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Environmental Health Focus

Managing the Environment for Health in the AsiaPacific

Volume 1, Number 2 2003

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WHO Statement of Support

WHO is pleased to have collaborated with the Malaysian Institute for Medical Research (IMR) over the past five years in the development of its Environmental Health Research Centre (EHRC). An integral approach in this process has been problem-based learning that encourages, among other things, the sharing of information and emphasizes the importance of learning from and building on the experience of others. The *Environmental Health Focus* will serve as an important communications forum for enhancing this approach both in Malaysia and throughout the Western Pacific Region.

The solving of environmental health problems of common interest among countries in the Region can benefit greatly from thorough and open discussion. By promoting this type of robust discussion, the *Environmental Health Focus* will contribute to improve understanding of complex issues and enhance leadership development in environmental health research. The extent to which this is accomplished, however, will depend on the enthusiasm and participation of an informed readership. So, every effort will be made to engage people in meaningful dialogue, through the *Focus*, about real problems in practice and place.

WHO is happy to support and be part of this initiative.

Stephen A. Tamplin
Acting WHO Representative for Malaysia, Singapore and Brunei Darussalam
December 2002

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We would like to record a word of thanks to Mr. James Arthur Ireland and Mrs. Robyn Longhurst for their invaluable advice and assistance in ensuring the succesful publication of this journal.

Environmental Health Focus

Managing the Environment for Health in the AsiaPacific

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This EH Focus serves an Environmental Health Research Information Clearinghouse function. It aims to develop environmental management for health with the following purposes:

- To promote Environmental Health (EH) research and development within Malaysia and the AsiaPacific;
- To translate research outcomes to EH policy makers, EH practitioners, community leaders and researchers;
- To engage stakeholders locally, nationally and regionally in Environmental Health Action Planing (EHAP);
- To equip these stakeholders as environmental managers for health in Malaysia and the AsiaPacific;
- To render national, regional and community life sustainable.

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About the cover

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The Editorial Board will be the final arbiter of publishable materials in this Focus.

Instructions to authors can be found at the back of this journal and other policy details may be obtained from either the Editor in Chief or the Associate Editor at addresses shown adjacent.

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In this edition all contributions have been peer reviewed to determine suitability for publication.

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Nicholas J. Ashbolt, Primary Author, UNSW, Sdyney, Australia.

Setting the Scene

How EH Focus promotes interaction

Environmental health is emerging as a broad intersectoral strategy to manage the environment for health. It engages on local to global scales to influence policy, practice, people and place for the sake of sustainable living. Stakeholders in government agencies, NGOs, industries and communities all need ways for connecting health and environment to make this possible.

Environmental health research and deployment are now critical in charting the future, as countries struggle to shape their development into healthy settings.

There are sometimes gaps between conduct of EH research, creation of EH policy and its deployment in communities by EH practitioners. This confounds good intentions and confuses decision makers, often with disastrous results.

This publication has been designed to promote dialogue in the hope of bridging some of these gaps. The Environmental Health Research Centre, at its very outset, was designated as an EH Information Clearinghouse for this purpose.

Editorially this poses a challenge in addressing multiple audiences of technical and non-technical readers. The EH Focus has been structured with interactive devices, in the hope of translating research and deployment with public exchange of ideas.

Promoting Interaction

'Guest Editorials' afford prominent persons opportunity to write scene setting articles to promote interaction between stakeholders.

'News and Views' afford readers opportunity to highlight events and write to the Editor as a form of interaction.

'Feature Articles' provide for authors to probe the future and challenge readers on environmental health issues.

'Shaping NEHAP' provides for articles which interact with **N**ational **E**nvironmental **H**ealth **A**ction **P**lanning to influence policy, practice, communities and research.

'Neighbours' provides for case studies which tell success stories or analyse failures in countries of the AsiaPacific.

'Technical Notes' affords researchers opportunity to publish technical notes and make progress reports on their work.

'Research Papers' provides a publishing venue, with peer review, of accomplished research outcomes in the Asia Pacific.

'Literature Reviews'; **'Book Reviews'** and **'Abstracts'**.

'Endnotes' support non-technical readers, giving plain language explanations. Bolded alphabetical characters are inserted into the text of technical papers – for example[a].

Guest Editorial

It gives me great pleasure to write a few words in conjunction with the publication of the second issue of the Environmental Health Focus. The first issue was a success as it was well received by individuals, institutions and libraries. This publication has projected the Environmental Health Research Centre as a 'Clearing House' for environmental health information in the region.

Environmental health continues to require attention and efforts in promoting sustainable development. As such we have to be vigilant at all times to address emerging and re-emerging diseases which has become a threat to human health due to man's incursion into nature's domain.

Research in the area of environmental health relies on a wide variety of disciplines. In order to effect meaningful change it must find ways to harness the findings of multidisciplinary science, and then use these findings to manage interactions within complex natural and man made systems. As the complexity of the modern world gains greater recognition in applied science fields, there is a growing recognition for the need to remove paradigmatic boundaries from conceptualization of research to the application of that science. Research in the area of environmental health for example, must necessarily draw from disciplines such as public health, epidemiology, biology, chemistry, toxicology, and community development in ways that work with whole systems.

Health and development are intrinsically interrelated. Better health is essential for achieving economic prosperity and poverty eradication. Protecting health is the principle objective of protecting the environment. Many of the environmental policies and regulations worldwide are motivated by public health concerns, and most economic valuation exercises have found that health impacts constitute the largest portion of environmental damages. Until recently, however, it was not possible to quantify the magnitude of health impacts from exposure to various environmental factors. Nor was it possible to compare the cost-effectiveness of preventive measures to reduce such exposure with health sector activities that cure the resulting illnesses. The opportunity to do so emerged from work on the "global burden of disease", which uses a standardized measure of health outcomes across various causes of illness and death. The National Burden of Disease Study, initiated in 2002 is an on-going process in Malaysia, which provides a comprehensive assessment of premature mortality and morbidity attributable to diseases and injuries. We can now utilise the data from the above programme to do a follow up analysis to link disease burden to environmental hazards.

I would like to conclude by urging all researchers in the field of environmental health to contribute articles of scientific interest to sustain the quality and success of the journal.

Datuk Dr. Hj. Mohd Ismail Merican,

Deputy Director-General of Health (Research and Technical Support),
Ministry of Health Malaysia.

News & Views

from Malaysia

Environmental Health Forum 2003 - Research & Development
Strategies in Environmental Health for Sustainable Development

The Environmental Health Research Forum (EH Forum) has been organised since the establishment of the Environmental Health Research Centre (EHRC) in 1996. This year's EH Forum (the 5th since the inception of EHRC) was jointly organised with the Institute of Environment and Development (LESTARI), Universiti Kebangsaan Malaysia (UKM), and the theme was 'Research and Development Strategies in Environmental Health for Sustainable Development'.

EHRC is now implementing the environmental health components of the 8th Malaysia Plan and the National Environmental Health Action Plan (NEHAP) is emerging as a unifying focus for this activity. On the NEHAP, we work closely with the Engineering Services Division and various departments of the Ministry of Health Malaysia as well as other national and international agencies. We are beginning to emerge as an environmental health clearinghouse and testimony to this is our inaugural publication of the Environmental Health Focus (2003).

The EHRC was involved in the MoH's mid term review of the 8th Malaysia Plan and we proposed a set of headline environmental health indicators for consideration as we felt that this will be the best way forward for ensuring sustainability in managing the environment for health. We have formed a partnership with LESTARI to adopt and validate EH indicators for Malaysia. This partnership will be extended to other potential collaborators in future.

The objectives of the current Forum was to address pertinent issues relating to funding, unparallel priorities and catergorisation of sectors. The participants who attended the Forum were from local universities, non-governmental organizations, associations, policy makers, users of EH information and practitioners, and researchers who generate and use EH data. To put it in perspective, it was a meeting of stakeholders, who had interests in current and important EH issues, strengths and weaknesses/gaps in EH research, smart partnerships and framework and strategies for future R&D.

The papers presented in this Forum are published in this issue of Environmental Health Focus.

Environmental Health - Its Contribution to Sustainable Development

[i]Ibrahim Komoo, [ii]Sarah Aziz and [iii]Mazlin B. Mokhtar

Introduction

The Malaysia Third Outline Perspective Plan for the period 2001 to 2010, aims for sustainable growth with resilience, whereby material welfare and level of prosperity will be raised accompanied by efforts to instil positive social and spiritual values as well as concerns for the environment to maintain the long term sustainability of the country's development (Malaysia, 2001 [OPP3]).

The three-pronged approach of economic growth, social development and environmental security supports the direction of sustainable development, which has been Malaysia's concern from the 1970's as encapsulated in the Third Malaysia Plan (1976-1980). The actual method of balancing these three concerns have been different over the decades: within the Federal and State Government frameworks, influenced by development priorities and concerns of various stakeholders, scientific advancements, social concerns and economic growth, and in this first decade of the millennium, the precautionary principle has been made the key (Malaysia, 2001[8MP]).

To better facilitate growth, environmental security is given a priority, with the focus on key factors such as status, capacity, health and resilience taking centre stage albeit the perspectives may differ from stakeholder to stakeholder. This paper will briefly look into the definition of environment with examples of the perspectives being used; the issue of environmental health and its fit in the sustainable development process.

The various perspectives of 'environment'

Defining 'environment'

The word *environment* has been defined in the Environmental Quality Act (EQA) 1974 to mean:

"The physical factors of the surroundings of human beings including land, water, atmosphere, climate, sound, odour, taste, the biological factors of animals and plants and the social factor of aesthetics."

The Act then goes on to define *elements* in relation to the environment as being:

"Any of the principal constituent parts of the environment including water, atmosphere, soil, vegetation, climate, sound, odour, aesthetics, fish and wildlife"; and *segments* in relation to the environment to include:

"Any portion or portions of the environment expressed in the terms of volume, space, area, quantity, quality or time or any combination thereof".

This can be read to include not only components that make up the environment, but the systems inherent.

This fundamental basis allows for the environment to include physical factors and systems, which provides a clearer understanding of what it encompasses. The fact that the definition itself is not exhaustive enables the widening of the scope in the advent of new scientific discoveries and understanding.

The perspectives

The environment as defined earlier, is in actual fact 'applied' differently by various agencies, giving rise to differing perspectives. To illustrate this, three examples from three different agencies are illustrated briefly.

The first agency, the Economic Planning Unit of the Prime Minister's Department, the agency that facilitates the preparation of the Malaysia Plans, looks at the 'environment' as being the environment *per se* and natural

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resources, and the focus is on management of the two, the former on quality of the environment (from issues of reduction of materials and activity that pollute; and strengthening management and decision making) and for the latter resource management and use (enhancement of resource use planning; intensification of resource conservation and sustainable management). Chapter 19 of the 8th Malaysia Plan outlines the strategic policy thrusts and prospect expected for the five-year plan period.

As for the Department of Environment, the mandate where the environment is concerned is therein contained in the EQA1974, the prevention, abatement, and control of pollution, and enhancement of the environment. It includes the use of the environment or any element or segment of the environment that is conducive to public health, welfare or safety and which requires protection from the effects of wastes, discharges, emissions and deposits. In perspective, the Department of the Environment functions as the custodians of the environment from human impact and activity, where pollution figures.

The Department of Forestry, who are custodians of forest resources that falls within the definition of environment, take on a different perspective, in that they are entrusted with the administration, management and conservation of forests and forestry development within the States in Malaysia.

LESTARI, in line with its science-policy research directions in environment and development, looks at the environment as being an Earth system, where physical-chemical resources, biological resources and human beings form integral parts of the system. The focus being that all three aspects essential to development, economic, social and environmental sustainability must be looked at from a holistic perspective and governed in a holistic manner.

With various stakeholders of the components that make up the environment having different perspectives where the word environment is concerned, in addition to being armed with different mandates, scope, jurisdictions and obligations, it does indicate that that there is fragmentation and discordance, but in reality, with a common goal reflected in the umbrella policy documents (OPP3 and 8MP) the goals of each agency should ultimately feed towards attaining sustainable growth with resilience.

Environmental health and sustainability

Environmental sustainability facilitates a process of economic and social development that can be maintained in the long run. It provides an important role for the environment itself (enables productive resource generation [regeneration for renewable resources and alternatives for non-renewable resources], healthy ecosystems, resiliency and mitigation against natural and man-induced hazards and risks) and the human-environment interaction that enables life support, economic growth and social stability. It can be looked at from at least two perspectives, sustainability from the human perspective, where dependency for social well-being and economic concerns are primary, or from the environmental perspective, where systems, functions and services are foremost.

The key factors in ensuring such sustainability would be the status, quality, quantity (of components) and capacity of the environment and its system. A poor environment can have such detrimental effects that its functions and the services provided would yield both insufficient quantity and quality of resources and inferior functions that can cripple the life support system which both humans and the environment depend on, thus hindering national growth.

The word "environmental health" itself has different connotations among the various stakeholders. One perspective as taken by the World Health Organisation states:

"Environmental health comprises those aspects of human health, including quality of life, that are determined by the physical, biological, social and psychosocial factors in the environment. It also refers to the theory and practice of assessing, correcting, controlling and preventing factors in the environment that can potentially affect adversely the health of present and future generations".

It is taken to be a science that protects humans from the damaging effects of physical, chemical and biological agents in the environment, combining the disciplines of environmental sciences and health sciences together with management sciences to create a healthy environment (Pillay *et al.*, 2003).

In some quarters, it has even been held that there are few diseases that are caused solely by genetic factors or environmental factors, and that genetics loads the gun but the environment pulls the trigger (J. Stern, USA Today quote), and it is the likelihood, potential and scale for harm that requires addressing (Olden, 2003).

From the environmental perspective, *environmental health* is seen as being the state of health of the physical-chemical, biological and human environment, the focus being the systems. The health of the environment (physical-chemical

and biological) is equally important as human health. From a biological health perspective loss of biodiversity for example is an indicator of poor ecological health. In the physical-chemical environment, landscape degradation, pollution (air, water and climatic changes), occurrences of hazards (such as landslides, floods, subsidence, soil and coastal erosion) indicate unhealthy physical-chemical systems. The inter-relationship and inter-dependency of both human health and environmental health is illustrated in Figure 1.

This in itself can be taken to read that environmental health regardless from the environmental or human (public) health perspective is an essential component in environmental sustainability, as a healthy environment would invariably lead to a system that is robust, which serves both environmental and human concerns. The perspectives are in themselves complimentary, as impact to either would upset the fragile equilibrium necessary for sustainability.

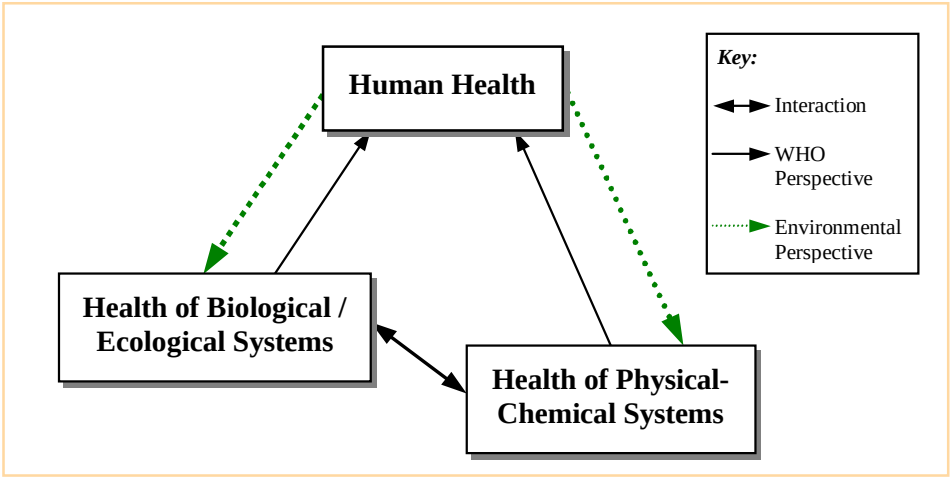
The Malaysian direction for a sustainable development process as reflected in the Third Outline Perspective Plan (OPP3) and the 8th Malaysia Plan are encapsulated in 7 main strategic policy thrusts in OPP3, one of which emphasises pursuing environmentally sustainable development to reinforce long-term growth. This includes raising the quality of life, promoting better health and environmental quality, and a clean, healthy and productive environment that is capable of sustaining the nation's needs and aspirations. To affect this, environmental considerations will have to be factored into the development process.

The 8th MP, in its key strategic policy thrusts emphasises on adopting an integrated and holistic approach in addressing environmental and resource issues to attain sustainable development. Environmental health has a large role to play in that it provides both human (or public health) and environmental health perspective, and can help set the standards (be it minimum or otherwise) necessary and acceptable for life support and healthy (public) living. This will in turn enable the setting of standards for what is necessary for environmental life support, systems, functions and services. One option would be the development of environmental health indicators that feed into sustainable development indicators, and the assessments of environmental (ecological) systems (functions and services), where public health in relation to environmental health can be used to assess the well-being of the system.

Conclusion

Environmental health is one approach that helps realises a development process that is sustainable, as both environmental and human health perspectives are crucial for sustainability, with health as the axis to ensure the betterment of the state of the two. The integration of the environmental and health disciplines will provide an ample wealth of synthesised information that will serve policy-makers, decision-makers, planners, implementers and enforcers well, with information being made available for use in either environmental governance or public health enhancement.

Figure 1: The inter-relationship on Environmental (Biological, Physical-Chemical and Human) Systems in Environmental Health



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Water Quality and Health

[i]M.S. Pillay, [ii]Kazal Sinha and [iii]Mohd Zaharon Mohd Talha

Introduction

Water and health are inter-twined in many ways. Water is one of the earth's most precious and threatened resources. Health is precious to all of us and as both are equally vulnerable, we need to protect and enhance them both. It is important to address the increasing need for adequate and safe water to protect both people and the planet.

Water is essential for health, which means not just the absence of disease but also the maintenance of well-being. The health aspects of hygiene, prevention of infection and nutrition all depend to some extent on access to water and water quality. Water plays an important part in rest and relaxation, as well as in cleanliness and the supply of basic needs.

The Relationship Between Water and Health

Water can affect people's health via either environmental factors, which affect food production, the state of the soil and air, or standing water conditions, direct human use for drinking or for hygiene and sanitation. The diseases associated with these effects fall into two main categories:

I. **Non-infectious diseases** associated with inadequate consumption of water (kidney failure) or with consumption of water containing toxic substances in harmful concentration e.g. heavy metals, fluorides or nitrates. These may be of natural origin or man-made. There are generally locality specific. Interventions include their removal (generally expensive) or selection of alternate sources.

II. **Infectious diseases** which are caused by parasitic organisms such as bacteria (typhoid), protozoa (malaria), viruses (polio) and helminths (schistosomiasis).

Infectious diseases are frequently classified according to water-related mechanism. The four main mechanisms of transmission are:

a) **Water-borne**: the pathogen is carried in the water by a possible host and when ingested at a sufficient dose to infect the drinker, e.g. cholera or typhoid. The majority of these pathogens reach the water through contamination with human excreta and ultimately enter the body through the mouth. Poor sanitation and bad personal hygiene cause the deterioration in the quality of the water used by the people. The diseases are therefore affected by the poor water quality.

b) **Water-washed**: the lack of water for domestic and personal hygiene leads to diseases of the eye, skin and intestine, e.g. trachoma, scabies and typhus. These diseases are dependent on water quality or accessibility, with intestinal diseases also depending on proper waste disposal.

c) **Water-based**: the pathogen spends a necessary part of its life cycle in an aquatic host for example schistosomes in snails and guinea worm in water fleas. The diseases are, therefore, dependent on water quality and contact plus the incidence of the aquatic host. Some of the diseases are affected by waste disposal.

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d) **Insect-vector**: the pathogen is carried by insect that breed in or bite near water, so the diseases are indirectly related to water, e.g. Malaria is spread by mosquitoes that breed in water and pathogens are transmitted by bites.

The various chemical qualities and quantities of water also affect health. Certain minerals in drinking water, because of their known hazardous properties, are considered undesirable if present beyond prescribed limits of concentration. Among these are arsenic, mercury, barium, cadmium, chromium, lead, selenium and silver.

Raw Water Sources For Drinking Water

The existing water supply systems in Malaysia are almost entirely dependent on surface water sources, i.e. rivers, streams and dams. According to Malaysia Water Industry Report 2001, 98 % of Malaysia's potable water supplies are derived from surface water sources. Water catchment areas are susceptible to pollution since the developments in these areas are not being strictly regulated by the relevant agencies. Rapid industrialisation and urbanisation has brought many development schemes into water catchments. The discharges from such development often contaminate their own water sources as well as those located down-stream. The roads and highways built to serve these developments tranverse many water catchments and bring with them the risk of accidental spillage of chemicals and other hazardous materials. This situation is worsened by the lack of infrastructure facilities to manage the sewage and other wastewaters produced. Added to the problem is the wide spread use of pesticides in agricultural schemes located within water catchments.

The health risk which is related to contamination of sewage for example is demonstrated by the following incidences of outbreak of water borne-diseases as a result of a combination of events in the past :

- 2,600 cases of gastroenteritis in Seremban in 1982
- 81 cases of infectious hepatitis in Raub in 1987
- 940 cases of infectious hepatitis in Kota Belud in 1988
- 300 cases of typhoid fever in Johor Bahru in 1990
- 1278 cases of cholera mostly in Pulau Pinang in May 1996

Due to the contamination of water sources by industrial, trade and sewage effluents as well as agricultural run off, chemical pollutants including heavy metals have been detected at raw water intakes of water treatment plants from 1992 to 2001. Among them are mercury and cadmium. Mercury is the heavy metal, which caused the Minamata (sometimes called madcat disease in Japan), which destroys the linkages between brain cells. This disease brought terrible misery to thousands of victims in Minamata, Japan. Cadmium causes a very painful disease which the Japanese have termed as "Itai-Itai", which destroys the structure of the bones of its victims.

Sewage and industrial effluents are rich nutrient sources for aquatic vegetation. The combination of rich nutrients, high ambient temperature and high intensity of sunshine found in Malaysia gives rise to risk of algal blooms where blue green algae would grow wild leading to possible release of algal toxins which cause nausea, vomiting, abdominal pain, diarrhoea etc., if such toxins find their way to our water supply. Such incidences have been reported to affect population for about 1000 km of the Darling River in Australia in 1991 resulting in declaration of a State of Emergency for three weeks by the government of New South Wales (J.Archer).

Water Treatment Systems and Distribution Networks

Most water treatment plants in the country are conventional treatment plants that use chemical aided flocculation, sedimentation, filtration and chlorination. In the conventional treatment of water, large quantities of chemicals are used. These chemicals include alum, soda ash, polyelectrolites, fluoride salts and chlorine. Many of these chemicals may themselves be contaminated in their production and thus can introduce other contaminants not present originally in the water. Very rarely are these chemicals tested for their purity prior to their usage.

Many of the existing water treatment plants are old and in need of upgrading and refurbishment. Conventional water treatment processes cannot adequately treat pesticide and heavy metal contaminated raw waters.

Many newly recognized microbiological agents such as Giardia and Cryptosporidium are also difficult to remove and disinfecte against. It has been found that such a treatment plant cannot effectively remove viruses and parasites such as crytosporidium. The organism caused more than 400,000 cases of cryptosporidiosis, a gastroenteric disorder, in April 1993 in Milwaukee, Wisconsin, USA (J.Archer). Vigilant

monitoring of water quality for such organisms is therefore our only defence.

There are also a number of treatment plants that only employ minimum treatment such as chlorination. These treatment plants are unable to treat raw water of varying quality. Water purveyors should evaluate the performance of these types of plants and carry out upgrading and refurbishment works or phase out these plants from operation.

Many water distribution pipes were laid decades ago and develop frequent leaks and breakages resulting in loss of water, loss of revenue and posing great potential for water contamination.

Complaints from consumers regarding turbid water in certain areas particularly in the Klang Valley are often being reported in the mass media. The reasons that cause the turbid water are: breakage of old pipelines; sediment deposited in service reservoirs; sediment deposited along the pipelines especially at dead ends. The water authorities concern should carry out scheduled flushing of pipelines and cleaning of service reservoirs, restudy the design of water reticulation and make necessary improvements especially at dead ends as well as to rehabilitate old pipelines.

Assurance of Drinking Water Quality

In Malaysia, legislative power to almost all matters in the water supply sector is vested with the State Government. However, there are policies and strategies put in place by the Federal Government to ensure good quality of drinking water supplied to consumers. Different agencies play different roles in the overall protection of water quality. One of the strategies adopted to ensure the quality of drinking water is the implementation National Drinking Water Quality Surveillance Programme.

