CHAPTER 1

Introduction to environmental health

The quality of "HEALTH"

Health is considered as the most valuable possession in this era. We often measure the health status by using statistics such as death rates from various illnesses, but when the death rate of a community in declining, does this show that the community live healthier? Probably they are living longer, but in an unhealthy condition. Therefore, our focus should be shifted from a person’s duration of life to the well being of his life which is the quality of his life.

There are various ways where the quality of the person’s health can be measured, whether in terms of alive or dead, sick or healthy. For example, a person’s vision can be a health measure. Vision can be varied from good to poor level without reflected in pain conditions. Other criteria which may be measured in the quality of health are nutritional status, physical fitness, resistance to disease, high levels of cholesterol in the blood, the allergies, weight and others.

In the previous healthcare system, we were more likely to cure the disease rather than maintaining good health. More attention is given to medication than prevention. Currently, the focus is on prevention, care and health promotion as part of the life style. Each individual in the population should conduct medical examination regularly to determine his health status. Doctor shortage should not stop such practices to be conducted widely. Most of the examination such as blood tests, measurement of blood pressure, cholesterol and measurement of glucose in blood and others can be performed by a technician or nurse. Next, the results of the test will be investigated by a doctor. This procedure saves time and money, and allows doctors to carry out other medical duties. However, another problem that complicates the situation is that most of the society’s attitude tends to ignore the health maintenance unless they are sick.

Beliefs and Health

Healthcare system has been growing since 1990's and it has been changing the directions more to care or promotion of health. Healthcare aspects have gained a more appropriate and emphasized attention in legal administration, cost control, availability, available findings, quality, quantity, continuity and community acceptance. Changes in attitudes and beliefs from the 1970's to the 1990's are related to the completeness, wellness and self-responsibility for their own health. Current health care is reflecting the individual’s awareness or participation in physical activity, nutrition, stress management and the person’s overall lifestyle. As a result of that, the holistic health centres, wellbeing centres, tourist areas and medical spas are start growing where the communities are more aware of the physical and mental well-being.

The main purpose of achieving good welfare is to give a space to the community to change their lifestyle in order to have healthy lifestyle as part of their habits. Well-being is functioned as the prevention and care involved the self-responsibility. Attention should be directed to the prevention by the self-responsibility.

In our life, faith is a concept which is used as a guide of belief formed through the knowledge or data without having the experience. Most of us hold firmly to the faith and do what they had learned long time ago from the experience. This is in response to what is happening now but the problem is we tend to stuck to it.

Normal Health

When we assess the level of health, perhaps no words are ever more frequent use than the word “normal”. The word is usually used in a vague sense without any specific purpose. In this case, it is used as a synonym for an average. Actually, normal should be understood as what is accepted as normal. When we refer to health, normal is more likely a field of a specific entity. It reflects the stage where a lot of individuals who are above and below the average health. It's clear that health is a
relative aspect, because there are individuals who have a higher level of health than others even though overall people may have normal health.

What constitutes normal health must be drawn arbitrarily, based on the knowledge, experience and assessment of the person who has health disciplines. Generally, normal health is considered as a state of well-being in which the individual is free from any disability and has enough energy to meet the needs of ordinary life, with social adaptation that produces pleasure and enjoyment of life. Relatively, it is easy to identify the level of health because most of the individual are in or out of normal range.

Normal health does not mean perfect health. In an imperfect world, every person will have their own shortcomings, but this deficiency has little or no significance in terms of normal health. The energy level of an individual is not steady. It tends to fluctuate or forming a cycle. Although this fitness level may decrease from time to time but the individual can still fall within normal health.

Today, health is no longer measured in terms of muscle strength or physical size. It is clear that a person should have certain strength to meet the day-to-day insistence of life. It probably also require additional strength for a particular condition, but it does not have to be a body builder. Health is the welfare of all the conditions which must be evaluated collectively, rather than a specialized progress. Someone with normal health may suffer a temporary illness such as a cold or appendicitis, or may have disabilities such as broken bones. Therefore, he is out of the normal range of health for a while. The people will recover quickly to normal condition if he complies with the good principles of health in daily life.

Modern Health Concept

The concept that health is merely free from disease is not exactly in the modern needs and understanding of the current health. Indeed, a person must be free from disease and disabilities in order to achieve a reasonable level of health, but a modern medical term has broader meaning than this. Today, health is described as the quality of the physical, mental and emotional changes that allow a person to live efficiently and pleasant. Disease is a harmful deviation from normal health.

Health should be considered relatively. This is also considering that the effectiveness and enjoyment of life are not accurate and absolute in terms of qualitative or quantitative. When a factor or activity is evaluated in terms of its contribution to health, it is best to assess in the form of the following question: What would happen to the individual's enjoyment of life? Health is one of the continuing channels towards enjoying a fruitful and productive life. For a normal person, the well being of physical, mental and emotional enables him to do things that he wants and should be done in order to achieve the goals in his life that could bring pleasure and self-indulgence. For a person suffered from any disease, health could be an urgent priority if he wants to achieve effectiveness and enjoyment of life.

Transitions of Disease Pattern

Transition point of chronic infectious disease occurred in the United States around the year 1925. This is due to the transition of the society from an agricultural to an industrial society. The disease struck the society can be used to characterize the conditions of the society at that time in terms of social, physical and cultural. At the beginning, we have started a lifestyle in the way of agriculture; with the start of the industrial era, the social roots had changed and caused a shift in disease patterns.

The agricultural era showed high fertility rates; the basic needs are: food, shelter and clothing; the diseases that commonly encountered are the infectious diseases. This is the typical types of population pyramid in the rural areas and developing countries where it is still based on the model of infectious diseases. Without specific treatment, parasite infections, infectious diseases and malnutrition are highly contributed to the mortality rate of infants and preschool children. In agricultural cultures, high fertility rates are driven by a high mortality rate. Large family size is also needed for assisting in crop harvesting.
The industrialization process has resulted in many changes in disease patterns. The disease pattern in the community during the industrial era is described by a model of chronic disease. Changing of the values could influence the way of living which could also cause a number of diseases. The way of living undermines the social, physical, emotional and environment arising from the change in luxury, values and lack of free time. These changes generally produce the low fertility rate. The young population which is under 20 years old is declining whereas the population over 65 years old is increasing. As a result, the third causal model, with various causes various effects, which is very complex and shows some of the causes can produce significant impact. This model uses a lot the concept of holism and wellness and describes a lot of the overall pattern of the disease in the 1990s. Different causes such as air pollution, smoking and certain types of radiation can result in lung cancer, emphysema and bronchitis in elderly in the country. Three major diseases such as heart disease, cancer and stroke are directly involved with more than 60% of all deaths.

**Concepts of Health**

Various health concepts have been developed as a result of changes in health which reflects that the shift of the patterns from infectious diseases to chronic diseases as a result of changes in agricultural society to an industrial society. Many basic concepts of health developed from infectious disease cycle are generally not suitable for chronic disease cycle.

**Ecology Model**

The first concept of health is the ecological model; it is relevant to the investigation of infectious diseases (Figure 1). This concept is based on the traditional approach of ecological balance. It involves three parties which are the agent, host and environment in equilibrium. When this balance is disturbed, the disease will occur.
Imbalances can occur when 1) changing the environment conditions that easily breed the agents such as poor hygiene or increasing of the ratio of the people who is susceptible in the population 2) the ability of the infectious agents to human increased or 3) the defence system or the immunity of human against diseases decreases such as AIDS or a person who fails to undergo immunization or vaccination. This concept allows drug therapy, sanitation, vaccination in order to help the three components to achieve balance. This concept is successful in controlling infectious diseases. The acceptance of the "germ theory" presented by Koch assumes that a single causative agent (single cause model and a single effect) based on statistical correlation is perfect. Because the method of drug therapy, vaccination and surgery is based on the epidemiology of infectious diseases, this approach may be outdated.

**Social Ecology Model**

A major adaptation of the ecological model is the social ecological model developed by Morris (Figure 2). Basically, this model replaces agents (for infectious diseases) by a factor of individual behaviour. This model suggests that the situation where the Thusus aetiological agent may not be available (model various causes, multiple effects or single effect). The model accepted the fact that many factors could influence a person's health. It also stated that behavioural factors have a greater impact than the physical environment as factors contributing to dynamic equilibrium.
World Health Organization Model

Health concepts held by the World Health Organization (WHO) is an extension of the social ecological model. “Health is a state of complete physical, mental and social wellbeing and not merely the absence of disease and disability”. This approach adds dimension to the mental well-being while maintaining the social and physical characteristics. The basic difference between the concepts of the previous model is that health is defined by the WHO as a state of well-being and not the way to achieve that goal. WHO concept has influenced the multi-dimensional models. These models can be characterized as holistic.

Holistic is seeing a person’s wellness from every possibly perspective, taking into account of all the concepts and skills available to the development of individual towards the harmony and balance. This holistic approach emphasizes mutual relations and unification of the body, mind and soul. It includes the use of a combination of the best of Western modern medicine with the best of health practices from the East regardless new or old.

Holistic Model

Many health activities admit the weaknesses of traditional health concept: ecology, social ecology and WHO. Therefore, a broad and comprehensive concept of health, conducted in terms of policies that are based on new approaches for the planning and formulation of health policy in the new era of disease patterns. Holistic concept of health assessed by Blum, Lalonde and Denver has come to the same conclusion. Health, with different dimensions, contains four basic features:

- environment,
- lifestyle,
- inheritance,
- health care system.
Blum emphasizes more on holistic model of health than “environmental health” (Figure 3). Lalonde called it a “health field concept” (Figure 10). This holistic model has formed a new belief system related to the forming of health. We have seen how the concept of health has changed, but we do not give up the belief that the medical system is the only way for our recovery. Alternatively, it is the concept and the idea of well-being that reducing the approach through the medical system as a single method for achieving healthy living standards.

**Figure 3: Environmental Health Model**

Health was the main responsibility of the individual in the 1990’s. Our dependent attitude to the medical system and doctors will be reduced and replaced by a holistic health and wellness. Causal epidemiological model and the concept of health are associated with the shift in disease patterns. Our system of belief affects health care and the way we pursue positive health.

**Factors Influencing Health**

**Inheritance and Health**

Hereditary or hereditary factors are associated with health. As we all know, family history is as important as individual medical history. Our genes whether it is good or not is inherited from both parents, grandparents and our ancestors. The doctors are usually more aware of the diseases that often experienced in the family of an individual. For example, we know that diabetes inherited genetically. If the disease occurred in the family of an individual, most likely the disease will be found in the individual. This is because of the diabetes is reduced by a recessive gene, only a minority of the families will be involved.

The development of health sciences and medicine has increased the survival rates and the level of welfare of the patients that inherited genetic disease. The lifespan of diabetes patients has prolonged through insulin injections and diet control. Epilepsy can now be controlled by drug therapy,
and also for other types of disease. Some people have suggested that the continuing development of medical science will fully control the problem and possibly the hereditary diseases are not important anymore.

In the focus of the health sciences, health can be measured quantitatively or qualitatively. Different hereditary and environmental factors have been studied, whether it has positive or negative contributions to health, separately, together, or in interaction with each other. Care and improvement of human health can now be planned and taught. The result can be measured and evaluated.

Environment and Health

At one time, health is generally considered as the personal matter. This attitude reflects that the individuals decide their own health status to be achieved. This condition is not true at this time because of the health status of an individual is dependent on his physical, biological and social status. Although the individual is responsible for cancer caused by smoking, he is not able to control the inhaling of air pollutants in urban areas. It depends on the government agencies to control the air we inhale, the water we drink and the food we eat. The cleanliness of surrounding will determine our lifespan. However, to what extent they are able to control in the above mentioned matter to ensure safety. Solving the environmental problems can only be implemented through a group or organization that has a responsibility and an interest in health.

National Health Study in the U.S. showed a positive relationship between economic and health status. It showed that low-income groups do not receive medical treatment. There may be an exception in this case; however, it can be concluded that the ability of a person to secure a medical treatment is associated with his income, affecting his ability of maintaining good health. The availability of health services is rarely considered as an environmental factor since it is the basic element in human health maintenance and the essential part in human environment. The community without medical services will have poor health. The population will be lack of protection by vaccines for diseases such as measles, polio, diphtheria and whooping cough.

In today's society which is more sophisticated, the question is not about having or not having the coverage of medical services, quality and availability of the service are given attention to all the members of the society. However, the willingness of society to work in medical rehabilitation is also important. Availability of staff and facilities to transform the individual into a positive way of lifestyle is just as important as saving his lives.

Lifestyle and Health

Health is a thing that has not been clearly understood. It is mentioned occasionally when we have drinks, we pray and thought it is always available. Many still consider health as a gift of God and not something that we can earned. We grieve when someone loses his vision while half of the cases of blindness can be avoided.

It proves that a person's lifestyle could greatly influence on the quality of health and lifespan. For example, in the United States, the leading cause of death and disability now is heart disease. What are the risk factors associated with this condition? Cigarette smoking, lack of exercise, overweight and malnutrition are the causal factors. Basically, most of the heart disease can be prevented if the persons change the way of living by practicing proper nutrition, adequate exercise and avoiding smoking habits. Usually, a person who managed to survive after his first heart attack will start a better lifestyle as a result of the fear of deadly threats.

Addiction to alcohol, drugs, emphysema and lung cancer are a few examples of health problems that show that how a person's lifestyle can affect his health status. Abuse of drugs, alcohol and smoking are social environmental problems that can raise serious health problems. One of the factors that complicate this problem is our disease oriented medical system. Action is only taken when a patient is sick. Modern health problems that we mentioned above are hard to be treated when the situation is in danger and when the symptoms occur; the damage is beyond the correction. Therefore,
prevention is better than medication. For the problem of sexually transmitted diseases, even though effective treatments are available, but the epidemic is still growing out of control. This is due to the lifestyle is something that is learned and not inherited, the community is necessary to be educated on how to increase health promotion through various perfect lifestyle. Obviously, this kind of education should not be delayed until they are in a hospital intensive care unit. Each individual should make an assessment of their own health status.

**Individual Responsibility on Health**

In our efforts to achieve and maintain the community health, we focus on the increment of personal responsibility. Results from studies often capture our attention if it comes in the form of a vaccine that can prevent a disease or a drug that can treat disease. On the other hand, if the results of the study suggest that cancer can be prevented by not smoking or the accidents can be avoided by not speeding, the attention will be neglected. This became our resistance to change. When we are advised to do something other than the daily activities, we will need to consider whether the expected results are in accordance with the changes. In certain circumstances, we will continue to adopt the same behaviour even if it goes against what is considered healthy.

The society must be aware of the results or changes in the field of health and do not consider the new information is just for doctors and other health professionals only. The society often thought the "magic pill" or "miracle drug" as the only form of contributions in health services rather than preventive measures.

Various diseases could be prevented if the individuals adopt a healthy lifestyle. For example, AIDS can be transmitted through casual sex relationship, dirty needles and blood transfusions that contain the virus. Hence, precautions are important because there is no cure for AIDS. Cardiovascular disease can be prevented through diet control, exercise and stress reduction. Apart from this, glaucoma can be controlled if it is identified and treated early. Strabismus which is blindness in one eye, usually ignore by the parents, leading to eye damage among children.

The use of false health practices that occurred since long time ago remains as a problem today. Selling of cancer and arthritis treatment, "healthy food" and "immediately" weight reduction program are some examples of the practices that are not only wasting of money but often dangerous to health. This practice will also reduce the use of medical services.

Medical and health experts do not deliver information about the control and prevention of certain illnesses to the public, and nearly half of all cases of cancer today are expected can be cured if it is identified immediately.

**Health Promotion**

The health promotion can be observed in the individual’s effort to monitor, maintain and improve his health status. It covers all the activities related to the improvement of a person’s health, including the use of public health resources, but it emphasizes the practice of health principles every day. Health Promotion does not focus on time; it is combined with daily activities. Such as this type of health promotion programs will be developed based on the framework of the requirements of a healthy life as follows:

1. Understand the disease, disability and genes inherited by offspring.
2. Undergo periodic medical examinations to know the details of their health status.
3. The practice of a balanced diet to supply adequate nutrients and energy.
4. Take care of bodily functions, including the factors that affect the skin, teeth, ears and eyes.
5. Adequate of rest and sleep.
6. Adjust the physical activity according to the capabilities and needs of individuals.

7. Prevent infection and treat any infection immediately.

8. Forming positive mental adjustment, emotional and social maturity.

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CHAPTER 2
Impact of development to the environment and health

Introduction

Development generates beneficial effects to human well-being. Sometimes, however, impacts associated with developments may cause unexpected negative effects on health and environment. Many of these can be avoided by careful planning. Industrial pollution is clearly one of the biggest contributors to our polluted landscapes. There are plenty of pollution sources, from urban and industrial ones, to rural and agricultural sources.

Deforestation

As civilization developed, people cleared most of the woodlands in Europe and large portions of Asia, the Middle East and India. Recent estimates suggest that approximately 40 million acres of forests are destroyed every year. Why deforestation become so serious? The reasons that can explain this situation are because human use wood to cook food and heat homes, to build homes, used as raw materials for industry etc. and cut down the forest and use it for agriculture purposes such as growing food crops or rear cattle. It is believed that 30 to 50 percent of the world’s forests have already been destroyed.

Forest soil act as natural filter that will filters polluted rainfall and cleanses it before it re-enters the surface or groundwater supplies. So, if the trend of deforestation is not improved, it will change weather patterns, such as decrease or increase in rainfall like El Nino and La Nina. Besides, when trees are removed and the land is overgrazed or cultivated, it will cause desertification.

Deforestation will also cause flora and fauna in some areas including Malaysia to face the extinction crisis. Some plants with medicinal value that can cure for HIV were lost during deforestation and they cannot be synthesized artificially. For animals, some of them are facing extinction in the forest of Peninsular Malaysia including Sumatran Rhinoceros and Malayan Tiger.

Water pollution

Water pollution means any physical or chemical change in water that adversely affects the health of humans and other organisms. The sources of water pollutants can be categorized into point source pollution, nonpoint source pollution and human induced water pollution. For point source pollution, it is the pollution that enters the water at specific sites, such as pipes from industrial or sewage treatment plants. Nonpoint source pollution or polluted runoff comes from the land rather than from a single point of entry. For human-induced water pollution, it can be grouped into three, which are agriculture, municipalities (sewage and urban runoff) and industries.

The environmental effects of water pollution include sediment pollution, inorganic plant and algal nutrients, inorganic chemicals, radioactive substances and thermal pollution. Instead of environmental effects, water pollution causes health effects to the community who uses the water daily. E.coli is one type of common intestinal bacterium. It is used as an indication of the amount of sewage present in water and as an indirect measure of disease-causing organisms. Other organisms are Vibrio cholerae, Schistosoma spp., Salmonella typhi and Entamoeba histolytica.

A lot of synthetic materials were found in polluted water. For examples,

- Aldicarb – It is a type of pesticide and will cause damages to the nervous system.
- Benzene – It is a type of solvent that will cause blood problems like leukemia.
- Carbon Tetrachloride – It is a type of solvent that may induce cancer or liver damage.
- Chloroform – It is a type of solvent that may induce cancer.
- Dioxin – It is a type of chemical pollutant that may induce cancer, damage the immune and nervous systems and reproductive organs.
- Ethylene Dibromide (EDB) - It is a type of fumigant that may induce cancer and attack liver and kidneys.
- Polychlorinated Biphenyls (PCB) – It is one of the industrial chemical that may induce cancer and attack the liver and kidneys.
- Trichloroethylene (TCE) – It is a type of solvent that may induce cancer and may induce liver cancer in rats.
- Vinyl chloride – it is used in plastic industry and may induce cancer.

**Air pollution**

Air pollution is the more critical environmental problems of this decade. It tends to be localized in urban and industrial regions of a country due to higher density of polluting sources. Air pollutants most often violating the WHO guidelines are suspended particulate matter (SPM) and ozone (O3). For example: the Klang Valley is the most urbanized region in Malaysia. Therefore, the air pollution profile is typical of other large cities. The sources of PM10 which is the particulate matter less than 10 mm are diesel (35%) and wood combustion (15%). Gasoline, even though contributes 1% of PM10, are a source of gaseous pollutants such as oxides of nitrogen, carbon monoxide (CO) and volatile organic compounds (VOCs).

Gaseous air pollutants include nitrogen dioxide, sulfur dioxide and ozone. For nitrogen dioxide, it can increase susceptibility of respiratory infection and Increase airway resistance in bronchitis. Sulfur dioxide could aggravate chronic respiratory disease among children while Ozone will reduce the pulmonary lung function, cause chest discomfort, irritation of respiratory tract, coughing and wheezing for sensitive individuals. It also causes the increase of incidence and severity of asthma attacks and moderate eye irritation.

Particulate pollutants include PM10, lead, hydrocarbons and sulfate. Generally, PM 10 is the particulate matter less than 10 mm. It will Increase respiratory disease risk and aggravation of bronchitis. For lead (Pb), it will disturb the formation of red blood cells (RBCs), affect the central nervous system (CNS) and IQ, cause anaemia, and affect the kidney function. Another type of particulate pollutant is called hydrocarbons. Normally, it will increase the susceptibility of respiratory infection and Aromatic hydrocarbons are carcinogenic. Last but not least, sulfate can cause increase in airway resistance.

**Chemical pollution**

Improper use of large amounts of chemicals and pesticides for agricultural and industrial production and for fighting diseases such as malaria has resulted in serious chemical pollution. These chemicals may contains persistent organic pollutants (POPs) such as polychlorinated biphenyls (PCBs), hexachlorobenzene (HCB), hexachlorocyclo-hexanes (HCHs), dioxins, furans and DDT.

Chemical pollution will bring some bad effect to our environment such as defects and embryonic death of birds and fish due to exposure to industrial chemicals or organochlorine pesticides. Besides that, the paper mill effluents will interference in the breeding and stunted growth in fish and the fish that live near municipal effluent channel will change their sex like from male to female.

One example of chemical is DDT. DDT was found in breast milk at a concentration between 4,220 to 7,300 ppb and is able to shorten a mother’s lactation period to her baby. Dioxin is another hazardous chemical which can cause cancer to most body organs. Other effects include increase cases of prostate, testicular and breast cancers, and increase in the “feminization” of males or “machonism” of females

**Solid wastes**

Garbage and refuse in modern life increase considerably as urbanization and industrialization take place. It may consist of paper, cans, bottles, waste foods, broken furniture, disposable containers, rubble and plastic bags. If they are not disposed properly, they can attract rodents and become a breeding place for flies. Besides that, lack of an adequate collection and disposal system and law enforcement has encouraged illegal dumping.
Solid wastes cause leachate contamination of groundwater and surface water due to illegal dumping sites or the sites without adequate plastic liner at the sides or at the bottom. Other effects including methane gas production which is a relatively potent greenhouse gas. One disease in particular that have attracted attention with regards to food wastes indiscriminate disposal is leptospirosis, especially at recreational areas.

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CHAPTER 3 Factors relating to changes in the physical environment

Part 1: Water quality and pollution

Introduction

We are surrounded by water. More than 70 percent of the earth’s surface is made up water, but almost all of it is in the form of salt water. Only 3 percent is available in fresh water form and most of the fresh water is locked up in the glaciers and poles. The ones we are able to use, surface water, is made up of streams, rivers, ponds, lakes and wetlands. There are also groundwater that we can use, which originates from aquifers, underground caverns and porous layers of rock.

Special properties of water

Water is able to keep heat that is given to it for a long period of time, and in the process it takes a long time to increase its temperature and then a long time too to cool down. Therefore, it has high heat capacity.

Water has high dissolving capacity, meaning it can dissolve quite a number of substances. In this, it acts as a solvent and results in creating a solution.

What is the water cycle?

The water cycle illustrates the movement of water on earth, be it on the surface, underground or in the atmosphere. In the cycle, water is always changing its appearance from vapor, liquid or ice. Atmospheric moisture, rain, snow, etc contains water that has been drawn from the earth by evaporation. Water evaporates from the ocean, streams, ponds, soil, moisture on leaves, transpiration of plants, and when falling. This natural cleansing of water allows atmospheric moisture to be water in its purest, most natural form. The atmospheric moisture then condenses and fall back to the earth as some form of precipitation.

