Chapter - 38
Human Population

Population

Population is number of organisms, By the word population means all those members belonging to a specific species living in a specific geographical area at a particular time. The term population has been originated from Latin word **populous** which means people. Initially this word was used for human species or people. In Ecology this term is used for all the living beings of a specific species or related species found at special area at a given time. i.e. population depicts the number of humans or any animal species present at a specific place at a given time.

Population has been differently defined by different scientists but there is no difference in the base of all definitions. The population is defined in the following way: All the organisms of a specific species or many species, which live in a specific area at a specific time, is the population of that area/region. Population can be of following two types:

(1) Monospecific Population: If at a specific/definite place only one species/sub species members are found it is called monospecific population.

(2) Polyspecific population : If at a specific place member of more than one species is found it is known as polyspecific population.

Population has its own organization and structure. According to Ally, 1949-following are the main characters of a population-shape and density. Many factors affect the population. Following are the main ones-

(1) Natality-birth rate (2) Mortality - Death rate (3) Population movement (4) Age (5) Distribution (6) Life space/Capacity (7) Population expansion (8) Response of Biotic factors.

Population Density

The number of individual's organisms found in any special area or unit volume is called population density. Population density is a numeric concept. For example-100 trees/acre, 200 fishes/km in water surface, 50 lakh diatoms cubic meter. Population density is the measurement of magnitude of population in a given area. i.e. Population density represents the number of all members/individuals of a species found in a natural habitat.

The population density can be calculated with the help of following formula easily :

$$d = \frac{N/a}{t} \quad \text{Where} \quad D = \frac{\text{Number of Individuals}}{\text{Area (km}^2\text{)}}$$

d= density N = Number of Organisms

a= area t= Unit of Time

Population keeps on changing. It is not stable. Due to change in the population, the density also changes. Population density is of two types:

(a) Crude density

(b) Ecological density

(a) Crude density :

During describing the population of organisms in the crude density, its density is represented in

relation to complete area. For example -If 1000 hares are living in one sq. mile then the crude density of hares is 1000/sq. mile. In this the number of organisms is represented per sq. mile, per acre, per sq. meter etc. It is called crude density.

(b) Ecological density:

This type of density is represented by habitat's relationship to real area, which is necessary for the organism to live. i.e. each organism occupies a specific/definite place to live. For example - If 500 hares are living in 1 sq. mile but for them only ½ sq. mile area is required then that area's ecological density will be 1000 hares per sq. mile.

Determination of population density

To determine the population density many methods are used in ecology. Some of the few important methods are following:

(1) Direct Count Method : Ecological scientists use this method for big sized organisms and which live in groups. This method is suitable for birds and large sized mammals. In this method each organism is counted. By this method correct density can be calculated. Human census is a good example of this. In our country after each 10 years. Total number of human is counted. The population density of tigers, elephants, rabbits etc. is calculating by this method.

(2) By Sampling method : In ecology, population density of organisms is usually calculated by this method. In this method many samples from different areas are taken and the number of organisms of each sample is counted. After that average is calculated and population density is calculated. For example- By this method population density of ***Paramecium*** can be calculated from the ***Paramecium*** culture. After stirring it from different areas/cubic cm culture is taken out in the watch glass and the number or ***Paramecium*** present is counted. In this way many times samples are taken and numbers calculated/counted. All the results are added and average number of ***Paramecium*** in 1cc is calculated.

Similarly, we can calculate the population density of terrestrial/land animals. The density of Which animal's/ organisms is to be calculated the distribution area is divided into units or Quadrat. The sample unit is dependent on organisms. In these sample units some areas are selected and the counting of organisms in these areas is done. Results obtained from counting is added and average is calculated. By this method correct Population density of any organism can be calculated.

(3) By Marking and Recapture Method : This method is used by ecological scientists for counting big sized animals such as squirrel, hare, birds etc. In this method one sample of definite number is taken in a population and they are specially marked and left free so that they can mix in the population. After some days again a sample is taken (recaptured). The marked animals are counted in the sample. By this way the direct ratio of marked animals and unmarked animals is taken and population density is calculated.

