1 and 2 and are described below.

1. Septic tanks, dual or twin chamber, where pre-treatment of wastewater from the house occurs: sedimentation, floatation, anaerobic digestion.

2. Two Ecomax cells, used in rotation, each comprising a storage and leaching vessel in leach drain or soak well format, underlain by an impervious membrane, strategically shaped in relation to the geometry of the leach drain/soak well by extension of a perimeter bund, to cause effluent to "pool" within a porous treatment medium and to flow through and out of the process.

3. "Amended soil" treatment medium, a porous prepared soil containing a combination of red mud residue (Alcoa by product) and sand.

4. A perimeter sub-surface drain and sump can be fitted to collect treated water for reuse or disposal elsewhere.

5. Sand veneer to provide substrate for grass growth and as a means of blending the cells to their landscape setting (the surface of the system may be positioned at or above ground level depending on site conditions).

6. Grass cover, to assist gas exchange, evapotranspirative losses, and conceal system within a passive recreation area.

A typical household system requires about $100m^2$ or slightly more and is generally positioned adjacent to the house and grassed over to blend into the garden landscape. Provided adequate grades are available, operation can be entirely by gravity.

The system operates as follows;

1. Wastewater drains from the house to the septic tanks where pretreatment occurs.

2. After 2-3 days residence the partially treated effluent flows out of the septic tank and into the infiltration structure located in the Ecomax cells. One cell at a time is used, and rotation is once in 6 months in order for hydraulic handling capacity to be maintained by resting and drying one cell at a time.

3. Due to the hydraulic head difference between the standing water level in the infiltration structure compared to the perimeter bund, effluent inside the infiltration

ECOMAX SINGLE RESIDENCE SEPTIC SYSTEM

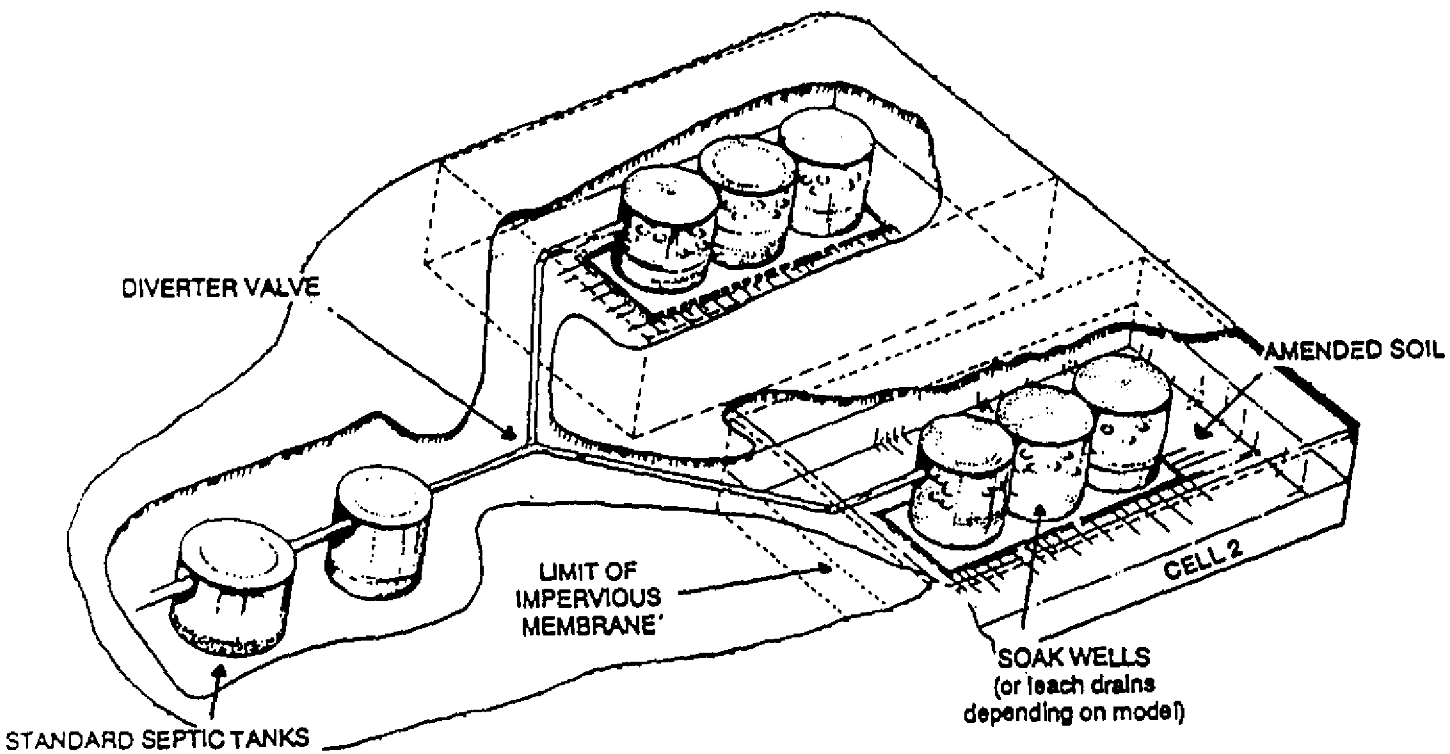


FIGURE 1

ECOMAX TREATMENT PROCESSES

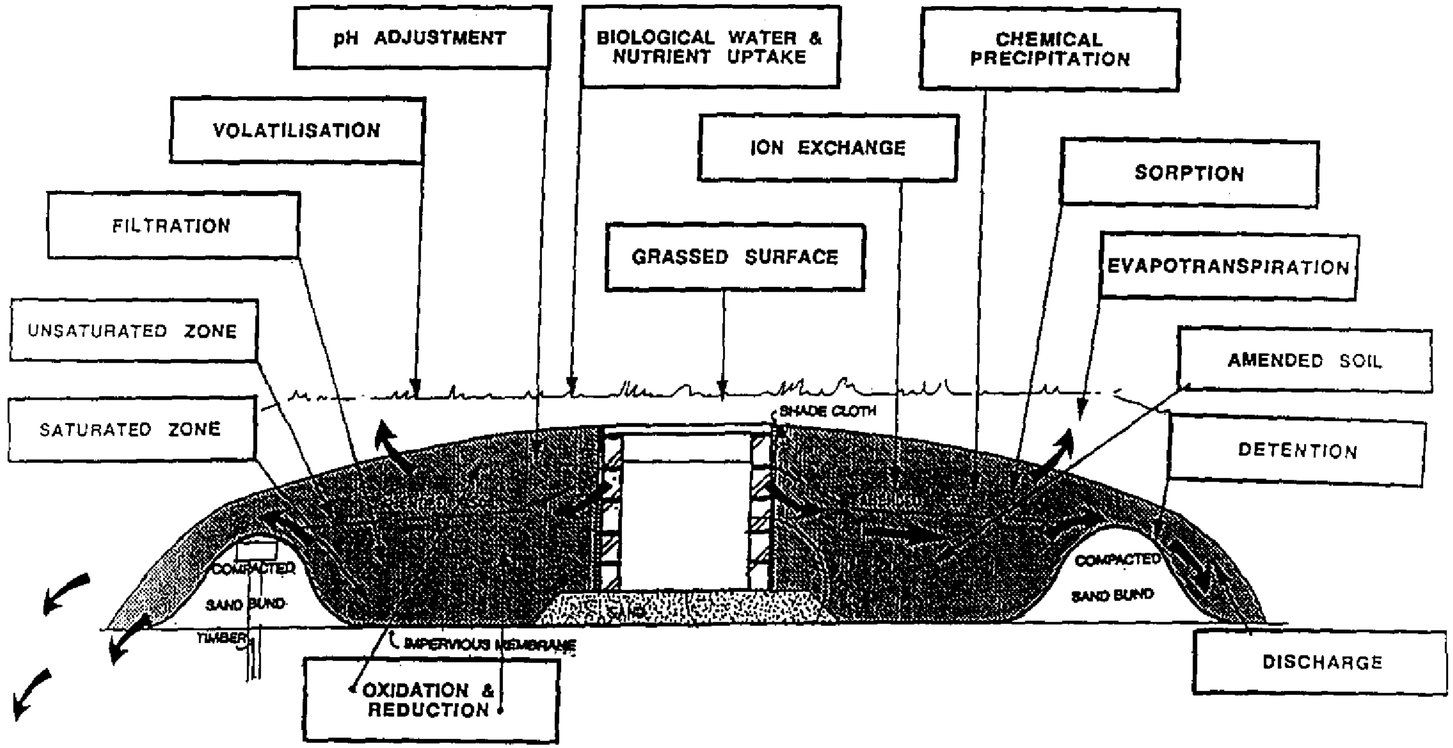


FIGURE 2

LEACH DRAIN CELL

structure flows radially by gravity into the amended soil and towards the perimeter bund where it exits the system.

4. In certain weather conditions such as the typical hot summers in Perth, evapotranspiration is a dominant process, and depending on hydraulic loading, the Ecomax cells may be zero discharge.

The treatment processes which are applied to the effluent as it is driven by gravity through the amended soil include: filtration, pH adjustment, ion exchange, volatilization, biological water and nutrient uptake, oxidation and reduction, sorption, chemical precipitation, detention, and evaporation or dilution depending on rainfall/evaporation balance.

As a result of this treatment, the final effluent produced by Ecomax has very high quality, with particular reference to phosphorus concentration.

Operating trials carried out in Perth over the last 7 years and in Sydney over the last 4 indicate that final effluent from Ecomax Septic Systems has the approximate composition presented in Table 1.

The effluent is clear, colourless and effectively odourless (having a faint earthy aroma to the sensitive nose). Phosphorus removal by Ecomax Septic Systems, at >99% is substantially higher than can be achieved by any other practical domestic treatment process. Nitrogen removal is generally very high, but sometimes variable, although even at the lower range of removal efficiency observed is generally at least as good as competing technologies. Nitrate concentrations are generally below drinking water standards. High ammonia removal is also a key feature as this contaminant is undesirable in aquatic ecosystems, even at low concentrations. BOD removal is very high, and final effluent concentrations will generally meet drinking water standards. In terms of faecal bacteria, Ecomax effluent meets the National Health and Medical Research Council guidelines for "reclaimed effluent", but it is not potable.

Table 1
Typical Effluent Quality from Ecomax Septic Systems

Parameter	Concentration
Total persulphate phosphorus, mg/L	0.01 - 0.05
Total persulphate nitrogen, mg/L	5.0 - 20.0
Ammonia nitrogen, mg/L	<5
BOD, mg/l	<10
PH	7.5 - 8.5
Faecal coliforms, c.f.u/100mL	<500 c.f.u/100ml
Suspended solids, mg/L	<10

Based on our performance trials for effluent treatment lifetime, the ability to treat effluent to this standard will be very long-lived. Operating trials in Western Australia using accelerated hydraulic loading technique have shown that phosphorus removal can extend to at least 40 years of domestic service, and test systems of this equivalent age are continuing to produce very high-quality effluent with no signs of deterioration of final effluent quality. Technical projections based on a soil core extraction from aged systems to determine the distribution of phosphorus in the amended soil bed indicate that an amended soil lifetime for phosphorus removal of over 200 years may be possible.

The data for nutrients, BOD and suspended solids, pathogens and trace metals indicate that effluent from Ecomax Septic Systems could be discharged to the environment with negligible risk of causing water quality deterioration.

It should be noted that in addition to the highly efficient removal of contaminants by the treatment of domestic sewage using Ecomax Septic Systems, natural processes - which occur after discharge from the system and as treated effluent percolates to the water table or is transported to the natural drainage system, including biological uptake, dilution, dispersion, oxidation/reduction, ion exchange, filtration and detention will further reduce risk of water quality or public health impact to surface water or groundwater.

Table 2 Compares Final Effluent Gravity from Ecomax Septic Systems to ANZECC Water Quality Guidelines and demonstrates that criteria for aquatic environments, recreation, irrigation and livestock are met.

3.0 TECHNICAL AND COMMERCIAL DEVELOPMENT HISTORY

The development history of Ecomax technology may be summarised as follows;

- Conceived in 1989 by application of research findings from Murdoch University and CSIRO.
- Tested and demonstrated at Kwinana Wastewater Treatment System 1990.
- Approvals from Health Department of WA for commercial use in 1991.
- Commercial installation commenced in WA around 1992.
- R & D Grant from Commonwealth Government 1993, demonstration in NSW in conjunction with Sydney Water over 2 years.
- Approval from City of Blue Mountains 1995.
- Approval from City of Shoalhaven and Great Lakes Council 1997.

Research and development and commercialisation is ongoing including application of the technology to stormwater treatment for nutrient removal.

4.0 BARRIERS TO COMMERCIALISATION

Much is said and written about the high costs of surface and groundwater contamination by sewage in Australia and throughout the world. Algal blooms are common in Australian inland waterways and cause dramatic decline in ecological, recreation and aesthetic values. Public health problems include the recent Hepatitis C contamination problem with oysters from the Great Lakes district in NSW. The massive blooms of toxic blue-green algae in the Darling river System in the early 1990's was triggered by excessive phosphorus in the waterways. CSIRO estimates about 40 % of phosphorus inputs to the river system was from treated sewage discharges from town ships along the river.

It would be forgivable to expect that a new technology such as the Ecomax Septic System, which can demonstrably yield so much benefit to environmental and public health protection,

Table 2

Comparison of Ecomax Final Effluent Quality with ANZECC Water Quality Guidelines ANZECC (1992)

PARAMETER	A AQUATIC	B RECREATIONAL	C IRRIGATION	D LIVESTOCK	ECOMAX EFFLUENT	COMPLIANCE
Micro-biol Primary Contact	No guidelines	<150 cfu/100ml	<1000 cfu/100ml	<1000 cfu/100ml	0 - 60 cfu/100ml (iii)	Meets ABCD
Colour & Clarity	<10% change ED	<20% Reduction	No guideline	No guideline	Clear - Odourless (iii)	Meets ABCD
pH	6.5 - 9.0	5.0 - 9.0	No guideline	No guideline	7.5 - 8.5 (iii)	Meets ABCD
EC	<1500 us/cm	NA	Low salinity	No guideline	2000 - 6000 us/cm (i)	Meets BCD (Note 1)
Susp. Solids	<10% change SM	No function Reduction	No guideline	No guideline	10(i)	Meets ABCD
Diss. Oxygen	>6mg/L	NA	No guideline	No guideline	4 - 7 (iii)	Meets ABCD
Total P	Variable	No guideline	No guideline	No guideline	0.05 (i)	Meets ABCD
Total N	Variable	No guideline	No guideline	No guideline	<10 (i)	Meets ABCD
Temp.	<2 C incr.	15 - 35 C	No guideline	No guideline	15 - 24 (iii)	Meets ABCD
BOD 5	No guideline	No guideline	No guideline	No guideline	<10 (i)	Meets ABCD
Chloride	No guideline	No guideline	30 - 700	No guideline	90 (i)	Meets ABCD
Sodium	No guideline	No guideline	<20	No guideline	120 (i)	(Note 2)
Aluminium	<0.1		5	5	0.03 (ii)	Meets ABCD
Ammonia	0.02 - 0.03	All toxic, irritating	No guideline	No guideline	<5 (iii)	(Note 3)
Arsenic	0.05	or mucous	0.1	0.5	0.015 (iii)	Meets ABCD
Cadmium	0.002 - 0.02	membrane	0.01	0.01	0.02 (ii)	Meets A
Chromium	0.01	damaging values	1	1	<0.02 (ii)	Detection Limit
Iron	1	not suitable	1	No guideline	<0.01 (iii)	Meets ABCD
Lead	0.001 - 0.005		0.2	0.1	No Data	No Data
Mercury	0.0001		0.0002	0.0002	<0.0005 (ii)	Detection Limit
Nickel	0.015 - 0.15		0.2	1	No Data	No Data
Selenium	0.005		0.02	0.02	0.002 (ii)	Meets ABCD
Zinc	0.005 - 0.05		2	20	<0.01 (iii)	Meets ABCD
				Calcium <1000	100 (ii)	Meets D
				Nitrate <30	30 (ii)	Meets D
				Nitrite <10	No Data	No Data
				Sulphate <1000	20 (ii)	Meets D

ED - Eutrophic Depth
SM - Seasonal Mean
No Data - Never Measured
(i) - Sourced from Sydney Water Study
(ii) - Chem Centre WA data
(iii) - Sheen Analytical data

Note 1 - Calcium compounds are incorporated in the treatment medium and impart slightly elevated concentrations of dissolved solids. Calcium is benign in the environment at the concentrations in Ecom effluent. Infiltration processes are improved by the presence of calcium in the outflow.
Note 2 - Sixfold dilution would render this concentration suitable for stock consumption.
Note 3 - Ongoing ammonia oxidation following subsoil discharge to soils can be expected to continue.

whilst also giving the flexibility for new development to occur in places people want to live rather than only where the reticulated sewer extends, would be eagerly embraced by regulatory agencies whose responsibility it is to manage public health, environment and development. Unfortunately this has not been the case.

We have now installed over 400 systems in WA, have demonstrated the system over 4 years in New South Wales under actual domestic service and have our first commercial orders in this State. However, we are moving forward very slowly compared to the environmental and economic demand which is so evident for improved sewage treatment to be achieved.

The factors, which are limiting wider use of the Ecomax technology, include:

(i) An apparent inability on the part of regulatory agencies to understand the technical aspects of the process leading to disbelief that such a simple system can work so effectively.

(ii) Attempts to assess and regulate Ecomax installations using acceptability criteria developed for conventional leach drains and other dissimilar technologies.

(iii) An apparent desire by assessing officers to find something wrong with the technology, possibly to demonstrate diligence in the discharge of their responsibility, rather than to encourage environmental improvements from new technology implementation.

(iv) Fragmentation of authority for technology approvals: in NSW on-site effluent disposal and technology approvals is the responsibility of local government, thus a separate approval must be obtained in every local government area;

(v) An ongoing belief in regulatory agencies that connection of new houses to a reticulated sewer system is a more acceptable solution than Ecomax Septic Systems to wastewater servicing of new development despite clearly demonstrable environmental and economic shortcomings of this view.

(vi) Reluctance to take a holistic view to effluent treatment and disposal and to give guidance to strategic planning and development for overall long term social and environmental benefit.

I will deal with the last of these propositions first.

4.1 Connection to Reticulated Sewer: Comparison to Ecomax Septic System

I will make the initial conclusion that for high density settlement, conventional effluent management solutions involving reticulated sewer systems and sewage treatment at large scale centralised plant is the apparent best solution. Technical challenges remain as to how to economically treat the large volumes of sewage which are collected by these systems, to a standard which enables point source discharges to surface water to be achieved with acceptable long term impacts.

However, recognising the performance limits which exist for large scale sewage treatment plants, on-site disposal should be considered the preferred option whenever this can be acceptably achieved.

Limits to effective on-site disposal include, lot size - any lots under around 1,000m^2 are difficult to service with on-site systems unless soils are very well drained. Plastic clays and rocky sites also limit the practical and commercial feasibility of on-site disposal, but for large lots eg 5,000m^2 and larger, even clayey rocky residential sites can be serviced by Ecomax Septic Systems.

Ecomax Septic Systems were recently proposed to support a large lot (1 ha) subdivision of around 150 lots in the Blue Mountains in NSW.

The NSW EPA opposed the use of Ecomax Septic System to manage domestic sewage, notwithstanding the provision of performance data for the final effluent quality, on the grounds that protection of water quality in the Hawkesbury - Nepean River system, to which the site drains, would be better secured by connection of the new residences to the reticulated sewer system.

Sewage from the proposed development area would be treated at the Winmallee STP. It is my understanding that Winmallee STP currently achieves final effluent with around 1ppm phosphorus, future plant upgrades will reduce this to 0.3ppm.

If we use 1 ppm P as the final effluent quality at the point of discharge from the Winmallee STP to the river we can conclude that sewer connection of 150 new houses as preferred by NSW EPA would create final effluent containing around 4.3kg/annum of phosphorous which will be directly discharged to the Nepean River.

By comparison, servicing 150 houses with Ecomax Septic Systems would create final effluent containing 0.2kg/annum of P, which would be discharged to the soil profile, several kilometers away from the nearest river tributary. It is unlikely that this phosphorus would reach the river system in the foreseeable future.

The logic employed in concluding that connection to sewer is preferable to using Ecomax Septic Systems in terms of protecting river water quality, is not at all obvious from a phosphorus discharge perspective, which is a key factor in protecting river water quality.

Also the economic outcomes of using Ecomax Septic Systems may be compared to the phosphorus removal costs estimated for large scale treatment plants discharging to the Hawkesbury Nepean River.

If we take a conservative lifetime estimate of 50 years for Ecomax Septic Systems and apply a conservative 98% phosphorus removal over this time, using an installation cost of $7,000, we can generate some treatment cost factors for phosphorus removal which can be compared to figures presented by Gamani Herath from La Trobe University, Department of Business, for the marginal cost of phosphorus reduction using addition of chemical treatment processes to Sewage Treatment Plants in the Hawesbury Nepean River in NSW.

Table 3
Costs of Reducing Phosphorus from the Discharge of Sewage Treatment Plants Hawkesbury Nepean: Source Herath G. 1996

Final Concentration of Phosphorus	Capital Cost \$/EP	Operating Cost \$/EP	Capital Cost \$/kg of P Removed	Operating Cost \$/kg of P removed
P<2mg/L	274	60	-	-
P<1mg/L	594	66	2,390	66
P<0.3mg/L	930	85	5,290	285
P<0.1mg/L	1,087	115	8,600	990
Wetland Reduction form 2mg/L to 1mg/L	200	12	2,109	131
Comparable Estimates for Ecomax Septic System over 50 years Service For an 8 Person Household				
Average Final P~0.05mg/L	875	75 (i)	16.05	8.59

Note
1. Based on 4 yearly Septic Tank Pumpout at \$300/service

The data in Table 3 demonstrates that Ecomax Septic Systems achieve phosphorus removal at substantially lower cost that can be achieved when sewage is treated at large scale at conventional sewage treatment plants

It is important to also note the following:

(i) The cited costs for Ecomax in Table 3 include total treatment of the effluent, not just t he P removal costs.

(ii) In contrast, the figures provided by Herath apply to P removal and do not include the cost of the initial stages of treatment ie. suspended solids and BOD removal.

(iii) The costs provided by Herath do not include costs for sewer installation, which can be as high as \$14,000 per lot for the household connection and further large costs for the main sewer network.

The overall economic cost of using Ecomax Septic Systems in this instance are shown to be much lower than to connect to the existing reticulated sewer system and associated treatment plant.

Recognising the superior outcomes of using Ecomax Septic Systems in comparison to reticulated sewer connections, in terms of water quality protection and costs, this example illustrates my contention that a holistic view to the benefits of on-site sewage treatment using Ecomax is not being taken.

4.2 Barriers to Government Approvals

New South Wales presents a particular problem to implementing the Ecomax technology on a widespread basis. Although in forums such as this conference, there is an audience with appropriate technical knowledge to understand the principles of soil science, geochemistry and hydrology and to accept how the process works, this is not the case in local government.

(i) By and large local authority health officers, even State Government Health agency personal do not have necessary technical knowledge, being trained more specifically in other areas of public health protection.

(ii) The need to obtain separate approvals for each local government area places a considerable burden on the commercial entities, which promote the technology.

(iii) There is no cross government agreements, which enable licenses and approvals, obtained under Western Australian legislation or individual local government jurisdictions in NSW to be transferable to other states and local government jurisdictions.

Recognising that much innovation in environmental technologies is borne out of small companies with limited human and financial resources, the bureaucratic process is a considerable barrier to implementation of environmental technology and the benefits remain largely unrealised. The losses will be evident in ongoing use of inferior, outdated technology, leading to sub-optimum water quality and unnecessary cost burdens to the community.

