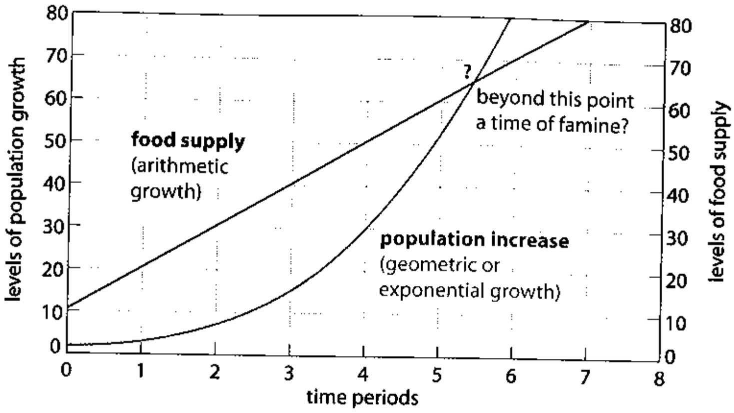


Figure 13.57 Relationships between population growth and food supply (*after* Malthus)

Theories relating to world population and food supply

Malthus

Thomas Malthus was a British demographer who believed that there was a finite optimum population size in relation to food supply and that an increase in population beyond that point would lead to a decline in living standards and to 'war, famine and disease'. He published his views in 1798 and although, fortunately, many of his pessimistic predictions have not come to pass, they form an interesting theory and provide a possible warning for the future. Indeed, his doomsday theory was resurrected in 2007, but due to rising global food prices rather than to food shortages. His theory was based on two principles.

1 Human population, if unchecked, grows at a **geometric** or **exponential rate**, i.e. 1 → 2 → 4 → 8 → 16 → 32, etc.
2 Food supply, at best, only increases at an **arithmetic rate**, i.e. 1 → 2 → 3 → 4 → 5 → 6, etc. Malthus considered that this must be so because yields from a given field could not go on increasing for ever, and the amount of land available is finite.

Malthus demonstrated that any rise in population, however small, would mean that eventually population would exceed increases in food supply. This is shown in Figure 13.57, where the exponential curve intersects the arithmetic curve. Malthus therefore suggested that after five years, the ratio of population to food supply would increase to 16:5, and after six years to 32:6. He suggested that once a ceiling had been reached, further growth in population would be curbed by negative (preventive) or by positive checks.

Preventive (or **negative**) **checks** were methods of limiting population growth and included abstinence from, or a postponement of, marriage which would lower the fertility rate. Malthus noted a correlation between wheat prices and marriage rates (remember that this was the late 18th century): as food became more expensive, fewer people got married.

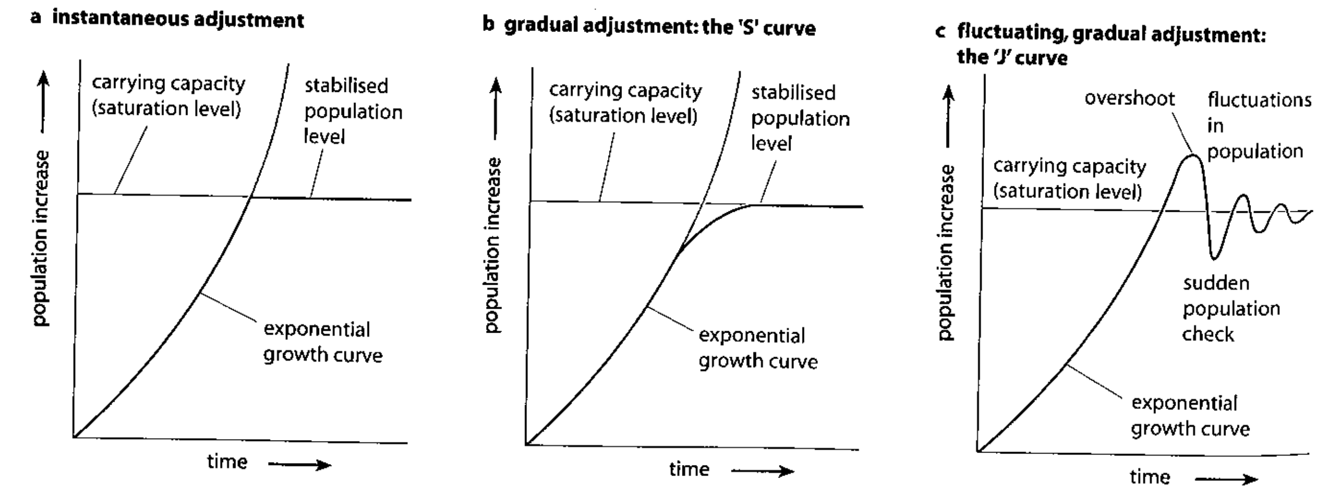
Positive checks were ways in which the population would be reduced in size by such events as a famine, disease, war and natural disasters, all of which would increase the mortality rate and reduce life expectancy.

