Family Planning to Reduce Fertility Rates

Family Planning / Birth Control

- Family Planning is about choice
- It is tied closely to:
  - Infant mortality
  - Maternal mortality
  - Health of families, including reproductive health
  - Education
  - Income
  - Religious and social values

Family Planning / Birth Control

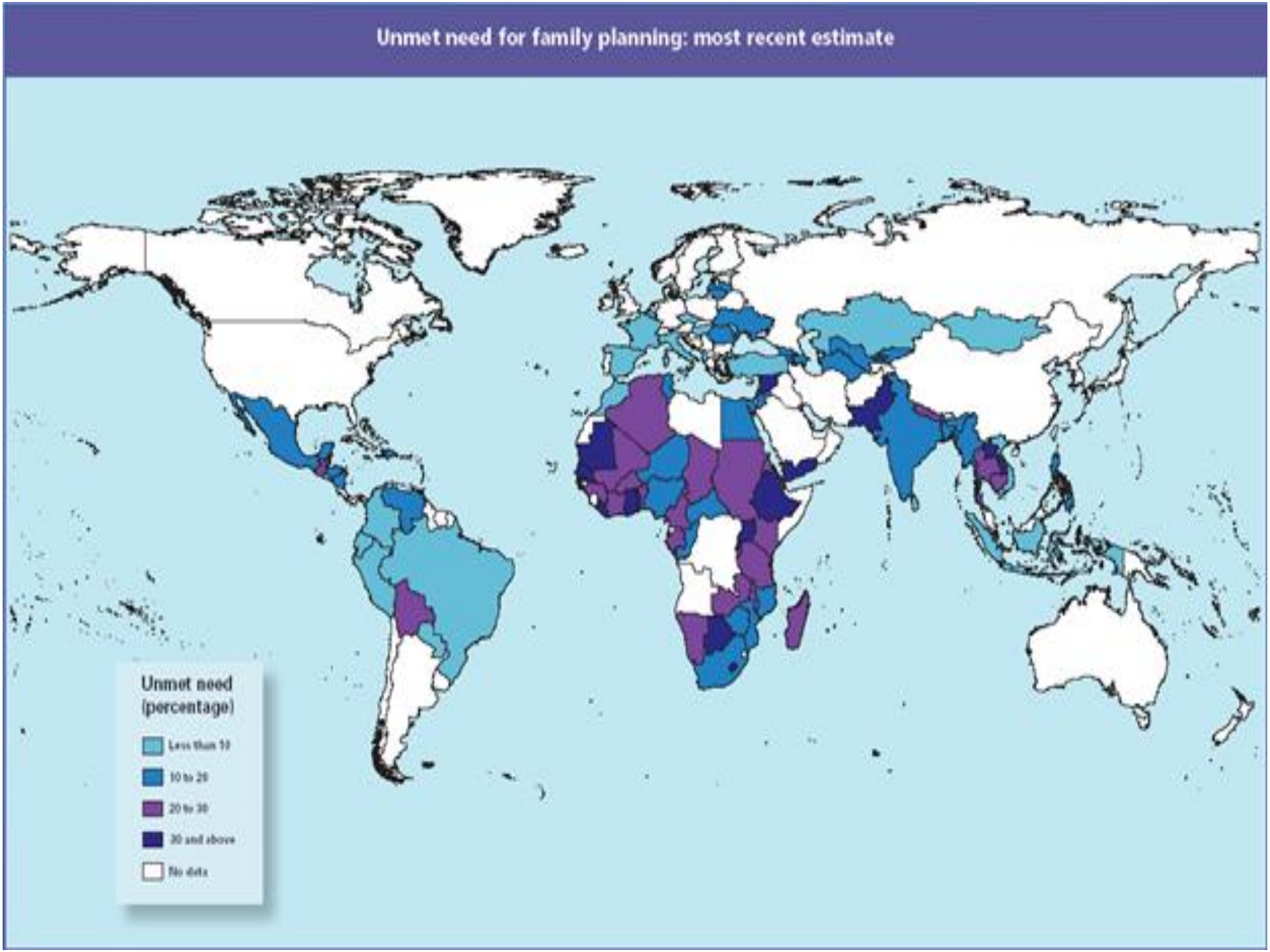
- 150 million women do not want another child, but do not use contraception (Campbell)
- Technology is a means to an end, but the ends (number of children / family) will vary by many factors
- High prevalence of contraceptive usage from surveys does not mean that fertility rates will be low

Family Planning / Birth Control

- Institutional barriers to availability
  - Cultural and religious
  - Legal (rules on abortion/contraception)
  - Medical and other practices
  - Provider bias
    - Rx needed for OCs
  - Cost
  - Lack of supply

Family Planning and Birth Control

- Personal/familial barriers to availability
  - Financial
    - More children required for familial support → part of the cycle of poverty
    - too expensive if >1% of income
  - Lack of knowledge, misinformation
  - Fear of side effects
  - Family and social disapproval
  - Ambivalence to future childbearing
  - Method of choice


Unmet need for family planning: most recent estimate
Unmet need (percentage)
Less than 10
10 to 20
20 to 30
30 and above
No data

Relationship between Prevalence of Usage of Methods of Contraception

	Women (1,000s)	Year	Prevalence- any method	Fertility rates 1970-75	Fertility rates 2000-5	% change in population 1970-2000
World	1,134,650	2003	63.1	4.1	2.6	62.6
More developed	154,469	1999	67.4	2.1	1.6	N/A
Less developed	980,181	2004	62.4	5.2	2.6	N/A
China	**260,743**	**2004**	**90.2**	**5.7**	**1.4**	**46.9**
Bangladesh	**32,074**	**2004**	**58.1**	**6.1**	**3.0**	**96.7**
India	**223,179**	**2005-6**	**56.3**	**4.9**	**2.8**	**87.5**
Europe	**96,762**	**1997**	**67.5**	**2.2**	**1.4**	**9.5**
Canada	4,239	1995	74.7	2.3	1.5	40.4
USA	35,491	2002	72.8	2.5	2.0	35.9

Lack of Support for Family Planning

- 1994 International Conference on Population and Development
- Estimated costs for family planning, safe childbirth, HIV/AIDS: $25 billion / annum (2005)

Lack of International Assistance

Table 1 2005 ICPD funding targets adjusted for inflation, broadened HIV/AIDS and reproductive health services compared to projected 2005 population assistance and domestic expenditures (in $ billions and percents)

	2005 Original ICPD target (1993$)	Revised 2005 target adjusted for inflation, HIV/AIDS and reproductive health (2005$)	2005 Projected expenditures	% of revised target
Donor share (one-third)	$6.1	$20.2	$6.1	30
Developing country share	$12.4	$25.6	$14.9	58
Total	$18.5	$45.8	$21.0	46

Notes and Sources:

Donor targets were assumed to be one-third of totals needed except for adjusted STI/HIV/AIDS targets, where donor share is assumed to be two-thirds.

Adapted from: Speidel (2005).

Not Meeting Priorities

Table 2 2005 ICPD funding targets for donors adjusted for inflation, broadened HIV/AIDS and reproductive health services compared to estimated 2004 donor population assistance by category targets (in $ billions and percents)

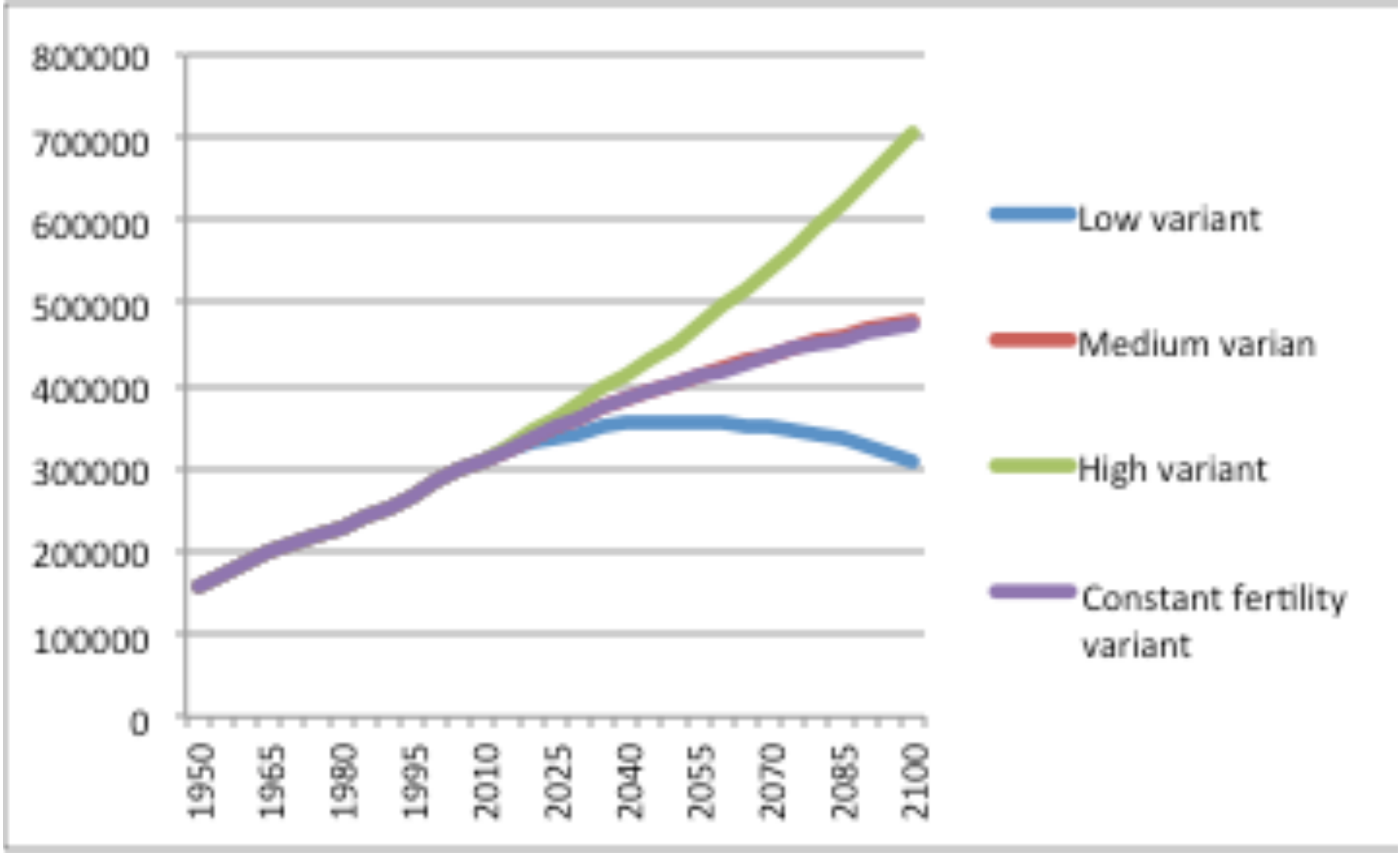
Expenditure category	2004	2005		2005	
	Donor expenditures estimated	Original ICPD donor target (1993$)	% of target	Revised donor target adjusted for inflation, HIV/AIDS, & reproductive health (2005$)	% of target
Family planning	$0.453	$3.8	12	$5.2	9
Reproductive health	$1.368	$1.8	76	$5.0	27
STI/HIV/AIDS	$2.695	$0.5	539	$9.9	27
Basic research	$0.752	$0.1	752	$0.1	752
Total	$5.268	$6.2	85	$20.2	26

Case Study: USA, Factors Affecting Fertility Rates

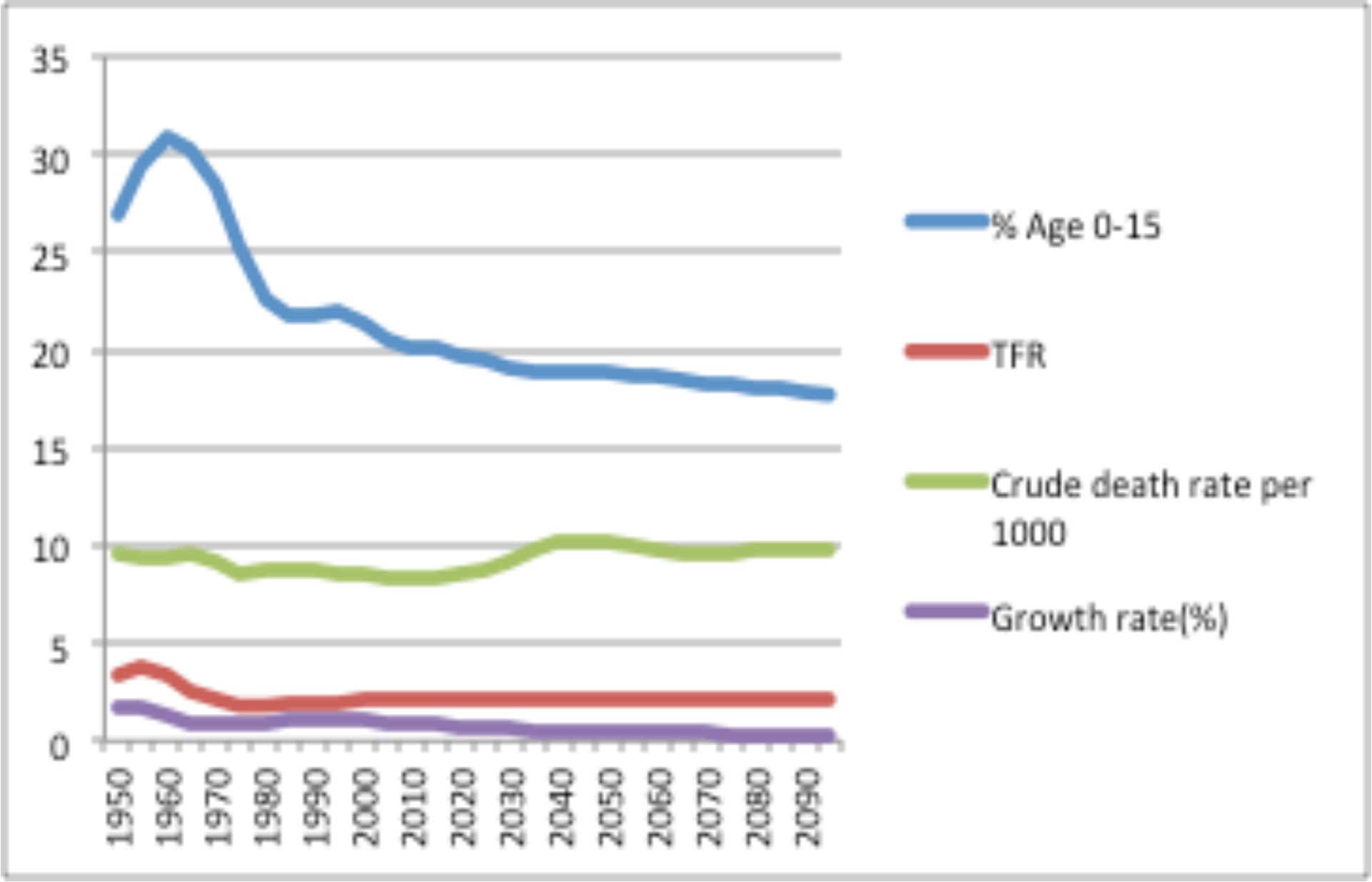
The USA

- Current population: **316.9** million
- Population 2050 (medium variant): 403.1 million
- % population 0-15: 20%
- Population density: 42/km^2

US Population, by Variant



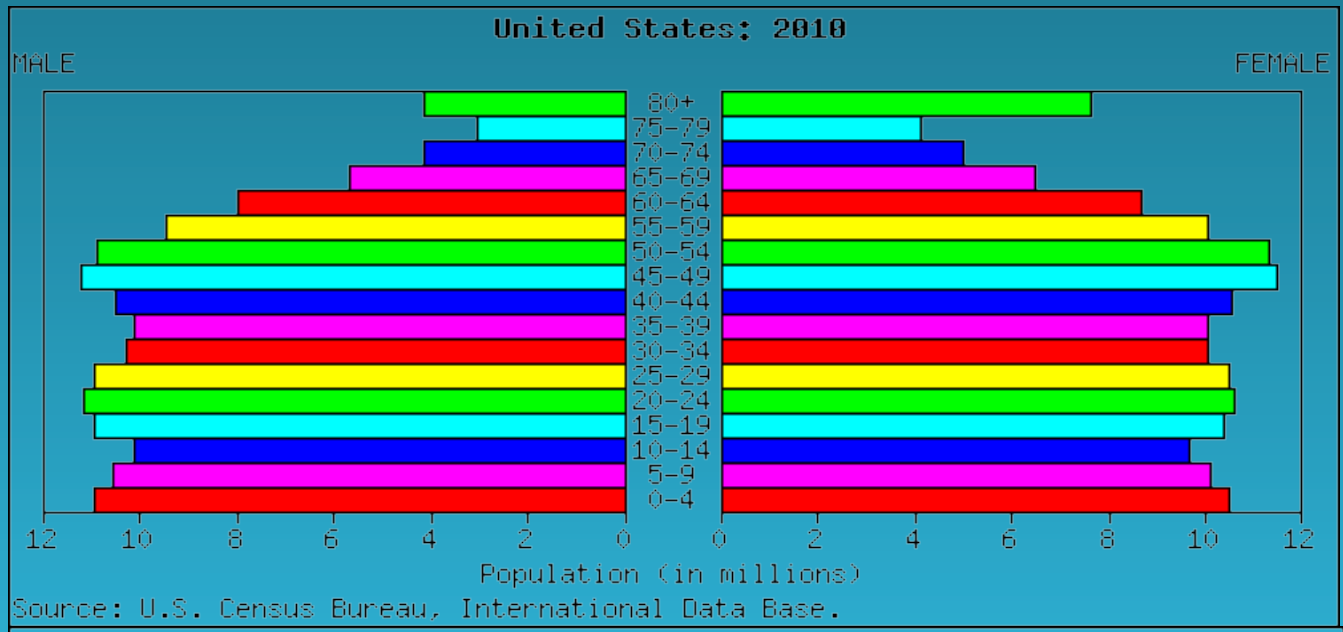
Other Parameters



Population Pyramids: US and Canada, 2010

TFR:

2.06



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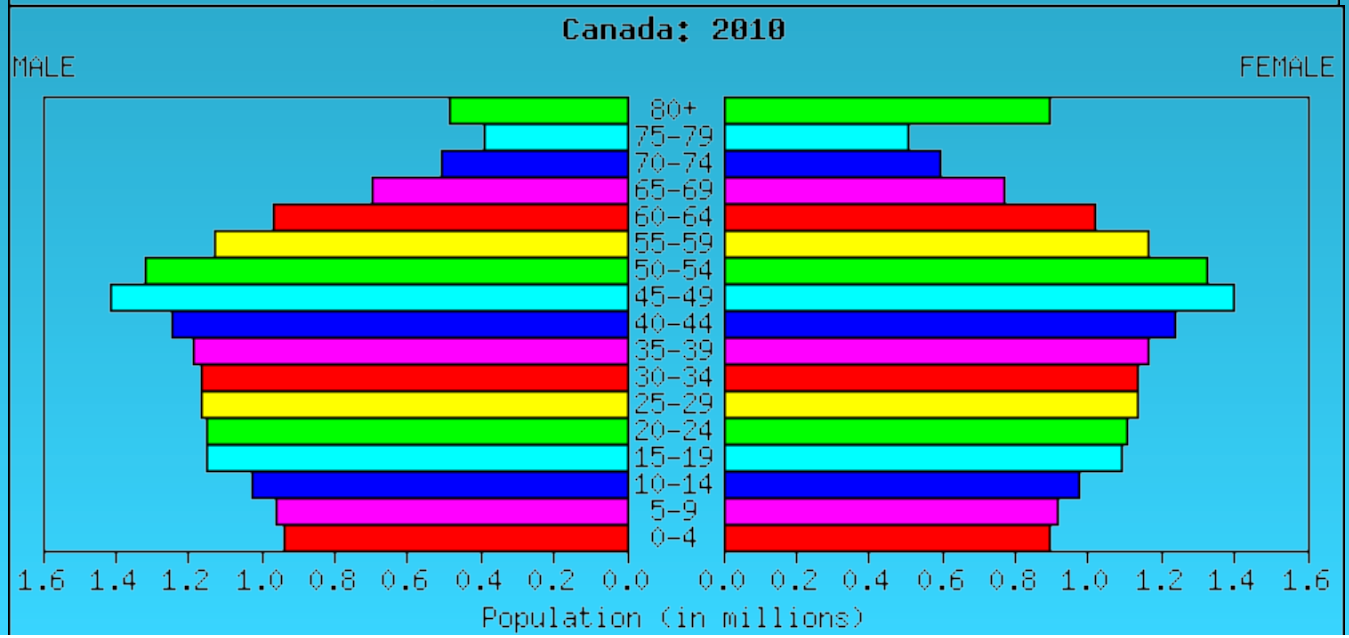

