

# Improving Education as Key to Enhancing Adaptive Capacity in Developing Countries

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Blindtext für Fußzeile "Titel der Präsentation"

## My approach

I'm a demographer (mathematics of people) who worked for 25 years in global modeling, systems analysis and forecasting in Europe, Africa and Asia.

**Motivation: Make a contribution toward understanding the priorities for sustainable development (long term, holistic, sensitive to distribution).**

I am interested in climate change because it is potentially **dangerous to human wellbeing**. The extent to which it will be dangerous will depend on both the changed climate conditions and the populations' capacity to coping with them.

I recently received a 5-year grant (ERC Advanced Grant) for **"Forecasting societies' adaptive capacities to climate change"**



## Hypotheses

- (a) Strengthening **adaptive capacity** to climate change is not fundamentally different from strengthening **general human development**.
- (b) **Human capital** as defined by the combination of education and health (with special emphasis on female primary and junior secondary education and basic health care including reproductive health) **is the key to such development**.
- (c) **Under conditions of uncertainty** about the exact climate changes to be expected for certain places **Human Capital Development** (general empowerment to self help and to flexibly react to the still unknown challenges as they arise) **is the only meaningful investment** in longer term adaptive capacity.

## Adaptive Capacity = General Development ?

Here the test is whether we can think of any important element of adaptive capacity which is not also an important element of development in general.

Aside from very specific purpose built infrastructure (such as sea walls) which can be viewed as part of adaptation but not of **adaptive capacity (= ability to adapt)**, I cannot think of any measure that would not also be considered an important element of general development.

**The criteria for successful adaptation are to avoid premature deaths and maintain health (WHO definition).**

Hypothesis is falsified through counterexamples. **Please, come up with suggestions !!!**

## Human Capital Formation = Root Cause and Priority for Development ?

***Sola Schola et Sanitate***: Title of paper recently published in *Philosophical Transactions of the Royal Society*.

An earlier version of this hypothesis was presented in June 2008 at the 40<sup>th</sup> Anniversary Conference of the Club of Rome.

Martin Luther's famous principle ***sola fide*** = salvation comes only through personal faith rather than blind subordination to the church hierarchy gave priority to personal conscience over institutional conformity and paved the way for the occidental path toward individual human rights, personal empowerment, empirical science and in consequence modern economic growth.

Half a millennium later, ***sola schola et sanitate*** (only through the combination of education and health, i.e., only through empowerment rather than corrupting monetary dependencies) could become a powerful new principle for international development.

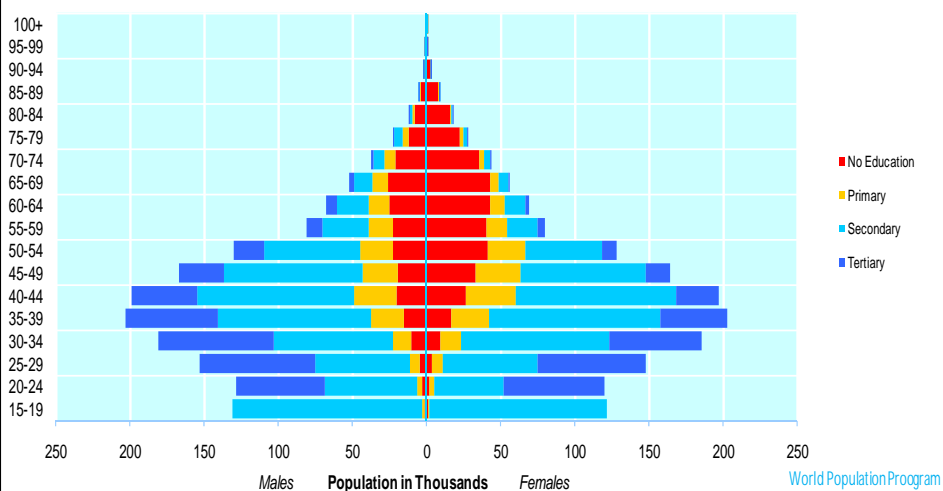
## Human Capital = POP x Education x Health

