POPULATION FACTORS

The two main drivers are the Crude Birth Rate (CBR) and the Crude Death Rate (CDR).

→ Using these will give you the Rate of Natural Increase (RNI)… RNI = CBD-CDR

The Population Growth Rate (PGR) includes Net Migration… Net Migration = Immigration (in-migration) – Emigration (out-migration)

→ PGR = RNI + Net Migration

THE NUMERICAL DIFFERENCE BETWEEN “RNI” and “PGR”

1. The Rate of Natural Increase is usually expressed as the “crude rate” (as are birth rates and death rates)… the crude rate is based on “per thousand population”.

→ If the CBR is 40/1000 and the CDR is 20/1000, the RNI = 40-20… RNI = 20/1000

2. The Population Growth Rate is usually given as a percentage rate (%). “Per Cent” means per hundred… so…

→ If the RNI is 20 divide 20 by 10 (move the decimal point one place to the left)…

→ …then then the PGR is… 2/100 or 2%

Try these on your own (remember… this could be on a quiz!)… Answers on next slide… do these <u>first</u> than check your results!

If the birth rate is 13 and the death rate is 7, what is the RNI? …the PGR?
If the birth rate is 27 and the death rate is 21, what is the RNI? …the PGR?
If the birth rate is 27 and the death rate is 13, what is the RNI? …the PGR?
If the birth rate is 4 and the death rate is 7, what is the RNI? …the PGR?

There are other factors that can have an impact on the population growth too, but <u>usually</u> these are more minor effects…

→ infant mortality, early childhood deaths, life expectancy, total fertility rate, replacement fertility rate

Examples of RNI and PGR…

If the birth rate is 13 and the death rate is 7, what is the RNI? …the PGR?

→ RNI = 13 – 7 …= 6 → PGR = 0.6%

If the birth rate is 27 and the death rate is 21, what is the RNI? …the PGR?

→ RNI = 27 – 21 … = 6 → PGR = 0.6%

If the birth rate is 27 and the death rate is 13, what is the RNI? …the PGR?

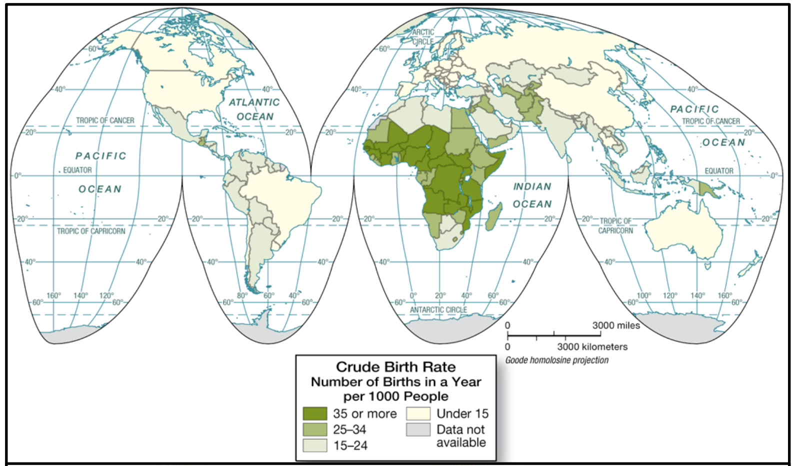
→ RNI = 27 – 13 … = 14 → PGR = 1.4%

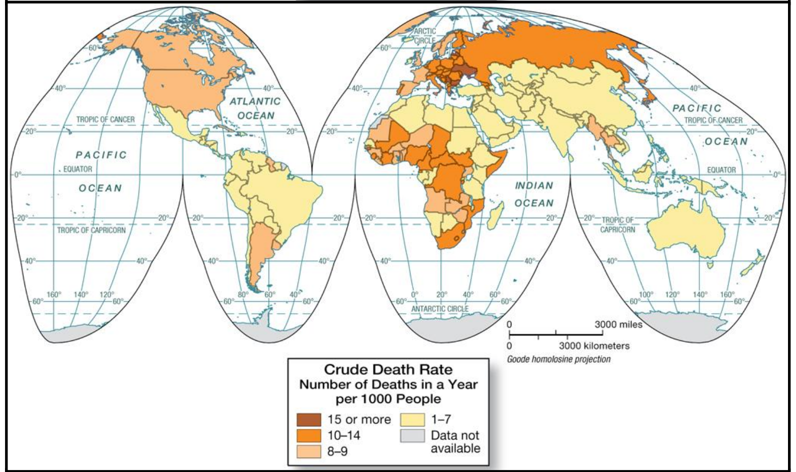
If the birth rate is 4 and the death rate is 7, what is the RNI? …the PGR?

