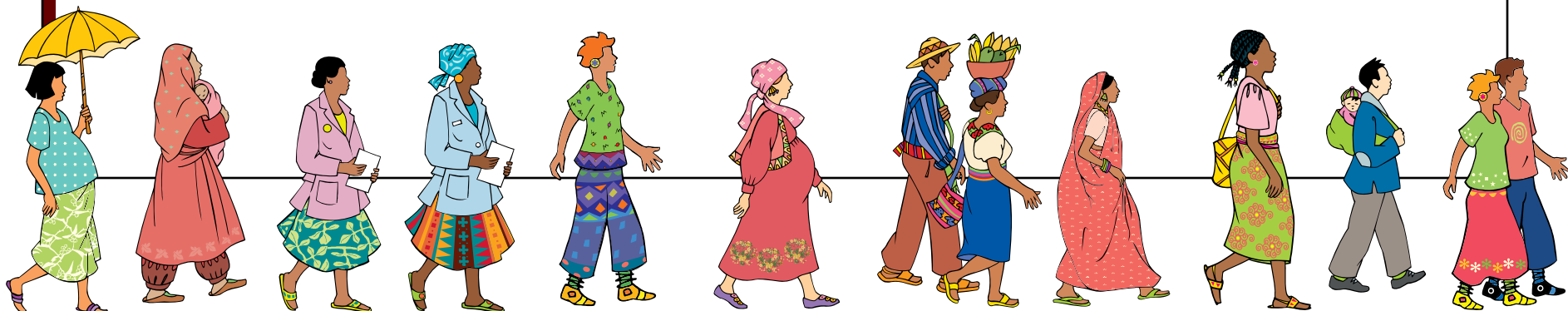# Principles of Population & Demography

**Moazzam Ali MD, PhD, MPH**

Department of Reproductive Health and Research

World Health Organization

Training Course in Sexual and Reproductive Health Research

Geneva 2014

- ☐ Definitions of population & demography and relevant indicators
- ☐ Why family planning is still important
  - ▪ MDG, RH Strategy, UNSG Strategy
- ☐ Key indicators on family planning
  - ▪ Contraceptive Prevalence
  - ▪ Unmet need for FP
- ☐ Special target populations groups
- ☐ Need for research in population & family planning

# Population: definition

- "Group of individuals of same species living in the same geographic area at the same time"

- A population is often defined by demographers according to the specific needs of the research and researcher. Three processes are relevant to demography:
  - Fertility, Mortality, and Migration

# Population: basic concepts

- There are only **two** ways to **enter** a population by birth and by in-migration.
- There are **two** ways to **leave** a population, by death and by **out-migration.**

□ For example, the population of interest may be that of students attending a specific university during a specific year. In this situation, the students are born (i.e., enter) into the population when they enroll, and they die (i.e., leave) when they graduate
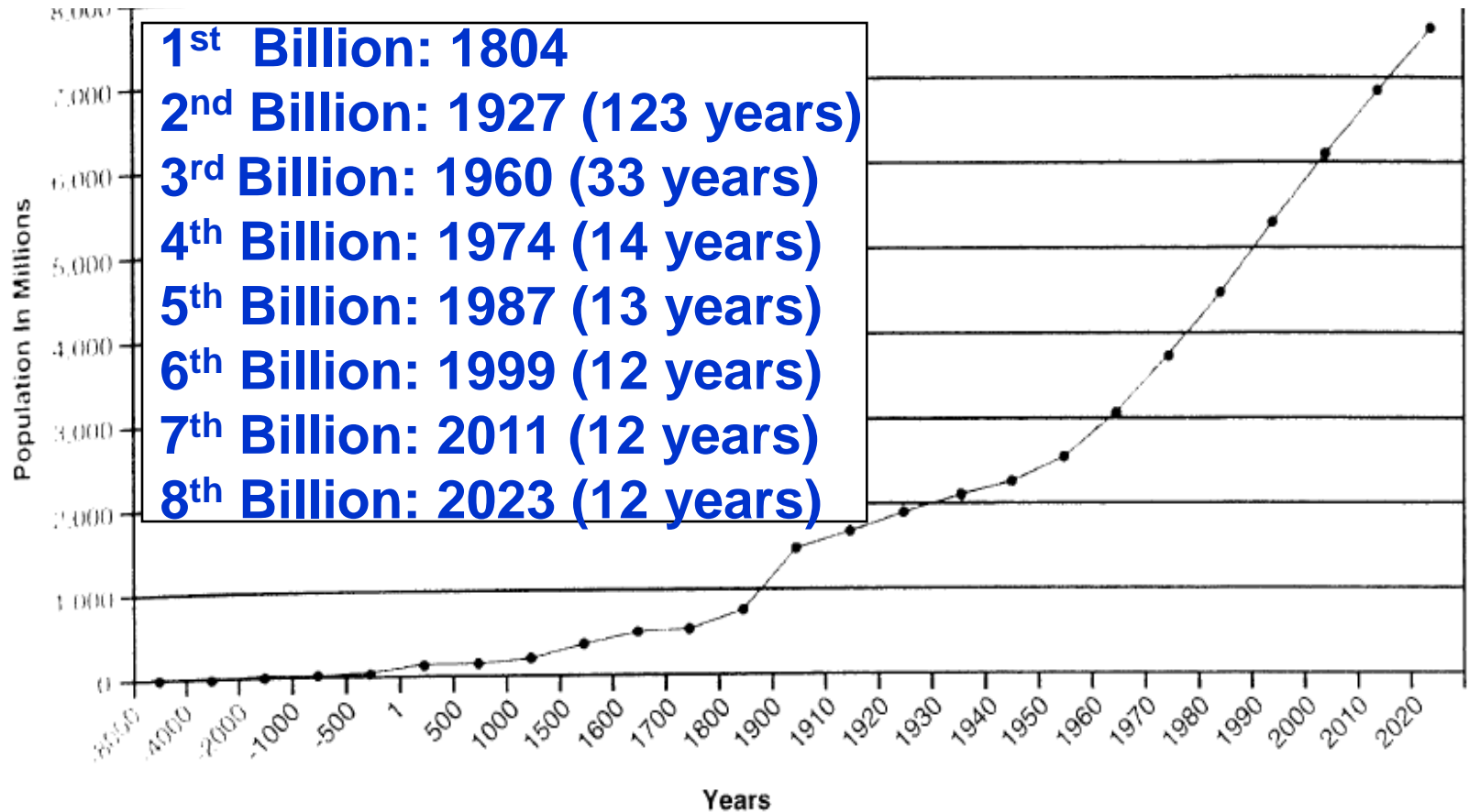
# Trends in global population growth



**1st Billion: 1804**
**2nd Billion: 1927 (123 years)**
**3rd Billion: 1960 (33 years)**
**4th Billion: 1974 (14 years)**
**5th Billion: 1987 (13 years)**
**6th Billion: 1999 (12 years)**
**7th Billion: 2011 (12 years)**
**8th Billion: 2023 (12 years)**

Population In Millions

Years

**Figure 3-1** The Growth of Population and, in Particular, the Extraordinary Changes of the Past 200 Years. *Source:* Data for the years 8000 to 1900 from U.S. Census Bureau, Population Division, International Programs Center (http://www.census.gov/ipc/ www.worldhis.html), and for the years 1910-2020 from United Nations Population Division, *World Population Prospects: The 2004 Revision Population Database* (http://esa.un.org/unpp/). Accessed June 22, 2005.

# Projecting future populations

- Human Population since 1980 is J-shaped curve
- Population is increasing however growth rate (r) has started to decline
- Projections for 2050 (2007)
  - Low = 7.7 billion
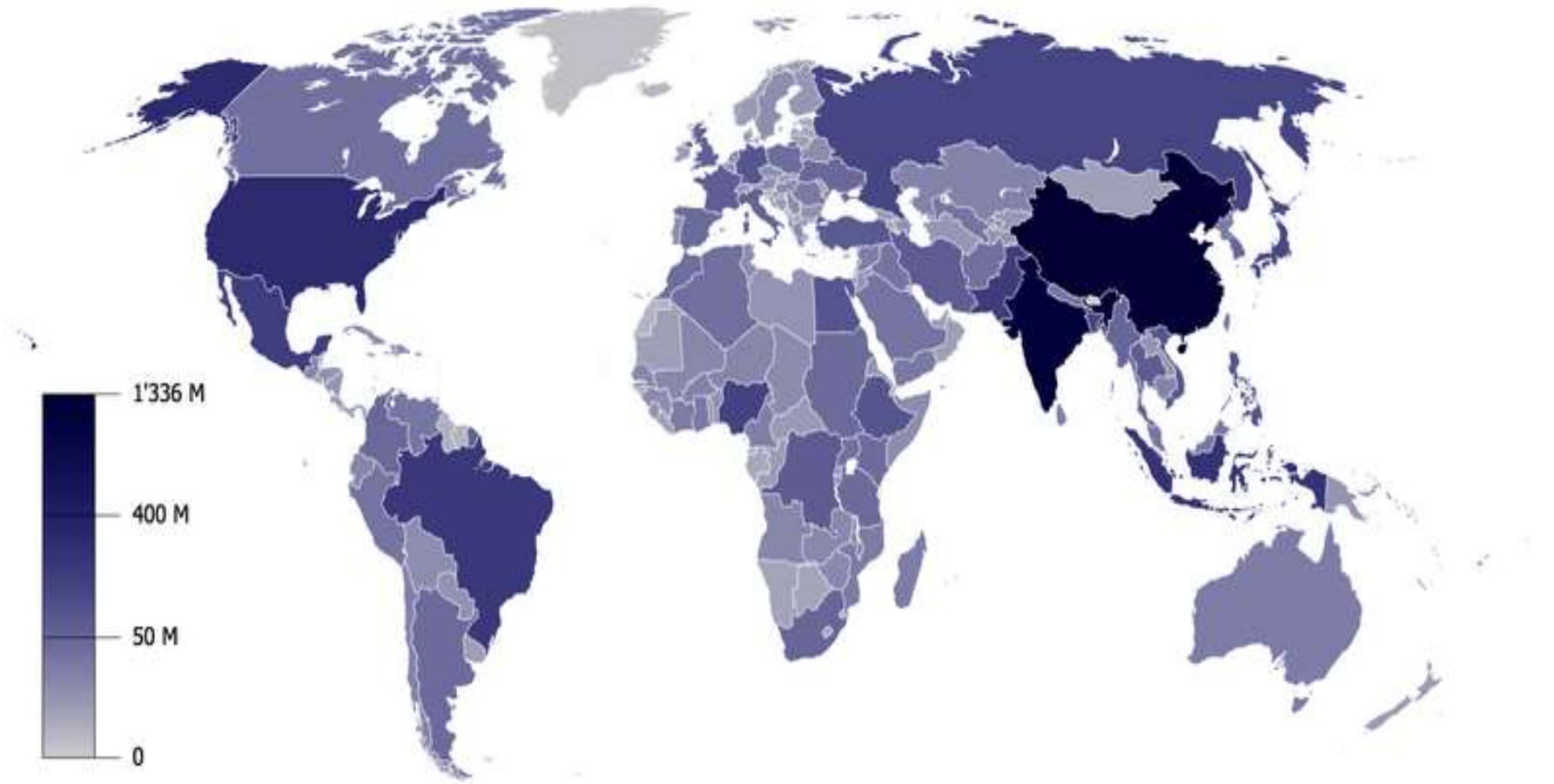  - High = 10.6 billion
  - Most likely = 9.1 billion
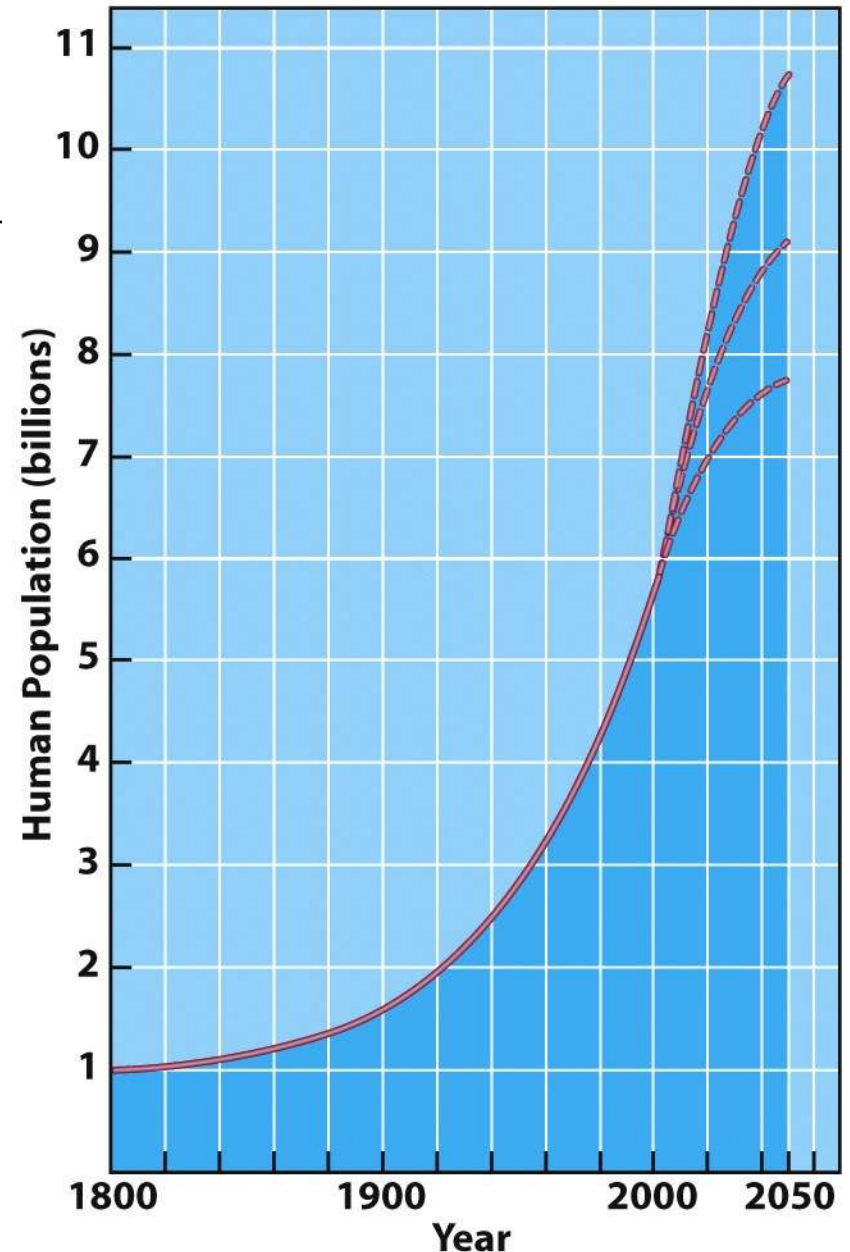
# Reaching the 7 billion mark…