Population Pyramids: US and Italy, 2010

TFR:

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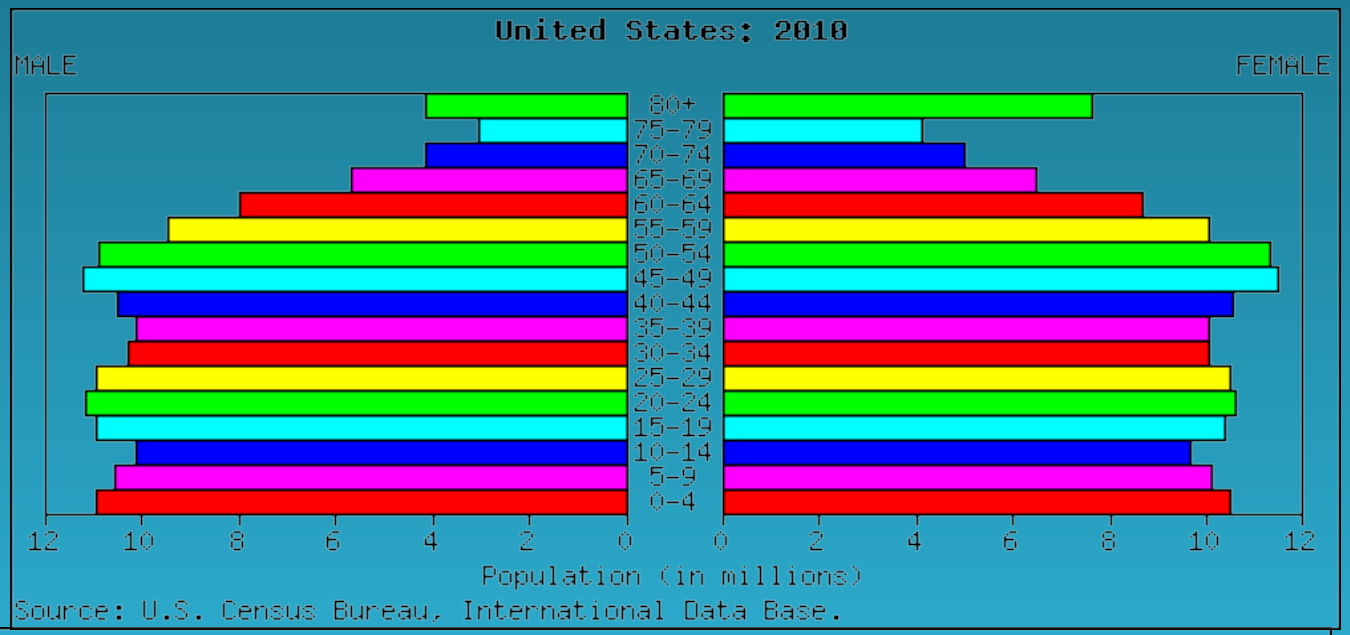

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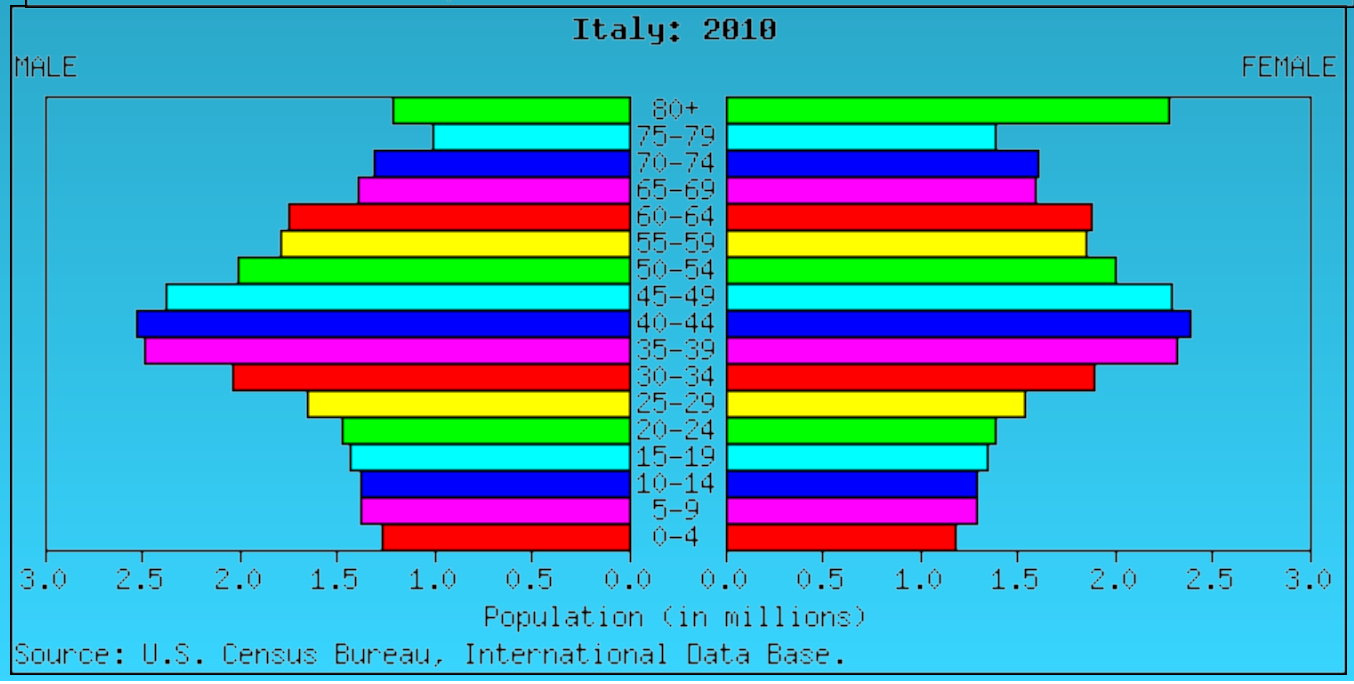
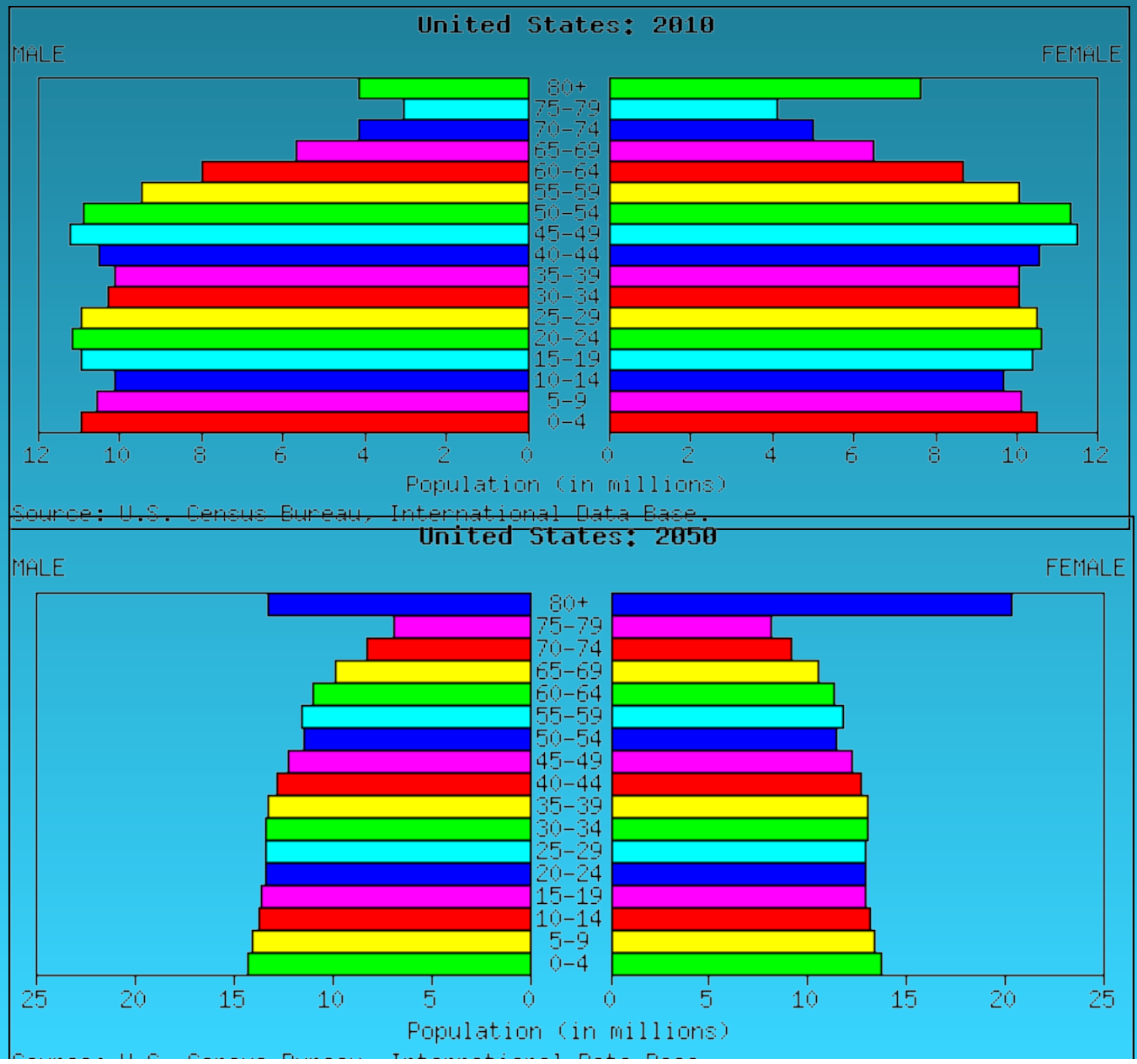


Population Pyramids: US 2010 and 2050

TFR:

2.06

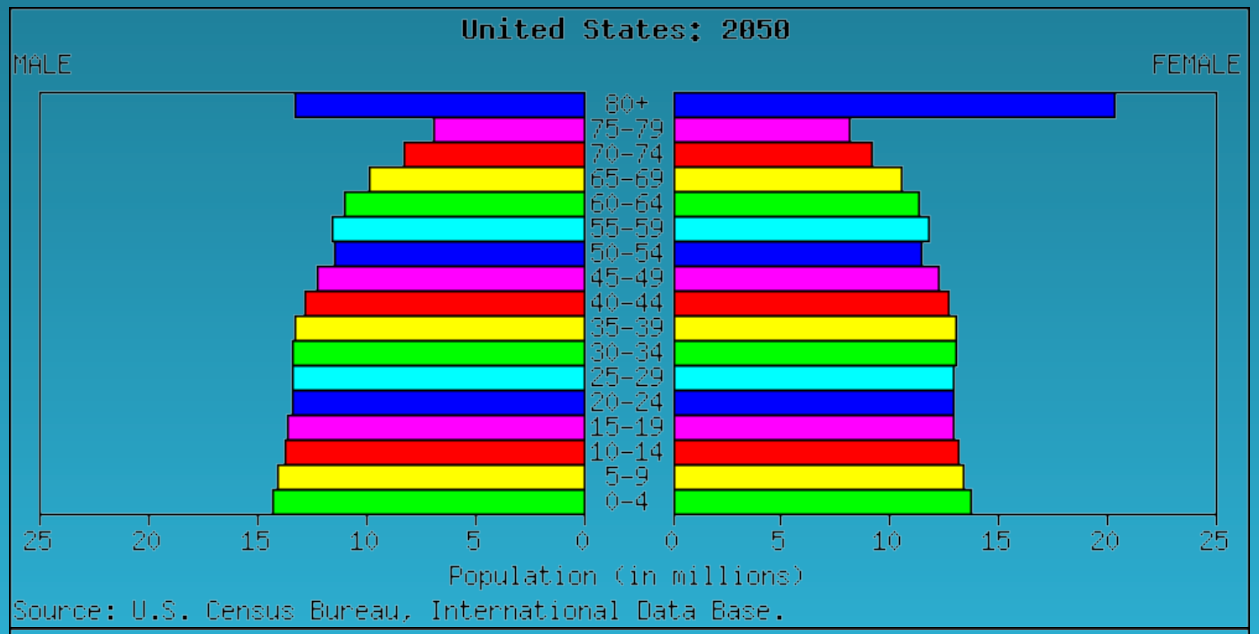
2.09



Population Pyramids: US and Italy 2050

TFR

2.09



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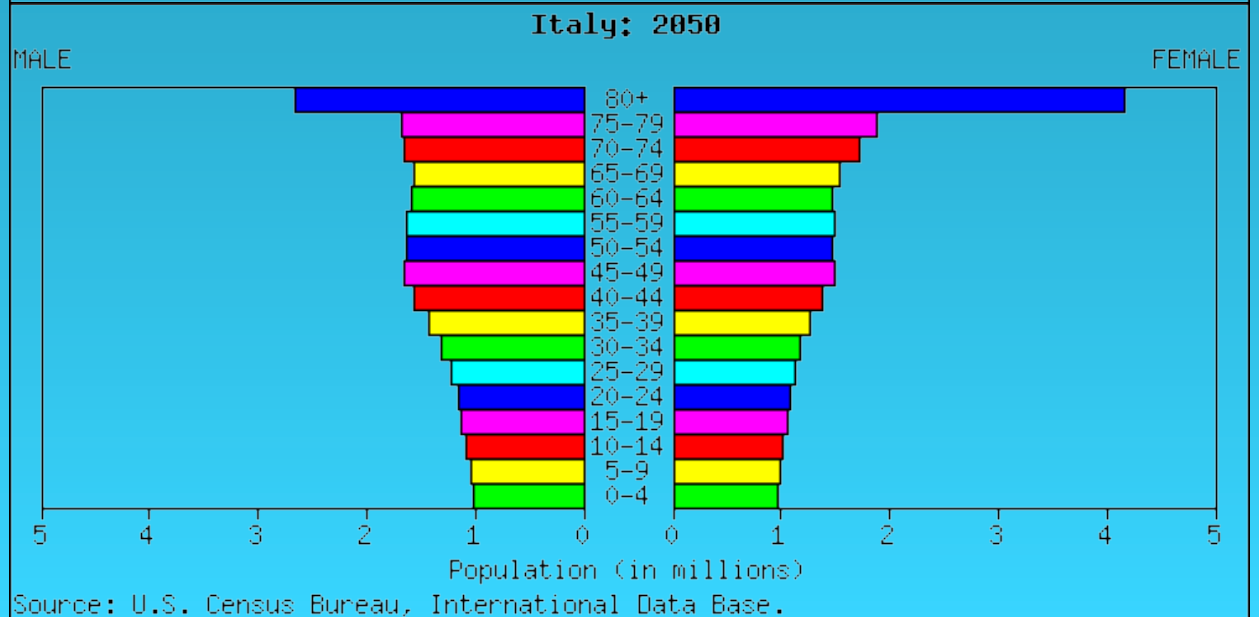


Effect of Immigration in the US: Comparison of Simplified Estimates

(in millions)

	US	
	With (0.9%)	Without (0.6%)
2008	304.5	
2025	354.6	337.1
Natural increase	17.5 (~35%)	

Potential Effect of Adequate Birth Control on the US Population

- ~60% of population growth from births exceeding deaths
  - 4.1 million births, 2.4 million deaths (2003)
- ~40% due to immigration
- Unintended pregnancies: 1.4 million
- If unintended pregnancies were prevented ➔ natural increase in the US population would be about 340,000
- Total annual increase with immigration = 340,000 + 1,160,000 = 1.5 million instead of 2.9 million

From Speidel et al.