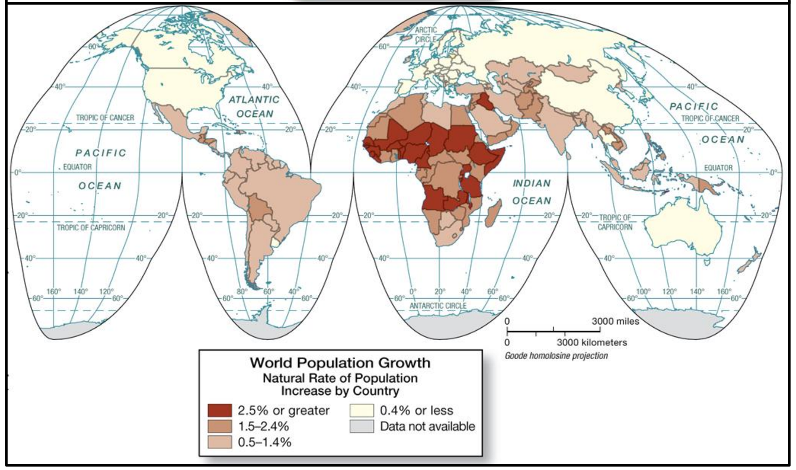
→ RNI = 4 – 7 … = -3 → PGR = -0.3%

Note: the Rate of Natural "Increase" and the Population "Growth" Rate can be negative…

…and it is in a handful of countries today.







Current Global Population Rates

The map at top left shows the Crude Birth Rates (CBR) as of 2018; the map in the middle left shows the Crude Death Rates (CDR), and the map at bottom left shows the Rate of Natural Increase (RNI).

There are a couple interesting things to note.

1. Look at Russia (it's the big orange blob in the north on the CDR map). Russia currently has a low CBR and a high CDR. Currently, Russia is experiencing a population decline (negative RNI). The population of Russia has dropped from about 188 million in 1990 to about 160 million today.
2. The US and Canada… both have low CBRs, and somewhat high CDRs. Both the US and Canada are close to equilibrium (no growth). Both have very low Rates of Natural Increase. Most European countries also have very low growth rates, and some are at equilibrium. A few are currently estimated to be negative (Italy, Sweden and Germany… Germany's has a positive Population Growth Rate, though, due to positive Net Migration).
3. Asia, including Indas and China… almost all of the Asian countries are experiencing a slow-down in population growth. While they are growing faster than the US, Canada and Europe, the growth rates have dropped in the last decade to around 1%.
4. Africa… note that many African countries have high CBRs and high CDRs. The first thought might be that they would be close to equilibrium, but the birth rates are higher in most countries than the death rates – and still considerably higher in many. The RNI in many African countries, as can be seen on the bottom left map, is still very high.

Population growth has been a focus of many population geographers and demographers since the late 1950 – early 1960s. Global population growth then was very high, and there was a great concern that the world's population, if it continued to grow at those rates, would overwhelm the available resources of the planet – especially clean water and good soils.

Why the concern over population growth?

One focus of many of the population studies looked at the population Doubling Time.

Doubling Time $$T_d = \frac{\log(2)}{\log\left(1 + \frac{r}{100}\right)}$$

Easy Approximation:
DT = 70/PGR
(Strip off the "%" and express in Years)

The Doubling Time is calculated as how many years would it take for the population to double in size from its current population, if the Population Growth Rate remained constant over that time. The fancy formula is basically the same formula that you would use to compute compound interest in, say, a savings account. Each day, you have to recalculate because on the first day, you have the amount you start with, plus the interest… but on the second day, you have the amount you started with plus the interest from the first day… plus the interest on that amount (not just the starting amount). It is the same with population: you multiply from the day you start by the Population Growth Rate, but on Day 2, you have to recalculate because now you have that starting population plus all the persons that were added that first day.