- World Population to surpass 7 Billion in 2011 and will reach seven billion on 31$^{st}$ October, a milestone that offers unprecedented challenges and opportunities to all of humanity, according to UNFPA

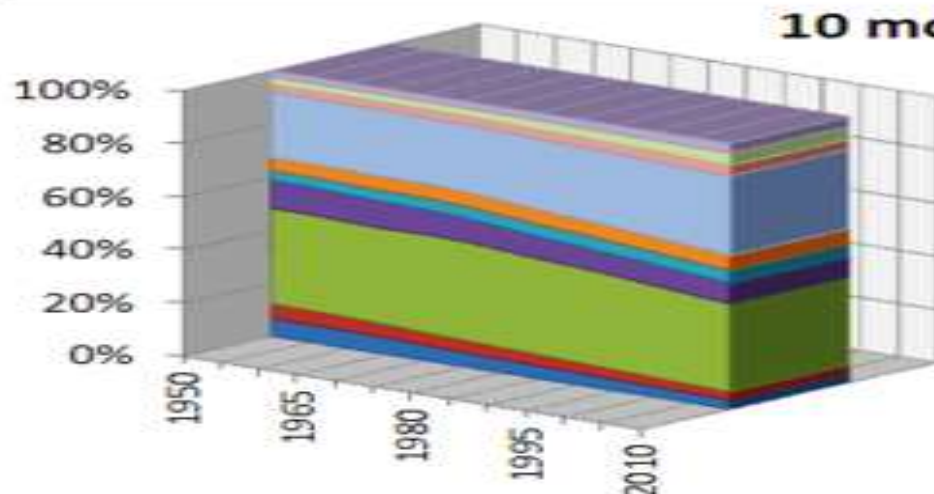# World population distribution: global overview

# Share of Population from 1950 to 2010 & Population Growth in the 2000-2010 Decade
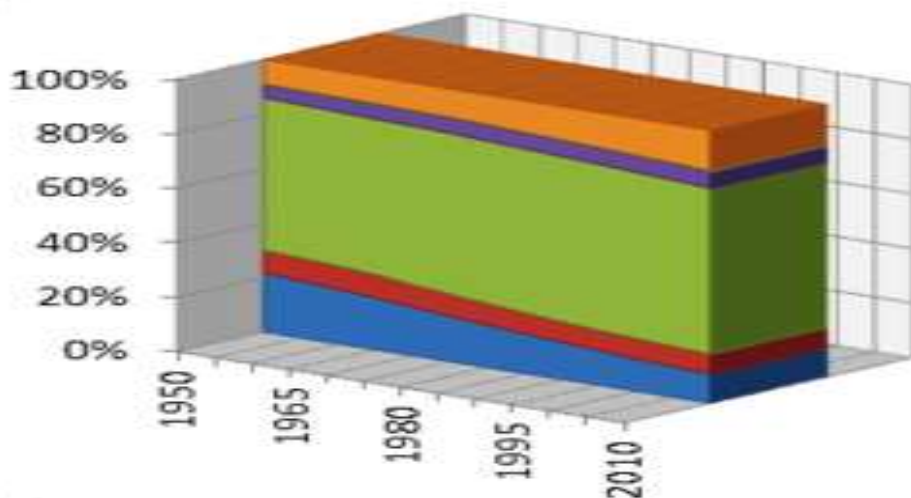


**Continents**
- (26.1%) #2 Africa
- (15.0%) #6 Oceania
- (13.2%) #5 South America
- (12.7%) #1 Asia
- (10.4%) #4 North America
- (00.8%) #3 Europe



**10 most populated countries**
- (26.8%) #8 Nigeria
- (24.7%) #6 Pakistan
- (16.8%) #7 Bangladesh
- (16.5%) #2 India
- (13.3%) #4 Indonesia
- (12.2%) #5 Brazil
- (10.4%) #3 United States
- (06.9%) #1 China
- (00.2%) #10 Japan
- (-4.3%) #9 Russia

Source: Department of Economic and Social Affairs, United Nations Population Division (UNPD). 2010. Available on-line at: http://esa.un.org/unpp/

# Population density

- Population density
  - The number of individuals of a species per unit area or volume at a given time
- Ovals below have same population, and different densities
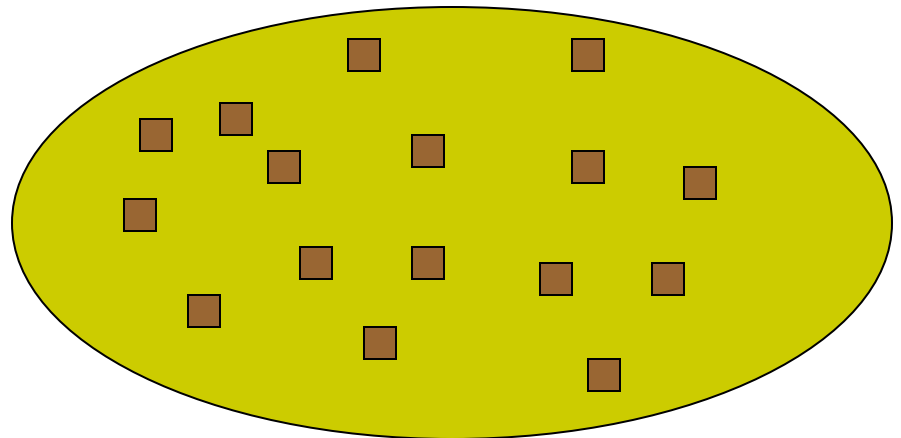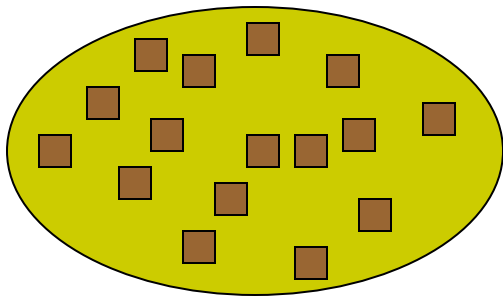
# Population density of countries

| Country | 2006 Population (in millions)* | Population Density (per mi²) |
|---|---|---|
| China | 1311.4 | 355 |
| India | 1121.8 | 884 |
| United States | 299.1 | 80 |
| Indonesia | 225.5 | 307 |
| Brazil | 186.8 | 57 |
| Pakistan | 165.8 | 539 |
| Bangladesh | 146.6 | 2637 |
| Russia | 142.3 | 22 |
| Nigeria | 134.5 | 377 |
| Japan | 127.8 | 876 |

* These figures are from mid-2006. At the end of 2006, the United States reached a population milestone of 300 million people.

# Effects of overpopulation

Some of the global effects of overpopulation include:

- Ultimate shortages of energy sources and other natural resources,
- Famine
- Serious communicable diseases in dense populations
- Shortage of arable land (where food crops will grow)
- Little surplus food
- Mass extinctions of plants and animals as habitat is used for farming and human settlements
- War over scarce resources such as land area.

# Effects of overpopulation

- High birth rates
- Lower life expectancies
- Lower levels of literacy
- Child poverty
- Higher rates of unemployment, especially in urban
- Poor diet with ill health and diet-deficiency diseases (e.g. rickets)
- Low per capita GDP
- Increasingly unhygienic conditions
- Government stretched economically
- Increased crime rates resulting from people stealing resources to survive

# Demography: historical perspective

- **Demography** is the study of human population dynamics.

 **Achille Guillard** first used the title on his book:
*"Elements de Statistique Humaine ou Demographie Comparee"*.

- Two Greek roots:
  - **demos** (people)
  - **graphy** (branch of knowledge regarding a particular science in this case, human populations).

- Guillard then defined demography as: 'the mathematical knowledge of populations, their general movements, and their physical, civil, intellectual and moral state' (Guillard 1855:xxvi).
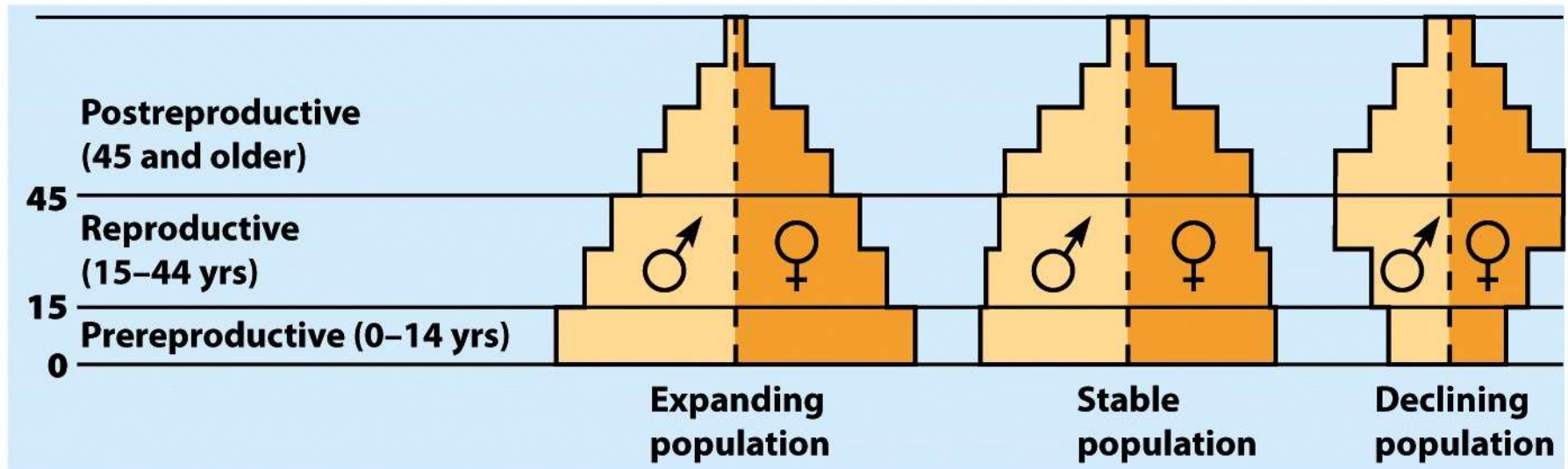
# Today demography encompass…

- …the determinants and consequences of population change and is concerned with **virtually everything** that influences or can be influenced by:

- Population Size
- Population growth or decline
- Population processes (levels and trends in mortality, fertility and migration that are determining population size and change).
- Population characteristics (education, religion, or ethnicity)
- Population structure (how many by age)

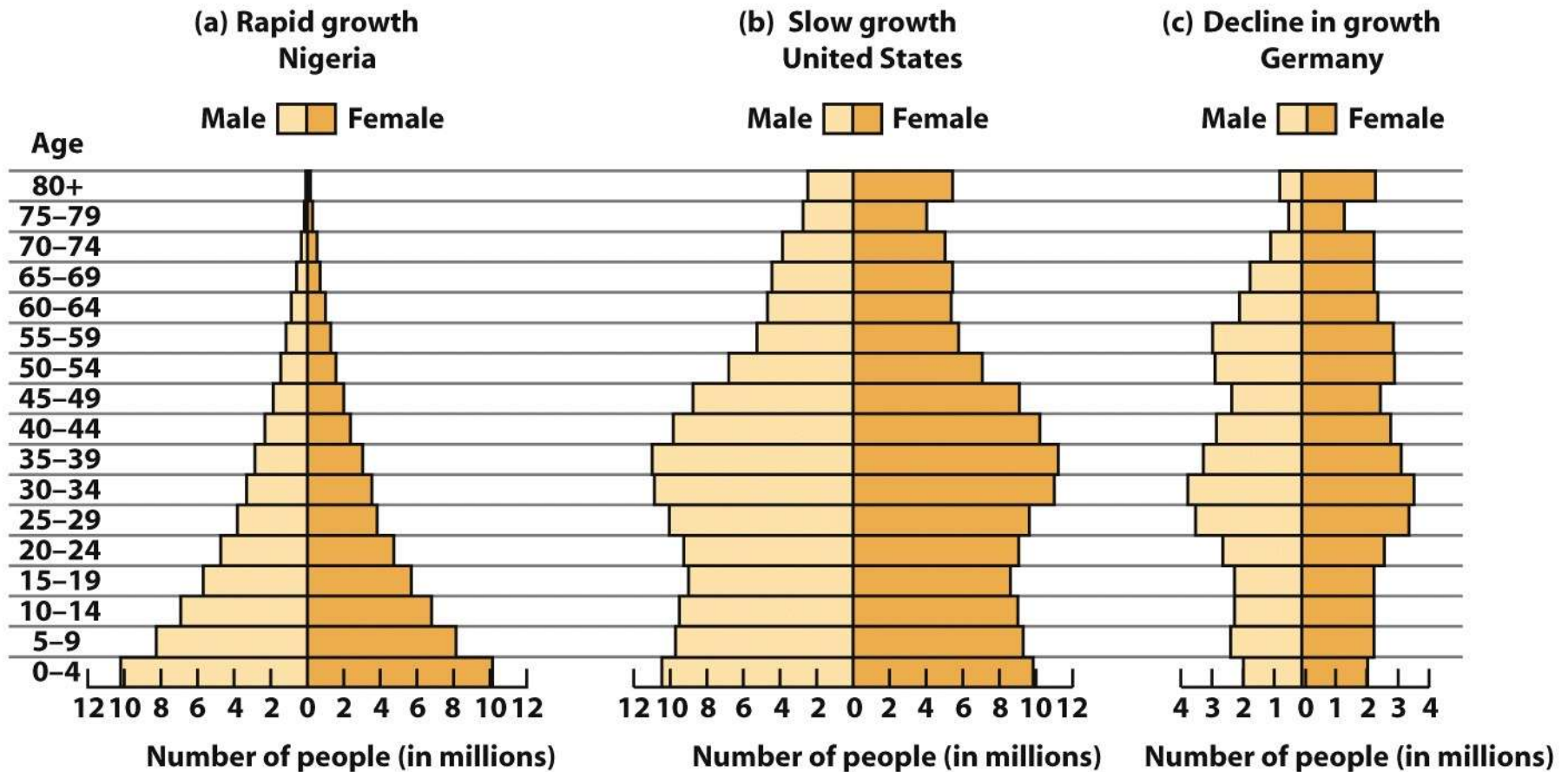# Population pyramid: age structure

- The number and proportion of people at each age in a population



Postreproductive (45 and older)
45
Reproductive (15–44 yrs)
15
Prereproductive (0–14 yrs)
0

