Global human population: summary

Very recent past: 200 years: 8X (1B → 8B);
since 1974: 2X (4B → 8B). Growth was
super-exponential, then sub-exponential.

Present: 8B population grows by ~80
million/year (another USA in 4 years), not
uniformly. >1 child in 5 under 5 years old
is stunted from chronic hunger.

Future population (to 2050, excluding
nuclear war, plague, climate catastrophe,
comets): larger, older, more urban, slower,
more Asian, more African.
**Past**

Genus *Homo* evolved early in Pleistocene Epoch, starting 2.58 million years ago. *Homo* left Africa 4 times; only 4th survived.

By end of the Pleistocene Epoch 11,700 years ago, modern humans, *Homo sapiens*, had displaced all other species of humans & migrated from Africa to all continents except Antarctica.

Holocene history (11,700 before present to now) omits >99.5% of human history.

**Population history in round numbers**

Early (Pleistocene, 2.57 million years):  
- human population 1,000 $\rightarrow$ 10 million  
- 10,000-fold growth =  
  - average annual growth of 0.0004%/year

Recent (Holocene, 11,700 years):  
- human population 8 million $\rightarrow$ 8 billion  
- 1,000-fold growth =  
  - average annual growth of 0.06%/year  
- 150-fold acceleration from early to recent
At the end of Younger Dryas, ~11.7ka, global average temperatures rose 10°C (18°F) in 10 years. Platt et al. Sci. Rep. 2017

4 changes in population growth
1. independent inventions of agriculture in Middle East, Asia, Africa, Americas
2. exchanges of plants, animals, & people between Old World & New World
3. reduced death rates of children in poor countries
4. decline in fertility rates

<table>
<thead>
<tr>
<th>invention</th>
<th>dates</th>
<th>people</th>
<th>before</th>
<th>after</th>
<th>doubling time (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>local agriculture</td>
<td>BCE</td>
<td>1-10</td>
<td>35,000-350,000</td>
<td>1,400-3,000</td>
<td>10-20</td>
</tr>
<tr>
<td>global agriculture</td>
<td>1750</td>
<td>750 million</td>
<td>750-1,800</td>
<td>100-130</td>
<td>20-40</td>
</tr>
<tr>
<td>public health</td>
<td>1950</td>
<td>2.5 billion</td>
<td>87</td>
<td>36</td>
<td>5-10</td>
</tr>
<tr>
<td>fertility control</td>
<td>1970</td>
<td>3.7 billion</td>
<td>34</td>
<td>50</td>
<td>5-10</td>
</tr>
</tbody>
</table>
Half of all global population growth occurred in most recent 48 years (1974-2022).

Since 10,000 BCE, population's growth rate rose, fell, rose, fell: NOT exponential growth.

Black Death mid-14th C. killed ~200 million, ~2/5 of all people.

Milestones of population growth

<table>
<thead>
<tr>
<th>people</th>
<th>year</th>
<th>years to add 1B</th>
<th>Growth rate from 10,000 to 1500 was 0.03-0.05%/y.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-10 million</td>
<td>-10,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>100-300 million</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>500 million</td>
<td>1500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 billion</td>
<td>1800-20</td>
<td>~300,000</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1927-30</td>
<td>110-130</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>1959-60</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>1974</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>1987</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>1999</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>2011-12</td>
<td>12-13</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>2022</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>
20th century was unique demographically.

1. Highest global population growth rate in history: 3.8 x. Only century in which global population even doubled.
2. Largest voluntary decline in fertility
3. Last century with more young people than old people
4. Last century with more rural people than urban people

World population by region 1820-2019

[Graph showing world population growth by region with specific data points for Europe, Africa, and Asia.]
Fertility = number of children born  
Fecundity = potential for fertility

Total fertility rate (TFR)  
TFR is the most widely used measure of fertility. It assumes no maternal deaths during childbearing ages.  
TFR = sum of age-specific birth rates  
= average number of children born per woman who lives to last age of reproduction.
Total fertility rate fell from ~5 children per woman per lifetime in 1950 to ~2.3 in 2022.

This decline may be the greatest voluntary change in human behavior in history.

