Chapter 13

Environment and health / Ecohealth

Learning objectives

You will be able to gain proper understanding and explain:

- What makes environment important for health of humans and survival of life.
- What effects each has on the health and lives of humans with several examples each of physical, chemical, biological, and cultural/psychosocial environments.
- The relationship between an environmental factor and human health based on its dose-response relationship.
- Through group work, and giving presentations, what impacts Cambodia's social and economic development has on the health of ecosystems, people's lives and main occupations (livelihood), and human health.

This chapter will discuss the effects environment has on human health, focusing on each of the following: categories of environmental factors as health risks; health effects of environmental pollution; the relationship between exposure levels and biological reaction; and environmental health issues of Cambodia addressed using an ecological health approach (loss of mangroves, deforestation and declining biodiversity, soil degradation, water pollution, vulnerability to climate change and natural disasters, landmines and unexploded ordnance, and deteriorating urban environment).

1. Importance of environmental health

First, we will look at what environmental health is and why it is important for human health. There are different definitions of "environmental health;" according to WHO:[1]

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

Human health and quality of life are determined by physical, chemical, social, and psychosocial factors that are present in the environment. The prevention of illnesses and disabilities, therefore, calls for theories and practices to assess, correct, and control these environmental factors.

This means that, in the context of school health, **environmental health** provides educational opportunities for children to gain a deeper understanding about the environment, learn about risk factors in the environment that cause human illnesses and disabilities and about present-day environmental issues, and think, together with teachers, about what can be done to maintain and improve the health and quality of people's lives in Cambodia as well as other countries.

What makes it important to address environmental health? According to WHO estimates, an unhealthy or unsanitary environment was responsible for as much as 23% of total global mortality or 12.6 million deaths worldwide, and for 26% of deaths in children younger than 5 years in 2012, which indicates that the environment has a large impact on human health.[2] Of the environmental factors, **environmental pollution** is the largest environmental cause of diseases and **premature deaths**. Diseases caused by environmental pollution were responsible for an estimated 9 million premature deaths or 16% of all deaths worldwide in 2015; this is estimated to be three times more deaths than from AIDS, tuberculosis, and malaria combined, and 15 times more than from all wars and other forms of violence.[2] It is evident that polluted environments significantly affect human health.

Among the different forms of environmental pollution, those of particular concern are **outdoor and indoor air pollution, water pollution, soil and food contamination by pesticides and other chemicals, and toxic/hazardous occupational exposure**. It should be noted that, compared to high-income countries, pollutants cause greater harm to the environment and human health in low- and middle-income countries, particularly pregnant women, fetuses, and infants, poor and minority populations, and residents of rural areas who make a living from agriculture and fisheries.[2] As a result of globalization, foreign capital seeking to secure food is making inroads into the agricultural and fishery industries of low- and middle-income countries, causing pollution of soil and waterways/groundwater through coastal development, deforestation, and use of pesticides/insecticides. In recent years, many countries are experiencing a concentration of population in cities, bringing global attention to the deterioration of urban environments such as vehicular exhaust and greenhouse gas emissions, domestic sewage pollution of rivers, and treatment of large quantities of waste. Cambodia is no exception. Though different countries and regions may face different pollutants, environmental pollution presents a major risk to the health of humans.

In low- and middle-income countries, including Cambodia, however, **environmental monitoring systems** are not well established yet, and few data are available on environmental pollution and other environmental issues. Building a system to gather and analyze environmental data is an undertaking that is necessary to promote effective environmental health measures. In the context of school health, providing **environmental health education** and **Ecohealth education** is a key to ensure understanding of the relationship between environment and ecosystems, human health, and social development.

2. What is an environment?

What does **environment** refer to, exactly? Living organisms are surrounded by many different conditions, objects, or circumstances of the external world, which are what constitutes the **environment**.[3] For the purpose of this chapter, "environment" refers to that for humans, namely the conditions, objects, organisms, and circumstances of the external world that surround humans. While the external world that surrounds humankind is a limitless expanse, like outer space, we primarily discuss the **biosphere** (i.e., the life-supporting parts that extend around the Earth including the layers on and under the ground, the

atmosphere, and the hydrosphere; a sum of ecosystems where living and non-living things interact), and limit our discussion at most to the extent to which humankind has thus far reached into outer space. That being said, we may need to take certain other things into consideration, such as the sun and meteorites; humankind has not reached the sun, and yet it has tremendous influence over the Earth, while a meteorite can cause major climate or environmental change or disasters if it hits the Earth, which makes meteorites something that we may not be able to ignore for their influence over our environment and health.

Of the biosphere that is the **Earth's environment**, environments and ecosystems relevant to the quality of life and well-being of human will be discussed in this chapter (see Chapter 1 for a definition of health).

3. Human survival and the Earth's environment

Now, why is the **Earth's environment** important for us? As we all know, it is because it is the environment that possesses all the conditions that have made it possible for life (including humans) to begin, evolve, and prosper as humankind does today. These conditions, for instance, include at the very least: the atmosphere; water; food; stable climates; protective layers that shield against harmful cosmic rays and radiation; biological diversity; and adequate supply of thermal energy from the sun. These are the conditions that are indispensable for life activities of organisms, which means that if these conditions of the Earth's environment are disrupted, it poses a threat to the health, or even the survival, of humans.