As the precipitation falls towards the earth, the water’s quality is influenced by the atmosphere through which it passes. Air pollutants such as carbon dioxide and sulfur from industrial processes change the qualities of falling water. Acid rain is one such result. After reaching the surface, some water may land in an existing reservoir, some will run over the surface of the ground towards lakes or ponds, and some may get absorbed into the soil. In short, water hitting the ground may become either surface or groundwater. Surface water picks up the characteristics of the surface over which it passes. The same goes for groundwater. As water enters the ground, it picks up the characteristics of the formation through which it passes.

Why is water important?

Water is the most valuable natural resource. Without water, there will be no living thing on earth. Furthermore, the human body consists of 70% or more of water. In oceans, many organisms are made up of more than 90 percent of water, such as the jellyfish. Presence of water has a great impact on an area’s economy and health. For example, a piece of land in the desert which has canals can change from a barren land to an intensive agricultural area bringing in wealth and income. In addition, water is important and used for agricultural, industrial and overall community growth. Potable and clean water helps prevent economic strains resulting from water-related illnesses affecting individual and thus increase in the health of the community.

History of Water Quality

As early as 5000 BC, the ancient Egyptians have been using sedimentation apparatus and wick siphons in order to produce clean water for drinking. Some may have used a special type of substance found naturally called alum to remove suspended solids in water. Alum was found through a technical accident. It was readily available in Egypt at the time and by the 5th century BC, alum was exported to other countries in the Middle East. Inventions to produce clean water came thereafter. The Hippocrates Sleeve, which is actually a cloth bag was invented in the 5th century BC to strain or
filter rainwater. To supply water to a growing number of people living in cities, aqueducts, a Roman engineering marvel channelling water from the rural areas to cities with thousands of people. Some are still carrying water until today.

Other method of water quality methods came in the form of water filters. The first was the sand filter which was first used in the 17th century A.D. The Italian physician Portius wrote the “Soldier’s Vade Mecum” in 1685, which details a multiple sand filtration method. More cities constructed sand filters which were viable economically to produce vast quantities of clean water for the ever increasing population.

In 1804, the first municipal water treatment plant was installed in Paisley, Scotland. This treatment plant consisted of concentric sand and gravel filters, and its distribution system consisted of a horse and cart. Glasgow, Scotland became one of the first cities to pipe filtered water to consumers. Greenock and London joined the fray of cities with treated water being piped to consumers. The city of London saw slow sand filtration as the water treatment method of choice. The problem was that it required a large area and the sand used was of huge amounts as it was 2 to 3 feet deep. Cleaning it was another problem: it must be done using raw energy of workers and shovels.

The famous incident which related water quality and a disease called cholera happened in London in the middle of the 19th century. John Snow was able to trace the culprit of which the deaths caused by cholera was identified as a hand pump in Soho. Water from this pump had become contaminated by a nearby leaking sewer. Better tasting water appealed many to come from across town to this pump. By removing the handle, it made sure that the water won’t be used again. In the 1870s, Dr Robert Koch and Dr Joseph Lister showed that disease can be caused by microorganisms existing in water supplies. Since then, several countries has relied on several processes of water treatment to ensure safer water quality for the public.

Other methods of producing clean water came into being in the early 20th century. Ozone was first used in Nice, France in 1906. It was less popular due to costs and infrastructure problems. Rapid sand filters and usage of chlorine as the basis for water disinfection became more popular. By the 1920s, the usage of chlorination and filtration methods has significantly eliminated epidemics of major waterborne diseases. Other positive developments including dissolved air flotation, early membrane filters, floc blanket sedimentation and the solids-contact clarifier.

Functions of water in the human body

Since water makes up more than 70 percent of the human body, it is not mistaken to say that it is very important to the everyday function of the body. Among the functions are to protect body organs and tissues, help dissolve minerals and other nutrients to make them accessible to the body, regulates body temperature, lubricates joints, lessen the burdens on the kidneys and liver by flushing out waste products, helps prevent constipation and carries nutrients and oxygen to cells.

Water pollution

Water pollution is defined as any physical or chemical change in water that can, in turn, adversely affects the health of humans using it and also other organisms. In the process of preventing water pollution, wastewater treatment is an important part of sustainable water use.

The main sources of contamination

Precipitation

For precipitation, contamination may occur through air pollution such as NOX and SO2 that form acid rain, as well as the source of metals and organic chemicals. If acid rain occurs, it will affect and facilitates metal dissolution. Therefore, the water used by humans may contain dissolved metals that can lead to human health hazards.

Surface water
Surface water such as lakes and river water can be easily contaminated by air pollutants. Apart from that, water from these sources is often contaminated with human and animal waste. There are also cases where solid waste and chemicals can be found near water sources. This is most evident in the urban and industrial areas. Surface water may also be contaminated from the use of pesticides in agricultural areas. In addition, the contamination from the oil spill and ship tank cleaning can also be a source of water pollution.

Case Study: Citarum River, West Java

Citarum River is a river which flows from the highlands of west Java to the Java sea. In the process, it flows through an area with a population of more than 5 million. The river is primarily used for agricultural, water supply, industrial and sewerage purposes. In 2008, the Asian Development Bank (ADB) called it “The Dirtiest River in the World”, and approved a loan of USD$500 million to clean up the river.

Groundwater

The earth and ground water can be contaminated by natural contaminants from the soil. This contamination may be caused by metals, such as Al, Se and compounds such as nitrate. It can also be polluted by sewage discharge from poorly-serviced toilets.

Sewage

Sewage is wastewater carried off by drains or sewers, eventually contributes to enrichment of water and produces an oxygen demand as it is decomposed. Microorganisms use the process of cellular respiration to break down sewage into CO₂, water and other materials. Biochemical Oxygen Demand or BOD is the amount of oxygen needed by microorganisms to break down sewage and other organic wastes.

Other types of Water Pollution

There are other types of water pollution which is quite as important including sediment pollution, inorganic plant and algal nutrients pollution, inorganic chemicals pollution, radioactive substances and thermal pollution. Sediment pollution consists of excessive amounts of suspended soil particles that eventually settle out and accumulate on the bottom of a body of water. It originates from erosion of agricultural land, forest soils exposed by logging activities, degraded stream banks and construction.

Inorganic plant and algal nutrients pollution include those originating from agricultural land. When high amounts of inorganic nutrients, for example nitrate, gets washed off during a thunderstorm, the water with nutrients will flow into rivers or lakes and the water body will be rich with nutrients which, in turn, can support a high number of plants and algal. Examples for the harmful algae bloom (HAB) are the red tide in the Red Sea and the blue-green algae or cyanobacteria bloom in North Carolina, USA. The latest news on this issue came from Canada, where a 3,800-square-mile algae bloom in the Pacific Ocean off Canada's British Columbia has been traced to a California businessman who promised a local tribe he could help their salmon runs by fertilizing the ocean with iron.

Inorganic chemical pollutants are naturally found in the environment but due to human development these pollutants are often concentrated and released into the environment in urban stormwater. The primary inorganic pollutants of concern in urban stormwater are cadmium, copper, lead, zinc, nitrogen, nitrate, nitrile, ammonia, phosphorous, and phosphate. These chemicals are used in every aspect of human activity and are often highly toxic to humans and the environment.

Radioactive substances occur naturally in water. They readily dissolve into water that is in contact with sand or soils. The acidity of water is believed to increase the amount of certain radioactive substances, for example radium, that dissolves into ground water.

Thermal pollution is termed as a harmful increase in water temperature in streams, rivers, lakes, or occasionally, coastal ocean waters. Thermal pollution is caused by either dumping hot water from factories and power plants or removing trees and vegetation that shade streams, permitting sunlight to raise the temperature of these waters. Like other forms of water pollution, thermal pollution is
widespread, affecting many lakes and vast numbers of streams and rivers in the United States and other parts of the world. A temperature increase as small as 1 or 2 degrees Celsius (about 2 to 4 degrees Fahrenheit) can kill native fish, shellfish, and plants, or drive them out in favor of other species, often with undesirable effects.

**Disease-causing agents from water pollution**

Bacteria, viruses, protozoa and parasitic worms, are transmitted in sewage. *E.coli*, the common intestinal bacterium, is used as an indication of the amount of sewage present in water and as an indirect measure of disease-causing organisms. The fecal coliform test determines the presence of *E.coli* in water.

**Schistosomiasis**

Schistosomiasis (also known as bilharzia, bilharziosis or snail fever) is a parasitic disease caused by several species of fluke from the genus *Schistosoma*. Although it has a low mortality rate, schistosomiasis often is a chronic illness that can damage internal organs and, in children, impair growth and cognitive development. The urinary form of schistosomiasis is associated with increased risks for bladder cancer in adults. Schistosomiasis is the second most socio-economically devastating parasitic disease after malaria. This disease is most commonly found in Asia, Africa, and South America, especially in areas where the water contains numerous freshwater snails, which may carry the parasite. The disease affects many people in developing countries, particularly children who may acquire the disease by swimming or playing in infected water.

Below is a list of other water-borne diseases inflicted on humans and their agents:

- Cholera – *Vibrio cholerae*
- Dysentery – *Shigella dysenteriae*
- Enteritis – *Clostridium perfringes*, other bacteria
- Typhoid – *Salmonella typhi*
- Infectious hepatitis – Hepatitis Virus A
- Poliomyelitis – Poliovirus
- Cryptosporidiosis – *Cryptosporidium* sp.
- Amoebic dysentery – *Entamoeba histolytica*
- Ancylostomiasis – *Ancylostoma* sp.

This list shows the types of synthetic materials found in polluted water and the damage it does to the human body:

- Aldicarb – pesticide (damages the nervous system)
- Benzene – solvent (blood problems, leukemia)
- Carbon tetrachloride – solvent (may induce cancer, liver damage)
- Chloroform – solvent (may induce cancer)
- Dioxin – chemical pollutant (may induce cancer; may damage the immune and nervous systems and reproductive organs)
- Ethylene dibromide (EDB) - (fumigant, *pengasap*) and polychlorinated biphenyls (industrial chemical) - (may induce cancer; may attack the liver and kidneys)
- Trichloroethylene (TCE) – solvent (may induce cancer; may induce liver cancer in rats)
- Vinyl chloride – plastic industry (may induce cancer)

**Global water problems**

In 2012, the population of the world has surpassed 7 billion people. In water terms, there are more people to supply clean drinking water to but the facilities are unable to keep up with the demand. The distribution of water resources in relation to human populations exacerbates global water problems. Population growth is outstripping water supplies in countries such as India, China and Mexico. People in poor and less-developed countries lack access to safe drinking water and wastewater disposal. International tensions over water rights could result in armed conflicts. Of particular concern are the Mekong River, Indus River, Ganges River, Tigris-Euphrates River, Jordan River and Nile River.
Long Term Goal of Water Management

In this context, water management is of utmost importance so that the current and future generations are able to live in a healthy world. In order to do that, water management is important to provide a sustainable supply of high-quality water. In another sense, sustainable water use will ensure humans can use water resources into the future without harming the functioning of the hydrologic cycle or ecosystems. Dams, in particular, ensure a year-round supply of water in areas that have seasonal precipitation or snowmelt. In some areas, river diversion is sometimes used to increase the supply of water to a particular area. In advance situations, desalination which is a process of the removal of salt from seawater or salty groundwater has been practiced by a growing number of countries especially with abundant amount of fuel which is needed to turn saltwater into water vapor and then harvested into drinking water.

Conclusion

Water source of high quality is important in order for a society to be free of diseases and in turn, move forward to become developed people. The early processes of bringing in water for the masses in aqueducts to using filters and methods of chlorination has prevented major disease outbreaks in many parts of the world from the Roman times to the current period. By learning about diseases which originated from polluted water, we are able to live more healthily thanks to the forefathers of water quality.

REFERENCES

CHAPTER 3 Factors relating to changes in the physical environment

Part 2: Air pollution and health

Introduction

Why air is important?

Air constitutes about 80 percent of man’s daily intake by weight. Human beings breathe nearly 22,000 times a day, inhaling about 16kg of oxygen. Thus pollution of air may have profound health effects and other consequences. No matter who we are, where we live or how healthy we are, the quality of air that we breathe each day is very important and it can affect us. According to the World Health Organization (WHO), the requirement of human of air is relatively constant which is $10 - 20 \text{ m}^3$ or $10 - 25 \text{ kg per day}$. As compared to food and water intake, we only need $1 - 2 \text{ kg}$ and $1 - 3 \text{ kg per day}$ of them respectively.

Besides that, human cannot sustain or live for a long time without air. It is estimated that human can only survive for a few minutes without air, a few days without water and a few weeks without food. Air is essential in our life and we cannot choose either we need or do not need air as without air, human will eventually die.

What is in the air?

The composition of unpolluted air is unknown to us. Human have lived on the planet thousands of years and influenced the composition of the air through their many activities before it is possible to measure the constituents of the air. Air is a complex mixture made up of many chemical components. The primary components of air are nitrogen (N2), oxygen (O2), and water vapor (H2O). About 99 percent of air is nitrogen (78%) and oxygen (21%). The remaining percent includes trace quantities of substances such as carbon dioxide (CO2), methane (CH4), hydrogen (H2), argon (Ar) and helium (He) (Figure 1).

![Composition of air](Source:EPA, 2003)

As theoretically, the air has always been polluted to some degree. Natural phenomena such as volcanoes, wind storms, the decomposition of plants and animals, and even the aerosols emitted by the ocean "pollute" the air.
Primary components of air are as Table 1 below:

<table>
<thead>
<tr>
<th>Gases</th>
<th>% by volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant gas</td>
<td></td>
</tr>
<tr>
<td>Nitrogen, N₂</td>
<td>78.08%</td>
</tr>
<tr>
<td>Oxygen, O₂</td>
<td>20.95%</td>
</tr>
<tr>
<td>Argon, Ar</td>
<td>0.93%</td>
</tr>
<tr>
<td>Neon, Ne</td>
<td>0.0018%</td>
</tr>
<tr>
<td>Helium, He</td>
<td>0.0005%</td>
</tr>
<tr>
<td>Krypton, Kr</td>
<td>0.00011%</td>
</tr>
<tr>
<td>Xenon, Xe</td>
<td>0.000009%</td>
</tr>
<tr>
<td>Gases</td>
<td>% by volume</td>
</tr>
<tr>
<td>Variable gas</td>
<td></td>
</tr>
<tr>
<td>Water vapour, H₂O</td>
<td>4.0%</td>
</tr>
<tr>
<td>Carbon dioxide, CO₂</td>
<td>0.0365%</td>
</tr>
<tr>
<td>Methane, CH₄</td>
<td>~0.00018%</td>
</tr>
<tr>
<td>Hydrogen, H₂</td>
<td>~0.00006%</td>
</tr>
<tr>
<td>Nitrous oxide, N₂O</td>
<td>~0.00003%</td>
</tr>
<tr>
<td>Carbon monoxide, CO</td>
<td>~0.000009%</td>
</tr>
<tr>
<td>Ozone, O₃</td>
<td>~0.000001% - 0.0004%</td>
</tr>
<tr>
<td>Fluorocarbon 12, CF₂Cl₂</td>
<td>~0.00000005%</td>
</tr>
</tbody>
</table>

Atmospheric Layers

The earth is surrounded by atmosphere, which is the body of air and gasses that protects the planet and enables life. Most of our atmosphere is located close to the earth’s surface where it is most dense. The air of our planet is 79% nitrogen, under 21% oxygen and the small amount remaining is composed of carbon dioxide and other gasses. However, according to Environmental Protective Agency (EPA,2012) has reports that most polluted occurs in ozone layer which containing troposphere and stratosphere. There are five distinct layers of the earth (Figure 2):

![Layers of the Atmosphere](source:EPA,2012)

Figure 2: The layers of the atmosphere which divided into five distinct layer

**Troposphere:** The layer of the atmosphere closest to the earth is the troposphere. This layer is where weather occurs. It begins at the surface of the earth and extends out to about 4-12 miles.
temperature of the troposphere decreases with height. This layer is known as the lower atmosphere and people live and extend out to approximately 12 km. In addition, most weather conditions are confined to this layer, where the atmosphere is relatively unstable and is also the layer where most air pollutants of health concern are found.

**Stratosphere:** Above the troposphere is the stratosphere, which extends to about 30-35 miles above the earth’s surface. Temperature rises within the stratosphere but still remains well below freezing. Within the stratosphere is the ozone layer which provides protection from the sun ultraviolet radiation.

**Mesosphere:** From about 35 to 50 miles above the surface of the earth lies the mesosphere, where the air is especially thin and molecules are great distances apart. Temperatures in the mesosphere reach a low of -184°F (-120°C). The stratosphere and the mesosphere are the middle atmosphere.

**Thermosphere:** The thermosphere rises several hundred miles above the earth's surface, from 50 miles up to about 400 miles. Temperature increases with height and can rise to as high as 3,600°F (2000°C). Nonetheless, the air would feel cold because the hot molecules are so far apart. This layer is known as the upper atmosphere.

However, ever since humans began to significantly alter the landscape through the development of agriculture after the last ice age about 10,000 years ago, our species has increasingly become a global change. This change may alter energy balance of the Earth and consequently the Earth’s temperature. This human alteration of the atmosphere in turn affects agriculture, human health, coastal communities and the terrestrial and marine ecosystems of the biosphere.

**Air Pollution**

*Definition for air pollution*

The release of contaminants into the atmosphere in the concentrations which can adversely affect humans, plants, animals and materials.

*Definition of pollution by EQA 1974*

“Pollution” means any direct or indirect alteration of the physical, thermal, chemical, biological, or radioactive properties of any parts of the environment by discharging, emitting, or depositing wastes so as to affect any beneficial use adversely, to cause a condition which is hazardous or potentially hazardous to public health, safety, or welfare, or to animals, birds, wildlife, fish or aquatic life, or to plants or to cause a concentration of any condition, limitation, or restriction to which a license under this Act is subject.

*Definition of air pollution by World Health Organization*

The contamination of indoor or outdoor environment by any chemical, physical or biological agent that modifies the natural characteristics of the atmosphere. However, the pollutants usually refer to when we talk about air pollution are those generated as a result of human activity. Pollutants can also be classified as either primary pollutants or secondary pollutants.

**A primary pollutant** is one that is emitted into the atmosphere directly from the source of the pollutant and retains the same chemical form. An example of a primary pollutant is the ash produced by the burning of solid waste. A secondary pollutant is one that is formed by atmospheric reactions of precursor or primary emissions. Secondary pollutants undergo a chemical change once they reach the atmosphere. An example of a secondary pollutant is ozone created from organic vapors given off at a gasoline station. The organic vapors react with sunlight in the atmosphere to produce the ozone, the primary component of smog. Control of secondary pollutants is generally more problematic than that of primary pollutants, because mitigation of secondary pollutants requires the identification of the precursor compounds and their sources as well as an understanding of the specific chemical reactions that result in the formation of the secondary pollutants.
Table 2: Major Air Pollutants

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Formation</th>
<th>Physical state</th>
<th>Sources</th>
</tr>
</thead>
</table>
| Suspended particles | Primary & secondary | Solid, liquid | • Vehicles  
|                  |                    |                | • Industrial processes  
|                  |                    |                | • Tobacco smoke  |
| Sulphur dioxide (SO2) | Primary            | Gas            | • Industrial processes  
|                  |                    |                | • Vehicles  |
| Nitrogen dioxide (NO2) | Primary           | Gas            | • Vehicles  
|                  |                    |                | • Gas heater  
|                  |                    |                | • Cookers  |
| Carbon monoxide (CO) | Primary            | Gas            | • Vehicles  
|                  |                    |                | • Tobacco smoke  |

(sources: EPA, 2011)

Air Pollution Episodes

1. Meuse Valley, Belgium, 1930

An air pollution episode is observed in Meuse Valley of Belgium in 1930. Along the 15 miles of narrow valley of the Meuse River from Huy to Liege, there are 4 coke ovens, 3 steel mills, 4 glass factories and 3 zinc smelters. A temperature inversion has affected this valley from 1st until 5th December 1930, which retains the pollutants emitted from these plants and increases the concentration of air pollutants in the atmosphere. On the third day of temperature inversion, approximately 6000 residents in the valley become ill with respiratory disease. There are 60 deaths before the week was over, and there are many deaths of cattle.

There is a variety of complaints from all ages from infants to older people which are irritation of eyes and the respiratory tract. The onset of acute illness has reduced significantly when the fog dispersed. It is estimated that the concentration of sulphur dioxide (SO2) is from 9.6 to 38.4 ppm, since the concentrations of air pollutants are not recorded in this area. There are some who think that fluorides might have contributed to the increase in mortality and morbidity, compared to SO2.

2. Donora, Pennsylvania, USA, 1948

The second disaster of air pollution has alarmed the world that air pollution might have serious adverse health impacts on communities. A similar air pollution episode has occurred in Donora, Pennsylvania in the year 1948. Donora is located on the inside of sharp horseshoe valley in Monongahela River, 30 miles away from Pittsburgh. The area along the riverbank is occupied with a large steel mill, a sulphuric acid plant, and a large zinc production plant. Starting from 26th October 1948, heavy smog spreads over the area surrounding Donora due to the temperature inversion. This stable atmospheric condition allows the accumulation of air pollutants emitted from the plants along the river. During this time, about 14,000 people of Donora which is equivalent to 42.7% of them are affected with a trend for the incidence of adverse effects from smog to increase with age.

Most of people who were affected became ill on the second day of the episode. 20 people died ranged from 52 to 84 years old. Most of those who died had pre-existing respiratory system disease. During the episode, it is estimated that the SO2 concentration has ranged from 1.4 and 5.5 mg/m3 (0.5 and 2.0 ppm) and that the particulate matter (PM) also increased.

4. Los Angeles Smog, 1960s
Episodes of air pollution can be simplified as below:

<table>
<thead>
<tr>
<th>Year</th>
<th>Air pollution issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>1273</td>
<td>Coal burning mainly from homes, metallurgy and ceramics industries is first prohibited in London</td>
</tr>
<tr>
<td>1700 – 1800s</td>
<td>Steam engine and industrial revolution. Pollution from burning of coal and oil from boiler furnaces</td>
</tr>
<tr>
<td>1900 – 1925</td>
<td>Advent of electric motor pollution mainly from electric power plants which burn coal. Oil and gas. Introduction of automobiles.</td>
</tr>
<tr>
<td>1930, Meuse Valley, Belgium</td>
<td>3 days of fog containing sulphuric acid mists from coal burning, 64 deaths.</td>
</tr>
<tr>
<td>1948, Donora, Pennsylvania</td>
<td>Similar to Meuse Valley, 20 deaths.</td>
</tr>
<tr>
<td>1952, London</td>
<td>4 days of fog (4.5 mg/m³ smoke, 1.34 ppm SO₂), 4000 deaths.</td>
</tr>
</tbody>
</table>

Common features of air pollution episodes: increased fuel consumption (cold weather), atmospheric inversions, and morbidity and mortality mainly among the elderly and those with cardiac and respiratory disease.

London Smog Disaster in 1952, the days of toxic darkness

Early of December 1952, London was so clear, the weather was considered as a clean and colder than usual. When a severe cold hit badly in London, people has done as usual heat their home. They did in such a situation where they burned coal to heat up their homes. As the result, they burned more coal to keep them more comfortable that time. However, they do not realize that activity actually contribute increasing thick of smog layer. It gets even worse when all of London’s usual factory emission had been prevented from escaping into the atmosphere by an inversion so that the fog and smoke combined into a rolling, thick layer of smog. In addition, the winds were light and the air near the ground was moist, conditions ideal for formation of radiation fog. Then on December 5, 1952, a layer of dense fog engulfed the city and stayed for five days.

Initially, the fog was not particularly dense; it just seems like a dry smoky character. However, when nightfall came the fog became thickened and visibility dropped to a few meters. Thus, visibility
across London was getting extremely poor. The incident also caused visibility had literally gone down to one foot means that we could not see our feet when looking down or our own hand if held out in front of us. In addition, transportation was also affected by the problem when transportation across the city came to a standstill and many people didn’t venture outside for fear of getting lost in their own neighborhoods. At least one theater was closed down because the smog had seeped inside and the audience could no longer see the stage.