In 1990, ~1/4 of all people lived in countries with TFR below replacement; in 2022, ~2/3.

UN Pop Div, *World Population Prospects 2022*
3 measures of fertility

1. Birth rate (BR) = number of births (both sexes) per year per person (both sexes, including non-reproductive ages)

2. Total fertility rate (TFR) = average number of births (both sexes) per woman’s lifetime at age-specific birth-rates, no female mortality

3. Net rate of reproduction (NRR) = average number of daughters per woman’s lifetime at age-specific female birth- & female death-rates (includes effects of sex-ratio at birth)
Global population growth rate peaked at 2.1-2.2%/y in 1962-1963, fell to <1%/y now.

China’s rates of birth, death, & natural increase (per 1,000 people), 1949-1997

One-child policy introduced 1978-80.
As population surpassed 3 billion in 1960, arable area leveled off, but average cereal yield rose with increasing fertilizer nitrogen use and irrigation.

Maximum available food has not been constant.

Green revolution (mid-1960s+) coincided with decline of population growth rate. Malthus was wrong.

Population growth rates fell in countries with more abundant food because of lower child mortality & lower birth rates.

The 1960s marked both the peak of the global population growth rate, which has since fallen by half, & the beginning of the "green revolution."
47 least-developed countries grow almost 3x as fast as rest of world ...

despite high child & maternal mortality, life expectancy 7 y < global average and, in some countries, violent conflicts & the HIV epidemic.

GDP per capita rose faster with lower total fertility rates.

**Sources:** United Nations Population Division, World Population Prospects: The 2010 Revision (2011); and World Bank, World Development Indicators Database. Population Reference Bureau

**TFR (children per woman):**
- Thailand: 2
- Egypt: 4
- Ghana: 6

**Year:**
- 1980
- 1990
- 2000
- 2010

**GDP (USD):**
- Thailand: $8,490
- Egypt: $6,281
- Ghana: $1,059
- Egypt: $1,095
- Ghana: $1,147
- Thailand: $474

[Graphs showing growth rates and GDP per capita trends over time.]
Population size fell by at least 1% in 27 countries 2010-2019. Most are European.

55 countries are expected to decrease by 1% 2019-2050, mostly European.

Population aging
Global period life expectancy at birth was 72.8 years in 2019, 71.0 years in 2021, higher than in any country in 1950.

UN Pop. Div. World Population Prospects 2022

The world grew older, 1950-2020.

While total population more than tripled: 2.5→8 billion,
population under 5 just doubled: 339→678 million.
The fraction of old people (e.g., %65+ years) in a population depends more on its fertility rates than on its death rates.

Why? Most people are born at age 0. Birth rates control the size of the bottom of the age pyramid. Immigration cannot keep a population young because immigrants age, too.
Record national period female life expectancy at birth rose 0.24 years of life per calendar year, 1840-2007.

Christensen et al. *Lancet* 2009

Which age groups contributed to rise in record life expectancy?

0-49 years: 90% → 10%

JEC figure based on data of Christensen et al. *Lancet* 2009
Life expectancy at birth rises with income, shifted upward over time for given income.

In USA, people (of both sexes) aged 70-74 in 2005-2009 had remaining life expectancy of people aged 60-64 years in 1935-39.

<table>
<thead>
<tr>
<th>Year</th>
<th>Age</th>
<th>Remaining life expectancy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1935-1939</td>
<td>70-74</td>
<td>9.95</td>
</tr>
<tr>
<td>1935-1939</td>
<td>60-64</td>
<td>15.72</td>
</tr>
<tr>
<td>2005-2009</td>
<td>70-74</td>
<td>15.24</td>
</tr>
</tbody>
</table>

http://www.mortality.org/hmd/USA/STATS/bltper_5x5.txt
How many people are "urban"?

UN Population Division estimates about 55% of people live in urban areas.  
UN Population Division, *World Urbanization Prospects 2018*

European Commission estimates about 85% of people live in urban areas.  
*Publications Office of the European Union*

There is no international standard or consensus on the definition & measurement of "urban."
% urban, last 12,000 years

% urban, last 500 years

Source: HYDE 3.1 (2010) OurWorldInData.org/urbanization • CC BY

Note: Urban areas are based on national definitions and may vary by country.