Race is a Predictor of Pregnancy Rate in the USA

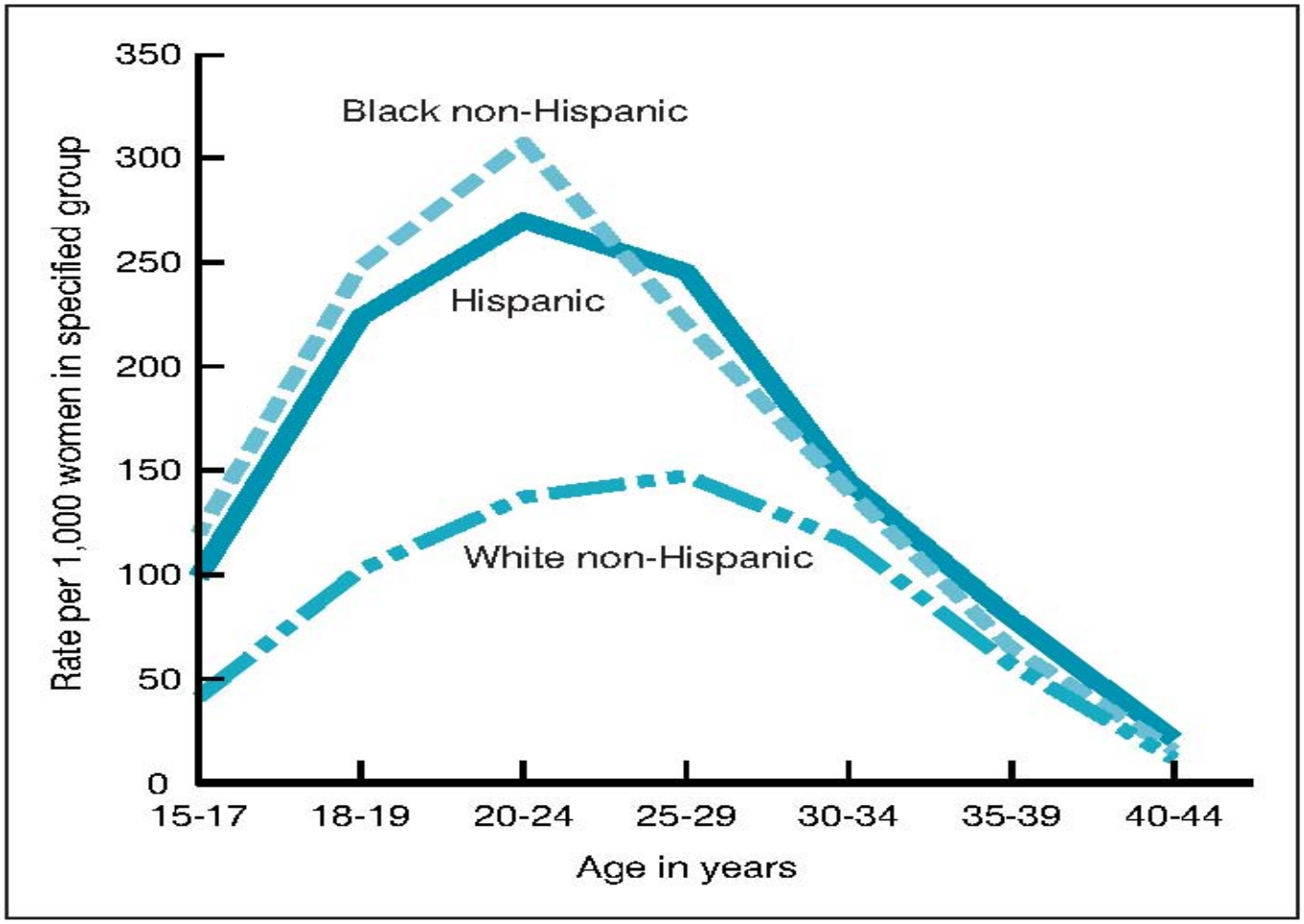


Figure 3. Pregnancy rates by age, race, and Hispanic origin of women: United States, 1997

From: Trends in Pregnancy Rates for the US 1976 – 1997. National Vital Statistics Report, Vol. 49, No. 4, June 6, 2001

Table 7-Supplement. Number of women 15–44 years of age and percent distribution by current contraceptive status and specific method, according to new race and Hispanic origin classification: United States, 2002

Contraceptive status and method	All Women[1]	Hispanic origin and race		
		Hispanic or Latina	Not Hispanic or Latina	
			White, single race	Black or African American, single race
	Number in thousands			
All women	61,561	9,107	39,498	8,250
	Percent distribution			
Total	100.0	100.0	100.0	100.0
Using contraception (contraceptors)	61.9	59.0	64.6	57.6
Female sterilization	16.7	19.9	15.4	22.6
Male sterilization	5.7	2.6	7.6	1.3
Pill	18.9	13.0	22.2	13.1
Implant, Lunelle or Patch	0.8	1.8	0.5	0.6
3-month Injectable (Depo-Provera)	3.3	4.3	2.7	5.4
Intrauterine device (IUD)	1.3	3.2	1.0	0.8
Diaphragm	0.2	–	0.2	0.1
Condom	11.1	10.9	10.7	11.4
Periodic abstinence — calendar rhythm	0.7	0.6	0.8	0.3
Periodic abstinence — natural family planning	0.2	0.3	0.3	0.1
Withdrawal	2.5	2.2	2.6	1.5
Other methods[2]	0.6	0.3	0.7	0.5
Not using contraception	38.1	41.0	35.4	42.4
Surgically sterile-female (noncontraceptive)	1.5	0.9	1.6	1.6
Nonsurgically sterile-female or male	1.6	1.7	1.7	1.4
Pregnant or postpartum	5.3	6.9	4.7	5.7
Seeking pregnancy	4.2	5.2	4.0	4.3
Other nonuse:				
Never had intercourse or no sex in 3 months before interview	18.1	18.7	17.0	19.0
Had intercourse in 3 months before interview	7.4	7.7	6.5	10.4
All other nonusers[3]	0.0	–	0.1	0.1

Race is Associated with Income: USA, 2001

Race	Population (1,000)	$
All	109,297	42,900
White	90,682	45,225
White, not Hispanic	80,818	47,041
Black	13,315	29,939
Asian/Pacific Islander	4,071	54,488
Hispanic, any race	10,497	34,099

Income in the United States: 2002. US Census Bureau

Issues

- The conservative and religious right and the Catholic Church
- No universal access to abortion
- No universal programs for birth control
- Poverty and lack of education
- ~17 million US women require services
  - Requires ~$3.5b of which $1.3b have been made available

Case Study: The Philippines

The Philippines

- ~7000 islands
- Current population: 93.3 million (12th most populous country)
- Expected population 2050 (medium variant): 155 million
- Population density: 311/km^2
- Religion: 81% Roman Catholic
- Per capita income: $US1,400

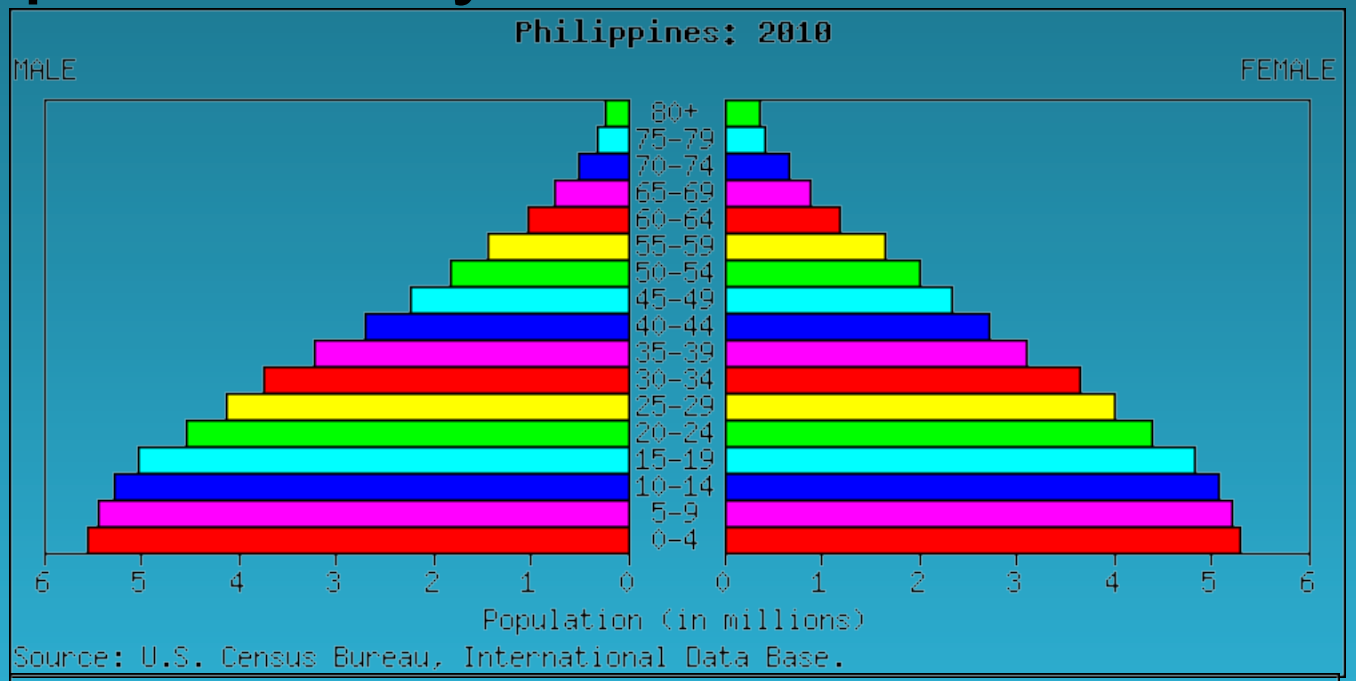
Population Pyramids: 2010 and 2050

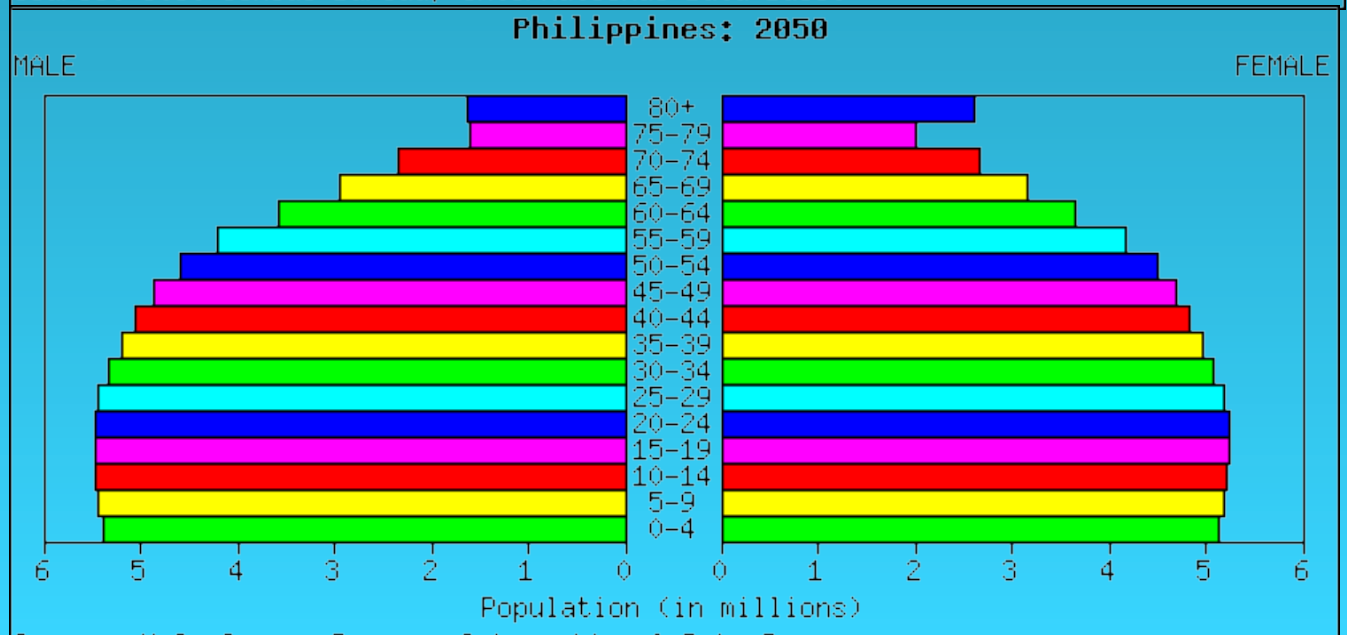
TFR

3.05

Population

93 million

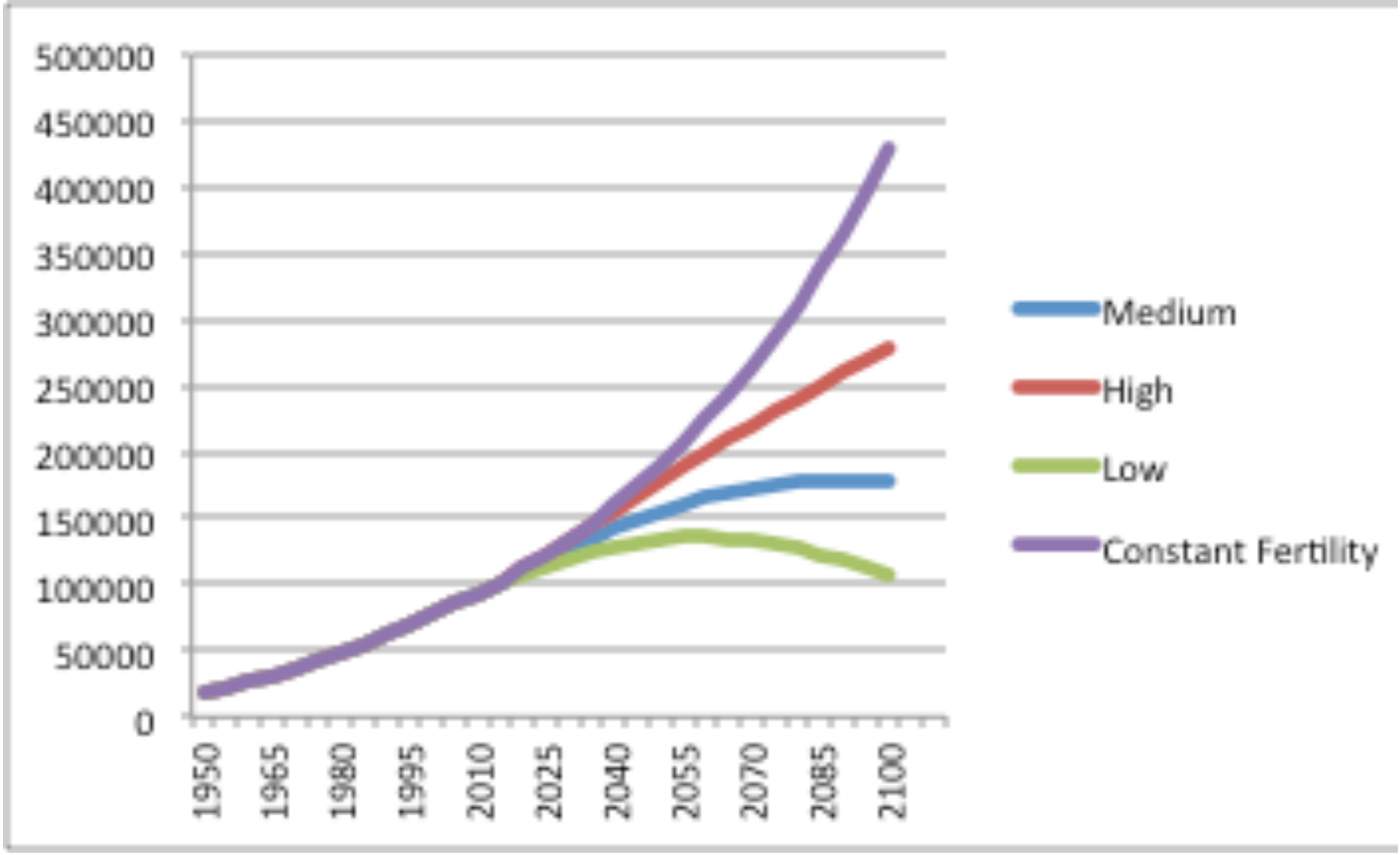


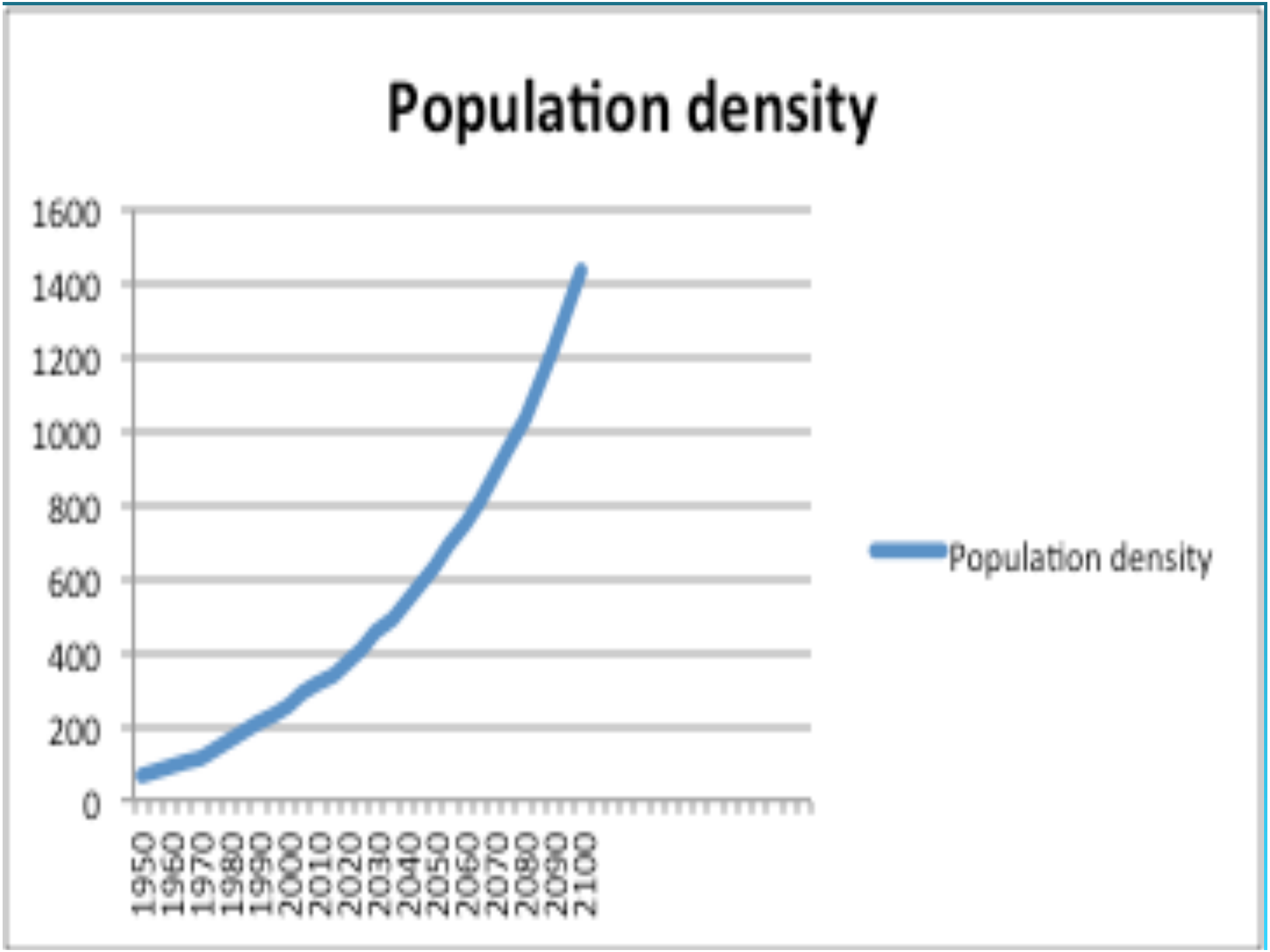


2.06

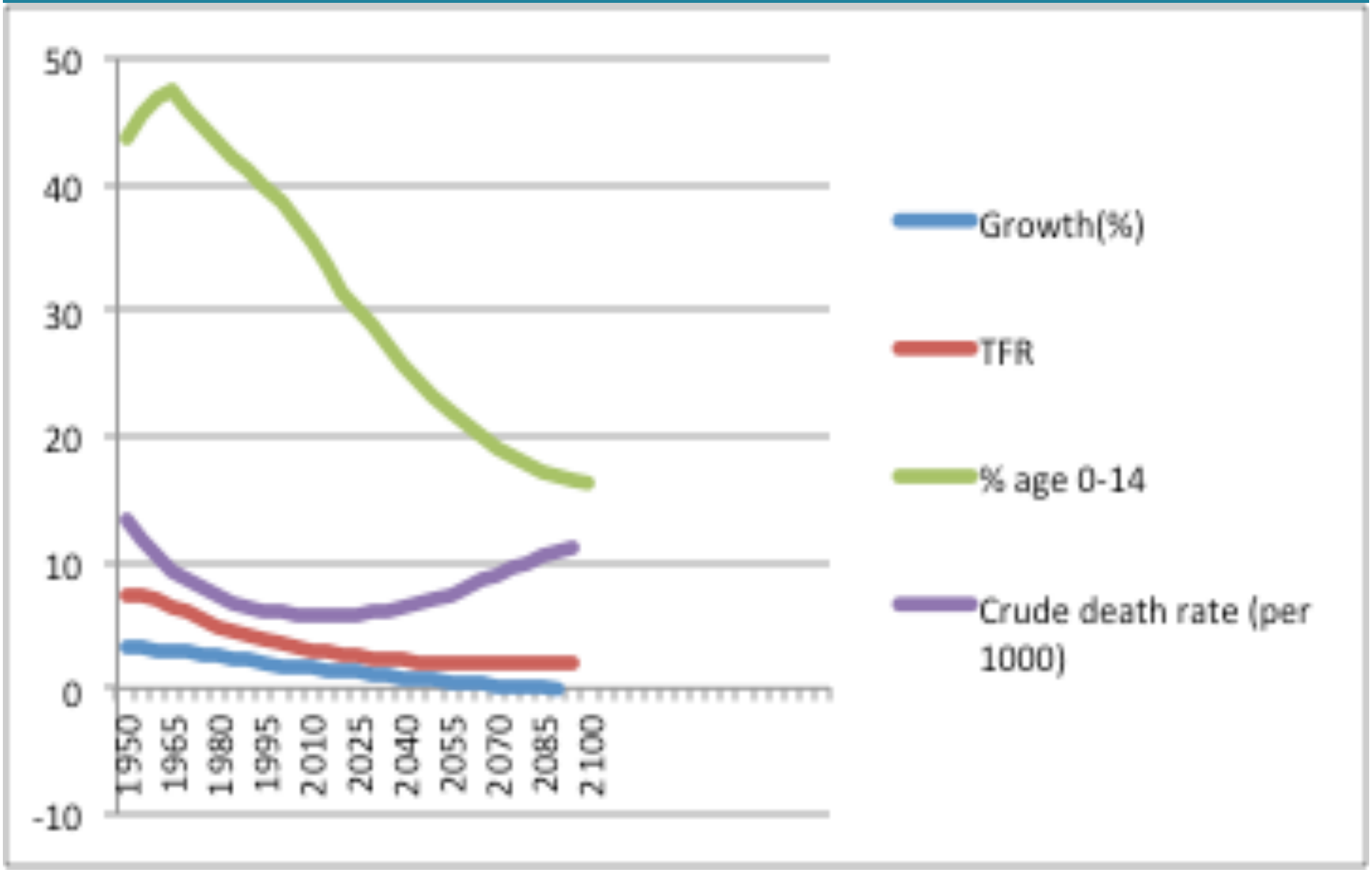
155 million

Population Projections: The Philippines




Population density
1600
1400
1200
1000
800
600
400
200
0
1950
1960
1970
1980
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100
Population density

