

# ***TERM PAPER – CARRYING CAPACITY***

*Submitted by –*

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## WHAT IS CARRYING CAPACITY?

Carrying capacity of an area can be defined as the maximum number of population that can be supported by the environment of that area through optimum utilization of the available resources.

## WHAT IS POPULATION?

Population is a group of organisms, all of the **same species**, that live in a **specific area** at the same time.



# WHAT CAUSES POPULATION CHANGE?

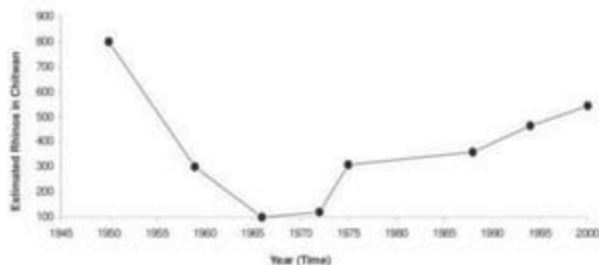
## FOUR FACTORS

Birth Rate : Number of births

Immigration : Movement into the population

Death Rate : Number of deaths

Emigration : Movement out of the population



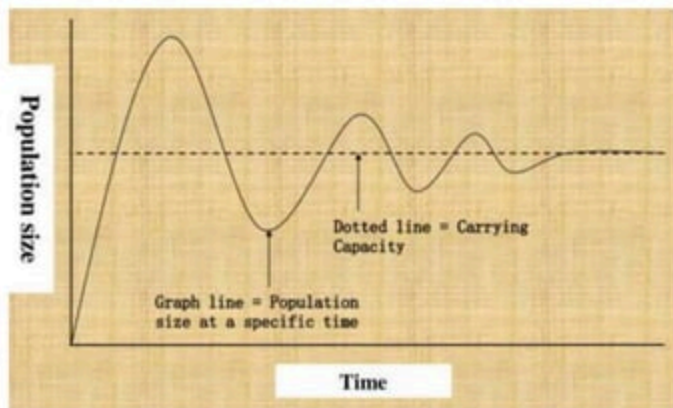
Source: <https://www.google.com/>

## WHAT IS CARRYING CAPACITY?

The maximum population a habitat can support indefinitely.

Population exceeds, for long periods, degrades its environment and reduces future carrying capacity.

- When population is below carrying capacity it will increase in size
- If increases too much and rise above its carrying capacity, it will decrease its size.
- Increases and decreases gets smaller.
- Until eventually the population size becomes stable at carrying capacity.



# WHAT AFFECTS CARRYING CAPACITY?

## LIMITING FACTOR

Factors that affect the size of a population.

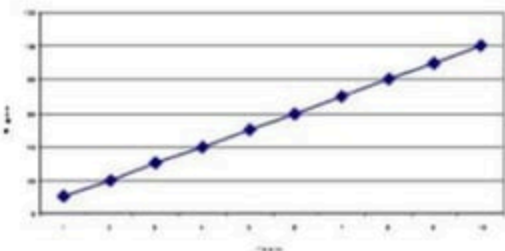
- Competition over resources
- Predation and Herbivore
- Parasitism and Diseases
- Natural Disasters
- Weather
- Presence of invasive species

# POPULATION GROWTH

## LINEAR GROWTH

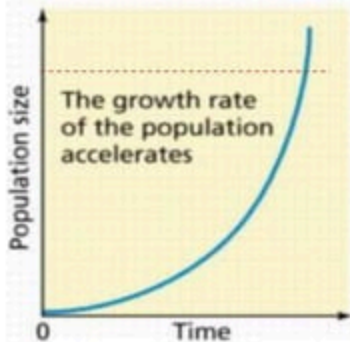
If a population grew at a set amount each year, say by 10 organisms per year, then the population has **LINEAR GROWTH**.