10 cities with most people in 1000 have no overlap with top 10 cities in 2015.

Source: UNDP, World Bank

Harrison & Pearce 2000 AAAS
### Cities grew in 20th century.

<table>
<thead>
<tr>
<th>Year</th>
<th>Urban population (billions)</th>
<th>% of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1900</td>
<td>0.21</td>
<td>13%</td>
</tr>
<tr>
<td>1950</td>
<td>0.75</td>
<td>30%</td>
</tr>
<tr>
<td>2000</td>
<td>2.87</td>
<td>47%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of cities with ≥10 million people</th>
</tr>
</thead>
<tbody>
<tr>
<td>1900</td>
<td>0</td>
</tr>
<tr>
<td>1950</td>
<td>1</td>
</tr>
<tr>
<td>2000</td>
<td>20</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>% of urban people living in cities with ≥10 million people</th>
</tr>
</thead>
<tbody>
<tr>
<td>1900</td>
<td>0</td>
</tr>
<tr>
<td>1950</td>
<td>1.6</td>
</tr>
<tr>
<td>2000</td>
<td>9.6</td>
</tr>
</tbody>
</table>

Urban populations surpassed rural around 2007.

Source: UN World Urbanization Prospects (2018)
Note: Urban populations are defined based on the definition of urban areas by national statistical offices.
Urban expansion competes with surrounding farms.

Urban growth could affect food supply.

Many cities (~3% of land) are located on prime agricultural land (~10% of land).

If doubling of urban population doubles urban area, prime agricultural land could be removed from food production.
Number of households grew faster than number of people.

Average people per household 1970-2000 fell in less-developed countries, from 5.1 to 4.4, in more-developed countries, from 3.2 to 2.5.

Reasons: lower fertility, greater longevity, later marriage, more divorce, rising wealth, urbanization, changing preferences

Energy use per person was greater in U. S. households with fewer people.

Energy use per person was greater in U. S. households with fewer people.

International migrant stock more than doubled, 1960-2000.

Migrant stock = people living outside country of birth

World Bank, The Evolution of Global Bilateral Migration 1960-2000, Çağlar Özden, Christopher Parsons, Maurice Schiff, Terrie Walmsley

UN Pop. Div., International migrant stock 2019
https://www.un.org/en/development/desa/population/migration/data/estimates2/estimatesgraphs.asp?0g0

Present

Berber girl, Atlas mountains, Morocco, 20090919, JEC
2022 world population pyramid: past rapid growth, recent slowing

Three worlds, one planet
Poorer countries have younger populations.

www.census.gov 2015
### Three worlds, one planet

<table>
<thead>
<tr>
<th>Population Reference Bureau, <em>World Population Data Sheet 2021</em></th>
<th>High Income</th>
<th>Middle Income</th>
<th>Low Income</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population (billions, mid-2021)</td>
<td>1.2</td>
<td>5.9</td>
<td>0.7</td>
</tr>
<tr>
<td>Infant Mortality Rate (deaths/1000 born)</td>
<td>4</td>
<td>29</td>
<td>51</td>
</tr>
<tr>
<td>Total Fertility Rate (children/woman)</td>
<td>1.5</td>
<td>2.2</td>
<td>4.7</td>
</tr>
<tr>
<td>Urban Population (%)</td>
<td>82</td>
<td>54</td>
<td>33</td>
</tr>
<tr>
<td>Population per km² of Arable Land</td>
<td>362</td>
<td>648</td>
<td>508</td>
</tr>
<tr>
<td>GNI / person, USD PPP</td>
<td>$52,629</td>
<td>$11,719</td>
<td>$2,449</td>
</tr>
</tbody>
</table>

Ratio of High to Low income: $52,629/2,449 = 21.5

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### Of world's ~8 billion people, Asia has ~60%, Africa ~17% (2020).

[Map of world's population distribution]
In cross-section, 10x income ↑ goes with 0.44x TFR ↓.

\[ y = 59.578x^{-0.359} \quad R^2 = 0.6345 \]

Data: PRB Population and Economic Development 2012 Data Sheet

"Development is the best contraceptive."