Following formula is used in this method :

$$\frac{\text{Number of marked animals in the sample}}{\text{Number of animals in recaptured samples}} = \frac{\text{Number of marked animals in total animals}}{\text{Total population}}$$

OR

$$\text{Total population} = \frac{\text{marked animals in total animals} \times \text{Total population of recapatured animal}}{\text{Number of marked animals in recaptured sample}}$$

Example : In first sample 100 orgenigms are marked and set free and after some time in second sample 100 animals are captured and 10 organisms / animals are marked. Population density according to above formula is:

$$\frac{10}{100} = \frac{100}{\text{Total Number}}$$

$$\text{Total Number of population} = \frac{100 \times 100}{10} = 1000 \text{ organisms}$$

(4) By Indirect Methods : In laboratory population density is calculated by indirect methods. Some indirect methods are following:

(1) On the basis of utilization of oxygen or production of carbon dioxide, population

density is calculated.

(2) On the basis of food consumption population density is calculated.

(3) Presence of residence of host in the stomach of consumer's population density is calculated.

(4) Residues of dead organisms such as number of body parts can be used to calculate population density.

(5) By Sample Plot Method : It is most used and simple method in ecology. In this method the area of which population density is to be calculated area is divided into equal plots. Now the number of organisms is counted in the definite plots. Now the average number of organisms is multiplied with the total number of all plots and population density in calculated.

For Example : If population density of any organism in 100 sq. kilometer is to be calculated, then that area is divided into 100 equal parts of 1sq km and organisms are calculated. Suppose in any 5 plots the average is 125, then average of one plot is 125/5 = 25. Thus the population density of 100 sq km will be:

= 25 x 100 = 2500

To calculate the population density by this method sample plots must be taken from allparts of the area and correct counting of each area must be done.

Human Population

Human, due to his structural and mental capabilities has established himself superior to all other organisms and because of his mental skills he has been successful in transforming his environment and situations. human's this ability human population is found in all types of climate on the earth. Human population shows direct relation with level, food supply, housing, health and medical pcilities. Therefore, study of different **aspects** of human population are of special importance. Human population growth and in this reference possibilities of development in future (predicted human population. Growth) study is called **demography**. The word demography has been derived from two Greek words. **Demos**=The people, **Graphos**= Measurement. People who Study about human population pattern and changes are called Demographers.

T.R. Malthus (1778) was first to mention about human population growth. Population grows in geometric ratio(i.e. 1,2,4, 8,….) and availability of food growth is in algebraic ratio (i.e. 1, 2, 3, 4, ….). In past few decades the human population has rapidly increased. In 1900 the human population in world was about 2000 million which rapidly increased to 6000 million in year 2000 some trend was seen in India. Our population, during the independence was approximately 350 million, it rapidly increased in year 2000 and reached above 1000 million. It means that every sixth person in the world today is Indian. The reason for all this is probably the rapid fall in mortality rate (death rate) and mother mortality and child mortality and along with it increases in the number of people in reproductive age. Though, we have reduced the population growth rate due to reproductive and child health services program but this reduction was marginal. According to the year 2001 census this growth is approximately 1.7 Per cent i.e. in per 1000, per year 17 people. Though, by this growth rate our population could be doubled in during 33 years. On 11 July, 1987 in the world 5 billionth children was born. This day 11 July is organized as World Population Day. In August 2017 the world human population will cross 750 crores (about 7.5 billion).

Population growth form :

Population of human or organisms always grows and increased population reproduces and increases more. This growing population grows in a definite pattern. This is called **population growth curve**. In ecology, there are two physical patterns of growth. These are called by following names due to the shape of growth curves:

1. 'S' Shaped growth curve

2. 'J' Shaped growth curve

1. 'S' Shaped growth curve or sigmoid growth curve : This type of growth takes place in natural situations/conditions. Initially the growth in organisms is very slow. In the region/area the organisms gradually **aclimatise** and establish themselves in the area. As a result, the growth in

organisms is slow/less.This is why this stage is called **establishment phase or Lag phase**. After the establishment of organisms in the region/area there is rapid increase in the population. Organisms for reproduction are also more and food and housing/habitat is available in enough quantity. This phase is called **exponential phase**. In the middle phase the growth of the organisms in number is at rapid speed and increases limitless. As a result the food and housing facilities become less. There is competition among the organisms. Due to all these factors the number of organism's growth reach the stage where the natality (birth rate) and mortality (death rate) are equal. This type of number of organisms establish equilibrium in the environment in the environment. This last phase is called **Stationary phase, Zero phase or Plateau phase**. The graph made between organism number us time is **'S' shaped**. Most of the organisms represent this model of growth in number.

