2. The Human Population and the Environment

2.1Basic Concepts of Population Dynamics

The Human Population as an Exponential Growth Curve

We can divide the history of our species' population into four phases. In Stage 1, the early period of hunters and gatherers, the world's total human population was probably less than a few million. Stage 2 began with the rise of agriculture, which allowed a much greater density of people and the first major increase in the human population. Stage 3, the Industrial Revolution in the late 18th and early 19th centuries, saw improvements in health care and the food supply, which led to a rapid increase in the human population. The growth rate of the world's human population, like that of the early population of the United States, increased but varied during the first part of the 20th century, peaking in 1965 – 1970 at 2.1% because of improved health care and food production. Stage 4 began around the late 20th century. In this stage, population growth slowed in wealthy, industrialized nations, and although it has continued to increase rapidly in many poorer, less developed nations, globally the growth rate is declining and is now approximately 1.2%.

2.2 Projecting Future Population growth

It is common to say that human populations, like that of the United States, grow at an exponential rate, which means that the annual growth rate is a constant percentage of the population.

An exponentially growing population theoretically increases forever. However, on Earth, which is limited in size, this is not possible, as Thomas Henry Malthus pointed out in the 18th century. Eventually the population would run out of food and space and become increasingly vulnerable to catastrophes, as we are already beginning to observe. Consider, a population of 100 increasing at 5% per year would grow to 1 billion in less than 325 years. If the human population had increased at this rate since the beginning of recorded history, it would now exceed all the known matter in the universe. if a population cannot increase forever, what changes in the population can we expect over time? One of the first suggestions made about population growth is that it would follow a smooth S-shaped curve known as the logistic growth curve.

A logistic population would increase exponentially only temporarily. After that, the rate of growth would gradually decline (i.e., the population would increase more slowly) until an upper population limit, called the logistic carrying capacity, was reached. Once that had been reached, the population would remain at that number.

2.3 Age Structure

The population age structure, which is the proportion of the population of each age group. The age structure of a population affects current and future birth rates, death rates, and growth rates; has an impact on the environment; and has implications for current and future social and economic conditions.

We can picture a population's age structure as a pile of blocks, one for each age group, with the size of each block representing the number of people in that group. Although age structures can take many shapes, four general types are most important to our discussion: a pyramid, a column,

an inverted pyramid (top-heavy), and a column with a bulge. The pyramid age structure occurs in a population that has many young people and a high death rate at each age—and therefore a high birth rate, characteristic of a rapidly growing population and also of a population with a relatively short average lifetime. A column shape occurs where the birth rate and death rate are low and a high percentage of the population is elderly. A bulge occurs if some event in the past caused a high birth rate or death rate for some age group but not others. An inverted pyramid occurs when a population has more older than younger people.

2.4 The Demographic Transition

The is a three-stage pattern of change in birth rates and death rates that has occurred during the process of industrial and economic development of Western nations. It leads to a decline in population growth.

A decline in the death rate is the first stage of the demographic transition. In a nonindustrial country, birth rates and death rates are high, and the growth rate is low. With industrialization, health and sanitation improve and the death rate drops rapidly. The birth rate remains high, however, and the population enters Stage II, a period with a high growth rate. Most European nations passed through this period in the 18th and 19th centuries. As education and the standard of living increase and as family-planning methods become more widely used, the population reaches Stage III. The birth rate drops toward the death rate, and the growth rate therefore declines, eventually to a low or zero growth rate. However, the birth rate declines only if families believe there is a direct connection between future economic well-being and funds spent on the education and care of their young. Such families have few children and put all their resources toward the education and well-being of those few.

2.5 The Human Carrying Capacity of Earth

What is the of Earth—that is, how many people can live on Earth at the same time? The answer depends on what quality of life people desire and are willing to accept.

As we have made clear in this chapter, on our finite planet the human population will eventually be limited by some factor or combination of factors. We can group limiting factors into those that affect a population during the year in which they become limiting (short-term factors), those whose effects are apparent after one year but before ten years (intermediate-term factors), and those whose effects are not apparent for ten years (long-term factors). Some factors fit into more than one category, having, say, both short-term and intermediate-term effects.