Causal ordering?
Countries with higher % extremely poor (<USD 1.90 PPP/day) have higher population growth rates.

7 countries in the western Sahel have very high proportions of youth & very rapidly growing populations.

Countries with higher % youth 12-17 have lower upper 2dary completion rates.

UN Population Div.,
World Population Prospects 2022

Who has contributed most to global CO₂ emissions?

Cumulative carbon dioxide (CO₂) emissions over the period from 1751 to 2017. Figures are based on production-based emissions which measure CO₂ produced domestically from fossil fuel combustion and cement, and do not correct for emissions embedded in traded goods and services or for emissions from international land use change.

CO₂ % / population %
No population at COP26, COP27.

WHAT DO WE NEED TO ACHIEVE AT COP26? COP27:
mitigation, adaptation, finance, collaboration

SECURE GLOBAL NET ZERO BY MID-CENTURY AND KEEP 1.5 DEGREES WITHIN REACH.

ADAPT TO PROTECT COMMUNITIES AND NATURAL HABITATS.

MOBILISE FINANCE.

WORK TOGETHER TO DELIVER.

To achieve our first two goals, developed countries must deliver on their promise to raise $100 billion to address climate change every year. This will allow their peers and their people to improve their livelihoods and adapt to the impacts of global climate change.


Population grows ~80 million/year.

2021:
+140 million births
- 60 million deaths
= 80 million increase on 8 billion population

COVID-19 has killed ~15 million people (~6 million/year).
Tobacco kills ~8 million every year. W.H.O.
Replacement (level) fertility

Replacement fertility is the TFR (number of live-born children per woman’s lifetime) required to replace one new-born girl by one new-born girl in the next generation. Because 106 boys are born per 100 girls, & because not all girls survive through reproductive ages, replacement TFR ranges from 2.1 to 2.4 in most cases, & as high as 3 in areas of very high mortality.
~2/3 of people live where TFR is below replacement, 2022, but global average TFR is ~2.3 children/woman.

Large regions of high fertility remain.

In 2019, fertility remains above replacement level, on average, in sub-Saharan Africa (4.6), Oceania except Australia, New Zealand (3.4), Northern Africa and Western Asia (2.9), Central and Southern Asia (2.4) (Afghanistan 4.5; Pakistan 3.6).
40% of global pregnancies are unintended.
45% of pregnancies in USA

| 213 million pregnancies occurred worldwide in 2012, 190 million (89%) in developing world. |
| 85 million pregnancies (40%) were unintended, |
| 47% unintended in more developed, |
| 39% unintended in less developed, |
| 35% unintended in Africa, |
| 56% unintended in LAC. |

Sedgh, et al. 2014
Jessica D. Gipson 2016

In 2012, 222 million women had an “unmet need for modern contraception”
(do not want pregnancy, are sexually active, are not using modern contraception).
In 2012, 57% of married women used modern contraceptives in the developing world.
Modern contraceptive methods for all women in the developing world would cost $8.1 billion per year. (Actual cost: $4.0 billion in 2012.)
45% of US pregnancies are unintended.

Figure 1. Rates of Unintended Pregnancy, 1981–2011.
Rates are reported as the number of unintended pregnancies per 1000 women and girls 15 to 44 years of age.
Women with unmet need for modern contraceptive methods account for 84% of unintended pregnancies.

Gantmacher Institute, Adding It Up, December 2017

89 million unintended pregnancies, 2017

- 74% Unmet need (no method)
- 10% Unmet need (traditional method)
- 14% Short-term reversible method
- Long-acting reversible method and sterilization
Random assignment to Bedsider vs. control group found women in Bedsider group less likely to have a pregnancy scare, an unintended pregnancy, or unprotected sex as compared to the control group (Antonishak et al. 2015)

Jessica D. Gipson 2016

15% increase in modern contraceptive prevalence goes with 1 fewer child per woman per lifetime.

U.S. Census, Global Population Profile 2002, data from years 1990-2002
Contraceptive use lowered fertility in Matlab, Bangladesh.


B) Ezeh, Bongaarts, Mberu 2012

National policy affected fertility.

Pakistan

Bangladesh

Ezeh, Bongaarts, Mberu 2012, from UN Pop.Div. 2010
More educated women use contraception more.