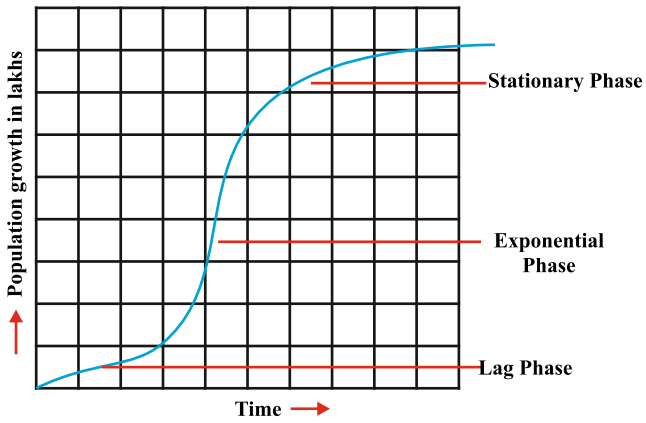

Fig. 38.1 'S' Shaped growth curve represents human population growth

2. 'J'Shaped growth curve : Some times the number of organisms/population (normally in laboratory) increases rapidly and at a definite point it becomes stationary i.e. the natality and mortality become equal. The growth rate becomes zero. The fall in the growth rate to minimum is due to the shortage of food. This growth curve is 'J' shaped and it has 3 phases:

(a) Lag phase : Initially or in the first stage/phase the growth is too less or negligible.

(b) Exponential phase : In this phase the population increases in the geometric pattern.

© Crash phase : In this phase the population growth stops/becomes stationary. This phase is obtained beyond the **carrying capacity** of the environment and the necessary requirements start to become less. It is the Last phase or **crash phase**.

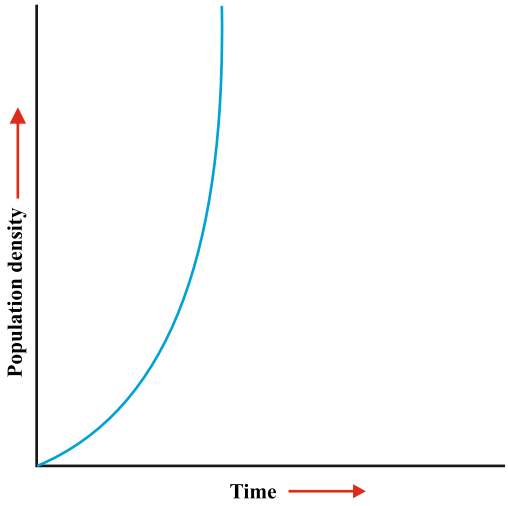

Fig. 38.2 (A) : 'J' shaped growth

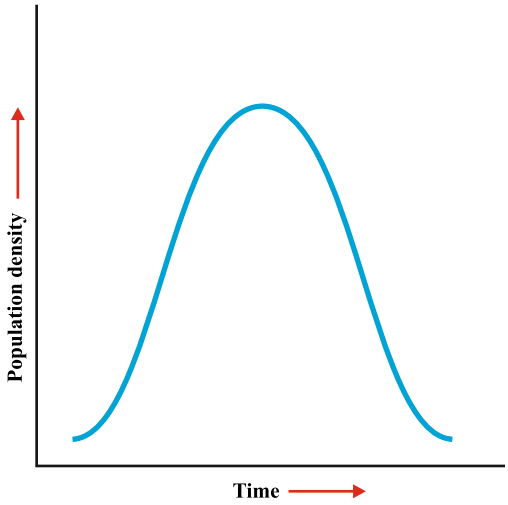

Fig. 38.2 (B) : Fall of number of individuals due to 'J' shaped growth

'J' shaped curve represents that phase in which the environmental resistance is negligible or zero. In the present situation the human population growth came in the world in 'J' shaped. In insects, that are found in a specific season growth curve is of this type. In this type of situation the population growth is J shaped growth curve.

Population in India :

From the population point of view India is the

second largest country in the world. The human population in India has reached approximately 1.37 billion in November 2017. Wold's largest population country, China has 1.41 billion in November 2017. At present the population in India is increasing at the rate of 1.2 per cent. If the population keeps raising in the same manner, then it will be the largest populated country by 2030. At present out of the total population 17.85 per cent live in India. Normally, in countries the population is increasing due to which there is effect on the economic progress and development.