5.0 Conclusion

Development of new environmental technology is a commercially risky business that is an essential activity if improvements to environmental quality are to be achieved at affordable cost. There is a requirement for significant professional commitment and very long term financial outlook. Federal Government assistance is inadequate and appears to be diminishing over time. The 150% Tax concession for R & D has recently been reduced to 125%, and the minimum R & D expenditure levels of $50,000/annum to access this small concession are too high.

A centralised government approvals system with transferable approvals is needed to assist the pace at which new technologies for on-site effluent disposal can be implemented and the benefits they offer realised in terms of improved environmental protection and lower environmental management costs to be community.

6.0 REFERENCES

ANZECC (1992). Australian Water Quality Guidelines for Fresh and Marine Waters.

Bowman, M. (1996). Desalination 106 pp 305 - 310

Herath, G. (1996). Review of Costs of Removing Phosphorus to Control Algal Blooms in Waterways Australian; Journal of Environmental Management - Volume 3.

BSD CONSULTANTS
CAPABILITY STATEMENT

BSD CONSULANTS PTY LTD
BSD Centre, 2 Bagot Road
PO Box 155, Subiaco, WA, 6008
Tel: (09) 273 3888 Fax: (09) 388 3831

1. INTRODUCTION

BSD Consultants is a WA company formed in 1982, owned and operated by its Board of Management, the members of which are all full-time employees of BSD and reside in Perth, Busselton and Geraldton. BSD Consultants is a multi-disciplinary company and is made up of the following divisions: -

- Environment
- Land Development Engineering
- Town Planning
- Building Design
- Infrastructure Engineering
- Traffic and Transportation Engineering
- Structural Engineering
- Geraldton Regional Office
- Busselton Regional Office
- Finance and Administration

BSD Consultants' specialist divisions are able to provide expert consulting services in their respective area, or alternatively can be assembled into a multi-faceted team to efficiently conduct and manage substantial and complex projects.

The company currently consists of over 90 personnel, of which 3 are employed as dedicated professional Environment staff.

Of particular relevance to the delegates of the conference on wastewater management are the following areas of expertise:
a) Environmental Management Planning
b) Environmental Impact Assessments
c) Preparation of Planning and Policies and Guidelines
d) Catchment/Aquatic Systems Management
e) Vegetation Management and Revegetation Programs
f) Landscape Planning/Recreation Planning
g) Community Consultation Skills
h) Structure and Concept Planning
i) Civil Engineering
j) Drainage Design/Engineering
k) Water Quality Monitoring
l) Waste management

2. RELEVANT EXPERIENCE AND CAPABILITY

Detailed below are some recent projects in the waste management, water quality and drainage areas.

Waste Management Area

In this area BSD has undertaken the full spectrum of waste management activities including:

- preparation of tender documentation for the full range of waste activities - recycling, operation of waste disposal sites
- design and documentation of all types of waste disposal facilities - transfer stations, landfill sites
- preparation of management plans
- detailed studies to determine a long term strategy of providing for waste management needs. As part of these investigations comprehensive computer models were developed by establishing all costs associated with the waste collection, waste disposal and recycling methods. Using this data, alternative waste collection, treatment and disposal options were investigated, including:
  - Available alternative landfill sites
  - Development of a regional material recovery facility for recycling
  - The processing of greenwaste by shredding and composting
  - The collection and composting of organic kitchen and garden waste
  - The establishment and operation of a waste to energy facility
  - An investigation of hazardous waste disposal
  - An investigation of inert waste disposal
  - Regional domestic waste collection and regional recycling collection.
  - An investigation of short term greenwaste disposal options.
  - Fortnightly split-bin waste collection.
  - An investigation of pay-by-weight technology.
  - An investigation of the viability of a transfer station located near Baywaste.
  - An investigation of a three bin waste collection system.

A listing of the projects that BSD have worked on are detailed below:

- Brockway Transfer Station Future Directions Study for the West Metropolitan Regional Council (WMRC)
- Future Directions and Strategies in the Area of Waste Management for the East Metropolitan Regional Council (EMRC)
- Transfer Station Design & Documentation at Red Hill for the Eastern Metropolitan Regional Council (EMRC)
- Busselton Waste Study for the Shire of Busselton
- Waste Management Tenders for the Town of Victoria Park
- Waste Management Options Study for the Town of Cambridge
- Waste Management Tenders for the Town of Cambridge
- Review of the Principles of Operating the Regional Council for the Mindarie Regional Council
- Accounting for Excavation Costs and Lease Fee for Tamala Park for the Min^larie Regional Council

Water Quality Studies

In the area of water quality studies BSD has undertaken the following range of studies:

- environmental assessment of canal estate developments
- preparation of an environmental management plan incorporating a lake relocation plan and a lake management and monitoring plan
- water quality and sediment monitoring programmes
- environmental assessment on a proposed special rural subdivision in close proximity to an internationally significant wetland environment

A listing of the projects that BSD have worked on are detailed below:

- Harbour City Canal Estate - Cedar Woods Limited (CER)
- Cedric Street Wetland Environmental Management Plan - City of Stirling and Private Landowners
- Review of Environmental Management Program (EMP) - Hill 50 Gold Mine, Mt Magnet
- Lake Management Plan - Cedar Woods Limited
- Port Mandurah Monitoring Programme - Cedar Woods Limited
- Lake Clifton Subdivision - Masterkey Constructions
- Kemerton Environmental Study – LandCorp
- Coastal Residential Subdivision - Harry Perry
- Leschenault Estate, Australind - Barriera Pty Ltd
- Cedric Street Peat Removal and Earthworks - Fini Group
- Bedfordale Road Train Assembly Area EIA and EMP- Main Roads WA

Drainage Studies

BSD Consultants has undertaken minor drainage investigations right through to major drainage studies. The range of works undertaken are:

- design and documentation of a wastewater treatment and disposal system
- design of wetlands as part of the design nutrient and sediment retention
- design and documentation for oil containment structures including the trapping of hydrocarbons
- modeling of existing drainage systems using Ilsax and Extran to determine upgrading requirements
- modeling of existing catchments using RatHGL and then modification of the catchment parameters to reflect proposed town planning schemes. This information can be used by local government to determine developers contribution towards upgrading of the drainage network to accommodate the proposed development.
- cost estimates of the proposed upgrading works
- asset valuation and depreciation of existing drainage network
- salinity investigation and location of dams to provide irrigation water for town ovals

Listed below are some drainage projects BSD Consultants have undertaken:

- Belmont Drainage Study - City of Gosnells
- City of Gosnells Drainage Studies, Town Planning Schemes 20 and 21 - City of Gosnells

- Cedric Street Wetland Relocation (CER), Stirling Regional Centre
  - DPUD, City of Stirling and Private Landowners
- Serpentine Caravan Park
- Westrail - Forrestfield Drainage Study
- Westrail - Joe White Malting Interim Drainage Strategy
- City of Perth - St. George's Terrace/Adelaide Terrace Drainage Design
- Shell Australia - North Fremantle Terminal Drainage Design and Soakage Ponds
- City of Gosnells - Gosnells Drainage Study
- City of Belmont - Belmont Drainage Study
- Water Corporation - Mt Lawley Main Drain Study
- Perenjori Drainage Study
- Forrestfield Fire Training Academy Drainage Study
- East Malaga Industrial Estate (40 ha) Drainage design for industrial subdivision, including design of compensating basins and floodway design
- Erskine Industrial Estate - detailed drainage design for an industrial subdivision
- The Proposed Hazelmere Industrial Area Drainage Study for the Shire of Swan. These works involved the preliminary analysis, design and documentation of the overall drainage requirements for the Hazelmere Industrial Area.
- A design modification to a Water Corporation main drain as part of she Thomas Foad Subdivision in Oakford. This analysis involved the computation of water surface profiles along the drain.
- Analysis of drainage issues and compensating basin designs for various residential subdivisions, including Rosehill Park Estate, Waratah Estate and Helena Valley Estate.

SESSION 16

Report from Delegates V:

Mr. I.M. Tamrakar, Nepal
Mr. A.A. Rahim, Bangladesh
Ms Suree Ummaralikit, Thailand
Mr. Qingci He, People's Republic of China

ENVIRONMENTAL CONDITIONS OF KATHMANDU

Ishwar Man Tamrakar
Regional Director
Central Regional Directoraic
Department of Water Supply and Sewerage
Ministry of Housing and Physical Planning
His Majesty's Government of Nepal

1 INTRODUCTION

- Kathmandu - the capital city of Nepal
- 1991 census 0.675 million
- Growth rate 5.0 percent during 1981-1991
- Political, industrial and the business center of Nepal
- large floating population: more than half million.
- 1997 Popn: 1.3 million.
- Environment deteriorated sharply since the beginning of the Eighties

2 ENVIRONMENTAL CONDITIONS: General Trends

2.1 Social Habits

- Low level of community awareness and concern
- Traditional habits existent

2.2 Solid Waste Management

- Lack of a central sanitary landfill site
- Increasing amount of non-biodegradable and hazardous wastes are being produced in marginal quantities.
- Both surface and ground water (source of drinking water) are being polluted by solid wastes to some extent.
- Decomposition and insufficient burning of solid wastes is contributing to air pollution.
- Sewerage system and storm water drains frequently get blocked by solid wastes.
- Lack of knowledge and awareness among the community dwellers about the solid wastes.

2.3. Water and Waste Water Management

- Non-sewered domestic discharge: Microbiological pollutants from sewage has caused water borne diseases such as cholera, gastero-enteritis at high level.
- Low or negative pressure in the mains due to intermittent supply.
- Industrial emissions being discharged into public water courses and public land without being treated.

2.4 Waste Water Management

- Sewers were laid only in core part of the city.
- Sewers not working property in the major parts of stream drains used as sewer.
- Sewers being disposed off untreated.
- The situation is horrible during dry season, when the river virtually terms into on drain or gutter.

2.5 Air Pollution

- Kathmandu valley is susceptible to air pollution due to its bowl like topography.
- Three quarters of country's petrol use and about two thirds of diesel consumed.
- Two thirds of the country's vehicles concentrated within the city.
- Systematic baseline data on air quality virtually absent.
- Existing information indicate several pollutants frequently exceeding safety level.

2.6 Land Degradation

- Increasing areas of land (polluted with solid wastes) losing their values.
- Uncontrolled mining of sand from some suburban land is creating environmental risks.
- Unchecked stone quarrying threatening the suburban ecology.

2.7 Environmental Management

- No environmental management programme.
- No legal bindings to prohibit abstraction of the river resources.
- No legal bindings to prohibit the discharge refuge.

3. ASSESSMENT OF THE PROBLEMS AND SOLUTIONS

Improvements required

- Strict adherence to policies and programmes related to pollution control.
- Building capacities of sector institutions.
- Acquiring appropriate equipments such as incinerators etc.
- The level of coordination amongst agencies concerned.
- Public awareness and participations.
- Laws to deal with the problems associated with pollution.
- Proper mobilization of resource, manpower and equipment.

In the area of water quality:

- Need for legalized national drinking water quality standards backed up by adequate regulations
- Need to import more knowledge and skills on maintaining water quality by field level workers and consumers.
- Need to promote water quality testing facilities.
- Need for water quality monitoring and surveillance program.

4. REFERENCE

HMG/Nepal National Habitat II Committee. Best Practice Nepal – The City Summit 1990.

IUCN, Solid Waste Management in Nepal, 1992.

National Planning Commission, A Compendium on the Environmental Statistics of Nepal, 1994

________, Base paper for Ninth Plan (1997-2002), 1997

Nepal Conservation Strategy Project, NCS News letter, 1992.

Nepal Consult (P) Ltd., Detailed Engineering Design of Sewage Treatment Plant for Pashupati Area –vol.1, 1997.

Nepal Environmental and Scientific Service (P) Ltd., Assessment of River Water/Wastewater Quality, Upper Bagmati Basin Kathmandu, 1990.

Environmental Conditions of Dhaka City

ASM Abdur Rahim
Assistant Chief
Planning Commission
Government of Bangladesh

Introduction:
Bangladesh is facing a severe environmental crisis. These have originated mainly from population pressure, extreme poverty, natural disasters, depletion of forest resource, energy crisis, unplanned urbanisation and industrialisation, water pollution and air pollution in major cities, soil degradation etc. Bangladesh has been trying to combat environmental degradation and improve the same with limited facilities and resources. Dhaka is the capital city of Bangladesh. It is a Metropolitan City. As a planner, I have some personal involvement with the subject mentioned above.

Background:
The Dhaka Metropolitan Area (DMA) is estimated to have a population of about 8 million. The area under the responsibility of the Dhaka City Corporation (DCC), covering and area of 260 sq.km., contains an estimated population of 4.8 million. Most of the population of city is concentrated at the western part, the eastern part of the city is less densely with considerable areas still under agricultural and non-urban uses. The population of Dhaka has been growing at a high rate of 5.5 percent per annum. While the contribution of Dhaka in the national economy is substantial, the living conditions in Dhaka have progressively deteriorated. About 60 per cent of the households in Dhaka are estimated to have incomes below the poverty level. Some 25 per cent of the population are living in slums. As the population increases, severe strain on municipal facilities such as water supply, sanitation, drainage and solid waste management have emerged. During the 1988 floods, one of the most severe on record, some 60 per cent of the DMA population and 80 per cent of the area remained submerged in water for periods up to four weeks.

A number of projects have been under taken to improve the city's environmental conditions. These projects aim at an integrated urban development program consisting of (i) flood control and drainage works (ii) complementary environmental programs covering improved sanitation and solid waste management for the low income residents and (iii) implementation assistance.

Environmental Conditions: Air quality of Dhaka City:
After analysing samples, the laboratory of Dhaka Division of the Environment Directorate has found that in three areas, the level of nitrogen oxide exists at an acceptable limit. This level is higher from the normal at the points of Bangladesh Beverage and Tejgaon. In February 1997, the level of Sulphur oxide was as high as 143.07 microgram per square meter. At industrial areas, acceptable level of sulphar-di-oxide is 120 microgram per square meter. Analysing the sample of Farmgate area it is found that the level of Sulphur Oxide was at a minimum i.e. 59.86 microgram per sq. meter on January and was at a maximum i.e. 74.44 microgram per sq. meter on February. In case of commercial and residential areas, the accepted level of sulphur oxide is 100 and 80 microgram per sq. meter respectively. It is observed that in case of the samples from Farmgate area, the level of sulphur oxide per sq.meter during the study period (January to March, 1997) was higher than the level of

previous three months (October to December, 1996). In these samples, though the level of sulphur oxide stands at an acceptable degree, but it can apprehended that this level would cross the acceptable level in a near future. The level of air borne particles at the area of Bangladesh beverage and Tajgaon at an acceptable rate.

Water Quality:

To study the level of coliform organism in pure drinking water, the office of the Dhaka Division collected 44 samples from pump station, adjacent streets of pump stations, taps of residences and under ground water reservoir connected with the pumps of different areas of Dhaka City. According to recent environmental conditions, the acceptable level of coliform organism in 100 milliliter of drinking water should not be more than two. But analysing the samples, it is found, the level of coliform organism in 18 samples out of 44 is higher than the acceptable level. Rest 26 sample show no presence of such organism. A tap in an adjacent street of pump No. 16 at Mirpur shows the presence highest level of coliform organism which is 350 ml. of drinking water. Result shows as improper chlorination treatment though the purification treatment in the pump stations are at work as usual. It is also found that in some case chlorination sets are out of work or those sets have lost connection with the pumps.

Solid waste Management:

Actually, the solidwaste management system of Dhaka city is good. So, a number of projects have been under taken to improve the solidwaste management system. The objectives of the project is to improve and upgrade solid waste collection. To enhance the impact of the project, drainage is proposed to extend the coverage of a new collection system recently introduced in Dhaka. An additional 60 collection trucks and 240 containers have been procured under the project, which will enable DCC to extend collection service to about 40% of the Dhaka City area. To complement the new system and to extend collection services to within the parts of slum areas inaccessible to trucks supporting facilities such as handcarts and collection bins are also to be provided.

Sanitation, Water Supply, and Local Drainage:

Sanitation, Water supply and local drainage system of Dhaka city is very poor. In order to improve the situation city corporation has been taken a number of projects. Only a few public toilets are available in Dhaka, which is inadequate to meet current demand. Some public toilets are to be provided under the project to cope with the problem. Bathing and washing facilities will be attached as needed. The project includes 1500 twin pit, 300 single pit and 1800 latrine shelters. To supplement these facilities, 600 public water supply standpipes are to be installed. DCC currently maintains about 120 km. of drain pipes, and most of these are damaged, blocked, or broken, causing a deteriorated living environment. A renovation program of the pipes is also proposed, together with provision for mechanical cleaning equipment and vehicles.

Policy, Strategy and Program:

Following policy, strategy and program for the Environment sub-sector will be taken up during the Fifth Five Year Plan for Dhaka City. Environment Committees with people's participation will be strengthened. Department of Environment will be strengthened in the light of existing Environment Policy, Act and Action Plan in order to co-ordinate, monitor and implement theses activities. Sectoral legislation's are to be reviewed and redrafted in the light of Bangladesh's commitment expressed through singing and ratifying of a number of International Conventions and protocols on environment. 'Polluters Pay Principle' will be followed in order to ensure strict compliance of environmental legislation.

Provable Solution and Recommendations:

- Promoting appropriate environment management system for sustainable development.
- Ensuring conservation of bio-diversity and its sustainable utilisation
- Ensuring active participation of the poor, specially the women in environment management activities.
- Promoting environment friendly activities in development program/ projects.
- Preserving and protecting of natural resource base.
- Strengthening the capability of public and private sectors to manage environmental concerns
- Environmental pollution from different industries has to be minimised.
- Monitoring and controlling present environmental pollution and degradation related to soil, water and air.
- Fulfilling obligations under international treaties and conventions for minimising adverse impact on global environment.
- Undertaking research and development for innovating technology in national perceptive and application of modern technology, information exchange and benefit sharing with other countries.

References:

i. Environmental information, Directorate of Environment
ii. The Fifth Five Year Plan of Bangladesh (1997-2002).

Managing on Municipal Solid Waste in Thailand

Ms. Suree Ummaralikit
Chief of Urban Environmental Management Sub-Division
Urban Environment and Area Planning Division
Office of Environmental Policy and Planning
Ministry of Science, Technology and Environment
60/1 Soi Phibul Wattana 7,
Rama VI Road, Phyathai,
Bangkok 10400, THAILAND
Tel. (662) 272-3051 Fax. (662) 270-1758

1. Present Situation and Problems

Thailand is one of the countries in Southeast Asia, of which 513,115 square kilometers in area and approximately 60 millions of population. The whole country consists of 76 provinces which can be divided into four main geographical regions namely; the North, the Central Plains, the Northeast and the South.

At present, managing of municipal solid waste is one of the most serious environmental problem in Thailand. In 1995, over 12 million tons of solid waste were generated in Thailand and accordingly more than 20% of these comes from Bangkok Metropolitan Region. Another 18% was generated from other municipal areas and 47% from rural areas.

Environmental problem concerning solid waste mainly stems from mismanagement of disposal and its inefficiency of waste collection. Many well-designed sanitary landfills have turned into open dumps and on site recycle which result in critical ordour and fly problems consequently.

However, within 146 municipalities and 981 Sanitary Districts, 20 urban centers have been already equipped with appropriate waste treatment facilities. Another 142 municipal areas will be studied and provided with facilities by the year 2000. Each of them are in the following steps:-

- 48 Urban centers are carrying out feasibility study
- 25 Urban centers are in detailed design step
- 13 Urban centers are processed land requisition step
- 56 landfill sites are being constructed

2. The Management of Municipal Solid Waste

The solid waste disposal service is an essential infrastructure of a modern city and its process is undoubtedly required costly and continuous activities. The solid waste management, however, is inevitably environmental protection not only for our own but also for the next generations.

By the principle under the Enhancement and Conservation of National Environmental Quality Act, B.E. 2535, local authorities such as Municipalities and Sanitary Districts have to manage their own wastes. In 1994, the efforts to manage solid waste under the Provincial Environmental Quality Management Action Plans were implemented. The capacity of the collection services within the Municipalities and Sanitary Districts were increased due to collection trucks and equipment provision from subsidized governmental budget.

According to the Provincial Action Plan, local authorities have to propose their solid waste treatment and disposal plans to the central government in order to acquire allocated fiscal budget. Steps to be taken for waste disposal are consisted of the followings;

Step 1 *Feasibility Study*

This step is to identify the existing waste management, condition and problems, the future trends and budgetary constraints as well as the appropriate and implementable methodology.

Step 2 *Land Requisition*

The result from feasibility study should indicate the appropriate method and site for waste disposal. Land purchase is subsidized by government budget ranged from 85-100%. In case local authorities shared more than 15% of land price, the property right belongs to that local authority.

Step 3 *Detailed Design.*

After disposal sites are obtained, the step of detailed design will be started. Actually, the selected disposal method for municipal waste in Thailand is sanitary landfill.

Step 4 *Plant Construction*

Normally, local authorities carry out this step by contracting out to the private companies.

Step 5 *Operation*

This step is carried out by local authorities themselves and no subsidies from government budget.

3. Measures and Action Plan for Solid Waste Management

Apart from increasing the efficiency of collection and promoting environmentally sound disposal for municipal solid waste, there are ways and means to reduce the difficulties of solid waste disposal in which the individuals must participate. A comprehensive framework with integrated programs has been developed to provide effective management tools in solving domestic waste problems.

The problems include various development activities as the following;

1) Waste Minimization Programs

Several programs are implemented to reduce domestic waste generation. Most of the current waste minimization programs are implemented through public campaigns and public participation. A comprehensive project to support application of technology which helps to reduce volumes of waste as well as encourages recycling and reuse.

2) Promoting Local and Public Participation

Decentralization of resource and environmental management is the principle in Environmental Acts, and local authorities were encouraged to prepare the site for sanitary landfills. At present, an environmentally - sound waste disposal approach is the main concern of communities around dumping site. Local communities near landfill sites area are bargaining for adequate compensation for their lands and living conditions. They have also taken part in monitoring and evaluating of solid waste management.

3) Enhancing Solid Waste Management Efficiency

To improve the existing management systems of solid wastes from the stage of waste collection, transportation, treatment to final disposal are implemented by formulating solid waste management plans for local level such as BMA, Municipalities and Sanitary Districts.

4. Conclusion

The problems of waste still exist, plans for action, therefore, are needed for Thai society to be concerned. Although modern technology for solid waste management are used as a tool for management, each technological measure cannot be the absolute best solution on its own. It is not logical to ask whether the landfill or the composting is better than incineration or otherwise. One needs to look at the "Garbage economy in a comprehensive picture". The optimum choice of technology requires the careful planning by experts and people who care are ultimately the true experts.

References

1. Ministry of Science, Technology and Environment, 1997, "Thailand's Action for Sustainable Development: Thailand's Country Report to UN Commission on Sustainable Development". Bangkok. Thailand.
2. Office of Environmental Policy and Planning, 1995. "Summary of Thailand State of the Environment Report 1994".
3. Office of Environmental Policy and Planning, 1997. Provincial Environmental Action Plan in 1997". (in Thai)

Environmental Situation and Countermeasure of Wuhan Peoples Republic of China

Oingci He
Sustainable Wuhan Project Office
Wuhan, People's Republic of China
Tel: 86-27-5800956
Fax: 86-27-5800956
E-mail:epiowh@public.wh.hb.cn

ABSTRACT

Wuhan is the fifth largest city in the center of PRC. It has a metropolitan population of 6.91 million. Approximately 1.7 million tons of coal are burned each year for heating and cooking. The total discharge volume of SO_2, NO_X and soot is respectively 178.4, 85.0 and 113.3 thousand tons a year; the total discharge volume of urban sewage reached 1.3 billion M^3 a year the displacement of COD in the urban sewage is 0.3 million tons; there 5 million tons of solid wastes and 1.6 million tons of urban garbage a year in Wuhan. The research results strongly suggest that urban ambient air pollution exposure in Wuhan contributes to retardation in the growth of children's lung function. The discharge volume of all pollutants should be controlled by taking efficient means to improve the environmental quality of Wuhan.