The "Easy Approximation" actually works to give you a very close estimate of the Doubling Time (and it's a lot easier). If you want proof, there are several website that show the mathematical proofs for this formula.

→ So, if a population is growing at 1% a year, then it will double in 70 years. At 2% … 140 years. At ½% … 140 years.

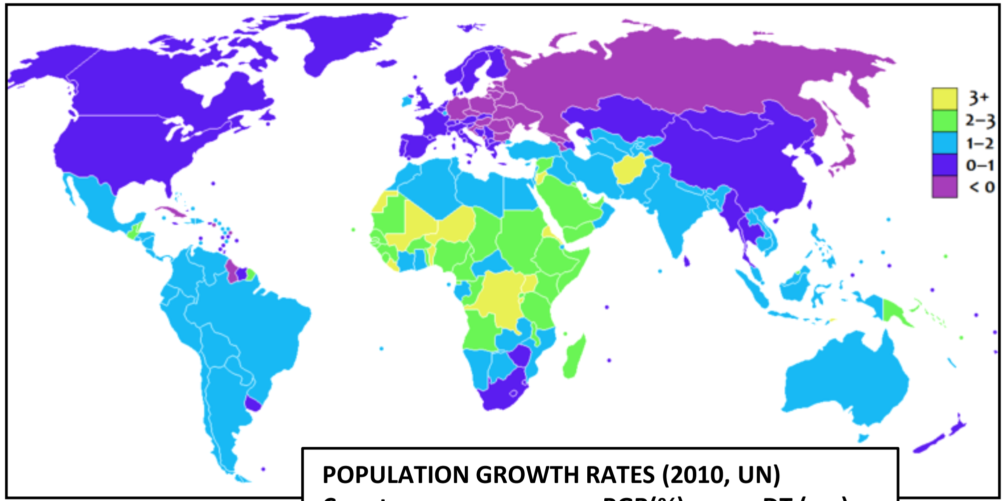
Annual Percentage Increase	Doubling Time (Years)
0.5	140
1.0	70
2.0	35
3.0	24
4.0	17

World population and growth rates

Year	Estimated Number of People	Percent Average Yearly Growth in Prior Period	Number of Years in Which Population Doubles at Current Growth Rate
400,000 B.C.	500,000	—	—
8000 B.C.	5,000,000	0.001	59,007
A.D. 1	300,000,000	0.05	1,354
1750	791,000,000	0.06	1,250
1800	978,000,000	0.43	163
1850	1,262,000,000	0.51	136
1900	1,650,000,000	0.54	129
1950	2,517,000,000	0.85	82
1994	5,607,000,000	1.78	38
2010	**7,100,000,000**	**1.14**	**61**