The Philippines



Prevalence (%) of Methods of Contraception: 2004

	Philippines	Canada
• All methods:	48.9	74.7
• Any modern method:	33.4	73.3
• Sterilization		
– Women	10.5	30.6
– Men	0.1	15.2
• OC:	13.2	14.4
• Condom:	1.7	9.4
• Injectable/implant:	3.1	0.0
• IUD:	4.1	2.9
• Rhythm/withdrawal:	15.7	1.5
• Unmet need:	17.3	-----
Pop. Growth/annum:	**~2.08%**	**1.01%**

Comparison of Modern Methods of Contraceptive Usage

Country	Percentage
Philippines	33
Thailand	70
Indonesia	55
Vietnam	56

Philippino National Policies Affect Fertility

- Population Commission established in 1970 and adopted by Congress
- Two opposing principles from the outset:
  - Achieve “optimal” population size
  - Choose methods of family planning according to “cultural values”
- Shift away from national administration/ oversight to a regional one

Barriers to Family Planning in the Philippines

- **Marriage**
  - Pre-marriage counseling for family planning required for marriage license
    - Many locals delegated authority to Parish priests

Barriers to Family Planning in the Philippines

- **Health care**
  - Few MDs write prescriptions; law stipulates that nurses and midwives can, but this is not done
  - "Magna carta" for health workers ➔ 80% of resources to salaries and benefits
  - Lack of training to health care providers to provide counseling➔ continuing education
  - Assumed that spousal consent required for tubal ligation

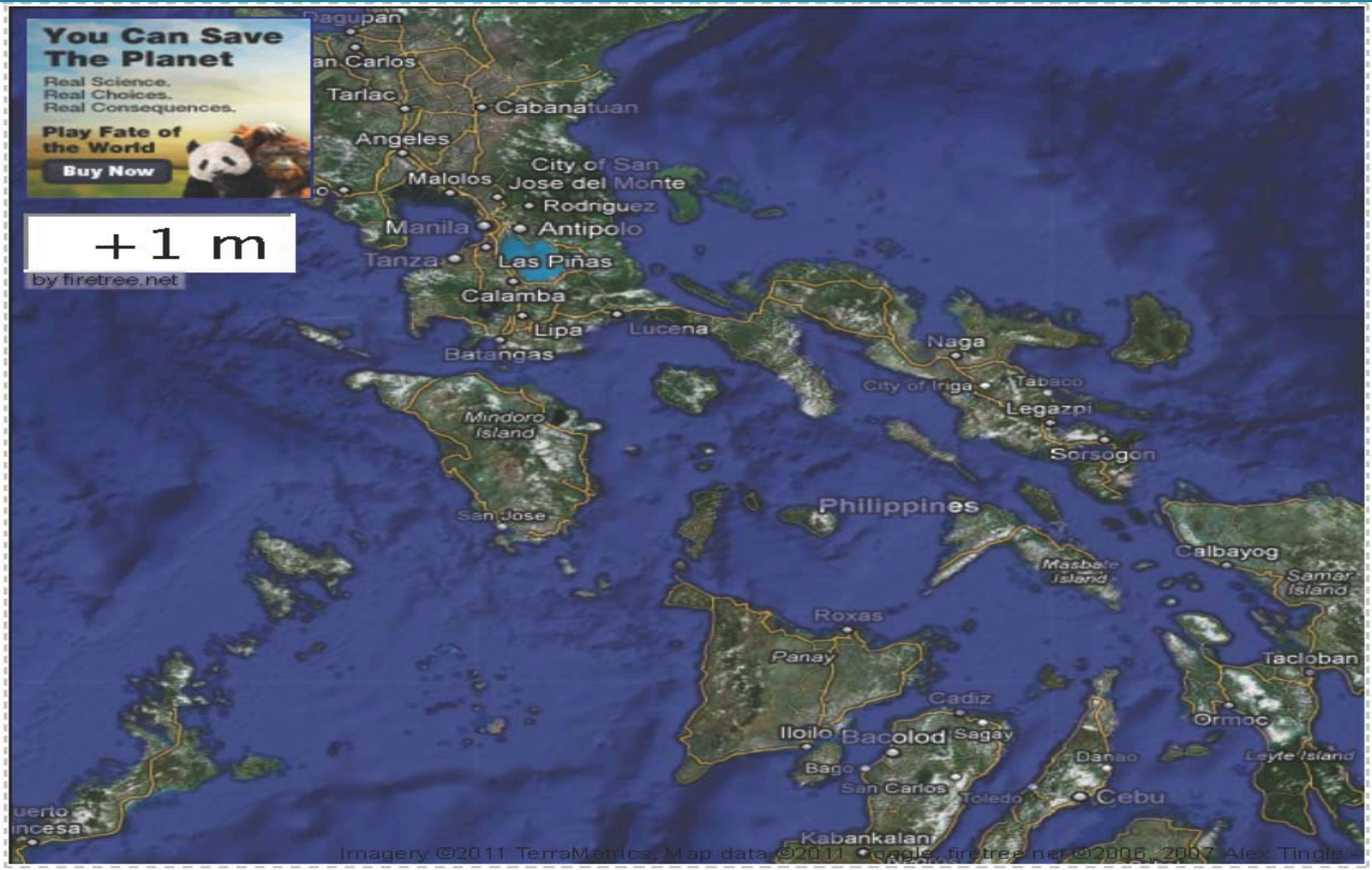
Barriers

- **Pharmaceuticals (mostly oral contraceptives)**
  - Drug formulary a barrier because of limited number of listed drugs
    - No new oral contracpetives listed since the 1980s!
  - Lack of coverage in private insurance
  - Lower prices
    - Importation of generics prices
    - Bulk purchasing between countries in region
    - 10% VAT

Barriers

- **Legal**
  - Some regions banned access to modern-day treatment (including Manila), in violation of national law
- Religion
  - The Roman Catholic Church has a profound effect on family planning in the Philippines

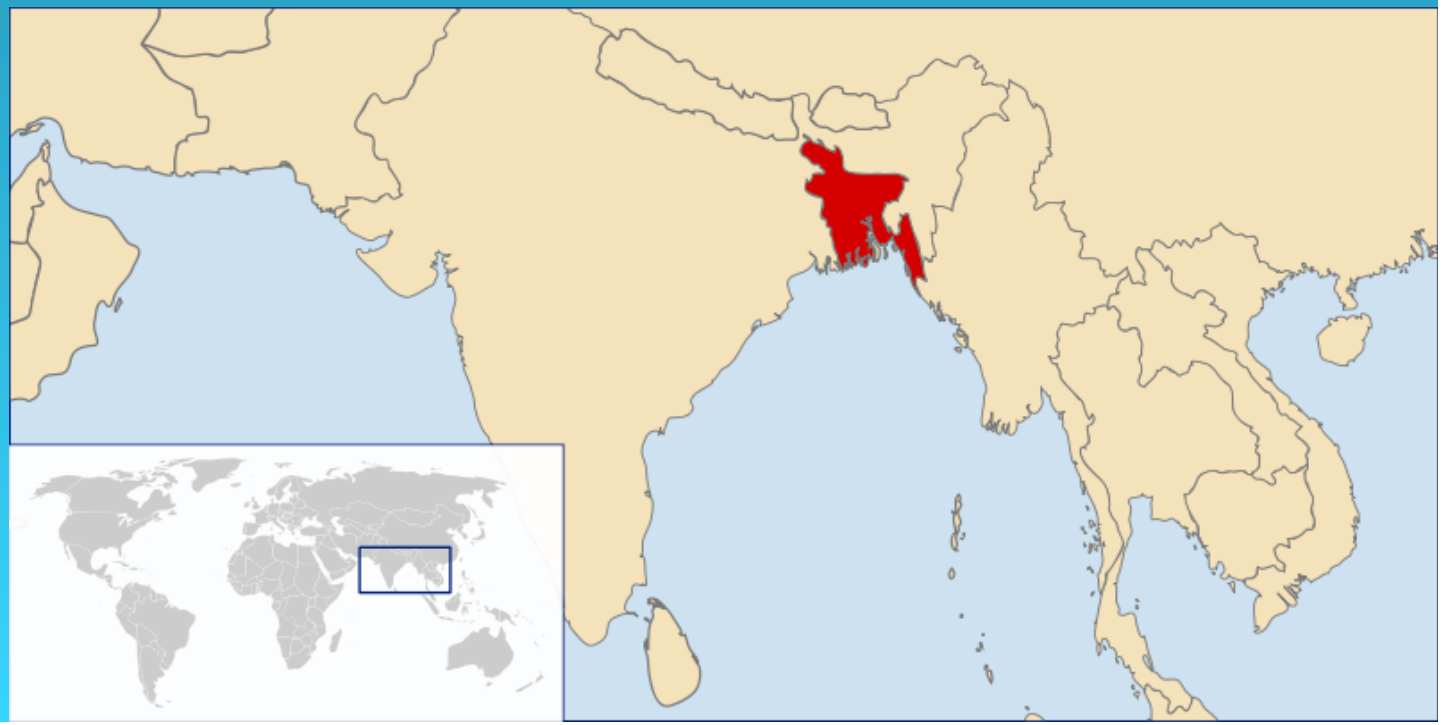
Sea Level Increase of 1m



Case study: Bangladesh

Bangladesh

- Current population: 148.7 million
- Population 2050 (medium variant): 194.3 million
- Population density: 1,033/km^2
- Religion: 89.7% Islam; 9.2% Hinduism
- Per capita income: $US 470