One grave issue that have faced in recent years is the fact that human activities can cause environmental destruction, which threatens human health and survival. In particular, it is our short-sighted activities in pursuing immediate economic interest and social utility. In fact, it has been pointed out that some ancient civilizations collapsed as a result of serious environmental issues. One example is Easter Island, known for its giant stone statues. It has been established that the civilization on the island collapsed because its inhabitants harvested its scarce forest resources to build roads to transport the stone statues to various ritual platforms across the island, which resulted in soil sliding and erosion, making it impossible to produce enough food to sustain its population.[4] Japan, in its effort to bounce back from its defeat in World War II, pursued a ten-year plan to double its national income starting in 1961 and promoted rapid industrialization, ultimately achieving spectacular economic growth. Behind these accomplishments, however, the nation suffered a tragedy; hazardous substances spewed from factories and polluted the environments and ecosystems, which destroyed the health of people in the communities, as represented by what are known as **the four big pollution diseases of Japan**, namely Minamata disease, Yokkaichi asthma, Itai-itai disease, and Niigata Minamata disease.[5]

What conditions, circumstances, or substances that are present in environments affect human health, including our quality of life and well-being? And what human or social behaviors cause what forms of ecosystem degradation and again affect human health, including our quality of life and well-being? We need to learn about these issues and consider what we can do to achieve **ecological health**, where environments/ecosystems are in harmony with human and social behaviors and human health (see Chapter 1 to learn more about ecological health approaches).

Column: Environmental pollution of methylmercury and the health of people

Minamata disease describes the poisoning from methylmercury compounds that affected the Minamata area along the coast of the Yatsushiro Sea in Kumamoto Prefecture, Japan. The cause of the environmental pollution was the release into the sea of methylmercury compounds, a by-product that occurs during the production of acetaldehyde, in the industrial wastewater from a factory owned by the Japan Nitrogenous Fertilizer Company. The methylmercury compounds polluted the environment of the Yatsushiro Sea, where fish and shellfish consumed the methylmercury compounds and passed them along the **food chain** in the ecosystem. This led to **bioaccumulation** of the pollutant, bringing about central nervous system disorders among humans and cats that ate polluted fish and shellfish due to mercury poisoning (see the Dose-Response Relationship section in this chapter to learn more about these symptoms).

The first patient identified was a young child who, in April 1956, exhibited severe symptoms, including difficulty speaking, walking, or eating. It was not until twelve years later in 1968 that the national government finally officially recognized Minamata disease as a pollution disease. During this twelve-year period, the nation experienced a plethora of social issues: various different theories and misunderstandings concerning the cause of the disease; counterarguments made by the company; prejudice, discrimination, and stigma against the patients and the local communities; lawsuits over patient certification; medical researchers making judgments in favor of the government and the company, and so on. It surfaced only recently that people inland had also suffered central nervous system disorders due to mercury poisoning after eating fish and shellfish from Minamata Bay, yet held back from seeking patient recognition for fear of discrimination, and that such inland sufferers had not received relief as the government would only certify coastal residents as Minamata disease patients. More than 60 years on, Minamata disease is still an issue.

Environmental pollution of mercury has raised concerns not only in Japan but in many countries. For instance, pollution of metallic mercury used for the refining of gold has been detected in the Brazilian Amazon basin, the Philippines, Tanzania, and Indonesia. In Cambodia, too, mercury was found at high concentrations in the hair of people who were living in fishery villages and who consumed large quantities of fish and shellfish, or those who were sorting waste at landfill sites.[6] Increasing environmental pollution and resulting health hazards caused by mercury are of great concern in Cambodia.

4. Health and environment

1) Host-environment interaction

Broadly speaking, there are two ways to understand the relationship between our health and the environment. One is to find out what kinds of health issues and diseases occur as a result of exposure to the conditions, objects, or circumstances in the environment. The purpose is to identify hazardous substances or conditions in the environment and eliminate or improve them in order to secure health and

safety. This is an important and fundamental approach in environmental health and hygiene for the purpose of protecting the safety and health of workers, especially in work settings where workers are exposed to substances and environmental conditions that are different from those they are faced with in their everyday lives. This approach concerns the relationship between **environmental exposure** and **human health**.

For instance, the WHO Regional Office for the Western Pacific (where Cambodia is one of the non-Pacific Islands Countries and Areas) regarded unsafe water, poor sanitation, air pollution, hazardous chemicals and poisons, occupational hazards, and extreme weather as being examples of environmental determinants of health.[7]

With this approach, the relationship between humans and the environment may be understood as **host-environment interaction**, with environmental factors organized according to a category of the environments, such as **physical, chemical, biological, and cultural/psychosocial environments** (Table 13.1). In the real world, these environmental factors do not exist independently from one another; rather, they form the environment in combination and exert influence over the health and lives of humans as such (Figure 13.1). Figure 13.1 shows a model that illustrates the relationship between humans and their lifestyle activities and environment, in which an entity that has certain genetic characteristics and constitution as its internal environment, namely a human (i.e., host), comes in contact, through their lifestyle behaviors, with environments (physical/chemical, biological, and/or cultural/psychosocial) of the external world, and as the two influence each other, the health condition of the human is determined by the results of such interactions.