On 5th December 1952 hanging in the air were thousands of tonnes of black soot, sticky particles of tar and gaseous sulphur dioxide, which had mostly come from coal burnt in domestic hearths. Smoke particles trapped in the fog gave it a yellow-black colour. Smoke and Sulphur dioxide pollution was monitored at various sites in London at the time of the December Smog. The daily average measuresments for 10 of these sites are given. During the four days between the 4 and 8 December 1952 smoke measurements taken at the National Gallery in London suggest that the PM$_{10}$ concentration reached 14mg/m$^3$ which was 56 times the level normally experienced at the time and the levels of sulphur dioxide in the air increased by 7 fold peaking at around 700ppb. Based on figure 2 shows that death rate peaked on the 8th and 9th days at 900 deaths per day.

![Figure 4: Death rates with concentration of smoke and sulphur dioxide.](Sources: The TORhado and Storm Research Organisation, updated: June 2010)

**IMPACTS OF THE SMOG**

Impacts of this event it was not until after the fog lifted on December 9 that the deadliness of the smog was discovered. In the five days the smog had covered London, over 4,000 more people had died than usual for that time of year. In the following weeks, approximately 8,000 more died from exposure to what has become known as the Great Smog of 1952. Most of those killed by the Great Smog were people who had pre-existing respiratory problems and the elderly. The death toll could be thousands higher if it were known how many died from complications of smog-related illnesses in the following months and years. Study done by Logan (1956) was summarized that almost 1000 additional death in Greater London during 4 to 6, 1956 after following year after smog episode, 1952. Pollution, which many had thought was just a part of city life, had killed 12,000 people. It was time for
change. Study done Michelle (2001) was stated that mortality rates for the smog episode from December 1952 to February 1953 were 50–300% higher than the previous year.

Finally, the Great London Smog galvanized the government to clean up the nation’s air and as a consequence the first clean air acts was introduced. These shocking revelations led to a rethinking of air pollution. The disaster demonstrated to people around the world that it was a real and deadly problem. New regulations were put in place restricting the use of dirty fuels in industry and banning black smoke. These included the Clean Air Acts of 1956 and of 1968, and the City of London (Various Power) Act of 1954.

Table 3: Sources, Health and Welfare Effect for Criteria Pollutants.

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Description</th>
<th>Sources</th>
<th>Health Effect</th>
<th>Welfare effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon monoxide</td>
<td>Colorless, odorless gas</td>
<td>Motor vehicle exhaust, indoor sources include kerosene or wood burning stoves</td>
<td>Headaches, reduced mental alertness, heart attack, cardiovascular disease</td>
<td>Contribute to the formation of smog</td>
</tr>
<tr>
<td>(CO)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sulfur Dioxide</td>
<td>Colorless gas that</td>
<td>Coal-fired power plants, petroleum refineries, manufacture of sulfuric acid and smelting of ores containing sulfur.</td>
<td>Eye irritation, wheezing, chest tightness, shortness of breath, lung damage</td>
<td>Contribution to the formation of acid rain, visibility impairment, plant and water damage, aesthetic damage</td>
</tr>
<tr>
<td>SO2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nitrogen dioxide</td>
<td>Reddish brown, highly reactive gas.</td>
<td>Motor vehicles, electric utilities, other industrial commercial and residential</td>
<td>Susceptibility to respiratory infections, irritation of the lung and respiratory symptoms (e.g., cough, chest pain, difficulty breathing)</td>
<td>Contribute to the formation of smog, acid rain, water quality deterioration, global warming</td>
</tr>
<tr>
<td>(NO2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ozone (O3)</td>
<td>Gaseous pollutant when it is formed in the troposphere</td>
<td>Vehicle exhaust and certain other fumes. Formed from other air pollutants in presence of sunlight.</td>
<td>Eye and throat irritation, coughing, respiratory tract problems, asthma, lung damage</td>
<td>Plant and ecosystem damage</td>
</tr>
<tr>
<td>Lead (Pb)</td>
<td>Metallic element</td>
<td>Metal refineries, lead smelters, battery manufacturers, iron and steel producers.</td>
<td>Anemia, high blood pressure, brain and kidney damage, neurological disorders.</td>
<td>Affects animals and plants, affects aquatic ecosystem</td>
</tr>
<tr>
<td>Particulate Matter</td>
<td>Very small particles of soot, dust or other matter, including tiny droplets of liquids.</td>
<td>Diesel engines, power plants, industries, wood stoves</td>
<td>Eye irritation, asthma, bronchitis, lung damage, cancer, heavy metal poisoning cardiovascular effects.</td>
<td>Visibility impairment, atmospheric deposition, aesthetic damage.</td>
</tr>
<tr>
<td>(PM)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(source: EPA, 2012)
CHAPTER 3 Factors relating to changes in the physical environment

Part 3: Sanitation

Introduction

Sanitation refers to the principles and practices relating to the collection, removal or disposal of human excreta, household waste water and refuse as they impact upon people health and the environment. Good sanitation includes appropriate health and hygiene awareness and behaviour, and acceptable, affordable and sustainable sanitation services (WHO, 2001). It is a hygienic means of promoting health through prevention of human contact with the hazards of wastes and could be achieved by using engineering solutions like sewerage and wastewater treatment, by simple technologies such as latrines and septic tanks or by practicing good personal hygiene such as washing hands with soap.

Hazard which is the agent of disease can be either in physical, biological/microbiological or chemical. For waste, it is something that can cause health problems such as human and animal feces, solid wastes, domestic wastewater (sewage, sullage, greywater), industrial wastes and agricultural wastes. Sanitation can be applied to a specific aspect, concept, location, or strategy, such as basic sanitation, on-site sanitation, food sanitation, environmental sanitation and ecological sanitation.

Basic sanitation refers to the management of human feces at the household level. This terminology is the indicator used to describe the target of Millennium Development Goal on sanitation. For on-site sanitation, the collection and treatment of waste is done where it is deposited like pit latrines, septic tanks and imhoff tanks while food sanitation refers to the hygienic measures for ensuring food safety.

For environmental sanitation, the control of environmental factors that form links in disease transmission and the subsets of this category are solid waste management, water and wastewater treatment, industrial waste treatment and noise and pollution control. Ecological sanitation is a concept and an approach of recycling to nature the nutrients from human and animal wastes.

History

The earliest evidence of urban sanitation was seen in Indus Valley civilization such as Moenjodaro, Harappa and Rakhigarhi (recently discovered). This urban plan included the world's first urban sanitation systems. Within the city, each houses obtained water from wells of individual homes or groups of homes. They also obtained water from a room that appears to have been set aside for bathing while the waste water was directed to covered drains, which lined the major streets (KHI experience on holy divers) and houses opened only to inner courtyards and smaller lanes.

Roman cities and Roman villas had elements of sanitation systems which can deliver water in the streets of towns such as Pompeii and use building stone and wooden drains to collect and remove wastewater from populated areas. There is little record of other sanitation in most of Europe until the High Middle Ages.

Somehow, unsanitary conditions and overcrowding were widespread throughout Europe and Asia during the middle Ages, resulting periodically in cataclysmic pandemics which killed tens of millions of people and radically altered societies. The pandemic include plague of Justinian (541-42) and the Black Death (1347-1351).

There are very high infant and child mortality prevailed in Europe throughout medieval times, due to deficiencies in sanitation and insufficient food for a population which had expanded faster than agriculture. This was further complicated by the frequent warfare and the exploitation of civilians by brutal rulers. So, the life for the average person at this time was indeed ’nasty, brutish and short’.
Wastewater Sanitation

1. Waste water collection

The standard sanitation technology in urban areas is the collection of wastewater in sewers and its treatment in wastewater treatment plants for reuse or disposal in rivers, lakes or the sea. Sanitary sewers are sewers combined with storm drains or separated. The combined sewers are usually found in central, older parts or urban areas. Sometimes, heavy rainfall and inadequate maintenance can lead to combined sewer overflows or sanitary sewer overflows and thus the diluted raw sewage was discharged into the environment.

Besides that, industries often discharge wastewater into municipal sewers. It will complicate wastewater treatment process unless industries pre-treat their discharges. The high investment cost of conventional wastewater collection systems is difficult to afford by many developing countries. Therefore, some countries have promoted alternative wastewater collection systems like condominial sewerage which uses smaller diameter pipes at lower depth with different network layouts from conventional sewerage.

2. Reuse of Wastewater

Reuse of untreated wastewater in irrigated agriculture is common in developing countries. Reuse of treated wastewater becoming increasingly widespread in landscaping especially in golf courses, irrigated agriculture and industrial use. Many pri-urban and rural areas households are not connected to sewers. They discharge their wastewater into the septic tanks or other types of on-site sanitation.

3. Ecological Sanitation

For ecological sanitation, sometimes it is presented as a radical alternative to conventional sanitation systems based on composting or vermi-composting toilets. There is an extra separation of urine and feces at the source for sanitization and recycling. It can eliminate the creation of black water and fecal pathogens from any still present wastewater like urine. If practiced, municipal wastewater consists only of greywater, which can be recycled for gardening and usually the greywater continues to be discharged into the sewers.

4. Sanitation and Public Health

Importance of waste isolation lies in an effort to prevent water and sanitation related diseases which afflicts developed and developing countries to differing degrees. From the estimation, there are about 5 million people die each year from the preventable water-borne disease as a result of inadequate sanitation and hygiene practices. Sanitation has also had a large impact on society. As published in Griffins Public Sanitation, there were studies that proved that higher sanitation produces more attractiveness. Poor or inadequate sanitation in the other hand, may lead to problems in drinking water quality, bathing waters, water resources, water supply and sanitation monitoring, developing water supply, sanitation and hygiene, water-related disease, wastewater use, healthcare waste, emerging issues, economic aspects etc.

How can water-related diseases be prevented during emergencies? The 3 top priorities concerning drinking water and sanitation during an emergency situation are by ensuring the provision of enough safe water for drinking and for personal hygiene to the people affected by the crisis, by ensuring that all people affected by the crisis have access to hygienic sanitation facilities and promoting good hygiene behaviours.

5. Global Access to Improved Sanitation

The Joint Monitoring Programme for water and sanitation of WHO and UNICEF has defined improved sanitation as the connection to a public sewer, connection to a septic system, pour-flush latrine, simple pit latrine and ventilated improved pit latrine. According to that definition, of the world's population has access to improved sanitation has increased from 8% in 1990 to 62% (2.6 billion) in 2008. The population with sustainable access to improved sanitation for Malaysia in 2008 is 96%.
Only slightly more than half of them or 31% of the world population lived in houses connected to a sewer. Somehow, 2.5 billion people lack access to improved sanitation and resort to, open defecation or other unsanitary forms of defecation, such as public latrines or open pit latrines. There are about 1.2 billion people who have access to no facilities at all. This outcome presents substantial public health risks because waste could contaminate drinking water and cause life threatening forms of diarrhea to infants. Around 1.5 million children died due to diarrhea caused by the combined effects of inadequate sanitation, unsafe water supply and poor personal hygiene.

Improved sanitation with simple hand washing and water purification could save lives of 1.5 million children who suffer from diarrheal diseases each year. In developed countries, where less than 20% of the world population lives, 99% has access to improved sanitation and 81% were connected to sewers.

Solid waste disposal

Solid waste is commonly disposed through landfills, incineration, recycling, composting and conversion to biofuels. For the case of landfills, advanced countries typically have rigid protocols for daily cover with topsoil while underdeveloped countries customarily rely upon less stringent protocols. The daily cover is important in the reduction of vector contact and spreading of pathogens (LiLaTi), minimizes the odour emissions and reduces windblown litter. Developed countries typically have requirements for perimeter sealing of the landfill with clay-type soils to minimize migration of leachate that could contaminate groundwater, hence jeopardizing drinking water supplies. Incineration of solid wastes will release air pollutants, including certain toxic components is an attendant adverse outcome. Recycling and biofuel conversion is a sustainable options that generally have superior life cycle costs, particularly when total ecological consequences are considered. For composting, the value will ultimately be limited by the market demand for compost product.

Sanitation in developed and developing countries

In USA, sanitation is a legislative requirement of OSH, which is governed by 29 CFR Part 1910.141. The United Nations Millennium Development Goals (MDGs) include a target to reduce by half the proportion of people without access to basic sanitation by 2015. In recognition of the slow progress being made towards the MDGs sanitation target, in December 2006, the United Nations General Assembly declared 'The International Year of Sanitation' in year 2008. The year aims to develop awareness and action to meet the target. Those particular concerns are removing the stigma around sanitation, so that the importance of sanitation can be more easily and publicly discussed and highlighting the poverty reduction, health and other benefits that flow from better hygiene, household sanitation arrangements and wastewater treatment. The Overseas Development Institute had make a research and suggests that sanitation and hygiene promotion needs to be better ‘mainstreamed’ in development, if the MDG on sanitation is to be met. Currently, promotion of sanitation and hygiene is mainly carried out through water or wastewater institutions.

For developing countries, more institutions should carry out activities to develop better sanitation and hygiene. For example, educational institutions can teach the communities on hygiene while health institutions can dedicate resources to preventive works like outbreaks of cholera. Research programme on Community-led Total Sanitation (CLTS) is a radically different approach to rural sanitation in developing countries and has shown promising successes where traditional rural sanitation programme have failed. CLTS is an unsubsidized approach to rural sanitation that facilitates communities to recognize the problem of open defecation and take collective action to clean up and become ‘open defecation free’. It uses community-led methods such as participatory mapping and analyzing pathways between faeces and mouth as a means of galvanizing communities into action. The Institute of Development Studies (IDS) 'In Focus' Policy Brief suggests that in many countries, the Millennium development goal for sanitation is off tracked and questions how CLTS can be adopted and spread on a large scale in the many countries and regions where open defecation still prevails.

Sanitation in the Food Industry

Sanitation within the food industry means adequate treatment of food-contact surfaces by a process that is effective in destroying vegetative cells of microorganisms of public health significance.
Besides, it also means substantially reducing numbers of other undesirable microorganisms and without adversely affecting the product or its safety for the consumer. Sanitation Standard Operating Procedures are indispensable for food industries in US, which are regulated by 9 CFR part 416 in conjunction with 21 CFR part 178.1010. Similarly in Japan, food hygiene has to be reached through the compliance of Food Sanitation Law. In Malaysia, Food Act and HACCP which stand for hazard analysis critical control points are adopted. Additionally, in the food and Biopharmaceutical industries, the term sanitary equipment means equipment that is fully cleanable using Clean-in-place (CIP),and Sterilization in place (SIP) that is fully drainable from cleaning solutions and other liquids. The design should have a minimum amount of dead leg or areas where the turbulence during cleaning is not enough to remove product deposits. In general, to improve clean ability, this equipment is made from Stainless Steel 316L, (an alloy containing small amounts of molybdenum). The surface is usually electro polished to an effective surface roughness of less than 0.5 micrometer, to reduce the possibility of bacterial adhesion to the surface.

**Basic Household Sanitation**

The minimum acceptable basic level of sanitation including appropriate health and hygiene awareness and behaviour, a toilet facility for each household, and lastly a system for disposing human excreta, household waste water and refuse which is acceptable and affordable to the users, safe, hygienic, easily accessible and does not have an unacceptable impact on the environment.

Unhygienic practices are clearly the results of lack of awareness on health and hygiene. Inadequate sanitation facilities, water supplies, toilet, hand washing facilities and poor facilities for the safe disposal of waste water and other domestic waste are causes of unhygienic practices.

**Impacts of Sanitation**

Most common health problems associated with poor sanitation are diarrhea, dysentery, schistosomiasis or bilharzias, malaria, cholera, worms, eyes infection, skin diseases and increased risk of bacterial infections and disease for people with reduced immune systems like HIV and AIDS.

Poor sanitation leads to these health problems because many of the infective organisms are spread from hand to mouth or from hand to food to mouth. Between through drinking contaminated water directly and during food preparation, oral-faecal infections are mostly transmitted in latter. A number of important public health problems will be reduced by improving hygiene practices and providing sanitation facilities. Public health messages are very important because if we understand how the infections are transmitted, we can break the cycle of infection.

Disease transmission paths are from waste and excreta to fingers, flies, food, fluids and field to the new host like healthy people. Faeces provide food for many organisms that cause diseases in humans. So in other to break the cycle of infection, the actions to prevent these organisms from getting to the faeces or from getting onto or into human bodies must be taken.

Most human activities will bring impacts on the environment. Well, sanitation systems actually involve disposal and treatment of wastes. A range of pollution risks to the environment are due to inadequate sanitation or inadequate maintenance or inappropriately designed systems and it may lead to contamination of water resources on the surface and ground. There’s a limit where the system can assimilate pollution without deteriorating water quality.

Factors that affect the impact of sanitation systems on water quality are size and density of the settlement being served, sensitivity (or Class) of the receiving water resource, type of sanitation system, capacity of the service provider to manage the system and depth to ground water and the soil type.

Pollution resulting from failed or inadequate sanitation systems is associated with direct contact with faecal contaminted or leachate water which can cause water borne diseases, other health risks such as blue baby syndrome (methemoglobinemia) in bottle fed infants (high nitrates). Besides, it also associated with the growth of aquatic plants (mostly algae), which in turn results in increased treatment costs, reduced recreational value of the water body, possible growth of toxic.
algae, loss of bio-diversity and depletion of the oxygen in the water column which can also result in a loss of bio-diversity and a complete shift in the natural biota of the stream.

The United Nations Children Fund (UNICEF) and World Health Organization (WHO) has linked investing in sanitation to reduced morbidity, mortality and increased life expectancy, savings in health care costs, reduced time caring and sick leave (back to work), higher worker productivity, better learning capacities of school children, increased school attendance (especially by girls), strengthened tourism and national pride, direct economic value of high quality water such as irrigation water for crops and reduced water treatment costs.

Social and psychological problems associated with poor sanitation are toilets placed at a distance from the home, inadequate communal facilities, inadequate disposal of waste and other poor sanitation practices result in loss of privacy and dignity. Poor sanitation causes exposure and increased risks to personal safety, especially women and elderly who are the most inconvenienced. Although the school attendance of girls in schools in remote area is high compared to other urban area, it is nationally recognized that poor sanitation facilities at schools can be one of the main reasons for girls to drop out.

Addressing Sanitation Problems

The sanitation problem will be addressed by means of strategic interventions such as facilitating the participation of communities, promoting health and hygiene awareness and practices, development and use of local resources, upgrading of existing facilities, adopting an integrated environmental management approach, developing a common approach to implementation and undertaking specific programmes to clear the backlog.

The improvement of sanitation is everybody's business and should not be seen as a government-sponsored top down programme. The role players who could contribute towards a sanitation improvement programme include first and foremost, the householders and communities, community based contractors, local government, state government, national government, non-governmental organization (NGO) and the private sector including funding institutions, consultants, contractors and materials and equipment suppliers.

REFERENCES

CHAPTER 3 Factors relating to changes in the physical environment

Part 4: Food safety

1. Introduction

Food safety can be defined as the practice of ensuring that foods cause no harms to the consumers. Essentially, the practice of food safety can be categorized into three basic operations:

- protection of the food supply from harmful contamination
- prevention of the development and spread of harmful contamination
- effective removal of contamination and contaminants

Food contamination can be refers to the presence of harmful chemical and microorganism in food which can cause consumer illness.

2. Food Safety Hazards

A food safety hazard or contaminant can be defined as any factor present in food that has the potential to cause harm to the consumer, either by causing illness or injury. Food safety hazard can be biological, chemical, or a physical object. Other than that, the problem of food allergy has been growing in importance as the number of people, particularly children, affected by allergy symptoms has increased.

3. Biological Hazards

Generally, biological hazards post the greatest immediate food safety threat to the consumer. For example, the ability of food-poisoning bacteria to cause large outbreaks of acute illnesses within a short time is a threat to food businesses and also consumers. Biological hazards consist of bacteria, viruses and parasites. Technically, biological hazards may include larger organisms, such as insects and rodents. However, these rarely present a direct threat to health. It is micro-organisms and certain foodborne parasites that are of most concern as food safety hazards.

a. Bacteria

A significant number of bacteria species can be classified into food safety hazards such as Salmonella, Listeria monocytogenes, Vibrio parahaemolyticus, Campylobacter, Yersinia enterocolitica, Clostridium perfringens, Bacillus cereus and Staphylococcus aureus. Bacterial food safety hazards fall into one of two categories according to the mechanism by which they cause illness which are infection and intoxication.

Infection

Most food borne bacterial pathogens cause illness by multiplying in the gut after ingestion of contaminated food. They may then provoke symptoms by invading the cells lining the intestine, or in some cases, invading other parts of the body and causing more serious illnesses. Salmonella, Campylobacter and E.coli O157 are all examples of bacteria that cause infective food poisoning. This type of food poisoning is usually characterized by a delay, or incubation time, at least 8 – 12 hours (sometimes much longer) before symptoms develop.

This category also includes some bacteria that produce symptoms by multiplying in the gut and producing toxins, rather than by actively invading the tissues. The example of this type is Clostridium perfringens.

Intoxication

There are a few bacteria that produce illness by intoxication. These organisms are able to grow in certain foods under favourable conditions and produce toxins as a by-product of growth. The toxin is thus pre-formed in the food ingestion and in some cases toxin may still
be present even after the bacteria cells have been destroyed by cooking. *Bacillus cereus* and *Staphylococcus aureus* are examples of bacteria able to cause intoxication, but the most important and potentially serious cause of intoxication is *Clostridium botulinum*. Intoxication usually have much shorter incubations times than infections, because the toxins are pre-formed in the food.

b. Viruses

Viral gastroenteritis is very common worldwide. There are a number of viruses that are capable of causing food borne infections. The best known are noroviruses and hepatitis A, which has been responsible for a number of serious foodborne disease outbreaks, often as a result of poor personal hygiene by infected food handlers.

c. Parasites

A wide range of intestinal parasites can be transmitted to human via contaminated foods, faecal-oral, or waterborne transmission. These organisms are much more prevalent in developing countries with poor sanitation. However, the increasingly global nature of the food supply chain may increase their importance in the developed world. Currently, protozoan parasites are the most important.

Protozoan

The protozoan parasites that can cause foodborne illness on human include *Entamoeba histolitica* (the cause of amoebic dysentery), *Cryptosporidium sp*arvum and *Cyclospora cayetanensis* (the cause of gastroenteritis related with fruit consumption).

Other types of parasite

Other type of foodborne parasite include nematode worms, such as *Trichinella spiralis* and the anisakid worms found in fish, and cestodes (tapeworms) such as *Taenia solium*.

4. Chemical Hazards

Acute toxicity caused by foodborne chemical contaminants is relatively rare as compared to biological hazards. Of much more concern is the exposure to low levels of toxic chemicals in the diet over a long period. In some cases, this can lead to chronic illnesses. There is also the risk that some contaminants may be carcinogenic.

The main chemical contaminants important in food safety are:

a. agricultural chemicals (such as pesticides)
b. veterinary drugs
c. natural biological toxins, such as fungal toxins, plant toxins, and fish toxins
d. environmental contaminants (e.g. dioxins and heavy metals)
e. contaminants produce during processing (e.g. acrylamide)
f. contaminants from food-contact materials (e.g. plasticisers)
g. cleaning and sanitizing chemicals
h. adulterants (e.g. illegal food dyes)

5. Allergens

Food allergen can be defined as an adverse, immune-mediated reaction to food. Often, people will refer to any adverse reaction to food as an allergy. Food allergies involve immune system and almost invariable mediated through immunoglobulin E (IgE). The majority food allergies are caused by proteins, which sensitize and then elicit an allergic reaction in sensitive individuals. Food allergy is different from food intolerance, a condition that has no immune-system involvement and includes reactions to certain food components, such as lactose, amines and histamine. Only food allergy can lead to the potentially fatal reaction of anaphylaxis.
There are twelve specific major food allergens, which are:

a. Cereals containing gluten (i.e. wheat, rye, barley, oats, spelt or their hybridised strains
b. Crustacean
c. Fish
d. Egg
e. Peanuts
f. Soya bean
g. Milk
h. Tree nuts
i. Celery
j. Mustard
k. Sesame seeds
l. Sulfer dioxide and sulfites

6. Food Safety From Farm-to-Table

Farm-to-Table initiative involves identifying possible contamination points along the farm-to-table continuum. The initiative implementing controls for preventing problems that might affect nation’s food supply.