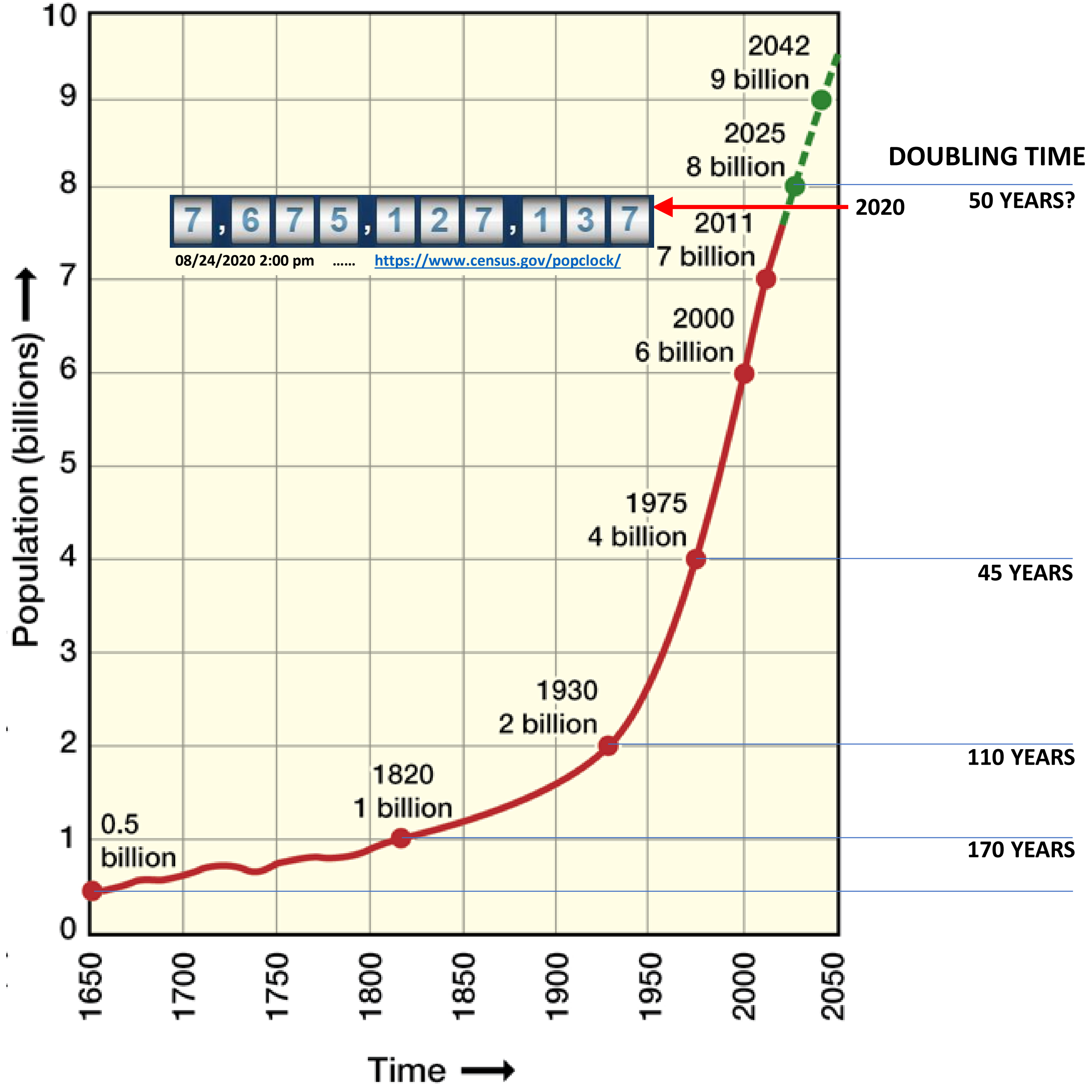
The table above shows the estimated doubling time of the world's population throughout history.

The map at right shows the calculated growth rate and estimated doubling time for certain countries. The US is lower than Brazil, but still higher than many of the Wester European countries (still higher than China too).
China and India are the two global giants, and global worries. At a current growth rate of 1.4%, India – already more than 1 billion – could double in size in just 50 years. India will likely have a larger population than China within the next 30-40 years.



POPULATION GROWTH RATES (2010, UN)

Country	PGR(%)	DT (yrs)
1. Dem. Rep. of the Congo	2.8	25
2. Nigeria	2.4	29
3. India	1.4	50
4. Brazil	1.0	70
5. China	0.5	140
6. Russia	-0.2	- -



GLOBAL POPULATION GROWTH

This population graph give you a sense of the rapid population growth that has occurred, especially starting in the 1800s.