National Drinking Water Quality Surveillance Programme

The National Drinking Water Quality Surveillance Programme (NDWQSP) aimed at protecting public health by ensuring safety and acceptability of drinking water supplied to consumers. With surveillance, the incidence of waterborne diseases and other problems associated with poor public water supply has reduced. The NDWQSP is a comprehensive programme consisting of 5 components, namely:

i. Monitoring

ii. Sanitary Survey

iii. Data processing and evaluation

iv. Remedial action

v. Institutional examination

This programme also serves to alert the public health personnel, water purveyors and other relevant agencies as soon as deterioration of drinking water quality is detected through monitoring or when potential sources of contamination are observed through any one of the surveillance activities. Corrective and preventive actions can then be taken before outbreaks of water borne diseases or intoxication occurs.

This programme covers all public water supply systems in the country namely,

- Urban public water supply
- Rural public water supply
- Privately owned public water supply

Guidelines for this programme were drawn up with help of World Health Organization (WHO) and a few other agencies in 1983 to ensure effective and systematic implementation and were adopted by all states in Malaysia in 1986. Together with the guidelines for surveillance are standards of water quality parameter for which water purveyors must comply with. The standards were reviewed and revised in 1990 and again recently, in 2000. The standards provide limits for physical, chemical, microbiological and radiological parameters mainly based on WHO recommendations.

In the surveillance programme, all public water supplies in Malaysia which consist of more than 400 treatment plants, are being monitored under the NDWQSP. There are designated sampling points for water samples to be taken for each water-course supplying raw water to the water treatment plant and to the distribution systems. Water samples are taken from the sampling points located at the: intake of water treatment plant, outlet of treatment plant, outlet of service reservoir and at strategic locations on the distribution system following the requirements under the NDWQSP. Samples are analysed for physical and bacteriological parameters as well as chemical parameters with relevant field test kits for physical parameters and are sent to the Department of Chemistry for bacteriological and chemical analysis. Under this programme, if any violations of the standards set by the Ministry of Health are detected, the relevant water authority will immediately be notified for remedial actions to be taken.

Annually, the number of drinking water quality samples taken throughout Malaysia is more than 100,000 samples for

physical and bacteriological analysis and over 20,000 samples for chemical analysis. As a whole in 2001 the percentage of water samples that were able to meet the national standards was 98% in terms of bacteriological quality, 96% in terms of residual chlorine and 96% in terms of turbidity. As for the chemical parameters, the drinking water quality for the country has generally been acceptable.

To further enhance the NDWQSP, a Quality Assurance Programmme (QAP) was initiated in 1993 to ensure continuous improvement in quality of the NDWQSP and to steer it towards achieving zero violation in some parameters. For this purpose, four performance indicators were used as a start; that is the violation rate of: residual chlorine; faecal coliform; combined residual chlorine and faecal coliform; and turbidity. These standards are revised each year so that they can be made more stringent to be consistent with improvement of the national annual average.

Research Needs In Drinking Water Quality Area

To further improve the quality of drinking water, research in this field needs to be enhanced and the following areas of research have been proposed:

a) To study the impact of developmental activities on the quality of water sources and treated water supply.

b) To develop appropriate technology and systems to upgrade existing conventional water treatment systems for urban and rural systems to meet current Drinking Water Quality Standards.

c) To develop a comprehensive health risk assessment systems for urban and rural water supply systems.

d) A research into the dilemma 'Whether home water filter is a tool for health protection or a source of health risk?'.

e) To determine health risks from Giardia and Cryptosporidium associated with Malaysian water supply.

f) To determine health risks from radioactive parameters associated with Malaysian water supply.

Conclusion

Water is vital to our survival and its quality has great bearing on health. If this limited resource is taken for granted, misused and contaminated, health effects will surface which will require enormous resources and efforts to rectify. All forms of available water resources are precious and should be well monitored and protected by all the parties concerned. For this purpose research has a vital role to play that will provide data and information for the formulation of national policies and implementation of strategies for providing safe water for drinking and hence protecting public health.

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Solid Waste Management in Malaysia - The Way Forward

Mohamad bin Said

Introduction

As you may all know the management of solid waste has become one of the most demanding and costly functions of local government administration. This problem has become more complex over the years with more wastes of changing characteristics being generated. This paper is based on the situation in Malaysia, which I believe will not be too different those of other countries in the region and elsewhere.

Status of Solid Waste Management in Malaysia

Solid waste management in this country has become an increasingly important task of local government authorities over the years as a result of urban population and industrial growth and an increase in the standard of living of the population resulting in an increase in quantity and variation in the types of waste generated. The problem of waste management has become more acute especially in urban areas due largely to significant migration of people from the rural to the urban areas. For example, the urban population in 1995 in Malaysia constituted about 55.1% of the total population and this has increased to about 61.8% in year 2000. For the more developed states, the urbanized population is close to 100% reflecting the changes that have taken place since the country gained Independence in 1957.

The inevitable growth of the urban population has brought significant pressure for local authorities to manage the large volume of municipal solid waste that is generated. It has been estimated that some 4.6 million tones or about 17 million cubic meters of waste is generated presently in the Peninsular. Over the period 1991 to 2020, waste generation is estimated to increase by an average of 3.24% per annum, although this is expected to fall subsequently in later years with measures for waste minisation, which will be introduced.

It is estimated that about 76% of the generated municipal solid wastes are collected while the remainder is deposited in illegal dumps, drains, watercourses or rivers. Of the collected waste, only a merge 1 – 2% is recycled, and the remainder is taken to disposal sites. Over 40% of the disposal sites are operating as open dumpsites, while the remaining sites have some countermeasures against some, bit not all expected environmental impacts. Intermediate treatment of municipal solid waste is limited to small-scale incinerators at some resort islands and some rural areas, although there was a 100 tonnes per day plant, which operated for a short period in Kuala Terengganu.

It is therefore clear to the Government that there is a need to radically improve solid waste management practices in Malaysia if we are to meet the vision of becoming a developed state by the year 2020. There is urgent need to increase investment in collection equipment and facilities, intermediate treatment facilities and sanitary landfills and to improve waste collection services.

There is need to reduce waste and to increase waste recycling. The Government is committed to recycling of waste and there have been concentrated media campaigns launched over the last 3 years. However, while some progress has been made in encouraging public participation, we need to overcome an important factor in the equation, which is low market demand for certain recyclables.

Local authorities, whose responsibility it is to manage municipal solid wastes, are faced with an ever increasing and difficult task to manage waste, as development and urban growth progresses in their area. Local authorities are presently not in the position to carry this burden alone in view of various inherent weaknesses. Meeting these

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challenges will require the assistance of state and federal governments.

Role of federal, state and local government

Presently, solid waste is being managed, either directly or indirectly by all three levels of Government, namely Federal, State and Local Government.

At the Federal level, the Ministry of Housing and Local Government handles all matters related to SWM funding and policy development and this is done in coordination with the Economic Planning Unit and other government agencies. The Department of Environment is the agency responsible for environmental management and control, while the Ministry of Health is responsible for developing programmes and guidance on solid waste management (SWM) in rural areas.

State governments play a coordinating role with focus on policy and financial matters pertaining to local authority functions. State may implement policies developed within the State or initiated by the Federal Government.

Local authorities are the implementing agencies and have direct responsibility over solid waste collection, treatment and disposal. These services are either provided directly by the local authorities or sub-contracted to private companies.

Waste generators constitute the most important group of stakeholders as they include households, industries and businesses. However the participation of this group in SWM presently is insignificant as there is no defined role or opportunity for them to participate in planning, operation or management.

Both large and small service providers from the private sector are active in SWM. These private companies are expected to form the backbone of the privatization programme to be implemented by the Government.

Manufacturers, unfortunately play an insignificant role in waste management presently as there is no clearly defined policy or incentives for such matters as waste reduction, recycling of products and recovery and reuse of materials.

Legislation related to Solid Waste Management (SWM)

There is currently no Federal or State legislation that deals specifically and comprehensively with all aspects of solid waste management. The Local Government Act 1976, and to a limited extent the Street, Drainage and Building Act 1974, is currently used to manage SWM nationwide. By-laws, such as the Refuse Collection, Removal and Disposal By-Laws have been made by some local authorities under the Local Government Act to regulate the service.

Although the Local Government Act and the Street Drainage and Building Act are federal legislation, and adopted by the states and implemented by local authorities, there is no direct role of the Federal Government in SWM. This is in lieu of the provision of the Constitution, which states that "local government outside of the Federal Territories" is a State Matter. However, the Federal Government can play a direct role in matters related to "public health and sanitation", for which solid waste management and public cleansing have relevance to public health. These provisions are important to enable the Federal Government to plan the way forward for SWM to meet the challenges of a developed nation.

The Way Forward

i. The Strategic Plan

The Government being fully aware of the difficult situation faced by local authorities in the management of solid wastes has taken various steps to overcome it. The issue of solid waste management has been recognized in the Eighth Malaysia Plan (2001 – 2005) and the Third Outline Perspective Plan (2001 – 2010). These Plans emphasise the need for improved management of solid wastes by the adoption of strategies and measures to improve waste disposal and to minimize waste generation.

Malaysia subscribes to the principles of Agenda 21, which arose from the Earth Summit held in Rio de Janeiro in 1992. The Agenda calls on government to adopt strategies for sustainable development and to implement this at all levels of government. The Ministry of Housing and Local Government has in recent years promoted that adoption of the principles of Agenda 21 for local governments. In fact several local authorities have adopted "Local Agenda 21" and are in the process of implementing the principles of "sustainable development". The management of municipal solid waste is a sector within Agenda that needs to be given attention.

To meet the challenges and targets set out in the Outline Perspective Plan, the Eighth Malaysia Plan and those prescribed in Agenda 21, the Ministry of Housing and Local Government commissioned the National Strategic Plan Study for Solid Waste Management to develop a Strategic and

Action Plan to guide the Government in its planning and in the implementation of a development programme for solid waste management. The Plan will identify measures to assist local authorities to address the solid waste issue and to assist them in their effort to achieve sustainable development.

It is the Government's vision to make Malaysia a "Clean and Beautiful" country and to be a leading country in this region in solid waste management. The Government has embarked on a programme for solid waste management with aim to improve efficiency and productivity, and reduce government involvement through private sector participation.

In this regard, the principles that will be used to guide the development of the Strategic Plan will include:

- Direct participation of the Federal Government in solid waste management through federalization of the function;
- Privatisation of the solid waste management services;
- Sustainable waste management through reducing, reusing and recycling; and the use of appropriate technologies, facilities and equipment to provide a sustainable and comprehensive solid waste management service;
- Adequate service standards to achieve a clean Malaysia;
- Inter-cooperation at all levels of Government;
- Social equity, with charges appropriate to the level of service and the ability and willingness to pay;
- Public awareness programmes; and
- Development of the technical and managerial capability in solid waste management.

ii. The Waste Hierarchy

The Government of Malaysia has committed itself to sustainable development and the waste hierarchy that is to be adopted in the Strategic Plan for Solid Waste Management shall reflect that commitment.

In principle, the waste hierarchy shall comprise a broad ranking of preferred solutions with prioritising of options, with the overall consideration of care for the environment.

The most effective environmental solution is often to reduce the generation of waste, thereby placing reduction at the pinnacle of the hierarchy.

Products and materials can be used again; hence ***re-use*** is to represent the next order of priority.

Valuable materials can often be recovered from wastes hence, recovery will follow the hierarchy of priority. This level of the hierarchy calls for the introduction of intermediate treatment facilities.

If there is no appropriate solution through the hierarchy of options mentioned above – ***disposal*** through sanitary landfill becomes the option.

iii. Legislation and Institution

We are at the stage of reviewing and preparing the necessary legislation and institutional changes to enable the privatisation and the federalisation processes to be implemented. The roles of the various stakeholders in SWM will need to be clearly defined and identified to enable the participation of stakeholders for successful implementation of the Strategic and Action Plan. Furthermore there is a need to consider adopting legislation to enhance waste reduction and recycling efforts targeted at manufacturers.

The Strategic Plan will require institutional strengthening at various levels of government and the active participation and commitment of various stakeholders. It is not intended to take away the traditional function of local authorities in waste management. In fact the role of local authorities will require more active participation, particularly in the area of monitoring and enforcement, public awareness and education and in the promotion of waste minimization and waste recycling.

iv. Privatisation

The Eighth Malaysia Plan (2001 – 2005) anticipates that waste collection and disposal services will be improved with the privatisation of these services. Privatisation is also aimed at relieving the financial and administrative burden of the Government besides facilitating economic growth with private sector participation. It is anticipated that private sector involvement in solid waste management will provide two distinct advantages:

- Where existing public service delivery is either too costly or inadequate, involvement of the private sector offers a means of enhancing efficiency and

lowering cost through the introduction of commercial principles and greater customer attention; and

- The private sector is suitably organisation to draw on a wider range of technical and managerial expertise than the government, and this is based on local and international experience in the waste management field. Where appropriate, the private sector is also able to introduce proven and cost effective technologies.

The Government is now in the final stages of drafting the Concessionaire Agreements which will define the responsibilities of the Concessionaire, the payment system for the services to be provided, the extent Government funding will be involved in the construction or operation of SWM facilities, as well as the importance of providing SWM service to all levels of society.

v. Technical Aspects

There is a very serious shortage of waste management facilities required for efficient collection and transportation of waste, supporting waste recovery and sanitary disposal of the waste at landfills with minimal impact on the surrounding environment.

There are a number of different options that can be developed to provide an integrated and sustainable waste strategy for Malaysia. There is no single or fixed route in solid waste management; therefore a mix of available technology options is deemed to be appropriate to ensure an integrated approach which is practical, but gives due consideration to economic, environmental and social implications within the context of local circumstances and conditions.

The Strategic Plan is scheduled to put forward a number of options for the Government's consideration by the end of this year. These options shall be based on providing sustainable solid waste management, ensuring that the much-needed improvement reaches all citizens in all areas of the country incorporating the principles of the waste hierarchy.

However as waste continues to be produced, it is not possible to stand idle and the Government has already built or is committed to building a number of important SWM facilities. These include a new transfer station serving the Federal Territory of Kuala Lumpur with a capacity of 1,700 tonnes/day; this had been commissioned late last year, the construction of three thermal treatment plants in Kuala Lumpur, Penang and Cameron Highlands, which have been scheduled to start in the near future; and the construction of sanitary landfills.

In the context of technical options perhaps the following areas have been identified as worthy of consideration by the Strategic Plan:

- Development of municipal waste thermal treatment facilities incorporating use of gasification technology which has significant environmental advantages over conventional incineration methods;
- 'Semi-aerobic' sanitary landfill design, construction and management experience;
- Development of integrated waste management facilities, where the concept of treating waste as a resource/commodity focuses on separating waste into its components on one site and disposing of the residual to landfill. Whilst not an innovative technology the approach of refining waste using a range of processes presents major opportunities;
- Development of the composing process;
- Technology including refinement of waste plastic materials/quality for use in downstream plastic industries;
- Promotion of green waste composting programmes; and
- Consultancy, training and management information systems.

The Government realises that much remains to be done in Asia in general, and this region in particular in the field of solid waste management. One important reason for handling the responsibility of SWM to the Federal Government is that technologically superior projects requiring large investments and technical skill may have a better chance of implementation. The Government is keen to advance such technologies in the country and possibly throughout the region and Asia.

vi. Public Participation

In general the public has little understanding of what constitutes solid waste management. In a study targeted at residents of Kuala Lumpur and Petaling Jaya, 46% of the respondents said that they did not know what happened to their waste after it was collected.

Experience in other countries, where high rates of waste reduction, re-use and recovery have been achieved, shows that the public contributed very much to these successes.

While this may not be a purely academic issue, it would be very beneficial of researchers to devote some research on the subject of enhancing public awareness and participation in SWM.

Conclusion

The Government is determined to provide sustainable solid waste management throughout the country. In this regard the Federal Government will play a more direct role with the proposal for federalisation of SWM. However there will be important roles for the state and local authorities, the latter for example will continue to take responsibility for the direct monitoring and enforcement of the service.

The private sector will become the main service provider under an institutional and legal framework that will ensure comprehensive and cost efficient service. We are often reminded that in adopting federalisation and full privatisation of the SWM, we are aetting a precedent in the world and there in no recorded experience to refer to. However, we have decided that this is the best way forward.

International Conference on Non-Ionising Radiation - A Summary Report, 20 - 22 October 2003, Kuala Lumpur, Malaysia

Introduction

As the result of public concerns on the health effects of non-ionising radiation (NIR), the Cabinet directed the Ministry of Health to make a study in 1996. The Interagency Ad-Hoc Scientific Committee reviewed literature on thousands of researches and studies available at that time and reported to Cabinet in July 1996 that there was no conclusive evidence that NIR at levels normally encountered can cause harmful health effects. This Committee further recommended that we should follow the latest findings on NIR, especially the findings of the World Health Organization's (WHO) International Electromagnetic Fields (EMFs) Project 1996-2005, and take the necessary actions such as disseminating relevant information to the public or enforcement actions if necessary. This task was given to the Interagency Scientific Advisory Committee on Non-Ionising Radiation, which replaced the Interagency Ad-Hoc Scientific Committee.

The public all over the world are concerned on the health effects of NIR due to the widespread use of household appliances and mobile phones. By the end of 2002 there were 9.2 million mobile phones in Malaysia. There were 106 mobile switching centers and 10,507 base stations to support these mobile phones. In 2002, Malaysia consumed more than 60,000 gigawatt-hour (GWh) of electrical energy. There are more than 50,000 substations (both transmission and distribution) and the total length of overhead and underground high-voltage transmission lines total more than 600,000 km.

Although NIR does not have sufficient energy to damage human cells, there have been reported health effects due to NIR exposure, which include headaches, nausea, tiredness, memory loss, loss of appetite and cancer. A number of epidemiological studies suggest the existence of weak links between NIR exposure and health. Epidemiological studies deal with medical statistics of human health and are not easily reproducible. The actual link between NIR exposure and human health, if any, may be a very complex one. There may be so many possibilities; the same NIR exposure to different individuals may not produce the same results. NIR exposure may just be a cofactor to produce health effects and actually need a complex mix of one or many other factors to produce health effects. This uncertainty makes the public very worried. This is further compounded by the very many studies and researches which reported positive findings but most of which were later found to be not reproducible; also meaning that these studies may not be creditable.

Malaysia and the World Health Organization's (WHO) NIR Programme.

WHO's International Electromagnetic Fields (EMF) Project aimed to find gaps in knowledge regarding NIR exposure and hopes to ultimately come up with fact sheets and dose limits. This Project also ensures that researches that are carried out are creditable and reproducible and that they follow scientific procedures. It coordinates researches worldwide so that scarce resources and personnel in this area are optimally and effectively used.

In addition to this, WHO is also preparing a framework for NIR standards so that the various countries have the same dose limits and the same type of guidelines or control. Malaysia joined the WHO Programme on NIR in 2001. A number of WHO sponsored workshops/conferences were held in different countries and all conference findings will contribute towards the final WHO objective. The meetings/seminars/conferences include,

- International Conference on Non Ionizing Radiation (ICNIR), 20-22 October 2003, Kuala Lumpur, Malaysia;
- 3rd International EMF Seminar in China, 13-17 Ocotber 2003, Guilin China;
- Application of the Precautionary Principle to EMF, 24-26 February 2003, European Commission, Luxemberg;
- 2nd International Workshop on Biological Effects of Electromagnetic Fields, 7-11 October 2002, Rhodes, Greece;
- 3rd International Conference: Electromagnetic Fields and Human Health, 17-25 September 2002, Fundamental and Applied Researches Moscow and St. Petersburg, Russia;
- The Bioelectromagnetics Society (BEMS)- 24th

Annual Meeting, 23-27 June 2002, Quebec City, Quebec, Canada;

- WHO/ICNIRP Conference on EMF Biological Effects + WHO Standards Harmonization for the African Region + WHO RF Research Coordination meeting, 4-7 December 2001, Cape Town, South Africa;
- WHO Meeting on EMF Biological Effects + Standards Harmonization in Asia & Oceania, 22-24 October 2001, Seoul, South Korea;
- European Bioelectromagnetic Association (EBEA) – 5th International Conference, 6-8 September 2001, Helsinki, Finland;
- WHO Workshop-Selection Bias in EMF – Childhood Leukemia Epidemiologic Studies, 27-28 July 2001, Whistler, British Columbia;
- WHO Standards Harmonization-Eastern European, 28 April-3 May 2001, Varna, Bulgaria; and
- Americas Regional Seminar on Bioeffects + WHO EMF Standards Harmonization, 7-9 March 2001, Lima, Peru.

The Conference in Guilin, China in October 2003 came up with the framework for guidelines on NIR. The International Conference on Non-Ionizing Radiation held in Kuala Lumpur, Malaysia on October 2003 will be followed by the Conference in Istanbul, Turkey on June 2004 whereby the study on childhood leukemia will be reported. This will be followed by a conference in Geneva, Switzerland in 2004, which will decide on the framework and guidelines to be adopted.

The International Conference on Non-Ionizing Radiation (ICNIR), 20-22 October 2003; Malaysia.

This Conference was held jointly by the Ministry of Health Malaysia (MOH)(Engineering Services Division), Universiti Tenaga Nasional, Energy Commission (EC) and the Malaysian Communications and Multimedia Commission (MCMC) with the cooperation of WHO, IEEE and Cigre. This Conference covered the whole range of the electromagnetic spectrum which included the extremely low frequency electromagnetic fields, radio frequency, microwaves and optical radiation. This conference looked at the local experiences, studies and researches by scientists from various countries as well as the different countries' practices in dealing with NIR. It is also aimed at creating public awareness and to be a platform for those who are interested to get more balanced and accurate information on NIR. It also acts as a forum for NIR researches to present and discuss their findings with peers. For the various Government agencies, this Conference acts as a two-way communication vehicle to transmit relevant NIR information as well as to gather feedback on issues under their purview.

A tutorial session was held one day before the conference. Both local and foreign lecturers covered topics on static and extremely low frequency radiation, optical radiation and radio frequency and microwave radiation.

There were 4 keynote addresses and 17 papers presented; 12 of these papers were presented by overseas speakers. The overseas speakers were from Japan, Saudi Arabia, India, China, WHO, USA and Australia. There were more than 300 participants; including quite a number from overseas.

Plans to Ensure the Safe Use of NIR.

Besides the Cabinet report on the health effects of NIR produced by the Interagency Ad-Hoc Scientific Committee in 1996 and the literature reviews on the latest research findings by the Interagency Scientific Advisory Committee on NIR, the Ministry of Health Malaysia also had the services of a WHO consultant in 2001. Malaysia follows closely the findings and recommendations of WHO on ways to control NIR. Depending on WHO's recommendations and other local criteria Malaysia may choose to control the use of NIR either by mandatory or by voluntary means. In the former case an Act will have to be instituted. In the latter case guidelines will be produced by the various agencies that are involved in NIR. These guidelines can be used by any government agency in their control of NIR. The final decision will be based on WHO's recommendations and the local situation.

Conclusion

This Conference enables the Malaysian public to be more aware of the latest findings on the health effects of NIR. It also provides local researchers and scientists a platform whereby they can discuss their findings with their peers from overseas. It also enables the enforcement people to know the practices in other countries and also the latest findings and recommendations by WHO. Meanwhile WHO has recommended the cautionary or prudent approach to occupational health and safety issues and to organize similar conferences to review the worldwide progress in NIR researches, findings and local issues. WHO also recommended the use of the International Commission on Non-Ionizing Radiation Protection (ICNIRP) Guidelines.

Planning Health Information System - Using Geographic Information Systems (GIS) for Better Health

Rezina Shams

Abstract

The development of Health Information Systems or HIS are proposed as a concept plan requiring database development, resource development and most importantly the process itself, which comprises the intangible component of the plan. The articles published in various journals on the use of Geographic Information Systems (GIS) in health are reviewed with a purpose to exemplify the range of applications and highlight the obstacles in its application. GIS is used in disease mapping, access provision to health service and policy formulation about intervention. Major barriers in developing countries are lack of geographically referenced data, inaccuracy of data, and gaps in record. Barriers in developed countries are an organisational culture positioned toward protecting information. Lack of technology and skills can be overcome with financial resources but inter-agency co-operation requires paradigm shift.

Introduction

Health information is more than a record of visits to the doctor. The patient's details (demography), visits to the physician (accessibility), source of the disease (epidemiology) are only a few examples of the immense amount of information generated around health. The plan of a better health for the community, therefore, requires the integration of a variety of health data. Effective integration is possible if this data is stored and managed within one repository that is a single **Health Information System or HIS**.