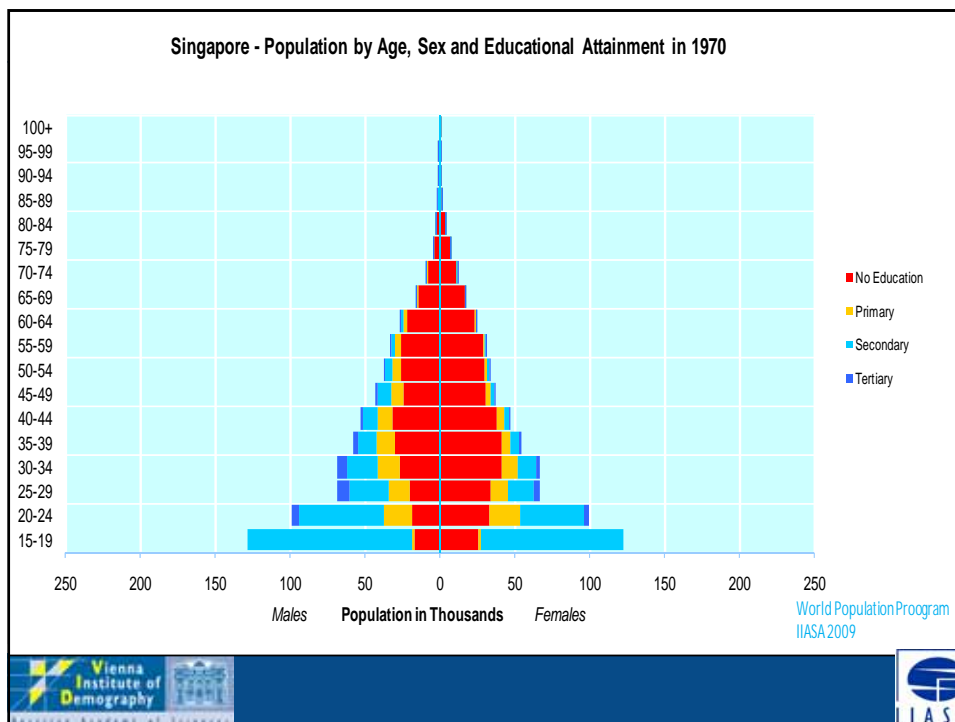
- **Education**: formal – informal  
quantity – quality – content
- Formal Education:
- **Education Flows** – Policy variable  
(Gross and Net Enrolment by Age, Repetition Rates)
- **Education Stocks** - Change very slowly due to great momentum
  - Mean years of schooling
  - Distribution by highest educational attainment
  - Functional literacy (IALS, LAMP)

## Our four education categories for 2000 based on ISCED, from censuses and surveys (mostly DHS)

- **No education** Never been to school
- **Primary** Some primary, complete primary, incomplete lower secondary
- **Secondary** Completed lower secondary to incomplete first level of tertiary
- **Tertiary** Completed first level of tertiary or higher.

Singapore - Population by Age, Sex and Educational Attainment in 2000 - Global Education Trend  
- Scenario