Expanding population

Stable population

Declining population

# Demographics of specific countries



(a) Rapid growth
Nigeria

Male ☐ ☐ Female

(b) Slow growth
United States

Male ☐ ☐ Female

(c) Decline in growth
Germany

Male ☐ ☐ Female

Age
80+
75–79
70–74
65–69
60–64
55–59
50–54
45–49
40–44
35–39
30–34
25–29
20–24
15–19
10–14
5–9
0–4

12 10 8 6 4 2 0 2 4 6 8 10 12
Number of people (in millions)

12 10 8 6 4 2 0 2 4 6 8 10 12
Number of people (in millions)
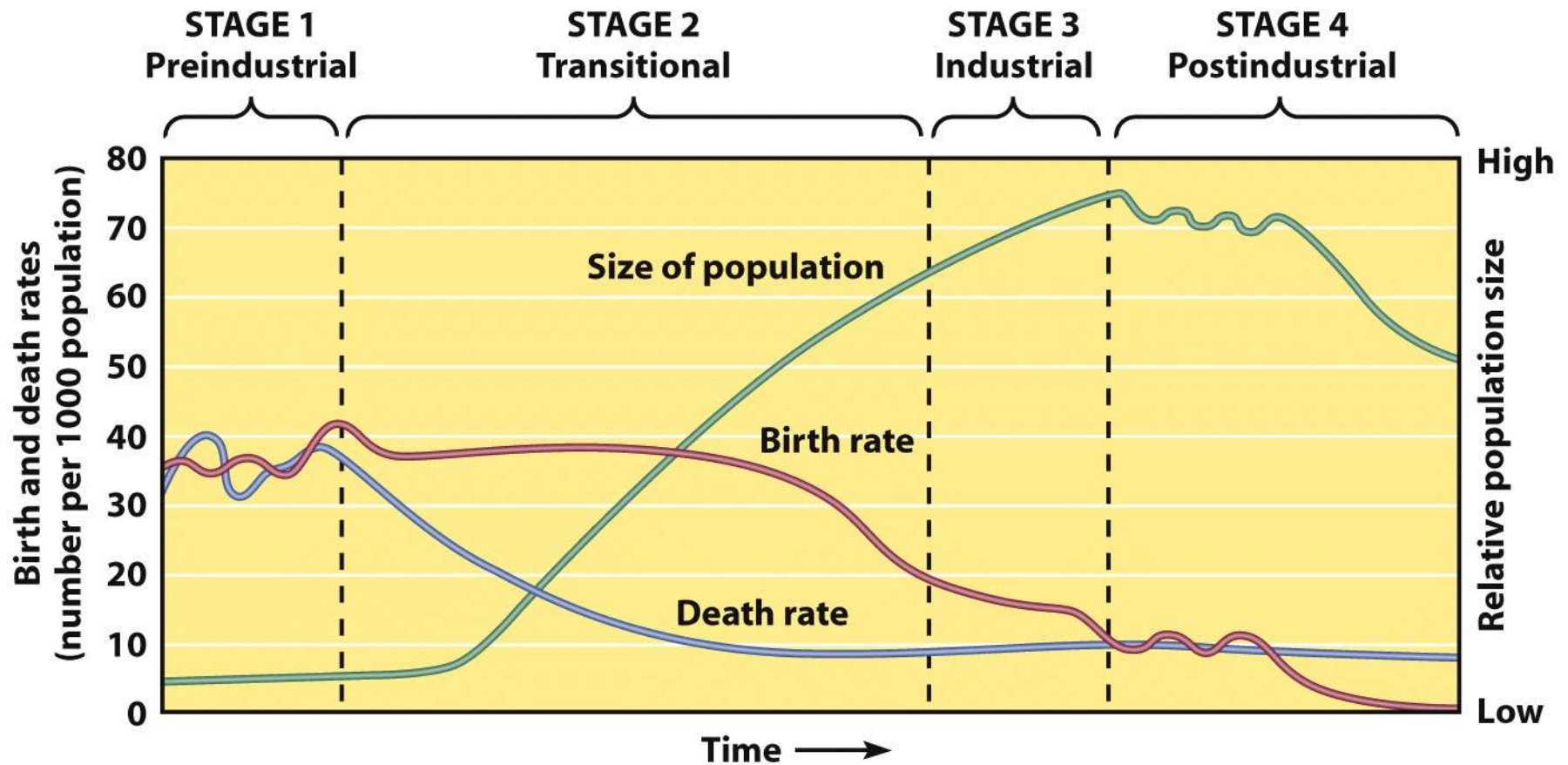
4 3 2 1 0 1 2 3 4
Number of people (in millions)

# Demographic stages

- Pre-industrial Stage
  - Birth and death rates high
  - Modest population growth
- Transitional Stage
  - Lowered death rate
  - Rapid population growth
- Industrial Stage
  - Birth rate decline
  - Population growth slow
- Post Industrial Stage
  - Low birth and death rates
  - Population growth very slow

# Demographic stages

# Demographic indicators

- Because demography is interested in changes in human populations, demographers focus on specific indicators of change.

- Two of the most important indicators are birth and death rates, which are also referred to as *fertility* and *mortality*.

- Additionally, demographers are interested in migration trends or the movement of people from one location to another.

# Fertility and fecundity

- **Fertility**, in demography, refers to the ability of females to produce healthy offspring in abundance. **Fecundity** is the potential reproductive capacity of a female. Some of the more common demographic measures used in relation to fertility and/or fecundity include:

  - **Crude birth rate**
  - **General fertility rate**
  - **Age-specific fertility rate**
  - **Total fertility rate**
  - **Gross reproduction rate**
  - **Net reproduction rate**

# Replacement level fertility

- It refers to the number of children that a woman (or monogamous couple) must have in order to replace the existing population. Replacement level fertility is generally set at 2.1 children in a woman's lifetime (this number varies by geographic region given different mortality rates).

- The reason the number is set to 2.1 children per woman is because two children are needed to replace the parents and an additional one-tenth of a child is needed to make up for the mortality of children and women who do not reach the end of their reproductive years.

# Total fertility rate

- The **total fertility rate** (**TFR**) of a population is the average number of children that would be born to a woman over her lifetime if ;

  - (1) she were to experience the exact current age-specific fertility rates (ASFRs) through her lifetime, and
  - (2) she were to survive from birth through the end of her reproductive life. It is obtained by summing the single-year age-specific rates at a given time.

# World historical and predicted total fertility rates (1950–2100) UN, 2010

| Years | TFR | Years | TFR | Years | TFR |
|---|---|---|---|---|---|
| 1950–1955 | 4.95 | 2000–2005 | 2.62 | 2050–2055 | 2.15 |
| 1955–1960 | 4.89 | 2005–2010 | 2.52 | 2055–2060 | 2.12 |
| 1960–1965 | 4.91 | 2010–2015 | 2.45 | 2060–2065 | 2.11 |
| 1965–1970 | 4.85 | 2015–2020 | 2.39 | 2065–2070 | 2.09 |
| 1970–1975 | 4.45 | 2020–2025 | 2.33 | 2070–2075 | 2.08 |
| 1975–1980 | 3.84 | 2025–2030 | 2.29 | 2075–2080 | 2.06 |
| 1980–1985 | 3.59 | 2030–2035 | 2.25 | 2080–2085 | 2.05 |
| 1985–1990 | 3.39 | 2035–2040 | 2.22 | 2085–2090 | 2.04 |
| 1990–1995 | 3.04 | 2040–2045 | 2.19 | 2090–2095 | 2.04 |
| 1995–2000 | 2.79 | 2045–2050 | 2.17 | 2095–2100 | 2.03 |

# Trends in TFR 1950-2050



Trends in Total Fertility Rate by Region, 1950-2050.
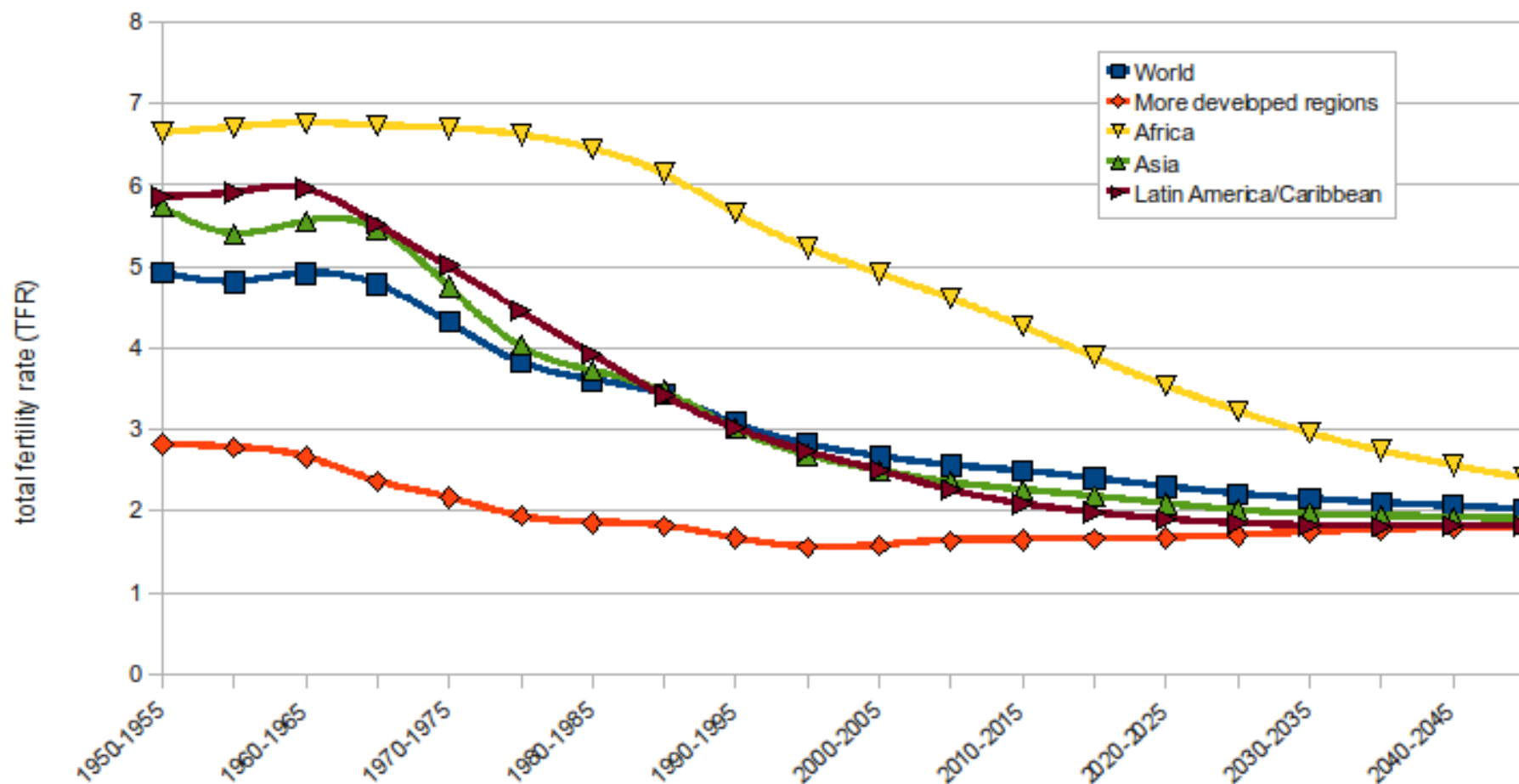
# Mortality

- **Mortality** refers to the finite nature of humanity: people die. Mortality in demography is interested in the number of deaths in a given time or place or the proportion of deaths in relation to a population. Some of the more common demographic measures of mortality include:

  - **crude death rate**: the annual number of deaths per 1000 people
  - **infant mortality rate**: the annual number of deaths of children less than 1 year old per thousand live births
  - **life expectancy**: the number of years which an individual at a given age can expect to live at present mortality rates