Wuhan, the fifth largest city in the PRC, is located in center of the country on the Yangtz river (28° 58′- 31° 22N, 113° 42′ - 115° E). It has a metropolitan population of 6.91 million, of which 3.87 million people live in the urbanized core of the city. The residential and commercial population density is highest (114000/km^2) within the urbanized core of Wuhan. Most Wuhan households burn coal domestically; approximately 1.7 million tons are burred each year for heating and cooking by small boilers and stoves, 9.53 million tons are burned for industry productions. "burning coal pollution" is the main air pollution resource. The total discharge volume of SO_2, NO_X and soot is, respectively 178.4,85.0 and 113. 3 thousand tons.

During 1982-1996 the air pollution measurement yielded mean concentration of SO_2 in the urban site and suburb site of 59μg/m^3(range of 8μg/m^3 - 245μg/m^3) and 13μg/m^3(rang of 8μg/m^3 - 83μg/m^3, respectively. The mean concentration of total suspended particles, were 251 μg/m^3 (range of 73μg/m^3 - 648μg/m^3) and 110μg/m^3 (range of 36μg/m^3 - 297μg/m^3 in urban and suburb area sites, respectively. The level of TSP and SO_2 observed at the urban sites were approximately 2.3 and 4.5 times higher, respectively, than in suburbs.

The mean concentrations of TEP and SO_2 measured from 1981 though 1995 exceed the annual Chinese ambient air quality standard (AAQS) (150μg/m^3 for TSP, 20μg/m^3 for SO_2), the World Health Organization (WHO) recommended annual limits for residential areas (60-90μg/m^3 for TSP, 40-60μg/m^3 for SO_2), and the former United States TSP Annal AAQS of 75 μg/m^3.

In May and June of 1988, the spirometric function of 640 children, who were wed 7-13 years and who were free of chromic respiratory conditions, was measured in urban core and a suburb of Wuhan, China. Proportions of families who burned coal and gas domestically were similar in both areas. In linear and logarithmic regression models, height was a stronger determinant of forced vital capacity and forced expiratory volume in 1 s than was age or weight. In linear models, the proportion of variance explained by height (R-squared) ranged from 0.54 for urban females' forced expiratory volume in 1 s to 0.77 for suburban males and females. Both forced vital capacity and forced expiratory volume in 1 s were consistently lower in urban than suburb children. The average forced vital capacity and forced expiratory volume in 1 s in children 132-14CE tall were 6.7% and 3.8% lower, respectively in the urban core than the suburb; suburb-urban differences increased with height, Suburban-urban differences in slopes of lung function growth curves were statistically significant for forced vital capacity. Rates of clinical upper respiratory irritation were also generally elevated in urban children. These results strongly suggest that urban ambient air pollution exposure in Wuhan contributes to retardation in the growth of children's lung function.

The water areas of Wuhan city made up mainly of the Yangtz, Han river system, East lake, Sa lake and Yanxi lake system were one third of the Wuhan total water areas of $330km^2$.

In 1995 the total discharge volume of urban sewage reached 1.3 billion M^3, a year of which the discharge volume of industrial wastewater were 0.9 billion M^3; the displacement of COD in the urban sewage were 0.3 million tons, of which COD from discharged industrial wastewater were 62 percent. But in 1995 the whole city had only one municipal wastewater treating plant with treating capacity of 50 thousand tons per day which fell far behind the need. There are not rain water and sewage separated drainage facilities in the urban areas of Wuhan Rain water and wastewater flow through the same pipes into rivers lakes or penetrate into the groundwater system.

The water quality of most lakes around or in the city become worsen because the lakes recepted more and more amount of municipal and industrials sewage. To control the more and more serious pollution resulting from eutrophication is the main problem in water environment protection.

For example the Muoshui Lake with area of $4km^2$ receipted 19 thousand tons of COD a year.

There were 5 million tons of solid waste and 1.6 million tons of urban garbage each year in Wuhan, the generation of urban garbage increased by 14 percent per year. Due to the lack of collection and transportation facilities, 20% of the garbage cannot be disposed in a timely way. Most of the garbage and night soil are either piled up in residential areas, or improperly burred or simply discharged into rivers and lakes without treatment. Over the past 10 years, local government concerned paid much attention to the comprehensive use and disposal of industrial solid wastes and industrial pollution controlled; however, urban domestic waste still polluted the environment.

In order to control the atmospheric pollution in 2000, the urban discharge volume of SO_2 should be less than 0.32 million tons, TSP less than 0.26 million tons. NO_x less than 0.17 million tons; the treatment rate of the industrial waste gas should be reach 90 percent.

By 2000, the quality of drinking water should be meet the national standards. The tap water coverage should reach 95 percent with a daily water supply of 200 liters per capita, the reusing rate of industrial water should be 66-70 percent. The total discharge volume of urban sewage should be controlled below 1.4 billion tons a year, of which industrial wastewater must account for less than 0.9 billion tons; the central treatment ratio of urban sewage should be reach about 25 percent, the displacement of COD in the urban sewage should be less than 0.38 million tons, of which COD from discharged industrial wastewater must be lass than 0.25 million tons.

Urban solid wastes treatment rate should reach 25 percent in 2000, the comprehensive utilization ratio of the industrial solid wastes should be reach 60 percent.

The general goal of urban environmental protection should be: by the end of this century, the environmental quality of Wuhan should reach national standards, a drive to control urban environmental pollution will also be launched to make environmental protection keep up to synchronize environmental protection with social and economic development and pave the way for the creation of a clean, beautiful and serene urban environment in Wuhan.

References

1. effects of air pollution on children's pulmonary function in urban and suburban Areas of Wuhan peoples republic of china, P382, archives of environmental health dec. 1993, vol. 48 No.6.
2. Wuhan urban area ambient pollution total volume controlling planning research, Wuhan environmental protection institute report, Nov,1986.
3. Wuhan urban area ambient pollution preventive treatment planning research, Wuhan environmental protection institute report, Oct., 1990.
4. Wuhan urban area water environment pollution preventive treatment planing research, Wuhan environmental protection institute report, Apr., 1990.

SESSION 17

Lecture IX:

From Symbolic Gesture to the Main Stream
- Next Steps in Local Sustainability

Prof. Peter Newman, Murdoch University

From Symbolic Gesture to the Main Stream: Next Steps in Local Sustainability

Professor Peter Newman
Institute for Science and Technology Policy,
Murdoch University, WA 6150
Australia

Abstract
Sustainability applied to cities and towns must mean an overlapping achievement of environmental, economic and social goals. To do this requires innovation in how we use energy, materials, water, waste and natural setting. Innovation involves a series of demonstrations at the local level that are usually seen as merely symbolic gestures; when tested and found to fulfil the sustainability objectives, then the opportunity is available to be mainstreamed. However it is rarely that simple and often there are major obstacles to the mainstreaming of sustainability. This paper examines innovations from around the world in Ecological Urban Renewal, Green Accounting, Transit Oriented Development, 'Car-Free' City Design, New Urbanist Design, Organic City Processes, and Urban Villages. It suggests that there are many signs of hope in the emerging innovations. Mainstreaming however will require visionary planning, new manuals and training of professionals, and a deep commitment to democracy at the grass roots to overcome entrenched positions and institutions. The role of local government in these innovations is critical.

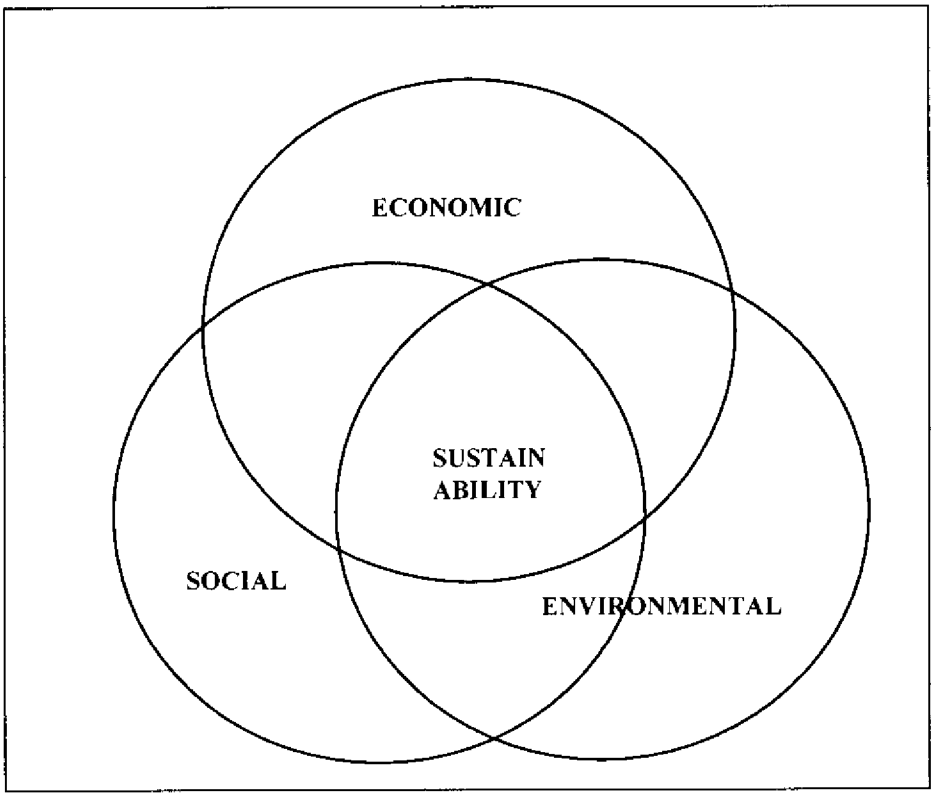
> "Developing a strategy for ecological change therefore may best be compared with planning a long journey. If the destination is far away and it is uncertain when we will get there, then it is wise to set off in the general direction and to make travelling meaningful and agreeable in itself. This implies creating steps that are self-motivating and choosing means that are meaningful and not just means to and end"
>
> Sybrand P Tjallingi (1996) "Ecological Conditions: strategies and structures in environmental planning" IBN Scientific Contributions 2, IBN - DLO Wageningen. p127.

Introduction

Sustainability is both a vision and a set of practical steps. The vision has been framed by a global political process that saw the need to bring environmental considerations into the mainstream of economic policy and social policy and practice.

The practical steps are the first outcomes which show that this vision can be done ie. that we don't have to "balance" environmental matters against economic development, or "trade off" environment for some social gain. Sustainability says the three areas are distinct but can be merged and it is this resulting "win-win-win" area of life which we must increasingly obtain in reality (Figure 1).

FIGURE 1: How sustainability merges environmental, economic and social parameters.



This conference is highlighting how sustainability is proceeding at the local level - the level at which all action must begin. The context for defining sustainability though is the global and we must always see that or we can easily slip into parochial national responses (as Australia is doing over Greenhouse) or parochial local responses that just want sustainability to mean 'no change' (Newman, 1995).

My paper will try to highlight the role of the local in doing "symbolic gestures" that start the sustainability process. This process can be looked at as a part of the innovation process. Any innovation requires demonstration. When they are tried out they are usually seen as "symbolic gestures" by those used to doing things the 'normal' way. But this is not just with green matters, it is a problem of all innovation; only some innovations make the transition to being mainstream. The 'mainstream' is seen to be when something is an accepted part of a culture. It is important to see why some innovations make it and others do not as the world needs sustainability to be mainstreamed. So an attempt will be made to draw out any key lessons which can help in mainstreaming these most critical innovations.

My major interests and expertise are in cities and it is here that my main case studies will be drawn. I will also use Scandinavian examples a lot, primarily because they seem to be doing such good work but also because I was able to visit recently to study them.

Urban Ecology and Sustainability

Ole Michael Jensen in a perceptive approach to local sustainability in Denmark made a distinction between urban ecology and environmental management/environmental planning. The former is a largely symbolic example of integrated ecological building with lots of innovation in the use of energy, materials, water, waste and natural setting. The latter is a more global application of an environmental task in all localities. Jensen says urban ecology is doing 'many little stories' as opposed to environmental management/planning doing 'major global ones'.

The distinction is useful in highlighting the need for the little stories but once established and illustrated the next stage must be to make them more mainstream and global. For much of the past decade these urban ecology 'symbolic gestures' have been appearing - now they must move on.

Below I am going to try and illustrate a few of the best urban ecology experiments that I know and see how close to becoming mainstream they are.

Ecological Urban Renewal: Kolding (Denmark)
Denmark is a world leader in urban ecology. Many examples of Danish urban ecology can be found from the book "A Guide to Urban Ecology in Copenhagen" by the Danish Town Planning Institute (Munkstrup and Lindberg, 1996). It contains 45 examples across the city and to be a part of the Guide the development needed to show most of the following characteristics:

- Better insulation than the building regulations require;
- Low-emissivity windows;
- Energy-efficient major appliances;
- Low-energy lighting in the common areas;
- Water-saving equipment in the dwellings;
- Rainwater recovery;
- Local percolation of rainwater;
- The opportunity to sort waste into more fractions than the three (paper, glass and other waste) required by law;
- Resident's gardens;
- Considered the existing natural features when the complex is constructed so that existing trees and lakes are preserved; and
- Car-free common areas that ensure pedestrians and cyclists can move around in the area safely."

There are obviously other characteristics which are found in particular developments. One of the most important areas of innovation is in Ecological Urban Renewal. This is perhaps the best contribution to urban sustainability as it shows how ecological considerations are being brought into the renewal of the inner city - a process which has many important social and economic benefits as well as reducing car dependence and thus helping with global and local sustainability issues to do with the car (discussed further below).
Perhaps the most spectacular of the Danish inner city urban ecology projects is in the regional town of Kolding. Here a run-down inner city block of some 145 apartments (in 5 storey traditional buildings) with an enclosed courtyard, was transformed by a process that not only renewed the houses but created a beautiful water recycling system based on a 'glass pyramid'. The waste water from the complex is first treated by a small scale primary and secondary waste treatment plant located underground, then the water which still contains some organic matter and most of its nutrients, is pumped to the glass pyramid using photovoltaic cells and a battery. Once in the pyramid, water passes into a series of ponds on the ground floor containing first algae, then plankton animals and finally a fish pond complete with aquatic plants that absorb much of the remaining material; water is then pumped to the top of the pyramid where it trickles down over trays containing 15,000 plants that when grown are sold to a local nursery. Inside the pyramid is like an exotic greenhouse.
The water then passes out to a small wetland before it is allowed to run down a cascade to form a small creek through the common gardens and a children's water playground. This water is mixed with rainwater collected from the roofs and stored in an underground cistern. After it has been aerated through the cascade and creek this water is used for toilets and washing machines in the buildings. Any excess water is percolated to the groundwater.
The complex also has solarised its buildings, has a solid waste recycling centre complete with a worm composting unit (that also takes sludge from the treatment process), and a community garden. The project was a partnership between the community and the local government whose engineers and planners are keen to make Kolding a global leader in city sustainability.
Such a powerful symbol of urban sustainability raises many questions about how it could be brought into the main stream of urban development. How ready are most city's populations to become involved in the management of water and wastewater, rather than just allowing them to be taken away in big pipes? Do you need to have each neighbourhood in a city doing this kind of urban ecology or are there better ways of sharing such tasks so that some areas are more urban and others take on more of the ecological servicing? How would the urban professionals manage if asked to provide such ecological processing within the city;

would they have the training to cope.

Green Accounting: Albertslund

The Municipality of Albertslund is in the middle suburbs of Copenhagen. In 1996 it won the European Sustainable Cities Award from ICLEI for its innovations which included an Agenda 21 Centre, various recycling activities and a highly significant innovation they called Green Accounting. Here the Municipality has provided each year since 1993 a set of green accounts for all of their 65 neighbourhoods consisting of the per household consumption of water, electricity, gas, heat, and the calculated CO2 from all energy. Some travel data is also provided.

Each neighbourhood then discusses the data in public meetings which are run by the Agenda 21 Centre. No legal or financial pressure is used by the Municipality, just moral pressure. The Agenda 21 Centre, manned by locals some of whom are paid by the Municipality and State, are critical to the community-based process assessing the accounts each year. Awareness of which neighbourhood is doing best motivates people to find out why and the people themselves come up with all kinds of suggestions as to how the resource and waste flows in their area could be reduced.

Each year since 1993 there has been a reduction in the energy and water use by almost all neighbourhoods, some have been quite sharp reductions.

The Green accounts are also done for all Municipality buildings and functions, and all industries with each of them being discussed internally. As well a list of all pesticides used in the borders of the Municipality is provided; no pesticides are used by the Municipality themselves.

Green Accounting is simultaneously addressing the global needs of sustainability and facilitating local urban ecology. Other local governments in Europe are now starting to copy this innovation from Albertsland so it is possible that this sustainability innovation will proceed rapidly to the mainstream. A few questions could be asked. What would be its application to areas where there is no similar civil society support (like the Agenda 21 Centre)? The emphasis on support and ideas from below means that political support would grow with its spread to other areas; but what if the idea were to be introduced into an economy where high consumption of energy or water was seen as necessary for their economy?

Transit Oriented Development: Stockholm

Transit Oriented Development is the approach that tries to bring an inherently different approach to cities than assuming car dependence. It builds the city around transit as its first priority (Bernick and Cervero, 1996). Such planning is often a goal for many cities but few have done it as well as Stockholm.

In our survey of Global Cities which is updating our 1980 data (Newman and Kenworthy, 1989), Stockholm, which is one of the richest cities in the world, turns out to be the only city to show an absolute decline in car use in the 80's. It reduced by 229 kms per capita. This was associated with a growth in transit from 302 to 348 trips per person.

In examining how Stockholm managed to make such an impressive step towards sustainability it is hard to go beyond its strong commitment to transit-oriented land use planning. The regulations which shape its planning favour development around rail stations in a dense, pedestrian-friendly form. But regulations do not always mean a city will have the kind of creativity which has been shown in Stockholm in recent years as they have shown the urban world how to do both reurbanisation and new suburb transit oriented development that has given their city its 'car-free' characteristics.

Our data on population between 1980 and 1990 show an increase in the density of the central city, the inner city and the outer suburbs. No other city in our sample has done that. Stockholm is setting the standard to follow on land use sustainability.

This they achieved by building urban villages around their rail system in the inner city (eg South Station) and in new outer suburbs (eg Skarpnak). These new developments are all dense, mixed use areas with a careful eye for the kind of design characteristics found in the old inner city of Stockholm. But most of all they are built around a quality rail service that links up the whole city. They have been popular as places to live and work and have some of the highest transit levels found in the world.

Cervero (1995) analysed the process that Stockholm has gone through in transforming itself from 'a pre-war monocentric city to a planned post war multicentred metropolis'. He found that there was not a high level of local self sufficiency in each of the subcentres but that the good rail and close land use pattern meant that people mostly used the rail system for their travel. Residents of the new subcentres along the rail lines were not as automobile dependent as those in UK New Towns which are more self sufficient (houses and jobs are more balanced); the UK New Towns like Milton Keynes (see below) have high car use because they are so low in density and dispersed in their land use. Promoting greater self sufficiency will be a necessary step at some stage (probably when fuel prices start to rise again) but Stockholm shows the importance of having a good transit system and planning around it as the basis for a city.

Stockholm has shown in the 80's that its good planning is enabling it to lead the world in sustainable urban development as it relates to reducing dependence on the automobile. Its next phase of development, called the Dennis Plan is designed to double the transit system with an orbital rail service and a downtown semi-rapid transit bus service. They are also building some further road infrastructure but it will all be heavily tolled and paid for out of that.

Stockholm is my most 'symbolic city' for 'car-free' physical planning, showing that a wealthy city can work well with reduced car dependence. Can it become mainstream across the world? It is not alone as similar cities like Singapore, Vancouver and Toronto have shown it is also feasible. But in most of the US and Australia, Transit Oriented Development policies remain very small, symbolic gestures. Part of the reason for the lack of action in such cities is that we say we are culturally unable to live any differently. The same things were said in Copenhagen which is studied below. However the major impediment is that urban professionals are very rarely trained to implement such policy, the TOD manuals are still very thin on the ground.

'Car-free' City Design: Copenhagen

'Car-free' city design is now firmly on the agenda (eg Car Free Cities Network, 1997). 'Car-free' does not mean banning cars, it means that an area has freedom over cars so that people can simply and easily choose other options. It is necessary for all parts of the sustainability agenda. The past 70 years of urban design have mostly been working out how to accommodate the car, or worse how to facilitate it, so to change this paradigm is not straight forward. There are however some good examples which can now be seen which help us to go from the symbolic to the mainstream on 'car-free' actions. These examples are documented in publications like the UN Global Review of Human Settlements (Newman,1996) and in Newman and Kenworthy (1997). 'Car-free' city design is mostly associated with older European cities, from which I have drawn my case study.

Copenhagen in 1996-8 is the focus of European activity on 'car-free' cities. This concept was initiated to try to manage the old medieval European cities which were being destroyed by cars. 'Car-free' city planning needs all the techniques of physical planning shown by Stockholm but Copenhagen shows much more of the importance of using innovative social planning in achieving its goals of managing the car.

Copenhagen was planned with a transit-oriented urban form ("finger plan" based on radial rail lines) like Stockholm however they were much less committed to physical planning than the Swedes. Thus by the 60's the physical plan alone was not enough as the car began taking over and urban sprawl was setting in. They needed to resist it; Professor Jan Gehl describes the process by which Copenhagen began to win back its 'car-free' city characteristics over the next 35 years:

"By the 60's American values had begun to catch on - separate isolated homes and everyone driving. The city was suffering so how could we reverse these patterns? We decided to make the public realm so attractive it would drag people back into the streets, whilst making it simultaneously difficult to go there by car" (Gehl, 1992).

Such a policy meant that Danes needed to become more urban and less suburban. There was an immediate outcry that such a policy was anti-Dane and was destined to failure. However the policy makers set out on their process of undermining car dependence with a small dose every year.

Each year Copenhagen reduced central area parking by 3%. Each year they pedestrianised more streets. Each year they built or refurbished city housing. Each year they introduced into the streets all kinds of attractive landscaping, sculptures, and seating (including 3000 seats along footpath cafes). And each year they introduced more buskers, markets and other street life and festivals that became more and more popular. As Jan Gehl said, "the city became like a good party".

The result has been not only a reduction in the traffic but growth in the vitality of the city area. Social and recreational activity has tripled in Copenhagen's major streets (Gehl and Gemsoe, 1996). And this despite pleas that:

"Denmark has never had a strong urban culture"
"Danes will never get out of their cars"
"Danes do not promenade like Italians".

But now they do. Danes are finding that the public realm of the city is so attractive that there is a declining market for single detached homes on the urban fringe - they are apparently "too far away" and "too private". hey are now building a light rail system in response to the increased demand for travel to the city and between its sub-centres which is being paid for entirely out of the land development opportunities it is creating.

Copenhagen is also one of the world's best bicycle cities. One third of the city goes to work on a bike. Like many European cities Copenhagen had a lot of bicycle use early this century but unlike other cities it has not removed bicycling as it modernised and became wealthy. Car usage grew and threatened the more humble bike but in the 60's, at the same time as the processes above were beginning to happen, Copenhagen decided to stay with its bikes.