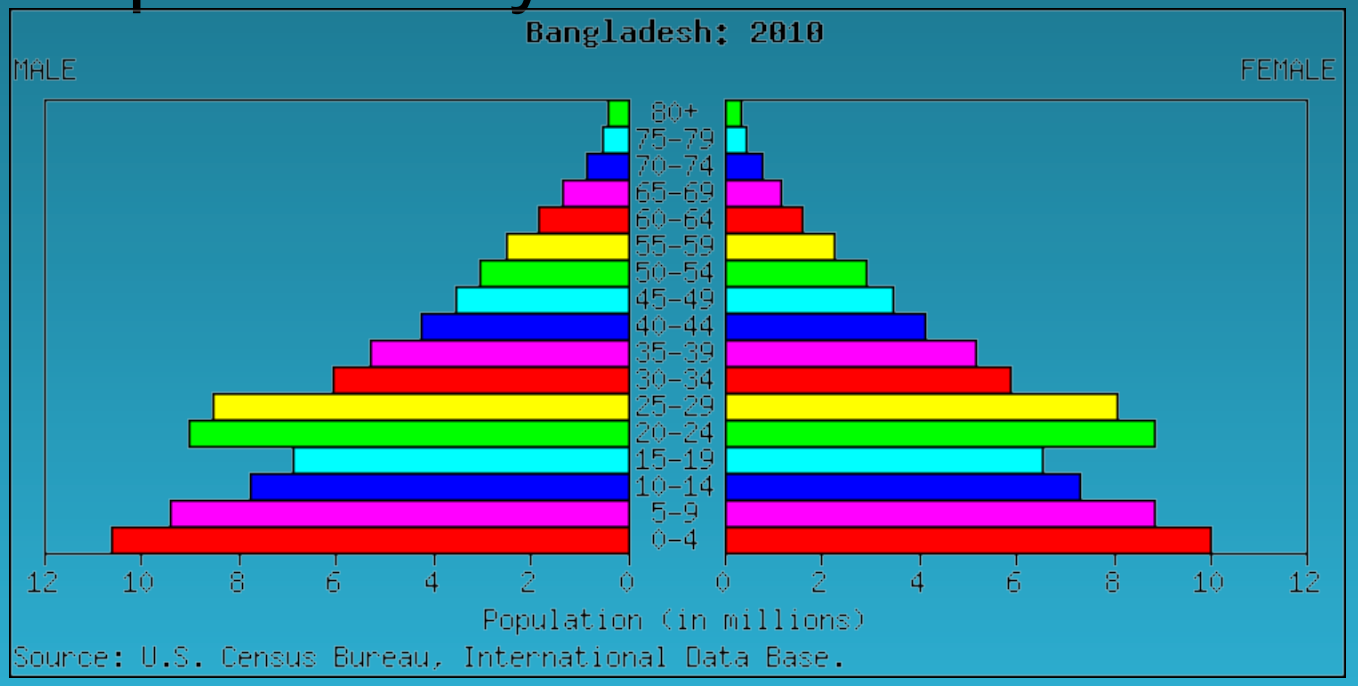
Population Pyramids: 2010 and 2050

TFR

2.2

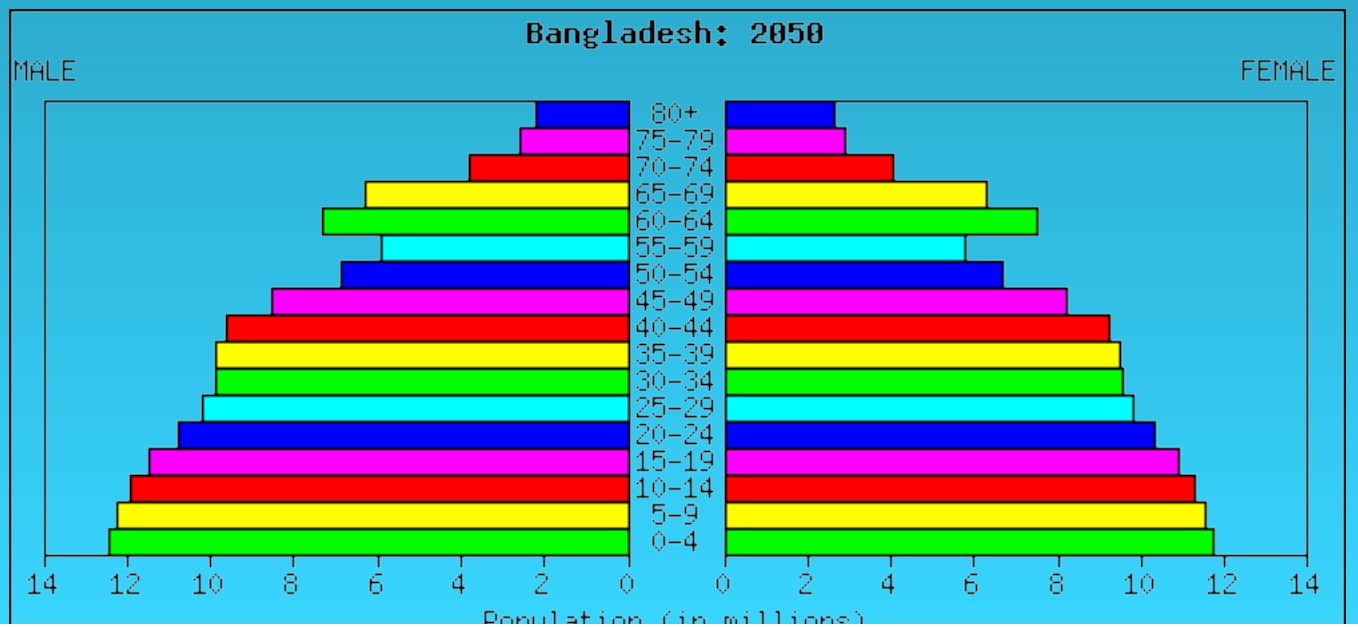
Population

148.7

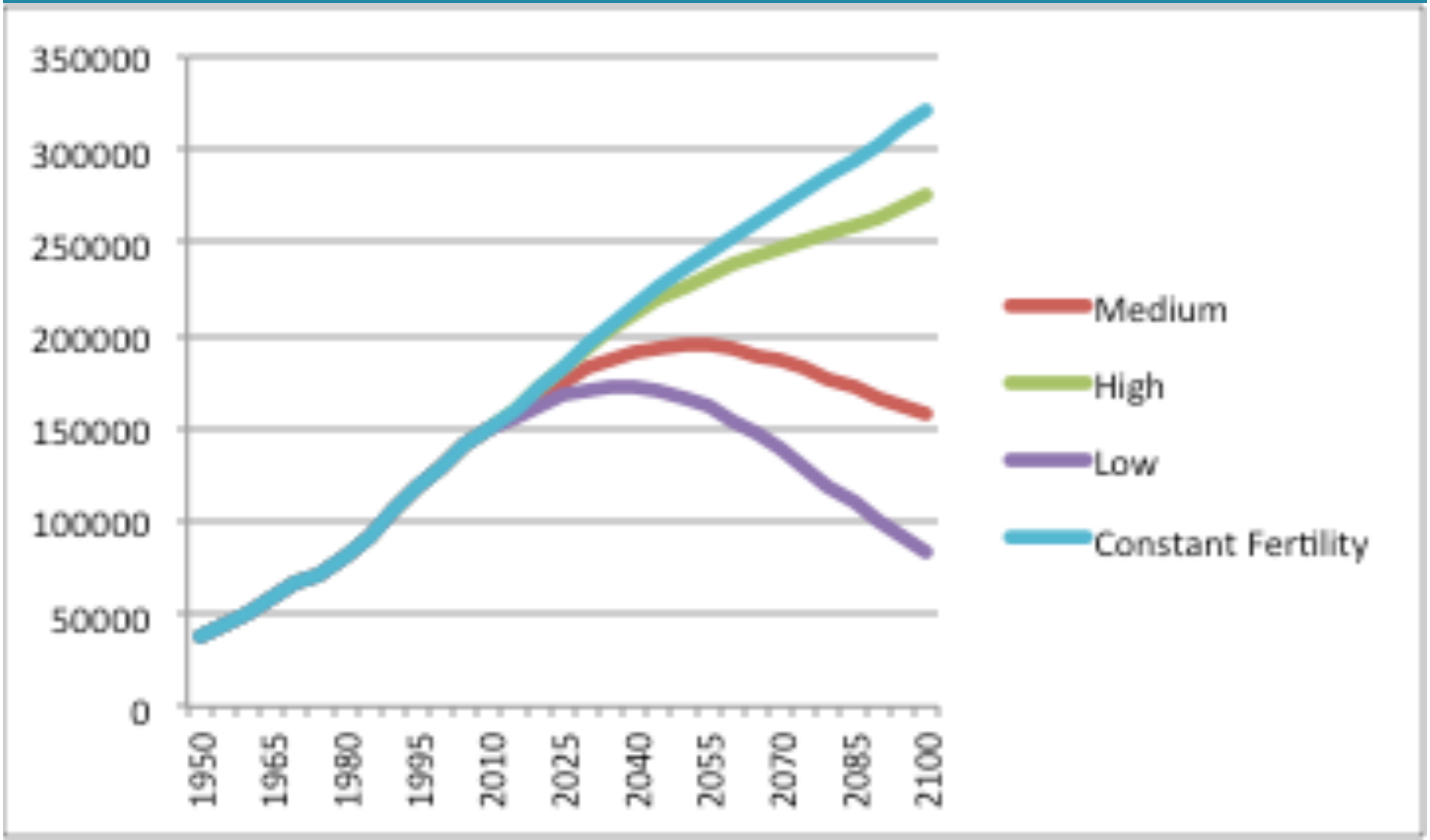


1.6

194.3



Bangladesh: Projections of the Population



Medium Projections

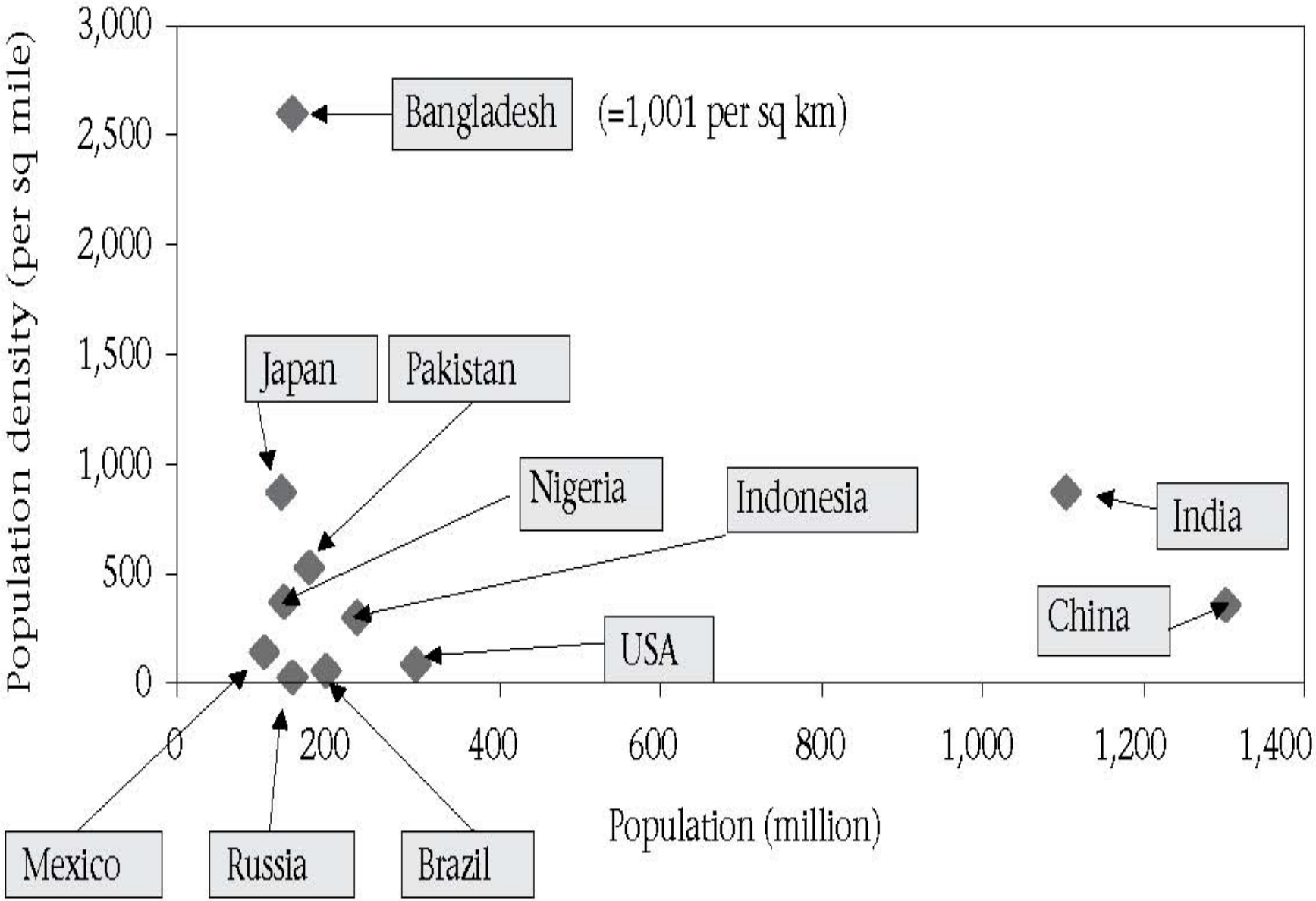
- 2020: 167.3 million
  - TFR = 1.84 (current: 2.2)
  - Population density ~ 1,162 / km^2
- Expected to stabilize by 2050: 194.4 million
  - TFR = 1.58
  - Population density ~ 1,350 / km^2
- Much lower than previous estimates

Population density of Montreal: 4,439/ km^2

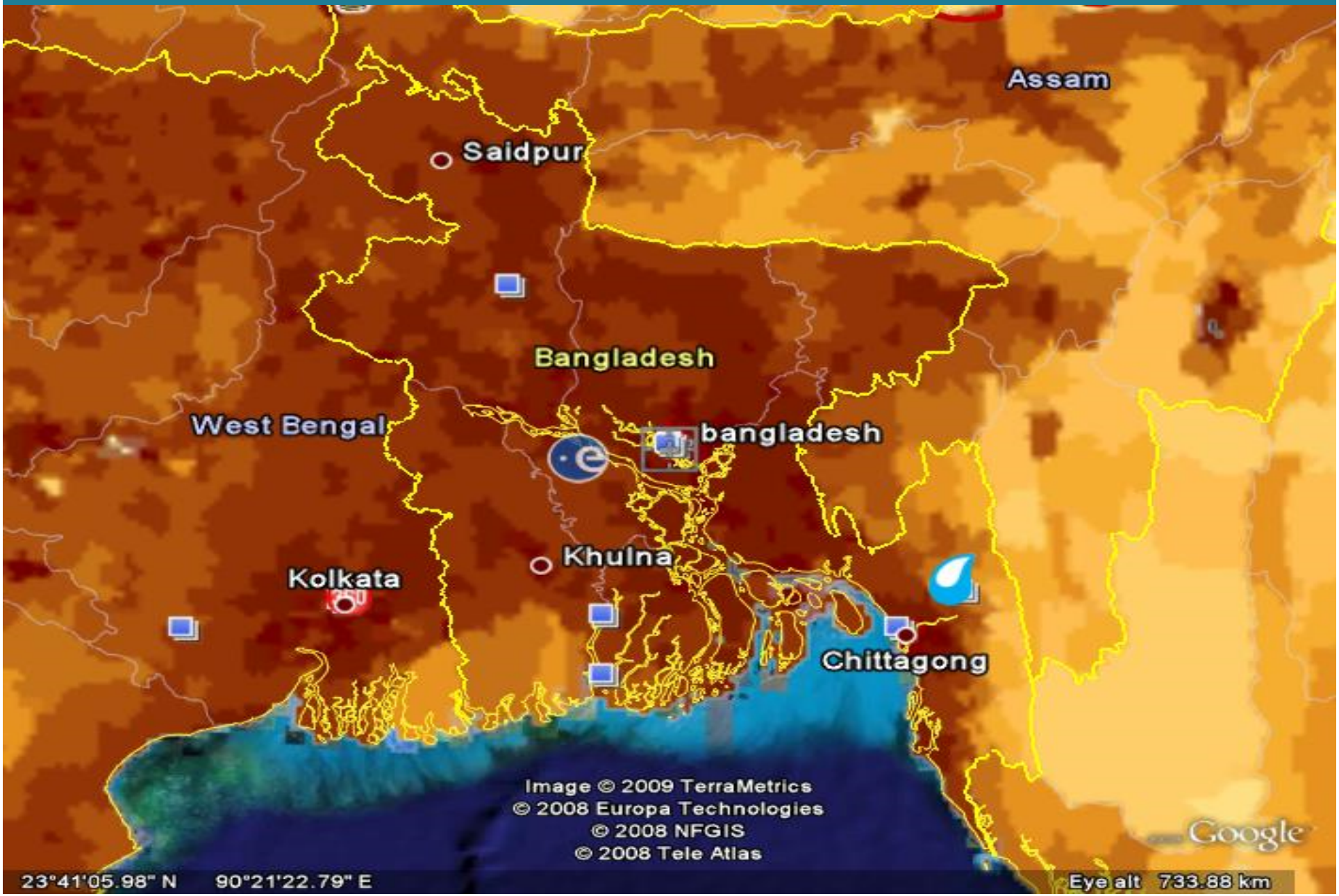
Highly Urbanised

City	City population	Metro population
Dhaka	11,918,442	23,024,863
Chittagong	6,920,222	11,256,369
Khulna	3,400,689	8,492,659
Rajshahi	2,727,083	4,983,641
Sylhet	1,339,368	2,658,025

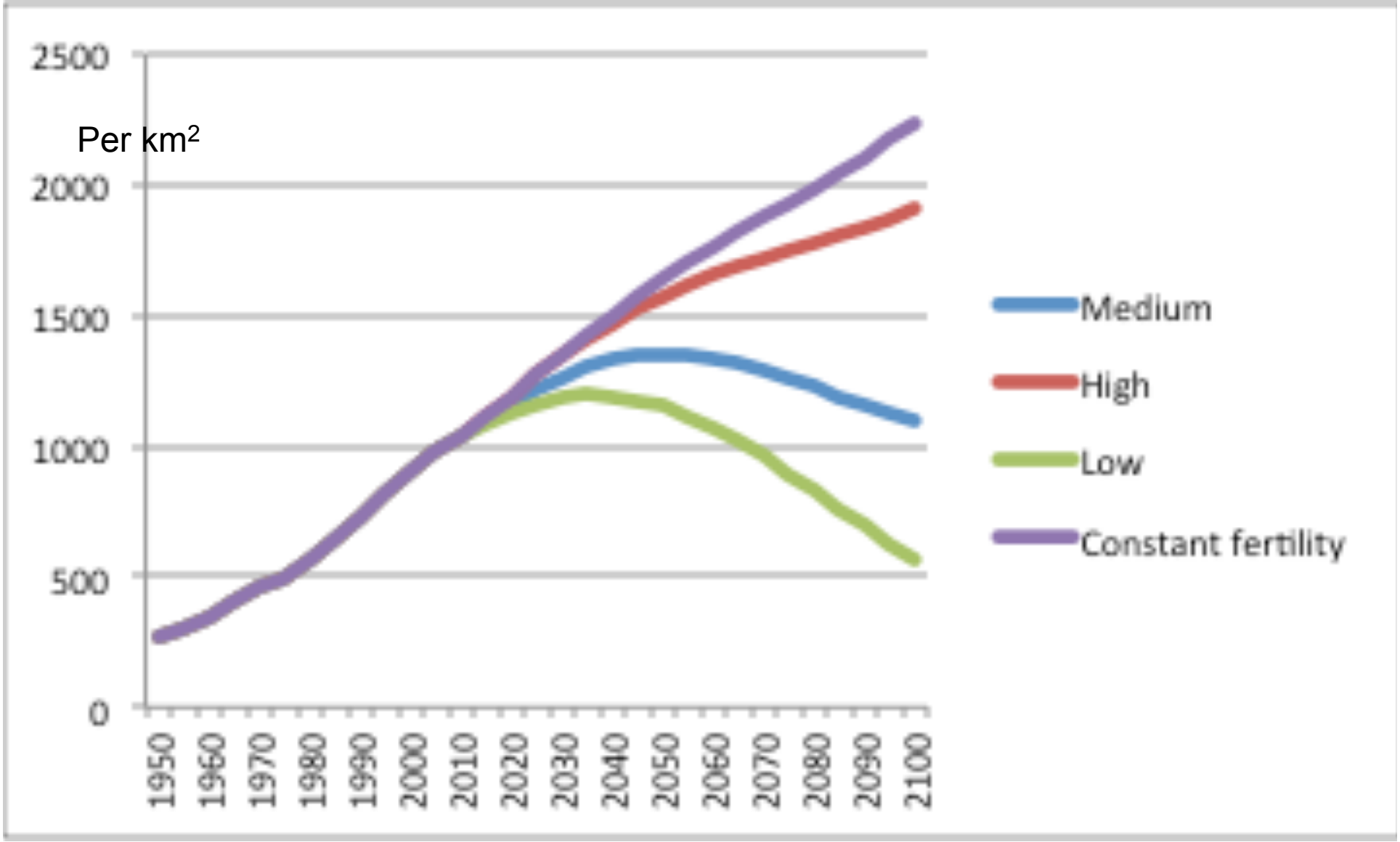
Fig. 4. 'Mega' countries with population of >100 million



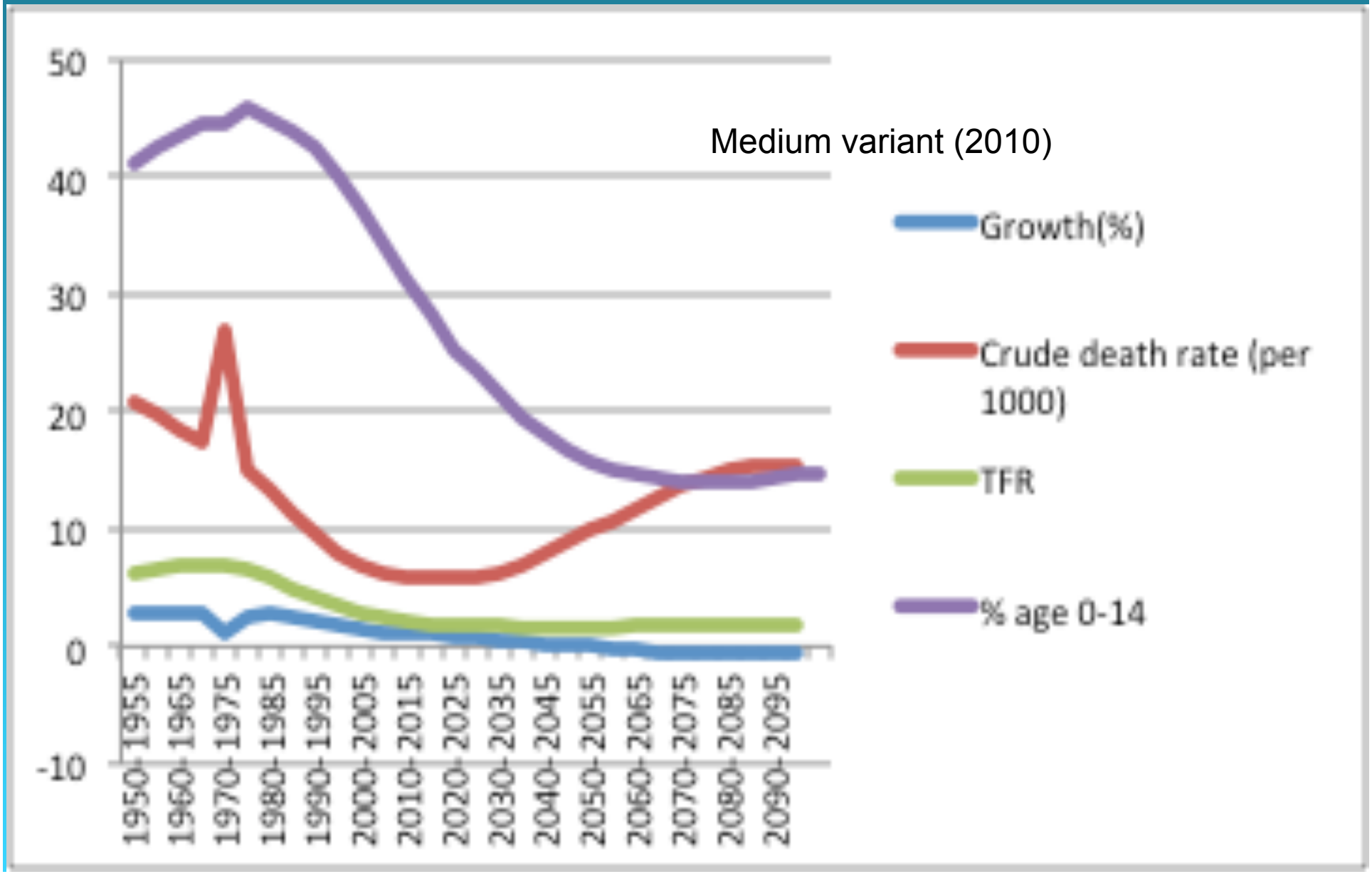
Population Density of Bangladesh



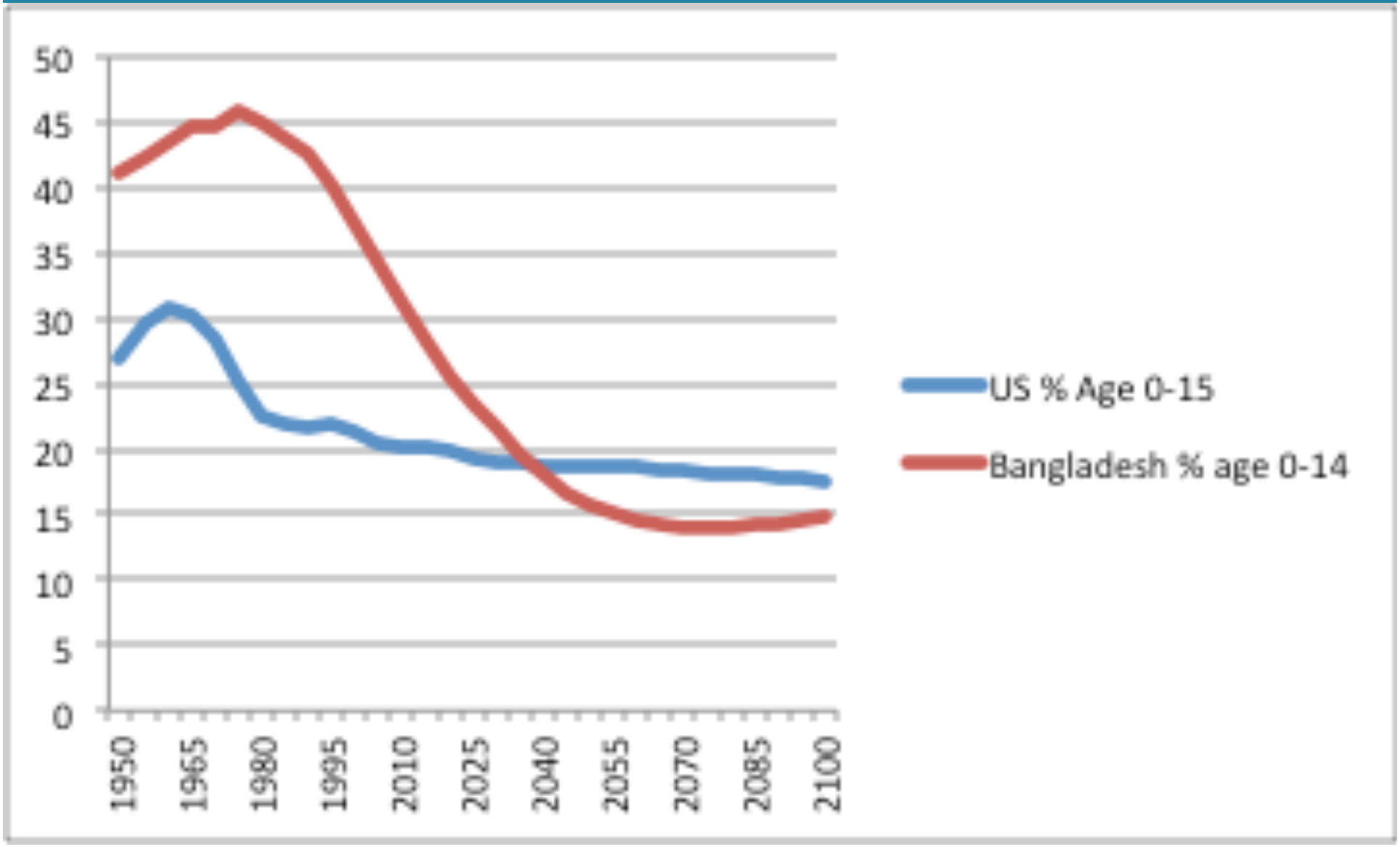
Bangladesh: Population Density



Bangladesh: Selected Indicators



Age Structure: US and Bangladesh



Prevalence (%) of Methods of Contraception: 2004

	Bangladesh	Canada
• All methods	58.1	74.7
• Any modern method	47.3	73.3
• Sterilization		
– Women	5.2	30.6
– Men	0.6	15.2
• OC	26.2	14.4
• Condom	4.2	9.4
• Injectable/implant	10.5	0.0
• IUD	0.6	2.9
• Rhythm/withdrawal	10.7	1.5
• Unmet need	11.3	-----
Pop. Growth/annum:	~1.89%	1.01%