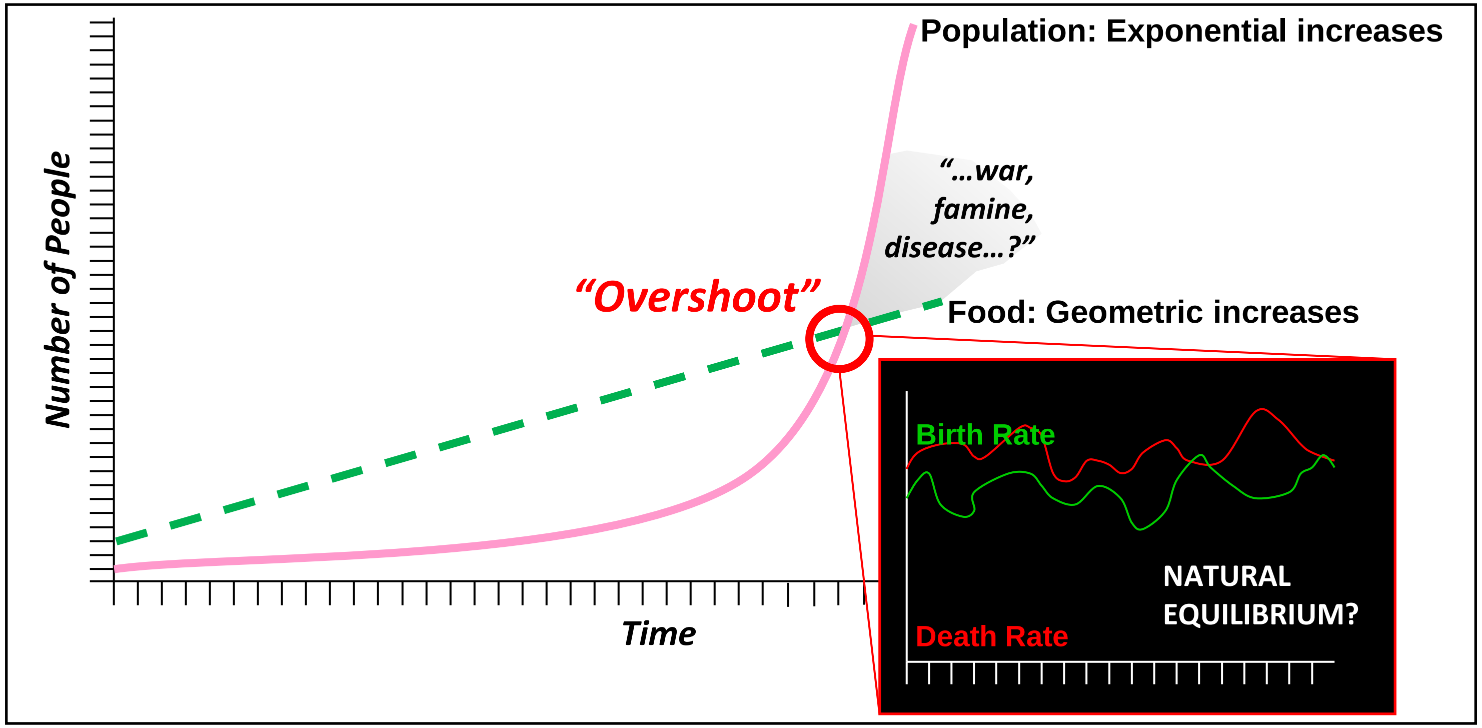
The Industrial Revolution started in England in the late 1700s, and began to spread into Wester Europe and then into the US and Canada. A lot of the initial innovations that came about in the Industrial Revolution were connected to agriculture – new tools that made farming easier, faster and required fewer people to farm more land. A "surplus army of labor" was created by the need for fewer farm laborers, and those people moved to the growing cities, where new factories offered more opportunities.

Along with the rapid urbanization of those countries' populations, there was also a slow growth in understanding sanitary conditions – keeping drinking water supplies safe, removing sewage and garbage from the urban environment, and more or less accidentally lessening the effects of certain disease vectors (draining swampy areas near cities to build canals or to develop reduced the mosquito problem).

And… the new farming technology also allowed us to grow more food, using new land that we couldn't farm before and increasing yields. More food meant better nutrition, and better health. Infant mortality and early deaths due to disease began to slowly decline, and life expectancy increased. But we did not, as a culture, recognize that these would be long terms effects, so family size – the only way to ensure that the family would live on up to then – stayed large… and the population began to grow rapidly.

The problem later on is that even as the Population Growth Rate declines, even a small growth rate adds a lot of people. 1% doesn't sound like much, but if the US population were currently growing a 1% per year, the country's population would double in 70 years (it would then be close to 700 million). For India, that problem is worse. A 1% growth rate in India would mean that the population would increase from 1.2 billion now to 2.4 billion by 2090.