However, populations normally do not have linear growth



## EXPONENTIAL GROWTH

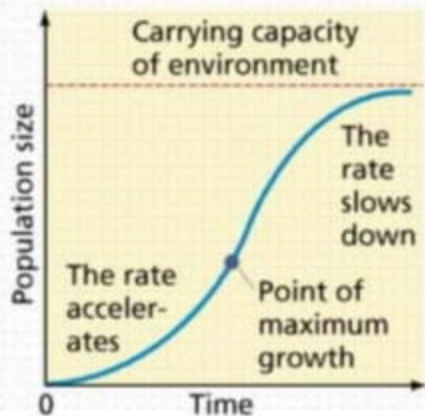
A population that is growing without any limits, would have exponential growth. But, populations cannot keep exponential growth for very long, because the environment would not be able to support



# POPULATION GROWTH

## LOGISTIC GROWTH

A population that is growing with limiting factors, would have restricted growth.



## LOGISTIC GROWTH – Example

### Easter Island –

Discovered by Polynesians ~ A.D.

Population grew to several thousand –

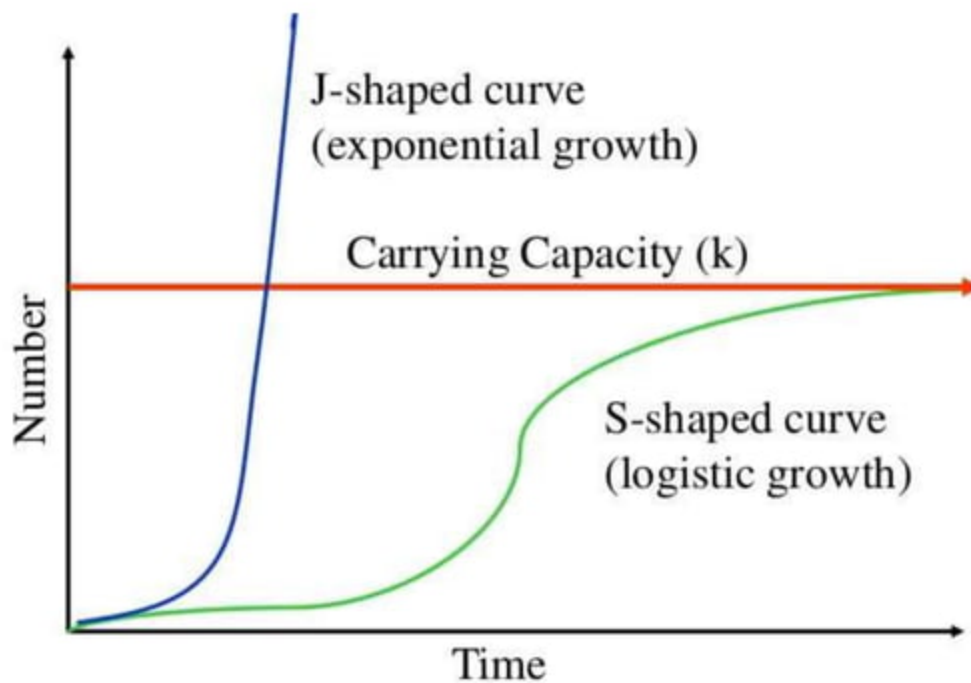
- Used trees for canoes to hunt dolphins,
- Used wood for cooking,
- Also ate birds, eggs, vegetables

Resources (trees) depleted –

- No canoes, no dolphins,
- Warfare over land, food resources

Population fell to ~ 100.