Take a working environment at a building construction site as an example. A worker who has certain genetic characteristics, constitution, and lifestyle would be exposed to physical factors such as vibrations, noise, high temperatures, ultraviolet light, and dust from building construction work. They may also be exposed to chemical factors such as organic solvents used for painting and adhesion, and if they smoked during a break, they would inhale various chemicals contained in the cigarettes, as well. If someone at their work site had COVID-19, they would have a higher likelihood of catching the virus, which is a biological environmental factor, as a close contact. Furthermore, at their workplace they may be influenced by cultural/psychosocial environmental factors, including working conditions (such as long working hours, working at high places, and uncertain employment contacts), stress from work relationships, and social norms of the employee population. Such diverse working environments are

Table 13.1 Categories of environment and examples of environmental factors as health risks

Category of environment	Examples of environmental factors
Physical	Vibrations, noise, electromagnetic waves, high temperatures, low temperatures, high voltage, humidity, radiation, ultraviolet, airborne particulate matter
Chemical	Dioxins, asbestos, organic solvents, mercury, lead, arsenic, pesticides/insecticides, food additives, pharmaceuticals, cosmetics, cigarettes and alcohols, illicit drugs, and other synthetic chemicals
Biological	Pathogenic microorganisms and parasites such as Escherichia coli O157, SARS, HIV (AIDS), and SARS-CoV-2, venomous snakes, wild animals, hygiene pests, mosquitos, plants
Cultural/psychosocial	Social systems and social organizations, political regimes, social norms, legal systems, values, discrimination/stigma, human relationships (including violence/abuse and bullying), overcrowding, family/kinships, religions, working conditions, financial situation, science and technology, academia, art

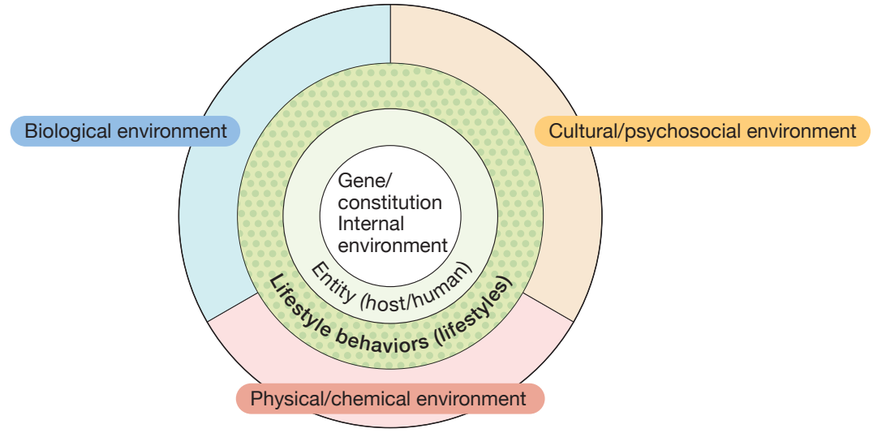

Figure 13.1 Model for the relationship between humans and their lifestyle behaviors and environment

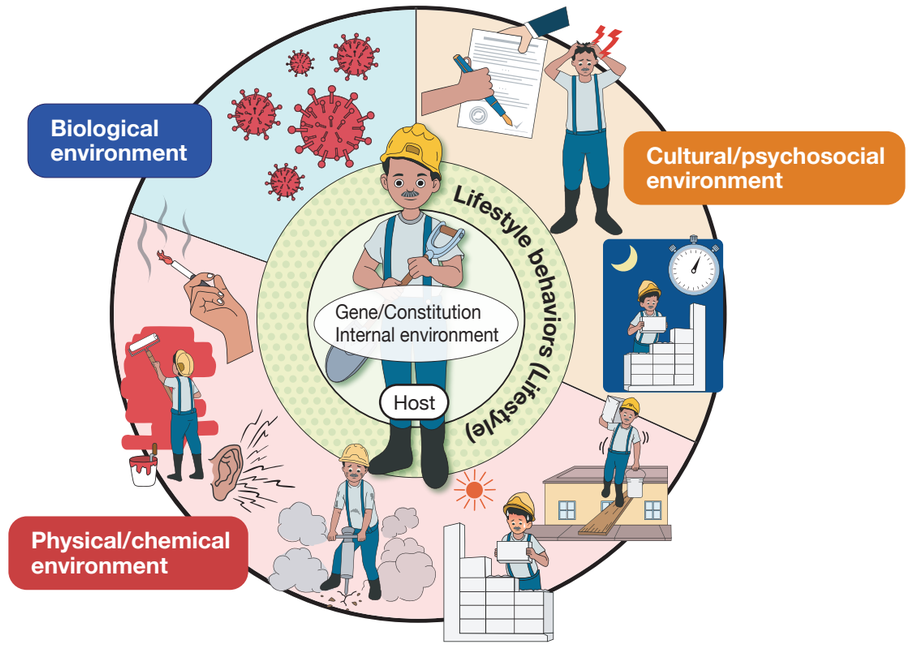

Figure 13.2 Human-environment relationships. A case of construction workers

believed to interact with a worker's biological and psychosocial characteristics, defining the health of the worker (Figure 13.2).