Abbreviated History

- Family planning seen as important when Bangladesh was part of Pakistan (circa 1970)
- Early 1970s:
  - “No civilized measure would be too drastic to keep the population of Bangladesh on the smaller side of 150 million for the sheer ecological viability of the nation”

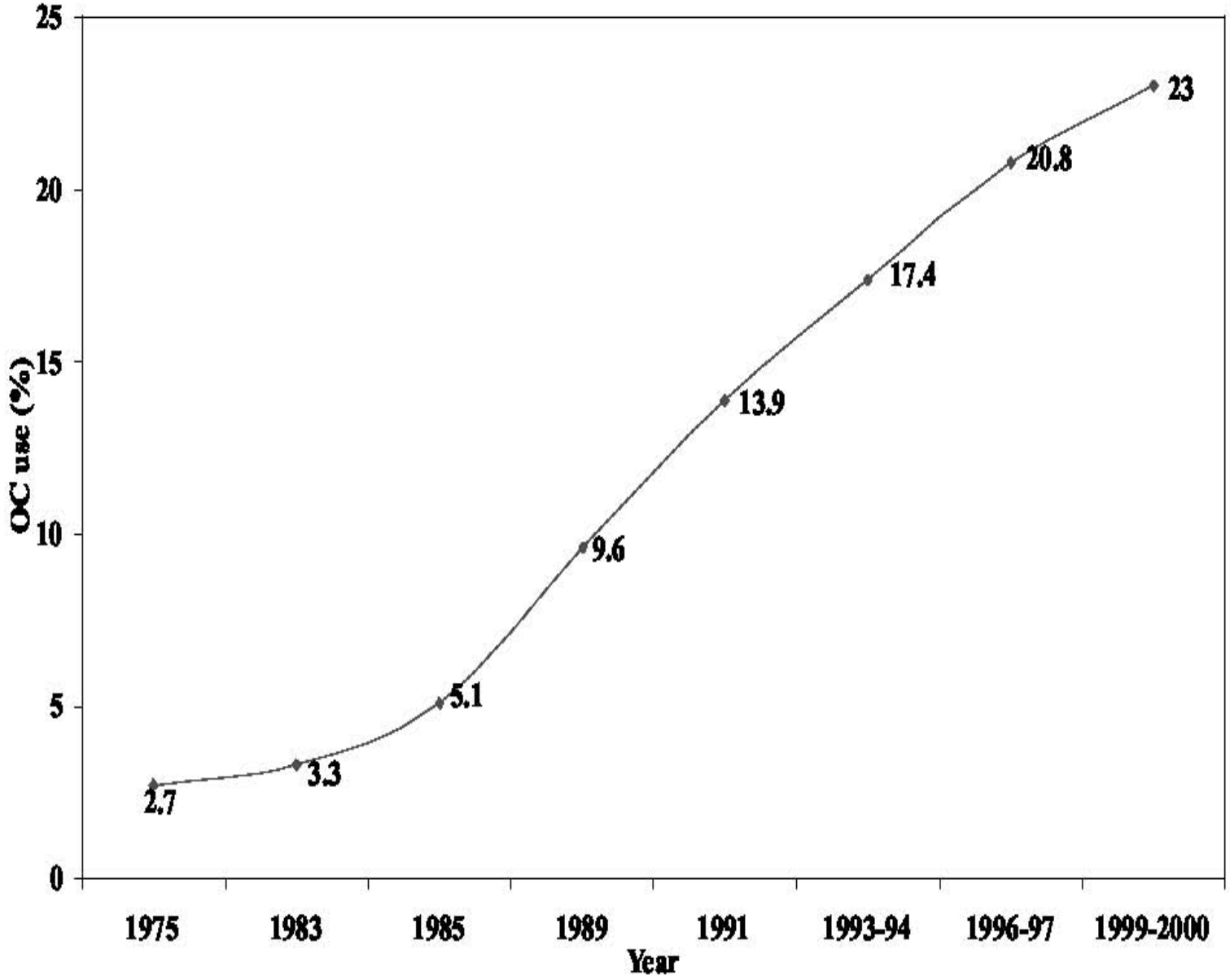


Figure 1. Trend in oral contraceptive use among currently married women aged 10–49 years, Bangladesh, 1975–2000

Factors Associated with Discontinuation of Oral Contraceptives in Rural Bangladesh

- Efficacy of OCs: in first year, one pregnancy per 1,000 women
- Effectiveness:
  - Thailand: 45 pregnancies / 1,000 women
  - Egypt: 165 pregnancies / 1,000 women
  - Bangladesh: 30 - 150 pregnancies / 1,000 women within first year of use

Factors Associated with Discontinuation of Oral Contraceptives in Rural Bangladesh

- Reasons for failure:
  - Discontinuation of OCs
    - 58% have ever taken OCs (2000)
    - 23% currently taking OCs
  - Not taking OCs as prescribed
  - Side effects

Survey in 1995-96 in Rural Bangladesh

Mean age of women	29 years
Mean no. of children	3 (±2)
Muslim	91%
Any education	46%
Mean use of OC	27.5 months
Other contraceptives	22%
Side effects within 3 months	60%
Support of husbands	55%
Discontinued within 12 months	47%
Missed one or more active pill(s) during the 6 months before the survey	50%

Reasons for Discontinuation of OCs

Table 1. Self reported main reason for discontinuation of oral contraceptive use in rural Bangladesh, 1995–96 (n = 569)

Main reason for discontinuation	%
Side-effects	46.6
Wanted children	24.1
Husband's/relatives' dislike	4.9
Became pregnant	2.6
Insufficient supply	3.9
Troublesome to take pills	2.3
Others	15.6

Predictors for Discontinuation

	Probability of stopping
More children	Lower
Husband not supportive	Higher
Longer use of OC	Lower
Side effects	Higher
Visited by welfare assistant	Lower
Positive about OCs and provided information	Lower

Some Major Factors

- Deteriorating interactions between workers and clients
  - Poor quality interactions
  - Not frequent enough
- Door-to-door distribution of services highly dependent on foreign aid (NGOs, etc…)
  - Shift to fixed-site service from door-to-door
  - Moving to “one stop shopping” clinics (1998-2002)
  - Education of husbands essential
  - Proper management of side effects will reduce discontinuation

Awareness of Husbands to Different Methods of Contraception, age 15-59, 1999-2000

Pill	94%
IUD	20
Injectable	45
Condom	80
Female sterilization	45
Male sterilization	27
Diaphragm	20
Abstinence	12
Withdrawal	3

Effectiveness of “Program”: Changes in Fertility Rates

Year	Fertility (mean number of children per woman)	Prevalence of use of modern contraceptive methods (%)	Population growth (%)	Population (millions)
1950	6.70		1.98	44
1970	6.15		2.47	70
1975	5.60	7	2.35	79
1980	5.25		2.47	89
1985	4.63	54	2.35	101
1990	4.12		2.22	113
1995	3.50		1.98	126
2000	3.22	58.1	1.89	139
2005	2.83	55.8	1.67	153
2010	2.63		1.56	167

New Directions

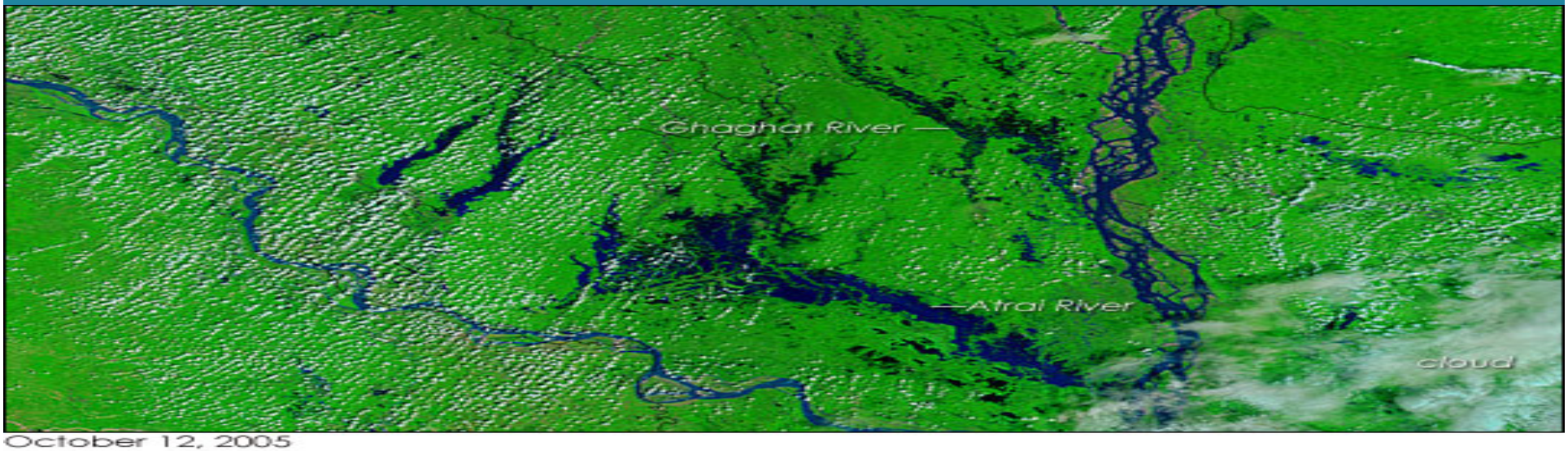
- Clinic-based approach
  - A big gamble
- Requires massive funding from developed countries
- Integrated Plan including overall health and welfare

Climate Change and Population

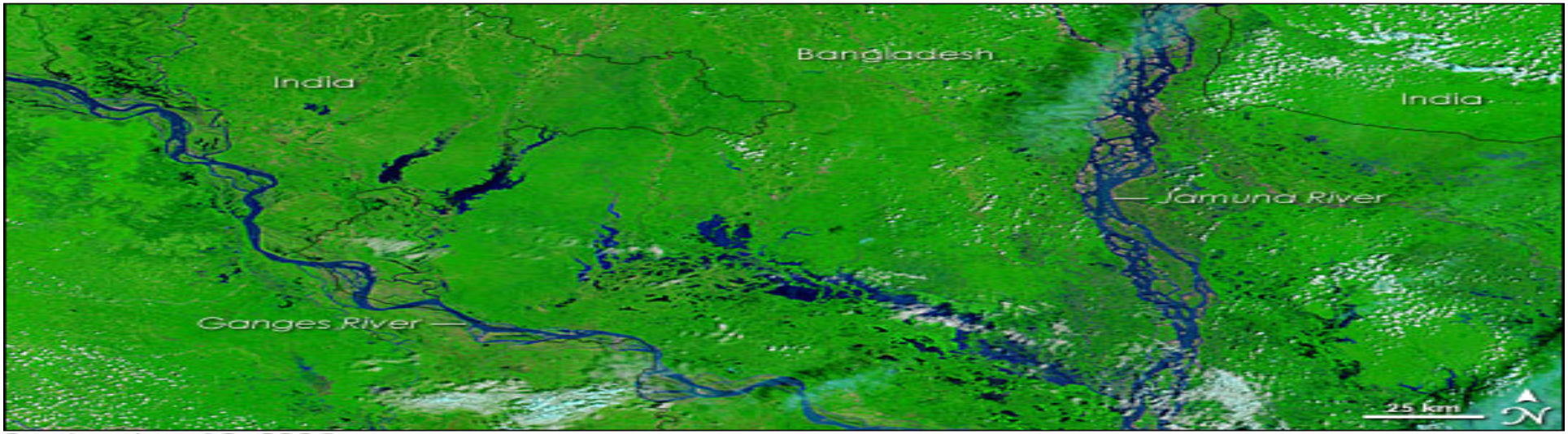
Effect of Climate Change in Bangladesh


Dacca
Chittagong
Chittagong
Kutubdia Island
Image © 2009 TerraMetrics
© 2008 Europa Technologies
Image © 2009 DigitalGlobe
Image NASA
Google
22°22'09.30" N 91°07'17.65" E
elev 1 m
Eye alt 269.44 km

Flooding from Rain in October 2005



October 12, 2005



September 19, 2005

Baridhara, Dhaka, during the 2004 flood

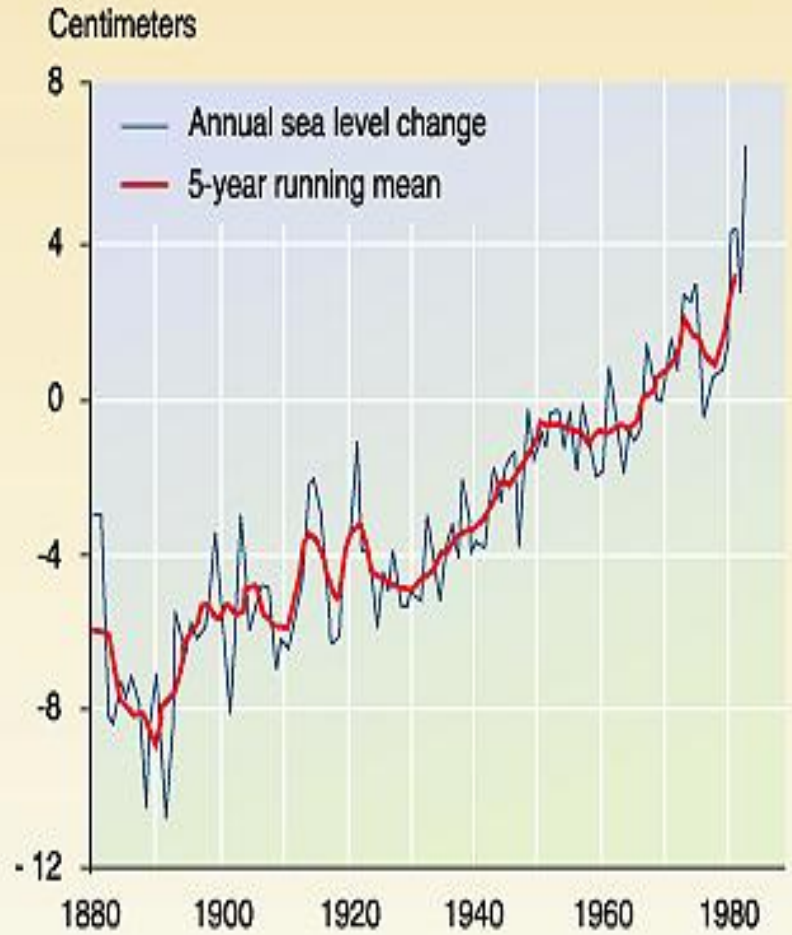
Bangladesh erosion along river cuts a town in the middle, an increasing threat from global warming

Bangladesh, M. A. Mohit at his family village, Bhola Island, where 6-7 Km of the town has eroded away.