An important short-term factor is the disruption of food distribution in a country, commonly caused by drought or by a shortage of energy for transporting food.

Intermediate-term factors include desertification; dispersal of certain pollutants, such as toxic metals, into waters and fisheries; disruption in the supply of nonrenewable resources, such as rare metals used in making steel alloys for transportation machinery; and a decrease in the supply of firewood or other fuels for heating and cooking.

Long-term factors include soil erosion, a decline in groundwater supplies, and climate change. A decline in resources available per person suggests that we may already have exceeded Earth's long-term human carrying capacity.

2.6 Can We Achieve Zero Population Growth?

Much of environmental concern has focused on how to lower the human birth rate and decrease our population growth. As with any long-lived animal population, our species could take several possible approaches to achieving zero population growth. Here are a few.

Age of First Childbearing

The simplest and one of the most effective means of slowing population growth is to delay the age of first childbearing. As more women enter the workforce and as education levels and standards of living rise, this delay occurs naturally. Social pressures that lead to deferred marriage and childbearing can also be effective

Birth Control: Biological and Societal

Another simple way to lower the birth rate is breast feeding, which can delay resumption of ovulation after child- birth. Women in a number of countries use this deliberately as a birth-control method—in fact, according to the World Bank, in the mid-1970s breast feeding provided more protection against conception in developing countries than did family-planning programs

Family planning is still emphasized, however traditional methods range from abstinence to the use of natural agents to induced sterility. Modern methods include the birth-control pill, which prevents ovulation through control of hormone levels; surgical techniques for permanent sterility; and mechanical devices.

However, although now medically safe in most cases, abortion is one of the most controversial methods from a moral perspective.

National Programs to Reduce Birth Rates

Reducing birth rates requires a change in attitude, knowledge of the means of birth control, and the ability to afford these means. As we have seen, a change in attitude can occur simply with a rise in the standard of living. In many countries, however, it has been necessary to provide formal family-planning programs to explain the problems arising from rapid population growth and to describe the ways that individuals will benefit from reduced population growth. These programs also provide information about birth-control methods and provide access to these methods. Which methods to promote and use involves social, moral, and religious beliefs, which vary from country to country.

Appendix: Useful Human-Population Terms

Crude birth rate: number of births per 1,000 individuals per year; called "crude" because population age structure is not taken into account.

Crude death rate: number of deaths per 1,000 individuals per year.

Crude growth rate: net number added per 1,000 individuals per year; also equal to the crude birth rate minus crude death rate.

Fertility: pregnancy or the capacity to become pregnant or to have children.

General fertility rate: number of live births expected in a year per 1,000 women aged 15 – 49, considered the childbearing years.

Total fertility rate (TFR): the average number of children expected to be born to a woman throughout her child- bearing years.

Age-specific birth rate: number of births expected per year among a fertility-specific age group of women in a population. The fertility-specific age group is, in theory, all ages of women that could have children. In practice, it is typically assumed to be all women between 15 and 49 years old.

Cause-specific death rate: the number of deaths from one cause per 100,000 total deaths.

Morbidity: a general term meaning the occurrence of disease and illness in a population.

Incidence: with respect to disease, the number of people contracting a disease during a specific time period, usually measured per 100 people.

Prevalence: with respect to a disease, the number of people afflicted at a particular time.

Case fatality rate: the percentage of people who die once they contract a disease.

Rate of natural increase (RNI): the birth rate minus the death rate, implying an annual rate of population growth not including migration.

Doubling time: the number of years it takes for a population to double, assuming a constant rate of natural increase.

Infant mortality rate: the annual number of deaths of infants under age 1 per 1,000 live births.

Life expectancy at birth: the average number of years a newborn infant can expect to live given current mortality rates.

GNP per capita: gross national product (GNP), which includes the value of all domestic and foreign output.