In the present population in India is approximately 697 million males and 652 million females. According to male female ratio, it is 1000 males to 945 females. From the age point of view 50 per cent population is between0-25 years of age. Approximately 72.2 per cent live in rural areas and approximately 27.8 per cent population lives in urban areas.

Factors affecting population growth:

For the increase or decrease of population in any country four factors are responsible :-

(1) Natality (birth rate) 2. Mortality (Death rate) 3. Resident-Migration 4. Age distribution.

If the birth rate is high and the death rate is low, then the population increases and if birth rate is low and death rate is high then the population decreases. Similarly if the number of immigrants is more than the emigrants then the population increases. In reverse situation the population decreases.

(1) Birth rate or Fertility : Fertility is the deciding factor for any population growth. Reproductively active individuals present in a population to produce offspring's is called fertility. In the reference to the increase in population growth along with fertility birth rate or natality is also an important factor. The rate or number of children produced by per one thousand individuals per year in a population is called birth rate of that population. It is calculated by following formula :

$$N = \frac{B}{t}$$

Where N= Birth rate, B= Number of children produced by 1000 individuals/person, t = time period in years. The basic difference between birth rate and population growth is that birth rate always shows positive value whereas population growth rate can also be negative. Birth rate cannot be the indicator of ongoing fertility. **Total fertility rate** is the average number of children produced by a woman in her life time. Similarly, that number of children which is expected to replace self the married couple from the population is called **replacement level**. Real replacement level is always slightly more than 2.0 because some children die before they reach the reproductive age. In developed countries the replacement rate is 2.1, whereas in developing countries it is approximately 2.7 because in these countries death rate is high before reproductive age and life span is less.

In the world in different areas the fertility rates are different. In developed countries it is generally close to replacement level and is comparatively less whereas in developing countries (in India it is 2.9) the value is high. In the factors regulating the fertility economics and human expectations are main. In developing countries where technology is lacking, economics is labor based and for production due to requirement of maximum labors the high fertility is natural. But in developed countries the reproductive couple becomes aware and understand this fact that producing more children will reduce their life level. As a result of this total fertility rate probabily becomes less.

(2) Mortality : The mortality rate of any population per 1000 individuals per year is equal to the number of deaths.

$$M = \frac{D}{t}$$

where M = Mortality, D = Number of deaths per 1000 individuals, t = time period in years.

In maximum countries the death rate is regularly/continuously falling. As a result there has increase in the growth rate. Fall in death rate has been possible by following reasons :

1. Availability of high treatment/medical facilities in which immunity vaccination is also included.
2. Increase in general level in cleanliness.
3. Raise of awareness in reference to personal health and cleanliness (hygiene).

4. Improvement in availability of food grains and drinking water.

In any population birth rate and death rate have important place in deciding the structure of the population. Besides this in any specific time period what will be the pattern of the population can be anticipated also by values of the birth rate or death rate. From this view the demographers believe following points are useful

1. Crude Birth Rate : This is the number of live births (children) produced per one thousand individuals per year.

$$\text{Crude birth rate} = \frac{\text{Number of live births in a year}}{\text{Anticipated population in mid year (normally on 7 July)}} \times 1000$$

2. Crude Death Rate : the number of deaths per one thousand individuals per year.

$$\text{Crude death rate} = \frac{\text{Number of deaths in a year}}{\text{Anticipated population in mid year (normally on 7 July)}} \times 1000$$

3. Annual Rate of Natural Increase/Growth: The difference between the birth rate and death rate is called annual rate of natural increase/growth.

Annual growth rate = Birth rate - death rate.

4. If the birth rate and death rate are equal then the population structure is stationary. i.e. this growth rate is zero. Generally this situation takes place rarely. In some developed communities it is visible. Birth rate, death rate, total population is shown in figure 38.3.

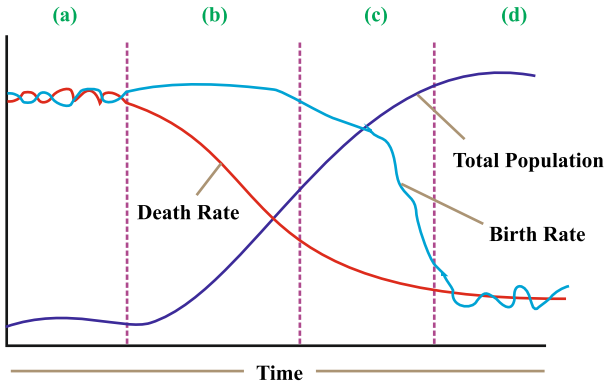

Fig. 38.3 In relation to birth rate, death rate, total population (a) High birth rate but high death rate, (b) Falling death rate and continuously high birth rate, (c) Falling birth rate and death rate, (d) Low death rate but fluctuating birth rate

(3) Migration : Migration means the movement of members of a species from one place to another or from different places to that place. If the members of a species move from one place or country to another place or country is called **emigration** and the members leaving the country are called **emigrants**. Reverse too it, if members of a species come from any area or country and start living such a migration is called **immigration** and such migration are called **immigration**.