DHS data for 9 countries in West Africa

Women with more education are less likely to have children before age 20.

UN, Concise Report on World Population Monitoring 2003
More educated women have fewer children almost everywhere.

Demographic & Health Surveys, 2003–2006; Population Reference Bureau
1/3 of urban people live in "slum" households. UN Habitat

Definition: "slum" household is a group of individuals living under the same roof in an urban area who lack one or more of:

1. Durable permanent housing that protects against extreme climate conditions.
2. No more than 3 people sharing same room.
3. Easy access to sufficient, safe, affordable water.
4. Access to private or public toilet shared by a reasonable number of people.

Sometimes: 5. Security of tenure against forced evictions.

2018, UN Habitat via World Bank

"Slum" lacks one or more of: improved water, improved toilet, enough living area, durability of housing.
Total fertility rates decline from rural to urban areas.

Montgomery et al. 2003 *Cities Transformed*  
www.nap.edu
Modern contraceptive use increases from rural to urban areas in most regions.

Montgomery et al. 2003 Cities Transformed www.nap.edu

Unmet need for contraception is greatest in rural & small urban areas.

Montgomery et al. 2003 Cities Transformed www.nap.edu
634 million people live in coastal areas at <10 m (33 ft) above sea level.

Of those 634 million, 360 million are urban.

>180 countries have people in low coastal zones. 2/3 of those countries have urban areas of more than 5 million people in low-elevation coastal zones.


In last interglacial (Eemian, 130-115 ka), global sea level was ~6 m higher. Migration?

--

**% of national urban population in urban LECZ**

<table>
<thead>
<tr>
<th>City size</th>
<th>Population of cities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small</td>
<td>Small: 100 - 500 thousand</td>
</tr>
<tr>
<td>Intermediate</td>
<td>Intermediate: 500 thousand - 1 million</td>
</tr>
<tr>
<td>Big</td>
<td>Big: More than 1 million</td>
</tr>
</tbody>
</table>

Asian cities in low-elevation coastal zones (< 10 m elevation)
Latin American & Caribbean cities in low-elevation coastal zones

UN Habitat, State of World’s Cities 2008-2009
2022-10-26

African cities in low-elevation coastal zones

UN Habitat, State of World’s Cities 2008-2009
2022-10-26
Sea Level +6M

from Sassen & Schroeder

Joel E. Cohen

Weiss and Overpeck, University of Arizona

Katrina, New Orleans, 2005-08-31

photo from Air Force One
Sandy, New York City, 2012-10-28/29

“largest hurricane ever recorded in the Atlantic basin” - Wikipedia

Storm surge at Battery Park of ~4.25 m (14 feet)

~750 million people (15% of adults) “desire to migrate permanently to another country.”

Gallup polls of 453,122 adults in 152 countries 2015-2017
"The one in six Americans (16%) in 2017 who said they would like to move to another country is the highest measure to date."

158 million → USA (312 million in 2010)
47 million → Canada (34 million 2010)
42 million → Germany (82 million in 2010)
36 million → France (63 million 2010)
36 million → Australia (22 million in 2010)
Future
High confidence (next 25-30 years, excluding nuclear war, plague, climate catastrophe, comets): larger by >1 billion, older, more urban, more slowly, more Asian, more African, more migration

Controversial (beyond 2050):
When will population growth end?
At what peak population size?

% people aged 65+ varies widely.

<table>
<thead>
<tr>
<th>Region</th>
<th>2022</th>
<th>2030</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>World</td>
<td>9.7</td>
<td>11.7</td>
<td>16.4</td>
</tr>
<tr>
<td>Sub-Saharan Africa</td>
<td>3.0</td>
<td>3.3</td>
<td>4.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>57% increase</td>
</tr>
<tr>
<td>Europe, Northern America</td>
<td>18.7</td>
<td>22.0</td>
<td>26.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>44% increase</td>
</tr>
</tbody>
</table>
"Long-range population projections to 2100" from UN WPP 2022

"Long-range population projections are highly uncertain, especially for high-fertility countries still in the early stages of the demographic transition."