![Diagram of Farm-to-Table Process]

Figure 1: From Farm-to-Table initiative in controlling food contamination

a. Good Agricultural Practices (GAPs)

GAPs is a general guidance to direct domestic and international food producers in growing, harvesting, sorting, packing, and storage operations to reduce microbial food safety hazard

b. Hazard Analysis & Critical Control Points (HACCP)

HACCP is a scientific-based and systematic approach to prevent potential food safety problems by anticipating how biological, chemical, or physical hazards are most likely to occur by installing appropriate measures to prevent them from occurring.
There are seven principles of HACCP:

1. Hazard analysis
   Identify steps in the food production process where hazards could occur, assess their severity and human health risk, and determine a preventive measure.

2. Determination of critical control points
   Identify critical control points in the process at which the potential hazard can be controlled or eliminated.

3. Specification of critical limits
   Institute control measures and establish criteria to measure control at those critical points. For example, minimum cooking times and temperatures could be established for a cooked food.

4. Monitoring
   Monitor critical control points by establishing procedures for how the critical measures will be monitored and who will be responsible.

5. Corrective actions
   Take action when the criteria are not being met, including disposal or reproducing of the food in question and fixing the problem.

6. Verification
   Routinely check the system for accuracy to verify that it is functioning properly and consistently.

7. Documentation
   Establish effective record-keeping procedures that document & provide a historical record of the facility’s food safety performance.

c. Cold Chain

It is important to maintain proper temperatures throughout the farm to table continuum to prevent the growth of food borne bacteria along the way. It is to keep the food ready for market and save to eat. For example, fresh produce is quickly cooled after harvesting to slow down the ripening process and reduce the spread of decay. The cold chain continues when food is stored, displayed, and served at retail outlets.

d. Food Code

The reference guide to instruct retail outlets, such as restaurants, grocery stores, and institutions (e.g., nursing homes) on how to prevent food borne illness. It consists of model requirements for safeguarding public health and ensuring that food is unadulterated (free from impurities) and honestly presented to the consumer.

e. 4 Cs of Food Safety

Below are the guideline to keep food safe:
- Clean - Wash hands and kitchen utensils with hot, soapy water before and after handling food.
- Combat cross-contaminate - Separate raw meat, poultry and seafood from ready-to-eat foods.
- Cook - Cook foods to safe internal temperatures. Keep hot food hot.
- Chill refrigerate promptly. Keep cold food cold
CHAPTER 3 Factors relating to changes in the physical environment

Part 5: Bacteria, viruses and fungi in environmental health

Introduction

Microbiology is the study of microorganism (sometimes called microbes)-living things that are too small to be seen by the unaided eye. Microorganisms are usually divided into six subgroups: bacteria, archaea, algae, fungi, protozoa and viruses. These subgroups are not closely related. Only the single property links them—their small size.

The primary distinction among subgroups is cell structure. Bacteria and archaea are prokaryotes (meaning “before the nucleus”). Their cells lack internal membrane-bound structure. In contrast, algae, fungi, protozoa are eukaryotes (meaning “true nucleus”). Their cells contain a membrane-bound nucleus as well as numerous other membrane-bound structure called organelles. Viruses are acellular. That is, virus is not a cell. It is merely a small packet of nucleic acid (the chemical form of genetic information) wrapped in a coat, usually made of protein.

In spite of their tiny size, they have enormous impact: They maintain our environment in life-sustaining balance, and they are some of our valuable industrial tools. But unchecked they can destroy our livestock and crops, and they can spoil our food. A few of them can make us sick and even kill us! The development of microbiology as a science has made astounding progress in human illness with regard to pathogenic microorganisms. Advances in medical microbiology have made it possible to identify the various pathogens that cause infections disease and devise ways to control most of them.

Bacteria

Bacteria (sing., bacterium) are distinguished by their size and prokaryotic cell structure. Bacteria are highly diverse. Most species have a characteristic cell shape. They can be spherical, rod-shaped, helical, comma-shaped, star-shaped or even square. Bacteria has been divided based on biochemical properties e.g based on gram staining – either Gram-positive or Gram-negative bacteria.

1. Gram-positive bacteria

Gram-positive bacteria contain two layers of envelope which are cell wall and cytoplasmic membrane (also called the inner membrane of the plasma membrane). Usually, Gram-positive bacteria will cause skin infection (folliculitis, carbuncle), food poisoning, lung infection, osteomyelitis and also caused toxic shock syndrome.

Streptococcus spp is a gram-positive bacteria that responsible for many cases of meningitis, bacterial pneumonia, endocarditis, erysipelas and necrotizing fascitis (the ‘flesh-eating’ bacterial infections). Streptococci are also part of normal commensal of the mouth, skin, intestine and upper respiratory tract of humans.

2. Gram-negative bacteria

Gram-negative bacteria contain all three layers of envelope which are outer membrane, a cell wall and a cytoplasmic membrane. Because they have two membranes (outer and cytoplasmic), they have an extracellular compartment; the one that lies between the two membranes and it is called the periplasm.

The examples of medically important gram-negative bacteria are Eisherichia coli, Salmonella spp, Salmonella typhi, Shigella spp, Campylobacter jejuni, Vibrio cholera and Helicobacter pylori.
a) Helicobacter pylori

_H. pylori_ were first isolated in 1982 and infect more than half of population. It is a helical microaerophilic gram negative organism. Peptic ulcer disease is associated with infection from these bacteria. Most people infected by _H. pylori_ develop chronic gastritis, and about 15 to 20 percent of them go on to develop ulcers. Ulcers can lead to gastric carcinoma, an aggressive and usually fatal form of cancer.

All patients with peptic ulcer disease should be given antimicrobial therapy. The most effective is triple therapy with metronidazole, tetracycline and bismuth subsalicylate (Pepto-Bismol).

b) Spirochetes

Spirochetes is one of the example of gram negative bacteria. It is motile by periplasmic flagella (endoflagella or axial filaments), between peptidoglycan layer and outer membrane. The spirochete's unique form of movement is well suited to viscous environment such as mud and the surface of mucous membranes. There are 3 medically important genus which are:

i) Treponema spp.

There are 2 species responsible for human diseases which are _Treponema pallidum_ and _Treponema carateum_. _Treponema pallidum_ divided into 3 subspecies; _Treponema pallidum_ spp. pallidum causing syphilis, _Treponema pallidum_ spp. pertenue causing yaws and _treponema pallidum_ spp. endemicum causing bejel. While _Treponema carateum_ cause pinta disease.

### Syphilis

Caused by _Treponema pallidum_, which is highly motile spirochete. It is difficult to culture and it infects only human being and extremely fragile. Because it is so fragile, _T. pallidum_ is transmitted only by direct body contact, usually by sexual contact (oral, anal or vaginal). These bacteria also can be transmitted through placenta (congenital), kissing or touching lesions on the lips and oral cavity and also through blood transfusion. An infection occurs when it crosses a mucous membrane or break in skin.

Primary syphilis begins a few weeks to a month later, when a chancre (a weepy ulcer with raised borders) appears at entry site. This was the painless sore, single ulcer and indurates with clean base.

Secondary syphilis usually begins 6 to 8 weeks after the chancre appears. It has multisystem involvement due to bacteraemia, for examples, maculopapular rash, condyloma lata, lymphadenopathy and less commonly are patchy alopecia, ocular syphilis, meningitis, hepatitis and glomerulonephritis.

Tertiary of final stage of syphilis develops in a minority of patients after 5 to 40 years of latent syphilis. It can progress to severe illness or death. The most common form of late syphilis is characterized by gummas, soft granulomas that usually replace skin or bone. They are life threatening only if they destroy vital organ. Gummas disappear with adequate antibiotic therapy, but damage cannot be reversed.

### Bejel

It is caused by _Treponema pallidum_ spp. endemicum. Also known as endemic syphilis, but not sexually transmitted. This disease usually in develops in low income groups with poor hygiene. Epidemiologically, bejel is common in Middle-East, Africa, Australia and central Asia. It can be transmitted by direct contact through skin lesions. Bejel begin as lesion on skin or mucous membranes and can spread deeper to the bones and causing major malformations. It can be treated by penicillin G.
Yaws

Yaws is caused by Treponema pallidum spp. pertenue. It is a chronic disease of poor hygiene practices. Yaws is found in Africa, south Asia and northern South America. The disease is transmitted by skin contact. The clinical manifestations are the presence of popular skin lesion at infected site, followed by crusted ulcer. The infection can be disseminated by lymphadenopathy and multiple skin lesions, followed by granulomatous skin lesion and deeper tissues which can lead to bone and joint deformities. It can be treated by penicillin G.

Pinta

It is caused by Treponema carrateum and transmitted by contact through skin lesions/cut. Epidemiologically, it was found in poor regions with sub-standard hygiene for example Caribbean, Central America and Northern South America. The clinical manifestations for pinta are lymphadenopathy and satellite or papular lesions at infected site with itchy scaly red lesion, pigmentation or depigmentation. Penicillin G can be used to treat pinta.

ii) Borrelia

Borrelia spp. causes relapsing fever. Lyme disease is caused by single species, B. burgdorferi. But, relapsing fever is caused by at least three other species. This infection has a sudden onset of fever, chills, headache and muscle aches. The spleen may become enlarged and a faint red rash may appear on the trunk. After 3 to 6 days, these symptoms disappear. The patient seems to have recovered. But about a week later, all the symptoms reappear. Cycles of illness gradually become less intense. Patients may have as few as 2 relapse or as many as 13 relapse.

iii) Leptospira

Leptospirosis is caused by Leptospira interrogans, a member of spirochete family. It usually enters human through mucous membranes or a break in skin, usually from animal urine, urine-contaminated water, or soil. The risks of exposure to these bacteria are during swimming, drinking, jungle tracking and walking with barefoot activities. Populations with high risk to be exposed are military personnel, loggers, sewer worker and people involves in recreational activities (fresh water swimming, canoeing and jungle tracking).

Many animals, including dogs, cats, cattle, rodents and various animals are reservoirs to Leptospira, but rats are the principle one. Once this highly motile organism penetrates mucous membranes or damaged skin, it enters the blood stream. Then, it's distributed throughout the body. Those cells that reach the kidneys multiply there and are excreted in the urine.

Probably most people infected by L. interrogans are asymptomatic, but some experience mild virus-like syndrome (flu-like illness: fever, myalgia, vomiting, chills, headache or conjunctivitis). More severe manifestations include Anicteric leptospirosis (aseptic meningitis, skin rash, uveitis) or icteric leptospirosis (sever jaundice, hypotension, myocarditis, hemorrhage, liver and renal failure).

Leptospirosis is common disease in tropical countries. The examples of outbreak in Malaysia were in Sabah, 2000 participants of Eco-Challenge were infected during swimming activity in 2004. In 2005/2006, military personnel in Perak were infected and PKN trainees in Melaka also infected in 2006. In Johor, the outbreak of this disease was occurring after the flood disaster in 2006/2007. Large doses of penicillin G are the preferred treatment.

Virus

Viruses are parasites, but they are not composed of cells. They are bits of genetic information (nucleic acid) package inside a protein coat. When they are inserting their package of genetic information into host cell, it directs the cell's metabolic machinery to make more viruses.
Viruses are very small in size (20-300 nanometers) and contain either DNA or RNA (not both as in higher forms of life). Viruses are classified according to host range, size, structure and life cycle.

a) Host range

The primary classification of viruses is based on the host range. There are animal viruses, plant viruses, viruses of eukaryotic and bacterial viruses. Bacterial viruses are called bacteriophages or simply phages (phages in Greek = eat) because they usually lyse (break down and destroy) bacterial cells. Host range is determined largely by the presence of appropriate receptors (usually protein) on the cell's surface. Each type of virus attaches to a particular type of receptor, so each type of virus can attack only those cells that have a receptor for it.

b) Size

Smallness and structural simplicity are the notable features of viruses. Some viruses are as small as 25 m. Others are large as 300 nm (Figure 1.1). Viruses lack most cellular structures, including cytoplasm, ribosomes and nucleus or nucleoid. Most are merely a piece of nucleic acid wrapped in protein coat.

c) Structure

The basic structure of a virion is a nucleic acid core surrounded by a protein coat called a capsid. The functions of the capsid is to protect the viral nucleic acid, participate in the viral injection and sharing the antigenicity. The capsid together with its enclosed nucleic acid is called the nucleocapsid. In addition, there may be a few enzyme molecules additional structural proteins, and a surrounding membrane, which is called envelope (Figure 1.2). Often other proteins form structures, called spikes, which protrude from the envelope. Viruses that lack of envelope are called naked viruses.

![Figure 1.1: Size of viruses](image1.png)

![Figure 1.2: Structure of viruses](image2.png)
All viruses have the same basic life cycle, which is radically different from any cellular organism. Outside a host cell, viruses exist only in the form of virions, which cannot replicate. To replicate, a virus must infect the host cells. To do so, the virion attaches itself to the cell, a process called adsorption. Then, the viral genome enters the host cells, a process called penetration. During penetration, some types of viruses open and dissemble so that only the nucleic acid enters the host cell. The process of removing the capsid and envelope is called uncoating. After uncoating, viral nucleic acid directs the cell to make viral components (nucleic acid and protein). Intact new virions reappear only as these components are reassembled in the process of maturation. Soon afterward the virus particles exit the infected cell during the process of release, often—but not always—killing the cell.

1. **DNA virus**

   a) Adenovirus

   Human adenoviruses (adeno is from Latin, meaning ‘glands’) are DNA viruses found in tonsil and adenoid glands. The modes of transmission of these viruses are by airborne and direct contact with body fluid. They cause mild respiratory infections in human and conjunctivitis.

   b) Papillomavirus

   Papillomaviruses cause genital warts (ketua) in human, which can convert to cancer and also causing natural cancer in animals. These viruses can be transmitted by sexual intercourse.
c) Herpes virus
Herpes virus causing chicken pox and shingles and can be transmitted by direct contact with body fluid.

d) Hepatitis B virus (HBV)
Hepatitis B virus is a DNA-containing virus belonging to the hepadnavirus family. HBV has a long incubation period, an average of 75 days. Because it is bloodborne, it's sometimes called serum hepatitis. Transmission often occurs through exchange of contaminated blood, sexual contact and body fluid contact. It cause liver inflammation, cirrhosis and cancer.

2. RNA virus

a) Influenza virus
The influenza virus is from Orthomyxoviridae family. This family is subdivided into types A, B and C, and type A is the most common. It has extremely wide host range with strains that infect many animals including humans, seals, pigs and bird. Type A strains have been responsible for many epidemics and pandemics. This virus can be transmitted by airborne and direct contact with body fluid. It causing upper respiratory disease.

b) Enteroviruses
The entroviruses (includes poliovirus, coxsackie virus and echovirus) is from Picornaviridae family and have naked plus-strand RNA properties. It can cause polio, CNS infection, myocarditis and pericarditis. Mode of transmission of this virus is via fecal-oral route.

c) Rotavirus
The rotavirus is from Reoviridae family. It is transmitted by ingestion of contaminated food or drinks. The disease associated with this virus is acute gastro-enteritis and it is severe among children and also caused infant diarrhea.
d) Paramyxoviruses
The examples of viruses in this family are mumps virus, measles virus, parainfluenza virus and respiratory syncytial virus. It is transmitted by direct contact with body fluid and it is causing mumps, measles, croup, bronchiolitis, and CNS infection.

e) Arboviruses
Arboviruses are a diverse group of RNA viruses that share a common mode of transmission: There are arthropod-borne, for example from mosquito (Aedes aegypti and Aedes albopictus). They infect many vertebrate species and causing devastating disease in human, including yellow fever and dengue fever.

Fungi
The fungi are a large and diverse group. With about 70 000 named species, they constitute a kingdom that includes single-celled organisms called yeast; filamentous organism called molds; and organism that aggregate to form fleshy, macroscopic, fruiting structures called mushrooms, puffballs or shelf fungi depending on their shape.

Fungi are eukaryotic organism whereas bacteria are prokaryotic organism. The difference between fungi and bacteria are:

i) Fungal cell wall:
Fungal cell wall consists of chitin, not peptidoglycan like bacteria. Thus, fungal are insensitive to antibiotics such as penicillins. Chitin is a polysaccharide composed of long chain of n-acetylegluacamine. Moreover, the fungal cell wall contain other polysaccharide, which is B-gluan, which is the site of action of some antifungal drugs.

ii) Fungal cell membrane
Fungal cell membrane consists of ergosterol rather than cholesterol in bacteria. Ergosterol is the site of action of antifungal drugs, such as amphotericin B and azole group.

iii) Atmospheric and carbon source requirements
Most fungi are obligatory aerobes, some are facultative anaerobes, but none are obligatory anaerobes. All fungi require a performed organic source of carbon, association with decaying matter.

iv) Natural habitat
Fungi live in the environment, except for Candida albicans which is part of normal human flora.

1. Morphology of fungi
i) Filamentous fungi
All fungi, except yeasts, grows as interconnected system of branced, tubelike filaments. The individual filaments are called hyphae. The entire interconected set of such hyphae, whch contains a multinucleate mass of cytoplasm, is called mycelium. The mycelia of lower fungi are called coenocytic because there are completely undivided by cross walls. Mycelia of the higher fungi appear to be divided by structures called septa, but these septa are incomplete. They have a central opening
through which cytoplasm can flow freely. In this sense, the thallus (body) of all fungi can be viewed as being a single cell.

Mycelium: septate

Mycelium: non septate
ii) Yeast

Yeasts are single cells, mostly oval shaped, that reproduce by budding. In budding, a bubble forms on the cell surface, grows, pinches off and usually separates. Sometimes, buds remain attached to the mother cell, forming a chain of cells called pseudohypha. A few yeasts divide by forming cross wall. On solid media, yeast form round, pasty or mucoid colonies with a pleasant odor. Yeast colonies resemble bacterial colonies in appearance and in consistency. The only pathogenic yeast in medical mycology is *Cryptococcus neoformans*.

*Cryptococcus neoformans* is a yeast with thick polysaccharide capsule. Unlike most other fungal pathogens, it is not dimorphic. *Cryptococcus neoformans* is plentiful in soil and can reach astounding concentration in birds droppings, especially those from pigeons. If *Cryptococcus neoformans* is inhaled into the lungs, it may only establish a respiratory infection with few syndromes. But it can enter bloodstream and spread to the central nervous system, causing deadly chronic meningitis. In skin, it can cause acneiform lesions and papules. It also can infect other organs such as eye, prostate, kidney, heart, bone and liver.
iii) Yeast-like fungi

These are fungi which occur in the form of budding yeast-like cells and as chains of elongated unbranched filamentous cells which present the appearance of broad septate hyphae. These hyphae intertwine to form a pseudomycelium. The yeast-like fungi are grouped together in the genus *Candida*.

*Candida albicans* are commensal fungi that colonize the skin, mucous membranes and gastrointestinal tract of almost every human being. It is causing candidiasis. The most common sites of infection are the vagina (*Candida vaginitis*), the mouth and diaper area of infants. Occasionally, *Candida* invades deeper tissues of patients with serious immunodeficiency disease. Then it does cause the life-threatening systemic infection that can affect any organs such as endophthalmitis (eye), kidney and heart. Systemic candidiasis can be fatal event for people with terminal illness such as AIDS and disseminated cancer.
iv) Dimorphic fungi

These are fungi which exhibit a filamentous mycelial morphology (saprophytic phase) when grown at room temperature 27 °C, but have a typical yeast morphology (parasitic phase) inside the body and when grown at 37 °C in the laboratory (e.g.: Histoplasma). Histoplasmosis is fungal infection affecting the lungs that will caused fatal in immunosuppressed patient.
Conclusion

As an active experimental science, microbiology is little more than 100 years old. Its pattern of accelerating progress seems likely to continue. The need is great! Environmental microbiology or virology will need to solve pressing problems of pathogen and evolution of new viruses that cause new disease to public health. We need to explore, the environment that plays role in transmission of disease, and specific microbes that cause many of the environmental transmitted disease of public health importance.
CHAPTER 4

Laws and rules regarding pollution and health

Environmental Quality Act 1974 (Act 127) and Regulations

Introduction

Malaysia has developed rapidly after the independence. The economy has shifted from an agriculture country to manufacturing, construction and service industries. Increase in wealth, accompanied by a shift of the population from rural areas to urban areas has created a lot of environmental problems such as South East Asian haze, massive landslides, flash floods and also (conversely but oddly related) water shortages. For example, the river water quality in Figure 4 indicated deterioration. The number of river declared as polluted and slightly polluted increased quite rapidly from 2005 to 2010.

Figure 1: The river water quality status in Malaysia (Source: DOE, 2005)

In essence, the country’s legal provisions are sufficiently comprehensive to cover practically all aspects of the environment. There are over 34 pieces of legislation that are directly or indirectly related to environmental quality control and management. For example, the lists of legislation below are the related legislation that applies to the management of the Putrajaya Lake catchment area;

1. Waters Act, 1920
2. Geological Survey Act, 1974
3. Irrigation Areas Act, 1953
4. Street, Drainage and Building Act, 1974
5. The Forest Act, 1984
7. The Drainage Works Act, 1954
8. The Fisheries Act, 1985
10. Land Conservation Act, 1960
11. Town and Country Planning Act, 1976
12. Local Government Act, 1976
13. Selangor Waters Management Authority Enactment, 1999
14. Mining Enactment, 1929
15. Sewerage Services Act, 1993
The Environmental Quality Act (EQA), 1974 (Act 127)

The Environmental Quality Act, 1974 (Act 127) was formulated and made law by Parliament with Royal Assent on March 8, 1974. It is an act relating to the prevention, abatement, control of pollution and enhancement of the environment, and for purposes connected therewith.

The Environmental Quality Act (EQA) provides;

(i) a common legal basis to coordinate all activities on environmental control throughout the country
(ii) It seeks to prevent, abate and control pollution and to enhance the quality of the environment

This act was enacted on April 15th 1975. The agency responsible in administering this Act is the Department of Environment (DOE) under the Ministry of Natural Resources and Environment (MNRE). The EQA is a regulatory framework based upon:

(i) the issuance of licences
(ii) prohibition and control of pollution
(iii) the prescription of premises to be regulated

The Act comprises the following:

- Part I: Preliminary - the interpretations
- Part II: Administration
  - Example: The function of Director General (DG) and other officers, the establishment of Environmental Quality Council, calling of meeting, quorum, voting, procedure and minutes etc
- Part III: Licences
  - Example: The licensing authority, the duration and renewal of licenses, licence fees etc
- Part IV: Prohibition and Control of Pollution
  - Example: Restriction on pollution of the atmosphere, noise pollution, pollution of the soil etc
- Part IVA: Control of Scheduled Wastes
  - Prohibition against placing, deposit etc of scheduled wastes
- Part V: Appeal and Appeal Board – deals with licensing issues
- Part VA: Payment of Cess and Environmental Fund
  - Research cees, establishment of Environmental Fund, Environmental Fund Committee etc.
- Part VI: Miscellaneous
  - E.g.: Power to examine person acquainted with case, service of notice, evidence etc

The Act is a framework law, for its general provisions to take effect, further rules or regulations need to be made. The Act gives power to the Minister to make regulations aimed at environmental protection and pollution control. Such regulations can prescribe standards or criteria, prohibit discharge, emissions or use of any equipment which is likely to endanger the environment, and determine the quantum of fines to be imposed
In accordance to this law, environment is defined as a physical factors of the surroundings of the human beings including land, water, climate, atmosphere, sound, odour, biological factors and the social factor of aesthetics.

Pollution is defined as the release of contaminants into the environment in concentrations which can adversely affect humans, plants, animals and materials.

The definition of pollution by EQA (1974) law;

“Pollution” means any direct or indirect alteration of the physical, thermal, chemical, biological, or radioactive properties of any part of the environment by discharging, emitting, or depositing wastes so as to affect any beneficial use adversely, to cause a condition which is hazardous or potentially hazardous to public health, safety, or welfare, or to animals, birds, wildlife, fish or aquatic life, or to plants or to cause a concentration of any condition, limitation, or restriction to which a licence under this Act is subject.

(Environmental Quality Act 1974, Act 127)

The duties and function of the Director General (DG) defined by this law are;

- Administer the act
- Responsible for and to coordinate all activities relating to discharge of wastes, preventing, controlling and protecting the environment
- To control the issue of license
- To conduct, promote and coordinate research in relation to pollution
- To publish annual report not later than 30th Sept

There shall be such number of Deputy Director General and officers for the due administration of this act. The Minister is assisted by a body, the Environmental Quality Council (EQC), whose functions are:

- Generally to advise the Minister on matters pertaining to the Act
- To advise the Minister on any matter referred to it by the Minister

There are about 17 members in the EQC, drawn from relevant Federal Ministries, Sabah, Sarawak, Oil & Gas Industry, Oil Palm Industry, Rubber Industry, FMM, Universities, NGO. The duration of office and eligibility for re-appointment are for a term of 3 years.