From the above description it is clear that members who leave this country/region are called emigrants in reference to this country and then members who enter and live in a region/country are called emigrants in reference to that country. Though migration can take place in one country among different regions and between different countries. But the migration between two different countries affects the population of any country. Due to emigration there is decrease in the population density and due to immigration increases the population density. The increase in population growth due to migration is equal to **net immigration**. The value of net immigration can be calculated by:

Net immigration = Immigration-Emigration

The total population growth of a country can be calculated by adding the value of net immigration to population growth due to birth rate.

The value of net immigration can be positive, negative or zero.

(4) Age distribution : Age distribution is an important characteristics of population. It affects both birth rate and death rate. The presence of individuals in different age groups of a population is called **age distribution**. In a population age distribution depends on the species and population state, i.e. it is stable or changeable. Age distribution in different age groups in a population is number of individuals. Death rate, often changes with age in a population. With different number of youth and old individuals in a population death rate is different.

Similarly, reproduction is often limited to special age groups. Thus in a population the reproductive stage depends upon the different age

groups in a population. On this ratio only the growth or reduction of a population is dependent. By this ratio the future of the population can be anticipated.

Age Pyramid :

The representation of different age groups of individuals in a population can be done by age pyramid. In this manner the formed pyramids are called **age pyramid**. This representation of number of different age group individuals is done by horizontal bands in composition to its width. In ecology following three types of age pyramids have been predicted.

(1) A Pyramid with broad base : In this type of pyramid the base is broad and it is represented by the infants. In rapidly growing population the birth rate is high and the population grows faster. In such situations the number of individuals in each generation more than the number of individuals in earlier generation. This type of pyramid is found in house fly, yeast and *Paramecium*.

(2) A Bell-shaped Pyramid : The population in which this type of pyramid is represented the growth rate becomes slow and becomes stationary. Then it becomes almost equal in between pre-reproductive and reproductive age group. Post reproductive age group becomes the smallest. In this type of stationary population the age group distribution representation is bell shaped pyramid.

(3) An Urn-shaped Pyramid : In this type of pyramid the infants are very less. In this type of population the birth rate becomes very less and in comparison to the pre-reproductive age group the reproductive and post-reproductive age groups increase. As a result the pyramid shape in the population is like an Urn.

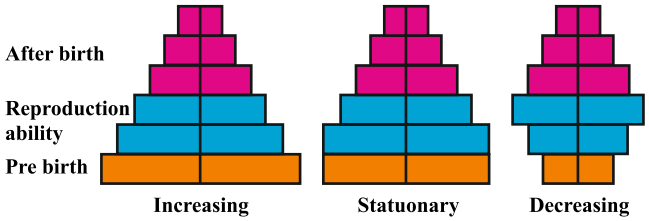

Fig. 38.4 Representation of age pyramids of human population

Factors to Control Population

The increasing population in India has created many problems related to social, economic and political. Thus, it is very essential to solve this problem at earliest, otherwise our economic progress will become slow and feeding, housing issues with be faced i.e. **population explosion** results have to be faced. In India careful population planning is required urgently so that the economic growth is not affected. Following solutions can be done for controlling the population growth.

1. Increase in age of marriage : To check the population growth in our country child marriage should be strictly controlled and the age for marriage should be 21 years for girls and 24 years for boys legally be done/fixed.

2. Expansion of Education : Population growth can also be checked by expansion of education. Illiteracy and poverty is also responsible for population growth. People must be educated about the benefits of a planned family and sex education should be provided in education institutions.

(3) Natural Methods : These methods work on the theory of checking the union of ovum and sperm.

Periodic control is one method in which the couple avoid copulation/intercourse/during 10^{th} to 17^{th} day of the menstrual cycle which is believed to be the period of ovulation. During this period the chance of fertilization and conceiving is high. Due to this, this time/period is also called **fertilization period**. By this way, conceiving can be avoided by not having copulation/intercourse.Cautious Interruption is another method. In this the male partner during copulation/intercourse/caution removes his penis out of the Vagina of female and semen ejaculation inside the vagina is avoided.