The decision was reflected most of all in its rejection of a massive freeway system that had been drawn up for implementation as in most developed cities at that time. The public opposition was very strong and creative. Researcher Michael Varming, one of the original activists tells of campaigns where they tied hot air balloons to major buildings threatened by the road program and large colourful buoys were placed in a lake showing how much would be reclaimed for a motorway. Mass rallies of bicyclists demanded that the plans be scrapped. And they were.

In their place and at much reduced cost the city began to invest in cycleways and traffic management. Although they have only 300 kms of separated bikeways (much less than in Amsterdam and other Dutch cities) the city has created safety and priority for cyclists by much cheaper means - paint on the roads and a successful education program that generated a 'culture of respect for cyclists'. Thus at every intersection there are blue strips for cyclists to ride in, giving them priority against all turning vehicles.

The result is a city where cyclists have safe and easy access comparable to other modes. Traffic accident data show Copenhagen among the best in the world; this must have something to do with the 'culture of respect' generated for bikes but which extends to all other road users, especially pedestrians. The bike is now used by people of all backgrounds, ages and incomes.

The latest innovation in Copenhagen is the City Bike program where colourful bikes are provided free (after a deposit is placed in the bike-holder like an airport baggage trolley). These bikes are paid for by commercial advertising and are maintained by the City of Copenhagen with assistance from the Prison system who collect and repair damaged bikes overnight. It is hard to find a free bike from among the present 2,500 bikes which are available but as the originator of the scheme, city administrator Soren Jensen, says: 'When there are 10,000 bikes in a few years it will be a normal thing for anyone downtown to just jump on a City Bike to move around the inner city'.

There is of course a close link between the policies to reurbanise and revitalise the inner city of Copenhagen and the policies to not build major infrastructure for vehicle access and to favour alternative modes. This link shows that sustainability can be a meaningful policy as the city has done very well economically as well as having no growth in car use in the inner city for 20 years (Gehl and Gemsoe, 1996). This policy has been consistent with community interests and political parties of all persuasions during the past 35 year period.

Copenhagen has been subject to all the pressures for suburbanisation and car use. It has developed some car dependent areas and some that tend that way. But overall it has not allowed itself to be dominated by car-based thinking. For example the city engineer who has overseen the infrastructure priorities for the past 15 years, Jens Rorbech, in response to motorists who suggest that unless they get more parking or road access in the inner city they will go to the suburbs, he just replies: 'Please go, because the reduced traffic in the city will only make it a better environment and we will get even more investment and people coming to the city'.

This approach has worked for the old inner city of Copenhagen. There are many other European cities where it has also occurred so there is now no reason for 'car-free' policies not to become a mainstream process for any old city with 'car-free' characteristics inherently in its design. But the challenge now is to see whether it can be mainstreamed for the whole city and for any other city with car dependent characteristics. It is possible to achieve a lot as Copenhagen has shown there are some spin-offs between the 'car-free' policies of the old city and its surrounding suburbs; however there would need to be other physical planning innovations as well.

New Urbanism: Almere (Holland) and Kentlands (US)

The New Urbanism is one of the ways that sustainability is being brought into the urban planning and design agenda (Katz,1994, Calthorpe, 1993, Duany and Platter Zyberk, 1991). Its origin is mostly in the US though it builds on a lot of European work and it is in Europe that the best examples can be found. The New Urbanism incorporates the need for a good transit system and good walking environments but critical to both these qualities is the associated land use and design. It tries to find a coherent design style to guide each development and its goal is to bring more community qualities back into design. There is a long way for these developments to go and they are often criticised but the New Urbanism is rediscovering how planning and design can better incorporate less automobile dependent land use, particularly the layout of streets and the orientation of buildings to the street as well as density and mix.

Critical to all the designs is that not only are they dense and mixed to allow pedestrian activity and to be viable for transit, they are also rediscovering the virtues of narrow streets where people enjoy walking and where buildings are linked organically together. The cul de sac or the large undifferentiated open space between high rise, have little place in a New Urbanism design nor have they ever had much favour in European urban design (Gehl, 1987).

The two symbols of New Urbanism I have chosen to highlight are Almere in Holland and Kentlands in the US. They are presented to highlight the important qualities of compactness in the first example and street layout in the second. In both cases they are presented by comparing them to two other towns/suburbs which do not show their innovations.

Almere

New Urbanist designer Andre Duany says that Almere is the best piece of urban design for 70 years. It is a small town on the outskirts of Amsterdam which is built with inner city characteristics of narrow streets, mixed housing densities and strong pedestrian and bicycle facilities. The density is well above the norm for new development in most English speaking cities and it is high for recent European standards (though it has little high rise).

One of the key features of car dependent urban design over the past 70 years has been the use of very low densities with an inevitable need for large roads to tie everything together. One reason for low density building was the desire for individualised space but another reason was a fear of density. One part of the nineteenth century town planning movement (primarily in England) identified all the environmental and social ills of industrial cities as being associated with density. This movement was captured in the Town and Country Planning Association's slogan 'Nothing gained by overcrowding'. They thus put all their effort into designing new low density 'garden suburbs' and low density New Towns. What they created was car dependence and what they lost was the human scale as little remained accessible by walking.

Milton Keynes is typical of the English totally planned 'garden city' New Town with low density heavily zoned urban parts that are set in a sea of heavily watered, grassed open space. No-one ever seems to be visible in Milton Keynes, the carefully designed walkways and cycle paths are almost unused whilst the roads and car parks are full. Milton Keynes has been studied in comparison with Almere, typical of a European tradition of building at a density that enables walking and cycling to be the central function (Roberts, 1992). The data are compared in Table1.

	MILTON KEYNES	ALMERE
Modal Split		
Car	59%	35%
Public Transport	17%	17%
Bicycle	6% }	28%}
Walk	18% }24%	20%} 48%
Av. Travel Distance	7.2km	6.9km (much less for non-work)
%Trips <3km	45%	85%
Density	20dw/ha	35-40dw/ha
Form	'scattered', separated use.	'organic', mixed use.
Proportion who see a car as 'essential'	70%	50%
% Households with children under 12 years who are always supervised outside home	52%	16%
% who are never supervised outside home	8%	48%

Table 1. Comparison of Milton Keynes (UK) and Almere (Netherlands) in travel and land use characteristics. Both are small New Towns.
Source: Roberts (1991).

Both cities are claimed to be influenced by the Garden City tradition but only Almere has anything like the density recommended by Ebenezer Howard 100 years ago. The British Town Planning profession (after Howard) believed they could have a green city without the density needed for pedestrian qualities - they were wrong and the differences in Table1 show it quite clearly. The rather sad differences in the freedom of children are particularly marked. The 'nothing gained by overcrowding'/abhorrence of density tradition was exported to all Anglo Saxon cities by the Town Planning profession (King 1978). It has rarely been questioned even though the evidence for problems associated with density has been shown to be false many times (Newman and Hogan 1981). Now that the sustainability agenda is recognising the need for more compact cities, it is important to see that this damaging planning philosophy does not prevent new suburbs from being built like Almere and not Milton Keynes.
A similar new suburb/satellite subcentre in Europe is Skarpnak in Stockholm. These places now show that we can make new urban areas which are substantially 'car-free'. But they are still not main stream urban design, even in Europe. Car dependent new development is still the model and needs to be challenged everywhere by reference to these emerging new symbols. The question could again be asked: what is stopping this innovation from being more rapidly adopted? I find it hard to answer as these places have immediate appeal to me and they are obviously well appreciated by their occupants. Developers of such places say the market is there. I can only suggest it is the cultural baggage about density which continues to dominate professional praxis.

Kentlands
In the US the first new suburb to be built entirely dependent on the car was Levittown in Philadelphia. It soon became the model and it went from symbol to mainstream in a few decades. There are some new models now being built in the US which are trying to reverse this car dependence; one outlined below is Kentlands which is a New Urbanist development by Andres Duany.
Kentlands is on the outskirts of Washington DC and is not yet connected to the Metro (though there are plans). The development is about three times the usual suburban density and has a much wider range of housing types, including small houses on tiny slivers of land normally incorporated into adjoining blocks, thus giving immediate diversity. There are attempts to mix development of other landuses though not much of this is done. The style of the buildings is like inner city Washington and the market response has been very positive.

Perhaps the most innovative aspect of the development is how the road layout has been handled. Andres Duany describes many examples from all his new urbanist developments where he has had to watch carefully how traffic engineers design subdivisions and how he has had to intervene to see how his values could be expressed instead. These values are just common sense organic planning such as how to preserve trees on the site or how to make streets safer and more conducive to community life rather than being sewers for traffic.
One such case was when engineers were designing roads that crossed at right angles and one road was on a slope. In order to meet the Institute of Traffic Engineers regulation, the road must be flattened out sometime before the intersection. This meant considerable reshaping of the contours was needed and before it could be stopped the hill had virtually been obliterated, trees removed and drainage patterns altered thus threatening all the adjacent trees.
Most new residents wanted to know why more trees couldn't be saved and a more natural setting retained. Duany then discussed how a more organic approach, which respected the integrity of the area, could be done instead. Why not have just the intersection flat? It was tried and it worked.
The approach was extended all around the site, instead of designing the streets to enable easy access for cars, the streets were allowed to follow contours and the needs of the community. The result was a much more haphazard set of roads with more sharp turns and hills than if they had followed the rules. But it worked much better because the trees could all be saved, it was more natural looking, and traffic automatically went slower because the roads demanded more attention. In the standard subdivisions engineers were putting in speed bumps to slow down cars as the roads too easily induced speed!
Another example was with fire engine access. Roads seemed too wide when using the set regulations designed primarily for such service access. As a result, cars went too fast in residential streets and thus did not respect pedestrians. The sense of fear on the streets meant that parents would not allow children to walk, so they would drive them. Traffic breeds traffic. People asked (especially women) why do cars go so fast, couldn't the street be safer for pedestrians?
A narrower road was designed as standard and the fire service asked to come and try it out. They were able to fit and so a new more organic design was feasible where children felt safe in the streets. Now it is found that people walk much more in these areas and the degree of community interaction is greatly increased. The reduced space for roads means less land is lost, more viability for transit is created and basically a more 'car-free' area is created.
Almost every aspect of street design and parking can be challenged by these organic values and be shown to work better for the community and for the ecology of an area.
These New Urbanist experiments in the US are still a long way from being mainstream. As the proponents have found little problem with the market for their products or from civil society which is delighted to see people living in a greener, safer, more 'car-free' environment, the real problem is with government regulation and professional praxis. These still assume car dependence in their regulations and manuals. The New Urbanists are beginning to rewrite the manuals but the regulations seem very hard to change. Without challenging both there is little chance of producing more Kentlands and fewer Levittowns.

Organic City Processes: From Zurich to Indonesia
One of the key words in the sustainable city literature is 'organic'. It means that the inherent characteristics of an area are respected, especially those that allow its natural features and its pedestrian qualities to be expressed. On the other hand the 'modernist' tradition has been to obliterate such qualities in a futile quest for uniformity and speed. Authors such as Jane Jacobs (1961, 1984), Alexander (1979), Schneider (1979) and Hough (1984) have built on a long organic city tradition that goes back through the Garden City philosophers and others in the 19th century like William Morris and John Ruskin to the deep sources of our culture in Judao-Christian and Greek ideas about 'good cities' (see Newman, 1996).
The application of organic thinking to cities can be seen everywhere such as in the work of those eco city activists who are reclaiming creeks from urban drains (Register, 1987) or those urban activists seeking to protect neighbourhoods against the ravages of freeway planners and high rise 'urban renewal' (Engwicht, 1992, and Gratz,1989). All of these groups are joined by a common belief in the power and integrity of local communities to know best about their local neighbourhoods.

Many local organic case studies could have been chosen to illustrate this major concept guiding the urban sustainability movement. Most remain relatively small, dwarfed by the power of modernism to sweep all before it, though the successes are starting to mount up. Newcastle itself has its fair share of small victories on heritage and environmental matters which seemed to go against the odds. My own experiences in Fremantle have been documented elsewhere (Newman, 1991). I have chosen to highlight Zurich because it has been so successful overall and some Indonesian examples to show that the ideas have application in any city situation.

Zurich

Zurich in the 1980's has had a spectacular increase in its transit service and managed to contain its growth in car use. The changes in Zurich have occurred despite substantial growth in per capita incomes and against expected trends. How has Zurich managed to channel its wealth into such positive city-building processes rather than the city-destroying processes of dispersal, pollution and community disturbance associated with automobile dependence? The key is Zurich's commitment to grass roots decision-making which is now a way of life in each Canton.

In the 70's Zurich had to make decisions about their trams. Why not build an expensive underground Metro and leave the streets for cars? This would be the 'modern' trend and it would make the city faster both above and below ground. Instead of bowing to the car lobby the community demanded that they expand their old tram system and upgrade the services so its citizens never had to wait more than 6 minutes. Furthermore the citizens demanded that their trams and buses be given right-of-way at lights.

"Suddenly trams became popular in Zurich. We found it impossible to attack the use of the tram... People simply won't accept it", says planning consultant Willi Husler. As trams became fashionable, public attention was directed to other amenities - pedestrian malls and outdoor cafes, which were allowed to take up road space and parking lots. The strategy, says Husler, was "to point out other better possibilities of use. That way we can fight a guerrilla war against the car and win". As a result of just organically upgrading the transit system which they had, rather than moving to a wholesale modernist solution, the city became a model for how public transport can work. Now with more than 500 trips per capita per year Zurich has the best transit usage in all Europe and car trips per capita fell by 10% between 1980 and 1990.

Most people can see that the key to a city tackling its car problems is to provide something more appealing to its citizens than automobile-based decisions can provide. However the lesson from Zurich was that you have to listen to your citizens first.

Surabaya and Malang, Indonesia.

The threat to 'clean up' low cost housing in Third World cities and replace them with 'modernist' high rise tower blocks, is a common story. In Surabaya an innovative process was instigated by Professor Johan Selas who believed a far better process would be to upgrade the houses and their infrastructure in a way that respected the basic structure and community functions in the area. The resulting Kampung Improvement Program has been an outstanding success as it is cheaper, more environmentally attractive and does not fracture communities like relocation into tower blocks has done.

The laneway which goes through the developments has been kept so narrow that motor vehicles can only crawl down (thus allowing deliveries but not fast through-movement by cars). The small gardens have been preserved for growing herbs and vegetables and shared kitchens and laundries have been maintained.

In Indonesian cities, as in many third world cities, there is no real sewerage. Septic tanks take wastes for a short period before they enter groundwater, surface drains or rivers. Major studies by groups such as the World Bank, are suggesting the standard 'big-pipes' solutions. These become impossibly expensive to contemplate and very difficult to implement as the very dense cities would need to be severely disrupted to put in the pipes.

A research project in which we are involved is demonstrating a localised, organic solution. It is providing several Kampungs in Malang, a regional town, with small scale treatment plants that do not need big pipes for them to work. The 50 household scale means that pipes can be placed into the stormwater drains thus not disturbing the Kampung. Final effluent can pass through a banana tree garden. Furthermore the management structure is already firmly in place at this scale and so the system has some chance of succeeding on this cultural level as well. If successful a new approach to third world city water and waste management praxis will have been forged.

Such organic projects as these Kampung Improvement Programs and small-scale appropriate technologies are still largely symbolic throughout the developing world. Modernist solutions are still those with status and they are the ones attracting the big financing. How these symbolic projects can be given more status and acceptance is a challenge for all those involved in local sustainability. Meanwhile it is important to do more good demonstration projects as the time for alternatives can occur very suddenly.

Urban Villages or Isolated Self-Sufficiency: Australia's Choice.

There are many choices facing Australian cities in the present era of government cut-backs and attempts to down-play the sustainability agenda (especially any international dimensions). I want to highlight one key urban issue which has become central to resolving whether we can be a major player in urban sustainability: the conflict over urban villages.

Urban villages have been suggested by many people (including us, eg Newman, Kenworthy and Robinson, 1992) as the necessary option for how we ought to rebuild our cities. We even designed one for Newcastle (Newman and Dawkins, 1996). These urban villages are more compact areas where opportunities are created for pedestrian scale activities and shared open space, with less car dependence and more opportunities for transit. However, it does tend to mean less private space and hence some commentators have seen it as a threat to the Australian way of urban life.

This conflict is a genuine issue between ecologically-oriented people trying to see what sustainability means for cities. Troy (1996) insists that the best way to improve the environment and livability in cities is to ensure everyone has a large block for gardening, growing trees and doing the recreational activities they like. Thus for greening the city it is necessary to make it less dense, not more. We have found that there is a growing dichotomy between the two approaches. Thus we have tried to examine the basis for this conflict and to see how it can be resolved.

The big problem in not resolving these two conflicting views of reality is that it gives the impression to politicians and developers that the environment in cities is just a matter of personal taste. Thus "green speak" is being adopted by developers to produce "environmentally sensitive" hobby farms and other packaged land which is designed to be "self sufficient" but in reality is just unserviced suburbia. The city just sprawls further and car dependence deteriorates.

There are however two ways in which the alternatives can be resolved.

(a) Rural town development

Throughout inland Australia and the US (as well as in many other continents) there is a decline in rural population accompanied by land degradation due to large scale monocultural agriculture. In such areas it is possible to imagine small country towns and rural villages facilitating a permaculture-based subdivision of land based on the ideals of urban villages.

The Crystal Waters Permaculture Village in Queensland seems to be a model of how such a community can work to bring greater diversity of rural products and jobs, and a more rehabilitating approach to the land (Young and Lindegger, 1990; Lindegger and Tap, 1989)). Such a concept can not only help to make a more sustainable countryside but it can slow the growth of the city. We are strongly of the opinion that sustainability means that cities should become more urban and the countryside more rural (Newman, 1990).

Thus the essential nature of this approach is to be rural where it matters most. It cannot be acceptable if people are going to have a small rural hideaway with uncommitted permaculture and unmanaged animals while they either commute long distance to the city for work or just live there on weekends; this is not a sustainable alternative - it does not take seriously enough the rural or the urban. This will not provide the resolution that is required. It loses the essence of both rural and city sustainability.

Although the Crystal Waters development has been successful there has not been much else happening in Australia apart from places like Nimbin. Most country development has been isolated coastal development which has an even worse kind of impact on ecology and community than dispersed suburbia (see the 1996 State of the Environment Report on Australia). Ecological cluster village developments in coastal areas are being suggested in a few areas as an option to these unsustainable practices. Perhaps it is time for the Australian countryside to have more ecological urban village experiments so we can have some symbols to guide us outside our big cities.

(b) Urban development

The urban villages approach is absolutely necessary for our cities. They can provide the option which would give life to urban centres throughout a city. It is no longer necessary to have the CBD as the one focus of a city, it is possible to develop a multicentred city that is linked by rapid transit. Urban villages thus can become the basis for a new transit system and leave the majority of suburban homes untouched, but within a short distance of their urban village.

Within these urban villages or small centres there can be a dense array of diverse urban activity all within a walking-oriented environment. Many people would live in such highly urban settings and have no need for backyards - they are prepared to exchange the time and energy involved in food production, even food preparation and certainly waste management, for other urban services. Or they would choose to be part of a community approach to ecological processing rather than a purely household one. Such is the nature of cities which exist because of their diversity of opportunities.

If cities put their resources into building these urban villages as well as the public transport links between them, then the pressure to sprawl the city outwards would be severely reduced. These pockets of urban development would be deliberately planned as the places where density should increase.

At the same time there are parts of the city where it is possible and easy to reduce density in order to better accommodate ecological processes. In these areas the land could become more oriented to shared production, urban forestry and to waste disposal and recycling for the local urban region (as large scale sewerage systems with their big pipes-in/big pipes-out approach are phased out - see Newman and Mouritz, 1996).

These parts of the city would be therefore a contributor to the adjacent urban area in terms of environmental and agricultural services. In return people living in these areas would have access to urban services. Although less accessible than for those in the adjacent urban centres they would hopefully not have to be as car dependent as in present urban structures. This would depend a lot on the extent to which the community in the area was able to create a meaningful life for the people involved. No doubt bikes and telecommunications would help as well. But a good transit system in a city will not occur unless there are pockets of high density activity.

The key to the resolution of the alternatives is that the urban villages approach is allowed to be sufficiently urban. This is the most significant part of the process which needs to happen before a city can begin to be seen as sustainable. At present in Australian cities there is a great deal of reurbanisation occurring in the form of urban villages. The Better Cities program developed models for urban villages across Australia (see Newman, Kenworthy and Diver, 1996). The Victorian government is facilitating this further by defining a series of urban villages around tram and train stops which would mean no further need for green-fields development (Urban Villages Project, 1996, Loder and Bayley, 1993). In Sydney there are new urban villages being planned each week, some quite innovative like the St Mary's site and the Sydney Olympic Village (Greenpeace, 1997).

Despite this some academics and professionals have become extremely upset about any kind of density increases anywhere. As a result the planning professionals have not embraced the concept other than very vaguely and have retreated to see how the battle works out. And the rhetoric has been in full flood. For example Troy (1996 p167) in
'The Perils of Urban Consolidation':
"...the proponents of high density living and the kinds of urban lifestyle they yearn for, and which they claim results from it, simply express a variation of cultural cringe."

In other writing he describes urban villages as just 'the new feudalism' (Troy, 1992).

As well as opposing the concept on cultural grounds there is also a debate that such urban villages are counterproductive for ecological matters. Troy (1996) argues that

you need large residential blocks for doing ecological things like recycling which needs space for composting. This is a very limited view as it assumes that people can only do composting as an individual household task. Collections of buildings can have neighbourhood composting and can share in the tasks of managing it.
In my recent travels overseas looking at urban ecology projects, the pattern that emerged was that unless there was an 'intentional community' established on a rural or urban fringe area, there was very little happening in the way of urban ecology apart from in the inner city. Although the promise of urban ecology on the big block is there, the reality is much less. Urban ecology needs commitment and help from others. It needs a community approach to make it anything more than superficial. Community for activities like urban ecology, seems to grow out of organic urbanism which seems to require a level of pedestrian contact.
One example of Danish urban ecology that is not as flattering as the others I have outlined above, may serve as something of a symbol as to how the individualistic approach to urban ecology may end up. It is a development paid for by industry as a demonstration Eco House-of the future. This commitment from industry is very worthwhile and to be encouraged. The problem with the demonstration, called Villa Vision, is in its design values which we would say does not help make a sustainable city. The development is a symbol of sustainability the way that Disneyland is a symbol of a city.
Villa Vison is a high technology eco-house designed to be self sufficient in heating and electricity with minimal water consumption and waste recycling. It has solar cells, water taps which you program for the exact water required (one cup, two cups etc), light sensors that turn off lights if there is no movement in a room, sensors that move outside shades (like petals around a flower) whenever the sun is too strong or that open and close windows for programmed climate control. Its waste water system treats water through a root zone ecosystem.
Villa Vision was lived in by a family but it was judged by them as a failure in terms of livability; it is now an office. It is not a livable environment as its circular shape reflects all sound inwards and so it is disconcertingly noisy. It would be best for a single occupant. The small den used as the 'entertainment room' contains all the electronic forms of entertainment including CD stereo, TV and internet connected computer. Everything about the building suggests these would be well used. The design is not for a community setting. It is designed to sit in isolation and create an even greater opportunity for isolation. It is the ultimate in selfsufficiency.
Villa Vision is located today in the Danish Institute of Technology and is surrounded by nothing more than a large car park! It symbolises that urban ecology can be expressed as high tech with the goal of creating selfsufficiency more for an elitist 'green' market than any broader goals of sustainability. If you want to escape the city and not have to interact with anyone other than electronically, if you want to avoid any civic responsibility at all, even the need to participate in a local community's infrastructure, then Villa Vision is the answer.
The importance of Villa Vision is that it shows how all technology, even green technology is subject to a set of values. It is not enough to say that urban ecology as expressed by Villa Vision is as acceptable as the other developments described above. We need to have symbols of urban ecology set in community, not set in isolated selfsufficiency.
Australia is developing urban villages. They are serving as symbols of how suburbia can be rebuilt. What we need now are some more examples, like the Sydney Olympic Village, which are incorporating ecological processes into the urban village. The urban village designed for Newcastle on the Wickham site is an inner city transit-oriented site and its design did incorporate a range of ecological processes that could be conducted on adjacent open land. Perhaps Newcastle could set up the first integrated, ecological urban village in Australia. Although the urban village concept is well underway in our cities, there is a long way to go before we can mainstream this kind of ecological urban village as we are not really at the first step yet in this country. We are not alone though.