All of the health information is in some way associated with place or places. For instance, patient's details contain residential addresses requiring geographical location; visits to the physician depend on available transport routes and services requiring geographical orientation; assessment and treatment of vector borne disease require identification of the geographical origin of illness. Due to the geographical association of the health information, it is sensible to record and store health data in a computerised database system that can manage the spatial[1] nature of the information. Geographic Information Systems (GIS) is such a system. Davis (2001) defines GIS as comprising three integrated elements:

- Geography: the real world or spatial location;
- Information: the data or record, its significance and utility;
- Systems: the computer technology in hardware and software, the supporting infrastructures.

The increasing application of GIS in health is evidenced from the amount of published literature that can be found in various journals - an observation expressed in the editorial of a journal by Higgs (2002). This special issue of Health & Place (2002) is dedicated to the research of wide-ranging applications of GIS in health.

[1] Spatial refers to space. "Spatial data occupies geographic (mappable) space. It usually has specific location according to some world geographic referencing system (such as Latitude- Longitude) or address system."(Davis, 2001).

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Selected journals publishing papers on GIS in health

- Applied Geography
- Australian Geographer
- Australian and New Zealand Journal of Public Health
- Computer, Environment and Urban Systems
- Economic Geography
- Environmental Research
- Health & Place
- Journal of Environmental Management
- Journal of Institutional Research in Australia

GIS has a multitude of roles. The tools in GIS function so as to store, manage, query, analyse and display geographically referenced health data. Although traditional uses of GIS are more about storage, management and mapping of data, the analytical functionality of the GIS tools have been innovatively applied in addressing health policy concern, health inequalities and accessibility, and resource allocation.

Aim

This paper presents several cases illustrating a range of applications of spatial information to health. Application is seen in many sectors of health from simple mapping of disease to understanding epidemiological context to decision making on health service provision. The paper also highlights many of the barriers to the development of HIS both in developing countries as well as developed countries. Considering the utility of HIS and the barriers to its development a concept plan is proposed in this paper. The plan outlines resources that need to be developed, actions that need to be carried out, and processes by which the objective of the plan can be achieved either in stages or concurrently in order to develop a powerful Health Information System.

GIS in Health – case studies

The case studies have been compiled from various publications. The selected cases focus on various aspects of the GIS in Health. Following themes are identified from these publications:

- Importance of geographical referencing of information
- Problems in using routinely collected data
- Ensuring quality control of data
- Need for data standardisation
- Ethical consideration of patient information in medical research
- Development of protocol for data sharing
- Develop and provide support for hardware and software resources of data management

The primary requirement of HIS is the standard geographical location data of a patient. This was one of the problems encountered by Scott *et al.* (2002) in the development of a health information system for cancer in KwaZulu-Natal, South Africa. The incompleteness or absence of patients address (e.g. having name of city only as the address) made it impossible to geo-reference cancer incidence. Lack of address was attributed to large number of patients residing in informal urban settlement or in rural traditional authority areas. Although this was resolved by aggregating data to a central district level address, this lost the actual incidence pattern over the whole district. In some cases patient's files could not be accessed. The database only captured the reported case while many more cases could be unreported due to lack of access to facilities and socio-economic condition. The data coverage was incomplete since only public hospital records were accessed thus privately treated patients were not part of the database. Therefore, limitations to be aware of in the disease mapping of a developing country are the incompleteness, inaccuracies and unreliability of medical records. The importance of creating standard address recording method to allow for accurate spatial referencing cannot be overlooked in this case. Myaux *et al.* (1997) has also restated the lack of demographic information and geographic location of population in the field as the limitation of spatial analysis application in developing countries. He applied GIS to map the distribution of acute diarrhoea in rural Bangladesh in order to identify risk areas.

Haas (2003) further emphasised the importance of reliable data in decision- making in the context of air pollution in Malaysia. He concludes that lack of quality data not only allows underestimation of environmental impacts analyses

and the discharge of polluters from conviction, but also becomes an important deterrent in political persuasion. This is undoubtedly a hindrance to the will to move toward better health.

Forand *et al.* (2002) cautioned the researchers and policy makers in using routinely collected health information at its face value. Health professionals need to be vigilant and critique hospital records, vital statistics and population data when preparing thematic maps of disease surveillance. Illustrating the under-reporting or misreporting of congenital malformations in New York State, Forand *et al.* (2002) demonstrated that using spatial representation of data in conjunction with descriptive statistics can help identify flaws and quality control in the application of routinely collected data.

GIS is widely applied to measure accessibility to health care facilities. Although accessibility encompasses quality and variety of services, waiting list, referral mechanisms and physical access. Martin *et al.* (2002b) outlines concerns with 'accessibility' in rural England as the spatial separation between demand and supply (i.e. adequacy of transportation network). A measure of separation can be the function of direct distance measurement (existing transport network and services) and associated travel time. Several variables were considered in this measurement such as type of road, mode of transport (car, bus, rail, walk), trip cost (parking charge), walking time to public transport and the type of health service provision at the supplier end. Although most of the information should be available from a transport information database (TID), this is not the case in UK where public transportation infrastructure is not currently represented by any single organization (Martin *et al.*, 2002b). Spatial separation between demand and supply can also be measured indirectly by population density/sparsity, which are an indicator of rurality and a proxy indicator for sparse transportation network or services. Integrating population census, location of District General Hospital (DGH), road network, public transport timetable, Martin *et al.* (2002) illustrated the transport accessibility (travel times to DGH) in a 'combined car and bus model'.

Producing a thematic map of spatial distribution of reported cancer, Scott *et al.* (2002) demonstrated the correlation between infrastructure development and reported cases. Areas with less efficient health facilities, less developed roads, lack of public transport and lower incomes contribute to lower reported cases. This finding indicates that the real world situation of a health issues at a national level, is obscured due to secondary factors such as the lack of transport facility in this case. These findings are important as they identify the intervention methods in health improvement.

Using GIS and statistical analysis, Ali *et al.* (2002) illustrated a positive relation between cholera incidence and poor sanitation, immigration, population density in a study to identify socio-environmental risk factors of Cholera exposure in rural Bangladesh. Dunn (2001) reports the application of GIS to test linear association between reported illness and distance from factory. The health status of a population living near a wallpaper factory in Durham, UK was measured as a function of estimated exposure to factory emissions. It used the results of a community health and lifestyle survey, and applied GIS to categorise population into exposure groups based on distance of home from factory.

Martin *et al.* (2002a) reports the development of a GIS based Malaria Information System (MIS) for the malaria affected provinces in South Africa. This was a collaborative project between the Malaria Research Programme and the Medical Research Council. The MIS provided data for practical decision-making, a basis for research, formulating drug and insecticide policy, information for the tourism industry, and a decision support platform for a malaria control program. Due to malaria being a notifiable disease in South Africa, detailed records of the patient (age, gender, address, movement history) are collected by health surveillance officers and regional health clinics and sent to the National Health Department. The computerised spatially referenced data management system comprised a data input front-end, automated mapping component, a relational database (malaria case data) and spatial map data (administrative boundary, road, river, health facility). Malaria incidence being determined by rainfall and temperature, and its occurrence identified in the low lying areas of South Africa, the GIS can further help in identifying potential risk areas by integrating land information data (topography, drainage), weather data (rainfall, temperature) and population data (distribution, density and socio-economic status). The development of MIS necessitated the design of standard data forms, provision of hand-held GPS (Global Positioning System) receivers, staff training and computer support. Martin *et al.* (2002a) describes the development of the database in some detail in this paper.

The sharing of geographically referenced data, collaboration and cross-governmental initiatives by health administrators are important steps towards improving health of the patients (Higgs and Gould, 2001). On the other hand the regulatory requirement with regard to maintaining confidentiality of medical records has been stressed. The health-GIS

researchers are, thus, challenged to work under the constraint of the type of data that can be collected, ethics of data disclosure, consent requirement of patients for registration on a database, and the ethics of geo-coding patient information in medical research. The issue of confidentiality requirement has prevented the Australian Bureau of Statistics from geo-coding census data (Hugo, 2001).

Hugo (2001) expresses his concern about the limited application of spatial information systems in the area of social and community planning, as compared to that of natural resources and environmental management. He argues that the mapping and visualisation capability of GIS is an important device to facilitate problem identification, analysis of complex issues and promotion of a particular course of action. From the point of social and community planning (the health of the community), the most pertinent issue is the analytical capacity of GIS as illustrated in Figure 1. GIS also offers methodology for overcoming resource allocation inequities and efficiencies. In this paper Hugo (2001) describes the work of National Key Centre for Social Application of GIS (GISCA) in the Australian context. Application of spatial information can be seen in assisting social and community planning of both private and public sectors such as in health, recreation, crime, emergency planning, transport planning, aged care, service provision to remote areas and dispersed population, population projections, education and urban planning.

Page (1993) summarises the potential application of GIS as follows:

- ***Earlier need detection***: Government assistance can be effectively targeted, by continuous evaluation and identification of community hardship with the help of GIS.
- ***Speedier conflict resolution***: Problem-solving discussion can be aided with the help of well-designed thematic maps.
- ***Better financial planning***: Resource deficient area can be emphasised, whether particular need of overall population or the overall need of a target population, with the help of a reliable and complete GIS.
- ***Continual monitoring***: Control measure programs can be re-designed or reoriented if monitoring data are regularly reviewed using analytical capability of GIS.
- ***Reassessment and evaluation***: Project managers can evaluate the long-term operation of a program by matching needs with services, using GIS.

Examples of some of the work by GISCA are the preparation of a crime atlas and a social health atlas of Australia. An important contribution is the development of an index to measure remoteness of population locality in Australia known as Accessibility/Remoteness Index of Australia (ARIA) which is based on population localities, distance between the localities, and the number of each class of service centres. This has been used to measure accessibility of health services, highlighting that remote areas are deprived of health service facilities (37.5% of population in the remote areas are from indigenous communities) and that there is an under provision of health services in non-metropolitan areas. GISCA also allows the publication of results on the Internet in order to deliver relevant data to health professionals and to empower the community to lobby for political decision. In the area of epidemiology, GIS can help prepare disaster management strategies by considering the various factors such as hospital beds, target population at risk, disease etiology etc. Another function performed by GISCA was to find suitable relocation sites for people displaced as a result of development. There are many barriers to practical application of GIS and some of these, as identified by Hugo (2001), are lack of understanding the capability of GIS, lack of trained personnel and lack of co-operation and co-ordination among relevant authorities.

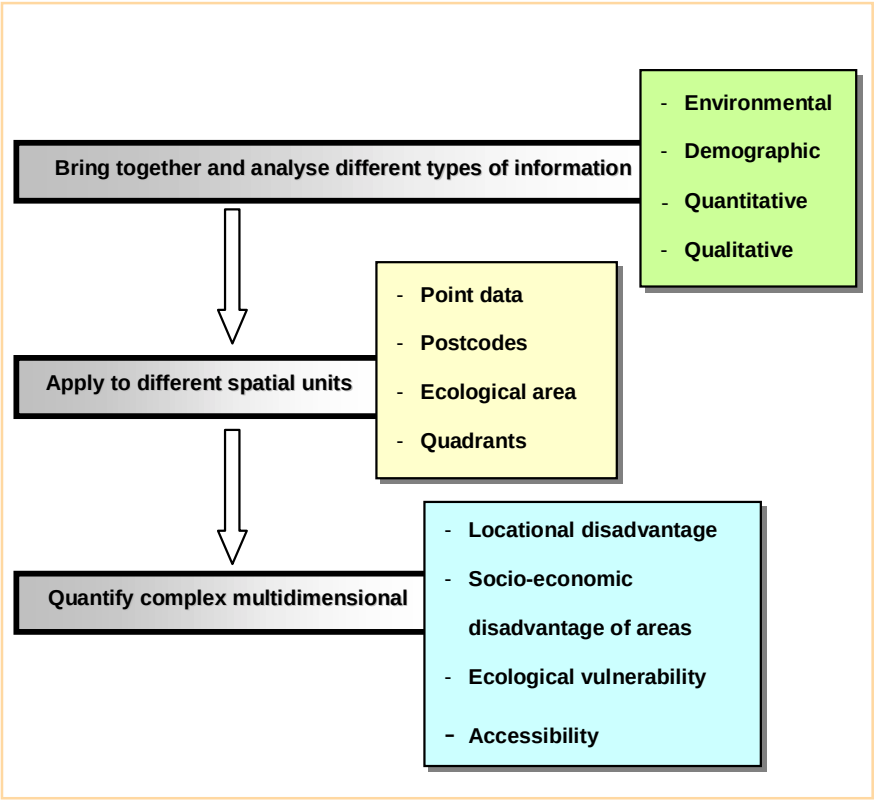
Higgs and Gould (2001) listed many examples of epidemiological study and health care delivery work using GIS. The applications of GIS in health by various workers, from both within National Health Service and academia, are summarised in this paper.

Barriers to GIS application

The will to apply new technology requires the resolve to overcome hurdles. The researchers have identified many obstacles in the implementation of GIS in health. The barriers identified by these authors (Forand *et al.*, 2002; Higgs and Gould, 2001; Hugo, 2001; Martin *et al.*, 2002; Myaux *et al.*, 1997; Scott, 2002) are outlined here.

1. The usefulness of GIS in health and community planning is little understood by planners and decision-makers. It is, therefore, a paramount task to convince the relevant authorities of the potential utility of GIS.
2. Individual government departments are reluctant to share data with other government departments/ institutions. It is imperative that agreements are signed between departments with regard to data sharing protocol.

Figure 1: **Analytical Capacity of Geographic Information System**



3. The acquired data from another organisation can be superfluous due to the variability of methods adopted for data collection and reporting by different agencies. To sustain the information sharing, standards have to be developed with regard to collection, measurement, instrumentation, technique and reporting of data.

4. Government departments are sometimes found to lack specific knowledge about the type of information that is collected by them. Individual departments must have a one-stop shop for their data and this can be achieved by streamlining their data collection and data delivery procedures.

5. There is a tendency for agencies to protect their data from public scrutiny. There is a need to review attitudes toward information that is collected by public agencies.

6. Private organisations are also creating huge databases on profiles of individuals and places. It is important to initiate a method to accrue this data. There is also a need to place controls on private data collection and the use of that data by these private enterprises.

7. Lack of trained personnel in GIS is a crucial obstacle in many organisations. There is serious need to train and/or recruit staff in the operation, maintenance and application of GIS.

8. Personnel sometimes lack the technical facility to carry out the task of GIS operation efficiently, such as identifying geographical location of data. Provision of GPS will allow geographical referencing of data, and adequate computing equipment will allow the timely transfer of information from field to central database.

9. The confidentiality of an individual's private information is a critical issue. The ability of GIS to trace an individual to a particular address may be subject to unwelcome intrusion by state or private sectors on individual's privacy. Clear ethical codes and legislation need to be developed to address the sharing and using of personal information in the data sets.

10. Technology and cost prevents the use of spatial information by the wider community. There is a need to make data easily available, both in a technical and financial sense.

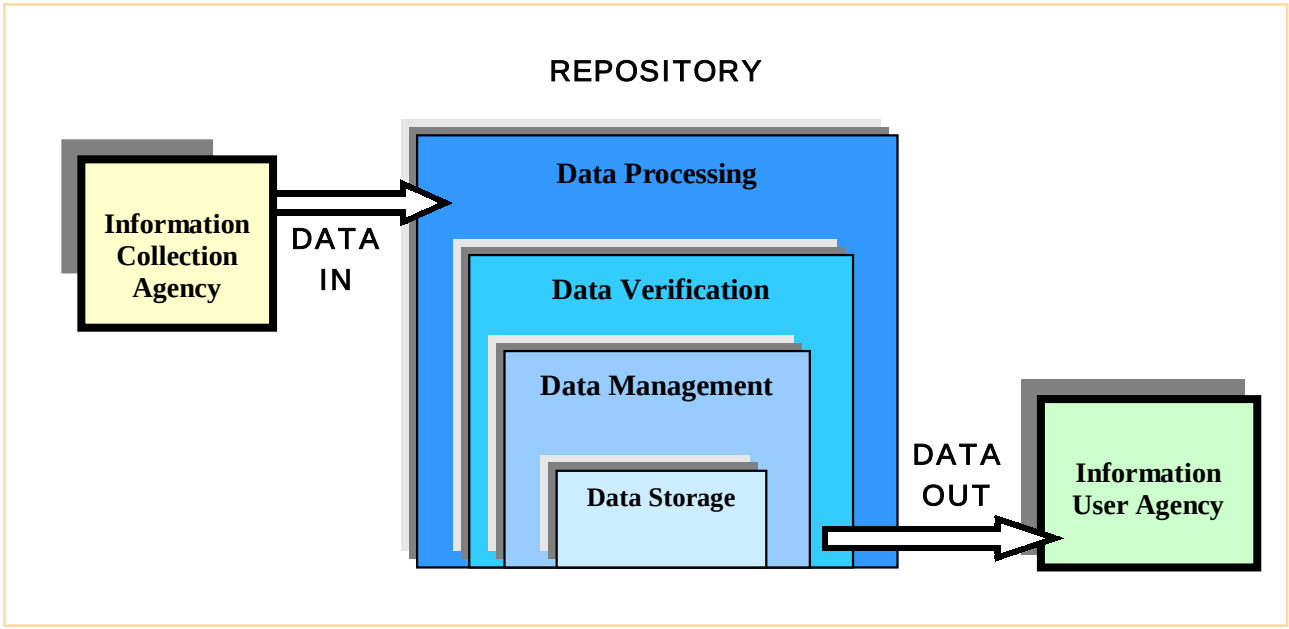
Concept Plan for Health Information System

A concept plan is proposed to develop a new HIS. The underlying considerations of the design of this plan are the barriers outlined in this paper. There may be many more obstacles that are not identified here. Some of these could be specific to a country, locality and organisation.

Once a decision is made to develop the **HIS**, a national central agency should administer the development so that consistency is maintained. A central data repository or central database system should be set up. This repository functions as the collector of data from the collecting agencies/individuals as

well as discharge point for the user agency/individuals (Figure 2).

Figure 2: Health Information system (HIS) – Concept Plan



A repository is a hardware system, a software system and a sub-section of a national agency. The agency takes the responsibility, with the help of stakeholder agencies, to instigate as well as facilitate the process. They oversee the development of consistent data collection protocol, initiate development of MOU for data sharing, and possibly management of the system of both hardware (computer) and software (data). Where possible individual agencies should have developed their hardware and soft ware resources. Until such capability is developed by individual organisations, the central repository must manage relevant data until such time when that responsibility can be discharged to the relevant organisation.

The implementation of the plan requires resource development, database development and process (Figure 3).

Resource development comprises human resources, hardware and software. This is infrastructure development, purchase of computers and GIS software, the training of existing staff and the recruitment of new staff. Training would encompass the use of new equipment (GPS), standard data collection procedures and measurement techniques, operation of GIS.

Database development comprises the collection of data in the field, digital entry of data, validation of data and storage of data in logical format.

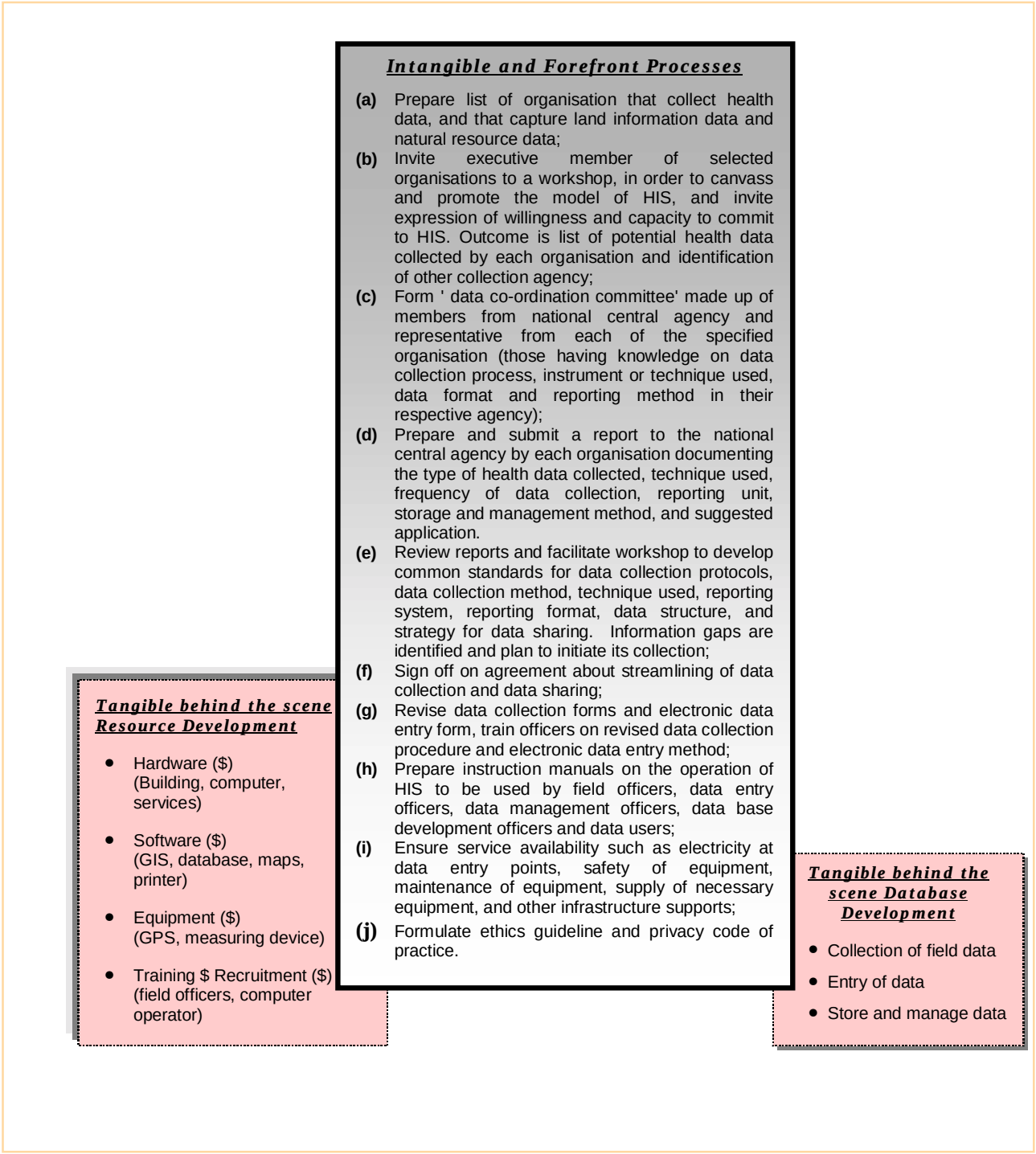
Both of these are a tangible part of the plan without which HIS cannot operate. However, these two components of the plan are accomplished behind the scene.

Process is at the forefront of the plan but it is an intangible component. This is where the barriers will be conquered, new co-operatives will be formed, standards will be set and decisions will be made. Processes include a series of meetings and workshops, dialogue and negotiations, and forming strategies. Processes are explained in some detail.

a) The first step towards development of HIS is the listing of a selection of organisations that collect health data as part of their routine work practice or hold health data in some sort of format. Organisations collecting land information data and natural resource data should also be part of this directory.

b) A subsequent step is to invite executive members

Figure 3: **Health Information System (HIS) – Implementation Plan**



of these selected organisations to a workshop. The purpose of the meeting would be to canvass and promote the model of HIS. Opinion should be sought about the individual organisation's willingness and capacity to commit to HIS. An outcome of this workshop should be an identification of organisations willing to contribute towards the building of HIS and a compilation of a list of potential health data collected by each organisation. The group should also identify other agencies with whom there is a perceived relationship with regard to data dependency/ data sharing/ data storing or data provision.

c) An essential step in the 'process' is to form a ' data co-ordination committee'. This committee is made up of members from a national central agency and representatives from each of the specified organisations. The nominated representative from each specified organisation is the officer responsible for data co-ordination in the department with knowledge on data collection processes, instruments or techniques used, data format and reporting method within their respective agency.

d) At this stage a project should be initiated to prepare and submit a report by each organisation to the national central agency. The report documents the type of health data collected, technique used, frequency of data collection, reporting units, storage and management method (e.g. paper copy and electronic format), and suggestion of its usefulness or application.

e) After review of these reports by national agency members, a facilitated workshop should be arranged in partnership with other member organisations. An outcome of the workshop would be to develop common standards for data collection protocols, data collection method, technique used, reporting system, reporting format, data structure, and strategy for data sharing. An alternative option is to deal with each organisation on a one to one basis, compile the results and then present them at the workshop in order to inform and then make a collective decision. Participants should also explore and identify gaps in information and make plans to initiate its collection.

f) Signing off on an agreement between the participating organisations regarding the streamlining of data collection and sharing, will lay down the foundation of HIS.

g) Subsequent steps in the 'process' are development of revised data collection forms and electronic data entry forms; training of technical officers on revised data collection procedures and electronic data entry method.

h) Preparation of instruction manuals is a fundamental requirement for the successful performance of HIS. A manual, on the operation of HIS, is for the use by field officers, data entry officers, data management officers, database development officers and data users.

i) Executives of HIS must consider the available services in their plan, such as electricity at data entry points, safety of equipment, maintenance of equipment, supply of necessary equipment, and other infrastructure supports.

j) Last but not the least is the formulation of ethics guidelines and regulation on privacy code of practice.