# Infant mortality rate by region 1950-2050
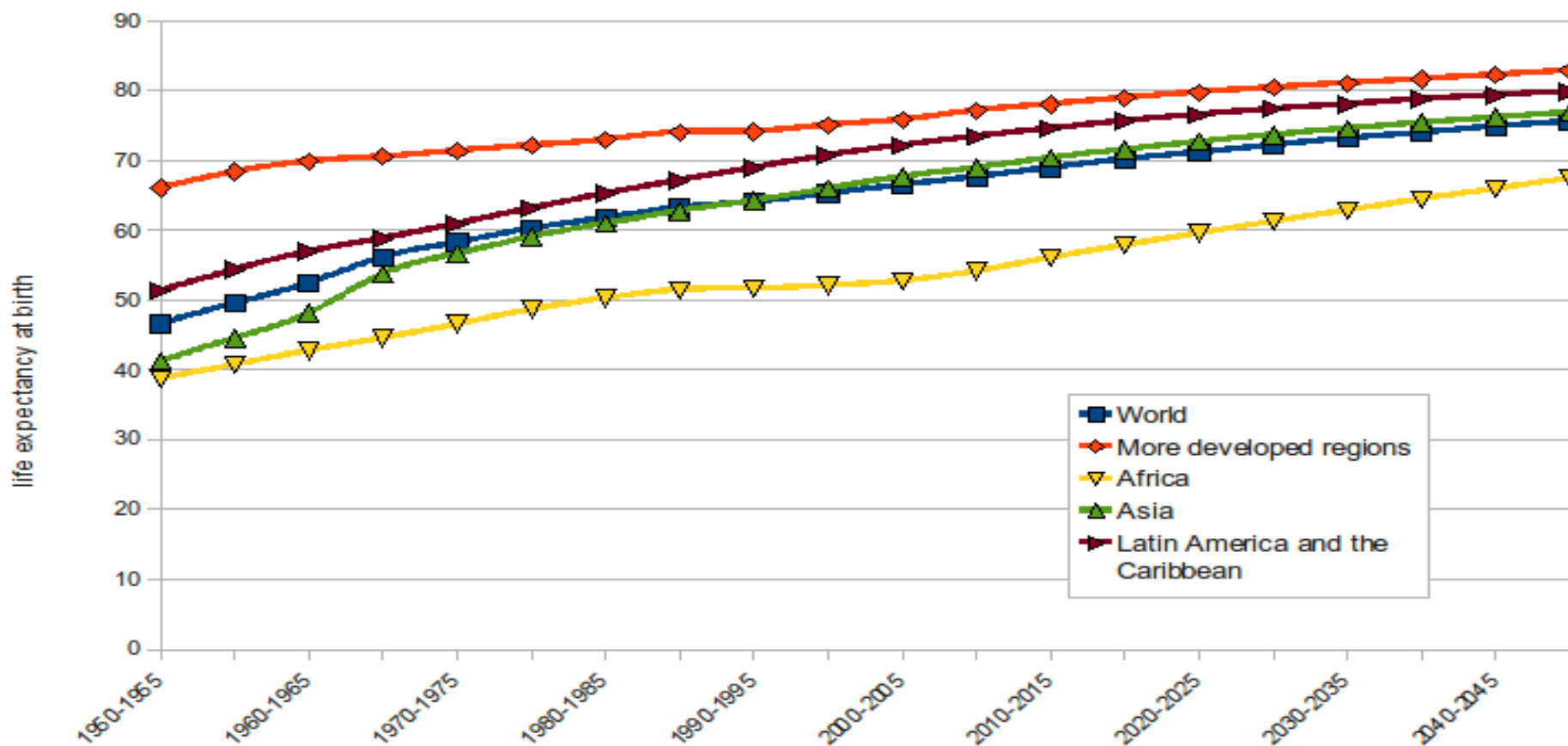


Infant Mortality Rate by Region, 1950-2050.

Source: UN World Population Prospects, 2008.
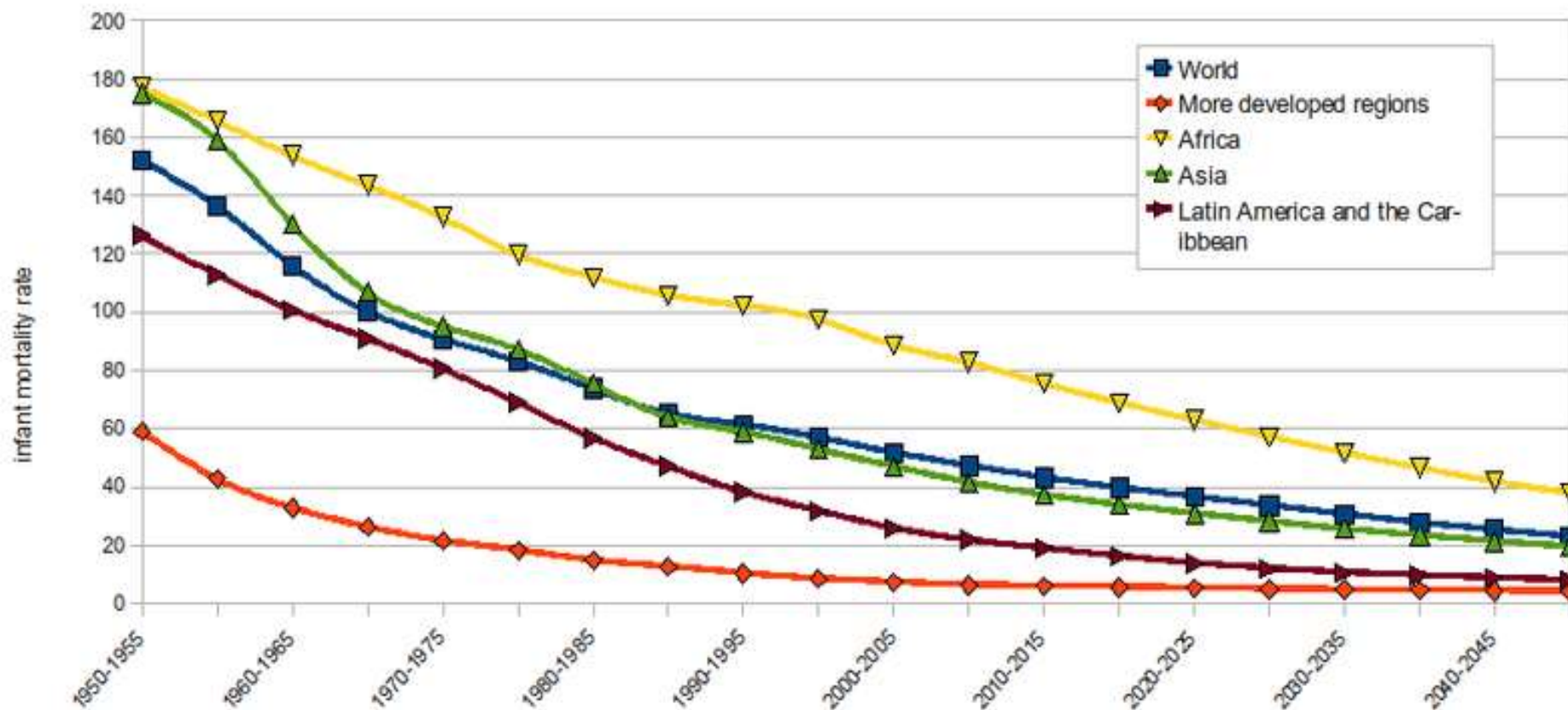
# Life expectancy at birth by region, 1950-2050



Life Expectancy at Birth by Region, 1950-2050.

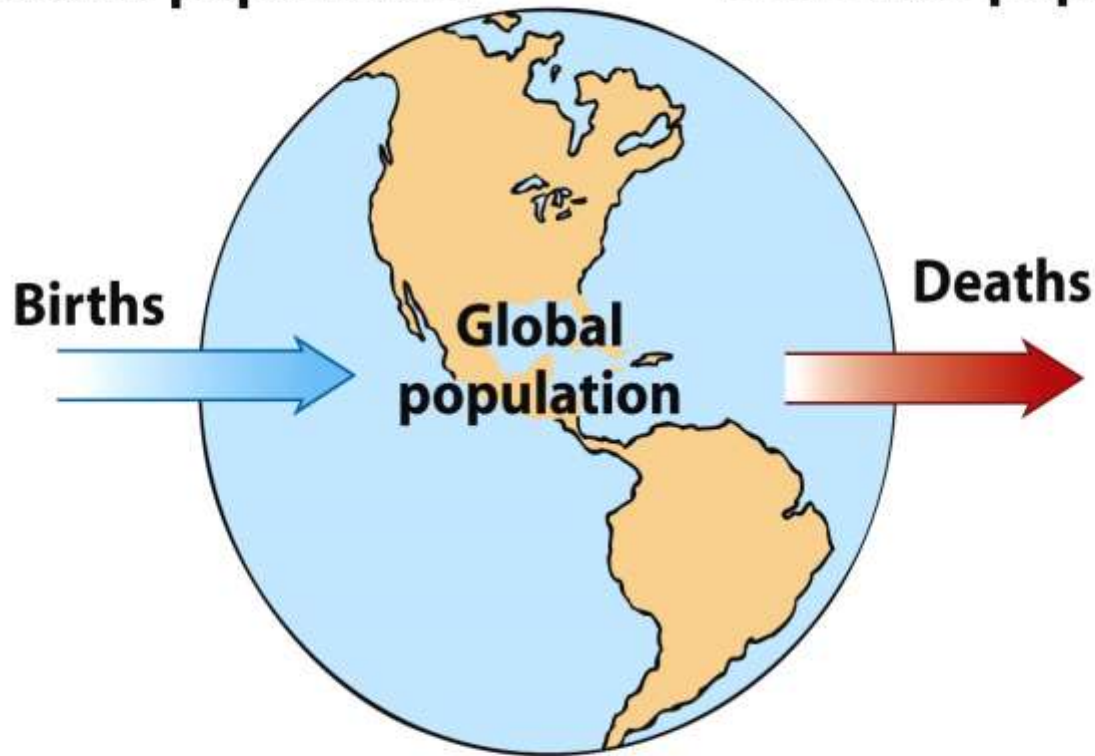Source: UN World Population Prospects, 2008.

# Change in population size



**Increases population:**      **Decreases population:**
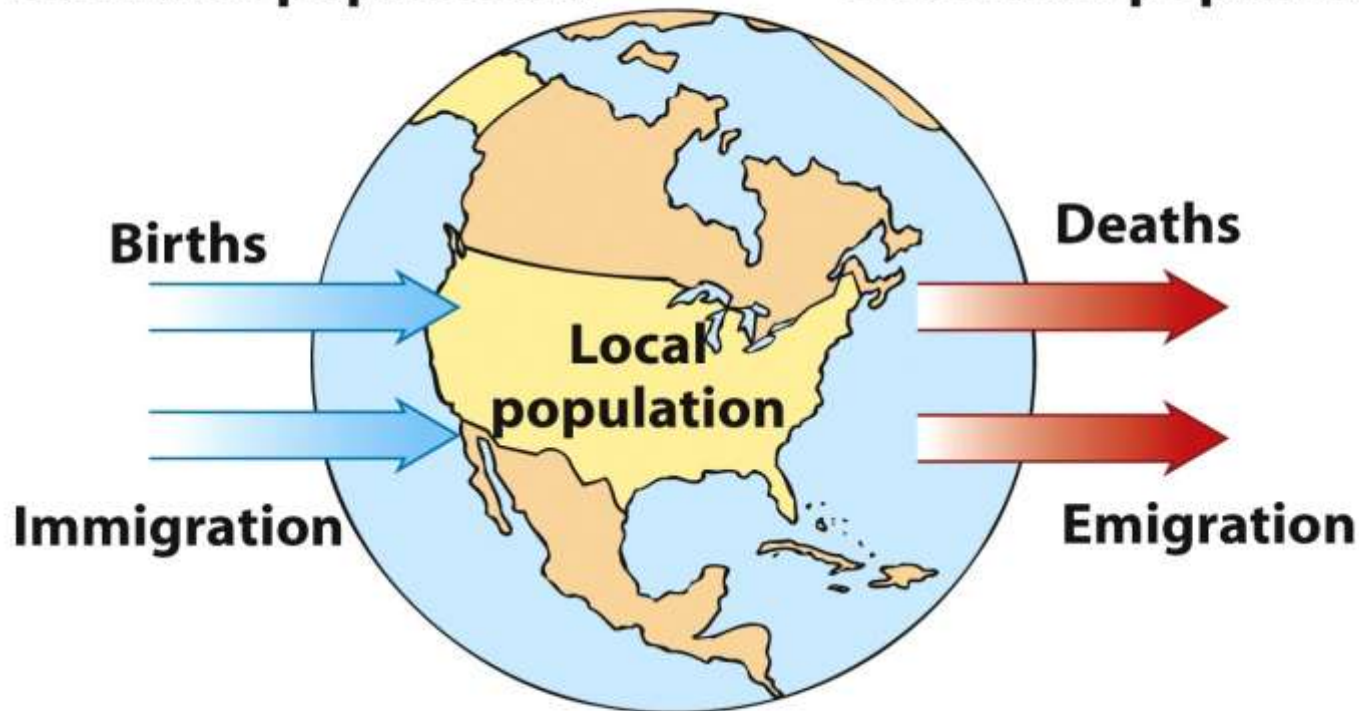
Births → Global population → Deaths

On global scale the change in a population is due to the number of births and deaths.

# Migration : change in population size



**Increases population:**     **Decreases population:**

**Births**

**Immigration**

**Local population**

**Deaths**

**Emigration**

In local populations, such as the population of the United States, the number of births, deaths, immigrants, and emigrants affect population size.