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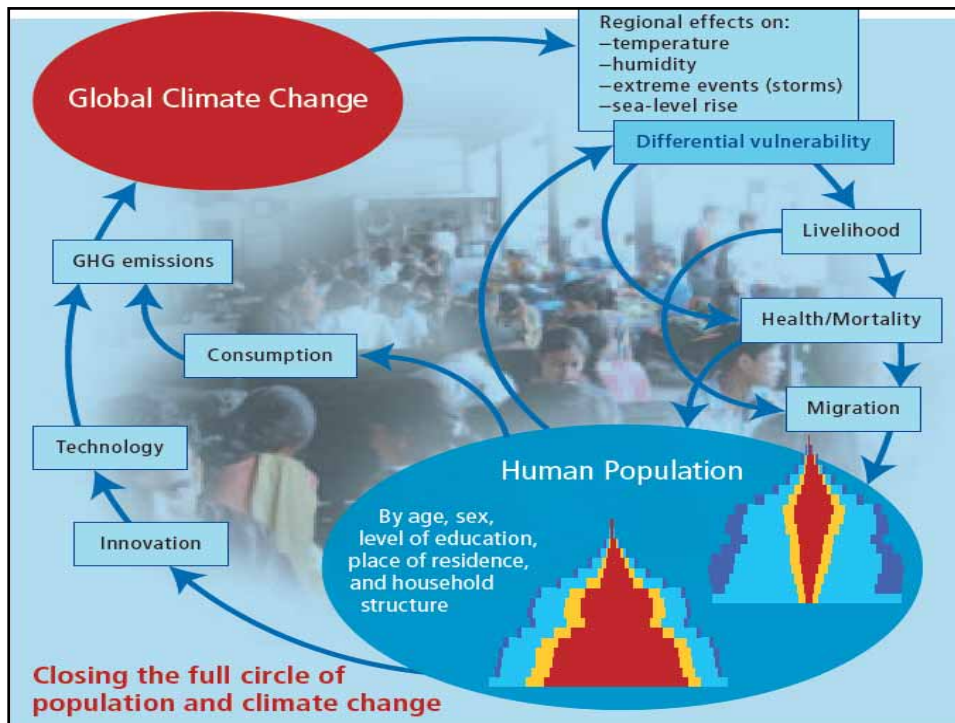
## Sample Table

### India

Population distribution ('000) by age, sex and level of education and mean years of schooling (MYS)

Males

		No Edu.	Primary	Secondary	Tertiary	MYS
2000	15-19	8867.9	14274.4	29681.6	0.0	<b>6.6</b>
	20-24	8917.9	10326.9	23088.3	3906.1	<b>7.2</b>
	25-29	10535.7	10117.4	18153.7	5191.1	<b>6.9</b>
	30-34	11251.9	9467.0	14566.2	4328.1	<b>6.4</b>
	35-39	11258.2	9195.7	11243.9	3274.6	<b>5.7</b>
	40-44	10281.5	8067.7	9242.1	2785.4	<b>5.6</b>
	45-49	8523.5	6780.7	7453.6	2298.9	<b>5.5</b>
	50-54	7591.1	5223.6	5313.0	1683.8	<b>5.1</b>
	55-59	6255.8	4633.0	3937.7	1157.7	<b>4.7</b>
	60-64	6389.9	3614.5	2346.7	619.9	<b>3.6</b>
	65+	12124.9	7331.6	3515.5	855.0	<b>3.2</b>
	15+	101998.4	89032.5	128542.2	26100.7	<b>5.9</b>
	25+	84212.5	64431.2	75772.3	22194.6	<b>5.5</b>

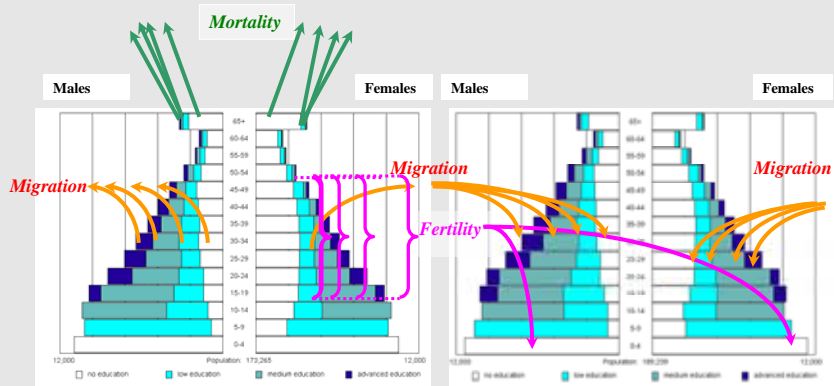


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## Toward a new (demographic) theory of social change with predictive power

- Societies change in important and measurable dimensions as a consequence of the changing composition of their members (people) characterized by certain properties.
- Many of these properties are persistent along cohort lines.
- The degree of persistence of these properties versus transitions to other properties can be empirically assessed by the means of age-period-cohort (APC) analysis.
- The future distributions of people with certain properties can be projected using the tools of multi-state population dynamics.
- Such projections can be tested and potentially falsified, which makes it qualify as a theory.
- It is a theory explaining structural change (macro) and not individual behavior (micro). But it shows how individual transitions and persistence at the micro level effect society.

