

POPULATION

WORLD POPULATION THROUGH AGES

Population

The total number of inhabitants of a specific area like city, country or any other location is termed to be population.

Rise in the world's population

Today, the world's population reached 7 billion. However, more than 50,000 years ago, it was barely a million.

Primitive life of man

From living a primitive life, man has come a long way today. He was at first a wanderer and later began living in caves.

- He hunted animals, using tools made of stone, wood and bones, and ate them either raw or by roasting them in fire.
- He also gathered fruits, nuts, roots and leaves from plants, and picked eggs from birds' nests, for food.
- He lived near rivers and lakes, from where he caught fish.
- He soon learned to live in groups for safety, and tried to prey on bigger animals such as mammoths.



Stone age

The tools used by early man for all the purposes gathering and hunting were mainly made of stone, and he kept improving them. This age, when stone tools were used, is known as the Stone Age.



Metal age

Stone tools were gradually replaced by those made of bronze and iron, and this period was called the Metal Age. Metal implements were now used for efficient farming and other tasks.



Development of human life

As time passed, man also learned to grow food and used his tools for farming.

- The tool-making revolution was responsible for the development of human life, which resulted in the growth of human population.
- With the beginning of agriculture, man also learned to store food. A sense of settlement prevailed on human life.
- Men started living in settled communities in primitive huts.
- He also started domesticating useful animals, such as dogs, cows, buffaloes and goats. Dogs were the first animals to be domesticated by humans.

With improvement in human life, world population increased.

GROWTH OF POPULATION

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Different patterns of population growth

In a population, some organisms are born, some die, some immigrate while some emigrate. These four processes are known as natality, mortality, immigration and emigration respectively.

Natality is the number of births in the population that are added to the initial density during a given period.

Mortality is the number of deaths in the population during a given period.

Immigration

is the number of individuals of the same species that come into a particular habitat from elsewhere during a given period.

Emigration

is the number of individuals of a population who leave a particular habitat and go elsewhere during a given period.

Factors affecting the size of a population

Populations of all organisms on planet earth are dynamic as they are constantly changing due to their interactions with various biotic and abiotic factors.

Natality and immigration result in an increase in population density.

Mortality and emigration result in a decrease in population density.

In the flow diagram, N is the population density at time t .

Density at time $t+1$ can be calculated as shown.

Although the number of births and deaths greatly influence population density, immigration and emigration assume importance.

Real life examples

If a newly formed habitat is colonised by great egret birds, the immigration of the egrets has a greater significance in determining the population density rather than the natality in this population.

If most of these birds fly to another wetland, then the emigration of these birds has a significant contribution to determining population

density rather than deaths in this population.

Thus, populations grow through births and immigration and decline through deaths and emigration.

Population growth

Growth is the most fundamental, dynamic feature exhibited by populations.

Population growth exhibits two patterns namely, exponential growth and logistic growth.

When resources available to the individuals in a population are unlimited, there is a tendency of the individuals to grow exponentially or in a geometric manner.

This behaviour was observed by Charles Darwin while he was developing his theory of natural selection. He also showed that a slow-growing animal, such as the elephant, could also reach enormous numbers if resources such as food and space were inexhaustible.

Let's take the example of the Pistia plant. When it is introduced in a water body, due to unlimited food and space, these plants grow exponentially and cover the entire water body in a matter of a few days.

Now, to determine the population growth pattern of the Pistia plant, we plot various readings of population density against time.

On plotting the readings, you will notice a J-shaped curve, which shows two phases – a lag phase followed by an acceleration phase. Moreover, with the basic knowledge of calculus, you can derive the integral form of the exponential growth using the equation as shown. Thus, an exponential growth pattern is seen when resources are unlimited.

Considering the population size as 'N', birth rates as 'b' and death rates as 'd', the increase or decrease in population size during a unit time period t is as shown. The difference between the birth and death rates provides the value of r or the 'intrinsic rate of natural increase'. Intrinsic rate of natural increase is a very important parameter for measuring the impact of biotic or abiotic factors on population growth.

The intrinsic rate of natural increase is a measure of the inherent potential of a population to grow.

Did you know that the value of r for the Norway rat is 0.015 and for the flour beetle is 0.12?

These numbers indicate that the rate at which the population size of the flour beetle increases is greater compared to the Norway rat.

When resources are limited, the population growth pattern is logistic. There is always competition between individuals for limited resources and finally the fittest individuals survive and reproduce.

Keeping this fact in mind, the governments of many countries have introduced various restraints to limit human population growth.

In fact, in nature, a given habitat has sufficient resources to support a maximum number of individuals, beyond which no further growth is possible.

This maximum capacity or limit is called the carrying capacity of the species in that habitat, which is denoted by the letter 'K'.

Let us consider the population growth pattern of the Mandarin duck in this wetland. For this, we plot various readings of population density against time.

On plotting the readings, you will notice an S-shaped curve or a sigmoid curve. From the graph, you can see that for a population

growing in a habitat with limited resources, there are three phases – initially a lag phase, followed by phases of acceleration and deceleration and finally, an asymptote, when the population density reaches the carrying capacity.

The logistic growth is also known as Verhulst-Pearl Logistic Growth after the scientists Pierre Francois Verhulst and Raymond Pearl and is described by the equation as shown. In nature, as the resources available for growth are limited, the logistic growth model is considered a more realistic one. Thus, we can say that population density is dynamic and the growth of the population is dependent on the resources available.

POPULATION EXPLOSION AND BIRTH CONTROL

After independence, living conditions improved as the government built hospitals, educated people about health-related issues and conducted immunisation programmes. These steps nearly doubled life expectancy rate and lowered the infant and maternal mortality rate. But with the birth rate remaining more or less the same, this led to population explosion. Demographers fear that if the current birth rate of 1.7 per cent is not lowered, India's natural and economic resources will be strained; depriving many of even basic necessities such as food, clothing and shelter.

To arrest the population growth, the government has raised the legal marriageable age of girls and boys to 18 and 21 years respectively. Government agencies are encouraging contraceptive methods. Which can be broadly categorised as natural, barrier methods, intra uterine devices, oral contraceptives injectable, implants and surgical methods. Barrier method makes use of either a condom, diaphragm or cervical or vault cap, which act as barriers to prevent the sperm and ovum

from meeting. Contraceptive efficiency of a barrier can be increased by applying spermicidal creams, jellies and foams. That's because these products contain chemicals that kill sperm. Another contraceptive method is the use of intra-uterine device. These are used by couples who want to delay pregnancy or space out their children. IUDs are tiny, T-shaped devices that doctors insert into the uterus through the vagina. There are many types. Apart from IUDs, women can also use oral contraceptives called the pill. This is a small tablet containing small doses of either progestogen or a combination of progestogen and estrogen.

While women have several contraceptive options men have only two options for birth control – condoms and a terminal surgical or sterilisation method called vasectomy. In this case, a tiny part of the vas deferens is removed and then tied to the scrotum by bearing a small incision on the same.

In tubectomy, a sterilisation method for women, a miniscule part of the fallopian tube is removed and tied up through a small incision in either the abdomen or through vagina. Both tubectomy and vasectomy are successful methods of birth control but they are irreversible and should only be adopted if a couple wishes to have no more children. In addition to surgical methods, couple today have several other contraceptive methods to choose from. However, before opting for a particular method, one should weigh its pros and cons and seek doctor's advice as some contraceptives can cause side-effects such as abdominal pain and irregular menstrual bleeding.