The carrying capacity of the environment

The concept of a population ceiling, first suggested by Malthus, is of a saturation level where the population equals the carrying capacity of the local environment. The **carrying capacity** is the largest population of humans/animals/plants that a particular area/environment/ecosystem can carry or support.

Three models portray what might happen as a population, growing exponentially, approaches the carrying capacity of the land (Figure 13.58).

Figure 13.58 Three models illustrating the relationships between an exponentially growing population and an environment with a limited carrying capacity



The rate of increase may be unchanged until the ceiling is reached, at which point the increase drops to zero. This highly unlikely situation is unsupported by evidence from either human or animal populations.

More realistically, the population increase begins to taper off as the carrying capacity is approached, and then to level off when the ceiling is reached. It is claimed that populations which are large in size, have long lives and low fertility rates, conform to this 'S' curve pattern.

Here the rapid rise in population overshoots the carrying capacity, resulting in a sudden check – e.g. famine and reduced birth rates. After an initial dramatic fall, the population recovers and fluctuates, then settles down at the carrying capacity. This 'J' curve is more applicable to populations that are small in number, and have short lives and high fertility levels.

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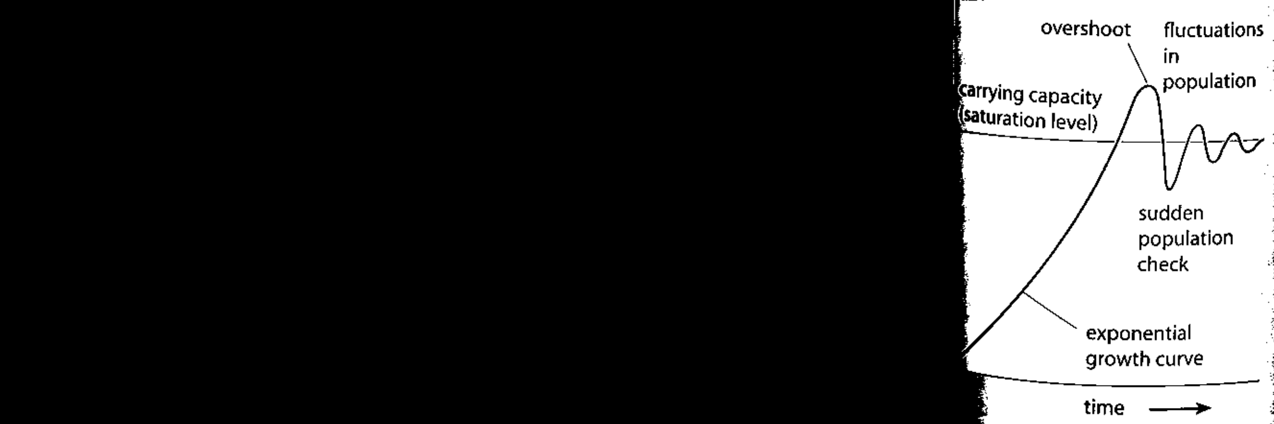

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Links between population growth, use of resources and economic development

An international team, known collectively as the **Club of Rome**, predicted in 1972, through the use of computers, that if the then rapid trend in population growth and resource utilisation continued, then a sudden decline in economic growth would occur in the next century. Their suggested plans for global equilibrium, few of which have been implemented, included:

- the stabilisation of population growth and the use of resources
- an emphasis on food production and conservation.