# Calculating population change

**Growth rate**

**Death rate**

**Emigration rate**

$$r = (b - d) + (i - e)$$

**Birth rate**

**Immigration rate**

Birth (b), Death (d), Immigration (i) and Emigration (e) are calculated per 1000 people

# Why Family Planning is still important ?

# Family planning can help prevent unintended and unwanted pregnancies

- It has intrinsic benefits to the women themselves, and contributes to child health and survival
  - gender equality and empowerment
  - fulfillment of human rights
  - child survival,
  - poverty reduction
  - opportunities (e.g. education, economic empowerment)
  - maternal health and survival

- Estimated that 27% of maternal deaths can be prevented by meeting unmet need for family planning

# Current situation on family planning



**Constraints**:

- 26 countries have CPR below 20%

- 215 million couples have an unmet need for family planning

- Decreased investment in contraceptive research and development by industry, despite increased demand

- Active mis - and disinformation
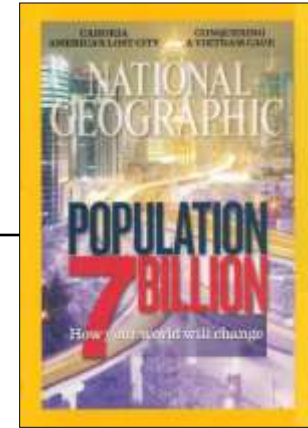
**Opportunities**:

- MDG 5b: Universal access to reproductive health

  - FP and other SRH services

- Renewed interest in supporting family planning internationally

# MDG 5: improve maternal health

- **5 A**:Reduce by three quarters, between 1990 and 2015, the maternal mortality ratio
  - 5.1 Maternal mortality ratio
  - 5.2 Proportion of births attended by skilled health personnel

- **5.B**: Achieve, by 2015, universal access to reproductive health
  - 5.3 Contraceptive prevalence rate
    5.4 Adolescent birth rate
    5.5 Antenatal care coverage (at least one visit and at least four visits)
    5.6 Unmet need for family planning

# UN Secretary General's Global Strategy for Women's and Children's Health: 2010



## Components

- Country-led health plans
- Comprehensive, integrated package of essential interventions and services
- Integrated care
- Health systems strengthening
- Health workforce capacity building
- Coordinated research and innovation



Global Strategy for Women's and Children's Health

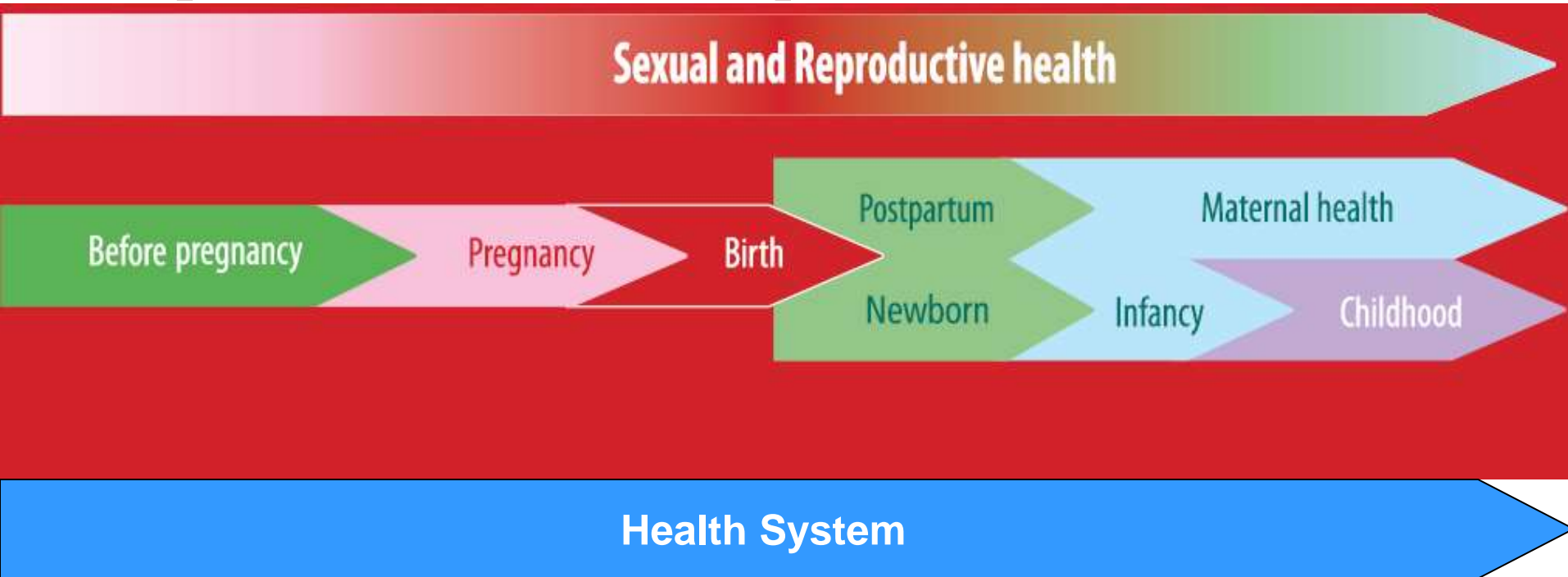United Nations Secretary-General Ban Ki-moon

## Role of UN agencies

- Define norms, regulations and guidance to underpin efforts
- Help countries align their national practices
- Work together and with others to strengthen technical assistance to scale-up
- Encourage links between sectors and integration with other international efforts
- Support systems that track progress and identify funding gaps
- Generate and synthesize research-derived evidence and provide a platform for sharing

# Accelerating progress in achieving MDG 5: Trends and lessons from countries

- Effective policies and coordination of stakeholders at national level in improving maternal health (Nepal)
- Increasing the utilization of skilled health personnel for delivery services (Benin)
- PMTCT as an integrated element of reproductive/maternal health programme (Botswana)
- H4+ coordination in countries – challenges and successes (Ethiopia)
- Accelerating progress in achieving MDG 5 – the international response (Dr M. Chan, for H4+)

*September 2010, World Summit, UN General Assembly*

This event is co-sponsored by **hrp**

UNDP - UNFPA - WHO - WORLD BANK
Special Programme of Research, Development
and Research Training in Human Reproduction

# Evidence-based packages of interventions to improve SRH (H4+) and partners



**Sexual and Reproductive health**

Before pregnancy → Pregnancy → Birth

Postpartum
Newborn
Maternal health
Infancy
Childhood

**Health System**

**Components**
Benefits and potential impact of interventions,
   including Family planning
Health system requirements
Service delivery recommendations
Indicators

# Family planning guidelines and tools

**Medical Eligibility Criteria**

**Selected Practice Recommendations**

**The Medical Eligibility Criteria Wheel**

CIRE
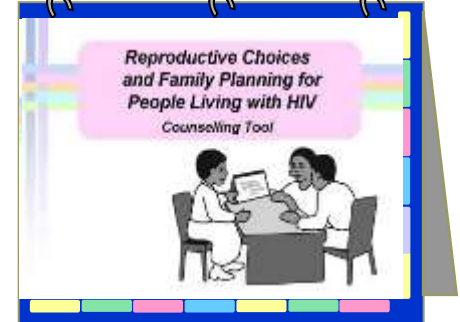
**Reproductive Choices and Family Planning for People with HIV**

4th edition just published!

2010

**Decision-Making Tool**

**Global Handbook**

New →

**Guide to family planning for health care providers and their clients**

# Indicators on family planning

# Contraceptive prevalence rate

- Contraceptive prevalence is the percentage of women who are currently using, or whose sexual partner is currently using, at least one method of contraception, regardless of the method used.

  - It is usually reported for married or in union women aged 15 to 49.

  - A union involves a man and a woman regularly cohabiting in a marriage-like relationship.

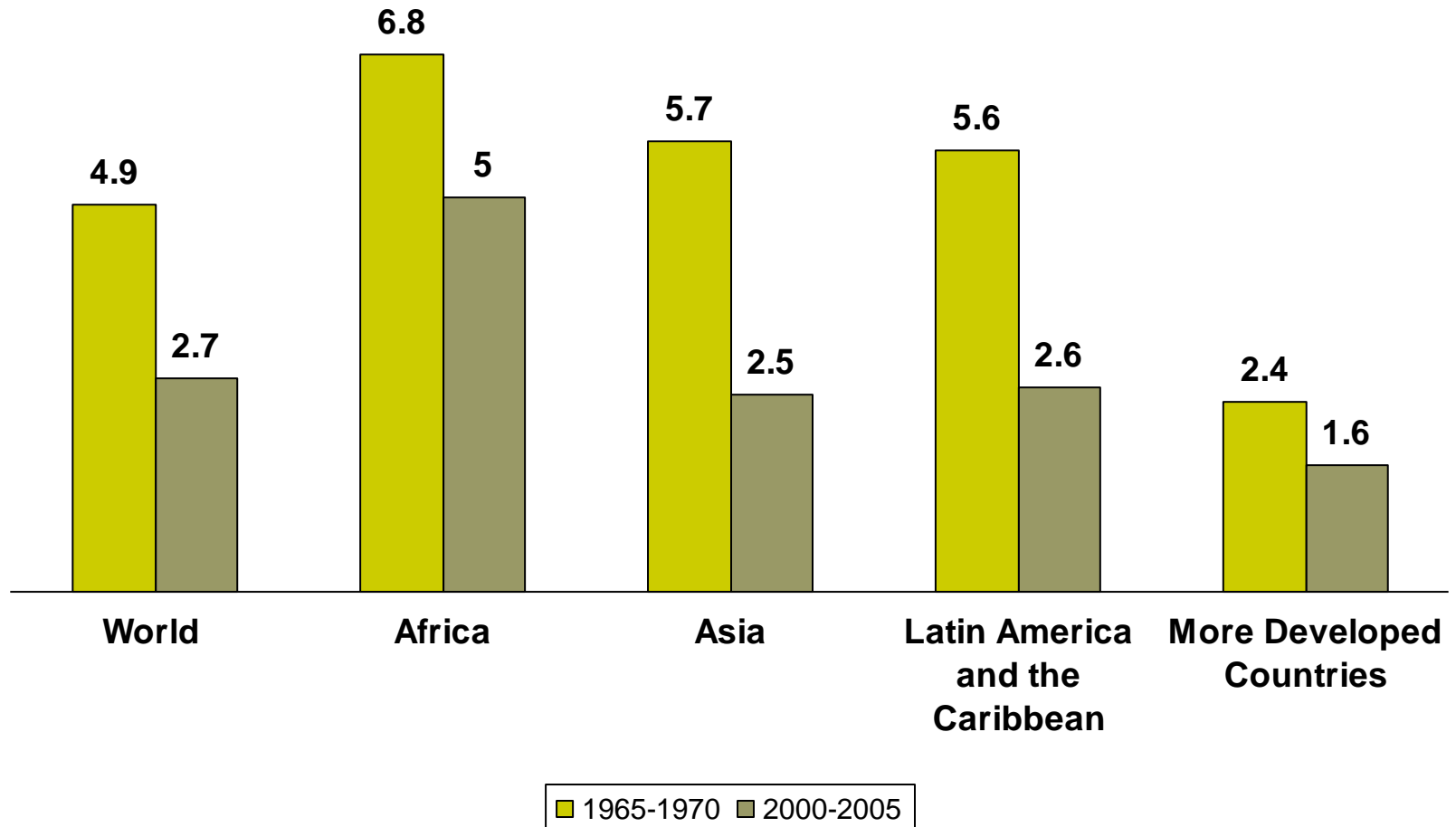# Global contraceptive prevalence rate
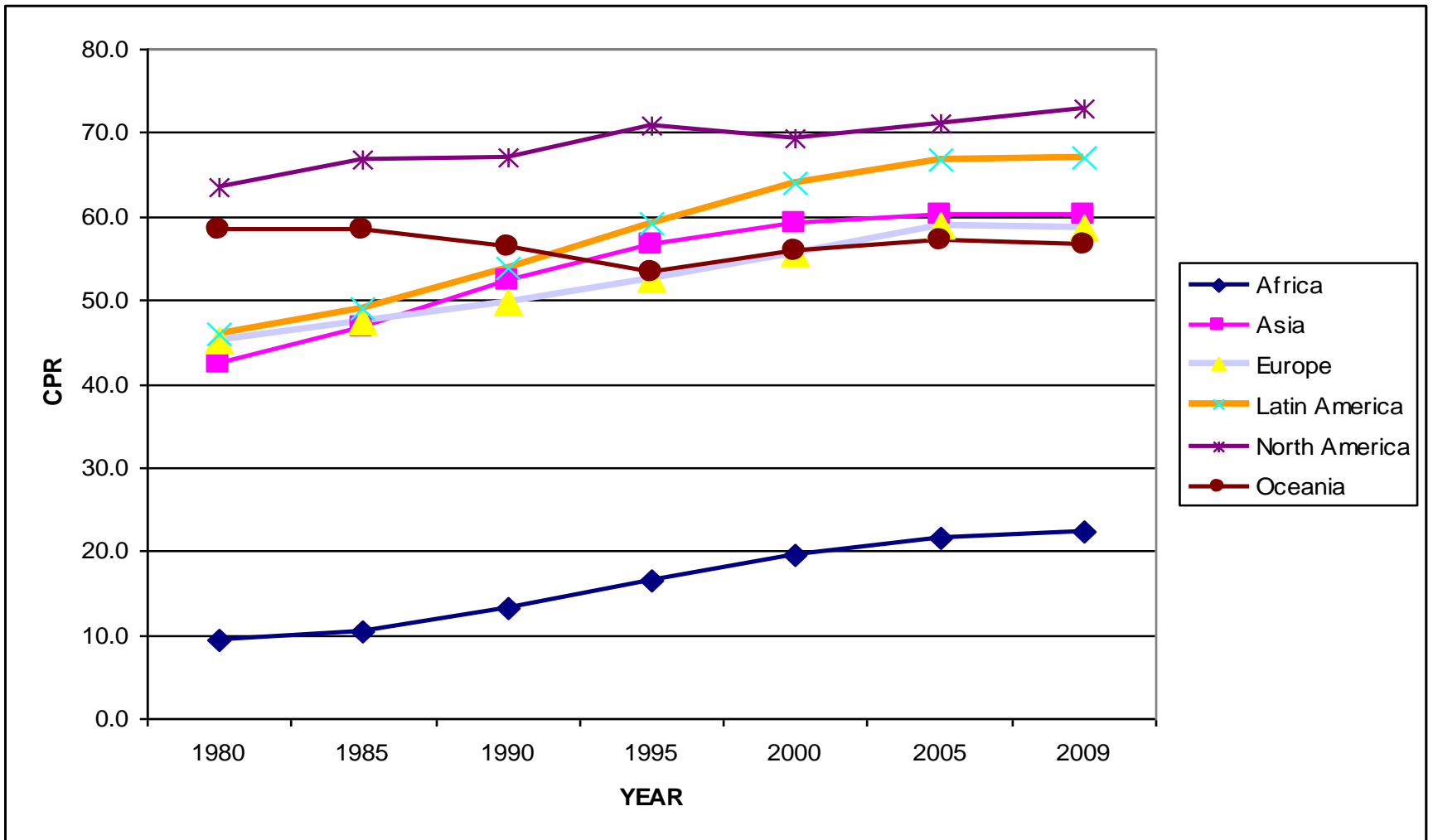
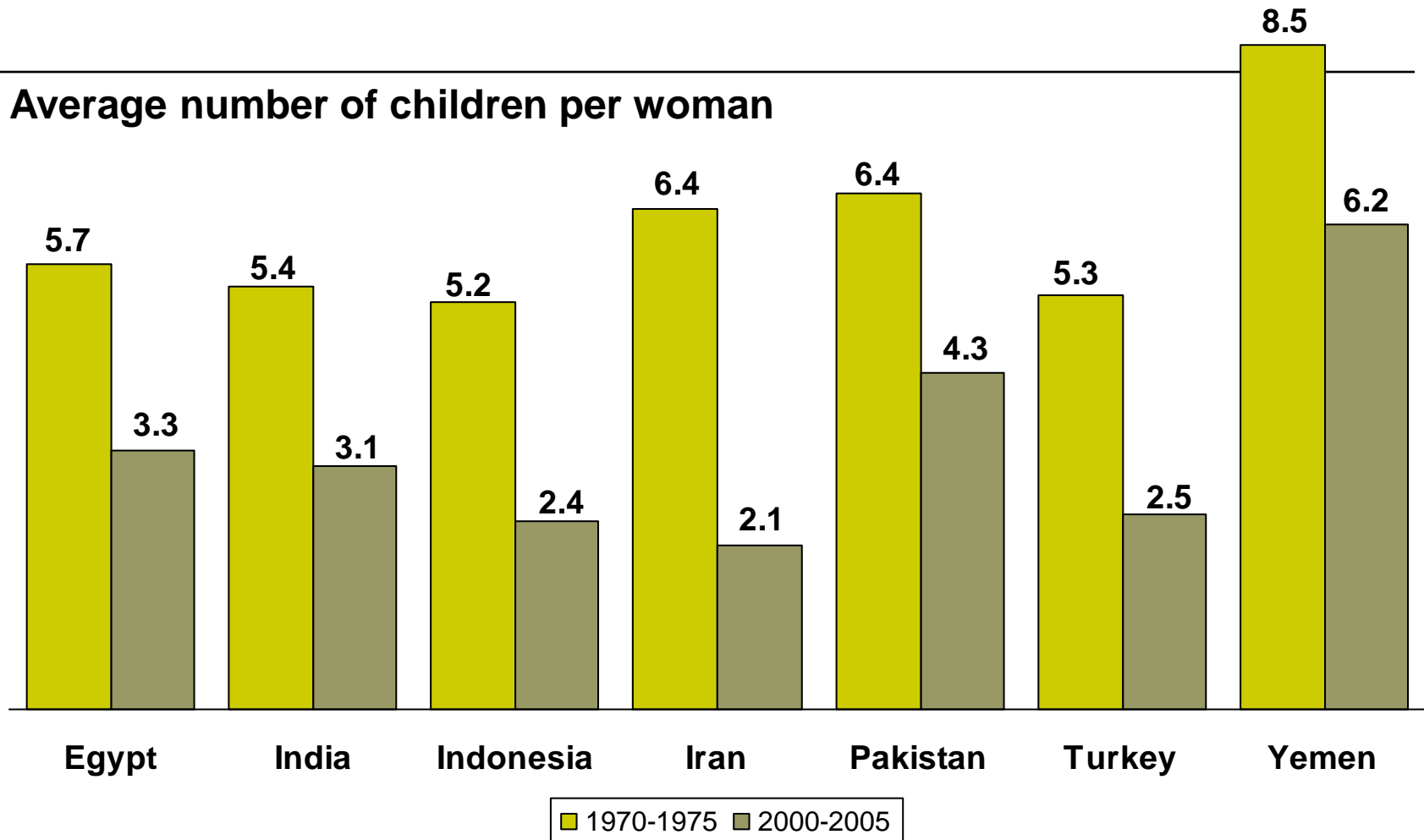# Contraceptive prevalence rate in Asia