Conclusions
The symbols of urban sustainability that have been outlined in this paper from around the world, are all important demonstrations of what can be done. The list of examples I have presented could be multiplied many times over. The examples offer a strong sense of hope that we are beginning to know what we can do to make sustainability a reality in our

cities and towns. They however must be mainstreamed. As shown above, some of these have been more able to be mainstreamed than others.
The important characteristics of those that have begun to move in this direction can be briefly summarised:

- Mainstreaming requires plans and visions to be articulated that build the 'locally demonstrated' into a more city-wide concept,
- Mainstreaming requires manuals and re-training of urban professionals into urban sustainability procedures based on the symbols that have been found to work,
- Mainstreaming requires democratic processes to be taken seriously; the political forces opposing sustainability are generally not so interested in democracy at the grass roots, but more in maintaining the entrenched positions and institutions that are part of the problem. Organic solutions will be the great hope for taking the symbols we now can see into more substantial change.

All of these are issues which mostly involve local government and local civil society. Thus it is critical that at the local level we have a continuous flow of innovations in sustainability, both in symbolic gestures and in institutional responses that lead to mainstreaming. Otherwise the process cannot start and it cannot become an accepted part of our cultures.

References

Alexander, C.(1979) **The Timeless Way of Building**, New York: Oxford University Press.

Bernick D and Cervero R (1996) **Transit Villages**, McGraw Hill, San Francisco.

Car Free Cities Network (1997) Car Free Cities Conference, Copenhagen, March, 1996.

Calthorpe, P. (1993) **The Next American Metropolis: Ecology, community and the American Dream.** Princeton Architectural Press, New York.

Cervero, R (1995) Sustainable New Towns, **Cities** 12 (1): 41-51

Duany, A and Plater-Zybeck, (1991) **Towns and Town-Making Principles** Rizzoli, New York.

Engwicht D (1992) **Towards an Ecocity: Calming the Traffic**, Envirobook, Sydney

Gratz, R.B. (1989) **The Living City**, Simon & Schuster, New York.

Hough, M. (1984) **City Form and Natural Process.** Rutledge, London

Gehl J (1987) Life Between Buildings, Van Nostrand Reinhold, New York.

Gehl, J. (1992)The Challenge of Making a Human Quality in the City: In **Perth Beyond 2000: A Challenge for a City**, Proceedings of the City Challenge Conference, Perth, September.

Gehl J and Gemsoe L (1996) **Public Space and Public Life**, Ministry of Environment and City of Copenhagen, Copenhagen.

Greenpeace (1997) **Olympic Report**, Greenpeace, Sydney.

Jacobs, J. (1961) **The Death & Life of Great American Cities**, Vintage Press, New York.

Jacobs, J. (1984), **Cities and the Wealth of Nations: Principles of Economic Life**, Penguin, Harmondsworth, England.

Katz, P. (1994) **The New Urbanism**, McGraw-Hill, Inc, New York

King, A.D. (1978) "Exporting Planning: The Colonial and Neo Colonial Experience. **Urbanism, Past and Present** 5:12-22.

Lindegger M and Tap R (1989) **Conceptual Permaculture Report: Crystal Waters Permaculture Village**, Nambour: Nascimanere Pty Ltd.

Loder and Bayly (1993) **The Low Energy Suburb: Greenhouse Neighbourhood Project**, Technical Report, for Ministry of Planning, Melbourne.

Munkstrup N and Lindberg J (1996) **Urban Ecology Guide to Greater Copenhagen**, Danish Town Planning Institute, Copenhagen.

Newman, P.W.G. and Hogan, T.L.F., (1981) A review of urban density models: Towards a resolution of the conflict between populace and planner. **Human Ecology**, 9(3), 269-303.

Newman, P. and Kenworthy, J. (1989) **Cities and Automobile Dependence: An International Sourcebook.** Gower, England, September, (388pp).

Newman, P.W.G. (1990) "Social Organization for Ecological Sustainability: Towards Sustainable Human Settlements", Workshop for Centre for Resource and Environmental Studies, Australian National University, April.

Newman, P., Kenworthy, J. & Robinson, L. (1992) **Winning Back The Cities - A Choice Guide**. Australian Consumer's Association, Sydney, 2204, 49pp.

Newman, P.W.G. and Mouritz, M. (1994) "Principles and Planning Opportunities for Community Scale Water and Waste Management" proceedings of Seminar on 'Localised Treatment and Recycling of Domestic Wastewater', RADG, Environmental Science, Murdoch University, also published in **Desalination**.

Newman PWG (1995) 'Globalisation and Sustainability', in **Local Matters**, Phillimore J (Ed), Institute for Science and Technology Policy, Murdoch University, Perth.

Newman, P (1996) "Greening the City: The Ecological and Human Dimensions of the City Can Be Part of Town Planning", **Alternatives**, 22(2): 10-17

Newman et al (1996) 'Human Settlements', chapter in **Australian State of the Environment Report**, Department of Environment, Sport and Territories, Australian Government Publishing Service, Canberra.

Newman P, Kenworthy JR and Diver G (1996) **An evaluation of the environmental component of Better Cities**, ISTP, Murdoch University, Perth.

Newman, P.W.G. (1996) Transport Chapter in **An Urbanising World: United Nations Global Report on Human Settlements 1996**, Satterthwaite, D. (Ed.), United Nations Centre for Human Settlements, Oxford University Press, Oxford.

Newman, PWG and Dawkins JR (1996) **Wickham Urban Village**, City of Newcastle, Newcastle.

Newman PWG and Kenworthy JR (1997) **Sustainability and Cities**, Island Press, Washington, forthcoming.

Roberts, J. (1992) **Changed Travel - Better World? A Study of Travel Patterns in Milton Keynes and Almere**, TEST, London.

Schneider, K.R. (1979) **On the Nature of Cities: Towards Enduring & Creative Human Environments**, Jossey Bass, San Francisco.

Troy PN (1992) The new feudalism, **Urban Futures**, 2(2):36-44

Troy PN (1996) **The Perils of Urban Consolidation**, The Federation press, Sydney.

Urban Villages Project (1996) **Encouraging Sustainable Urban Form**, Energy Victoria, EPA, Department of Infrastructure, ERDC, Melbourne.

SESSION 18

Lecture X:

Urban Growth Management, Sustainability and Ecological Imperatives for the 21st Century

Prof. Spencer Havelick, University of Colorado Boulder, USA Transport

Great Cities for the 21st Century

Spenser W. Havlick,
Professor Environmental Design,
University of Colorado-Boulder
Boulder, CO 80306 USA
and
Visiting Professor,
ISTP, Murdoch University,
Perth, West Australia

The Twentieth Century has been a remarkable period of experimentation with many forms of urbanization. The industrial revolution created intolerable living conditions for many large cities in Asia, Europe and North America. Sir Ebenezar Howard fostered the idea of garden cities and greenbelts as an escape, or at least, an alternative to sooty and soiled cities like Manchester, Liverpool, Glascow and London. Somewhat later the new town idea caught the attention of planners in Scandinavia, France, Germany, Hong Kong, and the United States especially after World War II and the following years of housing shortages in bombed out or overcrowded city centers.

A second generation of new town - garden city development emerged mid-century with prototypes like Stevenage, Tapiola, Islamabad, Farsta, Vallingby, Reston (Va.), Columbia (Md.), and several experiments that were very car-oriented such as Canberra, Brasilia, and Milton Keynes. However, none of these human settlements demonstrate the spectrum of principles and ingredients which are needed for livability and sustainability for the next century. Cities in the Asian subcontinent, Pacific Rim and South Pacific may possess the resources, political creativity and the flexibility to retrofit, or build new cities that perform better than any we have known in the present, or recent past. For example, Tokyo and Hong Kong have been world leaders in urban mass transit innovations.

Lessons from the failed or badly functioning cities of North America, Africa, and South America need to be heeded. Mistakes of urban planning and suburbanization need to be avoided. The crime, pollution, congestion, corruption and inefficiency known to exist today in what were once great metropolitan centers need not be a foregone conclusion or destiny of future urban development. The commonly recognized collapse or malfunction of Mexico City, Cairo, Los Angeles, Rio de Janeiro, New York, Calcutta, Miami, Bombay, Detroit, Sao Paulo, Nairobi, Athens, Taipei or Bangkok (to list a few) does not need to happen in the 21st Century.

The problems known to the cities listed above and to hundreds of others that suffer from excessive air and water pollution, traffic congestion, inadequate housing and other unspeakable conditions are not the result of poverty alone. Rather, the deteriorated conditions of these towns and cities are often the result of a laissez-faire philosophy applied to the health and functions of a city. So-called free market forces do not redress the social injustices or the toxic wastes. Urban planning, if it is to be even partly successful, must intervene and redirect public attention, resources, and political sensitivity in at least six categories. Some of the categories, or concepts, have been a cornerstone for the construction of livable cities. Seldom have all of them been tried in combination with each other. That may be a challenge for the new as well as the renovated urban centers of the Asian-Pacific megalopolis of the 21st Century.

Here are six concepts which tend to produce human settlements of livability, vitality and efficiency. <u>A great city should establish:</u>

1. **A carrying capacity with its geographically defined urban service boundary and maximum growth limit.** The rate, direction and type of urban development are specified in advance, not created ad hoc. The rate at which the city is permitted to grow (i.e. 1 or 2% per annum) provides greater social and economic stability. City leaders and citizens need to know their city limits or limiting factors of resources, i.e. air, water, solid waste disposal, etc. and design management practices to live within prescribed limits. A realistic city master plan is required with professional staff to implement it and elected officials who can set public policy to enforce the long term plan and vision of sustainability.

2. **An action strategy which will provide for safe, affordable housing, education, health facilities and other necessary social services for all members of the community.** Too often factories and industrial estates or commercial developments are built first, long before flats or other housing. Private capital is invested where quick profits can be made with little thought, or an occasional ad hoc after thought given to the supply of safe, economic housing and other human services. Without the rate of growth under control (as suggested in Concept 1) new industrial estates produce a rapid burst of new jobs and floods of low paid workers and their families are relegated to favelas, squatter settlements, shanty towns or other slum conditions. Real estate transfer fees, development impact taxes, environmental impact charges, subsidized co-housing and modest income housing are proven techniques which help provide the infrastructure and housing affordability that enable employees and their families to live in decent conditions near employment, schools and other social infrastructure. New development and growth must be asked to pay their own way. The private developer is assured fewer delays when impact fees are paid up front as a prerequisite to obtaining a building permit approval.

3. **Mechanisms which will absorb the shock of economic, political, and social unrest.** The renovated and new cities of the next century, especially in Southeast Asia and the South Pacific need to invent methods of citizen participation in the planning process. The new communities need to have rich diversity in their economic base. Monocultures do not survive in nature without being supported and upheld by chemical fertilizers, heavy dosages of pesticides and usually transported water supplies.
Cities that become sustainable provide a wide diversity of opportunities for a wide spectrum of people, including diverse jobs, social opportunities, and tolerance for differences. Pride in a city grows when the rich fabric of human diversity is present, active, and participatory in the political process.

4. **Strong regulations and incentives to avoid the loss of life and property from natural disasters.** Natural hazards pose an often-overlooked opportunity to make a growing city safer through enlightened land use zoning, disaster warning, and post disaster response. Natural hazard mitigation is one of the least costly methods for saving lives, preventing massive and widespread human suffering, and property loss. Disaster avoidance is one of the best examples of avoiding political disgrace or even political suicide. Catastrophic natural disasters come infrequently. But with expansive urbanization, slum settlements and helter skelter development, urban land which is hazard prone or high risk too often becomes built out. The return period of large devastating disasters such as flood, earthquake, cyclone (typhoon), volcanic eruption, and tsunami is infrequent. Developers and even city planners tend to forget or discount the severity of the next major natural disaster. As cities sprawl and occupy "marginal" land such as flood plain, steep slopes, and coastal zones, the loss of life will escalate not because the flood or typhoon or lava flow or earthquake is of greater magnitude or intensity than its predecessors, but rather because the city -- without proper

restrictive zoning – has spilled over on to very high risk landscape. Structural measures to combat the cataclysmic events tend to be cruel and costly band-aid treatments which give false hope or false security to citizens.

Flood plain management and riparian high hazard zone restrictions do work well with a growth management philosophy. Aesthetic, wildlife, water recharge and urban shaping are also values which complement sustainable practices especially along stream, estuary and river corridors of any city. Consider the cities around the world which have converted derelict waterfronts and riverfronts into (lower risk) parks, reserves, and aesthetic amenities. Examples include London (Victoria Embankment), Paris, Vancouver B.C., Copenhagen, Portland (the Williamette Waterfront), Chicago, Boston, Baltimore, Toronto, and Hong Kong. When nature needs to use the riverside parkland as a natural discharge for excess flood water she can do so at a minimum loss to life and limb. The United Nations Disaster Relief Organization (UNDRO) and the International Decade of Disaster Reduction are working diligently to reduce future unnecessary natural disaster losses in the future.

5. **Strategies which will provide all citizens, young and old, with mobility or affordable movement and access to the necessary functions of a city.** Currently in car-oriented, or car-dependent cities more than two thirds of the citizenry are commonly denied convenient access to employment, recreation, shopping, religious practice and other destinations. In most large cities it is very dangerous, and sometimes impossible, to be a "carefree" pedestrian. A great city should protect, cherish, and provide safe mobility via a variety of transportation alternatives to all individuals. The car has consumed land and made once human-oriented city centers chaotic with its destructive power, speed, noise, toxic wastes and hidden costs.

The single occupancy car (SOC) is neither affordable nor available to more than about 30 percent of the urban population. The SOC is not an option for people from age one to sixteen or seventeen who lack ability to drive or a driver's license. Frail, senior and handicapped citizens are typically eliminated. Economic constraints, fear of road rage, or a desire to travel more lightly eliminate others from the SOC useage. Thus a hierarchy of priority needs to be established which gives the majority of non-SOC users high status. Bicyclists and public transport users should be also given preference over the car in city centers where human interaction and movement is highly valued. Singapore is a good example of where SOC use has been discouraged by an "entrance fee". Chained or multiple non-car modes should also be favored in the design, pricing, and maintenance of transportation options. The car may serve important hinterland or remote area access needs but it is now seen as a primary cause for pollution, congestion, crime, stress and other wasteful resource practices within urban areas. The SOC needs to be radically calmed or whenever possible, totally eliminated.

Great cities for livability have demonstrated the success of bicycle paths, improved pedestrian infrastructure, light and heavy rail, buses, telecommuting, car pooling, and hybrids of the above. The key to long-term success is to make the multi-modal transportation systems available, and easy to use by all.

6. **An educational foundation for city dwellers of all ages and all walks of life to enable them to understand and practice an environmental ethic of stewardship.** The ecological imperatives which once were understood more than 5000 years ago have become unclear among most urbanites. As nomads and pastoralists long ago we moved from one temporary settlement to another. The move was determined, in large measure, by available food and water, or due to adverse seasonal weather changes.

As villages became permanent and towns grew into cities we lost the understanding of the mandatory relationship of resources sustaining a population. Today no town or even moderate sized city can support its population with the sole resources in its immediate environs. We are all interconnected, interdependent in one global village. We are all passengers on this big blue ball spinning in this galaxy without much of a clue about what it means to live in harmony and in balance with the resources needed to sustain the world's population. Most of us live primarily in 280 cities or metropolitan areas each of which has a population in excess of several MILLION residents.

The great and truly desirable cities in the Asian-Pacific Region and elsewhere will have a citizenry who has internalized an ecological ethic and a global stewardship which favors renewable resources over finite or depletable resources. Energy use will be an excellent indicator of economic and environmental sustainability. Solar, tidal, wind and energy efficiency through energy demand management will be trademarks of a new urban lifestyle and business ethic. Economies of scale will still be useful but environmental benefits must clearly outweigh environmental costs.

Potable water, arable land, clean air, absence of toxic and solid wastes due to resource renewal and recycling will become commonplace. A rubbish bin, a landfill, a solid waste dump will be known as practices of a century long ago. Family planning and population stabilization will be a key to a resource-rich destiny.

Part of the environmental I.Q. that is needed can be provided by retrained teachers and enlightened agency personnel. Instead of a government bureaucracy called the Environmental Protection Agency (E.P.A.) there needs to be an infusion of ecological responsibility and raised environmental consciousness which pervades urban society. The quality of healthy ecosystems needs to be synonymous with the quality of profitable business. The homemaker, the business executive, the computer software designer, in fact people young and old, need to possess a full understanding of life cycle costing, of demand management for water as well as traffic. The general population, for example, should know where potable water comes from, where it goes after use, and what is needed to purify it. Terms such as eutrophication, tertiary waste water treatment, aquatic succession, integrated pest management, activated sludge or biosolid application should become commonly understood household terms. In short, the precious urban commodity of potable water and its full cycle from local source to ultimate treatment and reuse should be common knowledge. Only can a citizenry enlightened to this level make informed decisions at the ballot box when money is needed to maintain safety, health and ecological vitality. Where no democracy exists, the politicians in office need to recognize and live by ecological imperatives in order to ensure long term sustainability.

The transition from the current unstable, unsustainable, problem-ridden city can best be made when the options or alternatives for an improved urban life are well known, and are proven to be workable. Prototype cities where growth management is practiced are emerging. Instead of building the highest tower or skyscraper, heights can be controlled and tailored to human scale. Real boundaries of a city and its carrying capacity can be defined by citizens or a benevolent despot. Food production close to home should be encouraged. Employment and residence are growing closer to each other. Car ownership is neither a necessity nor a symbol of status.

Mixed use developments, or microtowns within the larger city, are becoming a desired direction in the new prototype of sustainability. People treasure diversity in the natural habitat as well as in the built urban environment. People also value mobility that is NOT dependent on a car in their neighborhoods.

Of the six concepts listed above, growth management is the most controversial, and so it deserves some elaboration. Establishing an urban growth management plan based on a carrying capacity or long term sustainability has formidable political hurdles. In some cities, the idea of slowing the rate of growth, even for objectives of fiscal responsibility and environmental protection, may not be acceptable even though it will be necessary. That is the heart of a critical political dilemma. The widespread myth is that a city must grow or it will die. Curtailing growth to keep a town or city healthy is often seen as political suicide for the proponents. Therefore, I should say at this point that managing or controlling the extent and rate of growth may not be appropriate for every city or metropolitan area. However, there may be specific communities and cities in the Asian-Pacific arena that have found, or might find selected growth management tools useful.

A case study of a small (100,000 population) North American city is presented here. Boulder, Colorado is located 35 km. northwest of Denver, Colorado, USA. The city is situated exactly where the vast North American prairies meet the sharp sedimentary and metamorphic uplift of the Rocky Mountains which rise to 4200 meters just beyond the city limits of Boulder.

Forty years ago Boulder, Colorado was a sleepy, pleasant town with a state university, several federal research laboratories and a mix of small manufacturing, publishing, and service sector activities. Its popularity grew rapidly as a town that was set in an idyllic location with good schools, low crime and excellent employment opportunities. It became a magnet for individuals, employers, students, and professional people who were seeking a manageable, healthy community with superlative access to skiing, backpacking, camping, fishing, bicycling and other life style amenities. The city became a center of cultural resources, visual and performing arts with a lively pedestrian central business district.

It is not surprising then that annual population growth reached levels of four, five, and six percent in the 1960's and 1970's. Citizen concern escalated about sprawl and an erosion of public services such as schools, police, and fire protection. People who had come to Boulder from blighted, large cities recognized that immense pressures were being placed on the infrastructure, on the natural habitat, and on the simple tranquillity that attracted them to Boulder. There were signs that this little bit of "paradise" was becoming sullied by rapid expansion of the population. The container of the city defined by the urban service boundary was becoming filled. The carrying capacity of available land, a pure airshed, and available water purification and waste water treatment facilities was being reached, or in some cases, exceeded.

The important point to emphasize is that the recognition of the problems of excessive, rapid growth in Boulder, Colorado, was made by citizens of the city, not by state or federal agencies. It was through citizen initiatives and the mobilization of public opinion that growth regulation tools were implemented. The effectiveness of the various measures is debated frequently, but none have been repealed over the several decades of growth control. In fact, in the last five years more stringent provisions have been added to reduce the rate, and also require new growth to pay a larger percentage of its cost. What follows is a partial list of growth management regulations arranged in approximate chronological order from 1958 to 1998.

- Open Space Designation and Open Space salestax (Citizens voted to tax themselves in order to purchase $150 million (US) of greenbelt or open space land over 50 years.)
- A Blue Line established along the 2000 meter contour on the mountain backdrop of the city above which no development could occur without approval vote of the electorate. This also permits gravity feed of water supply only below that imaginary line.
- Height Ordinance -- no construction above 13 meters in order to preserve views.
- Urban service boundary delineated -- no water, sewer, or other services beyond this limit. This is part of a Comprehensive Plan which is reviewed by four local citizen bodies every five years.

- Establishment of county parks and mountain reserves – no development permitted in natural areas. Future development is locked out.
- Two percent per annum residential growth limit -- building permits restricted but with bonuses for affordable housing, center city infill, etc.
- Solar Access Ordinance to prevent new development from creating "solar fences". Other bonuses for building permits that promise water and energy efficiency.
- Strong historic preservation districts -- landmarking of noteworthy structures and neighborhoods to prevent demolition.
- Accelerated Greenbelt Acquisition Program -- money allocated to speed land purchases which have development potential (0.4 cent sales tax on every dollar purchase).
- Natural Hazard Land Use Zoning -- prevents development in areas of potential subsidence, slope failure, high winds.
- Strong Floodplain zoning to prevent all construction of buildings in all riparian high risk zones. Riverside land reserved for city-wide commuter bike network.
- Fifty per cent open land requirement of industrialized sites. Companies are also compelled to pay substantial property taxes to discourage new growth and offset some new growth costs.
- Development Impact fees on all new development to help pay for new growth—x dollars/square meter for library, schools, fire, police, recreation, social services, etc.
- Tap fees to connect utilities of new development. Monopoly utilities pay city franchise fees for electricity, cable, TV, etc.
- Regulations to slow down and control commercial and industrial development in order to "dovetail" with residential growth controls. Currently more jobs exist than housing units within the city because growth controls were not placed on commercial developments until 1994.
- Required environmental impact statements for all major private development and all public projects. Social impact assessment is also required.
- Wetland legislation to prevent or restrict development in fragile or sensitive aquatic habitat. 2:1 replacement is required.
- Density Transfer Regulations which transfer rural building permits to within urban service boundaries.
- Sales Tax Reallocation and Sharing with neighbor cities to discourage sprawl and commercial duplication.
- Aggressive programs to calm traffic, reduce car use, and provide alternative modes.
- Policy to widen no more roadways, build no more parking structures and divert up to 20% funding away from car infrastructure and move it to public transit, bikeways, other alternative modes including tele access.
- Change growth control rate from 2% per year down to 1% per year for both residential and commercial/industrial properties. A target is established to have no more than 98,000 - 103,000 as build-out population limit.
- Rezone or "downzone" commercially zoned land to residential use with 55 percent of future housing stock to be for low and modest income workers and families. (In 1997 3500 properties were rezoned to reduce job generation.)
- Through an integrated planning process, establish guidelines for long-term environmental and economic sustainability.
- Nurture neighborhood organizations which, in turn, favor mixed land uses, cohousing, increased density, reduced car use and pedestrian amenities.
- Develop schemes to recycle buildings, provide business incubators and favor local, home-grown business instead of bringing in new business. Small firms are favored over national chains.