In a school environment, children's physical, mental, and social health is influenced by physical environment (e.g., light, sound, electricity, and temperature), chemical environment (water, air, and disinfectants), and biological environment (bacteria, viruses, and animals), which are explained in Chapter 4 in the discussion of school environmental health, as well as cultural/psychosocial environment, including children's relationships among themselves and with teachers, and classroom culture, which may involve issues such as bullying.

In the category of cultural/psychosocial environment, psychosocial stress has become an important issue as a factor that damages health. The health effects of life stress that people experience in their working, family, or school environment are addressed in Chapter 12 in the discussion of mental health.

2) Dose-response relationship

One of the ways to determine what kinds of health issues or diseases humans may develop as a result of exposure to a condition, object, or circumstance in the environment is to analyze its **dose-response relationship** (Figure 13.3) and show the related levels of harm and margin of safety. These provide a basis for establishing **environmental safety standards** or **permitted levels** for it.

This is a method to assess what kinds of health effects may result from what amount of exposure to a physical factor in the environment, such as radiation, or by taking in what amount of a chemical factor, such as organic mercury.

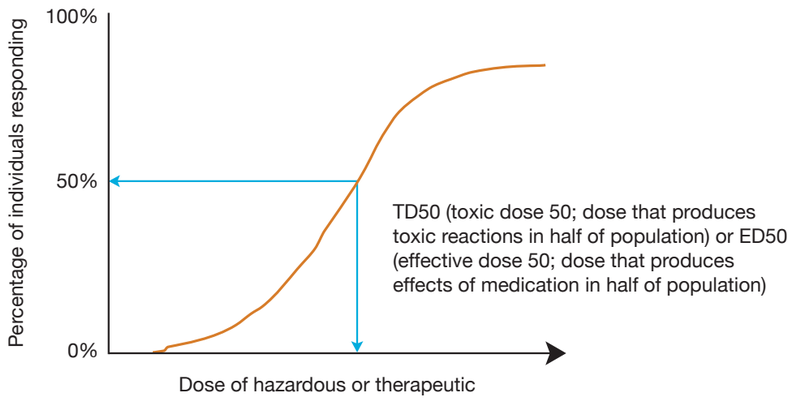

Figure 13.3 Sample dose-response curve

Figure 13.3 illustrates how this may look using **TD50 (toxic dose 50)**. Take methylmercury poisoning as an example. It is a form of health hazard caused by mercury contamination of the environment/ecosystem that is represented not only by Japan's Minamata disease but seen widely across the globe. Its TD50 refers to the dose at which half of the population exhibit the symptoms of methylmercury poisoning, such as impairment of sensory functions, including seeing, hearing, smelling, tasting, and touching, and impaired ability to control the movements of limbs. In a case of a chemical used as a treatment, **ED50 (effective dose 50)** is used instead as an indicator of its efficacy, referring to the dose that produces a therapeutic effect in half of the population. In either case, the dose-response relationship such as the one illustrated in Figure 13.3 is used to evaluate levels of harm, therapeutic effect, and safety.

Column: Environmental risk factors in low-middle income countries

The **disability-adjusted life year (DALY)** is a summary measure of the overall impact of disease on the health of a human population. This measure is used to assess the impact of a disease on humans in a population level, based on the number of years of life lost due to premature mortality caused by the disease and the number of lost years of healthy life due to disabilities caused by the disease. The number of years "lost" used to be calculated using the **life expectancy** (i.e., the average number of additional years that a person of a given age is expected to live) of the Japanese as the standard, as Japan has historically had the longest life expectancy in the world. Recently, however, different approaches have sometimes been taken, such as the use of national life tables for individual countries.

Note that one DALY represents one year of healthy life lost in life expectancy because of a disease. A higher DALY value indicates a greater burden posed on human health and life by the particular disease or health risk.

Using DALYs as a measure, the Global Burden of Disease Study 2019 estimated the 20 leading risk factors for countries grouped according to the levels of their social and economic development.[8] Thanks to its recent economic progress, Cambodia was now included in the group of low-middle-income countries.

For the group of these development levels, the leading environmental risk factors to health for females were[8]:

Household air pollution (5th);
Ambient particulate matter (7th);
Unsafe water (8th);
Unsafe sanitation (14th); and
Handwashing (17th).

For males:

Ambient particulate matter (6th);
Household air pollution (8th);
Unsafe water (12th);
Unsafe sanitation (14th);
Occupational injury (16th); and
Handwashing (18th).

These data show that environmental pollution represents a significant health risk and that males, in particular, are exposed to occupational risk factors.

5. Ecosystem health and human health

As an approach to understand the relationship between health and the environment, we discussed the approach of looking at exposure to environmental factors and human health in the previous section. Another approach is that of environmental health, focusing on impacts of economic development on ecosystems based on the **development-ecosystem-life or main occupation (livelihood)-health** relationships. To help understand the social and economic development-ecosystem-life and main occupation (livelihood)-health relationships, we use examples of banana plantations in the column below.