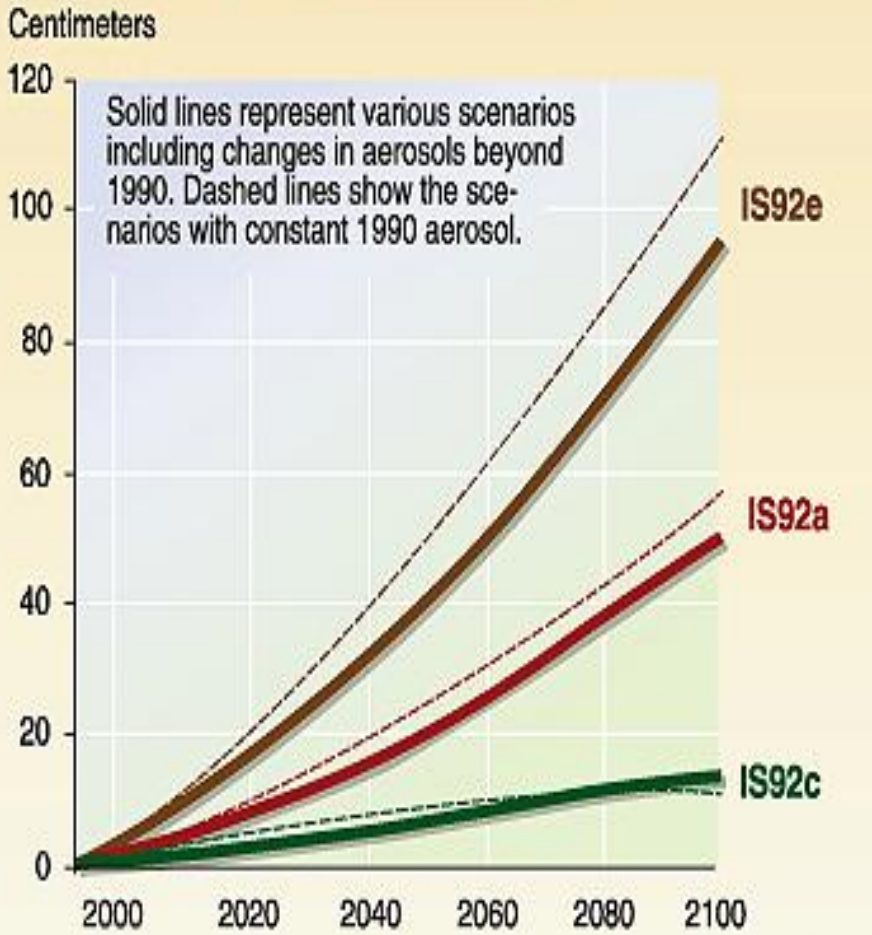
http://www.worldviewofglobalwarming.org/pages/rising-seas.html

Sea level rise due to global warming

Sea level rise over the last century



Sea level rise scenarios for 2100

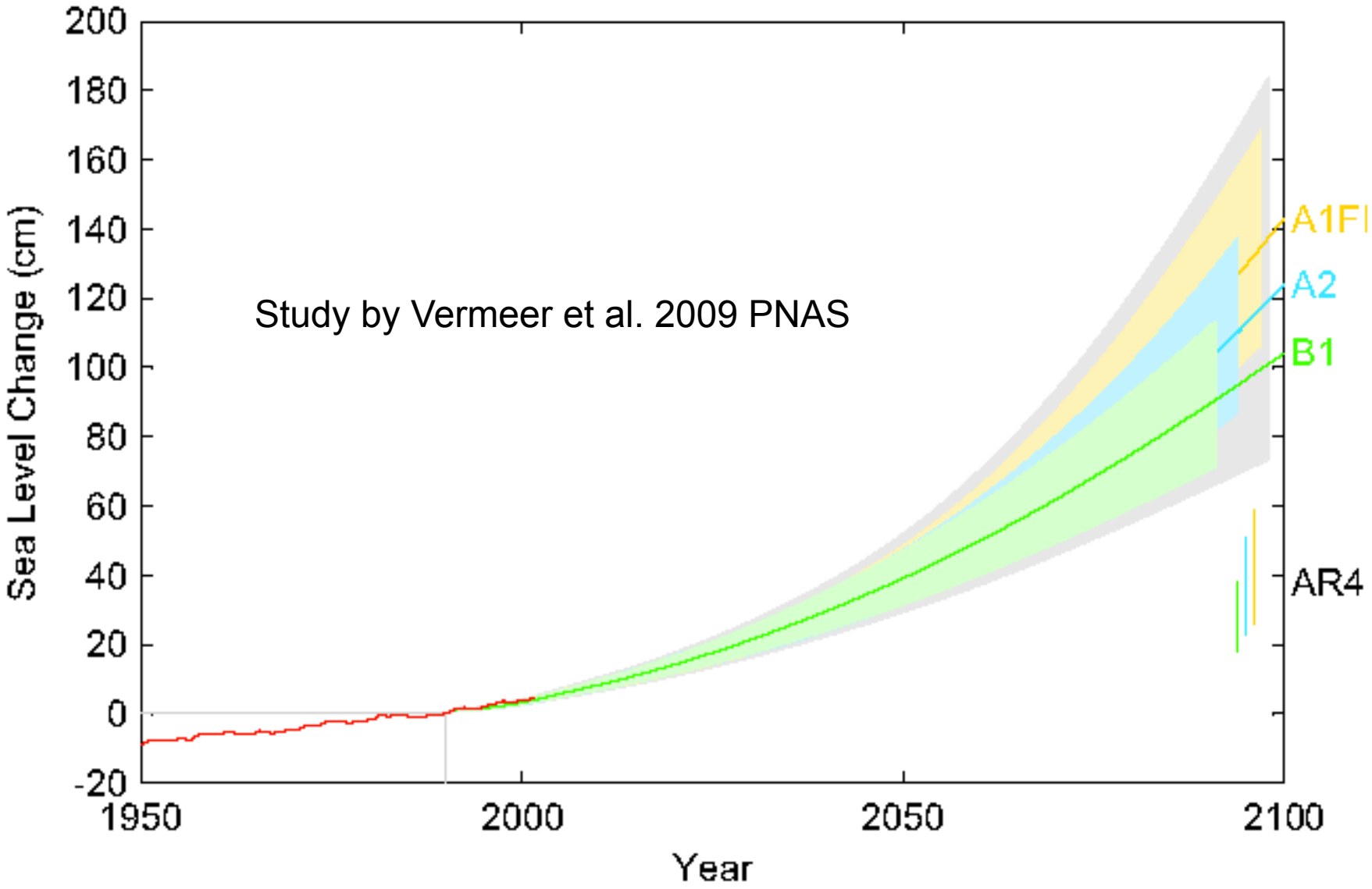


GRID Arendal UNEP

GRAPHIC DESIGN : PHILIPPE REKACEWICZ

Source: Climate change 1995, The science of climate change, contribution of working group 1 to the second assessment report of the intergovernmental panel on climate change, UNEP and WMO, Cambridge university press, 1995; Sea level rise over the last century, adapted from Gornitz and Lebedeff, 1987.

Projected Sea Level Increases



Potential impact of sea-level rise on Bangladesh

Based on IPCC TAR

Today (1989)

Total population: 112 Million

Total land area: 134,000 km^2

Chitagong (11.3 million)

1.5 m - Impact

Total population affected: 17 Million (15%)

Total land area affected: 22,000 km^2 (16%)

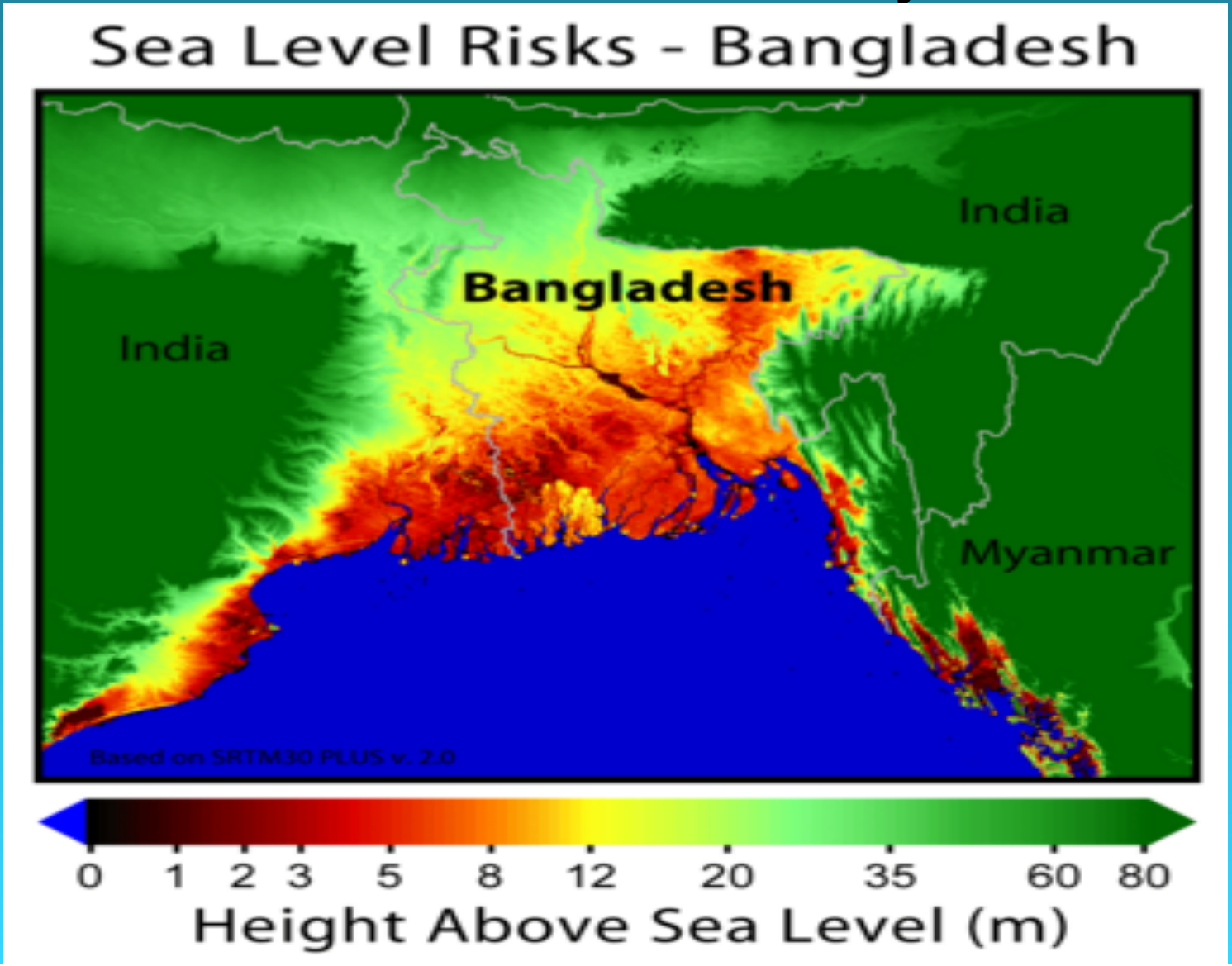
By 2020, expected population ~ 167 million ➔ 28 million affected

http://maps.grida.no/go/graphic/potential-impact-of-sea-level-rise-on-bangladesh

GRID Arendal UNEP

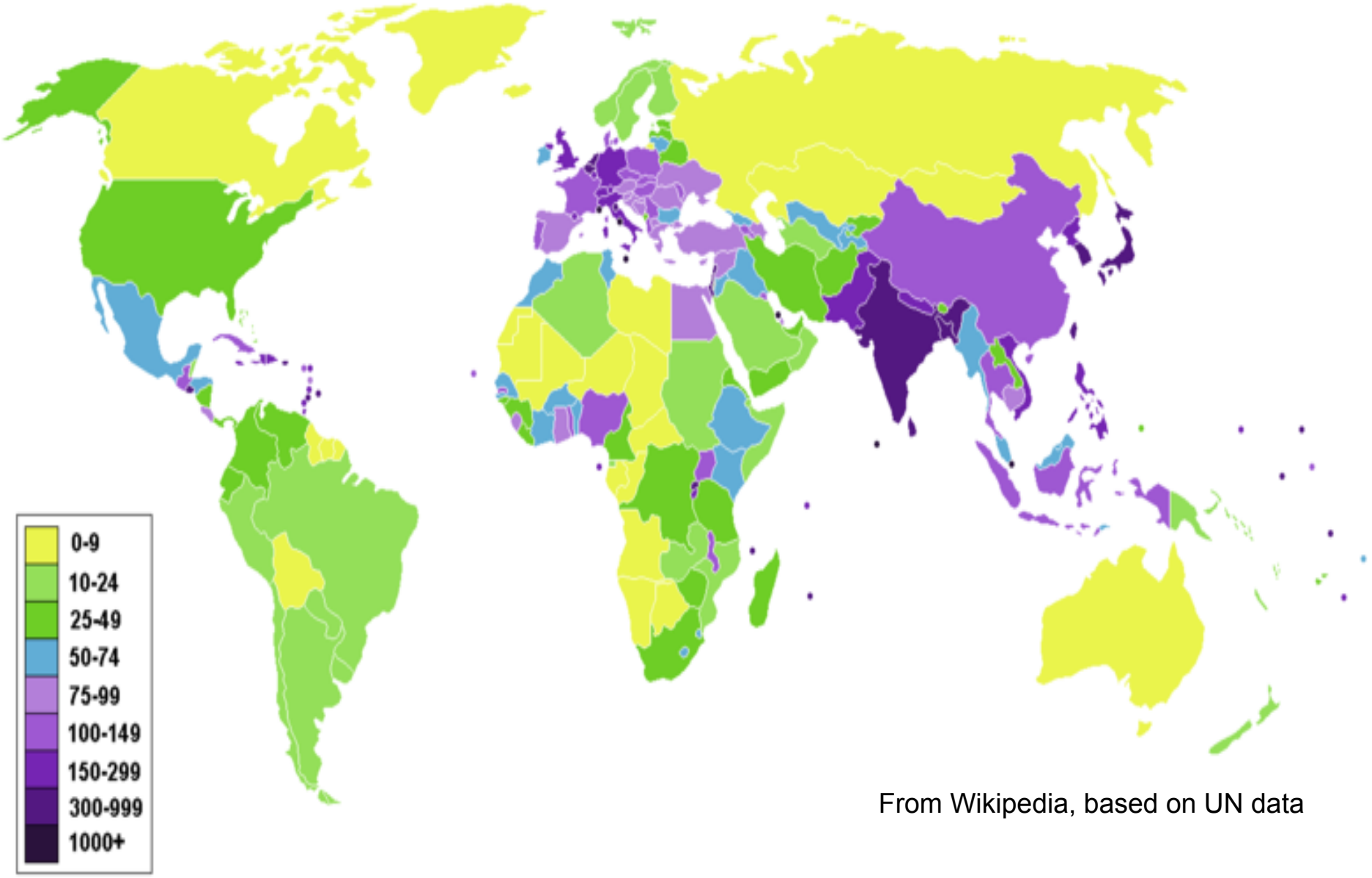
Source : UNEP/GRID Geneva; University of Dacca; JRO Munich; The World Bank; World Resources Institute, Washington D.C.

Sea levels could rise by up to 1.5m by the end of this century

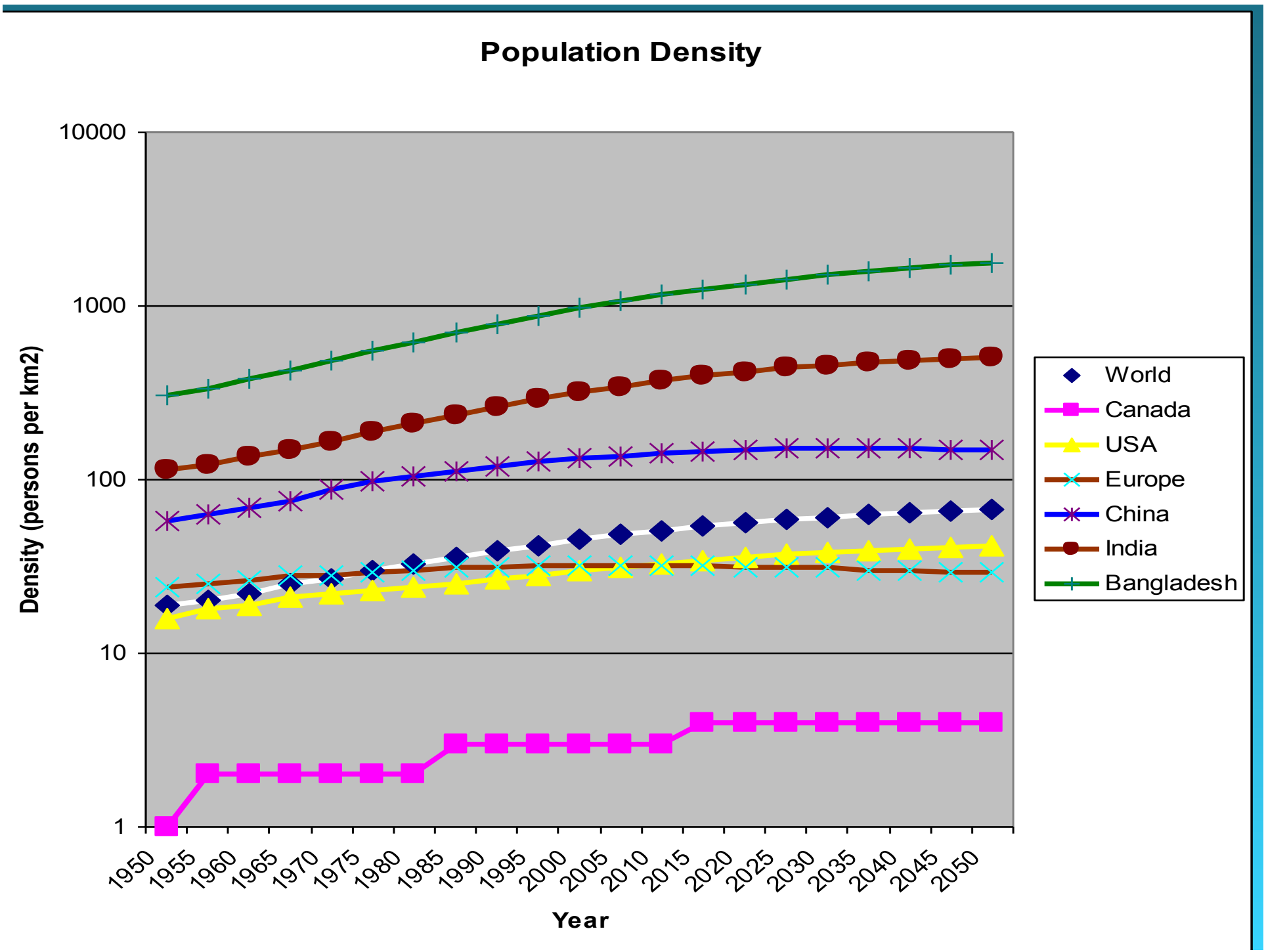


Population Density and Some Cascading Effects

Population Density



From Wikipedia, based on UN data


Population Density
Density (persons per km2)
10000
1000
100
10
1
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
2025
2030
2035
2040
2045
2050
Year
World
Canada
USA
Europe
China
India
Bangladesh

Some Population Densities

Rank		Persons/km^2
	World	48
1	Monaco	23,660
3	Hong Kong	6,407
30	Japan	339
	EU	112
172	US	31
219	Canada	3.2
	Montreal	4,439
	New York	10,456
	Chennai, India	24,000

Influenza Pandemic: Overcrowding and Questionable Animal Husbandry Practises

1918-1919 Spanish Flu (H1N1) Pandemic

- Within 10 months:
  - 500 million people infected
  - 20-50 million deaths (4-10%)
  - 50% of deaths were among people age 20-40

Influenza Today

- US: 36,000 deaths annually attributed to influenza-related complications (JAMA 2002;289[2]:179-86)
- Canada: ~4,000 deaths annually (Epidemiol. Infect. 2007;1-8)
  - Rate of 13/100,000 persons or 2% of all deaths

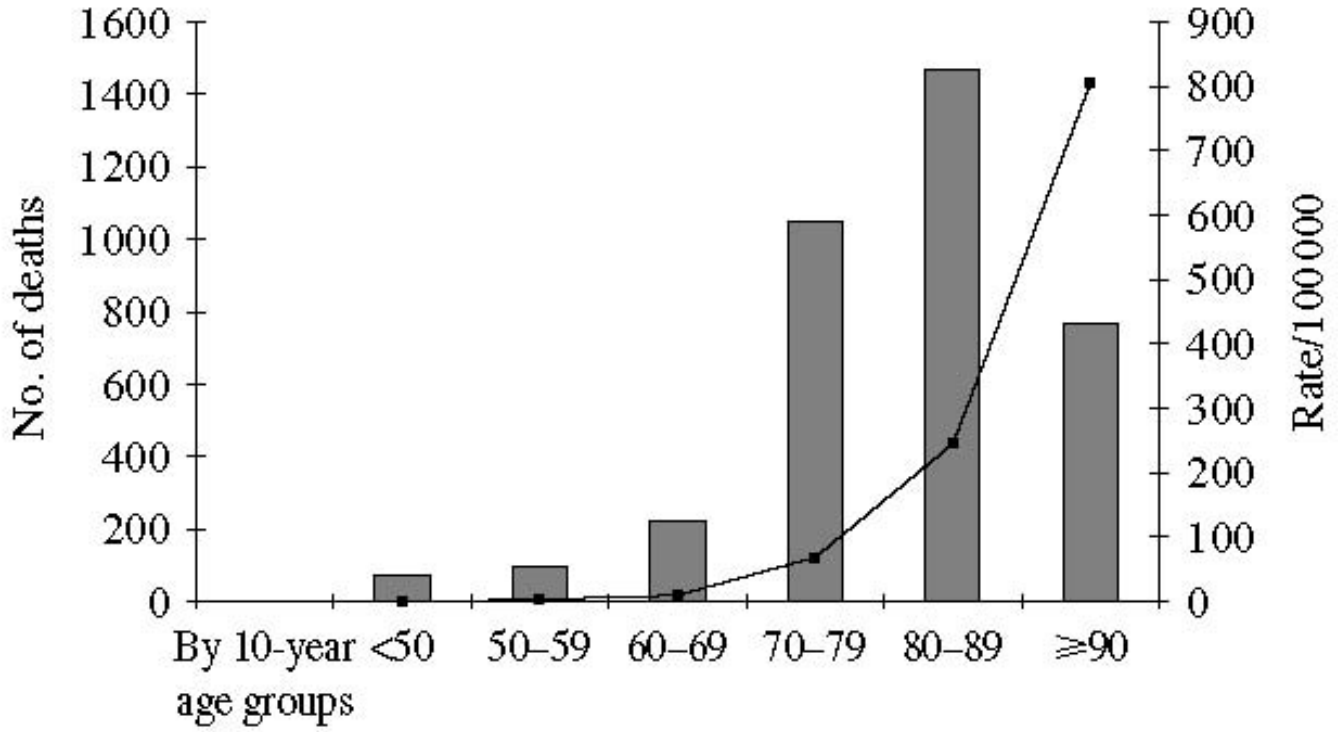


Fig. 3. Average annual influenza-attributable deaths and mortality rate by 10-year age group, Canada, 1990–1999. ■, Influenza-attributable deaths; –■–, rate/100 000.