95% probability of global population:
- 9.4-10.0 billion in 2050;
- 8.9-12.4 billion in 2100.
"Long-range population projections to 2100" from UN WPP 2022

"Thus, the size of the world’s population is almost certain to rise over the next several decades, as is the degree of uncertainty associated with these projections. Later in the century, there is about 50 per cent chance that the world’s population will peak—that its size will stabilize or begin to decrease—before 2100."

UN WPP 2022 estimates & medium scenario with 95% prediction intervals, 2022-2100

2030: 8.5 B
2050: 9.7 B
2100: 10.4 B
Aging

People 65+ are fastest growing age group.

Sculptor in Tipaza, Algeria, 2015

UN Pop. Div. World Population Prospects 2019
Fraction of people aged 15-64 years peaked, probably forever, at 66% in 2012.


**What does “old” mean?**

Age 65+ years? **OR**

Remaining life expectancy (RLE) of 15 years or less?  

Norman Ryder 1975

In 2010, people had RLE of 15 years at age:

71 in North America,

63 in Africa,

67 in world.  

Lutz et al. 2014
World

Lutz, Butz, KC et al. 2014

65+
RLE<15y

USA

Lutz, Butz, KC et al. 2014

65+
RLE<15y
“What can grow younger as it grows older?"

“Because of education changes and scientific advances, human populations can grow in productivity, creativity, and remaining life expectancy, even as the median age of the population increases. Functionally, human populations can become younger even as they grow older chronologically. This is the key to understanding what ageing will really be like in the twenty-first century.”

Lutz, Butz, KC et al. 2014
Add 5 billion in 90 years ≈ 1.1 million per week

The 20th century was the last with more rural than urban people.
Millions of people

UN Population Division, *World Population Prospects 2010*

medium variant

Virtually all population growth will be in cities of poorer countries.

Cities of the future will

• Have higher % of older people than now
• Be increasingly located in poor countries
• Have smaller household sizes
• Be concentrated along tectonic fault lines
• Be located coastally at low elevation
• Face energy & water limitations
• Demand more food from agricultural areas
Projections of future population size

Nobody knows

1. when global population growth will end; or
2. how big global population will be when growth ends.
Projections to 2100: 3 methods, 3 results

UN Pop.Div. (Adrian Raftery): Bayesian time-series models of TFR, life expectancy, migration
IIASA et al. (Wolfgang Lutz): Expert judgment of TFR & life expectancy
Global Burden of Disease (Christopher Murray): model TFR as function of education & unmet need for contraception

The view from New York: UN Population Division

Global population rises through 2100, passing 11 billion.
The view from New York: UN Population Division

World Population Prospects 2022

50:50 chance that global population will peak before 2100.

History and Future of the World Population by Total Fertility

Shown is the estimated total fertility rate – the number of children per woman – for each country in the world over time. Future projections are based on the UN Population Division Medium Variant projection.

The view from New York: UN Population Division

Below-replacement fertility spreads, but too slowly to end population growth before 2100.
Only sub-Saharan Africa is projected to grow through end of 21st century.

The view from Vienna: IIASA 2018

Global population peaks around 2080 around 9.8 billion.
Global population peaks around 2064 around 9.7 billion.

TFR projections for sub-Saharan Africa: UN medium model > IHME reference model.
Population interacts with economics, the environment & culture.

Culture, economics & environment are at least as hard to forecast as population. Choices influence the future.

Recommendations (based on science plus values)
5 targets for food security policy: the most vulnerable people

1. 200 million women or couples with unmet need for contraception
2. Pregnant women
3. Lactating women & nursing children
4. Weaned infants to 2-3 years
5. Teenage girls & boys

5 targets need 3 programs, as part of food security policy.

<table>
<thead>
<tr>
<th>Target</th>
<th>Family planning info, services, materials</th>
<th>Nutrition education for self &amp; children</th>
<th>Balanced adequate diet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unmet need</td>
<td>yes</td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td>Pregnant</td>
<td></td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Lactating</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Infants to 3</td>
<td>yes</td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td>Teenagers</td>
<td>yes</td>
<td>yes</td>
<td></td>
</tr>
</tbody>
</table>
Thank you! Questions?

Najibullah Musafer / Aina Photo