CPR Trends - Asia
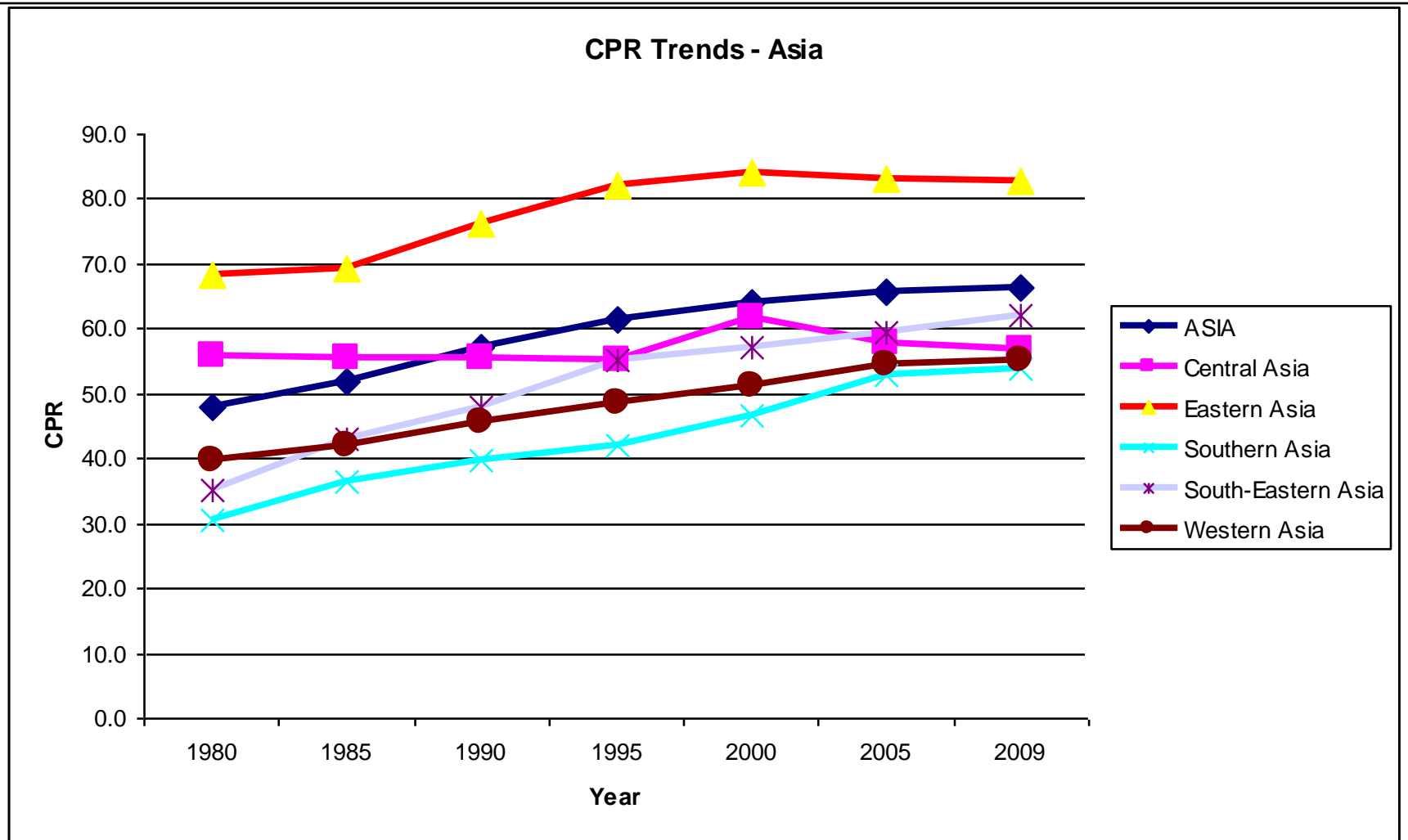
# Trends in childbearing, by region

**Average number of children per woman**



| Region | 1965-1970 | 2000-2005 |
|---|---|---|
| World | 4.9 | 2.7 |
| Africa | 6.8 | 5 |
| Asia | 5.7 | 2.5 |
| Latin America and the Caribbean | 5.6 | 2.6 |
| More Developed Countries | 2.4 | 1.6 |

Legend: ☐ 1965-1970  ☐ 2000-2005

Source: United Nations, *World Population Prospects: The 2004 Revision*, 2005.

# Diverging trends in fertility reduction

**Average number of children per woman**



| | Egypt | India | Indonesia | Iran | Pakistan | Turkey | Yemen |
|---|---|---|---|---|---|---|---|
| 1970-1975 | 5.7 | 5.4 | 5.2 | 6.4 | 6.4 | 5.3 | 8.5 |
| 2000-2005 | 3.3 | 3.1 | 2.4 | 2.1 | 4.3 | 2.5 | 6.2 |

■ 1970-1975  ■ 2000-2005

Source: United Nations, *World Population Prospects: The 2004 Revision*, 2005.
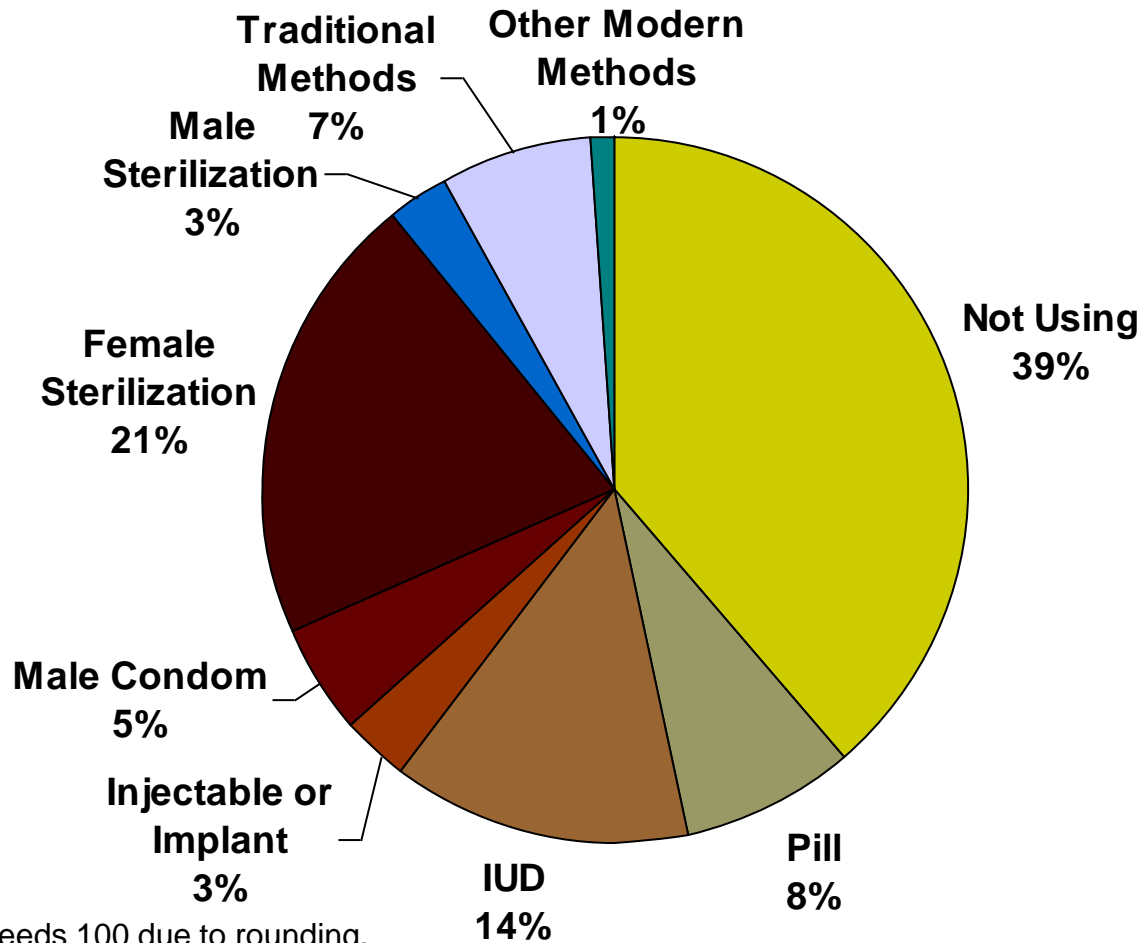
# Rising family planning use, developing countries