Conclusion

The successful implementation of Health Information Systems requires cultural change by organisations, towards data sharing and commitment to overcome many of the barriers. Training and skill development must commence along side with technology development, both incurring expenditure. The wide varieties of applications of GIS in health, in many countries of the world, are indicative of the usefulness of spatial data in health management. The co-operation and co-ordination of various government agencies is crucial to allow the implementation of an integrated approach to better health outcomes.

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Geographic Information System: Uses, limitations and challenges in environmental health

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Abstract

The links between environment and health are inherently spatial and the utility of geographic information system (GIS) in environmental health research lies in this ability to spatially link environmental and health data. The potential uses of GIS in environmental health include simple mapping of diseases and exposure, estimating exposures to individuals within defined geographic regions, identifying populations at risk for environmental hazards and identifying clusters of disease within populations. The limitations to using a GIS in environmental health research can be broadly divided into issues to do with quality of environmental and health data and technical issues relating to GIS. Finally, there are also some major challenges in the utilization of GIS in environmental health. These include greater collaboration between health, non-health researchers and scientists, improving data quality and accessibility, resolving confidentiality issues, improving GIS functionality for environmental health research, commitment to capacity building in the use of GIS and using GIS to answer the appropriate research questions around environment and health. These challenges will have to be met before GIS is routinely used by environmental health researchers.

The impact of geographic information systems (GIS) has been widely felt in all fields that use geographic information, for example, resource management, environmental management and planning of health care facilities. However, health researchers perceive the application of GIS as unproven technology (Tim, 1995). Nonetheless, there are increasingly new applications of GIS in analyzing the links between environment and health because these links are inherently spatial (Briggs, 1997). Environmental factors vary across geographical areas and hence the associated health risk and subsequent adverse health outcomes and health needs will also vary spatially. These spatial or geographical variations in disease and health needs should be of interest to health researchers, health service managers and policy makers.

There are many definitions of both environmental health and GIS. Environmental health can be defined as a discipline "concerned with the adverse health effects of exposures to environmental factors (primarily biological, physical, chemical)" (Kjellstrom, 1999). Examples of environmental health issues include effects of ambient air pollution and water pollution on health, adverse effects of exposure to electromagnetic radiation and adverse effects of pesticides and herbicides on human health. Social and cultural factors, for example, educational attainment, socioeconomic status and ethnicity, can also be thought of as environmental factors.

GIS has been described as a system that "links nongraphic attributes or geographically referenced data with graphic map features to allow a wide range of information processing and display operations as well as map production, analysis and modeling" (Antenucci *et al.*, 1991 cited in Vine *et al.*, 1998) or as "a series of computerised maps (a base map and overlays) that provide for the storage and retrieval of an extensive amount of geographically indexed data" (Bayea and Hatch, 1999).

The utility of GIS in environmental health research lies in this ability to spatially link environmental and health data. The potential uses of GIS in environmental health include: simple mapping of diseases, identifying associations between exposures and the spatial distribution of disease, estimating exposures to individuals within defined geographic regions,

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identifying populations at risk for environmental hazards and identifying clusters of disease within populations.

Mapping of disease is not new. One of the earliest examples of the use of mapping was in the investigation of the 1854 cholera outbreak in London by John Snow (Lang, 2000). John Snow mapped households where cholera deaths had occurred as well as the location of water pumps that provided potable water to those households. He was able to demonstrate that most deaths were clustered around one particular water pump (the Broad Street pump) and by removing the handle of that water pump he was able to reduce the incidence of cholera – a simple yet effective public health intervention, but at the time a very courageous one as the bacterial aetiology of cholera was not known.

Mapping disease and exposure is a descriptive analysis demonstrating spatial relationships. Such mapping of disease and/or exposure is also a very effective presentation tool – there is a very high impact factor on the audience, whether it is community groups or policymakers. However, using a GIS for purely presentation purposes does not utilize the full potential of a GIS. There are a number of GIS functions, for example, automated address matching, distance functions, buffer analysis, spatial query, polygon overlay analysis and spatial statistics that facilitate health research and are particularly useful in environmental health research (Vine *et al.*, 1998).

By layering exposures and disease on the same map the spatial association between the exposure and disease can be studied. There may be a very obvious spatial association between the two - however, the mere presence of such spatial correlation obviously does not infer causality. Such observed spatial patterns should generate hypotheses that can then be tested using analytical study designs, for example, case-control studies or cohort studies.

An important contribution of GIS to environmental health research is in exposure assessment. There are some good examples in air pollution research (English *et al.*, 1999; Briggs *et al.*, 2000; Bellander *et al.*, 2001). Air pollution concentrations for small geographic areas can be estimated using emissions inventories and dispersion modeling. These estimates can then be used in air pollution research as proxy measures of personal exposures for the population of these small geographic areas. Outcome factors, for example, prevalence of asthma or deaths from cardiovascular disease, and potential confounders, either measured at the ecological level or individual level, would be used in the analysis.

Other examples of modeling exposure data include lead levels (Guthe *et al.*, 1992), radon levels (Kohli *et al.*, 2000) and levels of electromagnetic radiation (Valjus et al. 1995; Wartenberg et al. 1993). This is by no means an exhaustive list. Spatially modeled exposure data overlaid on population data can also be used to identify and quantify the population at risk (Kohli *et al.*, 1997; Ward *et al.*, 2000).

Although GIS technology is now widely used by many organizations, governments and researchers in planning, policy making and decision-making there has been slow progress in environmental health research (Tim, 1995). There are limitations to using a GIS in environmental health research and they can be broadly divided into issues to do with quality (and accessibility) of environmental and health data and technical issues relating to GIS (Tim, 1995).

One of the major limitations is the quality and accessibility of available data – exposure, outcome and potential confounder data as well as the availability of thematic maps. Data quality issues include that of currency (how current is the information on the database), completeness (does the database have all the required information), lineage (that is, when and who collected the data) and data maintenance (who looks after the data) (Tim, 1995). Further there is also the issue of mismatch between the geographical boundaries for environmental and health data. Health data are usually collected for administrative units, for example, local government areas, whereas data on environmental factors are often only available for individual monitoring sites or for topographic areas. Finally, freely accessible electronic health and environment data will encourage the utilization of GIS in environmental health research.

There are also many technical impediments that inhibit the use of GIS. Firstly, users other than environmental health researchers have driven advances and developments in GIS software. Hence systems relevant to environmental health have not been developed. Secondly, although most GIS have provided a spatial data manipulation environment, they have yet to provide a spatial statistical analysis environment and often data have to be exported to other software for spatial statistical analysis. Finally, relatively little information has been available to guide potential users in the implementation of GIS technology (Tim, 1995).

There are many challenges in the utilization of GIS in environmental health. Some of the very limitations outlined above are some of the challenges that need to be met. A major challenge is in fostering not only greater collaboration among environmental health researchers, health planners, environmental scientists, medical geographers, GIS

specialists, biostatisticians, but also professional respect and trust amongst collaborators.

Another challenge is that many datasets essential in environmental health research are owned by government agencies and perhaps by private organizations. It is imperative that all owners of datasets commit to improving their quality and accessibility. Many of these datasets would already be collected for administrative purposes and it would simply be value adding to be able to use them for health research.

One of the inherent strengths of a GIS is its geo-coding ability. The increasing need to accurately map street addresses, for example, in the investigation of disease clusters, may lead to a breach of confidentiality especially if the study area is small or the number of health events is low (Vine *et al.*, 1998). Therefore, an important challenge for environmental health is resolving the confidentiality and associated ethical issues around sparse spatial data.

Improving GIS functionality to enable it to address environmental health research questions, for example, by providing a platform for spatial statistical analysis, will be a challenge for developers of GIS. Such improvements will facilitate the use of GIS in environmental health and help to answer important questions about disease associations.

There also has to be a systematic and committed approach to capacity building in the use of GIS in environmental health. This will be a challenge for managers especially when there are competing demands for scarce resources. Finally, perhaps the most important challenge is in using GIS to answer the appropriate research questions around environment and health.

In this paper, the uses and limitations of GIS in environmental health have been discussed and some of the challenges outlined. Understanding the complex interactions and associations between environmental factors and disease is essential to develop acceptable and effective public health policies. GIS is a powerful tool that enables the generation and testing of hypotheses involving environmental, cultural and social factors in the causation of disease. Although there are some major challenges to overcome before environmental health researchers routinely use GIS, the future looks promising.

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Connecting the Cultures in Sustainability Action Research

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Abstract:

Acting for sustainability through thinking globally and acting locally calls for cooperation both within and between countries in professional practice, monitoring and research. At the global scale, we need to develop the capacity to bridge the languages and community structures of different countries in the same region. At the local scale, groups of individuals, communities, specialists and governments need to work cooperatively within each country. Parallel research programs set in the different geographic regions and national cultures of Semenyih Catchment in Malaysia and Murray-Darling Basin in Australia, respectively, have developed a strategic framework and the concept of nested knowledges that have been used to guide action research in both places.

The authors' have gathered evidence on sustainability decision-making within Malaysian and Australian communities using a strategic framework which links individual, community, experts, government and holistic knowledge. In each region, community, specialists and government were found to construct sustainability issues so differently from each other that they set up different knowledge cultures between themselves. The relationships within each set of local knowledge cultures were surprisingly similar in Malaysia and Australia. Details of the similarities and differences in sustainability practiced within and between the countries are discussed.

Multiple Realities in Sustainability Decision-making: An Australian Study (Brown 2003)

Sustainability is by definition global and local at the same time, the local being the unit of, and receiving the impact from, the requirements for global change. The transition towards sustainability therefore requires cooperation between nations globally, and among decision-making sectors locally. The studies examined below examine the potential for a whole-of-community sustainability capable of forming a dialogue between nations. Using collaborative action research methods, research projects in Malaysia and Australia explore the conditions required for cooperation between community, experts and government within local initiatives for progress towards sustainability. The necessary conditions are found to include re-examining and repositioning the current Western culture approaches to the construction of knowledge in both Western and non-Western cultures.

Cooperation on sustainability issues among nations, in this case between Malayisia and Australia, is dependent on finding frameworks for shared decision-making that do not advantage one country or one culture over another. Forest fires, fresh water supplies, and energy emissions are but a few of the many examples of sustainability issues that involve the entire South Pacific region and involve very different social and economic circumstances. The need for even-handed cross-cultural communication is particularly acute wherever industrialised and industrialising countries are working together on scientific research, since the science itself is a Western construct and there is a risk of reproducing the old colonial dominance over the non-Western cultures. Working together on sustainable development issues could potentially lead to either avoidance of scientific method or its single-minded application regardless of cultural differences. Western technological decisions and adaptive management frameworks used without further consideration can only too easily dominate sustainability decision-making, at home or abroad (McMichael, 2001).

Often represented as a matter of sharing values or of combining tools, the transition to sustainability goes beyond

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either of these to the underlying knowledge base, the modes of construction of reality which are all too often taken for granted. While differing social structures and their power relationships mean that decision-making systems differ markedly between national cultures, identical lists of essential contributors to decision-making are found in the sustainability strategies of every country which has one, both in internal sustainability policy documents and increasingly strongly in global sustainability conventions (WCE, 1972; WCED, 1986; UNCED, 1992; WSSD 2002). Over the decades between 1972 and 2002 there has been a continual call for collaboration between community, experts and government, in policy development, setting priorities, and practical action. Increasingly the calls have widened to include a need for the inclusion of a holistic perspective, and key individuals as sustainability change agents. There are thus five sets of players nominated as key to sustainability decisions within most countries, and certainly in both Malaysia and Australia (Eighth Malaysian Plan 2001-2005; Australian NESD 1992).

As part of the need to match cross-cultural realities in sustainability decision-making, it is of value to examine the processes which link the individual, local, specialised, government and holistic decision-making sectors in parallel studies of different cultures. A joint study between Malaysia and Australian sustainability practitioners has taken that approach within the Local Sustainability Project of the University of Western Sydney, Australian National University and the Environmental Health Research Centre in Kuala Lumpur, Malaysia. In this paper, we will summarise four studies examining ways of combining the five sectors in whole-of-community decision-making on sustainability issues in the field of Environmental Health, two in Malaysia and two in Australia (Sahani, 2003; Ismail, 2003; Brown and Aslin, 2002; and Brown *et al.*, 2001).

There are marked similarities and marked differences between Australia and Malaysia. The two countries have much the same population numbers (about 19 and 20 million people) but with Australia's area being thirty-seven times that of Malaysia. Both countries inherited the nineteenth century British colonial tradition while being at a considerable distance from Britain, and both have Western democratic political, administrative and educational systems, but these are somewhat differently structured. Each country lies in the Asia-Pacific geographic and economic zones. Both are multicultural, but with very different cultural mixes, Malaysia being primarily Malay, with sizable Indian, Chinese and other ethnic groups. Australia, originally with an almost solely United Kingdom heritage now has one in three families with non-English speaking family members, who come from over 40 countries.

Australia is highly urbanised and industrialised (85% of the population live in the south-eastern corner, on 12% of the land). Malaysia is going through rapid urbanisation and industrialisation, with the explicit goal of being fully industrialised by 2020. In both countries, their natural resource base provides a high proportion of their gross domestic product, as a tourist drawcard and for primary production. The goal of sustainable development has been formally adopted by both countries, but with rather different emphasis. Malaysia gives it as one of the goals for the series of Malaysia plans, and in supporting documents relates this to sustainable resource management as an important part of development planning (Eighth Malaysia Plan 2001-2005). Australia has adopted the six principal ESD strategies commonly applied in OECD countries, namely:

- Increasing intragenerational equity:
- Preserving intergenerational equity
- Protecting or repairing ecological integrity
- Applying the Precautionary Principle
- Evaluating linked social, economic and environmental outcomes.

(NESD, 1992)

The policy documents and strategic programs of both countries consistently refer to the need for involving key individuals, communities, experts and government in coordinated decision-making that integrated social, economic and environmental concerns. Both countries emphasise the need for moving from a resource-based to a knowledge-based economy that involves all sectors of their populations, urban and rural, professional and technical workers. The Australian author of this paper had studied such collaborative decision-making and integrative knowledge management in the Australian context in a range of government and community studies, and drawn some conclusions (Brown *et al.*, 2000; Brown *et al.*, 2001; Brown, 2002; Brown, 2003) (Table 1).

The study was based on five three-year projects in each of which the researcher worked with change management teams who were involved in introducing sustainability action into individual post-graduate research programs, whole-of-community-engagement and monitoring, the expert professions of environmental and public health, and local government sector management systems, respectively. In

each case, the action was initiated from within the study context, and driven by the study population. The role of the researcher was to contribute skills and experience to the action itself, and to undertake research initiatives designed to answer the participants' own questions. The research thus incorporated a range of research categories, including:

- *participant observation*, that is, observation of the study group's activities while working as a member of the groups, with their full knowledge and cooperation;
- *action research*, in which the researcher's previous experience and the research findings contributed to forwarding the program of the research participants while documenting the outcomes;
- *collaborative research*, where the research was driven by the aims and outcomes sought by the research participants, and did not originate with the researcher;
- *grounded theory*, in which data is collected directly from the events and observations as they occur and only interpreted later through existing or emergent theoretical frameworks which evoke possible interpretations; and
- *integral research*, in which the primary research purpose was to reach an understanding of the interactions between the full range of participants and the context of the study, with an eclectic approach to the use of research tools.

Table 1: Local Sustainability Project Research Design 1997- 2003

Knowledge base	Focus of study	Field study context
Individual	Integral inquiry	PhD programme
Community	Term of engagement Sustainability monitoring	Murray-Darling Basin Western Sydney
Specialists	Professional practice Professional education	Environmental health Public health
Organisations	Local government management	25 change agents
Holistic	Synthesis workshops	5 management teams

The early study conclusions were that individual, local, specialist, and strategic constructions of knowledge are based on different sources of evidence, address different issues and used different languages, so much so that they can be described as different knowledge cultures (Figure 1). Although these knowledges can be shown to depend on one another, simplistic measures to bring these groups together, or to impose the priorities and solutions of any one of the groups on any of the others could lead to temporary but not sustainable agreements, and often to increased polarisation and even confrontation (Brown, 2000). The study continued to explore ways in which the five knowledges interacted with one another constructively, and came to the conclusion that successful cooperation between the decision-making sectors required recognition that knowledge is socially constructed, mutual transparency and respect between the different modes of construction, key individuals prepared to learn the ground rules of the five major modes of knowledge construction, shared terms of engagement between the knowledge cultures, and a shared holistic focus for the engagement (Brown, 2001).

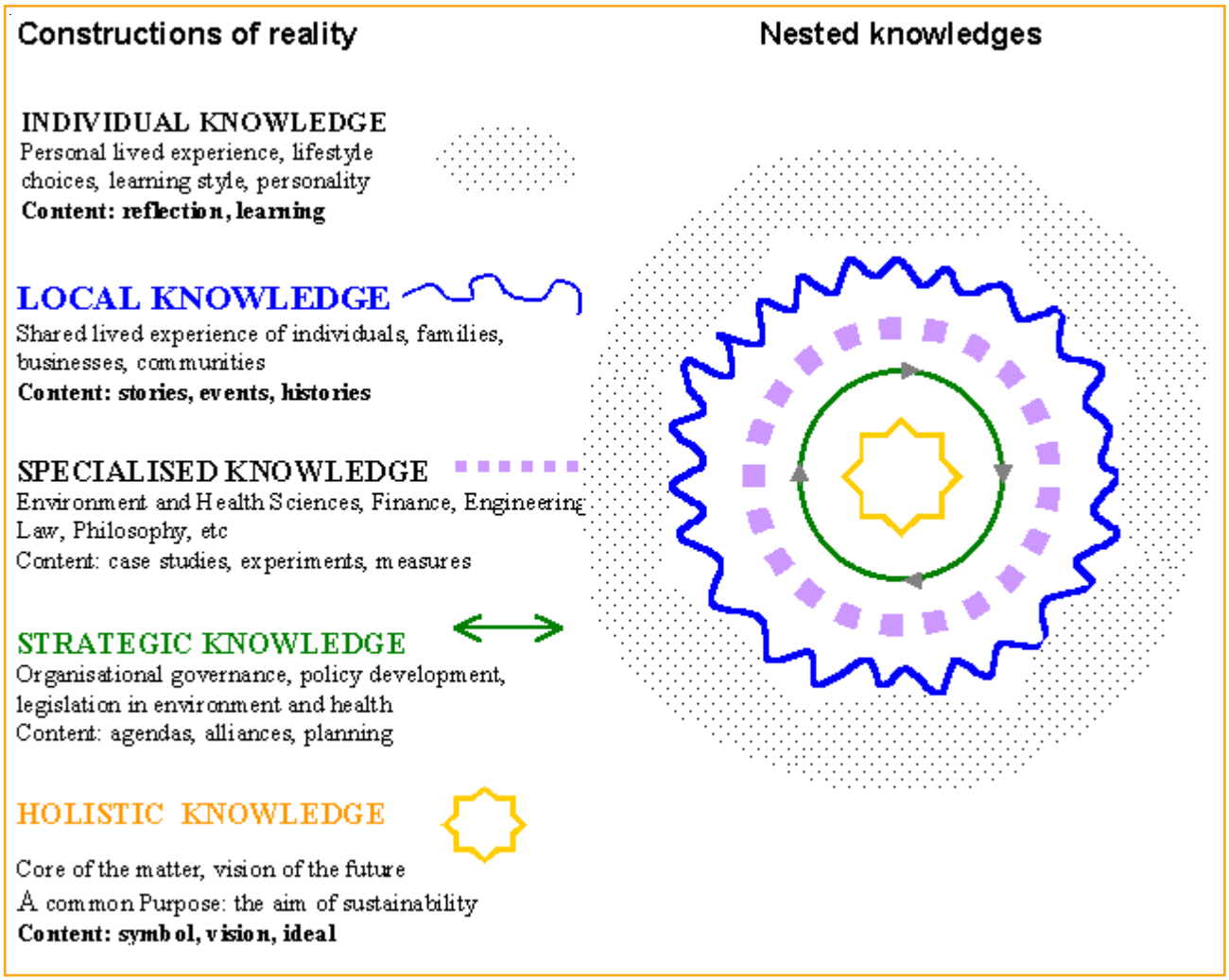
Some of these results should bring no surprise. Since the middle of the 20th Century has it been widely accepted that our knowledge, our understanding of how the world works, is not stored somewhere in libraries nor issues as an edict from some expert source. Knowledge is socially constructed within the human head. Berger and Luckmann's classic "The Social Construction of Reality" called attention to the ways in which powerful ideas such as health, environment, time, sustainability, and progress, are constructed through social interaction. Examined more closely, risks to both health and sustainability are the outcomes of lack of a synthesis between five different constructions of knowledge: individuals adopt high consumption lifestyles in spite of specialised advice; local knowledge supports them in favour of the production economy; specialisms fail to come up with the information effective for individuals and local conditions; a lack of political understanding of the issues leads to lack of strategic direction; and the absence of a shared holistic understanding means there are no connections between all these.

While the dominant system of specialised knowledge tends to mask the others (sometimes to the extent that it is proposed as the only reliable

construction of knowledge) it is always accompanied by individual knowledge, the separate lived experience of each person; commonsense or local knowledge, the shared experience of events in that context or place; and strategic knowledge, a collected overview of the feasibility of a certain course of action as interpreted by government and organisations. There is also a holistic construction of the situation, the central core or aim, within this sustainability.

Figure 1 gives more details of the ways in which each knowledge is constructed and the relationships between them. Note the icons representing the knowledge boundaries. That of individual knowledge is as varied as the number of people involved, a scattergun pattern of dots. Collections of individual knowledge give rise to commonsense knowledge, sets of local knowledge whose boundary is wavy and diverse, matching the variety of its local base. Specialist knowledge is derived from different, compartmentalised perspectives on collections from local knowledge, repackaged within a series of separate frameworks. Strategic knowledge draws on the forgoing knowledges, harnessing them within a system with a given direction. Holistic knowledge offers a focus, the construction of the essence of an issue, rather than a boundary. All five knowledges need to be connected within a synthesis on sustainable practices; crossing the boundaries needs negotiation. On the evidence of these studies, this synthesis is in practice more likely to arrive at a conflict or at best a standoff, rather than collaboration, unless serious measures are taken to provide links between them.