The following persons shall be disqualified from being a member if;

- They incapable performing duties
- Guilty of an offence involve fraud, dishonesty or moral turpitude
- Declared bankrupt

They should meet once every 4 months, 8 members shall be a quorum at any of the meeting and minutes shall be kept of all proceedings. The Chairman preside all meetings. Appointed members may be paid a sum determined by the minister.

In Part III of the act, highlight about the licence. The licencing authority is the Director General. The duration and renewal of licences are;

- Remain in force for a year from date of issue
- Renewal of license not less than 3 months nor more than 4 months before the date of expiration
- Whom fails to apply for renewal will have to pay a late – 1% of the licence fee or 10 ringgit
The licensee shall comply with licence, and whom contravene this section, shall be guilty of an offence and shall be liable to:

- Fine not exceeding 25 thousand ringgit or imprisonment not more than 2 years or both,
- And Further fine of one thousand for every day

The licence Fees is prescribed by the Minister with the consultation of the Council. Different fees according to the class of premises, the location, the quantity of waste, pollutant / class of pollutant, and level of pollution.

Under Section 18 of this act, mentioned the decision on the prescribed premises to be licenced lies on the Minister, after consultation with the council prescribe the premises or the vehicle or ship. The Section 19 prohibit of causing vehicle, ship or premises to be prescribed without prior permission from the Director General (DG). The requirement and approval of plans should be submitted to DG. This act has put a restriction on pollution of the atmosphere as mentioned in Section 22;

- No person shall emit pollutants to atmosphere unless being licenced
- Contravene of this act shall be fined of 100K or imprisonment not exceeding 5 years

Other restriction on noise pollution, soil, inland waters, discharge of oil into Malaysian waters, discharge of waste into Malaysian water, open burning etc. also highlighted in this act.

Under Section 29A (3), open burning is defined as any fire, combustion or smouldering that occurs in the open air and which is not directed through a chimney or stack. No person shall allow or cause open burning on any premises under this section.

However, the minister may by order published a gazette declare that any fire specified in that order is not open burning as such activity is carried out in accordance or such condition specified in the order. EQA 1974, made compulsory of the Environmental Audit as in Section 33A. The owner of any premises/vehicles (whether are prescribed under section 18 or not) should carry out an environmental audit and submit the audit report to the minister. The owner shall appoint qualified personnel (registered under subsection 3).

This Act also prohibit against placing, deposit of schedule waste (SW) without a written approval from the DG (Section 34B). No person shall place, deposit or dispose any SW on land or water, received or send the SW in or out of Malaysia or transit the SW.

In terms of appeal, as mentioned in this law, who can appeal?

- Refusal grant a licence or transfer of licence
- Imposition of any condition or restriction of licence
- Suspension of licence
- The amount required to pay under section 47
- Decision of DG under subsection (3) or (4) of Section 34 A (Report on impact on environment resulting from prescribed activities)
- Decision of DG under subsection (2) or (5) of Section 48 A (Power to test and prohibit use of vehicle)

The appeal board shall consist of 3 members; one of whom shall be the chairman. There shall also be a Deputy Chairman of the Appeal Board. The chairman may call upon to serve on the appeal board any two members from a panel of persons appointed by notification in the Gazette by the minister.
The appointment of any member other than chairman and the Deputy of Chairman shall be for a period of three years unless he sooner resigns or revoked.

In part VA of this law, highlighted the payment of cess and environmental fund. Research cess is a cess on the waste generated. The cess shall be paid into the fund. There shall be established a fund to be known as the Environmental Fund which shall be operated as a Trust Account within the Federal Consolidated Fund.

The Environmental fund committee shall be established to control the fund. Any person who engaged in exploration, refining or storage of oil or production, distribution of environmental hazardous substance or the bulk movement or storage of waste requires to contribute to the fund at a rate that may specify.

In addition, the fund shall be administered for the purpose of:

- Conducting research
- Recovering of waste
- Preventing or combatting spillage of oil, discharge of environmental hazardous substance or discharge of waste
- conservation

Subsidiary Legislation under the EQA

There are over 23 pieces of regulations, rules and orders under the Act. Some regulations, rules and orders under the Act:

- Environmental Quality (Prescribed Premises) (Crude Palm Oil) Regulations 1977
- Environmental Quality (Licensing) Regulations 1977
- Environmental Quality (Prescribed Premises) (Crude Palm Oil) Order 1977
- Environmental Quality (Prescribed Premises) (Raw Natural Rubber) Regulations 1978
- Environmental Quality (Clean Air) Regulations 1978
- Environmental Quality (Compound of Offences) Rules 1978
- Environmental Quality (Sewage and Industrial Effluents) Regulations 1979
- Environmental Quality (Motor Vehicle Noise) Regulations 1987
- Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 1987
- Environmental Quality (Scheduled Wastes) Regulations 1989
- Environmental Quality (Prohibition on the Use of Chlorofluorocarbons and Other Gases as Propellants and Blowing Agents) Order 1993
- Environmental Quality (Control of Emission from Diesel Engines) Regulations 1996
- Environmental Quality (Control of Emission from Petrol Engines) Regulations 1996

What is the difference between Act, Regulations, Rules and Order?

- Act is a law passed by Parliament. Before an Act is passed by Parliament it is called a Bill
- Rules refer to standards for activities.
• Regulations are laws made by the bodies under powers conferred by an Act of Parliament. Regulations generally deal with matters of detail or administration, or matters that are subject to frequent change.

• Orders in Council, rules, notices, determinations, proclamations, or warrants may also be referred to as Regulations

Issues and challenge

Through the delegation of legislative power to the Minister in charge of environmental protection, regulations, rules and orders are constantly being passed, amended or revoked under the aegis of the Act as necessity emerged.

However, there is a separation of rights and responsibilities between federal and state governments and local authorities, which is known as a three-tier system of government. Figure 5 indicates the task or list that execute within the jurisdiction of the three powers.

Figure 5: The list of task for Federal and State government

The three tier system has lack of clear hierarchy of enforcement; agencies upon which regulations can be formulated and enforced as circumstances demand. It is also difficult to have a comprehensive and totally uniform environmental law since the legislative powers being shared out between the State and the Federal Government.

Environmental Impact Assessment (EIA)

EIA is defined as the systematic identification and evaluation of the potential impacts (effects) of proposed projects, plans, programs, or legislative actions relative to the physical-chemical, biological, cultural, and socioeconomic components of the total environment.

As a long-term and comprehensive measure, for any major development project, the government has incorporated environmental factors along with techno-economic factors in the hope of avoiding the emergence of pollution problems in the future.
Towards achieving this goal, the government has enforced the *Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 1987*, in 1988. The EIA process enables the decision makers to **assess the impact of a proposed development project on the environment, and to incorporate mitigation measures** to reduce the risk and impact such a project may have on the environment.

The EIA process also provides an **avenue for public participation** in the decision-making process. The EIA process plays an important role in exercising the principle of **sustainable development**. In essence, the EIA process assists decision-makers to take into account the quality of development, the effect upon the conservation of natural resources, as well as its location and quantity. The *Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 1987* which is made under powers conferred by section 34A of the Environmental Quality Act, 1974 (Amendment) 1985 specifies those activities that are subject to EIA. Nineteen categories of activities are prescribed and these include those related to:

- Agriculture
- Airport
- Drainage and Irrigation
- Land Reclamation
- Fisheries
- Forestry
- Housing – housing development covering an area of 50 hectares or more
- Industry
- Infrastructure
- Ports
- Mining
- Petroleum
- Power Generation and Transmission
- Quarries
- Railways
- Transportation
- Resort and Recreational Development
- Waste Treatment and Disposal
- Water Supply

Many of the activities related to these nineteen categories are defined in terms of
(a) project size (as area),
(b) capacity (quantum) and
(c) not defined by any unit of measure.
<table>
<thead>
<tr>
<th>Quantum</th>
<th>Unit</th>
<th>Activity</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>60000</td>
<td>Barrel</td>
<td>Construction of product depot for storage of petrol, gas or diesel</td>
<td>12 (e)</td>
</tr>
<tr>
<td>5000</td>
<td>Tonne</td>
<td>Shipyards</td>
<td>8 (f)</td>
</tr>
<tr>
<td>4500</td>
<td>Cubic-metres</td>
<td>Groundwater development for industrial, agricultural or urban water supply</td>
<td>19 (b)</td>
</tr>
<tr>
<td>200</td>
<td>Tonnes/day</td>
<td>Iron and steel industries using scrap iron</td>
<td>19 (b)</td>
</tr>
<tr>
<td>100</td>
<td>Family</td>
<td>Agricultural programmes necessitating resettlement</td>
<td>8 (e)</td>
</tr>
<tr>
<td>100</td>
<td>Tonnes/day</td>
<td>Chemical production industries</td>
<td>1 (b)</td>
</tr>
<tr>
<td>100</td>
<td>Tonnes/day</td>
<td>Lime production industries using rotary kiln</td>
<td>8 (d)</td>
</tr>
<tr>
<td>100</td>
<td>Tonnes/day</td>
<td>Iron and steel industries using iron ore</td>
<td>8 (e)</td>
</tr>
<tr>
<td>50</td>
<td>Tonnes/day</td>
<td>Non ferrous industries other than aluminium and copper</td>
<td>8 (c)</td>
</tr>
<tr>
<td>50</td>
<td>Tonnes/day</td>
<td>Lime production industries using vertical kiln</td>
<td>8 (d)</td>
</tr>
<tr>
<td>50</td>
<td>Tonnes/day</td>
<td>Pulp and paper industry</td>
<td>8 (g)</td>
</tr>
<tr>
<td>30</td>
<td>Tonnes/hour</td>
<td>Cement industries</td>
<td>8 (d)</td>
</tr>
<tr>
<td>10</td>
<td>Mega-watts</td>
<td>Construction of steam generated power stations using fossil fuels</td>
<td>13 (a)</td>
</tr>
<tr>
<td>Project Size</td>
<td>Unit</td>
<td>Activity</td>
<td>Number</td>
</tr>
<tr>
<td>--------------</td>
<td>----------</td>
<td>--------------------------------------------------------------------------</td>
<td>--------</td>
</tr>
<tr>
<td>5000 Hectare</td>
<td></td>
<td>Irrigation schemes</td>
<td>3 (c)</td>
</tr>
<tr>
<td>500 Hectare</td>
<td></td>
<td>Land development schemes to bring forest land into agricultural production</td>
<td>1 (a)</td>
</tr>
<tr>
<td>500 Hectare</td>
<td></td>
<td>Development of agricultural estates involving changes in types of agricultural use</td>
<td>1 (c)</td>
</tr>
<tr>
<td>500 Hectare</td>
<td></td>
<td>Logging</td>
<td>6 (c)</td>
</tr>
<tr>
<td>400 Hectare</td>
<td></td>
<td>Construction of dams and hydroelectric power scheme reservoirs</td>
<td>13 (b) ii</td>
</tr>
<tr>
<td>250 Hectare</td>
<td></td>
<td>Mining of mineral in new areas</td>
<td>11 (a)</td>
</tr>
<tr>
<td>200 Hectare</td>
<td></td>
<td>Construction of dams and man-made lakes and artificial enlargement of lakes</td>
<td>3 (a)</td>
</tr>
<tr>
<td>200 Hectare</td>
<td></td>
<td>Construction of dams or impounding reservoirs</td>
<td>19 (a)</td>
</tr>
<tr>
<td>100 Family</td>
<td></td>
<td>Agricultural programmes necessitating resettlement</td>
<td>1 (b)</td>
</tr>
<tr>
<td>100 Hectare</td>
<td></td>
<td>Drainage of wetland, wild-life habitat or virgin forest</td>
<td>3 (b)</td>
</tr>
<tr>
<td>80 Room</td>
<td></td>
<td>Construction of coastal resort facilities or hotel</td>
<td>17 (a)</td>
</tr>
<tr>
<td>50 Hectare</td>
<td></td>
<td>Coastal reclamation</td>
<td>4</td>
</tr>
<tr>
<td>50 Hectare</td>
<td></td>
<td>Land-based aquaculture projects accompanied by clearing of mangrove swamp forest</td>
<td>5 (c)</td>
</tr>
<tr>
<td>50 Hectare</td>
<td></td>
<td>Conversion of hill forest land to other land use</td>
<td>6 (a)</td>
</tr>
<tr>
<td>50 Hectare</td>
<td></td>
<td>Conversion of mangrove swamps for industrial, housing, or agricultural use</td>
<td>6 (d)</td>
</tr>
<tr>
<td>50 Hectare</td>
<td></td>
<td>Housing development</td>
<td>7</td>
</tr>
<tr>
<td>50 Hectare</td>
<td></td>
<td>Industrial estate development for medium and heavy industries</td>
<td>9 (b)</td>
</tr>
<tr>
<td>50 Hectare</td>
<td></td>
<td>Sand dredging</td>
<td>11 (c)</td>
</tr>
<tr>
<td>50 Hectare</td>
<td></td>
<td>Hill station resort or hotel development</td>
<td>17 (b)</td>
</tr>
<tr>
<td>50 Kilometre</td>
<td></td>
<td>Construction of off-shore and on-shore pipeline</td>
<td>12 (b)</td>
</tr>
<tr>
<td>40 Hectare</td>
<td></td>
<td>Construction of dams and hydroelectric power schemes with dams over 15 metres high</td>
<td>13 (b) i</td>
</tr>
<tr>
<td>2.5 Kilometre</td>
<td></td>
<td>Construction of airports</td>
<td>2 (a)</td>
</tr>
</tbody>
</table>
Table 3: Activities not defined by unit measures

<table>
<thead>
<tr>
<th>Prescribed Activity</th>
<th>Activity</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIRPORT</td>
<td>Airstrip development in state and national parks</td>
<td>2 (b)</td>
</tr>
<tr>
<td>FISHERIES</td>
<td>Construction of fishing harbours</td>
<td>5 (a)</td>
</tr>
<tr>
<td></td>
<td>Harbour expansion involving an increase of 50 per cent or more in fish landing capacity per annum</td>
<td>5 (b)</td>
</tr>
<tr>
<td>FORESTRY</td>
<td>Logging or conversion of forest land to other land use within the catchment area of reservoirs used for municipal water supply, irrigation or hydropower generation or in areas adjacent to state and national parks and national marine parks</td>
<td>6 (b)</td>
</tr>
<tr>
<td></td>
<td>Clearing of mangrove swamps on islands adjacent to national marine parks</td>
<td>6 (e)</td>
</tr>
<tr>
<td>INDUSTRY</td>
<td>Petrochemicals industries – all sizes</td>
<td>8 (b)</td>
</tr>
<tr>
<td></td>
<td>Primary smelting of aluminium and copper – all sizes</td>
<td>8 (c)</td>
</tr>
<tr>
<td>INFRA-STRUCTURE</td>
<td>Construction of hospitals with outfall into beachfronts for recreational purposes</td>
<td>9 (a)</td>
</tr>
<tr>
<td></td>
<td>Construction of expressways</td>
<td>9 (c)</td>
</tr>
<tr>
<td></td>
<td>Construction of national highways</td>
<td>9 (d)</td>
</tr>
<tr>
<td></td>
<td>Construction of new townships</td>
<td>9 (e)</td>
</tr>
<tr>
<td>PORTS</td>
<td>Construction of ports</td>
<td>10 (a)</td>
</tr>
<tr>
<td></td>
<td>Port expansion involving an increase of 50 per cent or more in handling capacity per annum</td>
<td>10 (b)</td>
</tr>
<tr>
<td>MINING</td>
<td>Ore processing including concentrating for aluminium, copper, gold or tantalum</td>
<td>11 (b)</td>
</tr>
<tr>
<td>PETROLEUM</td>
<td>Oil and gas fields development</td>
<td>12 (a)</td>
</tr>
<tr>
<td></td>
<td>Construction of oil and gas separation, processing, handling and storage facilities</td>
<td>12 (c)</td>
</tr>
<tr>
<td></td>
<td>Construction of oil refineries</td>
<td>12 (d)</td>
</tr>
<tr>
<td>POWER GENERATION AND TRANSMISSION</td>
<td>Construction of combined cycle power stations</td>
<td>13 (c)</td>
</tr>
<tr>
<td></td>
<td>Construction of nuclear-fueled power stations</td>
<td>13 (d)</td>
</tr>
</tbody>
</table>
Food Act 1983 (Act 281)

Introduction

Food Act 1983, is an Act to protect the public against health hazards and fraud in the preparation, sale and use of food, and for matters incidental thereto or connected therewith. This chapter highlight the overview of the act and few important section in the act that significantly related to human health.

The Act comprises the following:

- Part I: Preliminary - the interpretations
- Part II: Administration and enforcement
  - Example: Appointment of analysts and authorized officers, approved laboratories, power to take sample, procedure for taking sample
- Part III: Offences and Evidence
  - Example: Food containing substances injurious to health, adulterated food, removal of food from food premises, prosecutions etc.
- Part IV: Importation, warranty and Defenses
  - E.g.: Importation, warranty, reliance on written warranty a good defence, penalty for false warranty
- Part V: Miscellaneous provisions
  - E.g.: Prosecution, power to compound, indemnity etc

In the context of this act, an authorized officer is defined as any medical officer of health or any health inspector of the Ministry of Health or of any local authority, or any suitably qualified person, appointed by the Minister to be an authorized officer under section.

Food is defined as includes every article manufactured, sold or represented for use as food or drink for human consumption or which enters into or is used in the composition, preparation, preservation, of any food or drink and includes confectionery, chewing substances and any ingredient of such food, drink, confectionery or chewing substances.

Administration and enforcement of the law

For the purpose of this Act, the Minister may appoint such number of analysts and authorized officers as he may consider necessary. Every authorized officer shall be issued with a Certificate of Authorization which certificate shall be admissible in evidence and shall be prima facie evidence of the facts so certified.

The Minister may authorize any public officer to procure for analysis samples of any food, and they (the analysts and authorized officers) shall be deemed to be public servants within the meaning of the Penal Code [Act 574].

The Minister also may, by order, approve such number of laboratories as he may consider necessary for the purposes of this Act. A laboratory shall be issued with a Certificate of Approval.

In Section 4 of this act highlight the authorized officer has power to;

1) enter any premises which he believes to be food premises and examine any food found therein and take samples of such food
(2) stop, search or detain any aircraft, ship or vehicle in which he believes on reasonable grounds that any food to which this Act applies is being conveyed and examine

(3) open and examine any package that contains any food to which this Act applies

(4) examine any books, documents or other records found in any food premises that he believes contain any information relevant to the enforcement of this Act and make copies or take extracts therefrom

(5) demand the production of the National Registration Identity Card, the Business Registration Certificate or any other relevant document which the authorized officer may require

(6) seize and detain for such time as may be necessary any food or appliance by means of or in relation to which he believes any provision of this Act has been contravened;

(7) mark, seal or otherwise secure, weigh, count or measure any food or appliance, the preparation, preservation, packaging, storage, conveyance, distribution or sale of which is or appears to be contrary to this Act.

An authorized officer may examine orally the owner, occupier or person in charge of the food premises, or any person found in the food premises, whom he believes to be acquainted with the facts and circumstances of any matter under this Act.

A person examined shall be legally bound to answer truthfully all questions put to him. Provided that a person examined under this subsection may refuse to answer any question the answer to which would have a tendency to expose him to a criminal charge.

Any person who knowingly makes any false or misleading statement either verbally or in writing to any authorized officer engaged in carrying out his duty commits an offence and is liable on conviction to imprisonment for a term not exceeding one year or to fine or to both.

An authorized officer shall release any food seized by him when he is satisfied that all the provisions of the Act with respect to it have been complied.

The authorized officer may at any place demand and select and take or obtain samples of the food for the purpose of analysis without payment from any manufacturer making food for sale or from any importer of any food or from his agent or servant (Section 5).

An authorized officer may require the person or his agent or servant to show and permit the inspection of the package in which such food is at the time kept and to take therefrom the samples demanded.

Section 6, highlight the procedure of taking sample. Where it is intended to submit any sample of any food for analysis the authorized officer purchasing or otherwise procuring the sample, shall inform the seller or his agent the food that he intends to have the sample analysed by an analyst. The procedure for taking and dealing with the samples shall be as prescribed by regulations.

If any authorized officer is of the opinion that there is reasonable ground for suspecting that any person is in possession of breach of any of the provisions of this Act or any regulations made thereunder, he may require such person to produce for his inspection any books, documents or other records or other information relating to the possession.

Any authorized officer who does not maintain the secrecy of all matters which come to his knowledge in the performance of his official duties under this section; or communicates any such matter to any person except for the purpose of carrying into effect the provisions of this Act, commits an offence and is liable on conviction to imprisonment for a term not exceeding three years or to fine or to both.
In Section 9, the Director General has a power to obtain particulars of certain food ingredients. Any substance to which this Act applies, the following particulars:

(i) of the composition and chemical formula of the substance
(ii) of the manner in which the substance is used or proposed to be used in the preparation of food;
(iii) for the purpose of determining whether and to what extent the substance, or any product formed when the substance is used as aforesaid, is injurious to, or in any other way affects, health;
(iv) for the purposes of determining the cumulative effect on the health of a person consuming the substance in ordinary quantities.

The Director or an officer authorized (by his own inspection or the report of an authorized officer) found, that any food premises is in a condition that fails to comply with any hygiene and sanitary requirements specified in regulations made under this Act, may order (in writing) that the premises or appliance be put into a hygienic and sanitary condition to the satisfaction of an authorized officer within a period specified (Section 10).

If after the expiration of that period, they are not satisfied with the condition of the premises, they may (by writing), order that—
(i) the food premises shall not be kept for the preparation, preservation, packaging,... of any food; and
(ii) the appliance shall not be used in or for the preparation, preservation, packaging, handling, supplying, or serving of any food,

until an authorized officer has given the owner a certificate in writing that the food premises or appliance has been put into a condition which complies with the hygienic and sanitary requirements.

The Director or an officer authorized may (in writing) order the closure forthwith not exceeding fourteen days of any premises preparing or selling food where that such premises is in a condition that fails to comply with the sanitary and hygienic requirements and it is likely to be hazardous to health.

The owner or occupier of the premises who fails to comply with the order is liable on conviction to imprisonment for a term not exceeding five years or to fine or to both

**Offences and evidence**

Under Section 13, any person who prepares or sells any food that has in or upon it any substance which is poisonous, harmful or otherwise injurious to health commits an offence and shall be liable, on conviction, to a fine not exceeding one hundred thousand ringgit or to imprisonment for a term not exceeding ten years or to both.

In determining whether any food is injurious to health regard shall be had not only to the probable effect of that food on the health of a person consuming it but also to the probable cumulative effect of the food of substantially the same composition on the health of a person consuming the food in ordinary quantities.

In Section 13A, the law highlight that any person who prepares or sells any food that unfit for human consumption (consists wholly or in part of)—
(a) any diseased, filthy, decomposed or putrid animal or vegetable substance;
(b) any portion of an animal unfit for food; or
(c) the product of an animal which has died otherwise than by slaughter or as game,

whether manufactured or not, commits an offence and shall be liable, on conviction, to a fine not exceeding fifty thousand ringgit or to imprisonment for a term not exceeding eight years or to both.

According to Section 13B of this Act, no person shall prepare or sell any adulterated food. Adulterated food is defined as;
(a) it contains or is mixed or diluted with any substance which diminishes in any manner its nutritive or other beneficial properties as compared with normal and undeteriorated food.

(b) any substance or ingredient has been extracted, wholly or in part, from the food in which from the extraction, the nutritive properties of the food are less than those of the normal food

(c) it contains or is mixed or diluted with any substance of lower commercial value than such food in a pure, normal undeteriorated food

(d) it contains any substance the addition of which is not permitted by this Act or any regulations made under this Act;

(e) it does not comply with the standard or specification prescribed by any regulations made under this Act;

(f) it contains a greater proportion of any substance than is permitted by this Act

(g) it is mixed, coloured, powdered, coated, stained, prepared or treated in a manner whereby damage or inferiority may be concealed;

(h) it is in a package, and the contents of the package as originally packed have been removed in whole or in part and other contents have been placed in the package.