## CARRYING CAPACITY



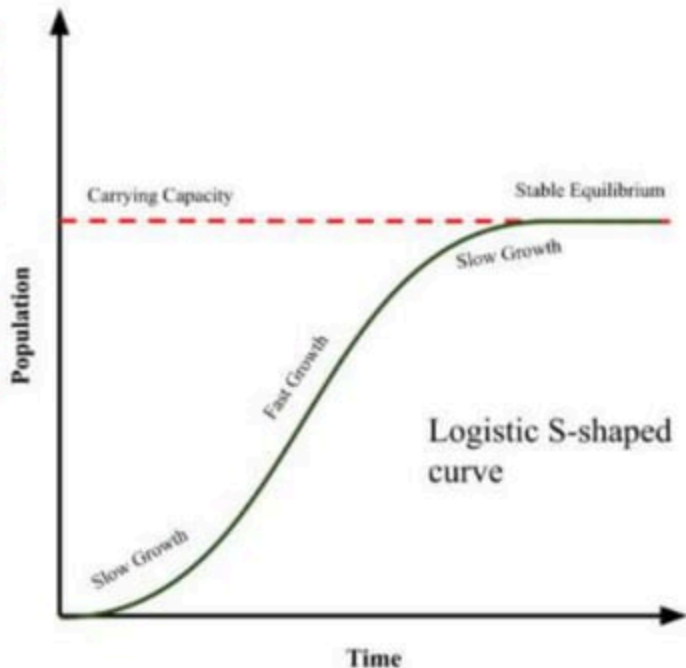


## CARRYING CAPACITY

The S-shape logistic growth forms when the growth rate is slow at first (lag phase) and next speeds up (exponential phase). Then, the rate slows down again as the population size reaches carrying capacity.

It coincides with the stable equilibrium, which refers to the population size that has reached a steady-state as it aligns with the carrying capacity.

This point indicates “zero-growth”.



## CARRYING CAPACITY

Carrying capacity is presented as the constant  $K$  in the logistic population growth equation,

$$\frac{dN}{dt} = rN\left(\frac{K-N}{K}\right)$$

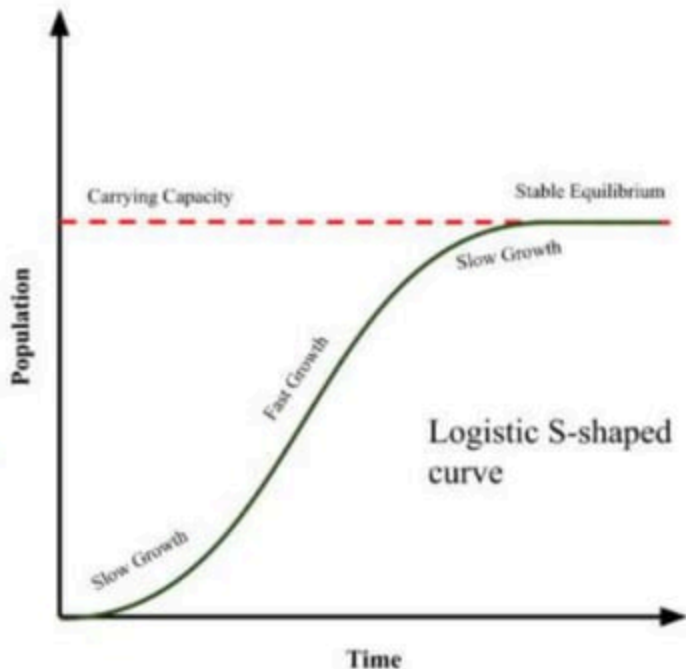
Where,

$N$  = population size or density

$dN/dt$  = change in population size

$r$  = intrinsic rate of natural increase (i.e., the maximum per capita growth rate in the absence of competition)