Figure 1: Knowledge Cultures within Western Decision Systems (Brown, 2001)



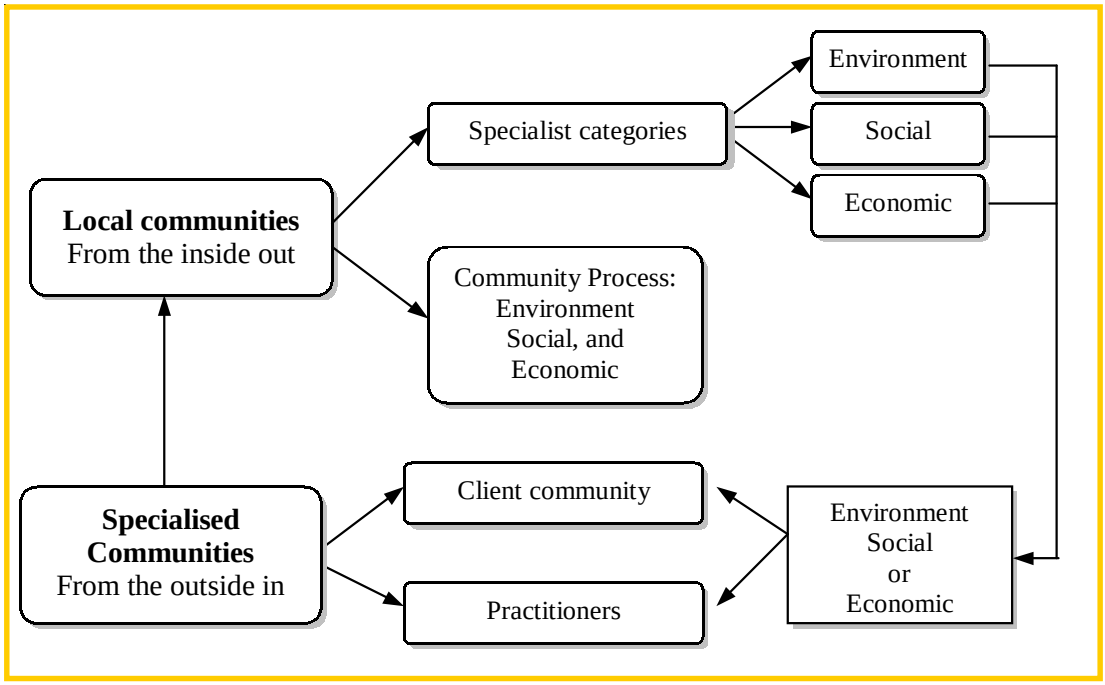
A recent study of the contributions to regional decision-making from the five constructions of knowledge found that that they shared very much the same values for, and an equal commitment to regional sustainability, no matter how much their other values differed. On the other hand, the study found that the five groups used different languages to describe distinctly different priorities among the sustainability issues, different choices among potential remedial practices, and applied different performance indicators. They also identified different opportunities for and impediments to their different interpretations of best practice (Aslin and Brown, 2002). Once the differences were on the table, processes for synthesis were designed which were able to bring about a whole-of-community engagement processes (MDBC 2002). The synthesis depended on the appropriate engagement processes for the four stages of sustainability decision making, developing principles, describing people and place, designing potential, and doing and reviewing in practice (Brown, Ritchie, Grootjans, Verrinder and Townsend, 2003).

Separate realities: Community-based environmental management for health from the 'inside-out' and 'outside-in' (Sahani, 2003)

Through a three-year project in Peninsular Malaysia, researcher Mazrura Sahani used action research and participant observation to generate insights into ways of creating collaborative constructions of knowledge within different forms of Malaysian community, and between communities and their scientific advisors. In six field studies of groups working to incorporate sustainable development she acted as a participant observer in four different place-based communities, one a traditional rural community, two on the urban/rural fringe, and one urban community implementing a Local Agenda 21 program. She also recorded interactions within two expert communities, one research-based working on environmental health issues and the other clinical, the consultation with parents of childhood asthma patients. She wished to determine whether local communities were acting as their own core providers of knowledge of their local environment, with their own reliable mode of construction of local knowledge consistent with the findings of the Australian studies (Sahani, 2001; 2003).

In interpreting the results, this study made use of grounded theory to generate an appropriate framework for linking specialist and community input into environmental management for health. Strengths and difficulties discovered through action research with the various communities (both community and specialist) are analysed using SWOT analysis as a generalisable tool that all sectors could share. The

Figure 2: Separate Realities Model for Environmental Management for Health (Sahani, 2003)



research approach proved capable of documenting the separate realities of the place-based and the knowledge-based communities within a common interpretative framework (Figure 2). The place-based communities held realistic interpretations of their capacity to contribute to local sustainable development, as distinct from the same events as perceived by the scientific community. The conclusion is drawn that each needs the other for any effective local application of scientific findings or government support.

A major finding from this study extends the standard frameworks for environmental health practice to include the establishment of partnerships between environmental health research and professional practice and the communities it serves. The new framework links the community capacity to act on local environment and health issues as perceived from the 'inside-out'; and scientists' methods of generalising issues from the 'outside-in'. It offers a different perspective and an extra set of tools or strategies for the professionals' community to work with communities in their environmental management for health, based on **separate realities** between these two layers of knowledge.

A further finding from this study is the need to make a distinction between disempowered, empowered and unempowered communities. Disempowered communities are familiar to both Australian and Malaysian cultures as communities which have been displaced, lost their resources, or colonised by other interests. Empowered communities are those who have been supplied with extra resources or ability to act from outside sources. Unempowered communities are those still dependent on their own resources as a community, and managing their own affairs. This distinction applies to both Western and non-Western societies, but has particular significance for countries with a history of colonisation.

Working within the web: linking knowledges in sustainability decision-making (S.Asmaliza, 2003)

The Malaysian Government declared its commitment to the principle of sustainable development in the Seventh (1996-2000) and Eighth Malaysia Plan (2001-2005) and outlines in the First Statement in Vision 2020. Tell-tale signs have emerged that indicate that the current sustainable development decision-making process has not been effective in achieving progress towards sustainability. This is of course true not only in Malaysia, with its seriously deteriorating air and water quality, but also in the developed, industrialised Western countries. A major cause, identified by most of the major state-of-the planet reports of this century, is the lack of coordination between the major decision-making sectors, key individuals, community, science, industry and government in addressing the issues.

This study tested Brown's (2001) conclusions that individual, local, specialist, strategic (government and industry) and holistic knowledges form the decision-making layers for sustainability issues, modifying and expanding the framework to suit the Malaysian scenario. Semenyih Catchment was chosen as the case study of sustainability decision-making because it represents an in-progress example of an interwoven set of social, environmental and economic issues in an important catchment area, in which the local, specialist, industry and government decision-making processes were readily accessible. It also allowed the researcher to build on her previous experience in conducting scientific field studies and observations on the river water quality in the Catchment, and so the biophysical conditions were well documented.

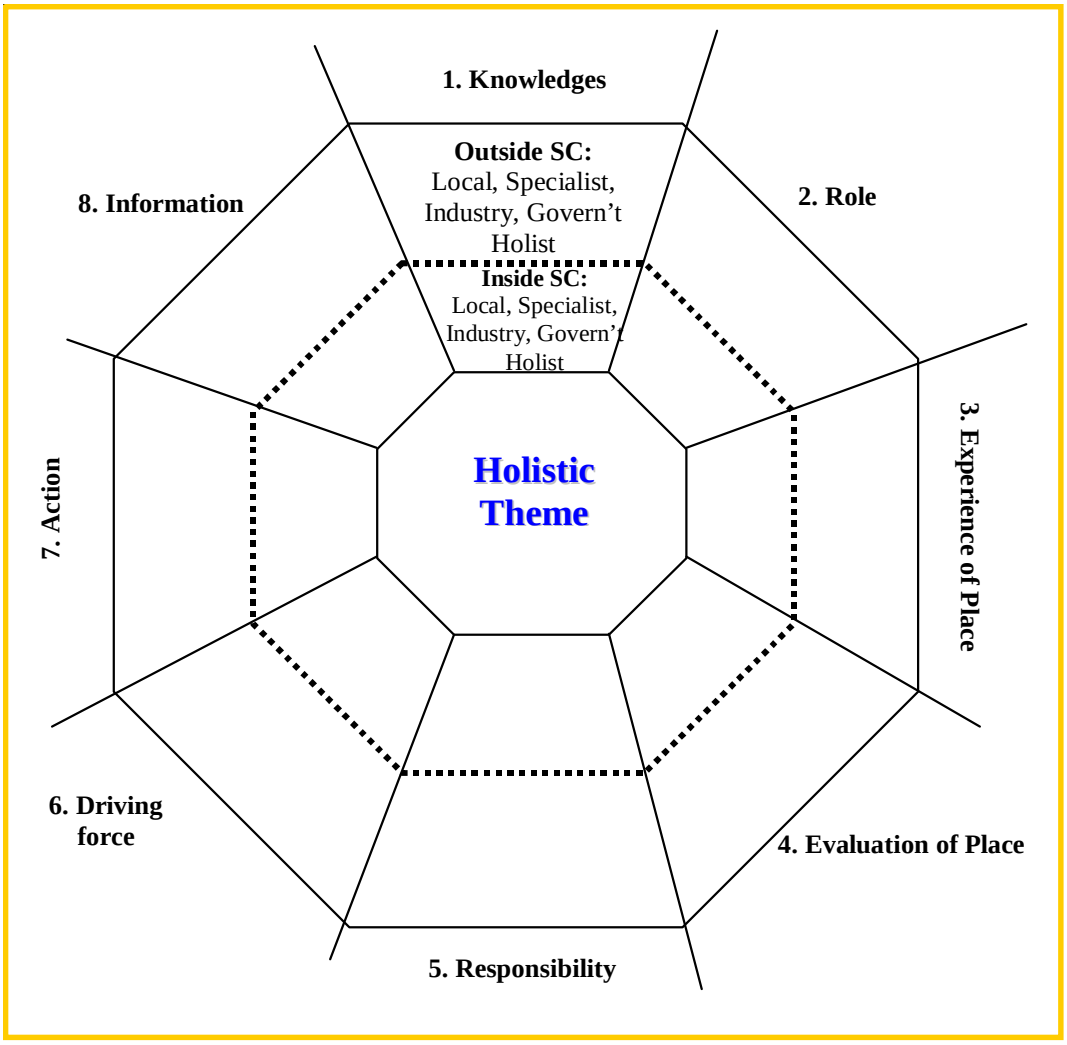
The research questions which arose in the earlier empirical study provided the foundation for the subsequent study, which employed an integral inquiry framework, and used interviews, observations reflections, and document analysis. The study design identified six decision-making layers whose knowledge construction is crucial to collaboration and cooperation in sustainability decision-making: individuals, local, specialist, industry, government and holistic. The common or shared issue was water/river quality. The selected representatives for interview were drawn from each of the five knowledges, and from decision-makers on catchment matters from both inside and outside the Semenyih Catchment. The responses from a total of 135 interviews from these two perspectives were coordinated through an integrating framework.

The synthesis of the research results took the form of a web (Figure 3). The central point of the web was the shared issue, of considerable importance in the decisions of all interviewees: water/river quality. The themes generated by the interviews formed the sections of the web. Whereas the inner layer of the web represented within-Semenyih Catchment and the outer layer as without-Semenyih Catchment, one of the findings of the study was the same knowledge sectors operated across those divisions and so could be linked together within a single web. The sections of the web represented themes pertaining to the Semenyih Catchment and their insights, values and perceptions (Figure 3) While the constructions of knowledge were distinct, there were common themes where the responses are similar, which

suggested the knowledges could be networked within the web formed by the full set of decision-makers. Members within each of the knowledge sectors relied on other sources other than their formal and accepted ways of getting information when they are in their informal networks e.g. a specialist identified going to a coffee shop as a way of getting information which in the formal system would have been dismissed as gossip, not evidence suitable for specialist or government.

The findings in general confirm Browns' framework of a nested system of knowledges that together make up sustainability decision-making. However, the present study has identified some amendments to Brown's position and added further dimensions, particularly in the area of cooperation between the knowledge sectors. It was found that one person in any of the web sections could be making use of all of the knowledges. Some held two or three, and in referring to catchment decisions it was rare to find only one. If public health practitioners, or environmental health practitioners, community members, industry and strategic policy makers can share their knowledges in an holistic approach to water issues, the conclusion was that sustainability can be achieved. Specialised knowledge was the most likely to hold aloof. It is strongly suggested that sustainable decision-making cannot occur with any compartmentalisation of these knowledge in decision-making.

Figure 3: Weaving the Web: Integrating Framework of Decision-making in Semenyih Catchment (SC) (Ismail, 2003)



Cross-cultural Lessons for a Sustainability Synthesis

A number of interesting conclusions can be drawn from consideration of the three studies. The first is that the compartmentalisation of knowledge within knowledge cultures can be identified in both Malaysian and Australian societies, making the concept of value in working between national cultures as well as within them. There were, however, with some further interesting similarities and differences. In the Australian Environmental Health and Malaysian Public Health specialised knowledge communities, the compartmentalisation was acute and the boundaries were strong. The knowledge sectors differed in the framing of the issues, the resources they needed and their priorities for action. They also rejected the validity of local knowledge, without active seeking to provide communication bridges. The gap between professional practice and community self-perception was so great as to be labelled by Sahani "Separate Realities". The role of action researcher, however, allowed for connections between community and specialist knowledges, a bridge between working from the inside out and the outside in.

The second Malaysian study examined the entire decision-making system of a catchment. While again identifying the separate knowledges, the researcher also found a pattern of connections, which she describes as a web. Within the web, when sharing an important issue, and meeting on a regular and informal basis, the knowledges became networked through the whole sustainability decision-making system. There is some evidence that the ability to network, and for the network members to use sets of informal knowledges may be due to Malaysian construction of knowledge being less compartmentalised than a Western society or a Westernised professional service within Malaysia.

Overall, it would appear that identifying the differences between the knowledges is not necessarily a step towards making the divisions worse, but rather towards identifying ways in which they can be joined, from whole-of-community cooperation on linked environment and health issues; to cross-communication from the inside (community-based knowledge) out and the outside (professional knowledge) in rather than the heavily channelled parallel top-down and bottom-up; and the idea of a web connecting the knowledges through informal place-based communication.

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Neighbours

Case Studies: successes and failures analysed

Towards a New Environmental Health Practice in Australia: the Challenges of Change

[i] Rosemary Nicholson and [ii] Peter Stephenson

Abstract

The hitherto unprecedented technological advances, rate of economic development and changes to our social structures that characterised the 20th century have brought with them an accompanying array of complex environmental health challenges. These new and emerging challenges are placing heavy demands on professional practitioners, and indeed on all environmental health stakeholders, as we grapple with the question of who needs to act and how in order to address an ever-increasing array of poorly understood causes and environmental health impacts. In recognition of the need to review our environmental health practice Australia's National Environmental Health Strategy (NEHS) and Implementation Plan articulate a "new approach to environmental health management", an approach based on intersectoral and cross-disciplinary partnerships and community participation. Accordingly, in May 2000, the Commonwealth Department of Health and Aged Care in Australia commissioned a team of researchers from the University of Western Sydney to produce a set of guidelines and a handbook for community-based environmental health action plans (CEHAPs). In this paper we summarise the key content of these two publications, each a product of extensive collaboration with experienced practitioners in the field. In discussing the implications of the NEHS and the CEHAPs research findings we identify some major challenges that now face environmental health stakeholders in moving environmental health practice beyond the traditional confines of top-down regulatory enforcement.

Introduction: Changing Issues

Environmental health has come a long way over the past 150 years. We have developed a good understanding of the causes of the 'traditional' and more localised environmental health problems of *under*development (poor sanitation, water and food-borne disease sub-standard housing conditions etc). Accordingly we have been able to achieve a great deal for a great many Australians through the appropriate development of environmental health regulations and the enforcement of legislated standards. But we are living in a period of increasing social complexity, increasing urbanisation, increasing globalisation and of rapid environmental change. We are living in an era in which socio-economic inequity is proving to be a major determinant of human health and wellbeing. We are living in an era when a range of newly recognised 'modern' environmental health issues have emerged as a direct result of *over*development and as yet poorly understood interactions between our economic, social and physical environments (World Health Organization 1992,1993). Causes of air, water and soil contamination extend far beyond the administrative boundaries of local, state or territory governments where the majority of Environmental Health Officers (EHO's) practice (MacArthur and Bonnefoy, 1997,1998; Guest, Douglas, Woodruff and Mc Michael, 1999; Lvovsky, Cropper *et al.*, 2000). Global climate change, ozone depletion and the use of persistent organic pesticides (POPs) all impact on local environments for health while at the same time local development, business and community activities contribute to an ever-increasing array of more global problems (World Health Organization, 1997; MacArthur, 1999). A graphic example of this is the 2003 SARS (severe acute respiratory syndrome) outbreak (WHO, 2003) with its major impact on

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world travel, international business and the national economies of the worst affected countries. SARS will undoubtedly go down in history as one of the major global environmental health issues of our time. And yet, as the socio-political and broader economic impacts unfold on the global scale SARS also manifests as an essentially local issue that highlights the need for community-based action in relation to the long-recognised environmental health threats of overcrowded living conditions, poor sanitation and questionable infection control procedures. The rationale for global thinking accompanied by local action is indisputable.

Changing Approaches

Australia's National Environmental Health Strategy

In recognition of the complexity of the issues with which we are now faced, Australia's National Environmental Health Strategy (enHealth Council, 1999) advocates a "new and actively collaborative approach" to environmental health. To this purpose the Strategy undertakes to ensure "a well equipped environmental health workforce". Through its Charter of Entitlements and Responsibilities for Individuals, Communities, Business and Government the Strategy expressly charges all stakeholders with a role in working cooperatively and collaboratively towards the achievement of positive environmental health outcomes. It clearly acknowledges that issues with multiple causes cannot be managed by a single agency. In this respect particular emphasis is placed on the value of cooperative and collaborative partnerships between environmental health stakeholders and across all sectors together with a broadening role for the environmental health profession. This 'new' role extends beyond the traditional and reactive procedures of environmental monitoring and regulatory enforcement to one that explicitly embraces *pro*-active and integrative risk management.

The language of the NEHS is couched in terms such as 'intersectoral links', 'collaboration', 'combined efforts', 'partnerships' and 'cooperation'. This terminology, now slowly infiltrating the environmental health literature, is strikingly different to the more traditional vocabulary of 'regulate', 'enforce' and 'prosecute'. Just as proponents of the new public health in the 1980s introduced the concept of an 'ecological' public health (Kickbush, 1989), so does the NEHS embrace the concept of a new environmental health practice based on the health promotion principles of community partnership and intersectoral collaboration.

Table 1: Implications of the National Environmental Health Strategy for Professional Environmental Health Practice

From		To
Environmental monitoring and regulatory enforcement.	⇨	Working in partnership to effectively manage risk.
Reactive responses.	⇨	Pro-active prevention.
Professional 'silos'.	⇨	Breaking down professional boundaries.
Fragmented service provision and health-environment divide.	⇨	Breaking down institutional boundaries.
Lack of knowledge sharing among government, industry and community.	⇨	Working 'with' rather than 'on communities. Breaking down language barriers. Building stakeholder 's trust and respect for differing knowledge constructs. Improving communication among all stakeholders.
Marginalisation of minority group agendas (e.g. Indigenous Environmental Health)	⇨	Elevation into mainstream practice

The implications of the NEHS for professional environmental health practice are summarised in Table 1. The extent to which professional practitioners already do, or believe they should, move beyond the role of regulatory control and towards one of coordinating cross-sectoral, integrative and community-based environmental health action is fundamental to the future direction of the profession (Nicholson, 2001).

The National Environmental Health Strategy Implementation Plan

The National Environmental Health Strategy Implementation Plan (enHealth Council, 2000) identifies a number of priority environmental health issues classified across three domains as follows:

- *Environmental Health Justice*: Indigenous Environmental Health and Sustainable Development;
- *Environmental Health systems:* Economic Analysis, Health Impact Assessment, Health Risk Assessment, Information, Research, Standards and Guidelines, Workforce;
- *Human-Environment Interface:* Air, Built Environment, Vector-Borne Disease, Water (drinking and recreational).

Action plans are presented for issues within the first two domains, with the enHealth Council, Australia's peak Environmental Health advisory body, identified as the lead agency. In the case of the more localised impacts arising at the human-environment interface (air, water, vector-borne diseases and the built environment) the enHealth Council recognises the relevant state or territory government to be more appropriate as the lead agency.

Each action plan follows a standard format comprising the elements of:

- A statement of the issue to be addressed;
- A description of the associated challenge for environmental health management;
- An analysis of the associated need in answer to the question: what is required to effectively respond to the specified challenge?;
- The specific action in the form of a list of task(s) to be undertaken to meet each need;
- The expected output, or product of the action Identification of the lead agency; and, significantly
- A list of partners with which the lead agency will need to collaborate in order to successfully undertake the proposed action.

Community-based environmental health action

In May 2000 a research team from the University of Western Sydney was commissioned by the Commonwealth Department of Health and Aged Care to produce a set of guidelines and a handbook for community-based environmental health action plans (CEHAPs). Each was developed through an extensive process of consultation with environmental health stakeholders across the four distinguishable 'knowledge groups' of community, specialists, strategists and integrators (Brown, 2001). Many of our 'CEHAPs advocates' described to us their own particular environmental health partnerships, some of which are presented in the handbook. Others indicated the various barriers they had experienced to working in this way.

Brown's 2001 analysis of the disparate knowledge constructs of the four groups is of particular significance to practitioners working across stakeholder groups. In summary:

- *Community members* base their local knowledge on their *lived experience, which* they share as *stories.*

  Their *common sense* is dismissed by other stakeholders as unsubstantiated *hearsay*.

- *Scientific and professional specialists* collect their evidence through *structured observation.*

  Their *objective truth* is dismissed by other stakeholders as *jargon.*

- *Governments* work to *strategically determined agendas.*

  Their *art of the possible* is dismissed by other stakeholders as *deals.*

- *Integrators* are the most poorly understood of the four stakeholder knowledge groups. Their role is to work holistically across the other three groups. They seek to define a *shared purpose*, or vision for the future, as a focus which allows everyone to move forward. Other stakeholders dismiss their *driving inspiration* as *airy-fairy*.

In analysing the CEHAPs research data we have added to the above list a further two environmental health practitioner knowledge groups. These are the educators and the researchers, each of whom may work either across or within any of Brown's four groupings (Nicholson, 2003).

The CEHAPs Guidelines

The guidelines were published as a component of the broader discussion paper "Grass Roots and Common Ground" (Brown *et al.*, 2001). The discussion paper itself comprises:

- An environmental health stakeholder analysis in the form of a detailed discussion of the four knowledge groups;

- A national review of statutory and voluntary, integrative environmental health frameworks;
- An analysis of the results of 36 in depth interviews with key informants from the four environmental health stakeholder knowledge groups; and,
- Community-based environmental health action guidelines based on the information provided by our key informants. The guidelines essentially evolved as a synthesis of principles of the new public health (WHO, 1986), Ecologically Sustainable Development (WCED, 1987), Integrated Local Area Planning (Australian Local Government Association (ALGA), 1992) and Landcare (Campbell, 1994).

The results of our CEHAPs consultations revealed strong in-principle stakeholder support for the formation of effective partnerships for community-based environmental health action. In particular:

- *Community advocates* advised of their need for more resources and stronger membership;
- *Specialists* wanted increased access to reliable information and greater attention to research and research funding;
- *Local and State government strategists* were looking for more effective planning frameworks and greater community responsibility; while
- *Integrators* sought environmental health connections, stronger community alliances and support for collaboration between community, government and professional services.

Collectively respondents called for CEHAPs to be broad, open, flexible, and amenable to change and based on the principles of:

1. Governance focussed at the local scale
2. Inter-governmental coordination
3. Community partnership
4. Integrated planning
5. Optimisation of resources
6. Shared vision
7. Local ownership, and
8. Sustainable long-term change.

The CEHAPs Handbook

The Community-based environmental health action handbook "Common Ground and Common Sense" (Nicholson, Stephenson, Brown and Mitchell, 2002) was drafted at a writing workshop by 40 authors representing the six environmental health stakeholder groups. A further 300 named contributors participated in the project, collectively informing the form and content of the handbook. The framework for the handbook, the web of community-based environmental health action (Figure 1) is based on the Planning Web framework and process previously developed by the workshop facilitator (Cumming, 1988).

The Handbook in summary:

Chapter 1: Local Governance: *people caring for place*

Theme: We are all caretakers for our environment

Topics: Local ownership - local governance - the importance of governance in addressing environmental health issues - contributions from community, industry and government harnessing governance for environmental action.

Chapter 2: Strong Communities: *Having our voices heard*

Theme: Communities acting for themselves – communities are rich in human resources

Topics: Teamwork – education and awareness-raising – building group strength – personal cost of taking action – financial resources – political resources – working the system – media resources – bringing the resources together.

Chapter 3: Community partners: *earning community trust and respect*

Theme: All stakeholders working with the community

Topics: Establishing a positive partnership with shared goals - strengthening the partnership - effective partnerships - sustaining partnerships

Chapter 4: Long-term alliances: *bridging the gaps*

Theme: Achieving cooperation within and between government and non-government organisations, community service organisations, industry and community groups

Topics: suggestions for starting up collaborative action – skills needed for alliances – actions required – power-sharing – frameworks for integration (cross-referenced to section 5) – resources required for building alliances

Figure 1: The web of community-based action for environmental health

Chapter 5: Place-based Planning: ***saving what we value, changing what we don't***

Theme: systems, strategies and processes for community planning

Topics: voluntary planning processes - planning overview – one size fits all: integrated planning process eight steps – community-based planning – access points to topics and information.