- In an election in November 1997, voters approved another (US) $147 million to purchase open space through the year 2018 thus securing a total of 36,000 acres.

The net result of most of these measures is an ironic one. More and more businesses and people want to come to Boulder—in spite of the growth control restrictions.

Perhaps there is an expectation that the boom and bust cycle has been eliminated. There is enough confidence in the business climate that Wal-Mart and other "big-box" retail stores have been turned away by the City Council. The environmental quality index still attracts new growth to the county where land costs are lower than in Boulder city limits. Providing enough affordable housing for low and medium income workers continues to be a serious problem. What most people believe is that if the measures listed above had not been put in place, Boulder, Colorado, would have been totally swallowed up in the sprawl of Denver and become part of the crime-ridden, polluted, congested, urban "waste land" which has become common in other U.S. cities like Phoenix, Los Angeles, Dallas-Ft. Worth, Atlanta, Detroit, and the Megalopolis stretching from Boston to Washington D.C.

In conclusion, nations generally north of the Equator have much to learn from their Sisters and Brothers in the Southern Hemisphere. Asian-Pacific cities could lead the direction toward more livable urban environments in the decades ahead. Implementing the concepts listed here with the necessary and appropriate modifications required by specific cities will help us move into the next century with new pride and hope. One goal is to create urban forms or human settlements which create a better and healthier life for our great grandchildren.

We need to nurture and manage the human and natural resources in a way that gives one full opportunity and joy living in our great cities of the 21st Century. The challenge is formidable. Not to try, or to fall short, spells chaos for the remarkable experimental cities we live in today.

(BIBLIOGRAPHY)

Dr. Havlick's e-mail address in the USA is <spenser.havlick@colorado.edu> or <havlicks@ci.boulder.co.us>.

SESSION 19

Training:

Design and discussion of regional/national training programs

Dr. C. H. Strohmann

Design of Regional/National Training Programmes on Adopting, Applying and Operating ESTs: Group Work on Generic Training Programme Design

Dr. Christian Holger Strohmann
Programme Coordinator, UNEP-IETC

SESSION INFORMATION

The main objective of this session is to encourage and to enable participants to initiate and to design regional/national follow-up training events back in their home countries. The session will guide through critical phases of training design and implementation, such as training needs analysis, curriculum development and programme design, as well as evaluation of and follow-up on a training event. Based on a common case, participants will be assigned in small groups to develop a training intervention on strengthening national capacities for adopting, applying and operating Environmentally Sound Technologies (ESTs).

LECTURE NOTES

1. SESSION GOALS
   - Identify steps and tasks which are involved in the design of a training programme.
   - Discuss possible problems associated with the design of training programmes.
   - Apply training programme design to the national/regional context of participants.
   - How to obtain funding.

2. TOPICS TO BE DISCUSSED

2.1 TRAINING NEEDS ANALYSIS AND ASSESSMENT
   - Identify the problem.
   - Can training help?
   - Focusing the problem.
   - Determine realistic goals which match training programme objectives.

   How to Determine Training Needs
   - Questionnaire
   - Interviews
   - Group problem analysis
   - Testing
   - Reports

2.2 INSTITUTIONAL FRAMEWORKS
   - Who are the stakeholders?
     - Finance Institutions
     - Government
     - Technology Developers and Providers

- Public Institutions (Multilaterals and Non-Governmental Organizations)

- How do you involve them?
  - Invite to attend meetings
  - Identify mandates
  - Educate

- How do you integrate them into a training programme?
  - Steering Committees
  - Recognize Need
  - Recognization Incentives
  - Mandatory

2.3 CURRICULUM DEVELOPMENT AND PROGRAMME DESIGN

- Design programme around objectives.
- Establish methods of presenting and communicating. (see overview)
- Who will conduct training?
- What institutions will be involved?
- Consider all logistical and administrative concerns.

2.4 EVALUATION OF TRAINING PROGRAMME

- Reaction: How well did the participants like the training programme?
- Learning: What was learned?
- Behavior: What changes in behavior occurred (value systems)?
- Results: What were the tangible results?

2.5 FOLLOW UP

- What are the ultimate results that you seek from the training programme?
- How can the training programme help institutionalize the subjects (topics) in the participants organizations?
- Does the training programme strengthen capacity building?

2.6 SUMMARY

- To accomplish a national ESTs adopting, applying and operating training programme, multiple sectors must be engaged in a manner in which their contributions are complementary, not redundant or conflicting.
- Training in adopting, applying and operating ESTs must be based on participants needs so that they acquire the knowledge, ability, and motivation to accomplish the goals that emerge from the training session.
- The ideal way to operate a national training programme is to first conduct a training of trainers programme in which a cadre of professionals acquires the skills to lead discussions and programmes at the regional/local level. A TOT program requires a disciplined approach to helping people know how to communicate information, generate discussions, and involve people in applying what they have learned. These skills cannot be assumed, and indeed they must be learned through training, practice, and feedback.
- At a very basic level, the purpose of training is to provide participants with information. However, at a more sophisticated level, participants work on building a

set of skills in a certain area. The third level that trainers try to focus on is changing attitudes, which demands much interactivity in the course in order to provoke critical thinking.

SLIDES

1. Trainer's Tool Kit (see attached copy)
2. A Learning Experience (see attached copy)

HANDOUTS

1. The Jamino Case Study (see attached copy)
2. Group Assignment (see attached copy)

Trainer's Tool Kit

Visual aids

Question and answer

Discussion

Demonstration

Simulation

The case method

Critical incidents

Role-playing

Instrumentation

Brainstorming

Nominal group technique

Force-field analysis

Action planning

A Learning Experience

WEAK

Words/Graphics

Auditory

Still/Motion Picture

Exhibits

Field Trips

Demonstrations

Simulations

Direct Experience

STRONG

Jamino Case

Scenario:

Jamino is a city of 1.5 million inhabitants located on a primary source river in a medium-sized developing country. There are two large industrial centres in the city where quite a few high-output industries are located. In the past, many foreign investors stayed away from Jamino because it appeared unstable. But now the government is encouraging ventures with outside interests. Accordingly, there has been a great amount of growth in industry and population in the last five years which made it difficult for the local government to control.

Recently, a local NGO has brought attention to the fact that there is an increased rate of asthma and respiratory problems among the children living near the industrial zones and close to open waste dump sites in Jamino. Some of the citizens now plan to protest the development of new industrial enterprises. They feel that there are not enough solid waste and wastewater treatment facilities to manage the current situation, and they see no valid plan to control future waste.

The Ministry of Environment is responsible for enforcing the regulation of waste management as they were implemented two years ago. Already overburdened with projects, the Ministry of Environment has indicated that they feel that adopting, applying and operating Environmentally Sound Technologies in both industrial production and municipal waste management are very important. But the ministerial bureaucrats have also confessed that they do not have trained staff to attend to the problem, and also neither staff nor budgets to provide training are available.

In the meantime, plans are underway for the development of an industrial park in Jamino. The Ministry of Commerce is responsible for establishing this project. The undertaking has sought permits from the Ministry of Environment which again reiterated the need for qualified adoption, application and operation of environmentally friendly technologies to ensure that the park is indeed cost-effective and has no negative effect on the environment. Ministry of Commerce officials, however, have expressed that they do not feel such training is their responsibility. At this point, plans are proceeding for building the industrial park and to re-organize the municipal solid waste management system, but there has been no movement so far on designing and implementing training in adopting, applying and operating ESTs.

NGOs would like to have the municipal government to perform organized selection and investment decisions for utilizing ESTs, but the government does not have enough qualified personnel. At the university, there are some people who are competent to chose appropriate technologies, to apply those to local conditions and to advise on day to day operations. The academics, however, have ongoing commitments and their budget does not provide for conducting outside training. Also the private sector has several qualified folks, but the government cannot afford to pay the rates charged for their management training. The government also feels that private industries should not be solely responsible for the training. This situation seems to be occurring in a few other smaller cities around the country, and various institutions have commented that there is a need for a national training programme on adopting, applying and operating Environmentally Sound Technologies.

Assignment:

Let s assume that the situation described in the case study is occurring in your country. You are part of an independent consultant group that has the assignment to determine if an EST adopting, applying, operating training is warranted, and if so by whom and how it will be delivered. You are to consider the following as you respond to the assignment;

Part One Assessment/Institutional Framework

What would be the goals of this national training programme?
Who needs to be trained? Why do these people need to be trained?
What institution s role is it to conduct the training?
What are the groups within the country that have an interest in the outcome of the training, and would provide financial support?

Part Two Curriculum Development and Programme Design

What will be the content of the training courses?
What logistical arrangements would you make to ensure that the courses took place smoothly and met the needs of the participants?

Part Three Evaluation

What criteria would you use to determine the effectiveness of the course for the participants?
How well do these criteria meet the needs of the stakeholders from whom you seek support to conduct the courses?

Part Four Follow-Up

How would the trainees apply course concepts to their job responsibilities?
What will each of the institutions responsibilities be for supporting the conclusions for the adopting, applying, operating ESTs process?
What kinds of problems do you think you might face in implementing this type of training and what solutions would you recommend to address these problems?

Training Programme: South Asia (SAARC)

High Lights

1. Sri Lanka
2. Maldives
3. Bangladesh
4. Nepal
5. Bhutan
6. India

1. Venue:	Colombo/Sri Lanka New Delhi/Bombay/India		
	Duration	10 days	1 Holiday 1 Outback field visit
2. Organizer/sponsors:	UNEP WHO Host Government Ministry of UD Ministry of MNES Other		
3. Number of participants:	30 Experts: 5 from each country		
4. Training method:	Lectures/Demonstration/Group discussion/Tutorial		
5. Purse/Budget:	US$ 39,000		
6. Field visits:	6 field visits Aqral tai or Candy		

1. Title and Objective

Title: Workshop on Adopting, Applying and Operating Environmentally Sound Technologies for Waste Water and Solid Waste Management for SARC Region (Sub region)

Objective: Capacity building for adopting application applying and operating ESTs for waste water and solid waste management for sustainable development

(a) To identify existing ESTs being used in the SARC region and their sustainability for replication in the SARC region

(b) Promote indigenous ESTs being used in the region

(c) Possibilities of technology transfer through exchange of information

2. Target group

1. Administrator
2. Technocrats
3. Planners
4. Public representatives
5. NGO's

Number of participants: from each country of SARC region
Total: 30

3. Venue of workshop

(1) Colombo/Sri Lanka
(2) New Delhi/Bombay/India
  - i) Availability of facilities, hotel, technique
  - ii) Logistic support
  - iii) Available technology options

4. Organizers/sponsors

UNEP/Host Government/WHO/Ministry of UD/Ministry of MNES

supported by- (1) Industrial houses
(2) Other UN agencies
(3) Companies in the field of waste solid and sanitation sector

Duration of workshop 10 days

Budget

Airfare	18,000
Basic living	15,000
Incidental	5,000
Local travel	2,000
Total	40,000

i) Total cost for 10 days workshop per participants.
(To and from air travel, basic living expenses incidentals)
@ Rp.40,000/Head. (ie US$ 1,000)
Rp.1,200,000 for 30 participants

ii) Cost of Venue,
Secretarial/Stationary/refreshment/tea
Rp. 220,000.00

During the workshop	1,420,000.00	
	142,000.00	....10(%)
	Rp.1,562,000.00	
	(US$39,000.00)	

Programme

Day 1 (Wed) (1) Inauguration/registration
(2) Keynote address
(3) Country presentation on waste water management from all the countries
(4) Over view of country presentations by experts/resource persons

Day 2 (Thur) (1) Case studies one from each country of ESTs
(2) Lectures from experts
(3) Presentation by industry promoting EST
(4) Field visits to waste water treatment plants

Day 3 (Fri) (1) Two presentation by industry
(2) Lecture by experts (Two no)
(3) Field visit

Day 4 (Sat) Outstation field visit to show pollution control methods being adopted in heritage city (Accra) or Candy in Sri Lanka

Day 5 (Sun) Holiday

Day 6 (Mon) (1) Country presentations by seven countries on solid waste management practices
(2) Over view of country presentations by experts/resource persons
(3) Field visit (Local)

Day 7 (Tue) (1) Case study presentations from countries (At least, case study)
(2) Lecture for expert
(3) Presentation by industry
(4) Field visit

Day 8 (Wed) (1) Country presentation on SWM from side countries
Over view of country presentation by experts
(2) Presentation by industry
Field visit

Day 9 (Thur) Case study presentation from six countries lecture from expert 2 NO
- Lecture from industry field visit

Day 10 (Fri) (1) Need for follow up activities discussion among participants and experts/resource persons/action plan
(2) Closing session
(i) Distribution of certificates
(ii) Closing remarks by UNEP/host country/other countries

Follow up activities

Interaction between various agencies and modalities of cooperation would be worked out.

Training Programme: South East Asia

Training Course on Domestic Waste Management Technology for South East Asian Region

Introduction

Major problem
- Management of domestic waste (solid & liquid)
- Limited knowledge on appropriate technologies for waste management
- Technical know-how on the design, operation and maintenance of facilities

Solution to problem
- Acquire knowledge through seminar/workshop, networking

Basis for design of training program
- People/organizers are aware the environmental condition
- Availability of staff with technical background.

1. Objective

General objective

To upgrade knowledge, skill and altitude on domestic waste management technology of the participants.

Specific objective
- To explain the principle of domestic waste management technology
- To identify the ESTs for domestic waste management technology
- To know the design criteria for domestic waste management technology

2. Target of participants

- LGUs: City engineer project management officers
- GO: Project implementor
- Univ.: Researcher

3. Venue

Bangkok, Thailand

4. Organizer/sponsor

- UNEP
- Ministry of Source, Technology and Environment, Thailand
- South East Asia region

5. Duration

15 days

Programme of activities

Tittle/activity (1)	Performance standard (2)	Time (3)	Methodology (4)	Resource person (5)
Day 1 - Registration billeting - Opening programme - Listening of expectant. - Overview of the course - Socials	Formally open the course Getting to know each other	1 hr 1 hr	Dialogue	Thai staff/UNEP UNEP/Thai ministry Facilitator or UNEP organization.
Day 2 Module I Regional Domestic Waste Management SEA situation - Problems - Program/plan - Available knowledge	- Discuss the problems and issues affecting domestic waste management in the region - Identified programmes plans including the technologies being implemented.		Lecture the audiovisual presentation	IETC Universities
Day 3 Module II Environmental Sound Technologies - Australian - Japanese - European - American - Indigenous	Explain the difference ESTs.		Lecture/discussion case study audio visual demonstration	Private Companies
Day 4 - Field visit	Observe different domestic waste treatment project	1 day	Observation	Training staff / CEO / plant management

- Report preparation	Compare the different treatment project		Criticizing	Participants and staff
Day 5 - Presentation and report				Participants
Day 6 Module III - Planning and designing - Domestic waste planning process	Discuss the difference procedure and steps in domestic waste management plan		Lecture/dialogue audio visual	University implementor
Day 7-12 Planning and designing preparation	Prepare a plan for ESTs adoption, application and operation		Group working	By country
Day 13-14 Presentation of plan and design Preparation for follow up activities	Present country EST plan Identify activities to ensure program sustainability	4 countries /day 3 hours	Oral presentation visual aids Group work	Participants Participants and staff
Day 15 Wrap-up program evaluation Closing program	The program process and mechanics			

Budgetary require

1. Traveling expenses
2. Supply materials
3. Miscellaneous
   - Accommodation
   - Allowance
   - Lecture's fee
   - Rental
     - Venue
     - Buses/equipments

Total US$120,000

Follow up activities

1. Submission of plan and design for country
2. Implementation of the plan
3. Monitoring and evaluation

Training Programme: Pacific

South Pacific: Sub Regional Workshop for Adopting, Operating & Applying of EST for Urban Management

Objectives:
- Identify environmental problems in urban centres of pacific island states.
- To produce and publicize new EST to pacific island countries
- Assess appropriateness of ESTs in island environments
- Discuss and establish an information system/network for pacific islands on ESTs (where necessary)

Trainees:
- Government agencies with interest in urban management
- NGOs
- Municipalities

Total 18 countries reps.

Venue:
Fiji (Suva)

Organizers:
USP/Fiji Government/SPREP/UNEP-IETC

Duration:
5 days

Budget:
will be dictated by the number of participants
number of resource people needed
and local administrative expenses
Total: US$105,000

Programme:
- Introduction: ESTs for sustainable development
- Situation in countries (Presentation of country reports)
- ESTs
- Discussion with funding agencies
- Networks (Group discussion)
- Field trips
- Assessments (Group discussion)
- Evaluation
- Computer sessions on software

Follow-up:
Each country will have national workshops

Training Programme: China, Korea

Sub-regional Workshop of Cooperation of Environmental Sound Technologies in Eastern Asia

1. Objective:

To introduce and exchange about municipal sewage concentrated treatment and separate residential household water treatment technologies

2. Trainers:

The workshop will provide the opportunity to bring together scientists, engineers and professionals from government departments, international aid agencies, private institutions and university organizations. We expect 25 delegates to participate in the workshop.

3. Venue of the workshop:

The workshop will be hold at the National Institute of Environmental Research (NIER) situated in the central city of Seoul. NIER is well equipped with facilities for workshop.

4. Organizers/sponsors of the workshop:

NIER is the official organizer of the workshop. It will prepare and provide conference rooms, exhibition places, accommodation, catering and transportation. The workshop will be sponsored by the Korean Ministry of Environment, the Seoul Metropolitan Government and Samsung Company.

5. Budget and financial resources:

From:	The Korea Ministry of Environment	
Budget:	Transports:	US$ 5,000
	Accommodation:	US$ 2,500
	Office fare:	US$ 2,000
	Others:	US$ 1,000
	Total:	US$10,500

6. Duration:

From 10th Oct. to 15th Oct. 1998

7. Program:

The first day (10th Oct.)
- Registration
- Welcome address
- Key person address
- Technological presentation
- Field visit to wastewater treatment plant

The second day (11th Oct.)
- Delegation reports
- Technological presentation
- Field visit to air pollutant control equipment

The third day (12th Oct.)
- Introduction of new EST
- Group discussion
- Report from the groups
- Field visit to solid waste disposal

The forth day (13th Oct.)
- Introduction of new EST
- Group discussion
- Reports from the groups
- Field visit to National Environmental Monitor Centre

The fifth day (14th Oct.)
- Design and discussion of further cooperation programs
- Evaluations of the workshop
- End address

8. Follow-up activities to the workshop:

- Establish a committee to strength the sub-regional cooperation
- Building a publication to report the dynamic information
- Using the internet to exchange the technologies
- Hold the similar workshop once a year
- Exchange the visiting scientists and experts frequently
- Hold the local ESL workshop step by step

SESSION 20

End of workshop evaluations, completing questionnaires and discussions

Dr. C. H. Strohmann

Session Information

All participants received an evaluation form for the workshop evaluation questionnaire at the end of the workshop (see ANNEX 5).

This resulted in a set of information that have been analyzed both in a quantitative and qualitative way (see ANNEX 4).

Annex 1: Workshop Announcement

1.30 pm ***Session 11***
Solid Waste Management Technologies, Assoc. Prof. Goen Ho, Murdoch University.
3.00 pm Coffee break

3.30 pm ***Session 12***
Field visit to landfill site, Collection of Methane by Atlas Co.

Thursday, 11 December

9.00 am ***Session 13***
Technology presentation on solid waste, organised by Murdoch University in collaboration with EMIAA.
10.30 am Coffee break
11.00 am ***Session 14***
Solid Waste Management. Technology presentation International, organised by IETC.
12.30 pm Lunch
1.30 pm ***Session 15***
Permaculture - a design approach for Sustainable Urban Agriculture. Martin Anda, Murdoch University.
3.00 pm Coffee break
3.30 pm ***Session 16***
Field Visit to permaculture sites at Murdoch University

Friday, 12 December

9.00 am ***Session 17***
Global issues on urban transport, Prof. Peter Newman, Murdoch University.
10.30 am Coffee break
11.00 am ***Session 18***
Urban Village - A Sustainable Living Practice, Dr. Jeff Kenworthy, Murdoch University.
12.30 Lunch
1.30 pm ***Session 19***
Introduction to Design of Regional/National Training Programmes on Adopting, Applying and Operating ESTs, Dr. C. H. Strohmann.
3.00 pm Coffee break
3.30 pm ***Session 19 (continued)***
Design and discussion of Regional/National Training Programmes, Dr. C. H. Strohmann.

Saturday, 13 December

10.00 am ***Session 20***
End of Workshop evaluation, completing questionnaires and discussion, Dr. C. H. Strohmann.

12.30 pm ***Session 21***
Farewell Lunch
Concluding address: Assoc. Prof. Goen Ho and Dr. C.H. Strohmann
Presentation of Certificates of Attendance

FELLOWSHIPS

Fellowships will be awarded by the international programme committee.
Each fellowship includes:

- Non-reroutable, economy air return tickets from the closest International airport to Perth, Western Australia and return, sent as PTA to successful candidates.
- Accommodation in single study bedroom with private WC, shower, coffee making facilities and refrigerator, as well as telephone.
- Health insurance.
- Registration and tuition fees.
- Alowance of A$35/day to cover all basic living expenses during the workshop, including transport from the airport to the hotel and back.
- All lunches and morning and afternoon refreshments during worshop.
- Transport from hotel to the workshop and to field trips will be provided on specific times.
- Conference dinner and BBQ.

AWARD

Participants successfully completing the Workshop will be awarded a UNEP IETC/Murdoch University ***Certificate of Attendance.***

For further information please contact:
Mr. John Whitelaw, Director
UNEP - IETC
2-110 Ryokuchi Koen
Tsurumi-Ku, OSAKA 538
JAPAN

ph: **+81 6 915 4580/81**
fax: **+81 6 915 0304**
email: ietc@unep.or.jp

UNITED NATIONS
ENVIRONMENT PROGRAMME (UNEP)
INTERNATIONAL ENVIRONMENTAL TECHNOLOGY CENTRE (IETC)

UNEP

Regional Workshop for Asia/Pacific

on

ADOPTING, APPLYING AND OPERATING ENVIRONMENTALLY SOUND TECHNOLOGIES FOR URBAN MANAGEMENT

3 - 13 December 1997

organised in collaboration with

Institute for Environmental Science
Murdoch University
Western Australia

RATIONALE

The heavy concentrations of populations in cities, together with an increase in economic activities, directly contribute to the severity of such environmental problems such as deteriorating air and water quality, waste generation, and slums. These can affect the life and health of people and their economic activities, not only locally but also regionally since the zone of impact often extends far beyond political boundaries.

In addition, where there is a lack of social infrastructure and/or managerial capacity among municipal officials, the trends in environmental degradation can be exacerbated. To reverse these trends, sustainable development principles can be promoted through, among other activities, the transfer of technologies enabling environmentally sound management of these centres of urban populations.

OBJECTIVES

Participants are expected to understand the importance of environmentally sound technologies (ESTs) in achieving sustainable management of cities. The workshop will create awareness and develop skils on how to identify and select ESTs. Moreover, knowledge will be extended in accessing sources of information on ESTs and in designing local training programmes on adopting and tranferring eco-friendly technologies.