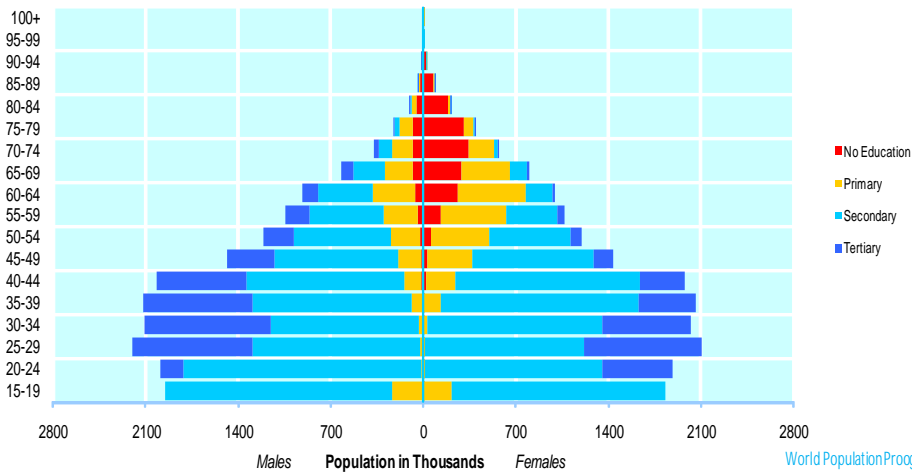
## The Demographic Multi-State Model: Principles of Population Dynamics by Age, Sex, and Education



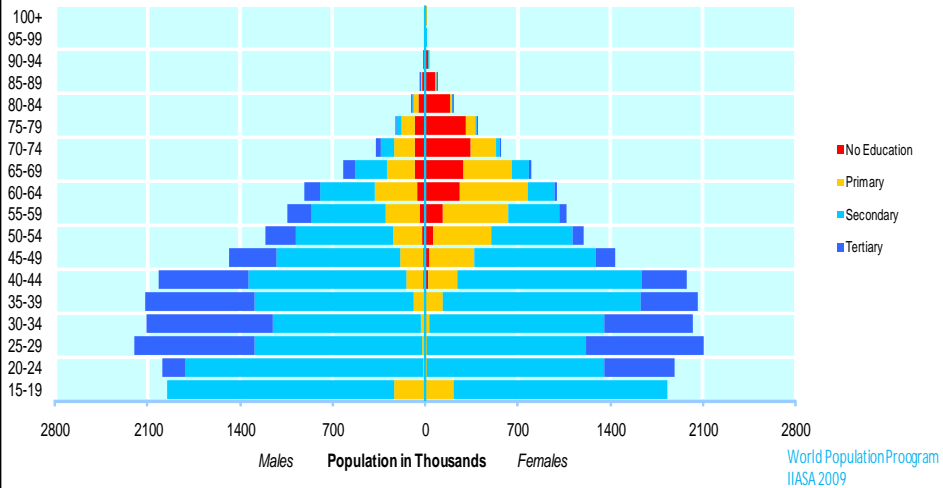
Population by Age, Sex, and Education 2000