At the World Population Conference in Mexico City in 1984, the emphasis was put on taking positive steps to reduce population growth, largely through family planning programmes. The general consensus view articulated the need for population strategies in integration with other development strategies. By 2005, international organisations were suggesting that high population growth rates were a symptom of poverty, not the cause of it. They claimed that all the spending on birth control measures and family planning programmes were having little effect in places where poverty remained the key influence on people's everyday lives.

Ecological footprint

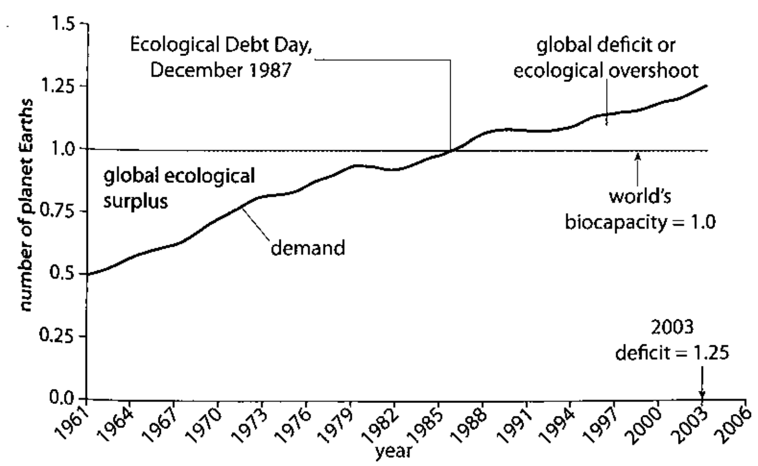
The ecological footprint is a resource management tool that aims to measure the impact of people's lifestyles upon planet Earth. It calculates how much productive land and sea a human population needs to generate the resources it consumes in order to provide all the food, energy, water and raw materials required in people's everyday lives. It also calculates how long it takes to absorb and render harmless the waste that humanity creates or for the ecological balance to renew itself.

Figure 13.59a shows how the ratio between the world's demand and the world's biocapacity has changed over time. Expressed in terms of **'number of planet Earths'**, the biocapacity is always 1 (the horizontal line). The graph shows that whereas in net terms humanity only used about half the planet's biocapacity in 1961, by 2003 this had increased to 1.25 times. The present global ecological deficit of 0.25 represents the world's **ecological overshoot**. This means that as humanity's ecological footprint is 25 per cent more than the planet can regenerate, it now takes one year and three months for the Earth to replace what people use and the waste they create in a single year. By measuring the ecological footprint of a population (a person, a city, a country, and even all humanity) we can assess our overshoot and should, therefore, be able to manage the Earth's ecological resources more carefully.

While the term 'ecological footprint' is now being more widely used and understood, methods of measuring it still vary, although some calculation standards are now emerging. Figure 13.59b lists the countries with the greatest global ecological surplus and the greatest ecological deficit. In 2003, the most recent year for data to be available, the total biocapacity for the world was 2.26 global ha/person. This figure was reached by adding together the global ha/person for each of the following footprints: cropland 0.49, grazing land 0.15, forest 0.23, fishing grounds 0.15, carbon 1.07 (page 638), nuclear 0.09 and built-up land 0.08.

Figure 13.59 The world's ecological footprint
a Human demand and the Earth's biocapacity
b Countries with the greatest global ecological deficit and surplus

a



b

Global ecological footprint			
Surplus		**Deficit**	
1 Gabon	17.8	UAE	−11.0
2 Bolivia	13.7	Kuwait	−7.0
3 New Zealand	9.0	USA	−4.8
4 Mongolia	8.7	Belgium	−4.4
5 Brazil	7.8	Israel	−4.2
6 Congo	7.2	UK	−4.0
7 Canada	6.9	Saudi Arabia	−3.7
8 Australia	5.9	Japan	−3.6

Other selected countries: Germany −2.4, China −0.9, India −0.4, Kenya and Bangladesh −0.2, Ghana +0.3, Malaysia +1.5, Korea, Sweden and Spain each +3.5