TARGET GROUPS

- Managers and decision-makers in the fields of environmental protection, planning, management and economic development in ministries, local/ municipal governments and the business sector;
- Local Government officials (elected and appointed) who need pertinent professional experience in water resources management, waste management, town planning and the various other sectors of environmental management;
- Senior representatives of regional and national environmental training institutions.

LANGUAGE

The course will be conducted in the English language. Therefore, a good command of English is a prerequisite for admission.

VENUE

The conference will be held at Murdoch University situated 20 kilometres west of Perth International Airport. There will be accommodation available at Murdoch University hostel. International standard accommodation is available in Perth and Fremantle, both of which are within easy commuting distance of the University. A set of recommended hotels will be published in the conference brochure with special rates for participants. All lunches, dinner and refreshments will be provided at the University Campus.

PROGRAMME

3 - 6 December 1997
International Conference on Environmental Technologies for Wastewater Management, including technical tour. The programme for this Conference is published separately. Workshop participants are encouraged to attend the Conference.

Sunday, 7 December

4.00 pm Registration
6.00 pm BBQ
8.30 pm Bus to hotels

Monday, 8 December

9.00 am ***Session 1***
Welcome: Assoc. Prof. Goen Ho from Murdoch University
Introduction: UNEP / IETC
Technology Choice and Sustainable Development: Dr. Kuruvilla Mathew and Martin Anda, Murdoch University.

10.30 am Coffee break

11.00 am ***Session 2***
Introduction to Practical ESTs for Sustainable Development of Freshwater Resources, Masahiro Yoshioka, ILEC/IETC.

12.30 pm Lunch

1.30 pm ***Session 3***
Environmental Technologies for Treatment and Maintenance of Water Supply Systems. Assoc. Prof. Goen Ho and Dr. Kuruvilla Mathew, Murdoch University.

3.00 pm Coffee break

3.30 pm ***Session 4***
Field Trip: Water Treatment plant at Jandakot, Water Corporation of Western Australia.

5.30 pm Bus back to hotels.

Tuesday, 9 December

9.00 am ***Session 5***
Water Treatment. Technology presentation Australia, organised by Murdoch University in collaboration with EMIAA.

10.30 am Coffee break

11.00 am ***Session 6***
Water Treatment and Maintenance. Technology presentation International, organised by IETC.

12.30 pm Lunch

1.30 pm ***Session 7***
Liquid Waste Management and Technologies. Assoc. Prof. Goen Ho, Dr. Kuruvilla Mathew and Martin Anda, Murdoch University.

3.00 pm Coffee break

3.30 pm ***Session 8***
Field Visit to on-site wastewater treatment and disposal. Coordinated by Murdoch University.

Wednesday, 10 December

9.00 am***Session 9***
Needs and Conditions of Technology Transfer Including case presentations: Prof. Nobuya Miwa, Osaka Gakuin University.

10.30 am Coffee break

11.00 am ***Session 10***
Needs and conditions of technology transfer (continutation).

12.30 pm Lunch

Annex 2: Program

Program

Monday, 8 December

8.15 am	Bus start from Citywaters Lodge, Perth
9.00 am	*Session 1* Welcome: Assoc. Prof. Goen Ho from Murdoch University Introduction: Dr C.H. Strohmann UNEP IETC *Sustainable Development and Technology Choice:* Dr. Kuruvilla Mathew and Martin Anda, from Murdoch University.
10.30 am	Coffee break
11.00 am	*Session 2* *An Introduction to Practical ESTs for Sustainable Development of Freshwater Resources* by Masahiro Yoshioka, from ILEC/IETC
12.30 pm	Lunch
1.30 pm	*Session 3* Report from Delegates: Mr. S. Pak, Cambodia, Mr. E. Ratukalou, Fiji, Mr. C. D. Serra, French Polynesia, Mr. S.K.P. Parekh, India, Mr. Yang Zhenqiang, The Peoples' Republic of China, Dr Doris Tenoria, Philippines. *Sustainable Water Technologies* Dr. Kuruvilla Mathew, Murdoch University.
3.00 pm	Coffee break
3.30 pm	*Session 4* Field Trip: Chemistry Centre (WA), 125 Hay Street, Perth.
5.30 pm	Bus back to hotels.

Tuesday, 9 December

8.15 am	Bus starts from Citywaters Lodge, Perth
9.00 am	*Session 5* Industry presentations 1. Process and Pollution Control 2. Biomax Pty Ltd 3. Environmental Solutions International
10.30 am	Coffee break
11.00 am	*Session 6* Reports from Delegates: Mr. B.B. Uppal, India, Ms Pema, Bhutan, Mr. K.M. Hussan, Maldives, Mr. Tun Than Tun, Myanmar, Mr. R. Shrestha, Nepal, Ms Sereana Kubuabola, Fiji. *Permaculture – A Sustainable Urban Agriculture*: Martin Anda.

12.30 pm	Lunch
1.30 pm	*Session 7* Field Visit Permaculture landscape at the Environmental Technology Centre (ETC) on campus. Martin Anda
3.00 pm	Coffee break
3.30 pm	*Session 8:* Field Visit Demonstration and discussion of technologies at the ETC: Stewart Dallas, Centre Manager: Renewable Energy, Climate Sensible Design Les Longwood, Recycled Paper Manufacture Dr Harrie Hofstede, Composting Systems Dan Boulton, Vermiculture Derek Hobbs: Low Energy Building Construction
5.30 pm	Bus back to hotels.

Wednesday, 10 December

8.15 am	Bus starts from Citywaters Lodge.
9.00 am	*Session 9* *Needs and Conditions of Technology Transfer including Case presentations* Prof. Nobuya Miwa, Osaka Gakuin University.
10.30 am	Coffee break
11.00 am	*Session 10* *Needs and conditions of Technology Transfer (Continuation)/ Presentation of UNEP IETC's Technology Information System:* C.H. Strohmann.
12.30 pm	Lunch
1.30 pm	*Session 11:* Reports from Delegates: Ms A. Siapno, Philippines, Mr. Soo-Hyun Shin, Republic of Korea, Mr. Jayasekara Jayasekar, Sri Lanka, Mr. Sukree Coompanthu, Thailand, Mr. H. K. Hingorani, India, Mr. Roy Enyatsang, Botswana. *Solid Waste Management - Technologies Options:* Assoc. Prof. Goen Ho.
3.00 pm	Coffee break
3.30 pm	*Session 12* Field visit to land fill gas site
5.30 pm	Bus to hotels

Thursday, 11 December

8.15 am	Bus starts from Citywaters Lodge
9.00 am	*Session 13* *Applying Lifecycle Assessment to Waste Management in Asia* Dr. Kanji Tamamushi, Procter & Gamble Far East, Inc.
10.30 am	Coffee break

11.00 am	*Session 14*
	Sustainable Development and the German Ordinance: A Case Study
	Dr. Gerhard Fahrbach, DER GRUNE PUNKT - Society for System Technology
12.30 pm	Lunch
1.30 pm	*Session 15:*
	Report from Delegates:
	Mr. Xiangyang Fang, The Peoples' Republic of China,
	Ms Injira Nyomtoon, Thailand,
	Mr. Paula Fokikovi Taufa, Tonga,
	Mr. Laavasa Malua, Western Samoa,
	Mr. Ervin Beat, Philippines,
	Mr. A I Al-Toub, Saudia Arabia.
	Industry Presentations:
	1. Western Wastewater Treatments Pty Ltd
	2. Ecomax Waste Management Systems Pty Ltd
	3. BSD Consultants
3.00 pm	Coffee break
3.30 pm	*Session 16:*
	Report from Delegates:
	Mr. I.M. Tamrakar, Nepal,
	Mr. A.A. Rahim, Bangladesh,
	Ms Suree Ummaralikit, Thailand,
	Mr. Trinison Tari, Vanuatu,
	Mr. Qingci He, People's Republic of China,
	Ms Laksni Sedyowati, Indonesia.
	Field Visit to on-site wastewater treatment and disposal.
5.30 pm	Bus to hotels.

Friday, 12 December

8.15 am	Bus starts from Citywaters Lodge
9.00 am	*Session 17*
	From Symbolic Gesture to the Main Stream
	-Next Steps in Local Sustainability
	Prof. Peter Newman, Murdoch University.
10.30 am	Coffee break
11.00 am	*Session 18*
	Urban Growth Management, Sustainability and Ecological Imperatives for the 21st Century
	Prof. Spencer Havelick, University of Colorado, USA.
12.30 pm	Lunch
1.30 pm	*Session 19*
	Introduction to Design of regional/national Training Programmes on Adopting Applying and Operating ESTS:
	Dr. C. H. Strohmann.
3.00 pm	Coffee break
3.30 pm	*Session 19* (continued)
	Design and discussion of regional/national training programmes:
	Dr. C. H. Strohmann.
5.00 pm	Bus to hotels.

Saturday, 13 December

8.15 am	Bus starts from Citywaters Lodge
10.00 am	*Session 20*
	End of workshop evaluations, completing questionnaires and discussions:
	Dr. C. H. Strohmann.
11.00 am	Coffee break
11.30 am	*Session 21*
	Evaluation - Feedback - Future Direction:
	Chair Dr. C. H. Strohmann.
12.30 pm	*Session 22*
	Lunch
	Concluding address Assoc. Prof. Goen Ho and Dr Christian Strohmann
	Presentation of Award of Certificates
1.30 pm	Bus to Hotels

Annex 3: List of Delegates

	Surname	First Name	Title	Organization	Address	City,/Region	Country	Phone/Fax
Mr	Rahim	Asm Abdur	Assistant Chief	Government of Bangladesh Block-14, Room 34	Planning Commission Sher-E-Bangla	Nagar, Dhaka	BANGLADES H	P: 880-2-9118203 F : 880-2-831939
Mr	Enyatsen	Roy		Botswana Technology Centre	P/Bag 0082, Faborone,		BOTSWANA	P : 267-31-4161 F : 374-677
Ms	Pema	Lhaden	Thrompen City Manager	City Corporation	Post Box -215, Thimphu		BHUTAN	P: 00-975-2-23665 F: 00-975-2-24315
Mr	Pak	Sukharavu t	Chief Office	Pollution Control Department Ministry of Environment	#48 Samdech Preah Sihanouk Tonle Bassac	Chamkarmon, Phen Penh	CAMBODIA	P : 855-23-42-7844 F : 855-23-42-7844
Mrs	Kubuabola	Sereana	Director	Institue for Natural Resources			FIJI	
Mr	Ralukalou	Eroni	Assistant Director, Engineering Services	Suva City Council	PO Box 176	Suva	FIJI	P : 679-313433 F : 679-302158
Mr	Serra	Claude Dennis	Environmental Inspector	Delegation for Environment Government of French Polynesia	BP 4562	Papeele, Tahiti	FRENCH POLYNESIA	P : 689-432409 F : 682-419252
Mr	Parekh	Shri Kanlilal Piafhudas	Executive Engineer (Environment)	MCGM Bandra Outfall Site, B. Block	Off Krishna Chandar Marg Gandra	Bandra (West) Mumbai - 400 050	INDIA	F : 91-22-6411338 /6402532
Mr	Uppal	Bharat Bhushan	Deputy Adviser (Training)	Central Public Health & Environmental Engineering Organisation (CPHEEO)	Ministry of Urban Affairs & Employment New Delhi, 110011	Nirman Bhavan	INDIA	P : 91-11-301-6419 F : 91-11-301-4459
Mr	Hingorani	Harish Kumar	Executive Engineer (Training)	Academy of Administration BHOPAL/Public Health	Engineering Department Government of Madhya - Pradesh	Hitkarni Nagar 1100 Qlrs Arera Colony Bhops 462 016	INDIA	P : 91-755-56-5237 ext. 212 F : 91-755-564241/553379
Mr	Hussan	Foroq Mohamed	Director	Maldives Water and Sanitation Authority (MWSA) H. Silver Mead	Majeedeemagu	Male'	MALDIVES	P : 960-31-7568 F : 960-31-7569
Mr	Than Tun	Tun	Head of Department	Yangon City Development Committee City Hall, 420/450	Maha-Bandoola St	Yangon	MYANMAR	P : 951-283219 F : 951-289705
Mr	Shrestha	Roshan	Environmentalist & Advisor to Mayor	Kathmandu Metropolitan City PO Box 8416	Kalimati	Kathmandu	NEPAL	P : 977-1-277574 F : 977-1-277576
Mr	Tamrakar	Ishwar Man	Regional Director	Department of Water Supply & Sewerage His Majesty's Government of Nepal	Panipokhari Maharajgunj	Kathmandu	NEPAL	P : 977-1-413744/428879 F : 977-1-419802
Mr	Zhenqiang	Yang	Project Director/Senior Engineer	China Inte'l Training Centre for Sustainable Development (CITCSD) No 109 Wanquanhue Road	Haidian District	Beijing 100080	THE PEOPLES' REPUBLIC OF CHINA	P : 86-10-6256-8146 F : 86-10-6258-8139
Mr	He	Qingei	Senior Project Officer	Sustainable Wuhan Project Office		13 Tianmendun Wuhan	THE PEOPLES' REPUBLIC OF CHINA	P : 86-27-5800956 F : 86-27-5800965
Mr	Fang	Xiangyang	Project Official	Shenyang Environment Protection Bureau	No 254 Zhenyang St	Shen He District	THE PEOPLES' REPUBLIC OF	P : 86-24-4844985 F : 86-24-4846929

							CHINA	
Ms	Siapno	Adeluisa		Regional Technical Director	DENR-Region 6	Iloilo City	PHILIPPINES	F : 63-33-3350002
Dr	Tenorio	Doris	Senior Scientist	Dept. of Science and Technology			PHILIPPINES	
Mr	Bael	Ervin		Planning Officer IV	City Planning & Development Office	Diplog City	PHILIPPINES	P : 63-65-212-2481 F : 63-65-212-4234
Mr	Shin	Soo-Hyun	Deputy Director	Technology Policy Division Ministry of Environment	1 Choonyang-dong Kwancheon City	Kyonggi-do	REPUBLIC OF KOREA	P : 94-1-872259 F : 82-2-504-9280
Mr	Jayasekar	Jayasekara Mudiyanse l	Deputy Director General (P & O)	Urban Development Authority	7th Floor Sethsiripaya	Battaramulla	SRI LANKA	P : 94-1-872259 F : 94-1-872260
Mr	Al-Toub	Abdulaziz Ibraheem	Engineer/Chief	Gizan Regoin Municipality			SAUDI ARABIA	telefax -+(966) 73225606
Mr	Coompanthu	Sukree	Deputy Governor	National Housing Authority 905 Nvamintra Road	Klongchan, Bangkapi	Bangkok 1024D	THAILAND	P : 662-375-5888 F : 662--375-7203
Ms	Niyomtoon	Injira	Subdivision Chief	Environmental Health Division	Department of Health	Bangkok Metropolitan Administration	THAILAND	P : 662-248-5742 /5743 F : 662-640-9982/245-9387
Ms	Ummaralikit	Suree	Environmental Officer	Chief of Urban Environmental Policy & Planning Office of Environmental Policy and Planning	Ministry o f Science, Technology & Environment 60/1 Soi Phibun	Wattana 7 Rama VI Road, Phyathai Bangkok 10400	THAILAND	P : 662-272-3051 F : 662-270-1758 /271-3226
Mr	Taula	Paula Fokikov	Terrestrial Conservation Officer	Land and Environmental Planning Unit Ministry of Lands, Survey & Natural Resources	PO Box 5	Nuku'Alofa	TONGA	P : 676-23-611 ext. 19 F : 676-23-216
Mr	Tari	Trinison	Environmental Education & Information Officer	Environment Unit Vanuatu Government	PMB 063	Port Vila	VANUATU	P : 678-25302 F : 678-23565
Mr	Malua	Laavasa	Senior Environment Planning Officer	Department of Lands & Environment Government of Samoa	PO Private Bag	Apla	WESTERN SAMOA	P : 685-23800 /24481 F : 685-2355
Miss	Ir Laksni	Sedyowati		Fakultas Teknik Universitas, Merdeka Malang				P : 62-341-560836 F : 62-314-560836

ANNEX 4: Summary of End-of-Workshop Evaluation

IETC has developed a clear and concise capacity building strategy focusing on design and implementation of pilot programs with regional and sub-regional scope which contribute, through awareness raising on Environmentally Sound Technologies (ESTs), to improved environmental management practices of urban areas and freshwater resources. These training projects also recognize the emphasis given by Agenda 21 to capacity building in developing and transition-economy countries to utilize resources in a sustainable manner. Professional target groups for IETC's post-graduate interventions are decision-makers in central/local governments, civil-society and industry, academia, NGOs and senior trainers of environmental training centers.

IETC training programme in adoption, application and operation of Environmentally Sound Technologies (ESTs), as one of the core programmes based on IETC's training strategy, has been developed as a pilot version in collaboration with the Murdoch University, Australia. The corresponding global pilot workshop was held 8-13 December 1997 in Murdoch jointly organized and sponsored by IETC and Murdoch University.

The training objectives towards the participants were as follows:

- Have a substantial insight in what adopting, applying and operating ESTs requires, and how these activities can contribute to strengthening their individual and institutional EST management skills.

- Have understood and appreciated how adopting, applying and operating ESTs can contribute to better environment for human health and well-being, and also can be related to developmental issues, sustainable development and technological cooperation programmes in their own countries.

- Have acquired basic knowledge to identify the potential impacts or consequences on the environment of technological solutions and innovations.

- Be able to design and implement national or local training events on adopting, applying and operating ESTs for local managers of ESTs.

In addition, IETC had also put forward as an objective that running the pilot workshop should give information and suggestions to optimize the training-content and training-format. The present evaluation is mainly focussing on the latter objective.

The participants were well selected and balanced in terms of geographical distribution, gender equity, professional background such as government, NGO, private sector and academia.

All participants received an evaluation form for the workshop evaluation questionnaire at the end of the workshop (see Annex 5). This resulted in a set of information that have been analyzed both in a quantitative and qualitative way.

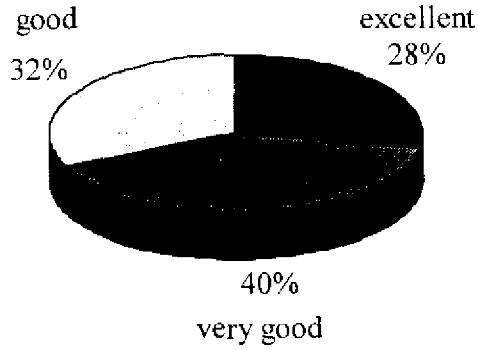
The evaluation results are summarized with an emphasis on what the participants suggested for future actions.

1. General evaluation of the Training

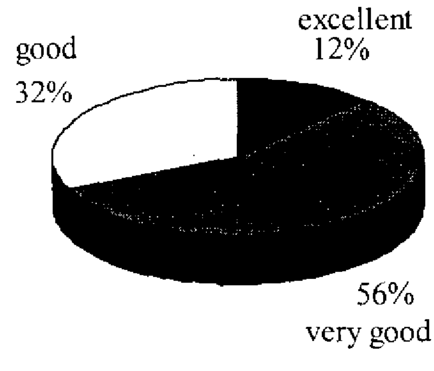
The training evaluation questionnaire contained a question in which trainees were asked to score their general appreciation of the workshop on a 5-point scale (see Annex 5 - question 1). This question presented eight issues of appreciation.

This resulted in the following scoring:

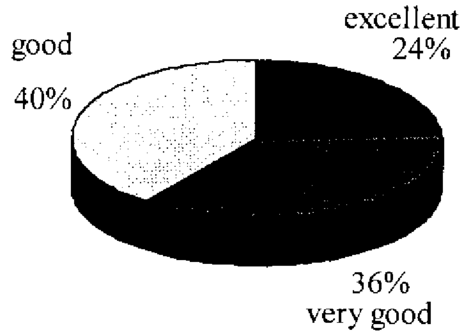
(1) Overall benefits of the program



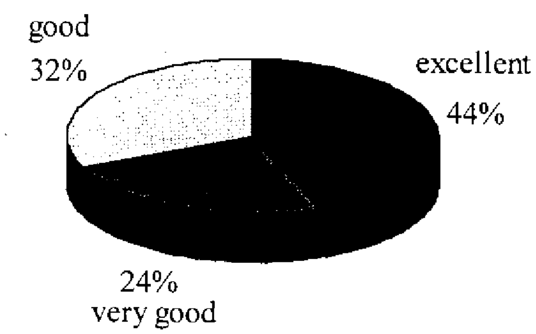
(2) Relevance to your job



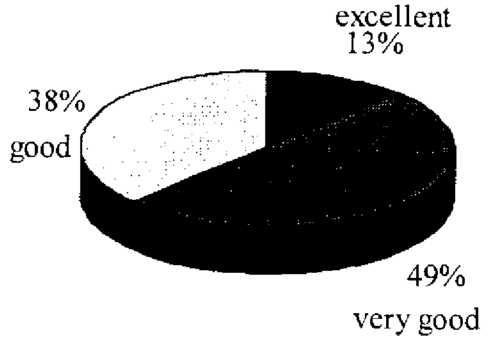
(3) Quality of the training



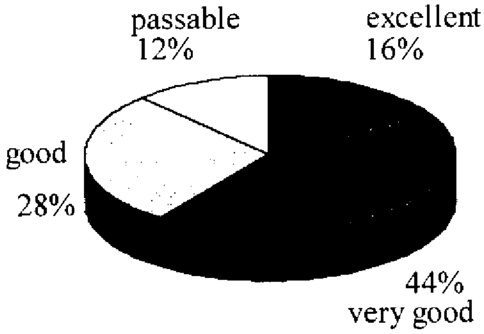
(4) Venue/location



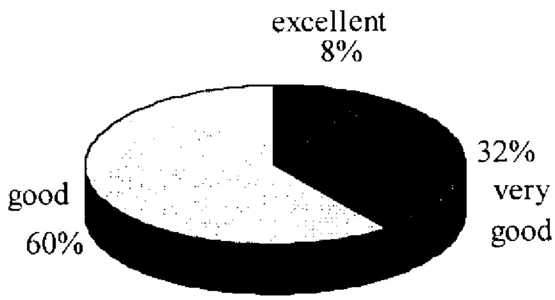
(5) Course facilities and administration



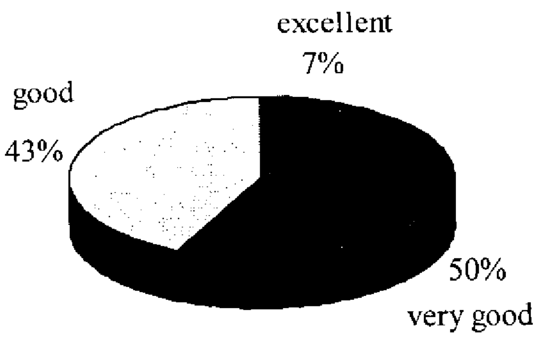
(6) Organization of the course



(7) Correspondence with the advertized program



(8) Achievement of objectives



2. More detailed comments/opinions on the following:

2.1 The value of the workshop to you?

- Very interesting to have a general view of EST and new technologies.
- Very valuable especially the field trips to new EST sites.
- Valuable to get to know about Environmental Technology Information System run by UNEP IETC and also very important to spread ESTs to developing countries.
- Great opportunity to be aware of EST available and to share/compare problems/ solutions.
- A good opportunity to learn new ideas, knowledge and technologies and share experience with other countries regarding waste management and associated problems.
- An exposure to new and sustainable technologies was good and timely.
- Would have been very valuable if it deals with small town or community.
- Developed friendship with whom I can communicate for further assistance.
- The skill received in this training workshop could be applied in my workshops benefit and project especially for waste treatment.
- To promote the knowledge of the EST and what EST are using in other place and what are the lacks in participants countries.
- Valuable as it gives me the modern technologies in solving environmental problems.
- Printed general information on suitable environmentally sound technologies.
- It gives me an eye opening opportunities in a global environmental perception.
- It is good of the time. Require immediate action for dissemination.
- Highly useful in application of EST to small communities with sustainable approach.
- The value of the workshop considering relevance of the job is very good, as ESTs can be applied to the relevant job/project as learnt in the workshop.