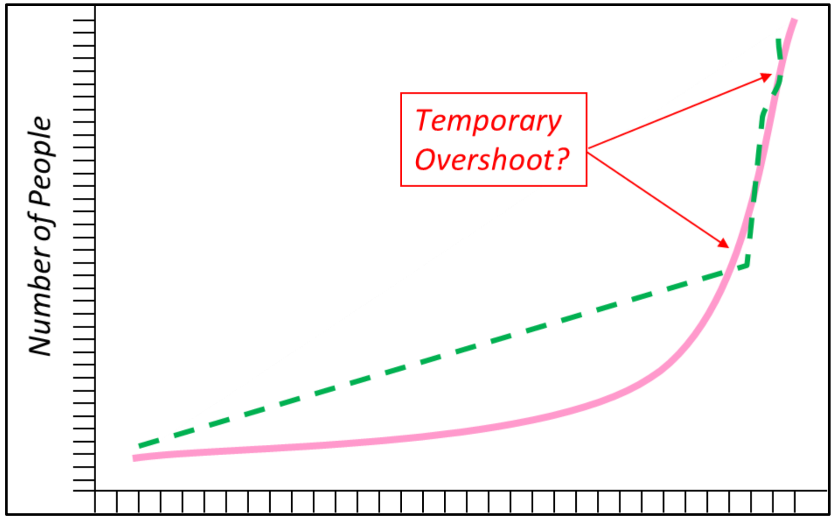
Is there a "maximum population"?
Thomas Malthus - *Essay on Population* (1798)



Malthus, in the late 1700s, was a London businessman who also owned farmland. He wondered about England's long-term ability to feed itself, knowing that the growth in the food supply was steady, but slow… and the population growth was very fast.

Malthus thought that it was possible that growth in population and growth in the food supply could lead to future events he called "overshoot" – when the population grew so large that even with modern farming methods, it would not be possible to feed the nation. Malthus's pessimistic view of this was that it would inevitably lead war, famine and disease… fighting over land for crops to feed hungry people that would suffer more from disease because of malnutrition.

He predicted that this would mean that there would have to be a natural cap on the number of people, or a natural equilibrium – a limit to the population enforced by nature, because there would be a limit to the amount of food that nature could provide, even with technological help.



Critics of Malthus are sometime referred to as Technocopians. The terms is derived from "Technology" (innovations that have vastly expanded our food supplies), and "Cornucopian" – the "horn of plenty." Technocopians have long argued that Malthus underestimated the inventiveness of humans, and note that most instances of famine have been the result of unpredictable nature phenomena (especially drought cycles) coupled with our inability (or unwillingness) to distribute excess food resources to where they are needed. Overall, the world's farmers have always grown more food than needed. Political barriers often prevent food getting to places that have shortages that may have been caused drought or war. In the US, we throw away nearly 80 billion pounds of food every year, worth about $161 billion (about 219 pounds of waste per person). This is 30-40 percent of the US food supply. And, we also pay farmers at times not to grow food. This has happened several times in the dairy industry because of over-prodution of fresh milk, cheese and butter, and it has happened in other farm commodities as well.

POPLATION and RESOURCES: *Is the world “overcrowded”?*

“CARRYING CAPACITY”