Assignments:

I. Preview the reading passage

II. Prepare the question

I. reading passage

An important environment that is more or less totally restricted to the intertropical zone is the coral reef. Coral reefs are found where the ocean water temperature is not less than 21 ° C, where

there is a firm substratum, and where the seawater is not rendered too dark by excessive amounts of river-borne sediment. They will not grow in very deep water, so a platform within 30 to 40 meters of the surface is a necessary prerequisite for their development. Their physical structure is dominated by the skeletons of corals, which are carnivorous animals living off zooplankton. However, in addition to corals there are enormous quantities of algae, some calcareous, which help to build the reefs. The size of reefs is variable. Some atolls are very large-Kwajelein in the Marshall Islands of the South Pacific is 120 kilometers long and as much as 24 kilometers across-but most are very much smaller, and rise only a few meters above the water. The 2,000 kilometer complex of reefs known as the Great Barrier Reef, which forms a gigantic natural breakwater off the northeast coast of Australia, is by far the greatest coral structure on Earth.

Coral reefs have fascinated scientists for almost 200 years, and some of the most pertinent observations of them were made in the 1830s by Charles Darwin on the voyage of the Beagle. He recognized that there were three major kinds: fringing reefs, barrier reefs, and atolls; and he saw that they were related to each other in a logical and gradational sequence. A fringing reef is one that lies close to the shore of some continent or island. Its surface forms an uneven and rather rough platform around the coast, about the level of low water, and its outer edge slopes downwards into the sea. Between the fringing reef and the land there is sometimes a small channel or lagoon. When the lagoon is wide and deep and the reef lies at some distance from the shore and rises from deep water it is called a barrier reef. An atoll is a reef in the form of a ring or horseshoe with a lagoon in the center.

Darwin's theory was that the succession from one coral reef type to another could be achieved by the upward growth of coral from a sinking platform, and that there would be a progression from a fringing reef, through the barrier reef stage until, with the disappearance through subsidence (sinking) of the central island, only a reef-enclosed lagoon or atoll would survive. A long time after Darwin put forward this theory, some deep boreholes were drilled in the Pacific atolls in the 1950s. The drill holes passed through more than a thousand meters of coral before reaching the rock substratum of the ocean floor, and indicated that the coral had been growing upward for tens of millions of years as Earth's crust subsided at a rate of between 15 and 51 meters per million years. Darwin s theory was therefore proved basically correct. There are some submarine islands called guyots and seamounts, in which subsidence associated with sea-floor spreading has been too speedy for coral growth to keep up.

Like mangrove swamps, coral reefs are extremely important habitats. Their diversity of coral genera is greatest in the warm waters of the Indian Ocean and the western Pacific. Indeed, they have been called the marine version of the tropical rain forest, rivaling their terrestrial counterparts in both richness of species and biological productivity. They also have significance because they provide coastal protection, opportunities for recreation, and are potential sources of substances like medicinal drugs. At present they are coming under a variety of threats, of which two of the most important are dredging and the effects of increased siltation brought about by accelerated erosion from neighboring land areas.

II. prepare the question

Coral reefs are being damaged by a wide range of things. Here are a few.

· Dredging, quarrying, destructive fishing practices and gear, boat anchors and groundings, and recreational misuse (touching or removing corals).

· Nutrients (nitrogen and phosphorous) from agricultural and residential fertilizer use, sewage discharges (including wastewater treatment plants and septic systems), and animal waste

· Toxic substances, including metals, organic chemicals and pesticides found in industrial discharges, sunscreens, urban and agricultural runoff, mining activities, and runoff from landfills

· Coral harvesting for the aquarium trade, jewelry, and curios can lead to over-harvesting of specific species, destruction of reef habitat, and reduced biodiversity.

Now, come up with a plan which can efficiently solve one of the threats listed above. (Note: you can also find a threat to coral reef by yourself, and then figure out a solution) Then, form a speech. You have up to 2 minutes to present your idea in class.