Lactational amenorhea : This method depends on this fact that after the parturition (child birth) the breast feeding of the new born in excess, ovulation and menstrual cycle does not start. This is why when the mother breast feeds the child in excess continuously the chances of conceiving is almost zero. (During this period the child should not be fed with water or other milk except mother's milk). This period is 4-6 months. This period is considered to be maximum of 6 months only after the parturition

(child birth). Because in these above methods no medicine or mode is used, this does not have any harmful effect. However, its rate being unsuccessful is very high.

4. Family Planning : To check the increasing population other methods are not that effective/worth as is the family planning. Family planning these days is named as family welfare. This is only one worth method/mode which to some extent can solve the population problem. The objective of family planning is to advertise and expand the awareness/knowledge about contraceptive methods due to which the married couple according to their wish can produce children and can control the growth of family. In our country by this program population control has been done but the success that is required has not been achieved. This is the only main method by which population control can be done. Government of India and state government are spending lot of money on this, even then the desired result is not obtained. For the family planning many have been used out of which following are main:

(i) Barrier Methods : In this methods the physical meeting/union of the ovum and sperm is checked. This type of method is available for both male and female. Condom (Nirodh) etc. as barrier method which are made of thin rubber or latex so that by using this, exactly before the intercourse the penis, of male, vagina and cervix of female is covered and the sperms cannot enter the reproduce tract. It can prevent from the conceiving. For male condom's most popular brand 'Nirodh' is quite popular. Recently there has been increased in the use of condom because besides conceiving prevention of transmission of sexually transmitted diseases (STDs) such as AlDS can be done. These are benefits. Both type or condoms for males and females are of disposal type. It can be used by self and by this the privacy/confidentially can be maintained. Diaphragm, cervix cap, valt etc; are made of rubber and are barriers which is used by women before the intercourse to cover the cervix or the reproductive tract. This covers the cervix and checks the entry of sperms and prevent the conception. It can be used again. Along with these barrier methods often used other alternatives/ options are-spermicidal cream, jelly and foam. Due to which their contraceptive capacity increases.

(ii) Intra Utrine Device (IUD) : This device is implanted by a doctor or an experienced nurse. These days' different types of IUDs are available. These are IUD (Lepas Loop) Copper releasing IUD (Copper T, copper-7, multi load 357 copper T) and Hormone releases IUD (Progestart, LNG-20) etc. By the IUD inside the Uterus, copper (Cu) are released due to which the Phagocytos is of sperms increases due to which its movability and their fertilization capacity is decreased. Besides this IUD makes the hormone unsuitable for implantation of the fetus in uterus and make the cervix opponent of the sperms. Those women who want delay or gap period among the children, for them this IUD is an ideal contraceptive. In India these contraceptive is widely popular.

(iii) Contraceptive Pills : In women the oral pills are contraceptive which have the combination of progesterone or progesterone and estrogen. These are tablets taken orally but are popular by the name of pills. These tablets are taken for 21 days daily and after 7 days of menstrual cycle/menstruation it is restarted. This process goes on till then contraception is needed. This not only changes the ovulation and implantation but also changes the quality of the mucous of cervix. Due to which the sperms are checked and their mobility is slowed down. These tablets are very effective and are less harmful and it is very acceptable by women. “Sehali' named contraceptive tablet is non-steroidal. It is taken once in a week. It has very less harm and has high contraceptive capacity.

(iv) Surgical methods : It is also called castration. Generally it is suggested to those people who do not want pregnancy and they want a permanent method for male/female. Due to the surgical intervention gamete transportation is checked as a result implantation does not take place. The castration method in males is called vasectomy and in female it is called tubectomy. Generally people call it by name of male or female nasbandi.