Chapter 6: Future-directed Action*: Keeping the end in sight*

Theme: Sharing the vision

Topics: thinking and acting for the future – bringing about social and cultural change – learning and empowering communities

Each of the chapters summarised above contains a link with a separate resources section. Each describes the skills needed to tackle the challenges of community-based action and contains practitioners' stories, handy hints, activities, connections with other chapters and sections, and a list of suggested progress indicators.

The web can be entered at any point an action program requires, but for any program to be effective, we are suggesting that the *full cycle of actions and* skills must be completed *and* continue on into the future.

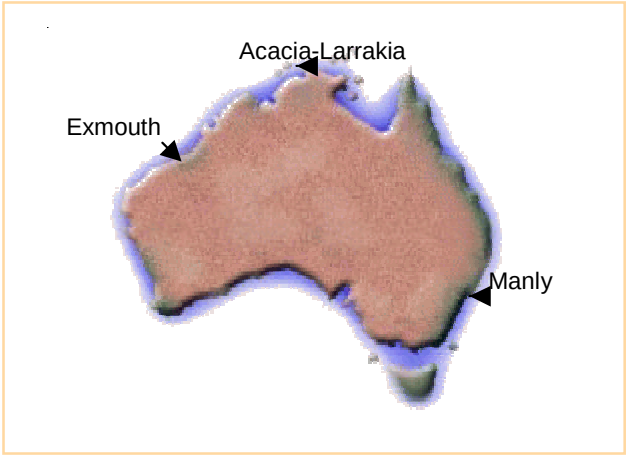
The Handbook Trials

During the second half of 2001 the Handbook in its draft form was trialed in three very different locations throughout the country; (i) a tightly packed harbour side suburb in Sydney; (ii) a small isolated town in Western Australia; and (iii) an Indigenous community outside Darwin (Figure 2). Despite the obvious differences between these sites, they each needed community, experts and government to work together to solve their respective environment and health problems. And they were all prepared to use the Action Handbook on Community-based Environmental Health Planning to help make that happen. The following brief overview and outcome for each site serves to exemplify the potential application of the handbook in a range of environmental health settings:

i) **Urban community:** Manly Council, New South Wales offered to trial the Handbook in an existing project, the development of a **Litter Avoidance Strategy** which, at the time the trial commenced, was at *Section 5. Integrated Place-based Planning.* Manly staff had not previously been involved with the Handbook, but they had an issue of significance they wanted to work with. Waste management was both a priority issues for environmental health practitioners and it formed part of a strong program commitment to the principles of Local Agenda 21.

➔**Outcome from using the Handbook:** After starting at Section 5 of the Handbook, the Manly CEHAPs team returned to *Section 3 - Earning Community Trust and Respect*. The Manly Litter Avoidance Strategy had been developed by the Council in-house, with some information from the community on their priorities. The next step was to recruit community partners to support the implementation of the strategy. Working with the Handbook, the Litter Strategy Working Group designed and ran a Litter Summit, which in turn led to key contributors to litter control in Manly forming a working partnership with the Council.

Figure 2: CEHAP's trial location



ii) **Rural/remote community:** Exmouth, Western Australia was strongly recommended by the Western Australian Municipal Association and the Australian Institute of Environmental Health, WA. The **Exmouth Townscape Project Committee** agreed to trial the handbook as they completed the first stage of their long-term plan (the launching of a town park) and moved to establish *Section 4. Long-term Alliances*. The group had not been previously connected with the CEHAPS project, and had just advertised for members of a community advisory committee.

➔**Outcome from using the Handbook:** The Exmouth Townscape Advisory Committee Project team entered the Handbook Cycle at *Section 4: Setting-up Long Term Alliances.* An Interim committee had developed the Townscape Project to ensure a positive environment for Exmouth citizens, and also to secure a long-term future for the town. The Interim Planning Committee was in the process of being converted to a long-term advisory committee, with understandable concern from the Interim Committee that their previous work would be forgotten, and a new agenda would develop that did not have the same commitment to the long-term interests of the town. The Handbook helped establish a working framework designed to address this concern

iii) **Indigenous Community:** Acacia-Larrakia Aboriginal Community, Northern Territory was the agreed site among the five Indigenous-based groups who contributed to the preparation of the handbook. The project had to be negotiated with the community members themselves, who decided to use the Handbook as a template to develop community-based environmental health action from the ground up. The coordinator was a member of the Handbook writing workshop, which was valuable in linking the Handbook to the interests of an Indigenous community. The priority issue to

be addressed was the development of a **Community Plant Nursery** for growing healthy food supplies, for passing on of traditional bushfoods knowledge and skills, for land rehabilitation and Landcare, and for employment of women in the community.

➜**Outcome from using the Handbook:** Acacia-Larrakia Aboriginal Community used the Handbook Sections 1-6 to set up a self-sufficiency project to take advantage of recent infrastructure developments. Through these steps the CEHAPs team brought together a range of possible stakeholders in the community and workshopped opportunities for long-term alliances around progressing the community's idea. Through the process, the Darwin Community Development Employment Program, Territory Health Services, Office of Local Government, Department of Primary Industries and Fisheries, Department of Lands, Planning and Environment (LandCare and WaterWatch), Greening Australia and the Northern Territory University each committed resources for training, equipment and employment related to the project.

The way forward

In this paper we have sought to explore the implications of the National Environmental Health Strategy and Implementation Plan in relation to professional practice. We have summarised the guidelines developed by the CEHAPs research team on the advice of practitioners in the field and described the associated framework from which the foundations were laid for a practical handbook for community-based environmental health action. The handbook itself has been trialed in three separate localities and in July 2002 was distributed to environmental health agencies throughout Australia. The question now is: ***Where do we go from here in facilitating effective community-based environmental health action?***

We know of some of the success stories. These have been incorporated into the handbook. There are undoubtedly many more such stories as yet undocumented. We believe that it is important to share and to celebrate these positive experiences. But it is equally important to acknowledge and address the barriers to broadening the role of the environmental health workforce. The NEHS emphasises a need to develop the workforce in order to increase capacity for effective and efficient environmental health action. This raises the key question of what are the specific issues that need to be addressed in order to build such capacity?

In pursuit of this Wilson (2001, p. 5) posed the following questions to a U.S. National Academy of Sciences workshop charged with creating a new vision of environmental health for the 21st century:

- What are the approaches that will maintain and extend environmental health beyond the traditional regulatory approach?
- How can we obtain the involvement and leadership of citizens, business leaders, public health workers, and others in addressing environmental health at the local community level?
- What new mechanisms are needed to realise the breadth of environmental health?
- How can we raise awareness and promote community-based environmental health? and
- How can we promote environmental health that is both sensitive to the needs of local communities and flexible enough to allow a range of approaches?

These questions essentially encapsulate our challenge in promoting cooperative and collaborative partnerships for community-based environmental health action. They are questions worthy of serious debate within the profession both in Australia and overseas. Our capacity to address both the ongoing and the emergent environmental health issues lies in our collective response to these and similar questions and in our preparedness to act accordingly.

Members of each of the six stakeholder groups face their own unique challenge in moving environmental health practice into the 21st century:

Community members, or civil society, are faced with enormous challenges to change some long-held traditional values and cultural norms, which mitigate against social and ecological sustainability. The NEHS, through its Charter of entitlements and responsibilities challenges individuals and communities to contribute through their own actions to the protection of the environment and of human health, to participate in the environmental health decision making process and to ensure a high standard of environmental health service delivery.

The challenge to **educators** in the rapidly changing world of environmental health practice is multifaceted. Today's graduates must be equipped for tomorrow's practice while

at the same time able to successfully compete in today's job market. Environmental health practitioners need to be lifelong learners, change agents, team workers and skilled problem solvers. Educators also have the task of improving the environmental health literacy of all stakeholders while equipping environmental health professionals to communicate across stakeholder knowledge groups. They play a key role in positioning environmental health as an integral component in the curricula of a range of professional degree programs from town planning to public health. As an example of this approach universities across Australia are currently collaborating to include the principles of sustainable development in public health curricula (Grootjans *et al.*, 2002).

Integrators are challenged with motivating and involving the various different stakeholders. This inevitably means working with conflict and indeed using conflict to drive positive change.

The **researchers'** challenge is clearly articulated in the NEHS through its call for 'a strong research base to determine the most appropriate strategies to manage environmental health issues and to identify emerging hazards.' The Strategy charges researchers with the responsibility to determine the most appropriate strategies to manage environmental health issues to identify new and emerging hazards. In order to maximise the benefits of research the results need to be appropriately communicated among stakeholders.

Specialists are being challenged to move outside their professional 'comfort zones', to expand their interests beyond their own immediate area of concern (e.g. health specialists to embrace environmental concerns and vice-versa), to communicate directly with community stakeholders and to recognise the potential value of other stakeholder contributions.

Governments face the challenge of driving the process through facilitating appropriate collaboration in the management of environmental health issues. This includes formulating policy and determining the legislative bases of environmental health which, in order to be effective, must be appropriately communicated to those at the 'coal face' at the local community level where policy is translated into practice.

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Technical Notes

Progress Reports on Research Projects

Health Assessment among Children and Pregnant Women in Malaysia Potentially Exposed to Transboundary Haze from the Southeast Asian Forest Fires: A Progress Report

The [i]Malaysia - [ii]U.S. Transboundary Haze Health Investigation Team

Introduction

In 1997, uncontrolled forest fires in Indonesia resulted in severe smoke pollution, known locally as haze. The haze affected seven countries throughout Southeast Asia and the Pacific: Brunei Darussalam, Indonesia, Malaysia, Papua New Guinea, the Philippines, Singapore, and Thailand. In September 1997, and again in March-April 1998, haze episodes peaked, coinciding with an El Niño atmospheric pattern, for which ambient concentrations of fine particulate matter increased at least 10-fold. Respiratory-related hospital admissions also increased significantly (World Health Organization [WHO], 1998). In most exposed areas of Malaysia, haze concentration levels exceeded local ambient air quality standards and guidelines for particulate matter.

In Sumatra, Indonesia, preliminary evaluation of ground-based environmental monitoring data indicated the presence of gaseous compounds (Ismail, Yamamura, unpublished data, 1998; Levine, 1998). During 1997-98, ground based monitoring in Sarawak, Malaysia, revealed elevated toxic chemicals, which included carbon monoxide, lead, other metals, sulfur oxides, and polycyclic aromatic hydrocarbons (PAHs) (Baird and Associates, personal communications, 1999).

WHO has compiled data on the 1997-98 haze episodes and its adverse effects on health. The haze episodes were thought to result in immediate health effects, which resulted in increased respiratory-related hospital visits in the most heavily affected areas during peak episodes, increased frequency of attacks among asthmatic children, reported persistent decreases in lung function among a cohort of school children (Brauer, 1998; Benedict, 1998), and possible adverse birth outcomes among pregnant women with higher levels of exposure at difference points in their pregnancies. Although principal findings have demonstrated that the haze episodes have presented a substantial health risk to the public, the full impact of the haze episodes has yet to be determined, particularly in children and in pregnant women.

We conducted an investigation to comprehensively assess short- and long-term health outcomes from short- and long-term exposures to biomass smoke and haze in children and in pregnant women. The purpose of this report is to describe the methods and procedures from the field rather than to provide results, which will be presented at a future date.

Methods

In September 2001, we conducted three studies. First, we retrospectively reviewed clinic records of children aged 12 years or younger with selected respiratory and ophthalmologic conditions to document these conditions. Second, we conducted a baseline cross-sectional study to obtain current biological and environmental exposures to the constituents of haze among children aged 12 years or younger, identified from the retrospective study. The baseline included a cross-sectional household survey of the homes of

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selected children to risk factors for respiratory and ophthalmologic illnesses related to the haze period and a medical assessment of the study children that included pulse oximetry, peak-flow testing, and a standard eye examination. Finally, we retrospectively reviewed records of pregnant women and their newborns to determine relations between maternal exposure to haze during periods of pregnancy and adverse birth outcomes, primarily low birth weight. Biological samples were analyzed for selected volatile organic compounds (VOCs), heavy metals, and PAHs. Environmental samples were collected in water, soil, and household dust media; in addition, the study children wore 3M™ 3510 organic vapor monitoring (OVM) badges on their clothing for at least 8 hours to provide readings of VOCs in the immediate environment. The studies were undertaken in three areas of the country: 1) Lubok Antu, Sarawak, where acute exposures occurred from peat-based fires in Kalimantan, Indonesia; 2) Pontian, Johor, where chronic exposures occurred from vegetation fires in Sumatra, Indonesia; and 3) Kota Bharu, Kelantan, which experienced little to no exposure to transboundary haze.

On the basis of the hypothesis that exposure to an air pollutant is associated with an increase in respiratory illness and eye disorders, we calculated a sample size of 214 participants per site for an anticipated probability of one of these diseases to be 40% for no exposure, an anticipated relative risk worth detecting at 1.5, and a power of 80% with alpha error of 5%. The anticipated probability of 40% for no exposure was based on data indicating that respiratory diseases accounted for 38.1%, 39.9%, and 42.5% of the 15 principal causes of new attendances at general outpatient department in hospitals in peninsular Malaysia, Sabah, and Sarawak, respectively, in 1996 (Ministry of Health Malaysia, 1996). At the request of the environmental health laboratory division at CDC, however, we modified the sample size for the baseline cross-sectional study from 214 to 75 per site, for a total of three study sites to accommodate logistical and financial resources. We obtained assurance of compliance for the protection of human research subjects from the Ministry of Health Malaysia and the United States (U.S.) Department of Health and Human Services.

Should another episode of transboundary haze recur in significant proportions, a fourth study—a prospective cohort study of children aged 12 years or younger from the most severely haze-affected area—is planned to determine exacerbation in respiratory and ophthalmologic conditions.

We also obtained air monitoring information—carbon monoxide, ozone, particulate matter, sulfur dioxides, nitrous oxides, methane, metals, daily ambient temperature, wind speed, and others—from selected monitoring stations in the study areas during the haze period to correlate with respiratory, ophthalmologic, and birth outcomes and to compare these with similar data from 1996 and 1998. These data are made available to the Institute for Medical Research (IMR) by various environmental and meteorological government agencies in the country.

Current Study Status

Retrospective study of clinic records of children aged 12 years or younger

We reviewed 1,181 records of respiratory and ophthalmologic conditions that occurred during the study period (June-November 1997); and for comparison periods (June-November 1996 and June-November 1998) from health clinics in Lubok Antu. We also collected 973 and 1,142 such records from Pontian and Kota Bharu, respectively. In addition to demographic data, we abstracted diagnostic and treatment information in an attempt to identify the types and quantities of medication and supplies that might be needed in a similar future haze emergency. A medical school graduate was recruited specifically to review and systematize diagnostic and treatment categories.

At the time of this writing, data cleaning and analysis are already in progress.

Baseline cross-sectional study

We enrolled 59, 75, and 71 study children with their households in Lubok Antu, Pontian, and Kota Bharu, respectively. Using a standardized form, clinical personnel assessed the medical status of each study child for anthropometrics, pulse oximetry, peak-flow testing, and vision. The study children provided urine and blood samples for measurement of baseline levels of VOCs, PAHs, and inorganics (lead, arsenic, and cadmium), and wore a 3M™ OVM badge for at least 8 hours. We completed analyses for whole blood specimens for 31 VOCs and for urine samples for 16 mono-hydroxy metabolites of PAHs. Analyses of blood lead and blood cadmium had been completed. Analyses of 3 VOCs—benzene, styrene, and toluene—in diffusional monitor badges had been completed using the 3M™ OVM test method.

From 12 households selected by convenience throughout the three sites, we collected samples of drinking water, soil outside the immediate vicinity of the residential structure,

and dust wipes from inside the home. Soil samples were analyzed by DataChem Laboratories, Inc. in Salt Lake City, Utah, USA, for PAHs (U.S. Environmental Protection Agency [EPA], 1986) and metals (U.S. EPA, 1996). Dust wipes were analyzed for PAHs (National Institute for Occupational Safety and Health [NIOSH] of the CDC, 1994), and for arsenic, cadmium, and lead (NIOSH, 1994). Water samples were analyzed by the Water Quality Laboratory of the U.S. Geological Survey (USGS) in Denver, Colorado, USA for PAHs by gas chromatography-electron-impact mass spectrometry (USGS, 1987) and for metals by dissolved inductively coupled plasma-mass spectrometry (USGS, 1993 and 1999).

At the time of this writing, analyses of arsenic in urine samples are already in progress. Data cleaning and analysis are also in progress.

Retrospective study of records of pregnant women and their newborns

We collected 2,317 records of pregnancy outcomes from prenatal clinics at the district level in Lubok Antu, Pontian, and Kota Bharu during the study periods (October 1997, January 1998, and April 1998) to assess 3rd, 2nd, and 1st trimester exposures to haze, respectively. We obtained similar data for comparison periods—October 1998, January 1999, and April 1999. The records provided information about demographics and socioeconomic status of the mother, obstetric and pregnancy histories, complications or special care, delivery record, and maternal and infant complications.

Data analysis is ongoing.

Discussion

This investigation represents an extensive and concerted effort to characterize the relation between the exposure to the constituents of haze during 1997-98 haze episodes and respiratory and ophthalmologic morbidity, as well as effects on maternal exposure in defined areas of Malaysia. Furthermore, this effort provides baseline information against which to compare exposures to haze in subsequent events, and estimates of exposure or dose used to quantify the relation between exposure to haze and the health status of individuals. Results from the baseline study may also be used to develop reference ranges for environmental exposures to toxic chemicals, such as lead and arsenic, among young children.

During the cross-sectional baseline study, we modified the protocols to reflect economic and logistical constraints. One modification was to reduce the sample size of the study children from 214 to 75 per site. Although this may affect statistical significance, descriptive results, rather than statistically significant analyses, from pediatric environmental exposures were important in providing baseline data from the study sites.

We attempted to conduct a standard set of examinations among the study children. However, two of the three medical teams per site did not have access to special equipment, such as pulse oximeters; consequently, pulse oximetry was performed on approximately 1/3 of the study children in each site. Because the children were visited by geographic proximity, selection bias may affect the results.

We began the overall investigation with a standardized set of questions for the baseline cross-sectional and household exposures study. However, cultural differences necessitated modification of questions, particularly in Lubok Antu, where the residents lived in longhouses, rather than in single-family dwellings as in Pontian and Kota Bharu. Interpreting and comparing responses from Sarawak (Lubok Antu) and peninsular Malaysia (Pontian and Kota Bharu) may require careful consideration of cultural practices, such as household cooking and pesticide application.

Finally, we noted that air-monitoring sites were located at varying distances from residences in the study areas. Quantifying exposures and relating them to individuals' dose-response may roughly approximate rather than accurately reflect exposure assessment. In addition, some monitoring stations expanded their complexity of chemicals to monitor several months after the haze event in 1997-98. Comparing levels of selected chemicals during 1996 and 1997 with those of 1998 may thus not be possible.

Next Steps

Since the fall of 2001, we have been cleaning and systematizing information from the three studies in the three sites throughout the country. A statistician has been contracted to manage the databases in preparation for analysis. We are also exploring the possibility of atmospheric transport modeling, in consultation with meteorologists from the U.S. National Oceanic and Atmospheric Administration, to track environmental exposures to haze constituents. A complete analysis is expected in early 2004.

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An Environmental Health Audit of High Voltage Power Transmission Lines in a Residential Suburb

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Abstract

Over the past 25 years a number of studies have been carried out to investigate the potential health risk of electromagnetic fields on those living close to high voltage overhead power transmission lines. While positive correlations between electromagnetic fields and some forms of cancer have been recorded a number of studies have not supported this finding. The existence of contradictory results has not assisted environmental health practitioners who must use the results of such studies in responding to community complaints by assessing potential hazards, communicating risk, and developing interventions. The present study carried out in a Cape Town suburb where a 400 kV, 50Hz line passed directly over houses, explored the integration of certain physical, social and economic monitoring approaches to address immediate community concerns. Physical measurements for electromagnetic field and corona discharge noise were contextualised in terms of social survey results and community concerns relating to microshocks, unsightliness, view obstruction, loss of property value, and potential for storm-related line damage were assessed in terms of local realities. While the small exposed population precluded the investigation of all but the commonest health states and conditions, the statistically significant difference observed in the prevalence of severe headaches between exposed and unexposed groups warrants further investigation.

Key Words: electromagnetic field, electrical field, EMF, ELF, microshocks, corona discharge noise, cell phones, environmental health.

Introduction

Urban expansion requires the construction of electrical power infrastructure and where new developments are interspersed with older ones the siting of electrical transmission lines in close proximity to existing housing may be inevitable. While high voltage lines can be buried to avoid unsightliness, this is a costly and environmentally unfriendly solution as cables normally arranged in vertical sets on pylons have to be strung out horizontally underground, taking up large tracts of land which must remain permanently clear of buildings or vegetation to maintain service access. While underground placement presents a barrier to electrical field the same is not true for the magnetic field, which passes through ground, building materials and human tissue (National Radiological Protection Board 1992)

Early research into possible relationships between electrical and magnetic fields (EMF) and cancer first took place in 1979 when "wire codes" based on the number of power lines, their proximity to houses, and their current-loading were devised as a surrogate for exposure (Wertheimer & Leeper, 1979). The study indicated a two to threefold increase in the risk of leukaemia, lymphoma and tumours of the nervous system, and subsequent occupational research supported an increased leukaemia risk (Milham, 1982). In Sweden a large case-control study with inclusion of confounding variables showed the existence of statistically significant correlations between an alternative EMF surrogate and childhood leukaemia, although no correlation with other forms of adult or childhood cancers was demonstrated (Feychting & Ahlbom, 1993).

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Subsequently over 300 studies have been carried out using a variety of methodologies and with widely varying results. Some recent studies with similar methodologies to those originally used have not detected a correlation with any forms of cancer (Pukkala, 1995; Tynes & Haldorsen, 1997).

A methodological weakness of many of the studies is that they adopt what is known to epidemiologists as an "ecological analytical" methodology in which surrogates for EMF exposure relevant to population sub-groups are used in preference to individual exposures, which could be most accurately assessed through personal dosimetry. Where such costly and difficult dosimetry has been used the hypothesised relationship has tended to lessen in significance or to disappear (Perry, 1994). Ecological analysis is said to fall foul of the "ecological fallacy", where exposure readings assumed for groups are not sufficiently representative for individuals in that group (Gordis, 2000). The need for personal dosimetry was illustrated in the present study where a 400kV line produced a magnetic field of only 1 microTesla (μT) directly below the line, whereas in an adjacent dwelling a hair dryer at 30 cm was found to produce 2μT, a bedside clock radio 3 μT, a television set 7μT, a microwave oven 8μT, and a fuse box over 13μT. In close proximity these devices were found to produce levels about one power higher than those recorded at 30cm.

Unfortunately personal dosimetry as a solution was beyond the budget of the present study.

The wide variation of results in existing studies and associated methodological issues provides little support for those vested with the task of attending to complaints, assessing potential risks, and giving balanced advice at community level (duToit, 1998). With this in mind the present study set out to explore approaches for the monitoring of power lines in terms of EH practice needs and limitations, and the contextualising of results in terms of community information regarding local perceptions and experiences. Some of the findings may be found relevant by those studying the health risks of electromagnetic fields from cellular telephones ("cell phones") and related transmission towers, from a community perspective.

The study was carried out in the suburb of Gatesville, Cape Town where community concerns were presented to the researchers by a colleague and broadcaster who ran a health discussion forum on the Islamic community radio station, "786". The 400kV power line had been commissioned in 1979 mainly to supply power to communities which had been forcibly removed from inner-city suburbs to the South-Eastern rural-urban fringe of Cape Town in terms of Nationalist apartheid policy. In the absence of a planned power line servitude to meet this expedient population resettlement it appears that the line had been taken directly over a row of 31 existing houses in the middle-city suburb of Gatesville. A total of 73 occupied houses were situated within 50m of the centre line, a zone traditionally kept unoccupied in terms of good engineering practice, as a known high EMF exposure zone (Forssen, Ahlbom, & Feychting, 2002).

When the African National Congress had subsequently taken the political reins in 1994 under President Nelson Mandela they had encouraged community capacity building within an environmental justice framework and long-standing concerns, such as those surrounding the Gatesville power line, had come to the fore in the later 1990s (African National Congress 1994; Strategic Management Team: Ministry of Health and Social Services 1995).

During preliminary interviews some of the long-duration residents informed the researchers that house owners had originally been paid compensation amounting to half the value of the developed property, but this could not be confirmed. They did not recall community objection to the power line when it was constructed and felt that this would have, in any event, been unproductive during the apartheid era.