Column: Truth behind banana plantations

It is believed that over a thousand kinds of bananas of different colors, shapes, and sizes are produced and consumed around the world. However, the Cavendish type makes up 47% of global production and 99% of exports. Cavendish bananas are all genetically identical clones, and overdependence on a single cultivar, or monoculture, poses the risk of disease spreading globally and causing tremendous damage to crops.[9]

While it is difficult to cite exact statistics on annual banana production, records show it was 114 million tonnes in 2017. The world's largest producer of bananas is India (29 million tonnes produced annually), followed by China (11 million tonnes) and the Philippines (7.5 million tonnes), with Ecuador and Brazil tying for 4th place (7 million tonnes). A majority of bananas produced in India and China are for domestic consumption with very little left for export; Ecuador, the Philippines, Costa Rica, Colombia, and Guatemala are the large exporters. India and China have seen expansions in domestic demand as a result of population growth, and between 2000 and 2015, they had an increase in production by 48% and 83%, respectively.[9]

Issues that surround banana plantations include the use of large quantities of chemicals, including pesticides, insecticides, and chemical fertilizers, to prevent diseases in banana crops and increase productivity, which can create soil and water pollution, exposing workers and residents to environmental pollution. In addition, the development of plantations may result in deforestation or land acquisition or leasing, which causes farmers to lose their land.

In Laos, for instance, many Chinese companies began arriving around 2010 and started operating banana plantations in the mountainous northern parts of the country, such as the provinces of Oudomxay and Luang Namtha. Bananas produced there were all for export to China. While these banana plantations generated jobs and income for the poor areas, they also brought about pollution of the local ecosystems and health hazards. Pollution of nearby rivers also killed large quantities of food fish, causing fisherfolk to lose work.[10]

In the summer of 2016, flooding led to massive spills of chemicals, polluting the ecosystems and environment of the region, and affecting the lives and health of the residents. This forced the Lao government to issue a ban on Chinese-owned banana plantations.[10]

Similar cases of soil and waterways/groundwater pollution and health hazards to residents caused by large-scale pesticide spraying and extensive use of insecticides and chemical fertilizers have been seen in the Philippines, Mexico,[11] and Ecuador.[12]

1) What is an ecosystem? What is an ecological health approach?

An ecosystem is a concept of seeing all the organisms that live within a certain area, together with the abiotic environment, as one cohesive system, focusing on energy flows, food chains, and geochemical cycles (cycles of earth materials). Multiple layers of micro-ecosystems form one large ecosystem that is the Earth.

In the case of humans, for instance, ecosystems exist at multiple levels, from individual to family, neighborhood, school, and workplace, municipality, county, and province, nation, and the world; across these levels are cycles or flows of energy, materials, information, cultures, politics, and economy. In other words, all these levels, from individual to global, are linked together and influence one another through such cycles and flows.

Applying the concept of ecosystems to human health is known as the **ecological health approach**. According to these approaches, the health and healthy behaviors of humans are influenced by factors at various different ecological levels, while the behaviors and lives of humans exert influence over and bring about changes to ecosystems at various different levels. This means that the health and healthy behaviors of children who live in a given area of Cambodia are influenced by, and have influence over, ecosystems at different levels on a global scale, albeit to varying degrees.

When it comes to defining different levels of ecosystems, an article titled Adolescent health in the 21st century, for instance, suggests the following levels (from smaller to larger): individual adolescents; school/friends; family; neighborhood; and macro-level society.[13] The US Centers for Disease Control and Prevention (CDC), meanwhile, as a framework for the prevention of violence, presents a social-ecological model, which comprises the following levels: individual; relationship; community (schools, workplaces, and neighborhoods), and societal (i.e., a larger society that forms norms and cultures concerning violence, or a society that has common politics, social policies, economy, and educational systems in it), which surround the lower levels.[14]

Using an ecological health approach, we can rearrange the health risk factors in the environment that are shown in **Table 13.1**; they exist in each level of an ecosystem, and they influence one another within a given level as well as across different levels, determining the health, healthy behaviors, and lives of individuals.

Column: Ecohealth and systems thinking

A system is a dynamic and complex whole, within which different elements influence one another. An ecosystem is a typical system where cycles or flows of energy, information, and materials occur among various elements that constitute the ecosystem. **Systems thinking** that is based on an ecological health approach is a concept that holds that, in an ecosystem which comprises multiple levels, different elements influence one another within or across levels, thereby defining the health of the ecosystem and that of humans. In cases of health issues such as dizziness, headaches, and

diarrhea among residents living near a banana plantation, for instance, issues of ecosystems and those of human health may be rising out of a complex web of elements influencing one another, including: the decisions made by the local authority to accept the company; standard of living, state of employment, and land use in the area; background factors for the company's entry into the area; operating policy and safety and health measures at the plantation; amounts of fertilizers and pesticides/insecticides used for banana plants and their levels of harm; geographical conditions of the rivers as sources of water; ways of life and main occupations of local residents; and levels of financial hardships of the residents. **Ecohealth** employs systems thinking to analyze and map such relationship, clear up complex issues, and find solutions.

2) Economic growth and social development in Cambodia

Cambodia is one of the more natural resource-rich countries in Southeast Asia, with resources including farmland, water/fishery/forest resources, minerals, oil, and natural gas. Putting these resources to good use promotes economic progress; in fact, the country has achieved steady economic growth over the past 20 years at an annual rate of 7.6%. Further economic progress may potentially reduce poverty.[15] Cambodia is a country of great opportunities.