2.2 The duration of the workshop?

- Among 25 participants, 17 considered the duration as " appropriate", 1 as "too long", 2 as "a little long", 2 as "too short" and 3 as a "a little short".
- Comments from participants who would have preferred a longer duration:
  - (1) Some of the presentations have to be cut short and sessions could have started earlier if participants were accommodated near the venue i.e. within walking distance.
  - (2) 2 weeks should be a good duration.
  - (3) The duration should be extended by 2-4 day, so that more discussion can be done among the participants.
- Comments from participants who would have preferred a shorter duration:
  - (1) The duration of the workshop should be 5 days.
- Comments from participants who considered the duration is appropriate:
  - (1) It should have done earlier as it's very hot day in PERTH during Dec.
  - (2) More field visits should be incorporated relevant to the topic/discussions.

2.3 The best issues of the workshop?

- Session 17 and 18
- Field visit to landfill gas site. (2 persons)

- Field visit to Atlas segregation plant.
- Several field visits.
- ESTs transfer and UNEP-IETC Technology Information system. (3 persons)
- Talks of Peter Neuman
- Industries presentations.
- The various EST presented by resource people.
- Wetland plants swage treatment technology
- Solid waste comporting technology
- Solid waste management (5 persons)
- Waste water management (6 persons)
- City plan & transport planning (2 persons)
- On-site wastewater treatment technologies and facilities. (2 persons)
- Toilet technologies
- Identification of environmental problems.
- Environmental Issues related to sustainability in developing countries.
- To reduce the sources of pollutants which will be impact on to future generation.

2.4 Was there something really important missing?

- No. (4 persons)
- Cost effectiveness especially suiting to developing counties. (2 persons)
- Air pollution was not so emphasized. No topics how to mitigate it. (3 persons)
- Participants' interaction. No time to exchange experience and knowledge. (2 persons)
- The topic of strategies to adopt and apply ESTs in each country.
- Assessment of appropriate EST methods of how this can be done.
- To analyze and assess in detail the problems of waste management of countries.
- Connection between individual technologies and overall sustainable strategy.
- On site sanitation for little towns or cities
- The main kinds of municipal wastewater treatment technologies
- Opportunity to present endogenous technologies of developing countries.
- Water treatment.
- Disseminating of specific (details picture) of EST which are appropriate for developing countries.
- Industry pollution. The clean produce and other utilization of waste technologies should be emphasized.
- Feasibility of suggested technologies
- Contact irrigation (wastewater disposal on surface) which are suitable for villages and remote areas.

2.5 What further course development should we consider?

- Economic aspects of EST
- A short course to develop ESTs that can practically work as well as affordable to all levels of society.
- Courses should deal with conditions, policies and strategies for capacity building for adopting, applying and operating ESTs.

- To take a real down to each case study of two urban countries, one from big countries and one from an island state. This will help participants to have a clear picture as to what the problems are like and which EST is most applicable to each urban country.
- Should bring in experiences of different countries and develop an overall strategy for cities/regions.
- Should concentrate sustainability operation of maintaining of project.
- Participants from developing countries should present their endogenous technologies.
- Sustainable groundwater management.
- A course in water problem in low-lying islands.
- Cleaner technology for small and medium scale industries.
- The course may be the sam nam subject, but to be involve EIA.
- It is considered to formulate the laws preventing pollution.
- Pay more attention on the concepts, not to be emphasized the detail technologies.
- On the job training or training in none benefit.
- Learn by doing course on urban conservation.
- Course should be focused on specific topic for developing countries.
- Technology transfer programs.
- Environmental management system for economic aspects.
- Air pollution should be considered strongly.
- More background material, guidelines, case studies should be provided.
- Course should have group discussion to bring out.
- Country presentation should be given more time.

2.6 What method of session presentation would you like better?

- Group discussion. (8 persons)
- Simulations such as Nominal Group Technique.
- Audio visual methods (2 persons)
- Short and brief presentation with slides or a video. (2 persons)
- Field visit
- Group work, case studies and analysis
- Discussion with transparencies and slides.
- Questions and discussion times should be lengthened and not very limited.
- Solid waste field trip
- Sewerage treatment
- Last session on transport/city plans
- Participatory approach method to be adopted to get better technology transfer
- To combine the practical cases to demonstrate.
- Session9, 12, 17 & 19
- The Atlas solid waste composing.
- A highly interactive format of presentation.
- Question and answer session immediately after field visits

3. Comments on each session and/or individual presenters:

Session 1: Technology Choice and Sustainable Development (Mathew and Anda)

- Excellent. Very informative and crisp.
- Very good (6 persons)
- Good (7 persons)
- Okay (2 persons)
- Passable
- Applicable – easy to apply
- Choices of technology exposed to us were useful.
- There is much relationship between the title and the contents.
- Good introduction and basic direction. No conclusion, but it's okay.
- Presenters are good, but the contents of presentation did not meet the expectation of participants.
- The concepts were not issued clearly. (2 persons)
- Should be more specific. (2 persons)
- Too brief. No slide and video.
- Mr. Anda spoke too fast so that understanding all was difficult.

Session 2: Introduction to Practical ESTs (Yoshioka)

- Excellent (3 persons)
- Very good (4 persons)
- Good (8 persons)
- Okay (3 persons)
- Medium
- Passable
- Well specified and very realistic.
- Useful and informative. (2 persons)
- Need to be more detailed.
- Should be more specific.
- Slight communication problem– it doesn't matter as English is not our mother tongue.
- The introduction to practical ESTs is passable.

Session 3: Environmental Technologies for Treatment and Maintenance of Water Supply Systems (Ho and Mathew)

- Very good (7 persons)
- Good (4 persons)
- Okay (2 persons)
- Medium (2 persons)
- Passable
- Excellent, very informative and crisp.
- Very interesting
- Introduced to good theories.
- Applicable in any country.
- Appropriate

- The topic is too large to express in the short paper.
- Should be more specific.

Session 4: Field Trip to Laboratory Chemistry Centre

- Excellent
- Very good (2 persons)
- Good (4 persons)
- OK (2 persons)
- Passable
- Too superficial.
- Very interesting. Wish it were longer.
- Very advanced.
- Impressive.
- Nice to see a well equipped lab, maybe a partner for the future.
- Air monitoring food technologies are very interesting.
- It made us know what the program and where it came from.
- Provided information on different analytical equipment might be needed in other county.
- Fantastic laboratory with all kinds of testing and doing confidential jobs.
- This is good only for countries that can afford such a centre.
- This session is not necessary.
- Too short to give any benefits.
- Not too much benefit. Just seeing what equipments are there and what kind of analysis are doing there.
- That is fine for Australia but developing countries have no modern technology.
- Too technical and difficult to derive much out of it.

Session 5: Industry Presentations (Australia)

- Excellent (2 persons)
- Very good (2 persons)
- Good (8 persons)
- OK (2 persons)
- Passable
- The presentations were suitable for us.
- Almost all technologies presented by Australian companies are too confined to small-scale technologies, so their application can be restricted.
- Useful but difficult to derive the benefit.
- It's not sure if they can be applied in our region or not. Should be tried once.
- Need to promote more technologies.
- More industry presentation should be included.
- Presentation should not be under the veil of secrecy since objection & answer session after the field visits could not be clarified. Process demonstration should be more open.

Session 6: Permaculture a Design Approach for Sustainable Agriculture (Anda)

- Excellent
- Very good. (5 persons)
- Good. (9 persons)
- Okay. (2 persons)
- Very encouraging.
- It's very useful to get familiar with the new concept of permaculture.
- We need the additional information from the document.
- Very clear and provided a sample site.
- Great approach but will need to be tested in social context for islands and developing countries for acceptability.
- Very interesting, but basic more research needed.
- Not suitable in all countries as it has been taught every workshop.
- I like this kind of ideas but since our organizations are not research oriented, it will be difficult to adopt. We'll be bogged down with implementation.
- Interesting but have to be shown also for tropical countries.

Session 7: Field Visit to Permaculture Demonstration

- Excellent
- Very good (2 persons)
- Good (10 persons)
- Okay (2 persons)
- Average
- Passable
- Very interesting. (2 persons)
- Nice
- Great visit
- Very realistic.
- It's interesting.
- Enjoyed the session.
- Good discussion on site.
- More research needed.

Session 8: Environmental Technology Demonstrations

- Excellent. (2 persons)
- Very good (5 persons)
- Good. (7 persons)
- Okay.
- Average.
- Much impressive.
- Very good for establishing this action.
- Good case of technology.
- It's interesting and can get new idea.
- Great real/live display of technologies
- Helpful to start. Had a lot of fun with hand on trial of more activities like paper making

and brick manufacture.
- Should be applied elsewhere.
- Good if more time is allocated to discussed some of the technologies in the centre.
- More environmental technology demonstration should be included.

Session 9/10: Needs and Conditions of Technology Transfer (Miwa)
- Excellent (3 persons)
- Very good (6 persons)
- Good (6 persons)
- Okay (2 persons)
- Should be more specific and detailed. (2 persons)
- New approach
- Good approach in training program.
- Very informative.
- Needed in every workshop.
- Needed for technology transfer.
- It will be useful for us to remember the needs & conditions of technology transfer.
- Cost economics should have also given consideration.
- Very clear.
- Today's basic equipment for developing countries

Session 10: Presentation of UNEP IETC's Technology Information System (Strohmann)
- Excellent (6 persons)
- Very good (5 persons)
- Good (7 persons)
- Okay
- Very interesting, we need one.
- The software should be sent to participants for effective use free of charge. (3 persons)
- This is one of the most important to have information of the computer program.
- It can solve my environment issues.
- It will be useful for the future.
- The best session.
- More information, organizing skills and coordination are necessary.
- Should be more specific.

Session 11: Solid Waste Management Technologies (Ho)
- Very good (8 persons)
- Good (5 persons)
- OK (2 persons)
- Appropriate.
- Basic.
- Passable.
- A big deal for all the countries
- Lot of lab is available.
- Very good state for developing countries.

Session 12: Field Visit to Land Fill Site

- Excellent (3 persons)
- Very good (4 persons)
- Good (5 persons)
- Okay
- Very useful (3 persons)
- Very informative. (2 persons)
- It's impressive.
- They were very active and kind in presenting their technologies.
- An eye opener can be adopted by countries and provided there's sample finance.
- Very encouraging as solid wastes are at least made use of by providing compost.
- Good technology with an action for future and sustainability.
- Provided information is advance techniques for waste management, but too expensive.

Session 13: Applying Lifecycle Assessment to Waste Management (Tamamushi)

- Excellent (3 persons)
- Very good (4 persons)
- Good (10 persons)
- Okay
- Procter Gamble gave the good example.
- Should have made software available to participants
- Can be applied in the island.
- Provide on how to do LCA. But provide different point on WMA.
- More on company information and little on the concept and principles of ALS to WM.

Session 14: Sustainable Development and the German Packaging Ordinance (Fahrbach)

- Excellent (3 persons)
- Very good.
- Good. (3 persons)
- Okay.
- Average.
- Made to start training on these lines.

Session 15: Industry Presentations (Australia)

- Very good (4 persons)
- Good (8 persons)
- OK (3 persons)
- Average
- Passable
- Excellent, all industry presentations discussed experiences in Asian Countries. Perhaps some experiences of these companies in island states should be provided.
- More industries should be included.
- Useful, but it will be a dream for us to derive the benefit.
- Presentation should be more open as far as possible to understand the technology lest somebody want to transfer the technology to his country.

Session 16: Field Visit to On-site Waste Treatment and Disposal

- Excellent. (4 persons)
- Very good. (2 persons)
- Good. (11 persons)
- OK. (3 persons)
- Average
- Very good to small on-site plants.
- Very impressive
- Nice place, nice technology.
- It's also applicable for a community rather than individuals.
- Background materials, design guidelines should have been provided along with merit and demerits of systems including analysis and O&M cost.
- Bio mass was excellent.

Session 17: Global Issues on Urban Transport (Newman)

- Excellent (8 persons)
- Very good (6 persons)
- Good (4 persons)
- Okay
- Very interesting.
- Quite the same everywhere.
- Very organized and well analyzed.
- Should have been in the first date to get the overall situation established.
- Good information on urban transport.
- The lecture was really interrupting and would be lightening to have further sessions.
- Needs more discussion of this issue.

Session 18: Urban Village – A Sustainable Living Practice (Havelick)

- Excellent (8 persons)
- Very good (7 persons)
- Good (4 persons)
- Okay.
- The best session of the workshop. (2 persons)
- Welcome to the new generation
- Very emotional. A very good approach to presentation.
- Well presented.
- More practical than factual, more specific action oriented
- Resources to be used for small developments case for future generation.
- More discussion is needed.
- Short time.

Session 19: Introduction to Design of Regional/National Training Programmes (Strohmann)

- Excellent (5 persons)
- Very good (4 persons)

- Good (6 persons)
- Okay (2 persons)
- Useful (2 persons)
- It's very helpful. (2 persons)
- Okay for a small island countries
- Possibly the best part, as participants tended to exchange most of their ideas during this session.
- Very useful for follow up activities of this workshop and promote participants what things are to be considered.
- The appropriate approach. The workshop and training approach/facilities are quite widened in today's information technology world.
- Should be more specific.

Session 20: Design and Discussion of Regional/National Training Programmes (Strohmann)

- Excellent. (5 persons)
- Very good. (4 persons)
- Good. (5 persons)
- Okay (3 persons)
- It helps a lot.
- Useful.
- Possibly the best part as participants tend to exchange most of their ideas during this session
- Excellent idea to get lissenative of information after his workshop.
- Participation is encouraging.
- It's needed to follow up of this workshop. (2 persons)
- Promote to understand objectives of training programs, keynote what are materials, venue for what are going to put in program.
- The opportunity was interesting to work with people from different knowledge of skills and countries with the output.
- Very good design with Excellency discussion.
- Best presentation by participants group.

Annex 5: Evaluation Questionnaire Sheet

WORKSHOP EVALUATION QUESTIONNAIRE

The workshop will be evaluated qualitatively by fellows and lecturers and an evaluation report will be written by the course developers. Your assessment, therefore, is very important to help us designing other regional and national programmes.

---

1. General evaluation of the Training

Please apply the following scoring

1 = poor
2 = passable
3 = good
4 = very good
5 = excellent

and circle the appropriate figure.

1.1. Overall benefits of the programme	1 2 3 4 5
1.2. Relevance to your job	1 2 3 4 5
1.3. Quality of the training	1 2 3 4 5
1.4. Venue/location	1 2 3 4 5
1.5. Course facilities and administration	1 2 3 4 5
1.6. Organization of the course	1 2 3 4 5
1.7. Correspondence with the advertised programme	1 2 3 4 5
1.8. Achievement of objectives	1 2 3 4 5

2. Please give more detailed comments / opinions on the following:

2.1. The value of the workshop to you?

2.2. The duration of the workshop?

2.3. The best issues of the workshop?

2.4. Was there something really important missing?

2.5. What further course development should we consider?

2.6. What method of session presentation would you like better?

3. Please comment on each session and/or individual presenters:

Session 1: Technology Choice and Sustainable Development (Mathew and Anda)

Session 2: Introduction to Practical ESTs (Yoshioka)

Session 3: Environmental Technologies for Treatment and Maintenance of Water Supply Systems (Ho and Mathew)

Session 4: Field Trip to Laboratory Chemistry Centre

Session 5: Industry Presentations (Australia)

Session 6: Permaculture a Design Approach for Sustainable Agriculture (Anda)

Session 7: Field Visit to Permaculture Demonstration

Session 8: Environmental Technology Demonstrations

Session 9/10: Needs and Conditions of Technology Transfer (Miwa)

Session 10: Presentation of UNEP IETC's Technology Information System (Strohmann)

Session 11: Solid Waste Management Technologies (Ho)

Session 12: Field Visit to Land Fill Site

Session 13: Applying Lifecycle Assessment to Waste Management (Tamamushi)

Session 14: Sustainable Development and the German Packaging Ordinance (Fahrbach)

Session 15: Industry Presentations (Australia)

Session 16: Field Visit to On-site Waste Treatment and Disposal

Session 17: Global Issues on Urban Transport (Newman)

Session 18: Urban Village – A Sustainable Living Practice (Havelick)

Session 19: Introduction to Design of Regional/National Training Programmes (Strohmann)

Session 20: Design and Discussion of Regional/National Training Programmes (Strohmann)

We appreciate your kind cooperation.

Please write down (optional):

Your name: ________________________________

Your country: ______________________________

Annex 6: Certificate Copy

THE UNEP INTERNATIONAL ENVIRONMENTAL TECHNOLOGY CENTRE (IETC) AND THE INSTITUTE FOR ENVIRONMENTAL SCIENCE OF MURDOCH UNIVERSITY, WESTERN AUSTRALIA

certify that

UNEP

Institute for Environmental Science
Murdoch University, Western Australia

has successfully completed the

Regional Workshop for Asia/Pacific on Adopting, Applying and Operating Environmentally Sound Technologies for Urban Management

8-13 December 1997
Perth, Western Australia

John Whitelaw
Director, UNEP IETC

Associate Professor Goen Ho
Director, Institute for Environmental Science
Murdoch University

Annex 7: List of Presenters

	Surname	First Name	Organization	Address	City/Region	Country	Phone/Fax
Assoc Prof	Ho	Goen	Murdoch University	South Street Murdoch	Western Australia	Australia	PHONE (09) 9360 2167 fax 93104997
Dr	Strohmann	C.H	UNEP/IETC	2-110 Ryokichi Koen, Tsumi-ku	Osaka 538	Japan	phone (81-6)915-458-3184 fax (81-6)915 0304
Dr	Mathew	Kuruvilla	Murdoch University	South Street Murdoch	Western Australia	Australia	phone 93602896 fax 93104997
Mr	Anda	Martin	Murdoch University	South Street Murdoch	Western Australia	Australia	phone 93606123 fax 93104997
Mr	Yoshoika	Masahiro	UNEP/ IETC	2-110 Ryokichi Koen, Tsumi-ku	Osaka 538	Japan	phone (81-6)915 458-3184 fax (81-6)915 0304
Mr	Ingraham	Doug	Laboratory Cemistry Centre (WA)	125 Hay Street Perth	Western Australia	Australia	phone 09 92223017 fax 09 93257767
Mr	MacDougall	Angus	Process and Pollution Control	P O Box 42 Kedron 4051	Queensland	Australia	phone (07) 3356 3098 fax (07) 3356 3096
Mr	Durrant	Roy	Biomax PTY LTD	P O Box 720 Balcatta 6914	Western Australia	Australia	phone 089 345 3071 fax 089 345 3171
Mr	Glennon	Dennis	Environmental Solutions International	P O Box 1495 Osbourne Park 6919	Western Australia	Australia	phnoe (08) 9242 2442 fax (08) 92425376
Mr	Dallas	Stewart	ETC - Murdoch University	South Street Murdoch	Western Australia	Australia	phone 93606123 fax 93104997
Mr	Longwood	Leslie	ETC - Murdoch University	South Street Murdoch	Western Australia	Australia	phone 93606123 fax 93104997
Dr	Hofstede	Harrie	Murdoch University	South Street Murdoch	Western Australia	Australia	phone 93602538 fax 93104997
Mr	Hobbs	Derek	ETC - Murdoch University	South Street Murdoch	Western Australia	Australia	phone 93606123 fax 93104997
Mr	Boulton	Dan	ETC - Murdoch University	South Street Murdoch	Western Australia	Australia	phone 93606123 fax 93104997
Prof	Miwa	Nobuya	Osaka Gakuin University	2-110 Ryokichi Koen, Tsumi-ku	Osaka 538	Japan	phone (81-6)915-458-3184 fax (81-6)915 0304
Dr	Tamamushi	Kanji	Procter and Gamble Far East Inc.				
Dr	Fahrbach	Gerhard	DER GRUNE PUNKT- Society for System technology	Frankfurter Str, 720-726,51145	Koln	Germany	phone 051 620 4732 fax 051 628 4469
Mr	Ivery	Graham	Aquarius/Western Wastewater Treatment	4th floor, 445 Hay street, 6000 Perth	Western Australia	Australia	phone 9325 8115 fax 93251327 / 9450 2570
Mr	Bowman	Martin	Ecomax	1298 Hay Sreet West Perth 6000	Western Australia	Australia	phone fax
Ms	Karpinski	Jan	BSD Consultants	BSD centre 2 Bagot Rd Subiaco 6008	Western Australia	Australia	phone (09)9273 388 fax (09) 9388 3831
Prof	Newman	Peter	Murdoch University	South Street Murdoch	Western Australia	Australia	phone 9360 2902
Prof	Spencer	Havelick	University of Colorado		Colorado	U.S.A.	

UNEP-IETC

The UNEP International Environmental Technology Centre (IETC)

The International Environmental Technology Centre (IETC) was established by the United Nations Environment Programme (UNEP) in April 1994. It has offices at two locations in Japan - Osaka City and Kusatsu, Shiga Prefecture.

The Centre's main function is to promote the application of Environmentally Sound Technologies (ESTs) in developing countries and countries with economies in transition. IETC pays specific attention to urban problems, such as sewage, air pollution, solid waste, noise, and to the management of freshwater basins.

IETC is supported in its operations by two Japanese foundations: The Global Environment Centre Foundation (GEC), which is based in Osaka and handles urban environmental problems; and the International Lake Environment Committee Foundation (ILEC), which is located in Shiga Prefecture and contributes accumulated knowledge on sustainable management of freshwater resources.

IETC's mandate is based on Agenda 21, which came out of the UNCED process. Consequently IETC pursues a result-oriented work plan revolving around three issues, namely: (1) Improving access to information on ESTs; (2) Fostering technology cooperation, partnerships, adoption and use; and (3) Building endogenous capacity.

IETC has secured specific results that have established it as a Centre of Excellence in its areas of speciality. Its products include: an overview on existing information sources for ESTs; a database of information on ESTs; a regular newsletter, a technical publication series and other media materials creating public awareness and disseminating information on ESTs; Local Agenda 21 documents developed for selected cities in collaboration with the UNCHS (Habitat)/UNEP Sustainable Cities Programme (SCP); Action Plans for sustainable management of selected lake/reservoir basins; training needs assessment surveys in the field of decision-making on technology transfer and management of ESTs; design and implementation of pilot training programs for adoption, application and operation of ESTs; training materials for technology management of large cities and freshwater basins; and others.

The Centre coordinates its activities with substantive organisations within the UN system. IETC also seeks partnerships with international and bilateral finance institutions, technical assistance organisations, the private, academic and non-governmental sectors, foundations and corporations.

UNEP

UNITED NATIONS ENVIRONMENT PROGRAMME - INTERNATIONAL ENVIRONMENTAL TECHNOLOGY CENTRE

Osaka Office
2-110 Ryokuchi koen, Tsurumi-ku, Osaka 538-0036, Japan
Tel: +81 (0)6 6915-4580
Fax: +81 (0)6 6915-0304

Shiga Office
1091 Oroshimo-cho, Kusatsu City, Shiga 525-0001, Japan
Tel: +81 (0)77 568-4581
Fax: +81 (0)77 568-4587

URL: http://www.unep.or.jp/
Email: ietc@unep.or.jp