$t$  = time



## CARRYING CAPACITY

Carrying capacity K formula –

$$K = \frac{rN(1 - N)}{\frac{dN}{dt}}$$

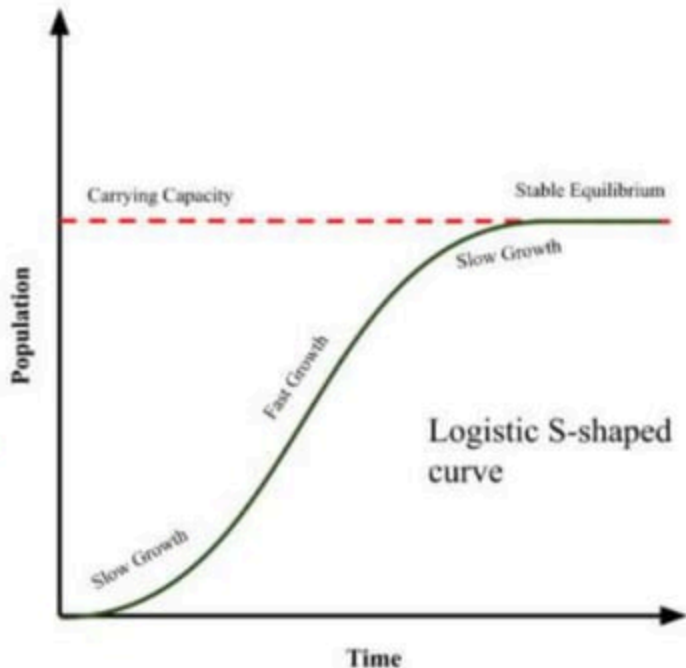
Where,

**N** = population size or density

**dN/dt** = change in population size

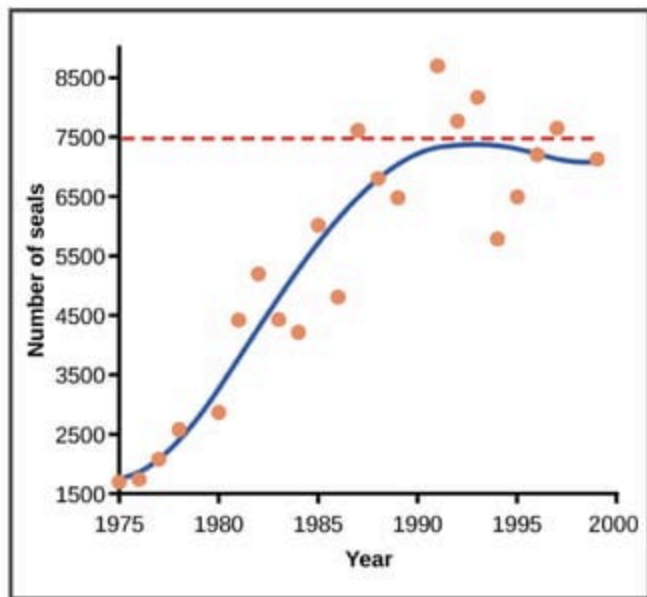
**r** = intrinsic rate of natural increase (i.e., the maximum per capita growth rate in the absence of competition)

**t** = time



## CARRYING CAPACITY EXAMPLE

In the real world, there are variations on the “ideal” logistic curve.  
the graph below, which illustrates population growth of harbour seals in Washington State.



## CARRYING CAPACITY IN URBAN PLANNING

Planners usually define carrying capacity as the ability of the natural or artificial system that can absorb the population growth or physical development without considerable degradation or damage

The evaluation of urban carrying capacity is a complex process as it is determined from basic needs such as food requirements, various kinds of resources consumed and the many kinds of wastes generated, different kinds of land use conversions leading to ecological imbalance and the great variability in technology, institutions and lifestyles created.

**Infrastructure Capacity Level**

**DEFINITION**

**Environmental Capacity Level**

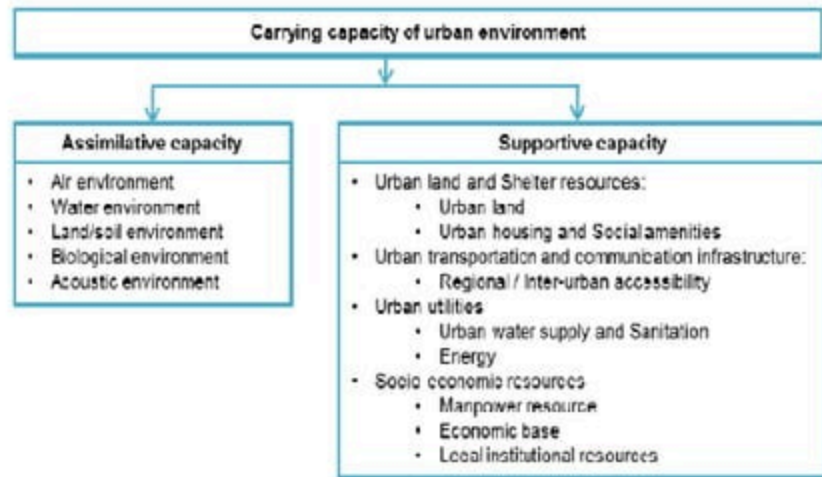
**CONCEPT**

**Sustainable Capacity Level**

**INDICATOR**

## APPLYING CARRYING CAPACITY

Planning based on carrying capacity deals with the management of human activities, supportive resources and assimilative capacities of the environment and general process of carrying capacity based planning is depicted.



### EXAMPLE:

**Urban carrying capacity of a urban area**

**Tourism Carrying Capacity**

## REFERENCES

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