**Married Women 15 to 49 Using Any Method**

(Percent)



| Year | Percent |
|------|---------|
| 1960 | 9 |
| 1970 | 24 |
| 1980 | 38 |
| 1990 | 53 |
| Late 1990s | 60 |
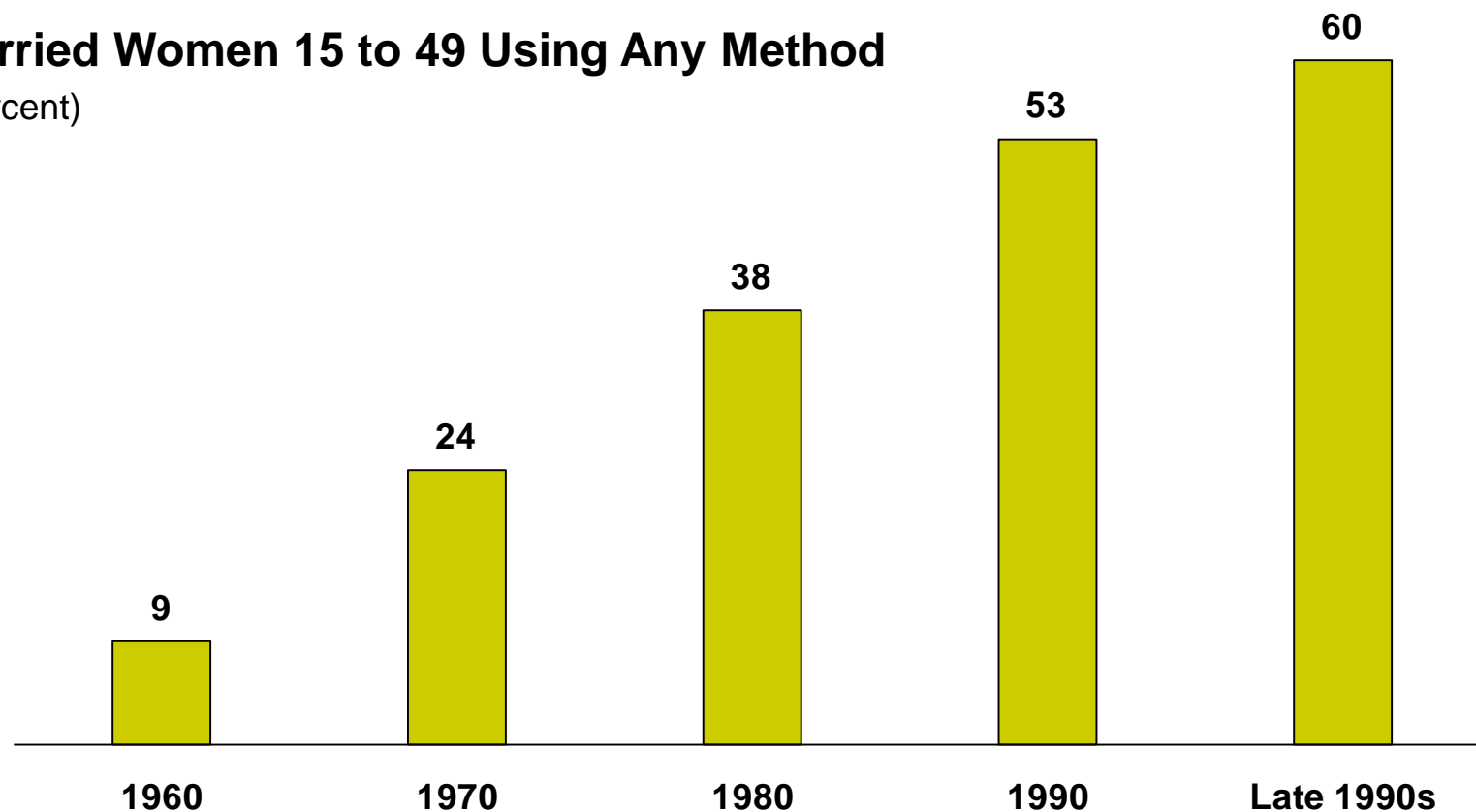
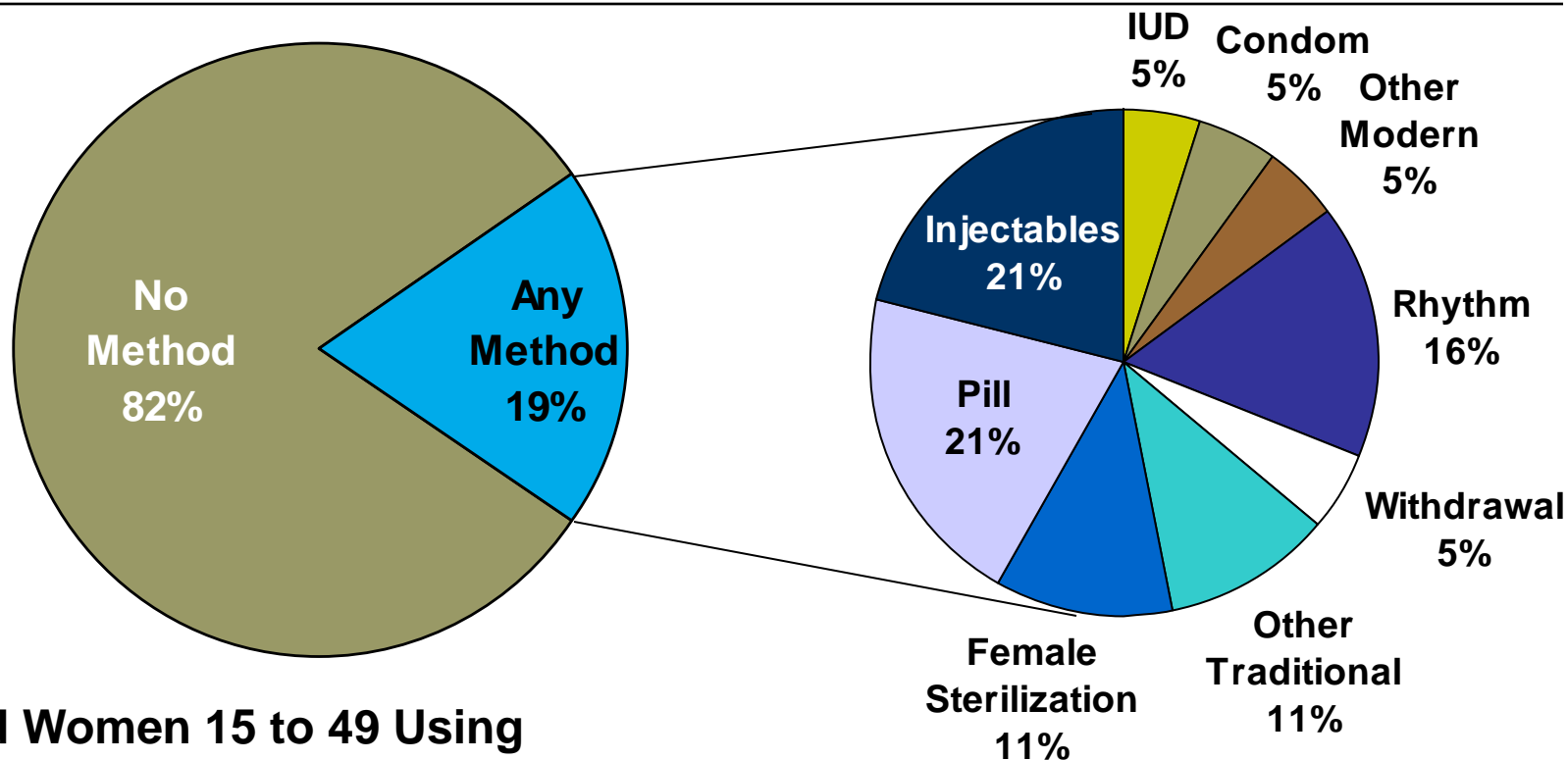Source: Population Reference Bureau, *Family Planning Worldwide 2002 Data Sheet*.

# Family planning methods, worldwide



Note: Total exceeds 100 due to rounding.
Source: United Nations Population Division, *World Contraceptive Use 2005*.

# Family planning methods, Sub-Saharan Africa



**Married Women 15 to 49 Using Family Planning, Late 1990s**

No Method 82%

Any Method 19%

Injectables 21%

Pill 21%

IUD 5%

Condom 5%

Other Modern 5%

Rhythm 16%

Withdrawal 5%

Other Traditional 11%

Female Sterilization 11%

Note: Total exceeds 100 percent due to rounding.

Source: Population Reference Bureau, *Family Planning Worldwide 2002 Data Sheet*.

# Defining unmet need for family planning

- <u>The number of women with unmet need for family planning</u>

  Women of reproductive age who are married or in a union     X 100

- Understood by many as
  – the percentage of women who are not currently using a method of family planning and want to stop or delay childbearing

- Complete calculation
  - – Is complex
  - – Is not widely understood
  - – Is difficult to calculate using data other than Demographic and Health Surveys (DHS)
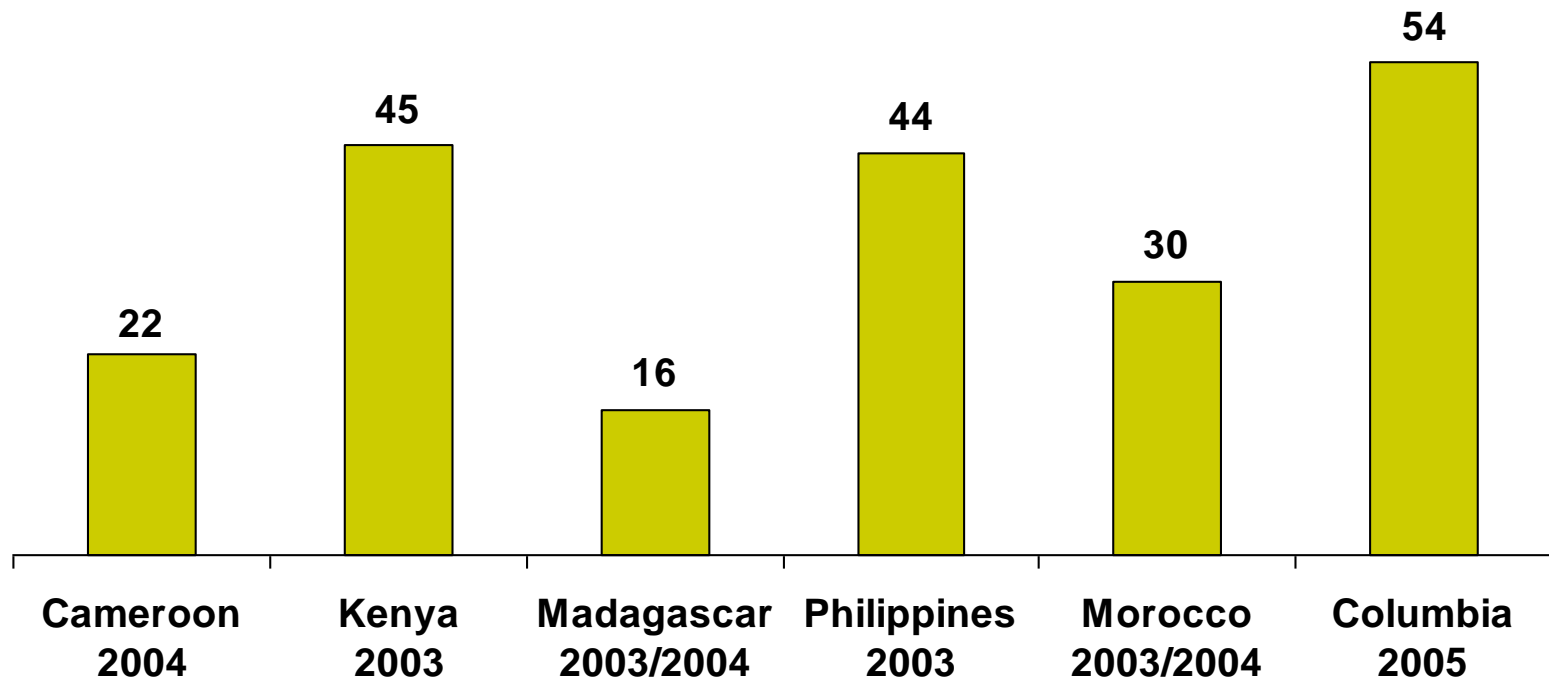
# Unmet needs for family planning

□ As unmet need is increasingly used for
  – advocacy
  – development of family planning policies
  – implementation and monitoring

And has been adopted as a Millennium Development Goal (MDG) indicator (target 5b, indicator 5.6)

□ Understanding this indicator has become crucial
□ New urgency to find a definition that can be applied consistently over time and across DHS, MICS, RHS, and other surveys
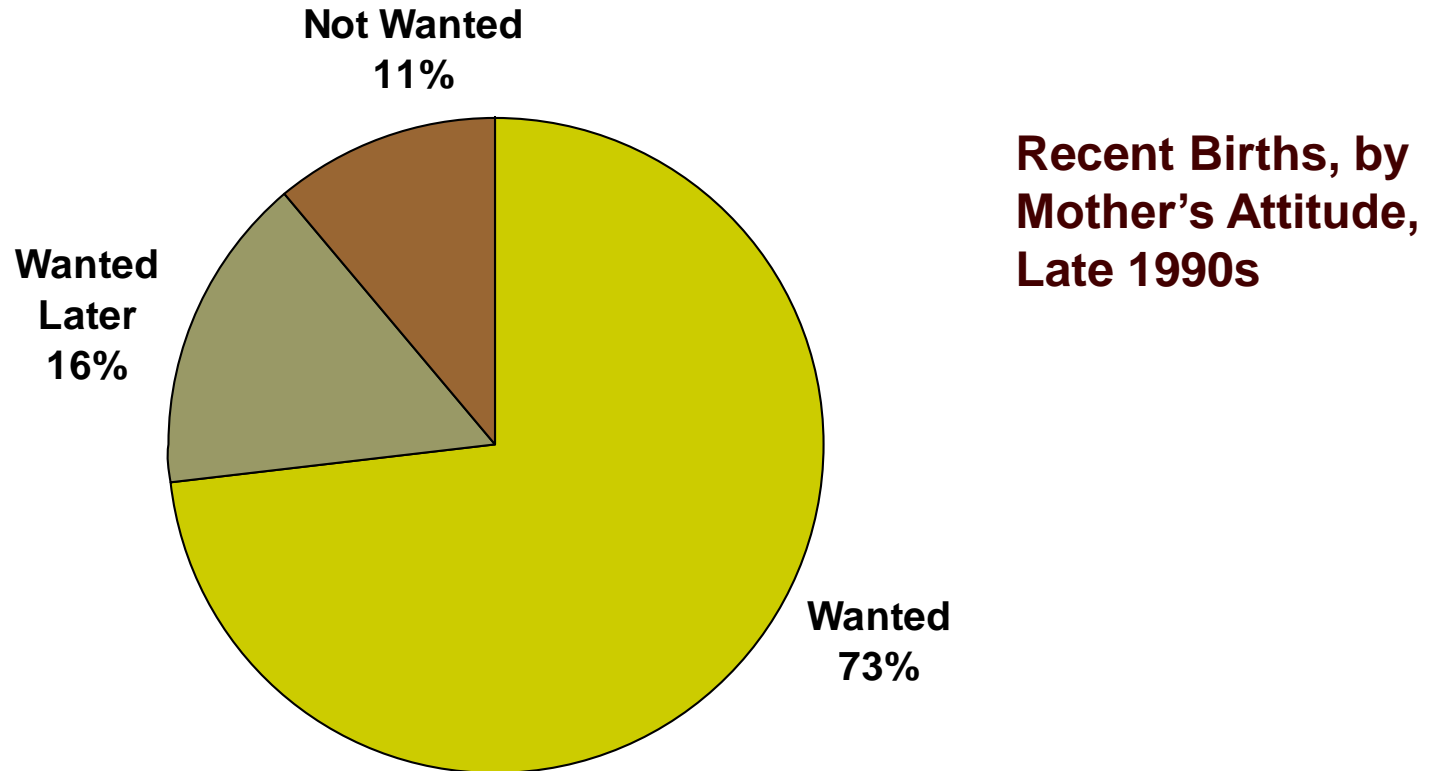
# Unintended births