Population by Age, Sex, and Education 2005

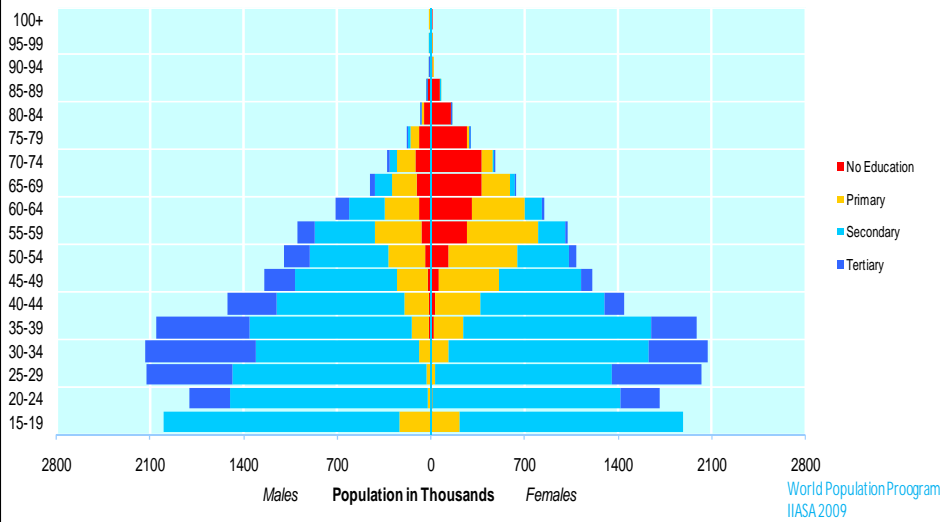
### Republic of Korea - Population by Age, Sex and Educational Attainment in 2000 - Global Education Trend - Scenario



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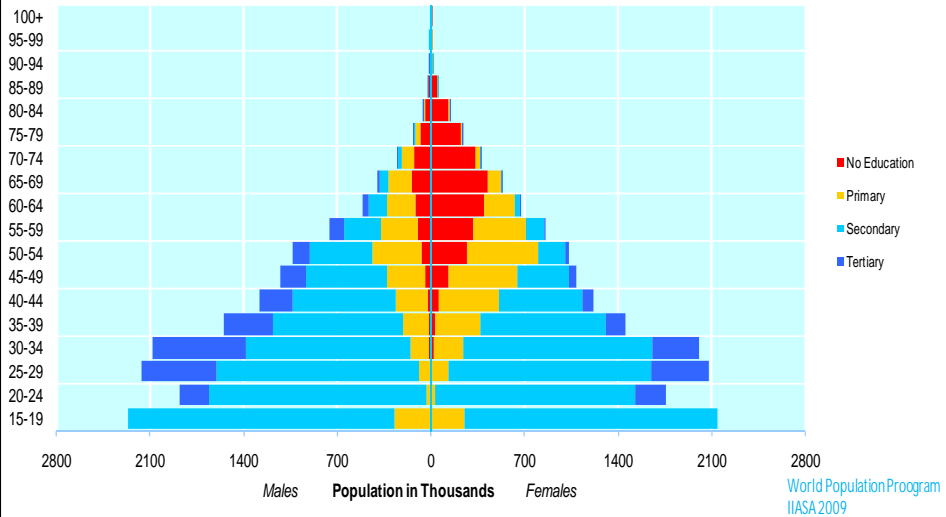