A person who contravenes any of the provisions of this section commits an offence and shall be liable, to a fine not exceeding twenty thousand ringgit or to imprisonment for a term not exceeding five years or to both.

Person who sells any food which is not of the nature, or is not of the substance, or is not of the quality of the food demanded by the purchaser (Section 14), commits an offence and is liable on conviction to imprisonment for a term not exceeding five years or to fine or to both.

Prevention and control of infectious diseases Act 1988 (Act 342)

Introduction

The Prevention and Control of Infectious Disease Act 1988 (Act 342) is an Act to amend and consolidate the law relating to the prevention and control of infectious diseases and to provide for other matters connected therewith. It applies throughout Malaysia.

The Act comprises the following:
- Part I: Preliminary - the interpretations
- Part II: Administration
  - Appointment of authorized officers; limitation of liability; Police assistance, etc
- Part III: Prevention of importation of infectious disease
  - Declaration of infected area; entry into and examination of vehicles and the measures thereafter; time for examination; Importation or exportation of human remains and pathogenic organism or substance
- Part IV: Control of the spread of infectious disease
  - Requirement to notify infectious disease; Declaration of an infected local area; Infected persons not to act in a manner likely to spread infectious disease etc
- Part V: Offences and penalties
- Part VI: Miscellaneous
Administration and enforcement

In accordance to this Act, infectious disease is defined as any disease specified in the First Schedule of this act (Table 4).

Section 3 of this Act, highlight the requirement of appointing an authorized officers. The Minister may appoint any suitable person to be an authorized officer for the purposes of this Act. An authorized officer shall, when acting within the scope of his powers and duties under this Act, be deemed to be a public servant within the meaning of the Penal Code [Act 574].

They shall maintain the confidentiality of all matters which come to his knowledge in the performance of his official duties under this Act and shall not communicate any such matter to any person except for the purpose of carrying into effect the provisions of this Act. An authorized officer who contravenes to this section commits an offence and is liable on conviction to imprisonment for a term not exceeding three years or to a fine or to both.

Police, customs and immigration officers and officers from other government departments and agencies shall render such assistance as any authorized officer may request for the purpose of enabling him to exercise the powers vested in him by this Act (Section 5).

Table 4: First schedule of the infectious disease

<table>
<thead>
<tr>
<th>PART 1</th>
<th>PART 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Chancroid.</td>
<td>Human Immunodeficiency Virus Infection (All forms)</td>
</tr>
<tr>
<td>2. Cholera.</td>
<td></td>
</tr>
<tr>
<td>3. Dengue Fever and Dengue Haemorrhagic Fever</td>
<td></td>
</tr>
<tr>
<td>4. Diphtheria.</td>
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<tr>
<td>5. Dysenteries (All forms).</td>
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<tr>
<td>5A. Ebola.</td>
<td></td>
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<tr>
<td>6. Food Poisoning.</td>
<td></td>
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<tr>
<td>7. Gonococcal Infections (All forms).</td>
<td></td>
</tr>
<tr>
<td>8. Leprosy.</td>
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<tr>
<td>9. Malaria.</td>
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<tr>
<td>10. Measles.</td>
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<tr>
<td>10A. Myocarditis.</td>
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<tr>
<td>11. Plague.</td>
<td></td>
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<tr>
<td>15. Syphilis (All forms).</td>
<td></td>
</tr>
<tr>
<td>16. Tetanus (All forms).</td>
<td></td>
</tr>
<tr>
<td>17. Tuberculosis (All forms).</td>
<td></td>
</tr>
<tr>
<td>18. Typhoid and Paratyphoid Fevers.</td>
<td></td>
</tr>
<tr>
<td>19. Typhus and other Rickettsioses.</td>
<td></td>
</tr>
<tr>
<td>20. Viral Encephalitis.</td>
<td></td>
</tr>
<tr>
<td>21. Viral Hepatitis.</td>
<td></td>
</tr>
<tr>
<td>22. Whooping Cough.</td>
<td></td>
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<tr>
<td>23. Yellow Fever.</td>
<td></td>
</tr>
<tr>
<td>24. Any other life threatening microbial infection</td>
<td></td>
</tr>
</tbody>
</table>
An authorized officer also may order any part of any vehicle, which he has reason to believe to be contaminated or infested, to be disinfected, disinsected or deratted to that officer’s satisfaction.

If he finds that any person is infected or is a contact, he may order such person;

(a) to be removed to a quarantine station and detained therein for isolation or observation; or

(b) to be put under surveillance until such time as the disease is no longer communicable to others.

Section 9 of this Act highlight that no person shall knowingly import into or export out of Malaysia;

(a) any human remains, human tissues or part thereof; or
(b) any pathogenic organism or substance or part thereof, except in accordance with regulations made under this Act.

Control of the spread of infectious disease

(i) Notification

The important aspect in the case of infectious disease (ID) is the requirement to notify ID. Under Section 10, every adult occupant of any house, every person in charge of the company, in which ID appears, and every person not being a medical practitioner attending on, any person suffering from or who has died of an infectious disease shall, notify the officer in charge of the nearest district health office or government health facility or police station or notify the nearest village head upon becoming aware of the existence of such disease, without delay.

Every medical practitioner who treats or becomes aware of the existence of any ID in any premises shall, give notice of the existence of the infectious disease to the nearest Medical Officer of Health without delay.

The person in charge of any boarding-house (hostel, hotel, refugee station etc) shall, notify the officer in charge if he knows that any person in the boarding house is suffering from or has died of an infectious disease, without delay.

Any police officer or village head receiving notification under this section shall, with the least practicable delay, notify the officer in charge of the nearest district health office or government health facility.

Whoever contravenes this section commits an offence.

(ii) Declaration of an infected local area

Under Section 11 of the Act, the Minister may, Gazette or declare such area to be an infected local area. The Minister may, by regulations made under this Act, prescribe the measures to be taken to control or prevent the spread of any infectious disease within or from an infected local area.

During the continuance in force of an order made under this subsection, it shall be lawful for any authorized officer to direct any person or persons living in an infected local area or in any part thereof to subject himself or themselves;

(a) to treatment or immunization

(b) to isolation, observation or surveillance, the period of which being specified according to circumstances; or

(c) to any other measures as the authorized officer considers necessary to control the disease.
The infected persons shall not act in a manner that likely to spread the ID as mentioned in Section 12 of this law.

“No person who knows or has reason to believe that he is suffering from an infectious disease shall expose other persons to the risk of infection by his presence or conduct in any public place or any other place used in common by persons other than the members of his own family or household. They shall not do any act which he knows is likely to lead to the spread of such infectious disease”

However, this section not applies to any person whose presence is necessary for the purpose of obtaining medical treatment.

(iii) Control of contaminated articles and infected animals

Under Section 13, the contaminated animals or articles shall not give, lend, sell, use or transmit to other person or buyer, before undergo disinfection. However, this Section does not apply to a person who transmits the animal for the purpose of having it disinfected.

Any person who is infected, should be removed to a quarantine station for treatment and detain at the station until he is no longer danger to the public. The authorized officer may ask the infected person to undergo observation or surveillance until he no longer danger to public.

In Section 16, the authorized officer may order the corpse (person who died of an ID) conveyed to such place for such necessary examination. In term of disposal of the dead, whom has died or suspected to have died because of ID, and has given direction to be buried, they shall bury in accordance with the directions of the officer (Section 17).

Section 18, highlight the disinfection and closure of premises by the authorized officer as of the following:

(a) examine or cause to be examined any person found on the premises with a view to ascertaining if the person is suffering or has been suffering from an infectious disease;

(b) examine the premises and any article or animal on the premises with a view to ascertaining if they are contaminated or infected, as the case may be;

(c) order the premises or any part thereof to be disinfected, disinfected (clear of insects) and deratted (clear of rodents)

(d) order the premises or any part thereof to be closed until the premises have been thoroughly disinfected, disinsected and deratted;

(e) order the disinfection of all contaminated articles and infected or contaminated animals on the premises or, if such article or animal is incapable of being thoroughly disinfected, order its destruction;

Miscellaneous

In terms of recovery costs and expenses, Section 28 of this Act highlight that Any cost or expenses charged or incurred by the Government without prejudice to any other remedy, be recovered by civil proceedings as a debt due to the Government.

The Government may recover from the owner of any vehicle, or his agent or servant, any cost and expenses charged or incurred by the Government under this Act or the regulations made for all or any of the following:
(a) the removal, medical attendance and maintenance of any person who is suspected to be suffering from an infectious disease and who is removed to any hospital or place from such vehicle for medical treatment or for isolation or observation;

(b) the burial or cremation of any person who dies of an infectious disease

(c) the cleansing, disinsecting, disinfection and deratting of such vehicle or of any part thereof;

(d) the disposal of contaminated articles or infected or contaminated animals on such vehicle.

Table 5 highlight the offences and penalties that applies to this law.

<table>
<thead>
<tr>
<th>Offences</th>
<th>Penalties</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) obstructs or impedes, or assists in obstructing or impeding, any authorized officer in the execution of his duty</td>
<td>a) in respect of a first offence, to imprisonment for a term not exceeding two years or to fine or to both;</td>
</tr>
<tr>
<td>(b) disobey any lawful order issued by any authorized officer;</td>
<td>(b) in respect of a second or subsequent offence, to imprisonment not exceeding five years or to fine or to both;</td>
</tr>
<tr>
<td>(c) refuses to furnish any information required for the purposes of this Act or any regulations made under this Act; or</td>
<td>(c) in respect of a continuing offence, to a further fine not exceeding two hundred ringgit for every day during which such offence continues.</td>
</tr>
<tr>
<td>(d) Gives false information,</td>
<td></td>
</tr>
</tbody>
</table>

Summary

From this overview of the related laws, We have understand that there is a system to control the pollution and also protecting public health. However, there are still issues and challenge of these laws in terms of enforcement, implementation and overlap execute powers at different level of the authority in the country.

REFERENCES

5. www.doe.gov.my
6. www.moh.gov.my
CHAPTER 7
Social aspects in environmental health

Introduction

1. Environment

"Environment" is most commonly used to describe the "natural" environment and means the sum of all living and non-living things that surround an organism, or group of organisms. It includes all elements, factors, and conditions that have some impact on growth and development of certain organism and also refer to both biotic and abiotic factors that have influence on observed organism. Abiotic factors such as light, temperature, water, atmospheric gases combine with biotic factors that are all surrounding living species. Environment often changes after some time and therefore many organisms have ability to adapt to these changes. However tolerance range is not the same with all species and exposure to environmental conditions at the limit of a certain organism's tolerance range represents environmental stress.

2. Environmentalism

It refers to a movement connected with environmental scientists and many of their goals, which include reducing world consumption of fossil fuels, to reduce and clean up all sorts of pollution (air, sea, river...) with future goal of zero pollution, to emphasis on clean, alternative energy sources that have low carbon emissions, to promote sustainable use of water, land, and other scarce resources, to preserve existing endangered species and to protect biodiversity.

Natural environment include beautiful mountain and river, blue sky and pristine sea shore. Man-made environment can be a sprawling city or smokes from the industries. Examples of man-made disaster could be oil spill in Korea, Dumping of waste, war etc.

3. Environmental health

Environmental health addresses all the physical, chemical, and biological factors external to a person, and all the related factors impacting behaviours. It encompasses the assessment and control of those environmental factors that can potentially affect health. It is targeted towards preventing disease and creating health-supportive environments.

Determinants of health

There are wide range of personal, social, economic, and environmental factors that could influence health status of people. For examples, social and physical factors, health services, individual behavior, policymaking, biology and genetics.

1. Social determinants

Social determinants of health reflect social factors and the physical conditions in the environment in which people are born, live, learn, play, work and age. Also known as social and physical determinants of health, they impact a wide range of health, functioning and quality of life outcomes. The examples of social determinants of health include:

- Healthful foods, educational and job opportunities, income
- Social norms and attitudes, such as discrimination
- Public safety – exposure to violence, and social disorder
- Social support and social interactions
- Mass media and communication and technologies, such as the Internet or cell phones
- Socioeconomic conditions, rural and urban poverty
- Quality schools
- Transportation options
2. Physical determinants

The examples of physical determinants include:

- Natural environment, such as plants, weather, or climate change
- Built environment, such as buildings or transportation
- Worksites, schools, and recreational settings
- Housing, homes, and neighbourhoods
- Exposure to toxic substances and other physical hazards
- Physical barriers, especially for people with disabilities
- Aesthetic elements, such as good lighting, trees, or benches

3. Health support and health services

Both access to health services and the quality of health services can impact health. Lack of access, or limited access, to health services greatly impacts an individual's health status.

4. Policy

Policies at the local, state, and national level affect individual and population health. Increasing taxes on tobacco sales, for example, can improve population health by reducing the number of people using tobacco products. Prohibiting smoking in public areas can reduce exposure to cigarette smoke.

Community and society

Generally, community refers to a group of people living in the same locality (geographical) and under the same government (political) and also district or locality (administrative) in which such a group lives. Community health is a discipline that deals with the study and betterment of the health characteristics of biological communities. It focuses on geographic areas rather than people.

A society means a group of humans broadly distinguished from other groups by mutual interest, shared institutions, and a common culture like society for the blind. It is a totality of social relationships among humans and can also mean the rich, privileges and fashionable social class. Sometimes, it also can refer to secret societies.

Social economic and health status

Social economic status refers to level or status of social and economic position of people within society as reflected by various indicators (measure and compare groups’ SES). Social indicators mean the status like head of household, education, jobs, housing, and access to services like health and recreation facilities. Economic indicators mean the financial position like how much the individuals earn, home ownership, assets, levels of dependency on welfare payments.

Below are some examples that show the relationship between social economic status and health status:

- Low-income and ethnic minorities are more likely to be exposed to toxic wastes and other forms of health-threatening environmental conditions.
- Children exposed to airborne toxins indoors.
- Parental smoking increases children exposure to a wide variety of indoor toxins. Poorer mothers are less likely to quit and smoke more than higher-income mothers.
- Use of contaminated water among low-income populations.
- Noise associated with low-income residents.
- Residential crowding – linked to income – low-income neighbourhood.
- Housing, schools, work, and neighbourhood quality.
- Housing quality – incomplete bathroom, no sewer/septic tank, holes in floor, open cracks, leaky roof, etc.
- Educational facilities – schools and day-care environment – tied to income
• Poorer people are subject to greater health risks on the job – poor working conditions, risky working conditions, most hazardous working conditions

REFERENCES
4. Giles-Corti B & Donovan RJ. Socioeconomic status differences in recreational physical activity levels and real and perceived access to a supportive physical environment. Preventive Medicine, 35, 601-611 (2002)

Related articles
Article 1: Social Determinants of Health: Implications for Environmental Health Promotion
• Amy Schulz, PhD, MPH
  Department of Health Behavior and Health Education, University of Michigan, School of Public Health, Ann Arbor.
• Mary E. Northridge, PhD, MPH
  Mailman School of Public Health, Columbia University, New York.
• Abstract:
  In this article, the authors draw on the disciplines of sociology and environmental and social epidemiology to further understanding of mechanisms through which social factors contribute to disparate environmental exposures and health inequalities. They propose a conceptual framework for environmental health promotion that considers dynamic social processes through which social and environmental inequalities—and associated health disparities—are produced, reproduced, and potentially transformed. Using empirical evidence from the published literature, as well as their own practical experiences in conducting community-based participatory research in Detroit and Harlem, the authors examine health promotion interventions at various levels (community-wide, regional, and national) that aim to improve population health by addressing various aspects of social processes and/or physical environments. Finally, they recommend moving beyond environmental remediation strategies toward environmental health promotion efforts that are sustainable and explicitly designed to reduce social, environmental, and health inequalities.

• Landsbergis, Paul A. PhD, MPH
  Journal of Occupational & Environmental Medicine:
  January 2003 - Volume 45 - Issue 1 - pp 61-72
• Abstract
  Recent trends in the organization of work may affect worker health through a variety of pathways-by increasing the risk of stress-related illnesses, such as cardiovascular disease, musculoskeletal disorders, and psychological disorders, by increasing exposure to hazardous substances and violence on the job, or by affecting occupational health services and training programs. Much remains to be learned about the nature of changes in work organization, and how they affect worker health and safety. While available evidence is limited, such evidence suggests that recent trends in work organization may be increasing the risk of occupational illnesses. In a groundbreaking publication, the National Institute for Occupational Safety and Health has provided a concise summary of available knowledge and a detailed agenda for research and development.
CHAPTER 6
Community health and relationship with environmental health

Introduction
Public health is defined by Winslow (1851), as the science & art of preventing disease, prolonging life and promoting health and efficiency through organized community measures such as control of infection, sanitation, health education, health services and legislation, etc. Organised community efforts include the sanitation of the environment, the control of communicable diseases, the education of the individual in personal hygiene, the organization of medical and nursing services for early diagnosis and preventive treatment of diseases, and the development of the social machinery to ensure everyone a standard of living adequate for maintenance of health.

History of public health
Public Health was developed in England in the middle of 19th Century. At that time, many towns in England were without proper water supply & drainage. Back to back houses without sun & ventilation, foul streams & rotting garbage were common in sights. London had a severe cholera epidemic in 1831 and the condition become worsened during the Industrial Revolution due to mobilization of a large population from villages to Industrial towns without sanitary arrangements. This led to the spread of communicable diseases and high infant & maternal mortality rates especially in industrial areas. It was during this time, that Edwin Chadwick, the then Secretary of Poor Law Board, championed the cause of community health & the first Public Health Act was passed in 1848.

The concept of specific prevention of disease gained solid foundation in the 18th Century. James Lind in 1753 showed the efficacy of fresh fruits & vegetables in preventing scurvy while Edward Jenner in 1796 found the efficacy of vaccination against small pox. Preventive medicine developed into a specialty after Louis Pasteur propagated in 1873 the germ theory of disease followed by discovery of causative agents of typhoid, pneumonia, tuberculosis, cholera & diphtheria.

WHO (1953) Proposed Development

1. Basic health services

   The basic health services include maternal & child health, communicable disease control, environmental sanitation, public health nursing, health education of public, maintenance of record for statistical purposes and medical care (primary).

2. Public health goals

   The public health goals are to prevent human disease, injury, and disability; protect people from environmental health hazards; promote behaviors that lead to good physical and mental health; educate the public about health; and assure availability of high-quality health services.

3. Essential public health functions (WHO 2002)

   It is a set of fundamental activities that address the determinants of health and to protect population’s health and disease threat like health situation, monitoring and analysis; epidemiological surveillance and disease prevention and control; public health policies and planning; strategic management of health systems and services for population health gain; regulation and enforcement to protect public health; human resources development and management; ensuring the quality of personal and population-based health services; research, development and implementation of innovative public health solution and etc.

4. Public health services

   - Public health services include Family Health Services, Environmental Health, Communicable Diseases Control, Non-Communicable Diseases Control, Drinking Water Quality
5. **Essential Public Health Services**

   i. Monitor health status to identify community health problems.
   ii. Diagnose and investigate health problems and health hazards in the community.
   iii. Inform, educate, and empower people about health issues.
   iv. Mobilize community partnerships to identify and solve health problems.
   v. Develop policies and plans that support individual and community health efforts.
   vi. Enforce laws and regulations that protect health and ensure safety.
   vii. Link people with needed personal health services and ensure the provision of health care otherwise unavailable.
   viii. Ensure a competent public health and personal health care workforce.
   ix. Evaluate the effectiveness, accessibility, and quality of personal and population-based health services.
   x. Conduct research to produce new insights and innovative solutions to health problems.

6. **Core Areas in Public Health**

   The core areas in public health include Health Care Management, Epidemiology & Biostatistics, Family Health (maternal and child health), Environmental Health, Occupational Safety & Health and Health Education & Promotion.

7. **Public health threats**

   Improved global health situation was seen with the eradication of small pox, reduction in childhood mortality and longer life expectancies but with some major reversals such as increased adult mortality due to HIV/AIDS and non-communicable diseases. Travel and migration led to spread of diseases become fast. Occupational diseases are increasing due to the exposure of asbestos, arsenic, solvents, Chromium, petroleum product radiation at the workplace or even non ergonomic working conditions.

   Leading causes of death in many developing countries include lower respiratory infections, diarrhoeal diseases, HIV, tuberculosis and malaria. The rates of infectious diseases in low-income countries account for much of the global morbidity and mortality due to infectious diseases. Measles and other infections such as parasitic diseases have to be added to the top ten causes of death for children less than five years of age.

   Wars and natural disasters also create environments where pathogens can thrive. New threats of bioterrorism, such as the anthrax assaults of 2001, are a consequence of the changing political and social environments that challenge organized public health systems.

   Other public health challenges include poverty, poor nutrition, poor environmental sanitation, poor health care infrastructure, lack of medical technologies, inequitable access to basic health services and low workforce capacity.

**Health**

Health is defined as “a state of complete physical, mental and social well-being, and not merely the absence of disease and infirmity” (WHO, 1948).

1. **Physical well-being**

   Physical well is refers to being deals mainly with the anatomical, physiological and biochemical functioning of the human body. Therefore the attributes of physical health depends to a large extend on how normal is the body structure, organs and their proper functioning. It must also be understood that what is normal to an Asian may not be normal to the European. As man progresses, what used to be the normal limits 1,000 years ago may not be normal currently. As example, anatomical or body structure of the stone-age man may not be normal if compared to the body structure of man in the new millennium. Physical health can be measured by height, weight, body mass index, head circumference (in infants less than 1 year old), blood pressure, temperature, blood hemoglobin level, chest x – ray and other laboratory investigation findings.
2. **Mental well-being**

Most abstract perspective of health is mental well-being. A positive mental health state means that an individual is able to enjoy his or her routine without undue conflicts, nor frequent outburst of emotions such as depression or mood elevation. The individual also develops harmonious relation within his or her family and community spheres. There may however be transient deviation from the normal state especially under the influence of stress or duress. In today’s world where there are datelines to meet and the pace of living is on the fast track it is not surprising that our state of mental health is affected to a certain extent. This is particularly true for women, particularly those married ones as they have multiple roles to play being wives, mothers, and employees.

3. **Social well-being**

It is more difficult to define social well-being. Social health means the level of health which enables a person to live harmoniously with his or her surroundings.

**Determinant of health**

Determinant of health means “any factor, whether event, characteristic, or other definable entity, that brings about change in a health condition or other defined characteristic.” (Last, 1995) Here are some of the examples:

i. Individual Factors

- age,
- gender,
- size,
- appearance,
- personality,
- physical & emotional state

ii. Housing

- Types of Housing
- Some Issues include overcrowding, number of rooms, “Sick Building Syndrome”, surrounding environment (Near land-fill), water & electricity supplies
- Improvements in housing and improved mental health and general health
- The possibility of improved housing leading to rent rises, impacting negatively on health,
- Movement of original tenants after housing improvement and therefore not benefiting from the improvements.
- Housing tenure, outdoor temperature, indoor air quality, dampness, housing design, rent subsidies, relocation, allergens and dust mites, home accident prevention, and fire prevention.
- Homelessness.

iii. Environment

- All that which is external to the individual human host.
- Can be divided into physical, biological, social, cultural, etc
- Any or all of these can influence health status of populations

iv. Educational level

- Most research studies reveal that there is a direct relationship between educational level and positive health outcomes
- Explanation

v. Transport

- Accidents between motor vehicles, bicycles and pedestrians (particularly children and young people)
Pollution from burning fossil fuels such as particulates and ozone
Noise from transportation

vi. Accessibility to Health Services

It is important to ensure accessibility to medical care especially when people are sick for curative care. It can be public or private health care facilities. Current policy ensures health service is easily available except for those in remote areas as example the Orang Asli Community and those in Sabah & Sarawak.

vii. Cultural Influences

viii. Socio-economic Status

ix. Food & Agriculture

x. Waste

xi. Urbanisation

xii. Other Environmental Factors

- Weather
- Population density
- Pollution of the habitat,
- Housing
- Public transport and health facilities

xiii. Other Educational Factors

- Formal
- Informal including education into a religious, ethnic or professional sub-culture

Conclusion

As conclusion, Public Health or Community Health is an integral part of Medicine. The Environmental Health is part or a sub-discipline of PH and also a determinant of health.