Preliminary visits to the area revealed that primary concerns included corona-discharge noise, microshocks, unsightliness, obstruction of view, loss of property value, and the perceived risk of pylon or cable damage during storm events which were common in the region. The study set out to examine these and other points of concern as they arose, and to explore methods for integrating physical monitoring of environmental health (EH) risk factors with social monitoring of community perceptions relating to hazards and annoyances. The relatively small population in proximity to the power line and lack of definitive direction from studies elsewhere was seen to preclude more traditional epidemiological assessment or risk analysis.

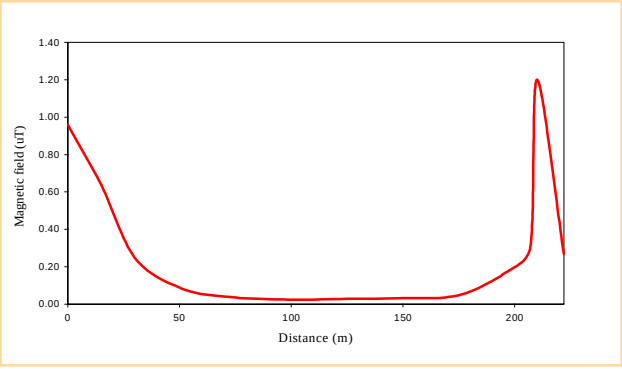
A study of maps in the Department of the City Electrical Engineer, Cape Town identified 73 "exposed" residences in two rows, occasionally expanding into three rows. For comparative purposes two double rows of "unexposed" residences similar in construction and size to the exposed residences were identified, at a minimum distance of 100m from the line extending to about 200m. Approximate matching for occupants' socioeconomic status using two indicators, as discussed in the following section, yielded 31 "unexposed" residences.

Design Considerations, Materials and Methods

The study design had three main components:

- The physical monitoring of a number of factors, including magnetic and electrical field strength, corona discharge noise, and a number of meteorological factors required for the interpretation of these readings
- The accessing of archived information such as district maps, cabling records and property transfer valuations.
- The assessment of community perceptions through social survey using a targeted questionnaire with response-interpretation criteria, as measuring instrument. The questions gathered information about perceived social, economic and environmental problems including microshocks, corona-discharge noise, unsightliness, view obstruction, loss of property value, storm-related line hazard, perceived health state and past and future community action with regard to electrical power interventions. The community survey was considered a preferable approach to the holding of action-group meetings, as questionnaire responses could be contextualised in terms of local environmental circumstances during house visits.

Figure 1: Magnetic Field Variation with Distance from Centre Point Beneath Line



Methods are discussed below with a supportive discussion of each factor where it is necessary to clarify the approach adopted:

1. Physical monitoring

Magnetic Field

A portable Magnumâ gaussmeter measuring field strength in microTeslas (μT) in three orthogonal directions (ie: x, y and z-axes) in the frequency range 40 - 310 Hz was used to obtain values for magnetic field strength from the lines. For consistency and to approximate human exposure all measurements were taken at a height of 1.5 m above ground level. To identify distribution of field with distance from source measurements were taken along a transect at right angles to the centre line of the power line to a point 222 m along the transect (Figure 1). Both the exposed and the unexposed areas lay within acceptable exposure values determined in other studies (Forssen, Ahlbom & Feychting 2002). An unexplained peak was found to occur at the distal end of the transect, which will be discussed under results. A number of other measurements were taken at random points throughout both exposed and unexposed areas to explore local variations in magnetic field.

Electrical Field

While electrical field contributes 75% of the total EMF field energy, electrical field does not have the same properties of penetration as magnetic field and may be blocked, severely distorted or run to earth by conductive materials and electrolytes. These substances are said to have a "shielding" or "screening" effect and can include the roofs, walls and floors of dwellings (National Radiological Protection Board 1992).

Both inductive and capacitive currents were measured in kiloVolts per metre (kVm^{-1}) in a number of positions relevant to the line using a Flukeâ multimeter with high impedance leads connected in terms of a relevant test to lines of known length with the required earthing configurations. Because of potential field distortion and screening by building and other structures, however, this information was used only to contextualise community information relating to phenomena such as microshocks, and magnetic field with its high powers of penetration was used as a proxy for EMF exposure.

In South Africa and other countries using solid building materials such as brick, reinforced concrete and ceramic tile, screening is likely to be more effective than in Nordic countries where much of the existing research has taken place.

On the other hand the generally outdoor domestic lifestyle in south Africa may predispose those living near lines to increased exposure. Such local effects need to be included in ecological studies before results are extrapolated to other regions.

Corona Discharge Noise

High voltage, extra low frequency (ELF) power lines continuously "leak" small quantities of electricity to the air surrounding the line. This loss is known as "corona discharge" during which some of the fugitive electrical energy is converted to mechanical energy including air vibration, perceived as a characteristic buzz, hum or crackle known as "corona discharge noise" (Pearsons, Bennet & Fidel, 1979).

This noise is intensified where power loss is aggravated through surface irregularities of the conductor (cable) including roughened or broken strands, deposited pollutants, dead insects, raindrops, and water from mist or fog. Other products of corona discharge are heat, light (sometimes visible as a blue glow), and ozone (O_3), when ionisation of air around the cable occurs.

Corona discharge noise was identified by the exposed community as an annoyance and was therefore included in the present study, while assessment of chronic exposure to low levels of ozone, a known respiratory irritant, was considered to be outside the scope of the present study.

While high levels of sound at specific frequencies are known to damage hearing causing temporary or permanent loss, sound also possesses a subjective "nuisance" component which is sometimes difficult to define in scientific terms and which can be very personal in nature. For example, the screech of chalk on a blackboard may be well below the sound level required to damage human hearing but it nevertheless has a high annoyance value. On the other hand, the sound of a barking dog may be very reassuring to the owner but might ultimately cause severe annoyance to a neighbour, particularly if there is a history of inadequate attendance to the complaint. Noise has been defined as "any unwanted sound" making appraisal in qualitative terms essential if quantitative readings are to be successfully contextualised (Hinchcliffe, 1997).

The corona discharge noise from the lines was analysed for intensity and frequency using a Rionâ type 1 integrating sound level meter with attached third-band analyser, calibrated in terms of the relevant Standard using a matched RionÒ field calibrator (South African Bureau of Standards 1994). Possible metering error from the action of EMF on the meter was minimised through regularity of calibration during the metering exercise.

Preliminary spot monitoring of noise near the line in the exposed area showed that the level was well within the limit set in the Standard. In addition, traffic noise from the arterial road which ran parallel to the power line at a distance of about 100 m was found to be acting as a confounder in the measuring process. As it was impractical for the power line to be switched off to measure its contribution to ambient noise level, monitoring of corona discharge noise was carried out on a surrogate line, with the same configuration and under similar conditions of load and climate, in the quiet Zandam rural area North of Cape Town.

Readings were taken for time-weighted loudness-equivalent sound level, frequency-weighted on the "A scale", to assess the mean equivalent sound level which would be experienced by the human ear over a series of time periods ($L_{Aeq,T}$dB(A)); and for the time-weighted, loudness-equivalent sound, frequency-weighted on the A scale which would be exceeded 90% of the time (L_{A90}dB(A)). The latter reading mode removed incidental sound, such as cows mooing or aircraft passing overhead, in order to determine an ambient, modal value for the sound.

Third-band frequency analysis was applied to identify major frequency components of the sound to enable characterisation for selective monitoring of corona discharge noise on return to the exposed area.

Because of the low level of noise produced by the line relative to action thresholds given in the Standard, and the known subjective nature of noise, community information relating to the corona discharge noise was also collected at the exposed site.

2. Archived information

Maps

Maps of the area showing individual houses and the location of major transmission lines were obtained from the Drawing Office of the City Electrical Engineer, Cape Town.

Cabling records and reports

These were obtained from the Technical Division of the South African Electricity Supply Commission (ESKOM) at Brackenfell, and from the Drawing Office of the City Electrical Engineer, Cape Town.

Property value impact

Median property transfer values for the previous five years for exposed and unexposed areas were obtained from Town Planning Department of the City of Cape Town.

3. Community perceptions

The survey of community perceptions used a targeted questionnaire with response-interpretation criteria, as the main measuring instrument in the community-data collection process. It was administered in the exposed and unexposed areas by second year environmental health students of the Cape Technikon University as part of second year epidemiological studies. These students were versed in EH problem identification, the organisation of surveys, sample selection, identification of bias, design and use of criteria-based questionnaires, interviewing techniques, survey ethics, and the collation, analysis and presentation of data. Time constraints did not permit the identification and training of interviewers from the community itself.

The main survey was carried out from 9:00 to 14:00 on a weekday, with daytime, night-time and weekend follow-up visits to capture information from residents who had not been available during the main survey. A 74% (n=54) response rate was recorded for the exposed area with 7% of the respondents declining to participate and 19% of the premises being consistently unoccupied at the times of visits. A similar response rate (71% (n=22)) was recorded for the unexposed area. A 70% response rate is considered satisfactory for community surveys (Abramson, 1990). [Note: where percentages are used throughout this study they have been approximated to whole units for ease of interpretation].

Information was collected as relevant to one principal respondent at each house with the exception of information regarding perceived health status, where other residents present were also asked if they wished to anonymously give information after having the nature of the survey and potential uses of the information explained to them.

Questions covered demography of household residents, length of residence, electrical household appliances in the house, experience of electrical shocks from these appliances, medical facilities in general use, impact of pylons and lines on view, perception of unsightliness, corona discharge noise annoyance, microshock occurrence, climatic effects on noise and shocks, past involvement in community action with regard to health and safety issues, perception of past community consultation by relevant institutions, anticipated future consultation and anticipated role, perception of personal health status relevant to the lines, and numbers of cigarettes smoked per day. Not all of the information obtained in the survey is presented here.

The questions relating to electrical household appliances and medical facilities provided an index of socioeconomic status for the crude matching of exposed and unexposed groups.

Microshocks

A "microshock" results when a person contacts an unearthed metal object in which current is induced or stored under the action of a strong electrical field, the current running to earth through the body of the recipient. This gives rise to a jarring, neuromuscular reaction resembling the "static" shock received when a passenger wearing non-conductive clothing alights from a car on a dry day. Microshocks can be received from a variety of suitable objects beneath power lines such as motor vehicles, fences on wooden posts, metal door and window frames and lintels. These shocks are not thought to be physiologically hazardous but the authors of the present paper believe they are sufficiently common and stressful to warrant inclusion in community-centred power line studies (International Program on Chemical Safety 1984).

Intensity of shock varies with a number of conditions, including the strength of the electrical field, the weather, skin sensitivity of the recipient, presence of sweat and type of footwear. The International Program on Chemical Safety (1984) have reported that "the state of knowledge of the interacting mechanisms operating when biological systems are exposed to ELF fields (including microshocks) are very limited". Larger shocks produced in an identical manner in long unearthed conductors, such as farm fencing or irrigation pump wiring positioned parallel and adjacent to high voltage power lines have proved fatal. Reported microshocks therefore also require attention as predictor events relevant to potentially dangerous outcomes.

Unsightliness and obstructed view

As no specific South African standard relating to the aesthetics of power lines exists, the subjective opinions of the community were sought in the survey.

Perceived health outcomes

The group living in the exposed residences was too small for reliable epidemiological study or risk assessment with regard to the relatively rare cancers hypothesised to be associated with overhead line EMF exposure. For this reason only health states or conditions known from studies elsewhere to have a potential prevalence of at least 20% of the

population was included in analysis.

Other community concerns: open-ended questions

Open-ended questions were included in the survey to enable the collection of qualitative responses for contextualisation of quantitative results.

Community empowerment

From responses to relevant questions it was possible to gauge perceptions of empowerment before and after the advent of democratically-elected government, and the anticipated level of future involvement in electrical power interventions.

Results and Discussion

Magnetic Field Measurements

At a height of 2 m from the ground directly below the centre point of the 400 kV line the strength of the magnetic field was 1.12 µT. At a height of 1.5 m (the metering height adopted for the study) this reading had decreased to 0.96 µT, and at 1.0 m to 0.86 µT, illustrating the rapid decrease of field strength with distance from the source.

While South African standards relevant to community magnetic field exposure did not exist at the time of the study the British National Radiological Protection Board (1993) has set a limit of 1.6 µT for time-varying 50-60 Hz field exposure for the general public. While the readings obtained were within this range, ESKOM estimated that the line was probably operating at one-half of its peak current loading during the monitoring period and that it was possible that on cold winter nights when power demand increased, magnetic field exposure at the centre line would probably exceed this standard.

In EMF studies much lower values than the NRPB limit have been adopted to define cutoffs between exposed and unexposed populations. In meta-analysis of EMF and cancer Ahlbom *et. al* (2000) identified selected cutoffs to vary between 0.1 and 0.4 µT. In the present study exposed residences within 50 m of the line were within the 0.100 to 0.960 µT field and unexposed residences were within the 0 to 0.091 µT field, indicating concurrence with studies elsewhere.

Readings taken along the right angle transect from the centre line of the power line to a point 222 m away within the residential area showed approximately exponential decay in the field strength with increasing distance to a point 50 m from the line where a field strength of 0.088 µT was measured (Figure 1). This field strength was consistent between 0.024 and 0.091 µT with increasing distance from the centre line until the 175 m mark was reached when a sudden increase in the field strength was observed, rising to a peak of 1.2 µT at a distance of 210 m. It should be noted that this reading was higher than that recorded directly below the line. After this point, field strength again decayed until the 222 m mark was reached.

It was hypothesised that underground cabling might have caused the localised peak at the end of the transect but this could not be confirmed using available technical drawings. It was concluded that either an uncharted ground cable was in existence or that there were interactions occurring in magnetic fields between lower-voltage overhead distribution lines. Further readings on a series of radii from the 210 m point revealed a number of small peaks and valleys which also might have resulted from field interactions from overhead lines. These findings again emphasise a need for personal dosimetry.

Microshocks

67% (n=36) of respondents had experienced microshocks in the previous month, perceiving them as ranging from “slight” to “severe”. 42% of respondents experienced them when cars were being washed, 17% when wires including fences, gates, wash lines or television aerial wires were touched and smaller percentages when a variety of other metal objects, including steel window frames or lintels, was touched. Many respondents commented that such shocks were a frequent occurrence, yet the shocks remained unpredictable and thus stressful. It was said that shocks increased in damp weather, when cars were being washed, or when woollen clothing was worn. About 14% (n=3) of the unexposed group reported having experienced microshocks in or around the home, an unlikely event considering local electrical field strengths, suggesting that some confusion with static-electrical shocks might exist in both groups. The lack of definitive conclusions as to the physiological outcomes of chronic exposure to microshocks, and the fact that they are perceived as stressful by recipients suggests a need for further integrated research.

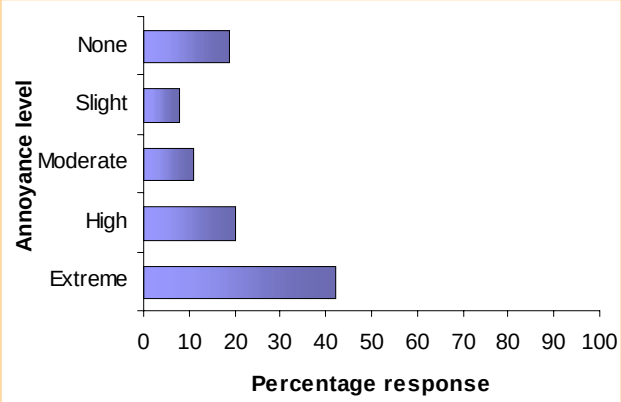
Corona Discharge Noise

Directly under the rural line used as surrogate for the Gatesville line the “total” sound level over a five minute sampling period ($L_{Aeq,5min}$) and “ambient” sound level (L_{A90}) were both 34.0 dB(A), whereas the same reading modes at the exposed site yielded 60.9 and 53.0 dB(A) respectively.

The relevant South African Standard (1994) specifies an annoyance threshold ("rating level") for this type of area of 60dBA, showing the assumed corona discharge noise component at the exposed site to be well within the Standard.

As sound is measured on a logarithmic scale the data imply that the daytime traffic and other urban noise at the exposed site far exceeded the noise generated by the line. This does not, however, detract from the potential annoyance value of the noise at times when it might increase in intensity or change its character, such as at night-time when the current loading increased or during winter peak loads or damp weather. In this regard 62% (n=34) of respondents to the relevant

Figure 2: Annoyance of Corona Discharge Noise



question found the noise extremely or highly annoying (Figure 2). Some commented, however, that during the daytime they tended to "forget it", but at night, during storms, or when visitors drew their attention to it, it became annoying. During storms when the hiss changed to a crackle and blue light might be emitted, there was fear of electrical hazard.

Third band frequency analysis at the surrogate site showed a fairly sharp peak in corona noise at 150Hz and similar peaks for traffic noise at the exposed site suggested that traffic noise could easily mask corona noise during the daytime, while late at night the masking effect might be diminished.

The "aeolian harping" (whistling or whining) heard when strong winds blew through the cables was associated by some respondents with pylon fall or line breakage. An ESKOM engineer advised that while exposure to >100 kph winds sometimes experienced in the Western Cape was extremely unlikely to cause damage or displacement of the pylon, it was possible that harmonic oscillations in a cable could break insulators causing sudden drop of a loop of live cable to a low level (Ware, 1996).

Four of the residents reported such an incident during a storm and one reported that "sparks flew into the house". This incident could not be reconciled with ESKOM records but it was said by ESKOM engineers that in the heat of an emergency repair it was possible that the completion of certain documentation might have been omitted.

These results suggest a need for careful evaluation of community perceptions and experiences in all investigations relating to overhead powerline complaints.

Unsightliness and obstructed view

While the majority of respondents in the exposed area did not believe that the wires or pylons obstructed their view,

Figure 3: Perceived Obstruction of View

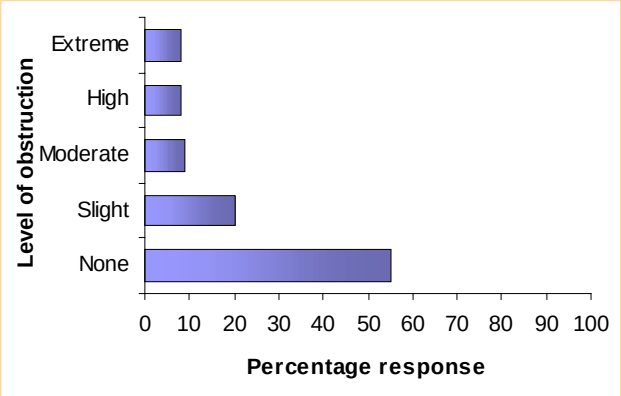
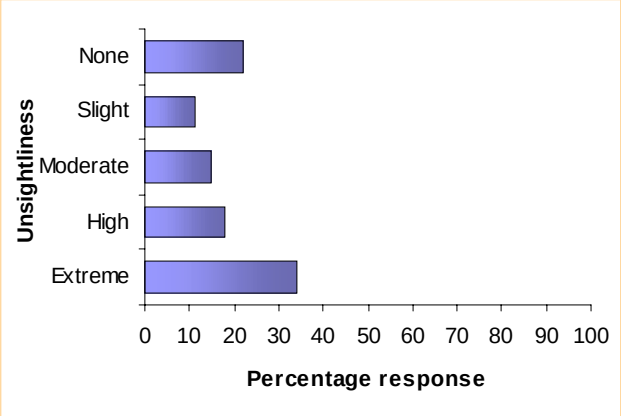


Figure 4: Perceived Unsightliness of Wires and Pylons



the majority felt that they were extremely unsightly, emphasising the importance of distinguishing between physical and aesthetic changes which engineering interventions can impose on a community (Figures 3 and 4). In recent years a number of less obtrusive pylon designs involving single posts rather than the classic girder-pylon design (Plate 1) have been developed and power distributors would be advised to weigh extra costs of such options against claims relating to reduced property value which might occur following construction of less acceptable designs.

Reduced property value

At the time of the survey the owners of the houses immediately beneath the line were receiving a 10% reduction in rates from the Cape Town Council by way of compensation, which suggested an assumed 10% devaluation of property by virtue of proximity to the line. The record of property sales for the five-year period prior to the study, however, indicated that houses in the exposed area fetched only about 75% of the price of those in the unexposed area, although size, construction and facilities were similar. Some "older" residents commented that when ESKOM had built the power line, property owners had received 50% of the estimated value of their property as compensation. These apparent discrepancies point to a lack of standardisation in process. In any event, such compensation is an economic solution aimed at placating the owner while not ensuring the health and safety of the occupant.

Stress and headaches

9% (n=18) of residents in the exposed area perceived that they were suffering from stress and 23% from frequent severe headaches. A test of association for non-parametric data revealed that the difference in the number of perceived stress cases between the exposed and unexposed areas was not statistically significant at $p<0.05$, but that the difference in the number of severe headaches between the exposed and unexposed areas was statistically significant at $p<0.001$.

A conclusion that EMF *per se* was related to severe headache prevalence would be premature when confounding social and environmental co-factors have not been fully identified and investigated for the local area, but a need for further research is indicated.

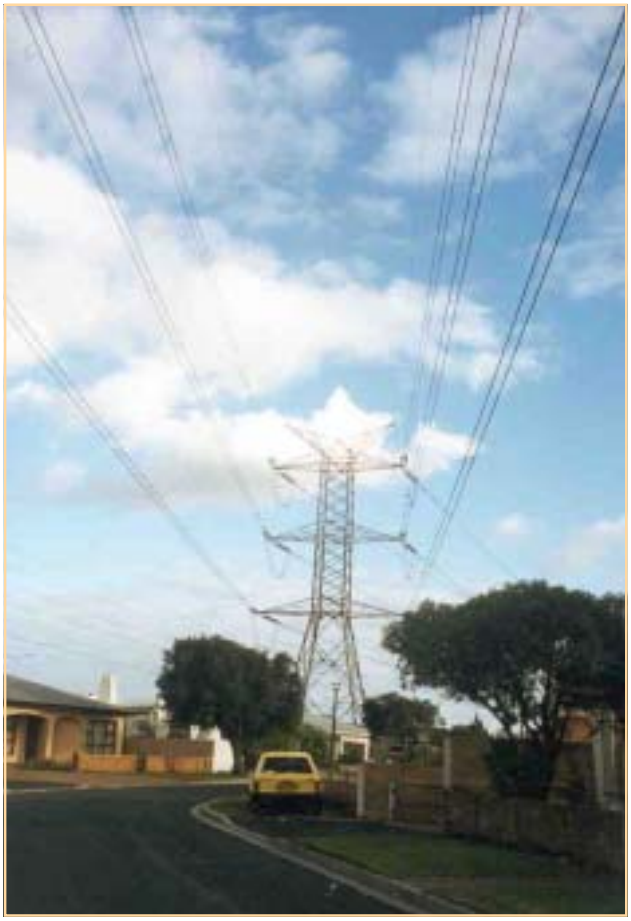
Other community concerns: responses to open-ended questions

63% (n=34) of respondents said they had been effected by the power lines in ways other than those included in the questionnaire.

Of comments received, 35% (n=12) revealed the aforementioned fear of pylons breaking or falling over during bad weather and about 18% revealed a fear of cable breakage or drop. Of this perceived threat one respondent said "It is more frightening when the wind blows as the pylons may snap" and another "This (cable drop) would slice your roof in half and the fear is the physical damage it would do regardless of whether the line was dead". Comments such as these revealed a dire need for risk communication between bulk power distributors and communities in proximity to lines as part of an overall risk management process incorporating other stakeholders such as government, local government and researchers.

24% of the comments concerned apparently inexplicable "explosions" or "loud bangs" emanating from the line at night during strong winds, again suggesting a need for technical

Plate 1: 400kV Powerlines over Gatesville, Cape Town



investigation in terms of risk communication. 21% of comments concerned television or radio interference which was said to be so bad in some locations that television reception was impossible. Only one respondent felt the lines had caused a computer problem which related to hard disc failure. No interference with telephonic communication was identified.

Perceived future community role

76% (n=41) of respondents in the exposed community felt the community had not been adequately involved in the past with regard to power distribution projects, with responses to open ended questions suggesting that the apartheid system had originally disempowered the community. 57% were, however, confident they would be involved in decision making by local government and ESKOM in the future.

Conclusions

While existing studies regarding the health impacts of overhead power lines are of epidemiological significance they are only of minimal support to practitioners who must address community concerns in terms of integrated engineering, health and social approaches.

The present study of a small, exposed population investigates some of the community issues and problems raised during social survey and attempts to contextualise these in terms of objective evaluation through physical measurement.