### Republic of Korea - Population by Age, Sex and Educational Attainment in 1995



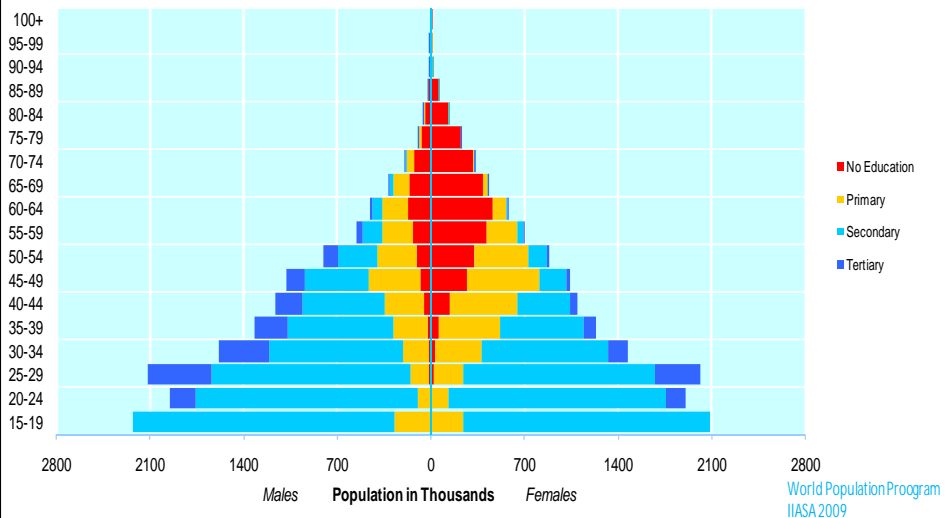
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### Republic of Korea - Population by Age, Sex and Educational Attainment in 1990



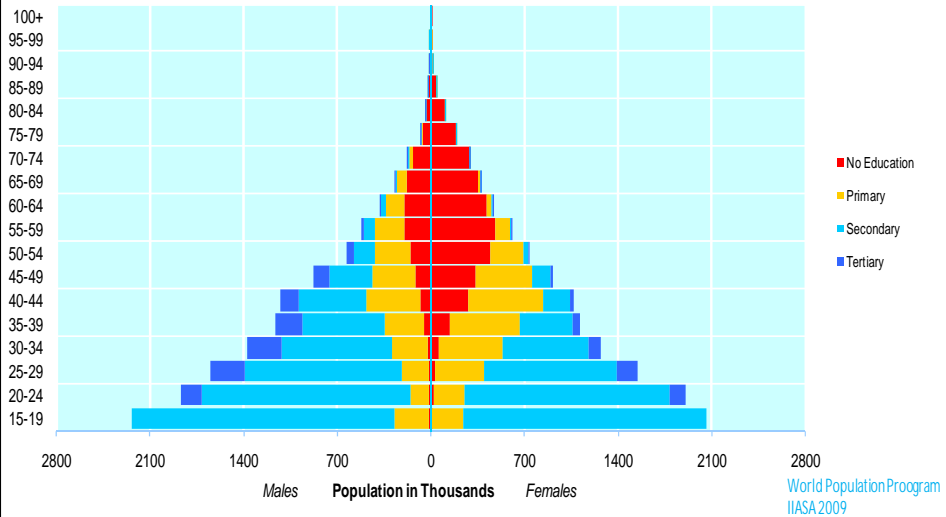
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### Republic of Korea - Population by Age, Sex and Educational Attainment in 1985



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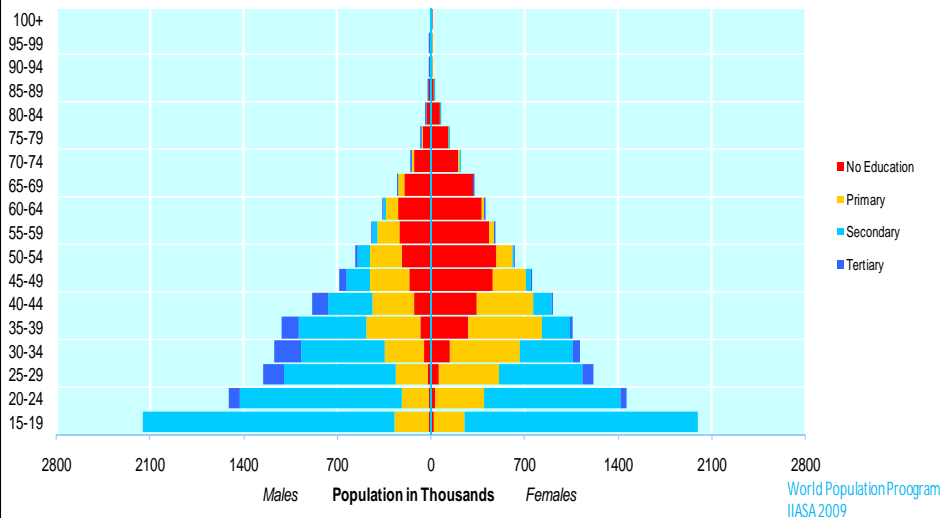
### Republic of Korea - Population by Age, Sex and Educational Attainment in 1980