REFERENCES

CHAPTER 7 Environmental health issues

Part 1: Environmental hormones

Introduction

Hormones are chemicals produced by body which crucial for metabolism, reproduction, sexual identity and development. Environmental hormones refer to chemical substances in environment. These hormones disrupt the endocrine functions of humans and animals (Endocrine Disrupting Chemical, EDCs), impede reproductive and other functions in the body. EPA (2011) stated that EDC is define as exogenous agents that interfere with the production, release, transport, metabolism, binding, action or elimination of the natural hormones in the body responsible for the maintenance of homeostasis and the regulation of developmental processes. Endocrine disrupting chemicals (EDCs) give effects in a number of ways in different parts of the body by reducing production of hormones in endocrine glands, affecting hormones release from endocrine glands, counteracting hormones action at target tissues or speeding up hormones metabolism.

In 1999, EPA initiated testing program to identify the potential endocrine-system impact of over 87,000 chemicals in commercial use. EDCs comprise man-made chemicals such as natural chemicals found in plants (phytoestrogens), pharmaceuticals, pesticides, plasticizers or hormones that are excreted in animal or human waste (Figure 1). Human are exposed to chemicals in their everyday life because EDCs are found in low doses in thousands of products. EDCs are found in DDT, polychlorinated biphenyl (PCBs), bisphenol A (BPA), polybrominated diphenyl ethers (PBDE’s) and a variety of phthalates.

Table 1: Information on Endocrine Disrupting Chemicals (EDCs)

<table>
<thead>
<tr>
<th>Type of EDC</th>
<th>Description</th>
<th>Hormone target</th>
<th>Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>DDT</td>
<td>Widely used in World War 2 to control insect problems. Still being used as vector control in the world particularly for malaria, typhoid fever and use against the mosquitoes. Similar chlorinated pesticides went into agricultural market.</td>
<td>Estrogen</td>
<td>Largely predatory birds unable to develop thick eggshells to support the adult bird sitting on them. Biomagnification of DDT through the food chain. Interfere reproductive development Decrease in fertility in adult males Increase a child’s risk of childhood obesity</td>
</tr>
</tbody>
</table>
Polychlorinated biphenyls

Used as industrial coolants and lubricants

Sources are from commercial and by product of combustion

Cortisol

Direct skin contact results in a severe acne-like condition called chloracne
Risk of skin cancer, liver cancer and brain cancer
Toxic to the liver and thyroid
Increase childhood obesity
Increase risk of developing diabetes

Bisphenol A (BPA)

Commonly found in plastic bottles (including many baby bottles), plastic food containers, microwave ovenware, dental materials and the linings of metal food and infant formula cans
Receipt paper commonly used at grocery stores and restaurants

Estrogen

Similar neurotoxic effects with Bisphenol A (BPA)
Potential to disrupt thyroid hormone balance and contribute to a variety of neurological and developmental deficits, including low intelligence and learning disabilities
Ingestion has been considered an important route of exposure in phthalates.
Disrupt hormonal systems, which can cause harm during critical periods of development.
High doses of some phthalates causes reproductive and developmental toxicities in both male and female animals.

Polybrominated diphenyl ethers

Flame retardants used in plastic cases of electric and electronic devices (televisions and computers), carpets, car components and foam cushions

Thyroid

Can be found in some flooring, medical equipment, soft toys, flooring, cosmetics and air fresheners.
Also found in cosmetics to hold color and scents and have also been found in nail polish and treatments.
Alkylphenols

Mainly used to make detergents, also used as plasticisers in plastics and as UV stabilizers in plastics.

In some pesticide formulations in Europe countries.

Alkylphenol ethoxylates are also used in many domestic products outside Europe.

Absorption through skin from shampoos, cosmetics, spermicidal lubricants and domestic and industrial detergents, contaminated drinking water, inhalation and ingestion from pesticide sprays and contamination of food from fields spread with sewage sludge containing alkylphenols

Perfluooctanoic acid

Perfluooctanoic acid is a long-chain perfluorinated chemical (LCPFC) that does not occur natural in the environment.

Perfluooctanoic acid occurs as synthetic chemical substances with special properties and hundreds of manufacturing and industrial applictaions.

What are the important issues in understanding EDCs?

Identification of cause and effect relationship between specific EDC exposures and diseases is virtually impossible in most cases. This is because EDCs often act by mimicking or antagonizing the actions of naturally occurring hormones (Figure 2). Naturally occurring hormones are present at different physiologically functional concentrations compared to EDCs. Till today, scientists continue working to better understand how EDCs act in the body and consequences of EDCs exposure. There are several keys to understanding the effects of EDCs.
Figure 2: EDCs mimicking or antagonizing actions of naturally occurring hormones

- Exposure during critical periods

Dose response relationships are likely to vary for different chemicals and endocrine mechanisms. Exposure during critical periods is absolutely critical to the understanding of dose relationships for EDCs. This exposure is crucial to be understood for cancer as well as for developmental, reproductive, immunological and neurological effects. Numerous examples exist in the literature where adequate exposure is a known risk factor. A developing fetus or infant is more vulnerable to the effects of EDCs than an adult because organ systems are still developing. Exposure during this time period can lead to different and more harmful health impacts that might result from adult exposure.

- Delayed effects

Delayed effects can be noticed between the time of exposure and signs of a disorder. For an example of reproductive health, effects of exposure to an EDC in the womb or shortly after birth may not be seen until puberty or adulthood.

- Chemical mixtures

Chemical mixtures present in the environment make an understanding the effects of individual in human health due to EDCs are more complicated. On the other hand, understanding of effects due to environmental contamination is easier due to a single compound.

REFERENCES

CHAPTER 7 Environmental health issues

Part 2: Heavy metal contamination

Introduction

The term heavy metal refers to any metallic chemical element that has a relatively high density and is toxic or poisonous at low concentrations. Heavy metal has specific density of more than 5 g/cm³. It mainly includes the transition metals, some metalloids, lanthanides, and actinides (Figure 1). Examples of heavy metal includes mercury (Hg), cadmium (Cd), arsenic (As), chromium (Cr), thallium (Tl), and lead (Pb).

Figure 1: Types of heavy metal

Heavy metal cannot be degraded or destroyed. It enters our bodies via food, drinking water and air. As trace elements, some heavy metals (e.g. copper, selenium, zinc) are essential to maintain the metabolism of the human body. Heavy metals are dangerous because they tend to bioaccumulate. Bioaccumulation means an increase in the concentration of a chemical in a biological organism over time, compared to the chemical's concentration in the environment (Figure 2). At higher concentrations they can lead to poisoning. Heavy metal poisoning occurs in drinking-water contamination (e.g. lead pipes), high ambient air concentrations near emission sources, or intake via the food.
Heavy metals disasters in the world

1932 Minamata
Sewage containing mercury is released by Chisso's chemicals works into Minimata Bay in Japan eventually lead to mercury poisoning in the population and sea.

1952 Minamata Syndrome
In 1952, the first incidents of mercury poisoning appear in Minimata Bay, Japan, caused by consumption of fish polluted with mercury.

1986 Sandoz
Water used to extinguish a major fire carries fungicide containing mercury into the Upper Rhine. Fish are killed over a stretch of 100 km.

1998-04 Spanish nature reserve contaminated after environmental disaster
Toxic chemicals in water from a burst dam to a mine contaminate the Coto de Donana nature reserve in southern Spain containing sulphur, lead, copper, zinc and cadmium flow down the Rio Guadimar.

Metals in the human environment

Main threats to human health from heavy metals are associated with exposure to lead (Pb), cadmium (Cd), mercury (Hg) and arsenic (As, arsenic is a metalloid, but is usually classified as a heavy metal). Thus, these metals will be selected for further discussion in this study. Details of selected heavy metals are as in Table 1 Heavy metal occurs naturally in our environment, especially in the Earth's crust, and contributes to the balance of the planet. As a result of human activities such as mining, industrial and agricultural activities, large amounts of heavy metal are distributed, concentrated and chemically modified. These heavy metals end up as waste in air, water, soil, microorganisms, plants, animals and human being. Sources of Pb, Cd, Hg and As are summarized in Table 2.
Table 1: Details of selected heavy metals (Pb, Cd, Hg and As)

<table>
<thead>
<tr>
<th>Heavy metal</th>
<th>Properties</th>
</tr>
</thead>
</table>
| Pb          | • A metal belonging to group IV  
              • Period 6 of the periodic table with atomic number 82, atomic mass 207.2 g cm⁻³, melting point 327.4°C, and boiling point 1725°C.  
              • Naturally occurring, bluish-gray metal usually found as a mineral combined with other elements, such as sulphur (i.e., PbS, PbSO₄), or oxygen (PbCO₃), and ranges from 10 to 30 mg kg⁻¹ in the earth’s crust. |
| Cd          | • Transition element with atomic number 48, atomic weight 112.4, density 8.65 g cm⁻³, melting point 320.9°C, and boiling point 765°C.  
              • Cd occurs as the divalent Cd(II) ion.  
              • Cd is not known for any essential biological function.  
              • Cadmium is directly below Zn in the periodic table and has a chemical similarity to that of Zn, an essential micronutrient for plants and animals. Substitution by Cd may cause the malfunctioning of metabolic processes |
| Hg          | • Belongs to same group of the periodic table with Zn and Cd.  
              • It is the only liquid metal at standard temperature and pressure.  
              • It has atomic number 80, atomic weight 200.6, density 13.6 g cm⁻³, melting point −13.6°C, and boiling point 357°C and is usually recovered as a byproduct of ore processing.  
              • After release to the environment, Hg usually exists in mercuric (Hg²⁺), mercurous (Hg²⁺), elemental (Hg₀), or alkylated form (methyl/ethyl mercury).  
              • Redox potential and pH are factors which determine the stable forms of Hg that will be present. |
| As          | • Arsenic is a metalloid in group VA  
              • atomic number 33, atomic mass 75, density 5.72 g cm⁻³, melting point 817°C, and boiling point 613°C, and exhibits fairly complex chemistry and can be present in several oxidation states (−III, 0, III, V)  
              • Can be recovered from processing of ores containing mostly Cu, Pb, Zn, Ag and Au. |

Table 2: Sources of selected heavy metals (Pb, Cd, Hg and As) in human environment

<table>
<thead>
<tr>
<th>Heavy metal</th>
<th>Sources</th>
</tr>
</thead>
</table>
| Pb          | • Exhaust emissions from leaded petrol driven vehicles  
              • Dust in the roof void (attic), wall cavity or under floor area  
              • Paint (older homes, old toys, furniture, crafts)  
              • Soil  
              • Drinking water  
              • Air  
              • Folk medicines, ayurvedics, and cosmetics  
              • Children’s jewelry and toys  
              • Lead-glazed ceramics, china, leaded crystal, pewter  
              • Imported candies or foods  
              • Imported food in cans  
              • Firearms with lead bullets  
              • Mini-blinds  
              • Other common sources of lead (car batteries, radiators, some inks, etc.)  
              • Consumer Products |
| Cd          | • Ceramic products in contact with foodstuffs  
              • cigarettes and cigarette smoke  
              • batteries;  
              • Food chain  
              • drinking water  
              • vegetables  
              • seafood |
Heavy metals: a public health problem

Heavy metal at higher concentrations they can lead to poisoning due to its toxicity. Toxicity is a function of solubility. Insoluble compounds as well as the metallic forms often exhibit negligible toxicity. The toxicity of any metal depends on its ligands. In order to understand how a chemical will harm people is determined by how the body absorbs, uses, and releases the chemical.

1. Pb

Exposure to lead can result in a wide range of biological effects depending on the level and duration of exposure. Inhalation and ingestion are the two routes of exposure which both effects are the same. The most serious source of exposure to soil lead is through direct ingestion (eating) of contaminated soil or dust. Pb accumulates in the body organs (i.e., brain), which may lead to poisoning or death. The gastrointestinal tract, kidneys, and central nervous system are also affected by the presence of lead. Various effects occur over a broad range of doses, with the developing young and infants being more sensitive than adults. Lead exposure to children (under the age of six being at a more substantial risk) may lead to shortened attention span, impaired development, hyperactivity, lower IQ and mental deterioration with children. On the other hand, adults usually experience decreased reaction time, loss of memory, nausea, insomnia, anorexia, and weakness of the joints. Lead can cause serious injury to the brain, nervous system, red blood cells, and kidneys (Figure 1).

![Lead poisoning](image1.png)

- Mental retardation, coma, convulsions and death
- Reduce IQ and attention span, impaired development, hyperactivity, lower IQ and mental deterioration, with children.

Figure 1: Danger of Pb poisoning
2. **Cd**

Inhalation of cadmium can be life threatening although acute pulmonary effects and deaths are uncommon. Cadmium exposure may cause kidney damage, kidney damage and/or bone effects are likely to occur at lower kidney cadmium levels. The first sign of the renal lesion is usually a tubular dysfunction. An excess risk of kidney stones, possibly related to an increased excretion of calcium in urine following the tubular damage, has been shown in several studies. Long-term high cadmium exposure may cause skeletal damage, first reported from Japan, where the itai-itai (ouch-ouch) disease (a combination of osteomalacia and osteoporosis) was discovered in the 1950s. The exposure was caused by cadmium-contaminated water used for irrigation of local rice fields. Relatively low cadmium concentration exposure may give rise to skeletal damage, evidenced by low bone mineral density (osteoporosis). Symptoms of cadmium poisoning are as in Figure 2.

![Cadmium effects to human health](image)

**Figure 2: Cd effects to human health**

3. **Hg**

Mercury is a highly reactive toxic agent which difficult to identify its specific mechanism of damage, and much remains unknown about the mechanism (Figure 3). Acute inorganic mercury mercury exposure may give rise to lung damage. Chronic poisoning includes and psychological symptoms, such as tremor, changes in personality, restlessness, anxiety, sleep disturbance and depression. Metallic mercury causes kidney damage and also possible to detect proteinuria at relatively low levels of occupational exposure. Metallic mercury is an allergen, which may cause contact eczema, and mercury from amalgam fillings may give rise to oral lichen. High organic mercury doses may lead to death, usually 2–4 weeks after onset of symptoms. The Minamata catastrophe in Japan in the 1950s was caused by methyl mercury poisoning from fish contaminated by mercury discharges to the surrounding sea. A high dietary intake of mercury from consumption of fish has been hypothesized to increase the risk of coronary heart disease.
4. As

Inorganic arsenic is acutely toxic and large quantities intake leads to gastrointestinal symptoms, severe disturbances to cardiovascular and central nervous systems. This can also cause to death. Bone marrow depression, haemolysis, hepatomegaly, melanosis, polyneuropathy and encephalopathy may be observed. Risk of mortality from lung, bladder and kidney cancer is increasing with an exposure of arsenic via drinking water. There is also an increased risk of skin cancer and other skin lesions, such as hyperkeratosis and pigmentation changes. Studies on various populations exposed to arsenic by inhalation and cause lung cancer among smelter workers, pesticide manufacturers and miners in many different countries. The relationships between arsenic exposure and other health effects are less clear though there are relatively strong evidence for hypertension and cardiovascular diseases (Figure 4).
Figure 4: Mercury symptoms in human health

REFERENCE:

CHAPTER 9 Environmental health issues

Part 3: Ozone depletion

Introduction

Ozone consists of simple molecules of three Oxygen atoms that bound together. It has different effects depending upon its location. In the earth surface where ozone comes into direct contact of life forms, it displays a destructive side due to strong reaction with other molecules, meanwhile; at higher altitudes, it does remarkable job of absorbing ultraviolet radiation emit from the sun. Ozone can be destroyed by number of free radical catalyst which occurs both naturally and man-made source, the most important of which are hydroxyl radical (OH-), the Nitric Oxide radical (NO-), atomic chlorine ion (Cl-) and atomic Bromine ion (Br-). These elements are found in certain stable organic compounds, especially Chlorofluorocarbons (CFCs).

The Stratosphere and Ozone layer

The ozone layer is a concentration of ozone molecules that naturally occur in the Stratosphere. The Stratosphere is the next higher level than the Earth atmosphere, troposphere that is surrounds us. It was about 10 to 50 kilometers above the Earth’s surface. In the Stratosphere the temperatures increases slightly with altitude and the highest temperature is 0°C. Ozone is produced when O 2 absorbs UV radiation at wavelengths of less than 242 nanometers, and is removed by photo-dissociation from sunlight for wavelengths greater than 290nm. The combination of these processes is effective in maintaining a relatively constant amount of ozone in the layer, and in absorbing 90% of UV sunlight.

Importance of Ozone Layer

The ozone layer absorbs much of the incoming solar ultraviolet radiation (UVR) and thus offers substantial protection from this radiation to all organisms living at, or near to, Earth’s surface. The maintenance of enough stratospheric ozone to absorb harmful UV sunlight is therefore vitally important to all life forms on earth.

Picture 1: Different layers of the Atmosphere
(source:http://ds9.ssl.berkeley.edu/lws_gems/3/layers.htm)
Ozone hole

There is 'hole' that is gradually thin at the Antarctic ozone of the ozone layer between particular altitudes over Antarctica that is caused by a springtime. Such thinning has been detected each year for the past decade. Formation of the 'hole' occurs each September and recovery to 'normal' conditions occurs in late spring or early summer. Nowadays, there is widespread concern due to ozone layer deteriorating that is cause by the release of pollution containing the chemicals Chlorine and Bromine. The ozone deterioration will allows large amount of ultraviolet to reach earth which can cause harm in humans and animal as well. According to a United Nations report, the annual dose of harmful ultraviolet radiation striking the northern hemisphere rose by 5 percent during the past decade. The combination of weather conditions and ozone-depleting substance create the thinnest ozone levels in the sky above the South Pole. A worldwide monitoring has shown that stratospheric ozone has declined for at least two decades, with losses of about 10 percent in the winter and spring and 5 percent in the summer and autumn in such diverse locations as Europe, North, America and Australia. Researchers also found the depletion over the North Pole is getting worse year by year. All in all, there appear to be two major reasons for the 'hole' the worldwide observed increases of CFCs detected throughout the atmosphere, and the unique wintertime meteorological environment over Antarctica. Between particular altitudes above Antarctica, the very cold stratospheric temperatures allow ice crystals clouds to form.

➢ Statistic of ozone hole (1979-2006)

Graph1: shows the size of the Ozone hole over the Antartic continent through the years of 1979-2009.

(Source: NASA)

Picture 2: False-color view of total ozone over the Antarctic pole on October 2012. The purple and blue colors are where there is the least ozone, and the yellows and reds are where there is more ozone. (Source: NASA)
The causes of Ozone depletion

Scientific evidence indicates that stratospheric ozone is being destroyed by “Ozone-depleting Substance” (ODS), a group of manufactured chemicals which containing Chlorine and/or Bromine. ODS are very common, stable, nontoxic and environmentally safe in the lower atmosphere. However, their stability allows them to suspended and intact to the stratosphere. Ultraviolet light broke them to release chlorine and bromine that demolish ozone at an alarming rate by stripping an atom from the ozone molecule. It was suggest that a single molecule of chlorine can break apart thousands molecules of ozone. Besides, ODS have a long life time that can be up for several centuries in the atmospheres and will add to the ozone destructions.

The main ODS are Chlorofluorocarbons (CFCs), hydrofluorocarbons (HCFCs), Carbon tetrachloride and methyl chloroform. Halons also play a large role and can destroy ozone up to 10 times as much as CFCs can but their application is quite limited. Scientist have developed Hydrofluorocarbons (HFCs) to replace CFCs and HCFCs for air conditioning application as it do not deplete ozone, but they are strong greenhouse gases that even more powerful contributors to global climate change. However, HFCs are still the better option until even safer substitutes are discovered.

The Montreal Protocol

The Montreal Protocol is an international treaty of a protocol to Vienna Convention for the Protection of the Ozone Layer designed to protect the ozone layer by phasing out the production of numerous substances believed to be responsible for ozone depletion. The treaty was opened for signature on September 16, 1987, and entered into force on January 1, 1989, followed by a first meeting in Helsinki on May 1989. Currently over 180 countries are parties to the Montreal Protocol. This protocol was issued due to fears of ozone depletion cause by human activities that first emerged in the late 1960s was made a decade of denial and debate followed with eventual acceptance by scientists and policy-makers that ozone depletion was likely to occur and would represent a global environmental crisis.

The protocol was tightened further in the 1990s. the first modification suggested the solution to this particular global environmental change appears by a substitution of particular industrial and agricultural gases for others with low risk substances such as HFCs. However, the problem has not yet been definitely solved. First, it was due to there is a large range of human-made ozone-destroying gases, including some of those chemicals developed to replace the early CFCs. Second, compliance with the international agreement remains patchy. Third, scientists did not foresee the interplay between a warming lower atmosphere and an ozone-depleted stratosphere. Nevertheless, scientists anticipate that there will be slow but near-complete recovery of stratospheric ozone during the middle third of the twenty-first century. Recently, there is evidence that The Montreal Protocol is working as
the effects shows the decrease of atmospheric burden of ozone-depleting substances and some early signs of stratospheric ozone recovery.

Main types of health impacts

There is a range of certain or possible health impacts of stratospheric ozone depletion (Table 1). Many epidemiological studies have implicated solar radiation as a cause of skin cancer in fair-skinned human. There are several assessments was projected that showed the significant increases in skin cancer and skin cancer incidence due to ultraviolet radiation exposure. The high intensity of ultraviolet ray exposure also will damage the eye’s outer tissue causing “snow blindness”, the ocular equivalent of sunburn. Besides, the experimental study in humans and experimental animals on exposure to UVR found both local and whole-body immunosuppression. Finally, there is an ecological factor to be considered as UVR impairs the molecular chemistry of photosynthesis on land as well as at sea. This could affect world food production and thus contribute to nutritional and health problems in food-insecure populations.

However, the effect of solar radiation on human health depends on the amount and type of radiation impinging on the body. This in turn depends on, firstly, the concentration of atmospheric ozone that is available to absorb ultraviolet radiation, particularly UVB. Next, the amount and spectral structure of radiation reaching the body is dependent on the angle at which the sun’s rays pass through the atmosphere – at low latitudes (closer to the equator) there is more intense solar UVR with a greater proportion of shorter wavelengths, related to the low angle of incidence of the incoming radiation. This strongly influences biological activity. Increasing altitude increases UVR intensity by decreasing the air mass through which solar radiation must pass. Similarly, time of day and season as well as presence of clouds, dust, haze and various organic compounds can alter the intensity of incident solar radiation. Variations in cloud cover usually reduce ground level UVR, although this effect is highly variable, depending on the characteristics of the cloud itself. Indeed, cloud cover can result in increased ground level UVR if both direct sunlight and light scattered from clouds, reach the earth’s surface

![Web causal for Health Impact due to UVR (Lucas,2006)]
Table 1: Summary of possible effects of solar ultraviolet radiation on the health of human beings

<table>
<thead>
<tr>
<th>Systems</th>
<th>Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skin</td>
<td>• Malignant melanoma</td>
</tr>
<tr>
<td></td>
<td>• Non-melanocytic skin cancer—basal cell carcinoma, squamous cell</td>
</tr>
<tr>
<td></td>
<td>carcinoma</td>
</tr>
<tr>
<td></td>
<td>• Sunburn</td>
</tr>
<tr>
<td></td>
<td>• Chronic sun damage</td>
</tr>
<tr>
<td></td>
<td>• Photodermatoses</td>
</tr>
<tr>
<td>Eye</td>
<td>• Acute photokeratitis and photoconjunctivitis</td>
</tr>
<tr>
<td></td>
<td>• Climatic droplet keratopathy</td>
</tr>
<tr>
<td></td>
<td>• Pterygium</td>
</tr>
<tr>
<td></td>
<td>• Cancer of the cornea and conjunctiva</td>
</tr>
<tr>
<td></td>
<td>• Lens opacity (cataract)—cortical, posterior subcapsular</td>
</tr>
<tr>
<td></td>
<td>• Uveal melanoma</td>
</tr>
<tr>
<td></td>
<td>• Acute solar retinopathy</td>
</tr>
<tr>
<td></td>
<td>• Macular degeneration</td>
</tr>
<tr>
<td>Immunity and infection</td>
<td>• Suppression of cell mediated immunity</td>
</tr>
<tr>
<td></td>
<td>• Increased susceptibility to infection</td>
</tr>
<tr>
<td></td>
<td>• Impairment of prophylactic immunization</td>
</tr>
<tr>
<td></td>
<td>• Activation of latent virus infection</td>
</tr>
<tr>
<td></td>
<td>• tuberculosis</td>
</tr>
<tr>
<td></td>
<td>• possible decreased risk for schizophrenia, breast cancer, prostate</td>
</tr>
<tr>
<td></td>
<td>cancer.</td>
</tr>
<tr>
<td>Other effects</td>
<td>• Cutaneous vitamin D production</td>
</tr>
<tr>
<td></td>
<td>• Non-Hodgkin's lymphoma</td>
</tr>
<tr>
<td></td>
<td>• Altered general well-being</td>
</tr>
<tr>
<td>Indirect effects</td>
<td>• Effects on climate, food supply, infectious disease vectors, air</td>
</tr>
<tr>
<td></td>
<td>pollution, etc.</td>
</tr>
</tbody>
</table>

(Source: Stratospheric Ozone Depletion, Ultraviolet radiation and Human Health (A.J. McMichael))

REFERENCES


CHAPTER 7 Environmental health issues

Part 4: Haze

Introduction

Haze is defined as the presence of fine particles (0.1 - 1.0 \textmu m in diameter) dispersed at a high concentration through a portion of the atmosphere that diminishes the horizontal visibility, giving the atmosphere a characteristic opalescent appearance (MMS, 1995). We can see the haze in our city skyline is caused by tiny particulates suspended in the atmosphere. Haze is not confined to urban environment in fact it may also be observed in rural areas. Haze is caused when sunlight encounter tiny pollution particles in the air. Particles, which are of respirable sizes, are of concern because of their negative effect on health, as well as their other environmental impacts. Particles<10 \textmu m can affect meteorological processes (visibility and solar radiation), and they can be involved in chemical reactions in the atmosphere producing secondary pollutants (EPA, 2012).