What we need to take into consideration here is that a prerequisite for economic progress based on natural resources is social development. Depending on the kind of development that is carried out, it can produce impacts not only on economic progress but also on the environment and ecosystems where the resources exist. It is therefore important to continuously monitor any impacts on the natural environment and ecosystems produced by development that is made for the sake of economic progress, because some of these impacts may have negative effects on the lives and health of people (see Column: Truth behind banana plantations). In addition, whether or not economic progress leads to a reduction in poverty also depends on social systems, such as redistribution of wealth and social security, as well as the national political system that is in place. Poor people and rural and remote areas where poverty rates are high and building an economic base is challenging are also the people and areas that are more vulnerable to issues related to natural environment and ecosystems.

3) Environmental issues in Cambodia

What kinds of environmental issues face Cambodia today? We will address this by referring to two reports, one by the University of Gothenburg in Sweden,[15] and the other by the Ministry of Environment of Cambodia, titled Cambodia Environment Outlook.[16]

The primary environmental issues in Cambodia identified by the two reports include: **loss of mangroves; deforestation and declining biodiversity; soil degradation; water pollution; vulnerability to natural disasters (floods, droughts, and windstorms); climate change; land mines and other unexploded ordnance; waste pollution; and deteriorating urban environment**.[15,16] These issues represent impacts on the ecosystems that are produced in ways that are connected to Cambodia's economic growth and social development, and they arise in a complex, interconnected manner. If such an impact exceeds **ecosystem resilience**, even if economic growth and social development bring economic wealth to people's lives in the short term, ecosystem degradation will produce health hazards, which ultimately makes any such growth or development not worthwhile in the long term for people who live in the ecosystem. In other words, we cannot call it sustainable development.

(1) Coastal development and loss of mangroves

Mangroves are communities of plants that grow in intertidal zones (i.e., brackish water where freshwater and seawater mix, primarily in coastal areas or estuaries) in the tropics and subtropics. In addition to absorbing CO_2, mangroves help protect fishing grounds and **biological diversity**, and mitigate damage from cyclones and high tides. Cambodia's coastline (443 km), which makes up 14.7% of the country's borders, is on the Gulf of Thailand. A large portion of the coastline is found in the province of Koh Kong, which used to be the country's largest home to mangroves, accounting for 75% of all mangroves in Cambodia in 1992. However, illegal logging of mangroves by local inhabitants for the purpose of charcoal production destroyed the mangrove forests over a vast area. Over the course of around 30 years between 1973 and 2002, 40% of the mangrove areas were lost. Although reforestation efforts through replanting of mangroves have been made since 2000, the loss of mangroves has not been curbed, with as much as 45% of the mangroves lost by 2016/2017 compared to 1973.

Shrimp farms, which were introduced in 1989 and started expanding in 1991, also stimulated mangrove deforestation. Shrimp farming is practiced in four provinces, namely Kampot, Kep, Preah Sihanouk Ville, and Koh Kong, where large ponds were created close to or within mangrove forests.[17] For that purpose, large swaths of mangrove forests were cut down. In Cambodia, the rapid destruction of mangrove forests has caused soil and water degradation, adversely affecting the lives of residents living on coastal fishing (i.e., livelihood). Furthermore, organic matter and chemicals, phytoplankton, and bacteria that are present in the effluent from shrimp farms may potentially degrade the ecosystems along the coast.[17] If these issues cause the yields of fish to decrease and lead to declines in fisheries, it may result in food problems for Cambodia.[15,17]

In addition, there are concerns that large-scale port development projects, offshore oil and natural gas drilling, and other development projects by the hotel business and tourism may also lead to mangrove deforestation.[15]

(2) Deforestation

Forests provide people with a place to preserve their traditional culture and gather food and fuelwood. In the context of the environment, forests help regulate climate at local levels, filtrate water, retain water to control river volumes, or prevent floods or mudslide disasters.[16,18] Degradation of such forests is one of the environmental issues facing Cambodia.

The percentage of Cambodia's total land area covered by forest (forest area) was 75% in the late 1960s, but it declined to 60% in 1993, 59% in 2006, and was down to 47% in 2018. It has been pointed out that this rate of reduction in forest area in Cambodia is considered to be greater than those in its neighboring countries or international standards.[16]

Causes for deforestation include rubber tree plantations and logging for timber or charcoal

production.[18] They also include constructing roads or securing land for residential use to accommodate an increasing population. Illegal logging is thought to account for 90% of deforestation, attributable to the lack of a forest management system, absence of rules and laws on land ownership, and the corruption that surrounds logging.[15,16,18]

(3) Soil degradation

Cambodian soil tends to be of low fertility, and land productivity is low. According to 2001 statistics, agriculture accounts for only 21% of the total land area.[16] To make matters worse, deforestation promotes soil erosion, while excessive use of pesticides to increase crop yields creates pollution of soil, water, and crops. These forms of pollution can ultimately threaten the safety of food and the health of humans. Agricultural practice that involves excessive use of pesticides is not sustainable.