**Births Reported by Women as Either Unwanted or Wanted Later**
(Percent)

# Wanted Births, Worldwide

**Not Wanted 11%**

**Wanted Later 16%**

**Wanted 73%**

**Recent Births, by Mother's Attitude, Late 1990s**
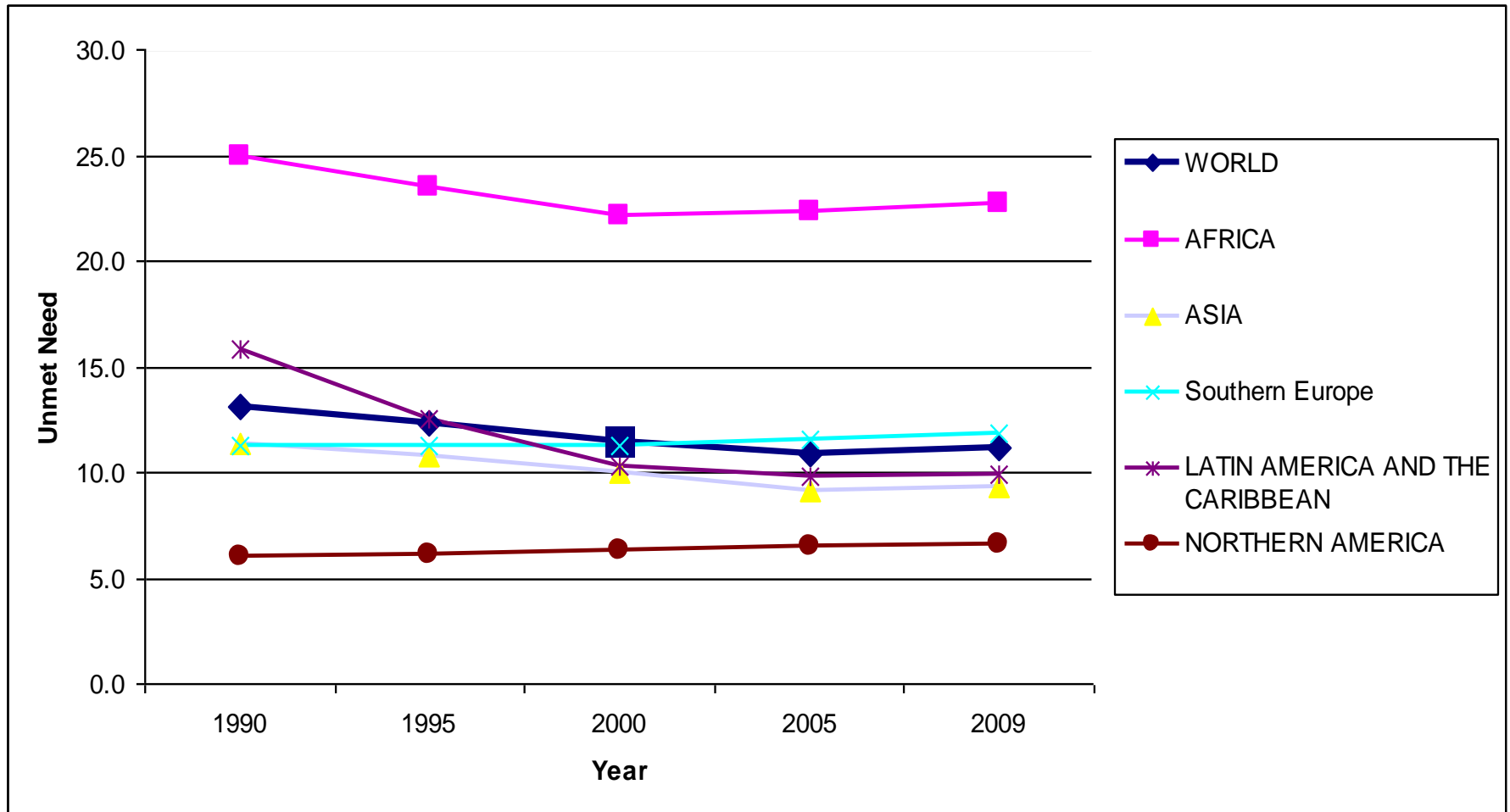
Note: Estimates based on approximately 60 percent of births worldwide.
Source: Population Reference Bureau, *Family Planning Worldwide 2002 Data Sheet*.

# Global unmet need for family planning

# Reasons for high unmet need

- Perceived lack of exposure to pregnancy was the most common reason cited
  - Between one-third and two-thirds of women with unmet need said they were never or infrequently having sex.
  - Believed they could not become pregnant because of menopause, breastfeeding, or another reason.
- Opposition to family planning (by women, their husbands, or others).
- Gender imbalance –
  - Men's unmet need tends to be lower because men want to have more children (or sooner) than do women
- Method-related problems were cited by about one-third of women with unmet need.
  - Problems related to side effects and health concerns
  - Cost and access also mentioned.
- Lack of knowledge about methods or sources of supply

# Special groups: lack of Access to family planning

- 215 million couples worldwide don't have access to family planning

- Groups without access:
  - Adolescents
  - Unmarried women
  - Women postponing their first pregnancy
  - People with disabilities
  - Poor, especially people in rural areas and urban slums
  - Migrants
  - Postpartum women

# Why to do the research in family planning
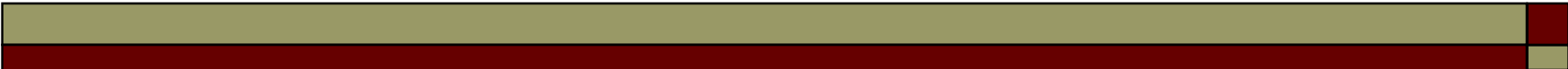
# Why do we need more research?

- High unmet need

- High percent of non-use

- Existing methods do not meet the needs of all
  - Some are difficult to use consistently and correctly
  - High typical use failure rates of temporary methods
  - Side effects or fear of side effects
  - High discontinuation of temporary methods
  - Changing needs and desires over reproductive lifespan

# …we can improve upon existing methods

- Less expensive
- Easier to use in a compliant way
- Highly effective in typical use
- Safe and Acceptable
- Rapidly reversible
    - Convenient and easy to use
    - Use in chronic disease states
- Provide additional health benefits
- Easier to deliver in service settings: availability, affordability and acceptability
- User-independent (Forgiving of misuse)
- Provided by CHWs (task shifting), or provider independent

# …or develop new methods that could be game changers

- Male methods that are practical
- Non-condom approaches for dual protection
- Non-surgical sterilization
- Peri-coital methods
- Immuno-contraceptives
- Novel and/or non-hormonal contraceptives (daily or long acting)
- Methods with non-contraceptive health benefits

# Research is important

☐ Research can play a critical role in responding to the challenge of <u>unmet need</u> for family planning, especially during periods <u>when resources are limited</u>.

☐ To fill the knowledge gap regarding contraceptive technology & safety, and address implementation issues related to improving contraceptive uptake, removing barriers and increasing acceptability.

☐ Aims to develop new innovations in service delivery and contraceptive methods.

# Research prioritization for next decade

□ Research priorities must be <u>reviewed and updated periodically to maintain their relevance in a fair and transparent way</u>.

# CHNRI Prioritization Process: Setting the agenda

- The CHNRI priority setting process aims to include not only research that produces <u>new knowledge</u>, but also research that focuses on <u>implementation of existing knowledge</u>.

- The CHNRI process is systematic. This diagram details the process of prioritization.
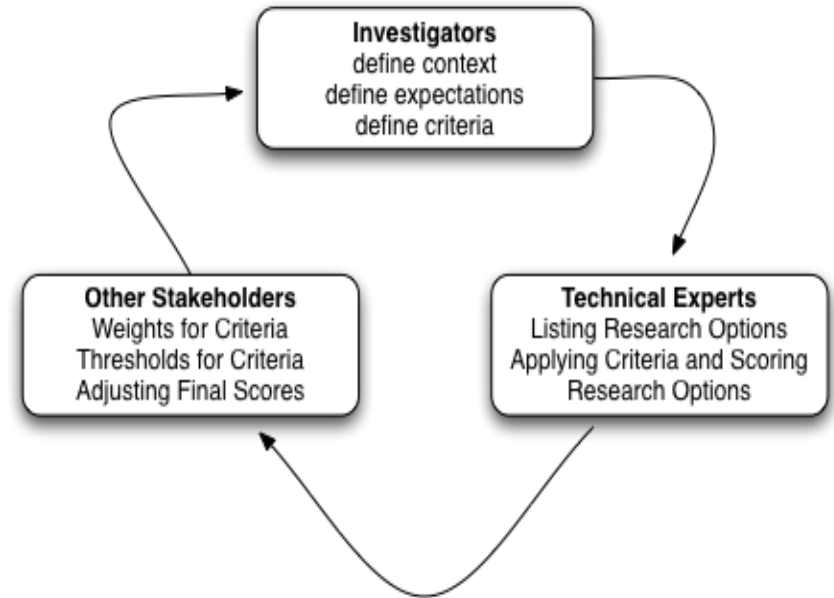
# CHNRI process: research prioritization

| Research Instrument | Research Avenue | Research Option (Research Project) | Research Question (research papers) |
|---|---|---|---|
| **Basic Epidemiological Research** | Measuring the unmet need | (list research options within each research avenue) | (list research questions within each research option) |
| | Understanding barriers to use | | |
| | Evaluating existing contraceptives | | |
| **Health Policy and Systems research** | Study the capacity to reduce obstacles to use of contraceptives | | |
| | Studying capacity to deliver efficacious interventions | | |
| **Research to improve existing interventions** | Research to improve deliverability | | |
| | Research to improve affordability | | |
| | Research to improve sustainability | | |
| **Research for development of new contraceptive technologies** | Basic research | | |
| | Clinical research | | |
| | Public health research | | |
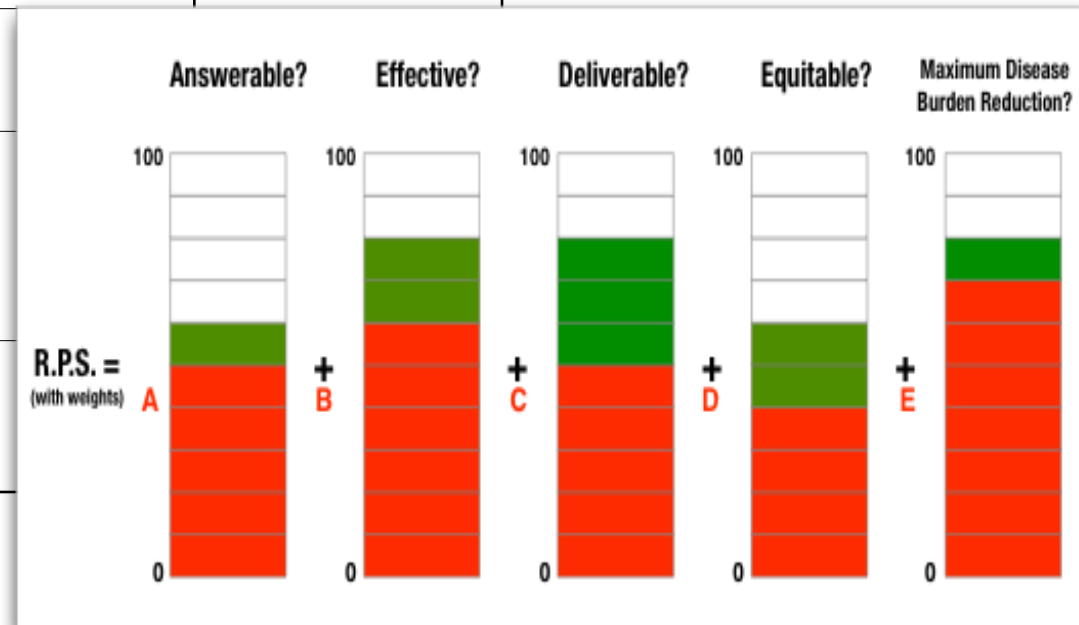
# Conclusion

- Use in reducing MMR is under emphasized.

- Potential to reduce poverty and hunger and avert 32% of all maternal deaths and nearly 10% of childhood deaths.

- Fall in total fertility rate from 6 to 3.

- Need for political willingness and commitment.

- Call for renewed commitment by donors and the potential of commercial sector through partnerships should be explored.