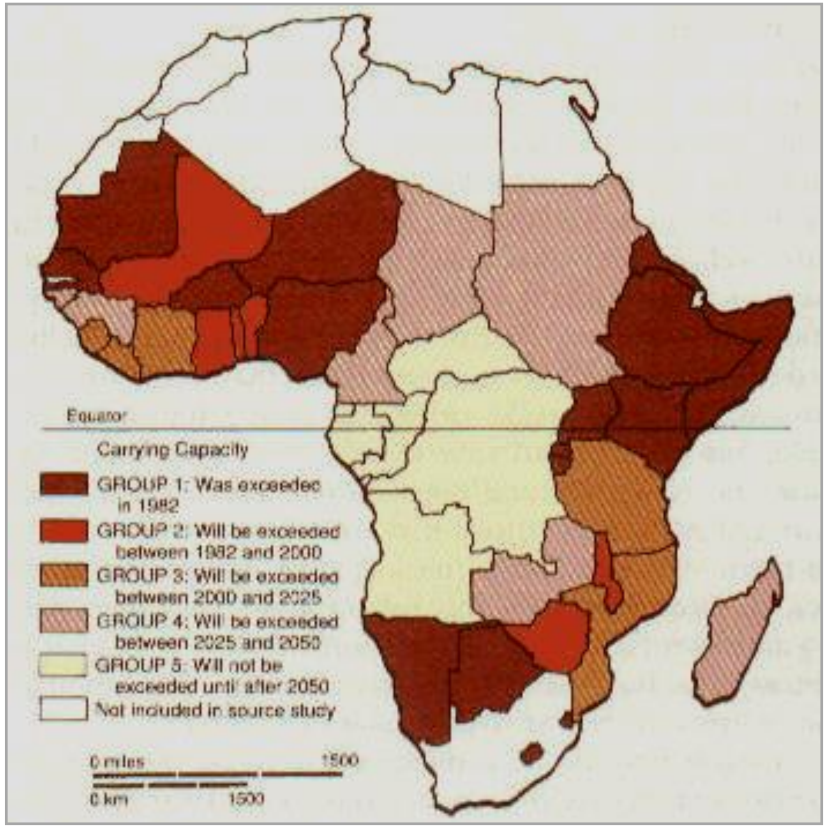
The map at right was produced by the Club of Rome in the early 1980s. The study was complied in order to look at parts of the world that were, or would be, possible crisis points for food security,using the ecological idea of carrying capacity – how many of something can be supported in a given environment context?

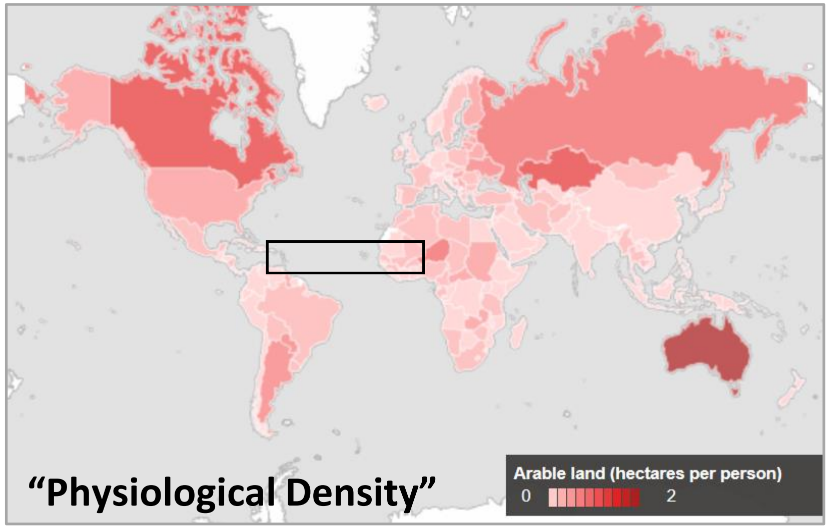
The Club of Rome study adapted this to consider: (1) the size of the population, (2) the population growth rate, (3) the amount of arable land (that that can be used for crops or livestock), (4) typical annual average rainfall and water resources, and (5) type of agricultural technology in common (from traditional to highly mechanized).

The physiological density map at bottom shows the amount of arable land per person (1 hectare is about 2.5 acres). Note that throughout the Sahara region (in the box), few countries have much… and many of those are countries with fast-growing populations. And in many places – including in the US – there has been over the years a loss of farmland due to development and the loss of soil fertility due to erosion and misuse of agricultural chemicals.

For those countries, the problem is made worse because they have long been subject to political unrest, and are also very under-developed in terms of manufacturing and technology. They often have weak infrastructure (roads, highways, phone systems, internet), and they are frequently in such debt to other nations that it is almost impossible to pay the interest on the debt, much less pay down the debt itself.

African countries in particular have struggled to increase their development status, have many are reliant on agricultural products and natural resources (oil, metals, minerals). Those commodities are at the bottom of the value-added chain – consider, for example, the metals needed to build and automobile. The mined ores have little value compared to the automobile that was built from them. The debt situation gets worse and worse for any country that is exporting low-value metals and importing cars.





“Physiological Density”