The annual sum of pesticides imported to Cambodia was around 37,500 metric tonnes in 2019. It was approximately 3,300 metric tonnes for Laos, one of its neighbors; this means that, while their populations and land areas differ widely, Cambodia is importing, and presumably using, approximately ten times more pesticides than Laos. The sum was approximately 48,000 metric tonnes for Myanmar, while it was approximately 199,000 metric tonnes for Vietnam, which makes it a large importer.[19]

(4) Water pollution and water shortages

Cambodia is generally considered a water-rich country. However, around 3.4 million people, many of whom live in rural areas, lack access to safe water, and 5 million people have no access to improved water (see Column: Drinking water situation in Cambodia in Chapter 4). In five of thirteen provinces, naturally occurring arsenic has been detected in 9% of the groundwater sources at levels above the WHO standards, which makes the water hazardous for drinking.[15] Furthermore, pesticides, when used in large volumes as mentioned earlier, are released not only into soil but into groundwater and rivers as well, polluting the water sources. Securing safe water in sufficient quantities is a challenge for Cambodia.

Meanwhile, the construction of impounding dams upstream in the Mekong River may have impacts on the flood pulse, fish resources and fisheries, agriculture, and downstream water supply. So far, the impacts of industrial effluents on water quality have been small, owing to slow industrial development.[15]

(5) Climate change and natural disasters

Cambodia is not yet highly industrialized and therefore has very low emissions of CO_2 and other **greenhouse gases**, which are contributing factors to **climate change**, with a per capita CO_2 emission of 0.97 metric tonnes in 2019,[20] compared to 4.14 metric tonnes for Thailand, 4.58 metric tonnes for Laos, 0.49 metric ton for Myanmar, and 2.57 metric tonnes for Vietnam.

The country has been less affected by climate change so far. Potential future increase in volume and frequency of rainfall and intensity of windstorm as a result of climate change, however, may lead to unseasonal floods, which, combined with soil degradation/erosion due to deforestation, may produce mudslide disasters. Such events may well produce extensive damage, given Cambodia is not highly resilient to natural disasters. Flooding itself has served to make the soil more fertile and produce benefits, and people have adjusted to dealing with seasonal flooding over the ages. Floods that come at unexpected times of the year due to climate change are difficult to respond to, however, potentially causing flood damage and health hazards. Mudslides caused by soil degradation/erosion can deprive people of their houses or farmland, which may force them to relocate.[15]

In addition, if global warming brings about sea-level rises and mangrove forests are no longer in brackish water, it may also affect the ecosystems in the coastal areas.[15]

Health effects of concern produced by climate change or extreme weather events that are not natural disasters include vector-borne diseases (e.g., malaria, dengue fever), food security (malnutrition, famine), water-borne infection, food poisoning, rodent-borne infection, and non-communicable diseases.[21]

Column: Community-based tourism and ecotourism

Tourism is a growing industry globally. In 2014, it generated revenues of US$7.6 trillion, which accounts for 10% of global GDP, and 277 million jobs. In the past, however, tours would be organized by travel agents both small and large, and such companies would take most of the profits, leaving very little to local communities. Tourism has also been responsible for environmental issues. As an alternative to such traditional tours, various types of **community-based tourism (CBT)** recently emerged in many countries, including Cambodia. With CBT, tours are organized and operated by members of the community. This makes their tours more aligned to the preservation of the local natural environment, society, and culture, while profits are given back to the community, which helps raise the standard of living of community members and empower the community. Compared to conventional styles of travel, CBT may also minimize damage to the local environment, society, and culture.

Community-based ecotourism that utilizes Cambodia's nature as an environmental resource may help improve the well-being and economic life of people while protecting the society and culture of the community as well as the well-being of ecosystems. People of the local community can earn income, which allows them to live in a manner that helps protect forest resources and valuable ecosystems such as mangrove forests. Tourists, meanwhile, can experience the true Cambodian nature, society, and culture. Hopes are high that community-based ecotourism will grow into a new style of tourism that is in keeping with the philosophy of Ecohealth, which promotes a harmonious balance among development, ecosystem health, life, the main occupations of people, and their health.

(6) Land mines and unexploded ordnance (UXO) (Figure 13.4)

It is estimated that there are **100 million mines buriel in the ground globally**. As a result of the Vietnam War followed by a civil war that went on for around 20 years, Cambodia may have four to six million mines and over 2.4 million pieces of unexploded ordnance (UXO),[22] leaving 40% of arable land inaccessible (see Column: Measures related to land mines in Cambodia in Chapter 14).