World Population Program  
IIASA 2009

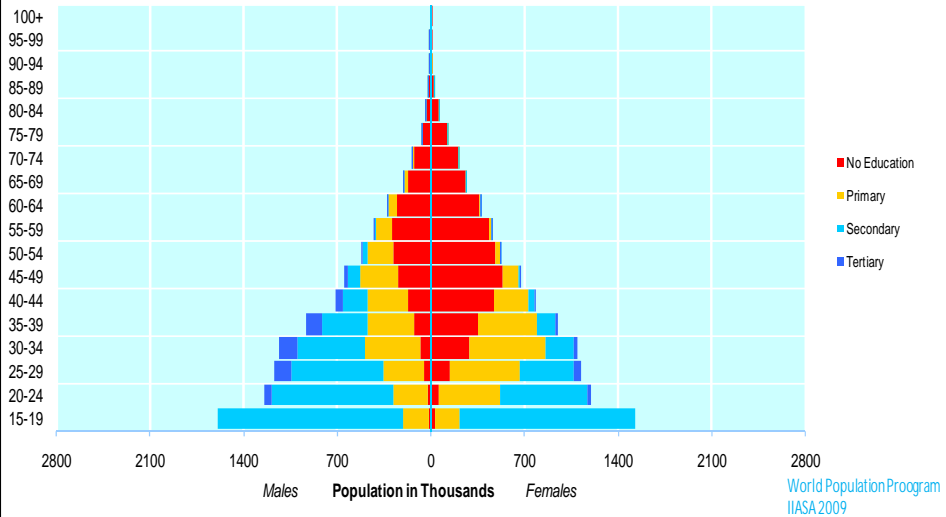
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### Republic of Korea - Population by Age, Sex and Educational Attainment in 1975