Often, haze is confused with mist and fog. During the early morning or after rain showers when temperatures are low and humidity is high, mist and sometimes fog forms in valleys and lowlands, gradually clearing when the sun reappears. Mist and fog are formed as a result of the condensation of water vapour on particulates suspended in the atmosphere. Meteorologically, mist is defined as being present if diminished visibility occurs (with no other weather condition being present) and relative humidity of the atmosphere at the surface of the earth is above 95%. When the horizontal visibility falls below 1000 metres the phenomenon is classified as fog (Malaysia Meteorology Department, 2012).

Haze in Malaysia

Episode of bad air pollution is not only happens in countries mentioned above, but also occur in Malaysia. Haze is a condition that can be seen as the result of rapid development and increased in industrial activities. The haze that is seen in the air is caused by particulates or fine particles that cannot be seen by naked eye that are suspended in the atmosphere in high concentration. Haze is happens when sunlight encounters tiny pollution particles in the air. Some light is absorbed by particles. More pollutants lead to more absorption and scattering of light, which reduce the clarity and colour of what we see. Some types of particles, such as sulphates scatter more light, especially during humid conditions.

In the year 2005, there has been week-long choking smog-like haze occurs over Malaysia. The haze was at its worst on August 11, 2005 and it is a comeback of the haze crisis which last hit Malaysia in September 1997. The haze is caused by “hotspot” (zone with high temperature levels as seen through satellite image) in Malaysia and Indonesia. Lingering smoke from forest fires on the Indonesian island of Sumatra is identified as the primary cause of the haze. Land clearing for agricultural purpose is the cause of forest fire where the farmers are regularly burn the scrub and forest.

On August 11, 2005, the air quality in the Malaysian capital city of Kuala Lumpur is so poor and citizens have been advised to stay at home with doors closed. Some schools are also closed to keep children from being exposed to the haze. A state of emergency is announced at Port Klang and the district of Kuala Selangor after air pollution there reached dangerous level (defined as a value greater than 500 on the Air Pollution Index or API). This is the first time the state of emergency is imposed in Malaysia since the September 1997 haze, when Sarawak is placed in a state of emergency due to similar reason. After the API levels dropped to an acceptable level, the state of emergency is later removed on August 13.

By August 13, air quality and visibility returned to normal in Kuala Lumpur, as the haze moved northwards to the state of Perlis, Kedah and Penang, according to the Department of Environment (DOE) API reading. On August 16, air quality throughout Malaysia had returned to normal according to DOE statistics, as the haze is blown further northwards into Thailand.
Review Several Haze Episode in Malaysia

In Malaysia, haze was reported as unhealthy in the Klang Valley since 1980s. The haze phenomenon in the Klang Valley region is an important and serious problem. Unusually thick haze, which occurred during September 1982 was the first to attract a great deal of public attention and to be extensively reported in the local media. The Malaysia Meteorology Service (MMS) reported these haze episodes which occurred during April 1983, August 1990, June 1991, October 1991, August to October 1994 and August to October 1997. In the Klang Valley region there are two kinds of haze which are shallow localized haze and dense haze. Recently, Malaysia again shocked by the worst haze in June, 2012. Haze returned to Malaysia again because of forest fire in neighbouring Indonesia blanketed parts of Malaysia including the capital causing air pollution to hit unhealthy levels. The Air Pollutant Index reached 127 in the capital Kuala Lumpur, 144 in Port Klang, the Southeast Asian country’s top port and 129 in the township of Shah Alam. Readings of 101-200 are considered unhealthy (DOE, 2012).

During August 1990, Klang Valley was reported to have hazy conditions during the period from the 15th to the 30th of August 1990, with the worst conditions persisting from the 20th to 30th of August. The high concentration of suspended particles in the atmosphere found to persist during a dry spell in August 1990, and there were numerous reports of open burning in Selangor, Negeri Sembilan. A study has found concluded that a persistent supply of haze particles from sources coupled with the surface inversion associated with the dry spell, light surface, and the nature of the topography resulted in the haze particles being trapped the Klang Valley. (SHAM et al., 1991). However, the mountain range in Peninsular Malaysia acts as a barrier preventing the dispersion of haze particles from the Klang Valley. Also, the sinking air currents from the return flow (from the west) at levels between 1500 m and 3000 m of land-breeze circulation in the early morning acted as another factor contributing to the entrapment of haze particles in the Klang Valley.

( Source: News Straits Time, 1997)

During October 1991, The Klang Valley was reported to experience haze conditions during much of October 1991. The haze episode occurred during a relatively dry period of the year resulting in poor visibility and disruption of flight schedules; this haze was considered to be the most severe and persistent to date in the Klang Valley. The reason for the high concentration of suspended particles was reported to be intrusion of particulates arising from forest fires in Indonesia brought over by the southerly winds. The continual influx of particulates had made it very difficult for the atmosphere to effectively disperse and dilute the particles. According to Malaysian Meteorological Department (1990) has found that there has severe haze condition mainly resulted from smoke which was transported from forest fires in Sumatra and Kalimantan, and aggravated by local emissions from vehicles and industry.

August-October 1994, Malaysia again has shocked regarding haze episode. Hazy conditions were first observed over the northwestern states of Peninsular Malaysia and over the Klang Valley in early July. These conditions persisted throughout July with hazy conditions spreading across the central states in early August. The haze conditions worsened towards the middle of August in the central and southern states, and persisted with further deterioration into a dense haze condition in September and early October. Haze recurred in southern Peninsular Malaysia from October 21st and cleared towards the end of the month (MMS, 1995). In its report on air quality, MMS (1995) reported
that the haze occurred, as usual, during the relatively dry period during the months of July to September of the southwest monsoon season (Aiman, 2001).

Haze Particles - Their Origin

The particles that cause the haze phenomenon can originate from many sources, some of which are natural and some anthropogenic. Natural sources include the oceans, forests and ground surface. However, the majority of the particulates are from human activities which include open burning, land clearing, vehicular use and combustion of fossil fuels in industrial boilers. In the tropics, wind speeds are generally low. During certain periods of the year, particularly during the Southwest Monsoon season, the atmosphere is very stable and horizontal as well as vertical air movements are reduced. The subsiding air mass does not favor active cloud development, thus the weather is dry. Several factors such as prolonged dry weather, a stable atmosphere, and an abundant supply of pollutants from urban or rural sources are the ideal ingredients for the formation of haze. Particulates emitted into the atmosphere are trapped within the stagnant air mass causing the particulate concentration to increase thus producing a hazy condition. In Peninsular Malaysia, haze is most likely to occur during the months from January to February and June to August.

Health effect of Haze

The health effects of haze are mainly caused by the irritant effects of fine dust particles on the nose, throat, airways, skin and eyes. The health effects of haze will depend on its severity as measured by the Pollutants Standards Index (PSI). There is also individual variation regarding the ability to tolerate air pollution. Most people would at most experience sneezing, running nose, eye irritation, dry throat and dry cough from the pollutants. They are mild and pose no danger to the health of the general population. However, persons with medical problems like asthma, chronic lung disease, chronic sinusitis and allergic skin conditions are likely to be more affected by the haze and they may experience more severe symptoms. Children and the elderly in general are more likely to be affected. For some, symptoms may worsen with physical activities. For persons under medical treatment, it is important that they take their medication regularly. Persons with chronic heart and lung problems are advised not to engage in outdoor sporting activities if the PSI is above 100. There is otherwise no need to take extraordinary precautions. Air pollution is a major environmental risk to health. By reducing air pollution levels, it can help countries reduce the global burden of disease from respiratory infections, heart disease, and lung cancer. The lower the levels of air pollution in a city, the better respiratory (both long- and short-term), and cardiovascular health of the population will be. (WHO, 2012) A selection of important health effects linked to specific pollutants is summarized in Table 1.
Table 1. Important health effects associated with exposure to different air pollutants.

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Effects related to short-term exposure</th>
<th>Effects related to long-term exposure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Particulate matter</td>
<td>• Lung inflammatory reactions&lt;br&gt;• Respiratory symptoms&lt;br&gt;• Adverse effects on the cardiovascular system&lt;br&gt;• Increase in medication usage&lt;br&gt;• Increase in hospital admissions&lt;br&gt;• Increase in mortality</td>
<td>• Increase in lower respiratory symptoms&lt;br&gt;• Reduction in lung function in children&lt;br&gt;• Increase in chronic obstructive pulmonary disease&lt;br&gt;• Reduction in lung function in adults&lt;br&gt;• Reduction in life expectancy, owing mainly to cardiopulmonary mortality and probably to lung cancer</td>
</tr>
<tr>
<td>Ozone</td>
<td>• Adverse effects on pulmonary function&lt;br&gt;• Lung inflammatory reactions&lt;br&gt;• Adverse effects on respiratory symptoms&lt;br&gt;• Increase in medication usage&lt;br&gt;• Increase in hospital admissions&lt;br&gt;• Increase in mortality</td>
<td>• Reduction in lung function development</td>
</tr>
<tr>
<td>Nitrogen dioxide</td>
<td>• Effects on pulmonary function, particularly in asthmatics&lt;br&gt;• Increase in airway allergic inflammatory reactions&lt;br&gt;• Increase in hospital admissions&lt;br&gt;• Increase in mortality</td>
<td>• Reduction in lung function&lt;br&gt;• Increased probability of respiratory Symptoms</td>
</tr>
<tr>
<td>Sulphur dioxide (SO₂)</td>
<td>• Adverse effects on pulmonary function&lt;br&gt;• Increase in hospital admissions&lt;br&gt;• Increase in mortality</td>
<td>• Reduction in lung function&lt;br&gt;• Increased probability of respiratory Symptoms</td>
</tr>
<tr>
<td>Carbon monoxide</td>
<td>• Lung inflammatory reactions&lt;br&gt;• Increase in hospital admissions&lt;br&gt;• Increase in mortality</td>
<td>• Reduction in lung function&lt;br&gt;• Damage at cellular level&lt;br&gt;• Increased probability of respiratory, CNS, Endocrine</td>
</tr>
</tbody>
</table>

(Sources: Environmental Protective Agency, 2012)

Precaution Step during Haze

During a prolonged haze period when the air quality is poor, you can take the following precautions to protect yourself (WHO, 2012):

- Minimize outdoor activities, especially outdoor sports.
- When you need to go outside, wear a face mask.
- Close all windows and openings that may allow haze to enter your home or office.
- If you are staying in a building with a central air conditioning system, install an air cleaning device to reduce the amount of air contaminants in your building.
- At home, use a portable air purifier to keep the particulate levels low.
- Fine particles can enter an air-conditioned building through the fresh air intake and by infiltration through openings and gaps. Keep your air-conditioner in tip-top working condition with regular cleaning and servicing.

**Regional and global effects**

1. Acidification caused by acid rain (acidic compounds formed in the atmosphere from emitted sulphur and nitrogen oxides)

2. Formation of photochemical oxidants resulting in elevated concentrations of ozone in the troposphere (which may affect forestry and agriculture and also contribute to the formation of photochemical smog);

3. Global warming: the earth climate is influenced by the sun. Most of the sun’s energy known as solar radiation is absorbed by the earth, but some is reflected back into the space. A layer of atmospheric gases known as greenhouse gases absorbs a portion of the reflected solar
radiation, releasing some of it into the space but bring much of it back to earth and it then warms the earth. This is known as “greenhouse effect”.

The greenhouse effect is being increased by the release of certain gases to the atmosphere that causes the earth’s temperature to rise. Carbon dioxide (CO₂) comprises of 85% of greenhouse gases and it is due to the combustion of fossil fuels in electric power generation. Methane (CH₄) emissions which result from agricultural activities, landfills, and other sources and the second largest contributor to greenhouse gases.

Ozone is produced naturally in the stratosphere. It protect people, animals, plants and other living things by absorbing most of the sun’s harmful ultraviolet radiation, which can lead to more cases of certain types of skin cancer and cataracts and can harm crops and ecosystem. But this “good” ozone is gradually being destroyed by man-made chemicals referred to as ozone-depleting substances (ODS), including chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFC’s), halons, methyl bromide, carbon tetrachloride, and methyl chloroform. These substances were formerly used and sometimes are used in coolants, foaming-agents, fire extinguishers, solvents, pesticides, and aerosol propellants.
CHAPTER 9 Environmental health issues

Part 5: Cancer

Introduction

Cancer is in a group of diseases which characterized by abnormal growth of cells with its ability to invade adjacent tissues and even distant organs. The eventual death of the affected patient if the tumor has progressed beyond that stage. The carcinogenesis holds cancer cells arise from accumulation of many small alterations in DNA of normal cells. These small alterations, or mutations are combined and begin to grow in an abnormal as a hallmark of cancer. Cancer is a condition that results from abnormal cellular DNA (Figure 1). It is a condition wherein cells mutate and increase number, with changes in their morphology and without any function. Cancer cells compete with normal cells for sustenance from the blood, kill healthy tissue and deprive them of nutrition. In the long run, cancer cells cause cellular malignancy, nutritional deficiencies, and ultimately, death.

Figure 1: Cancer cells

Environmental factor: Causes of Cancer

Environmental factors that influence development of cancer are diverse in its broadest sense. Thus, a central concept in understanding of cancer is that it does not arise from a single event, but results from many changes of potential cancer-causing agent. Potential cancer-causing agents are from outdoor air, water, soil, diets, tobacco smoke, alcohol, home and workplace environments, certain infectious agents, some medical therapies and physiological factors (Figure 2). Physiological factors, including hormones can also influence cancer development.
1. **Tobacco**
Cigarettes contain hundreds of carcinogens and other harmful chemicals. Cigarette smoke as well as second-hand smoke increases risk of cancers of lungs, oral cavity, lips, esophagus, and larynx. Smokers who inhale the smoke have an increased risk of lung cancer as the smoke reaches the lungs. Recent studies showed that second-hand smoke particles become active in surfaces for days and inhaling near these surfaces also carries carcinogens into the system.

2. **Diet**
Studies conducted showed that a diet high in nitrates (processed foods), benzopyrenes (grilled foods), alcohol, red meat and fat tend to increase cancer risk. Moreover, a diet low in vegetables and other greens significantly increase the risk for colon cancer.

3. **Physical Activity**
Inactive lifestyle contributes to obesity as much as development of cancer. Thus, it is crucial to control weight in order to avoid such problems. It is recommended to have at least 150 minutes of non-vigorous or 75 minutes of vigorous exercise per week.

4. **Sun and UV Exposure**
Sunlight and ultraviolet radiation increase cancer and melanomas risks. Ultraviolet light alters DNA of cells and causes malignancies if not controlled by the immune system.

5. **Occupational factors**
Many of the links between cancer and environmental occupational studies have been established. Community-based cancer surveillance is currently developing as a tool to identify occupational causes of cancer, however, it is one of the most difficult challenges in public health. Exposure data for chemical carcinogens in the workplace are also difficult to obtain. Employers are required to have lists of all hazardous substances used on the premises and workers usually receive training in how to safely handle these substances.
6. Other Carcinogens

Certain drugs, viruses, chemicals, pollution, and infectious agents are carcinogens. These carcinogens have the potential to cause malignancy and cancer (Figure 1). It is important to live in a clean environment to be able to avoid these triggers.

![Cancer stem cells diagram](image)

**Figure 1:** Stem cells in normal development, tissue homeostasis, and carcinogenesis

**REFERENCES**

ISO14000 & Environmental Management System

The ISO 14000 family addresses various aspects of environmental management. It provides practical tools for companies and organizations looking to identify and control their environmental impact and constantly improve their environmental performance. ISO 14001:2004 and ISO 14004:2004 focus on environmental management systems (Table1). ISO 14001 is an internationally recognized standard for the establishment of an organization's environmental management system. The standard requires the organization to systematically identify and manage the environmental aspects and impacts resulting from its activities, products and/or services. ISO 14004:2004 provides guidance on the establishment, implementation, maintenance and improvement of an environmental management system and its coordination with other management systems. The other standards in the ISO 14000 family focus on specific environmental aspects such as life cycle analysis, communication and auditing.

ISO14001 is the cornerstone standard of the ISO 14000 series. It specifies a framework of control for an Environmental Management System against which an organization can be certified by a third party. ISO14004 provides guidance on the development and implementation of environmental management systems (Figure 1).
Table 1: ISO 14000 family  
Source: Zhang et al. (2000)

<table>
<thead>
<tr>
<th>Document no.</th>
<th>Title</th>
<th>Publication</th>
</tr>
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<tbody>
<tr>
<td>ISO 14010</td>
<td>Guidelines for Environmental Auditing – General Principles on Environmental Auditing</td>
<td>1996</td>
</tr>
<tr>
<td>ISO/WD 14015</td>
<td>Environmental Aspects of Sites and Entities</td>
<td>1998</td>
</tr>
<tr>
<td>ISO 14020</td>
<td>Environmental Labels and Declarations – General Principles</td>
<td>1999</td>
</tr>
<tr>
<td>ISO/DIS 14031</td>
<td>Environmental Performance Evaluation</td>
<td>1999</td>
</tr>
<tr>
<td>ISO TR 14032</td>
<td>Environmental Performance Evaluation – Case studies illustrating the use of ISO 14031</td>
<td>1999</td>
</tr>
<tr>
<td>ISO 14040</td>
<td>Life Cycle Assessment – Principles and Guidelines</td>
<td>1997</td>
</tr>
<tr>
<td>ISO 14041</td>
<td>Life Cycle Assessment – Life Cycle Inventory Analysis</td>
<td>1998</td>
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<tr>
<td>ISO/CD 14042</td>
<td>Life Cycle Assessment – Impact Assessment</td>
<td>1999</td>
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<tr>
<td>ISO/DIS 14043</td>
<td>Life Cycle Assessment – Interpretation</td>
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</tr>
<tr>
<td>ISO/TR 14048</td>
<td>Life Cycle Assessment – Life cycle assessment data documentation format</td>
<td>1999</td>
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<tr>
<td>ISO/TR 14049</td>
<td>Life Cycle Assessment Examples for the application of ISO 14041</td>
<td>1999</td>
</tr>
<tr>
<td>ISO 14050</td>
<td>Environmental Management – Vocabulary</td>
<td>1998</td>
</tr>
</tbody>
</table>

Environmental Management System (EMS) is a management of an organization's environmental programs in a comprehensive, systematic, planned and documented manner. Overall, EMS is defined as management procedures to improve operations and environmental impacts of organization. EMS uses interconnected procedures to ensure that best management practices are consistently used within any part of an organization to reduce environmental impacts. Elements of EMS are built based on Plan, Do, Check and Act (Figure 1). There are seventeen points needed in an EMS cycle (Figure 1).

Figure 1: Key elements of EMS

**PLAN**

1. Develop an environmental policy and a statement of the organization's commitment to the environment. This policy will act as framework for planning and action.
2. Environmental aspects. Identify environmental attributes of products, activities and services and determine which ones have significant impacts on the environment.
3. Legal and other requirements. Identify and learn relevant laws, regulations and other requirements that the organization needs to be in compliance.
4. Objectives and targets. Establish environmental goals according to the organization's environmental policy and impacts and the interest of other organization.
5. Environmental management program. Plan the roadmap that is necessary to accomplish objective and targets.

**DO**

6. Structure and responsibility. Establish roles and responsibilities and provide suitable resources.
7. Training, awareness and competence. Make sure everyone in the organization has the training and the capability to fulfill their environmental responsibilities.
8. Communication. Establish processes for internal and external communications on environmental management issues.
9. EMS documentation. Maintain documentation of the EMS.
11. Operational control. Identify, plan and manage your operations and activities in line with your policy, objective and targets.
13. Monitoring and measurement. Monitor selected activities to track performances and assess compliances with laws and regulations periodically.

14. Nonconformance and corrective and preventive action. When a nonconformance occurs, correct and implement corrective actions to prevent future occurrences.


16. EMS audit. Verify regularly whether or not the EMS is working as planned.

**ACT**

17. Management review. Periodically review your EMS with an eye to continual improvement.

International Organization for Standardization (ISO) is the world's largest developer and publisher of international standards. This organization promulgates worldwide patented, industrial and commercial standards. Headquarters of ISO are located in Geneva, Switzerland. For Malaysia, Department of Standards Malaysia (DSM) is mandated by The Malaysian Government to function as the National Standards Body (NSB) and National Accreditation Body (NAB) through Standards of Malaysia Act 1995 (Act 549). DSM vision is to lead the nation to be an effective global player in Standards and Accreditation in consonance with Malaysia's Vision 2020. DSN promotes standardization and accreditation as a means of

- Advancing the national economy
- Benefiting the health, safety and welfare of the public
- Protecting the consumers
- Promoting industrial efficiency and development
- Facilitating domestic and international trade and further international cooperation

**How ISO decides to develop a standard**

Experts from the industrial, technical and business sectors which have asked for the standards, and which subsequently put them to use. This is joined by representatives of government agencies, testing laboratories, consumer associations, non-governmental organizations and academic circles.

An International Standard is the result of an agreement between the member bodies of ISO. It may be used as such, or may be implemented through incorporation in national standards of different countries. International Standards are developed by ISO technical committees (TC) and subcommittees (SC) by a six-step process:

- Stage 1: Proposal stage
- Stage 2: Preparatory stage
- Stage 3: Committee stage
- Stage 4: Enquiry stage
- Stage 5: Approval stage
- Stage 6: Publication stage

**Corporate Environmentalism**

There are two facets of corporate environmentalism namely orientation and strategies. Environmental orientation is recognition by managers of the importance of environmental issues facing their firms. On the other hand, environmental strategy is the extent to which environmental issues are integrated with a firm's strategic plans (Figure 2).

Internal environmental orientation reflects a company's internal values, standards of ethical behavior, and commitment to environmental protection. External environmental orientation refers to the aspects of a firm's environmental orientation that affect its relationships with external constituencies, such as financial or community stakeholders. Environmental strategy is divided into four levels which are enterprise, corporate, business, and functional strategies. Enterprise strategy speaks to the fundamental mission of the firm and its role in society, and few businesses show evidence of having integrated environmental concerns at this level. Corporate strategy pertains to the
kinds of businesses a firm should enter to meet its enterprise strategy goals. Strategies leading to product differentiation or targeting niche markets exemplify business environmental strategies, whereas modifying operating procedures within different functions, such as advertising or sales, is typical of functional environmental strategies. Thus, corporate environmentalism is defined as the recognition of the importance of environmental issues facing firm and integration of those issues into the firm’s strategic plans.

Figure 2: Key elements of Corporate Environmentalism

REFERENCES