Between 1979 and 2015, land mines and UXO caused approximately 65,000 casualties. The number has been on the decline; according to the Cambodian Mine Action and Victim Assistance Authority, Cambodia recorded 111 casualties (18 killed; 93 injured) of mines and UXO in 2015. According to the

Photos provided by NGO JMAS (Japan Mine Action Service)

Figure 13.4 Mines and unexploded ordnance (UXO) in Cambodia

recorded cumulative total of casualties, 30% were killed, 56% were injured, and 14% had legs amputated. Casualties are unevenly distributed across the country, with Battambang being most heavily affected, followed by Bantey, Meanchey, and Siem Reap.[23]

The effects of land mines and UXO span a broad range, from local economic activities such as agriculture and tourism to people's everyday lives, access to medical treatment, mental and physical health, and burden on families caring for victims. Specifically, mine injuries leave the victims and their families emotionally traumatized, negatively affecting their mental health; people who live in the area cannot feel safe; and mines and UXO restrict access to land that may be used for food production through farming or stockbreeding, other facilities, services or markets, or safe drinking water. These constraints, in turn, give rise to issues such as the following: food production, distribution, and supply are affected, causing food shortages and ultimately malnutrition; as the number of injured people increases, medical care, which is poor to begin with, becomes even more strained; financial burdens become greater due to medical fees for the treatment of casualties and a loss of earnings because they are unable to work; municipal governments have to divert funds for clearance of mines and UXO away from other local public services, including healthcare and education.[23] On the flip side, clearance of mines and UXO will resolve these issues; this is why international cooperation and aid for clearance of mines and UXO are important.

However, the area of land that was cleared of land mines and UXO during a five-year period between 2014 and 2018 was 190.52 km^2, compared to 890 km^2 of remaining contamination, which is 4.7 times as large as that of the cleared area.[24] At this rate, it will require another 25 years to rid Cambodia of mines and UXO.

In order to help keep people from falling victim to land mines and UXO, it is important to provide **mine risk education** in school health.[24] According to statistics, youth under 18 account for 11% of casualties, and a majority are boys (9%). What should we teach? A Japan-based international NGO[25] that is active in Myanmar, Afghanistan, and Uganda teaches the following:

(i) The colors, shapes, and sizes of mines and UXO
(ii) The typical locations where mines and UXO are found
(iii) What to do if one encounters a mine or UXO

(7) Urban environment and health issues

As a result of population growth, many countries are seeing a migration of population from rural to urban areas, which is creating a concentration of people in cities, thus giving rise to various environmental and health issues that are unique to cities.

In Cambodia, population was growing at an annual rate of 2.2% up until 1970, when it reached 6.8 million. It then saw a sharp drop due to genocide under the Khmer Rouge. The population then recovered to its pre-genocide levels, and from 2010 onward, it grew at a rate of around 1.5% to reach 16.25 million in 2019. People in rural areas would depend on the use of natural resources in the environment for their livelihood; as a result of resource decline, however, there arose a trend of migration to urban areas to search for employment.[15,16] According to estimates in World Urbanization Prospects,[26] **the rate of urbanization** (i.e., percentage of people living in urban areas) in Cambodia was 22.0% in 2020, compared to 78% of the population living in rural areas. The rate is estimated to reach only 36% by 2050. For reference, the 2020 estimate was 36% and 31% for Laos and Myanmar, respectively. Japan's rate of urbanization is approximately 92%.

While the advancement of urbanization is slow in Cambodia as a whole, Phnom Penh does have some concentration, with a population of 2.13 million (2019), which accounts for 14% of the overall population of the country. This is even higher than the proportion of Japan's national population living in metropolitan Tokyo (9%). The urbanization of Phnom Penh brings about levels of concentration of population that are comparable to those of capitals in European and North American countries. Phnom Penh's social infrastructure, however, is said to be not adequate to accommodate such a large population. The city's unemployment rate is twice as high as that of rural areas, at 9.2% versus 4.7%.[15] The vulnerability and insufficiency of infrastructure in Phnom Penh is reflected in issues of waste treatment, drinking water, and wastewater treatment discussed in Chapter 4.

Urban environmental issues, unlike those of rural areas which concern natural environment and natural ecosystems, are issues of the **built environment** (**Figure 13.5**), which is created by people; it

Figure 13.5 The urban environment in Phnom Penh

involves many elements, including buildings, neighborhoods, streets, parks, transportation systems (including cars), housing, water supply and sewage disposal, energy grids, recreational facilities, distribution systems, information systems, industrial facilities, and commercial facilities (**Figure 13.4**).[27] Built environments, therefore, have large impacts on the **urban ecology** and human health. Human health may be determined by the following dichotomies, for instance: if one's physical activity is promoted or hindered; whether or not one can obtain health-promoting food; if one enjoys good or poor indoor or outdoor air quality; if one is socially excluded or isolated, or has smooth social relationships; whether or not one has access to safe water; whether or not there is a safe transportation system; whether or not one can get a job; whether or not one has elevated opportunities to become infected due to crowding, and so on.[27] It is necessary to monitor how Phnom Penh's built environments affect human health.

Exercises for further thought and research

[13-1] Name environments that are important for the health of humans and survival of life and discuss why they are important.

[13-2] Give one example each of physical, chemical, biological, cultural/psychosocial environments, and look into how they are related to human health.

[13-3] Look for a case where Cambodia's social and economic development produces impacts on the health of ecosystems, people's lives and main occupations (livelihood), and human health. Review the case and draw a chart that illustrates what links lead to health issues.

[13-4] Pick up one issue associated with urban built environments in Phnom Penh and look into how it is related to lives and health of humans.

[13.5] Have a group discussion about which of the SDG 17 goals (Cambodia Sustainable Development Goal: https://csdgs.org/km/) the environmental health and ecological health issues correspond to.

[13-6] Do research on organizations that are engaged in the protection of the environment or ecosystems and report the results.

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