A need for further integrated research in a number of areas has been identified, including the feasibility and desirability of different types of physical monitoring in local situations, the role of corona discharge noise in community annoyance, physiological and community reactions to microshocks, and the nature and meaning of perceptions of health. In this regard the statistically significant prevalence of severe headaches in the exposed group as compared to an unexposed group requires special attention if risk factors are to be correctly identified.

Research into EMF in general needs to be duplicated in areas other than high Northern latitudes if the impacts of warm climate, low summer current loading, screening impact of regionally-preferred building materials and implications of local outdoor behaviour are to be explored.

Until consistent epidemiological results are obtained which are well-supported by clinical and toxicological findings, the precautionary principle with regard to the prevention of habitation and occupational activity within a suitable distance from lines should be investigated and applied.

While existing action thresholds for physical threats were not exceeded in the Gatesville study, assessment of the subjective reactions of communities to these threats has been shown to be important in contextualisation of hazard. In this regard a need for sound, multi-directional risk communication was identified.

Power lines are a necessary feature of the landscape of any industrialised society but can ironically become symbols of disempowerment if community concerns are not addressed in a meaningful way.

Acknowledgement

The researchers wish to thank South Africa's Electricity Supply Commission, ESKOM, who supplied electrical and magnetic field metering equipment and who gave specialist engineering support during the study. They also wish to thank EH students of the Cape Technikon University who conducted most of the survey interviews.

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Literature Reviews

Water and Health in Malaysia: Integrated Water Resources Management Approach for Sustainability

Mazlin B. Mokhtar

Introduction

We are all dependent on water. We need it all the time, in so many ways. We need it to stay healthy, we need it for cleaning, for agriculture and industry. Water is indeed an important resource in our lives, but we are not taking care of this resource with respect. Much water nowadays is being wasted, polluted, and abused. These abuses and wastage must stop in order to ensure a sustainable lifestyle for present and future generations.

The World Environmental Day is celebrated every 5th June since 1972. The theme chosen for 2003 International Year of Freshwater is "Water – Two Billion People are Dying for It!" This theme is chosen to remind us about the 1.1 billion people with no access to improved water supply and the 2.4 billion people with no access to improved sanitation. Thus it is a call on each of us to help safeguard the most precious source of life on Planet Earth (UNDPI, 2002).

Participants of the third World Water Forum in Kyoto, Shiga and Osaka, Japan from March 16 – 23, 2003 had agreed that freshwater is a very precious and finite resource central to sustainable development, poverty alleviation, social stability and economic development. The Ministerial Declaration of the Second World Water Forum in the Hague (March 2000) stated that meeting basic water needs, securing food supply, protecting ecosystems, sharing water resources, managing risks, valuing water and governing water wisely as the key challenges for our sustainable future. Participants of the forum discussed the actions needed in order to solve the global water challenges and to meet the goals set forth at the Millennium Summit of the United Nations in New York (2000), the International Freshwater Conference in Bonn (2001) and the World Summit on Sustainable Development in Johannesburg (2002). Based upon these discussions, all participants from various governments, NGOs and other organisations were encouraged to make specific and tangible commitments (World Water Forum 2003).

To balance increasing human requirements for adequate water supplies and improved health and sanitation with food production, transportation, energy and environmental needs, would require most countries to be more effective in their governance, improved capacity and adequate financing. Community level public participation is also fundamental in achieving these goals. The common basic requirement for water by all is indeed an opportunity for cooperation amongst the many races and communities of the world.

This year 2003 is the International Year of Freshwater. Water is a matter of life and death. About 2.4 billion people, which is more than a third of the world's population do not have access to proper sanitation. More than 2.2 million people, mostly from developing countries die each year from diseases associated with poor quality water and poor sanitary conditions (UNDPI, 2002).

Water Quality and Human Health

We must understand the relationships between water quality and quantity and their effects on human health. Water quality impacts on human health are especially serious in areas of high water stress, where the water withdrawn for human use is more than the water available. Freshwater, both surface water and ground water, is an important medium for the transport of toxins, viral and bacterial diseases and parasitic infections. Waterborne bacterial infections had caused millions of cases of diarrhea and some of these had resulted in deaths, mostly among children. Water quality is a complex

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issue. It includes all phases of the hydrological cycle from precipitation inputs, through terrestrial surface water and ground water systems, to the marine environment into which freshwater runoff ultimately discharges. Water quality could be defined by various physical, chemical and biological parameters, and shows complex variations spatially and temporally. Many of the water quality problems of today are caused by the use of water for industrial, agricultural and domestic purposes. Surface, ground and coastal waters have become polluted with a variety of pollutants, which include heavy metals, organics, nutrients, radioactivity and suspended solids.

Malaysia and Its Water

There are some 150-river systems in Peninsular Malaysia and about 50 river systems in Sabah and Sarawak. Rivers in Malaysia have played a major role in shaping and influencing the development of the nation and the cultures of its people (Keizrul Abdullah, 2001). Almost all major towns in Malaysia are located near a river. Kuala Lumpur was founded on the confluence of the Klang and Gombak Rivers. Malaysian rivers have also provided a means of transport, helped to establish ports and towns, opened up the hinterland, irrigated the land, generated hydropower, and supply drinking water to the people and other living things. Rivers of Malaysia also offer recreational opportunities and share a wide variety of flora and fauna.

Rivers in Malaysia are also receiving the impacts of rapid growth through land development, urbanisation and industrialisation. The problems normally associated with rivers are water shortage, flooding, water pollution, sedimentation and squatters. The river at source is unpolluted but after human use, the water becomes discoloured and contaminated with a variety of pollutants. Water pollution is the result of discharges from point and non-point sources. According to the data by the Department of Environment Malaysia, of the 116 rivers monitored about 61 are slightly polluted and 13 polluted (Keizrul Abdullah 2001). The main sources of organic water pollution are domestic and industrial sewage, effluent from palm oil mills, rubber factories and animal husbandry. Mining operations, housing and road development, logging and clearing of forest are major causes of high concentration of suspended sediment in downstream stretches of rivers. In the Klang Valley, an estimated 50 – 60 tons of wastes end up in the river system daily.

To prevent deterioration of the river environment calls for innovative and comprehensive approaches at bringing nature back to rivers (Keizrul Abdullah, 2001). To do this, the issues that must be addressed are legislation, enforcement, River Basin Authority, curative cleaning, preventive measures, planning, public participation, finance and Integrated Water Resources Management (IWRM).

In Malaysia, the water resources management problem has grown in magnitude and complexity as the country moves from a basically agriculture-based economy in the 1970s into an industry or manufacturing based economy in the 1990s. Some of the water problems encountered by Malaysians are flooding (water excess), water supply shortage, water quality deterioration and overall environmental degradation. Currently the management of development activities in the river basin is based on administrative boundaries rather than on the geographical boundaries of the river basin. This problem is further made complicated due to a number of government departments and agencies with fragmented responsibilities in land and water resources management. Some efforts have been made to bring about improved coordination in the planning and management of land and water resources-related development activities. Malaysia has embarked on a programme of bringing nature back to the rivers. This could be achieved if there are initiatives to review and strengthen legislation, to improve enforcement effort, to establish river basin authorities, to promote public participation, to improve planning mechanism, and to secure adequate finance for the activities (Hiew, 2001).

Water Resources Management in Malaysia is being carried out by the Federal and various state government agencies. The federal agencies are generally responsible for the studies, planning and development of the water resources. Water is a resource, which belongs to the state, and hence state agencies are responsible for water supply infrastructure development including financing, operation and maintenance (Elfithri & Mokhtar, 2003). Watershed management falls under the purview of Department of Environment (DOE), Department of Irrigation and Drainage (DID), Federal Public Works Department (PWD), Department of Town and Country Planning (TCPD), Forestry Department, Economic Planning Unit (EPU) of the Prime Minister's Department, and Local Authorities. Water quality management is carried out by the DOE, DID, Health Department, Department of Mineral and Geoscience, Department of Fisheries (DOF), Department of Wildlife (DOW), Veterinary Department, Alam Sekitar Malaysia Sdn. Bhd. (ASMA), and Local Authorities. Water supply services for various uses are delivered by DID, Water Supply Department, PWD, private companies, and local authorities. Research and development

initiatives in water-related matters are being performed by universities, research institutions, DOE, PWD, Malaysian Meteorological Services (MMS), Health Department and Department of Agriculture (DOA). An integrated and holistic approach to management of water resources in Malaysia is certainly a recommended approach for this millennium in ensuring a sustainable water resource development and conservation in the country.

Integrated Water Resources Management

Southeast Asia's Vision for Water in the 21st Century is the attainment of sustainability of water resources to ensure sufficient water quantity of acceptable quality to meet the needs of the people in terms of health, food security, economy and environment (Keizrul Abdullah, 2003). With this, people will have access to safe, adequate and affordable water supply, hygiene and sanitation, while the effects of water related hazards will be mitigated. One of the implementation strategies of the Framework for Action for Southeast Asia in achieving the vision is to manage water resources more efficiently and effectively through integrated water resources management (IWRM). IWRM recognises the many competing interests in how water is used and allocated and that the various stakeholders should be active participants in the water management process. IWRM takes into account all the natural aspects of water resources including the sectoral interests, the policy frameworks and the institutional arrangements. Essentially this is a transformation process from one that is over-focused on development to one that give greater emphasis on conservation and management. To ensure the success of this transformation process, capacity building is essential and a critical component to impart the additional skills in management, institutional reform, conflict resolution, social and communication skills needed to the existing and new water managers.

IWRM is a process which can assist countries in their endeavour to deal with water issues in a cost-effective and sustainable manner (Shahrizaila Abdullah, 2003). The Global Water Partnership (GWP) has defined IWRM as "a process, which promotes the coordinated development and management of water, land and related resources, in order to maximise the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems". Multi-disciplinary and multi-sectoral approaches are the premise of IWRM and strong institutions and capacity building are essential pre-requisites.

Capacity building is the sum of efforts needed to nurture, enhance and utilise the skills and capabilities of people and institutions at all levels – locally, nationally, regionally and internationally – so that they can better progress towards a broader goal (Shahrizaila Abdullah, 2003). Building capacity involves empowering people and organisations to solve their problems, rather than attempting to fix those problems directly. Human resources development through education and training is a key dimension of capacity building. A successful capacity building will produce more effective people and better institutions, which in turn will provide products and services on a sustainable basis. Although IWRM has been accepted as a concept for several years, most countries and their agencies are still struggling with the translation of this concept to the practical day-to-day application (Mokhtar *et al.*, 2003). Strategic planning and activities in capacity building for IWRM are indeed critical in our efforts to establish credible national and regional institutional arrangement in delivering appropriate measures. One such institution is the Malaysia Water Partnership.

Malaysia Water Partnership

The Malaysia Water Partnership (MyWP) is a non-profit organisation registered with the Registrar of Societies Malaysia. MyWP is the Malaysian chapter to the Global Water Partnership (GWP) and hence carries a similar mission to support the sustainable management of water resources in the country. The objectives of MyWP are:

i) to provide strategic advice to the Government and relevant stakeholders on water and water-related matters with particular emphasis on the adoption of IWRM principles and practices;

ii) to promote greater awareness in IWRM among all stakeholders including the public, water users and potential polluters;

iii) to provide and disseminate synthesised knowledge and experience on best management practices (BMPs) in IWRM;

iv) to foster interaction among the members by promoting cross sectoral and multi-stakeholder dialogues at local, river basin, state and national levels to meet critical needs;

v) to provide support in capacity building and training programmes and activities related to IWRM;

vi) to provide support for research and development initiatives related to IWRM; and

vii) to act as the focal point and coordinating centre for collaborative action with similar or related organisations locally, regionally and internationally.

Membership of MyWP comprises government agencies, private sectors, NGOs, Institutions of Higher Learning, research institutions, and water user groups.

Malaysian Water Vision 2025

Since the formation of MyWP at the end of 1997, it has held a series of consultations, seminars and workshops from time to time (Shahrizaila Abdullah, 2001). Initially, the main focus was to facilitate and undertake activities to develop the Malaysian Vision for Water and Framework for Action mandated by the World Water Council, the Global Water Partnership, and SEATAC-GWP in preparation for the Second World Water Forum held in the Hague in March 2000. The Malaysian Water Vision 2025 is:

"*In support of Vision 2020 (towards achieving developed nation status), Malaysia will conserve and manage its water resources to ensure adequate and safe water for all (including the environment).*"

The framework for action comprises four main challenges that were identified for a better water future as follows:

i) managing our water resources efficiently and effectively (addressing both quality and quantity aspects);

ii) moving towards integrated river basin management;

iii) translating awareness to political will and capacities; and

iv) moving towards adequate (safe) and affordable water services (befitting a developed nation status by 2020).

Malaysian Network for Capacity Building in IWRM (MyCapNet) and Southeast Asia Network for Capacity Building in IWRM (SEACapNet)

In Malaysia, a national network in capacity building for IWRM, MyCapNet, has been set up under the Malaysian Water Partnership (MyWP). The objective of this network is to enhance IWRM and service delivery at local scale, focusing on education and training, through a networking process of various institutions and organisations of similar objectives, armed with knowledge and information in addition to tools and materials (Mohd Desa & Mohamed, 2003). MyCapNet is part of the newly formed Southeast Asia Capacity Building Network for IWRM (SEACapNet) which are emphasising on the following issues (Abdul Ghani Aziz *et al*., 2003):

i) establishment of a mechanism for virtual communication;

ii) enhancement of the role of women in IWRM and addressing gender issues in water;

iii) establishment of appropriate financial and administrative relationships between capacity building institutions;

iv) recognition of the importance of research and development;

v) incorporation of trans-boundary aspects in designing capacity building programmes in IWRM;

vi) promotion of success stories; and

vii) integration of social, environmental and water resources sectors in IWRM activities.

Clearly, there is much to be done. The challenges are tremendous and emergent issues for capacity building as a whole are both generic and unique in nature. The SEACapNet is established in a situation with the presence of various international organisations, both within and outside of the United Nation system, as well as other regional and national organisations addressing water and water-related issues (Pereira *et al*., 2003). This calls for the development of effective linkages at all levels after taking into account regional and national demands as well as the principles of subsidiary and complimentarity.

Conclusion

Integrated Water Resources Management is the recommended approach in ensuring a sustainable development and utilisation of water resources in Malaysia. IWRM is the holistic and integrated approach involving all stakeholders in addressing the many and complicated issues of water, involving not only the science and engineering of water but also law, economics, finance and public policy, that determine the quantity and quality of water resources. Integrated decision-making and R&D are critical in overcoming the problems involving water, in this era of rapid development and high water demand due to the increasing

human population. IWRM is also recommended in the development of decision support systems of water resources management; excess water management; water demand analysis; water reuse; wastewater treatment; water distribution; groundwater systems; surface water resource systems; development of computer model for water quality analysis; management of wetlands, estuaries, groundwater, rivers, lakes and reservoirs; water quality; water laws; planning and financing for water resources; and water economics for sustainable development in Malaysia.

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Abstracts

Importance of Respiratory Exposure to Pesticides among Agricultural Populations

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Abstract:

In the majority of cases, respiratory exposure accounts for a small fraction of total body exposure to pesticides; however, higher volatility pesticides pose a greater risk for exposure, particularly in enclosed spaces and near application sites. In 2000, nearly 22 million pounds of active ingredients designated as toxic air contaminants (TACS) were applied as pesticides in California (combined agricultural and reportable non-agricultural uses; California Department of Pesticide Regulation, 2001a, Summary of Pesticide Use Report Data, 2000, Sacramento, CA: author). Agricultural workers and agricultural community residents are at particular risk for exposure to these compounds. The TAC program in California, and more recently the federal Clean Air Act amendments, have begun to address the exposures of these groups and have promulgated exposure guidelines that are, in general, much more stringent than the Occupational Safety and Health Administration (OSHA) and American Conference of Governmental Industrial Hygienists (ACGIH) worker exposure guidelines. Choosing lower volatility pesticides, lower concentrations of active ingredients, and handling equipment designed to minimize exposure can often reduce worker respiratory exposures significantly. The use of personal protective equipment, which would be facilitated by the development of more ergonomic alternatives, is important in these higher respiratory exposure situation. Finally, in the case of community residents, measures taken to protect workers often translate to lower ambient air concentrations, but further study and development of buffer zone and application controls in a given area are necessary to assure community protection.

Original Source: International Journal of Toxicology, Vol. 21, Number 5/September 01, 2002, 371 - 381.

The Toxicology of Inhaled Woodsmoke

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Abstract:

In addition to developing nations relying almost exclusively upon biomass fuels, such as wood for cooking and home heating, North Americans, particularly in Canada and the northwestern sections of the United States, have increasingly turned to woodburning as an alternate method for domestic heating because of increasing energy costs. As a result, the number of households using woodburning devices has increased dramatically. This has resulted in an increase in public exposure to indoor and outdoor wood-smoke-associated pollutants, which has prompted widespread concern about the adverse human health consequences that may be associated with prolonged woodsmoke exposure. This mini-review article brings together many of the human and animal studies performed over the last three decades in an attempt to better define the toxicological impact of inhaled woodsmoke on exposed children and adults; particular attention is given to effects upon the immune system. General information regarding occurrence and woodsmoke chemistry is provided so as to set the stage for a better understanding of the toxicological impact. It can be concluded from this review that exposure to woodsmoke, particularly for children, represents a potential health hazard. However, despite its widespread occurrence and apparent human health risks, relatively few studies have focused upon this particular area of research. More laboratory studies aimed at understanding the effects and underlying mechanisms of woodsmoke exposure, particularly on those individuals deemed to be at greatest risk, are badly needed, so that precise human health risks can be defined, appropriate regulatory standards can be set, and accurate decisions can be made concerning the use of current and new woodburning devices.

Original Source: Journal of Toxicology and Environmental Health Part B: Critical Reviews, Vol. 5, Number 3/ July 01, 2002, 269 - 282.

Cardiovascular Effects Associated with Air Pollution: Potential Mechanisms and Methods of Testing

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[5] Department of Medicine, University of North Carolina, and Center for Environmental Medicine and Lung Biology, Chapel Hill, North Carolina, USA.

Abstract:

A recent series of epidemiologic reports have shown associations between fine particulate matter (PM) levels and increased cardiovascular morbidity and mortality. Elevated PM levels have been linked with cardiac events, including serious ventricular arrhythmias and myocardial infarction. A workshop brought together epidemiologists, cardiologists, and toxicologists from academia, government, and industry to examine plausible mechanisms that could be responsible for such effects, and to consider the armamentarium of noninvasive tests available to examine these relationships. Possible mechanisms considered by the participants include: (a) effects on the autonomic nervous system; (b) alterations on ion channel function in myocardial cells; (c) ischemic responses in the myocardium; and (d) inflammatory responses triggering endothelial dysfunction, atherosclerosis, and thrombosis. A large number of tests were identified to assess specific mechanistic pathways underlying the cardiovascular effects of air pollution and include: (a) autonomic control of the cardiovascular system assessed primarily by heart-rate variability; (b) myocardial substrate and vulnerability assessed by the electrocardiogram and estimations of ejection fraction and wall motion abnormalities in imaging studies; and (c) endothelial function, atherosclerosis, and thrombosis assessed by clotting parameters, cytokines, lipid profiles, and forearm blood flow. A variety of approaches ranging from molecular and genetic investigations to human clinical studies were recommended to further investigate the important epidemiologic associations.

Original Source: Inhalation Toxicology, Vol. 14, Number 12/December 01, 2002, 1231 - 1247

The purpose of the Environmental Health Focus (EH Focus) includes promoting research and development, translating research outcomes, engaging and equipping stakeholders both locally and regionally in the Environmental Health Action Planning (EHAP) purpose, and to achieve sustainable living within Malaysia and Asia Pacific.

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The EH Focus accepts articles, research papers, views and news in relation to environmental health which have not been published previously. All articles submitted will be sent for refereeing and the decision of the editorial board as to the suitability of the article for publishing will be final. Neither the Editorial Board nor the Publisher accepts responsibility for the views and statements of authors in the paper.

Manuscripts in English should be submitted in soft copy (preferably MS Word) with the hardcopy of the article send by mail. Manuscripts should be typewritten on A4 size paper and double-spacing throughout.

Articles for Feature Articles, Technical Notes, research papers and literature reviews must be accompanied by an abstracts of not more than 300 words in English. Supplementary abstract in author's national language could be published above the English version if there is a request.

Figures and tables should be submitted in original electronic form (e.g. MS Excel for table).

References List all references at the end of the paper, follow the Harvard system of referencing, as shown in the following examples.

a) *Books*

Pescod, M.B. (1989). *Environmental Engineering*. Wiley. London. pp 123-124.

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c) *Conference Papers*

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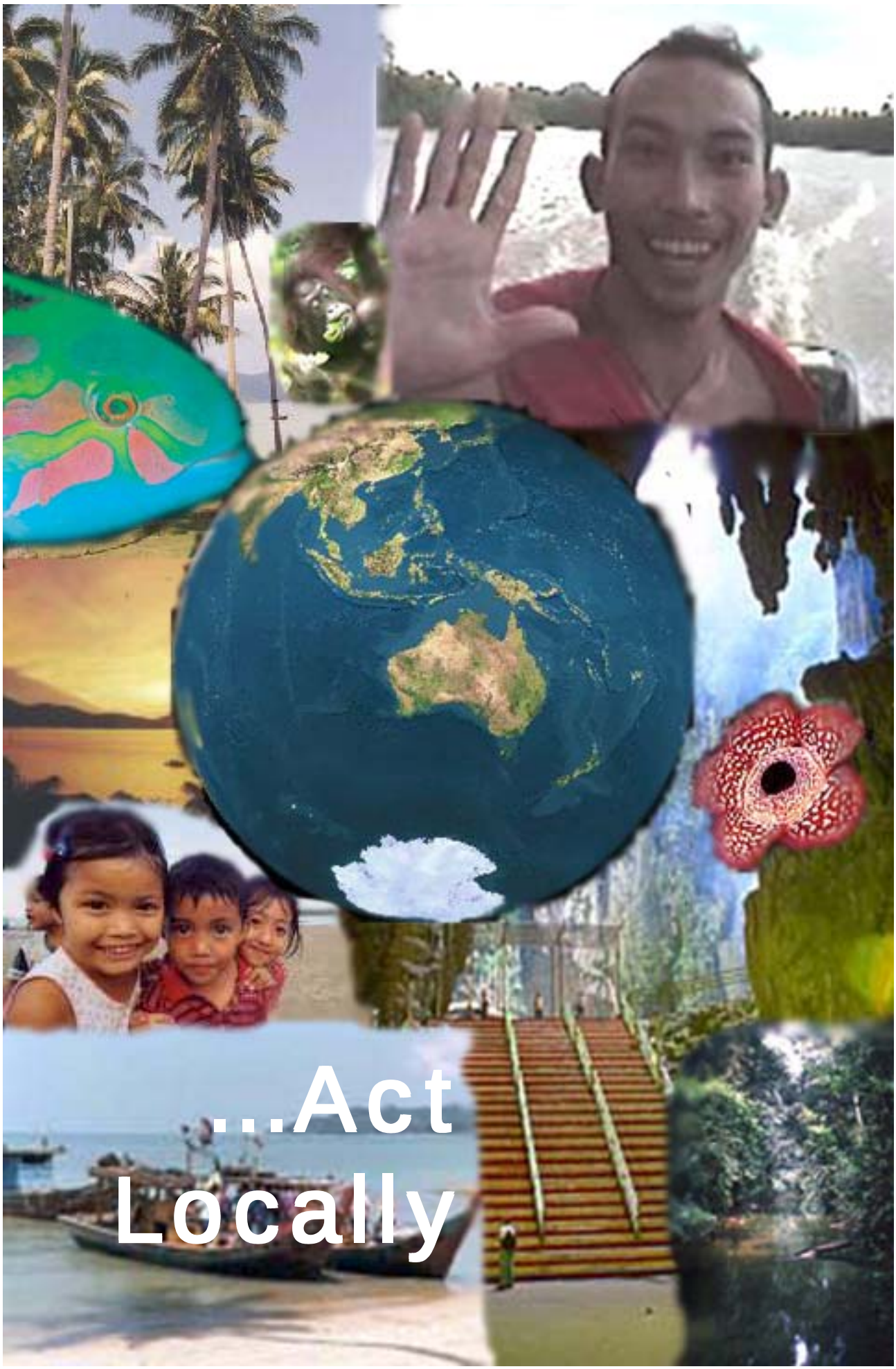
...Act
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Healthy communities are places where:

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- ecological balance is a source of pride

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