In vasectomy a small part of the vas deferens is cut and removed and open ends tied after incision on

scrotum. Whereas in women the incision is done in abdomen or from Vagina a small portion of oviduct

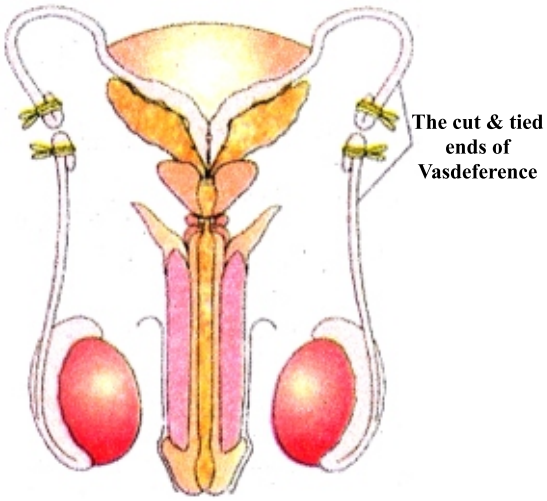

Fig. 38.5 (a) Vasectomy-extraction

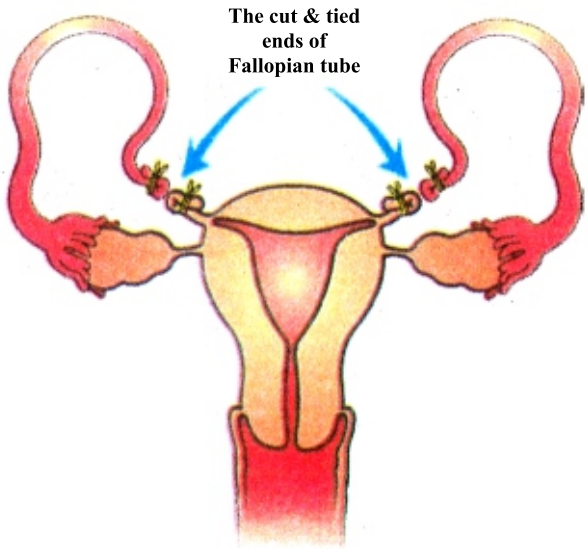

Fig. 38.5 (b) Tubectomy (Fallopian tube)-extraction

is cut and removed. The open ends are then tied. These methods are very effective but these methods cannot be reverted to the original state.

Important Points

1. The group of members of a species or its related species in geographical area at a given time is called population.
2. Population can be of a species or many species.
3. Population density is the total number of individuals living in any special area at a given time period.
4. Population density is of two types, crude density and ecological density.
5. T.R. Malthus (1778) was first to publish an essay related to population and stated that human population growth is quite higher than the food growth rate.
6. World Population Day is celebrated on 11th July each year.
7. Growth of human population is shown by growth curve. Growth shows two forms J shaped and S shaped curve (Sigmoid curve).
8. The factors affecting the population growth are-birth rate, death rate, and migration are main.

Practice Questions

Multiple Choice Questions-

1. The scientist who first proposed the theory or human population is:
   (a)Malthus (b) Lamark
   (c) Badenhaymar (d) Darvin
2. The contribution of India in the total world population is:
   (a) 12.4% (b) 17.85%
   (c) 16.2% (d) 15.1%
3. The reason for rapid population growth is:
   (a) Increase in the birth rate
   (b) Improvement of life style
   (c) Global Warming
   (d) Fall in the death rate
4. The shape of population due to maximum olds is:
   (a) Increase in the future
   (b) Decrease in the future
   (c) Will be stable
   (d) None of these
5. Which one of the following is not a contraceptive?
   (a) Condom (b) Sehali tablet
   (c) Valt (d) Steroid Pill

Very Short Answer Questions-

1. Define population.
2. What is population growth curve?
3. Mention one responsible factor for fall in the death rate in India.
4. What will be the fate (future) or the population growth when the birth rate and death rate will become same/equal?
5. What is IUD in contraception methods?
6. What are contraceptive tablets/pills?
7. What is vasectomy?
8. What is tubectomy?

Short Answer Questions-

1. Differentiate between birth rate and death rate.
2. What is population density? Mention the formula to calculate it.
3. Explain the methods of calculating population density.
4. Comment on following:

   (i) 'S' shaped growth curve/pattern, (ii) Factors effecting population, (iii) Birth rate and death rate.
5. Clarify the structure of age group in population.
6. What is age pyramid?
7. Mention about the contraceptive methods used by women.
8. Write a note on castration,

Essay Type Questions-

1. Express your thoughts on 'Increasing population of India is a major problem of tomorrow'.
2. Comment on following:

   (i) Human growth pyramid.

   (ii) Male-female ratio in Indian population.
3. Explain in detail about Population growth curves.
4. Discuss about the different factors of population control.

Answer Key-

1. (a) 2. (b) 3. (d) 4. (b) 5. (d)