Schanzer et al. Epidemiol. Infect. 2007;1-8

Other Pandemics

- 1957-58: “Asian flu” (H2N2) 70,00 deaths in the U.S.
- 1968: “Hong Kong flu” (H3N2) ½ million deaths worldwide
- 1976: “Swine flu”
- 1977: “Russian flu”
- 2009-10: “Swine flu” (H1N1/09)

New Threat in China (Avian H7N9)

- Usually restricted to birds but last year people were infected
- May 2013: 132 cases,
- 37 deaths (~30% case-fatality)
- Shandong, Zhejiang, Henan, Hunan, Fujian, Jiangxi, Jiangsu, Beijing

H7N9

- Natural infections with H7N9 viruses in chickens, ducks and other birds are asymptomatic
- An immune response can be detected through blood tests
- Currently no human to human transmission
- Human transmission was limited by closing live poultry markets

Avian Flu as a Source of Human Influenza

Onset of Pandemic

- Mutation of virus
- Mixing of this avian and a human flu
  - "Naturally" (transformation in pigs)
  - From infected individuals (e.g., workers involved in the cull)

See paper by Webster on DVD

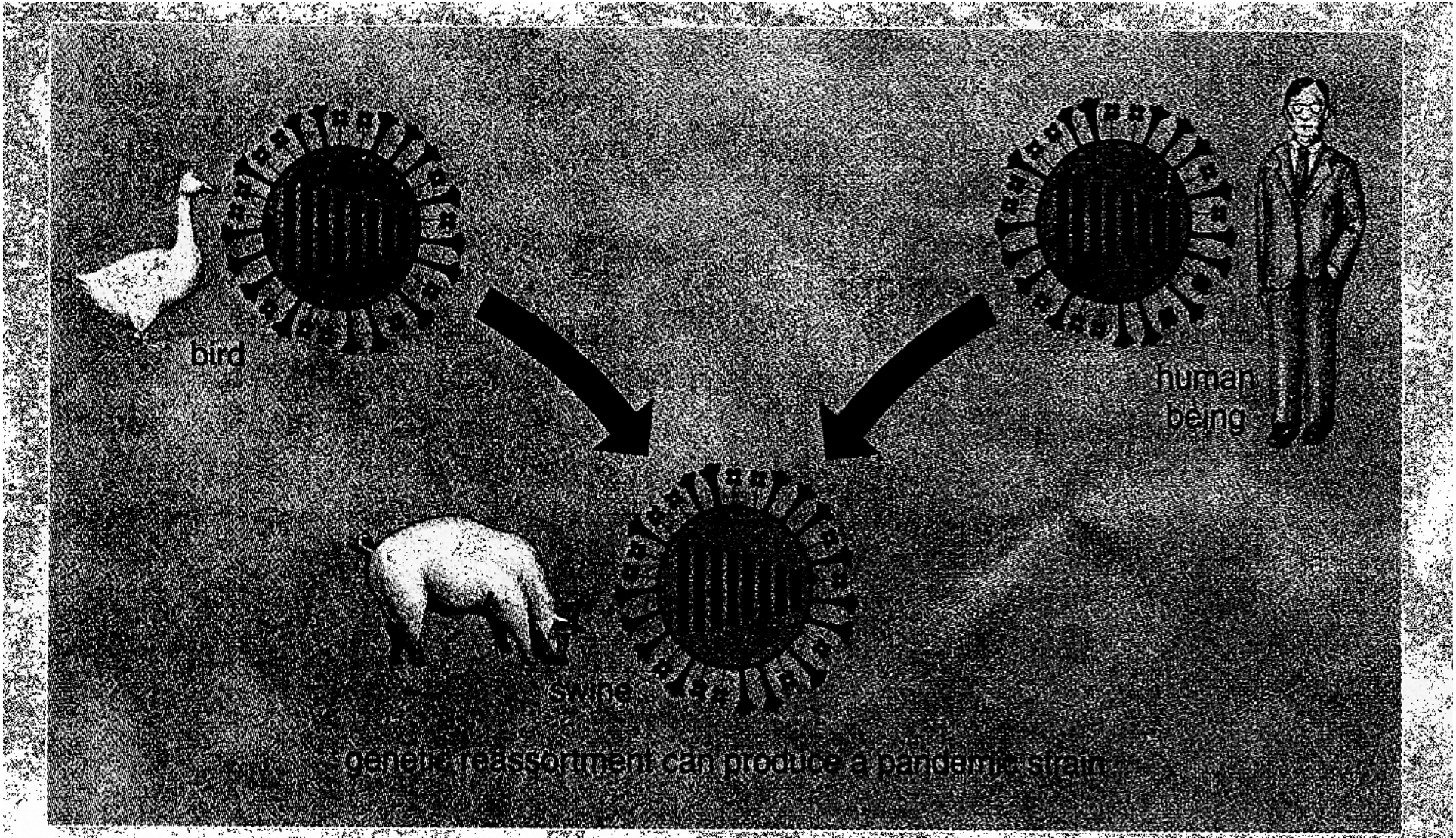


Figure 4. Swine serve as "mixing vessels" for the genes of avian, porcine and human forms of the influenza virus. In the host pig, the avian and mammalian viruses can share (reassort) their genes and so create new strains of flu. Swine have probably played an important role in the history of human influenza epidemics.

Other Avian Outbreaks

- 1999: Influenza A (H9N2) in 2 children
  - likely infected from poultry
- 2003: Influenza A (H5N1) in 2 members of a Hong Kong family who visited China (1 death)
  - Unknown source of infection

Other Avian Outbreaks

- 2003: Influenza A (H7N7) in poultry workers and their families in the Netherlands
  - 80 cases of infection
- 2003: Influenza A (H9N2) in 1 child in Hong Kong
- 2004: “US avian flu”
  - Delaware: H7 strain
    - 12,00 chickens culled so far

Chickens in a market in Shanghai.

A vendor sells chickens in a market in Ho Chi Minh City in early January 2004.

Cock Fighting in Bangkok

A bundle of live chickens gets a quick squirt of disinfectant
Long Bien market, Hanoi

A masked man on a motorcycle carries ducks from Long An to market in Ho Chi Minh City, Vietnam, on Jan. 15, 2004.


25 12:31PM

Farmers in Indonesia burn their dead chickens:

Jakarta said it would vaccinate infected birds

Hong Kong Outbreak 1997

- 1 million birds slaughtered after the spread of the “bird flu”
- influenza A virus (H5N1)
- 18 people infected; six died
  - *“The world is teetering on the edge of a pandemic that could kill a large fraction of the human population” Webster and Walker, Am Scientist 2003*

Recent Threats

- H5N1 avian flu in Asia
- Highly pathogenic
  - 14 people infected and 11 have died
  - Human-human transmission may have been observed in Vietnam on February 1
- Containment
  - Culling: 20 million chickens slaughtered in 8 countries
  - Need to protect workers involved in the cull

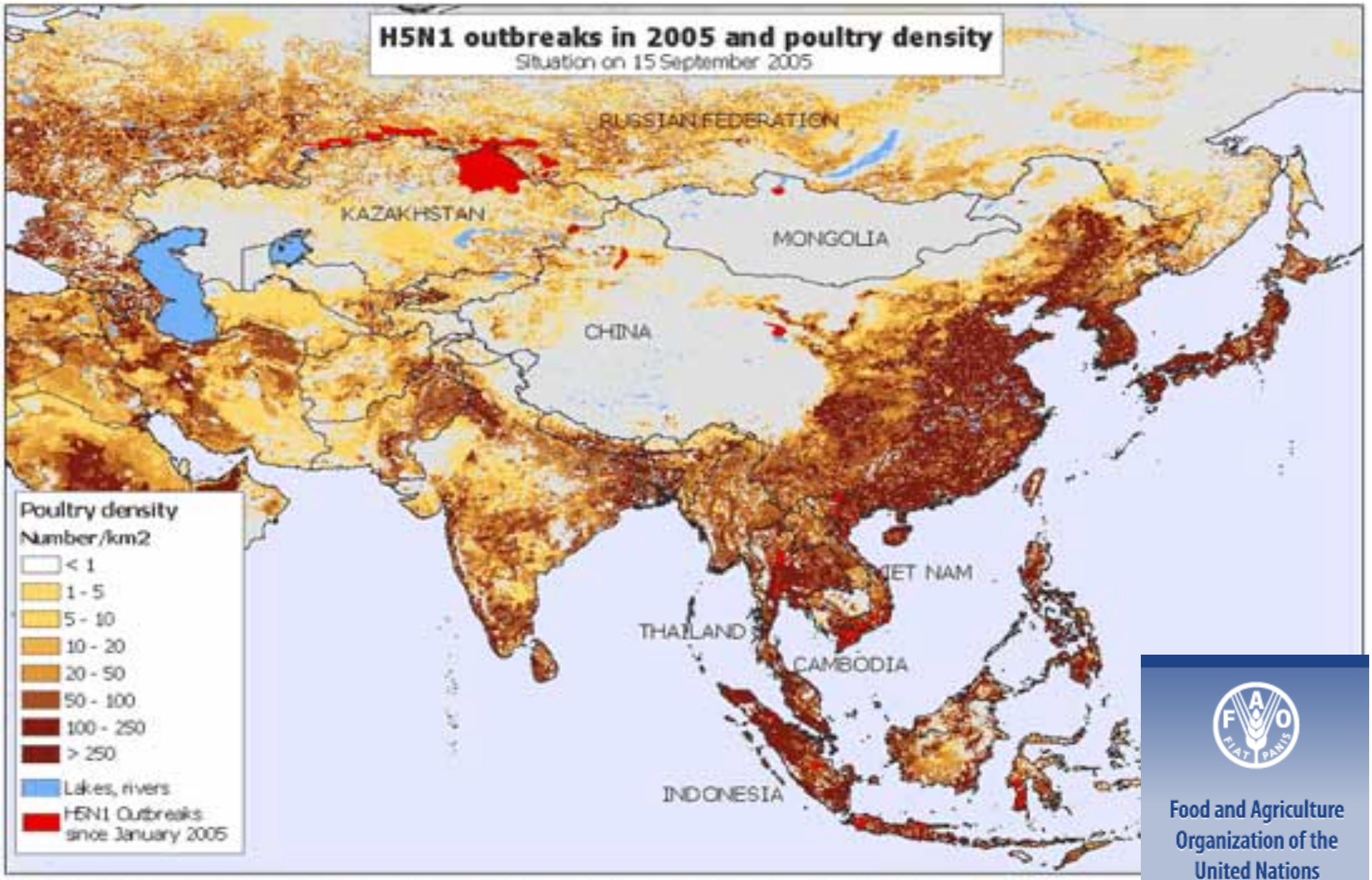
2009 Pandemic

- H1N1 variant
- Affected all age groups
- Can develop pneumonia or acute respiratory distress syndrome
- Started in Mexico and was pandemic between June 2009 and August 2010
- About 14,000 deaths worldwide

Recent Pandemics and Epidemics

Pandemic	Year	Influenza virus type	People infected	Estimated deaths worldwide
Spanish flu	1918–1919	A/H1N1	33% (500 million)	20–100 million
Asian flu	1956–1958	A/H2N2	?	2 million
Hong Kong flu	1968–1969	A/H3N2	?	1 million
Seasonal flu	Every year	mainly A/H3N2, A/H1N1, and B	5–15% (340 million – 1 billion)	250,000–500,000 per year
Swine flu	2009–2010	Pandemic H1N1/09	> 622,482 (lab-confirmed)	~18,036

http://en.wikipedia.org/wiki/2009_flu_pandemic



Food and Agriculture Organization of the United Nations

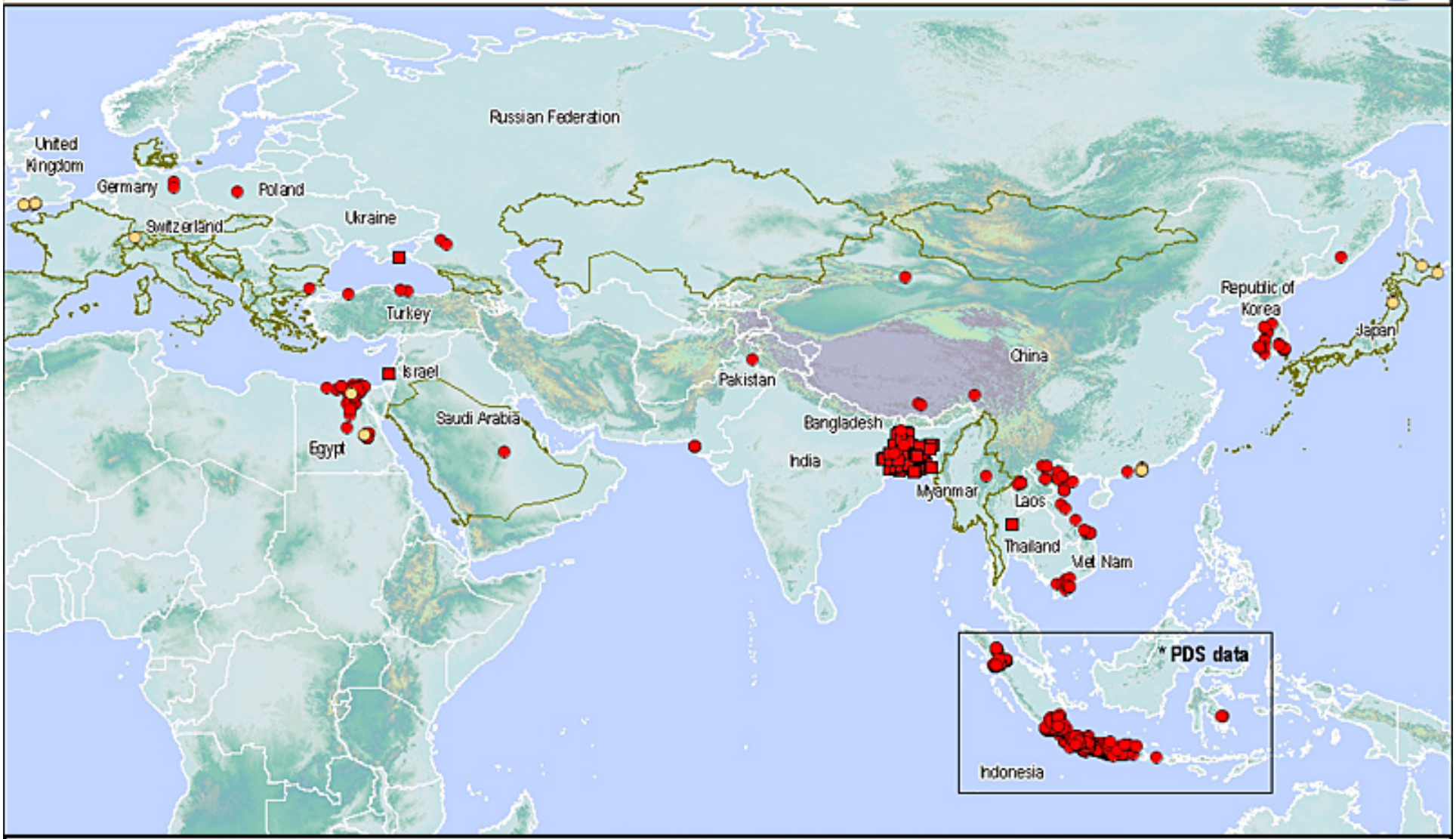
for a world without hunger

http://whyfiles.org/230birdflu2/

HPAI outbreaks: Outbreaks reported in poultry and cases in wild birds

Six months period (19 December 2007 - 19 June 2008)

EMPRES
EMERGENCY PREVENTION SYSTEM



Legend

- Self-declared free country
- H5N1 Domestic
- H5 Domestic
- H5N1 Wild
- H5 Wild

This map represents occurrences of HPAI observed from 19 December 2007 to 19 June 2008. H5 cases are represented n this map only for countries in which H5N1 is known to be endemic and where N-subtype characterization is not being performed for secondary cases. Countries with HPAI occurrence only in wild birds are not considered as infected according to OIE status. The original data have been collected and aggregated at the most detailed administrative level and for the units available for each country.

NOTE: FAO compiles information from numerous sources (FAO representatives or country missions, FAO reports, OIE, official government sources, EC, Reference laboratories and others) and produces these composite maps in a representative effort to provide full and accurate information. Omissions and errors are regretted, but FAO welcomes messages to that effect with supporting documentation to make the required changes based on FAO validation and verification procedures. Send messages to EMPRES-livestock@fao.org

Carrying Capacity to Support Human Populations: What about Other Species?

Just South of Dakha

Bangladesh

- What is the capacity of agriculture to generate employment and absorb the expanding population into gainful employment? What is the capacity of agriculture to feed the growing population?
- 88% of 8.774 million hectares has been cultivated
- Double (59%) and triple (22%) cropping increases the effective crop production by 150%
  - Can the land support this?

Has Bangladesh Reached the Limits of Agriculture?

- Key factors, all related to climate change
  - Availability of water
    - seasonality of precipitation
    - lack of infrastructure to capture water from rivers
  - Flooding
  - Increases in temperature
    - Affecting crops and human health
- Will likely require massive influxes in food
  - See paper by Hardin “Carrying capacity as an ethical concept”

Carrying Capacity

- Definitions of carrying capacity:
  - The supportable population of an organism, given the food, habitat, water and other necessities available within an environment is known as the ... (en.wikipedia.org/wiki/Carrying_capacity)
  - The number of people that an area can support given the quality of the natural environment and the level of technology of the population (www.let.rug.nl/usa/GEO/glossary.htm)
  - The maximum population size that an ecosystem can support. (www.macmillanmh.com/science/2008/student/sc/grade5/glossary/c.html)

Carrying Capacity

- Ecological Footprint is supposed to estimate this for people
  - Other estimators?
- Is this the wrong question?
- Is it answerable?

Additional Slides

Eliminating Unintended Pregnancies

- 2001: 6.4 million pregnancies (811,000 in teens)
  - 1.1 million miscarriages
  - 1.3 million abortions
  - 4 million births
- 3.1 million pregnancies were unintended (48.4%)
  - ~640,000 in teens (78.9%)
- 1.4 of 4 million births were unintended (35%)
- Increment in the total US population is about 2.9 million per annum
- Natural increment is 60% x 2.9 million = 1.74 million
- If unintended pregnancies were prevented (1.4 million) ➔ natural increase in the US population would be about 340,000
- Total annual increase with immigration = 340,000 + 1,160,000 = 1.5 million instead of 2.9 million

From Speidel et al.