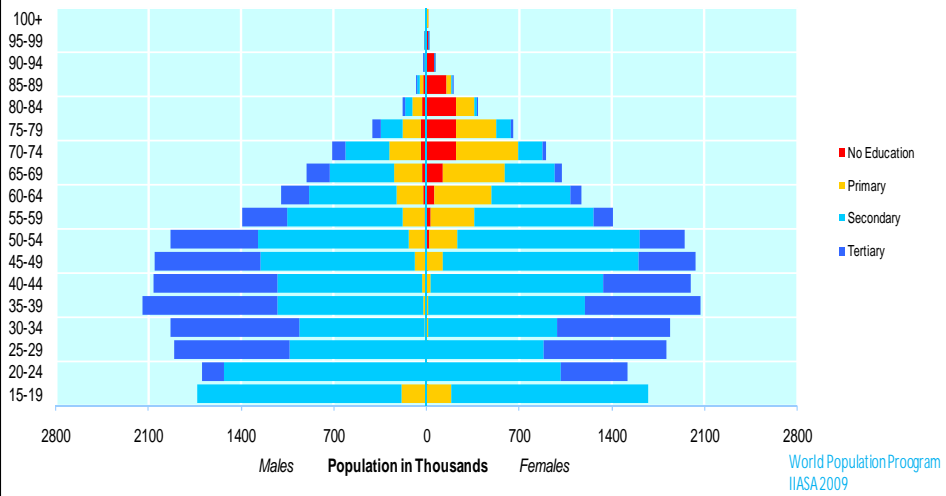


World Population Program  
IIASA 2009

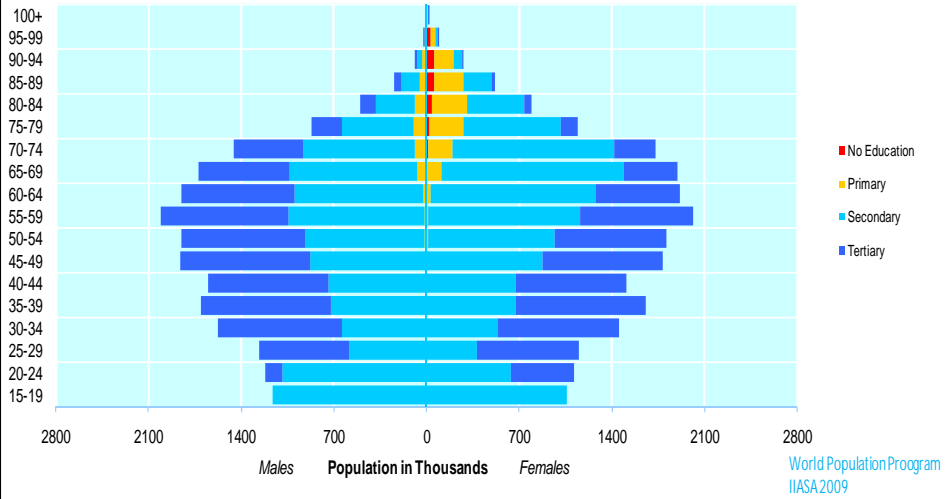
### Republic of Korea - Population by Age, Sex and Educational Attainment in 1970



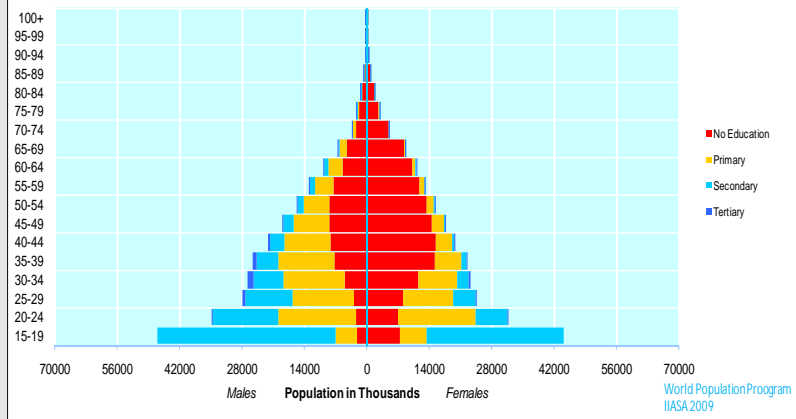
### Republic of Korea - Population by Age, Sex and Educational Attainment in 2010 - Global Education Trend - Scenario

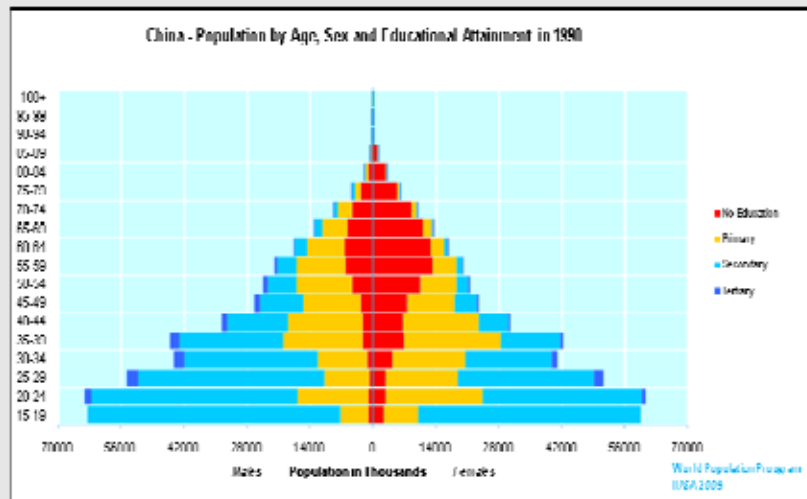
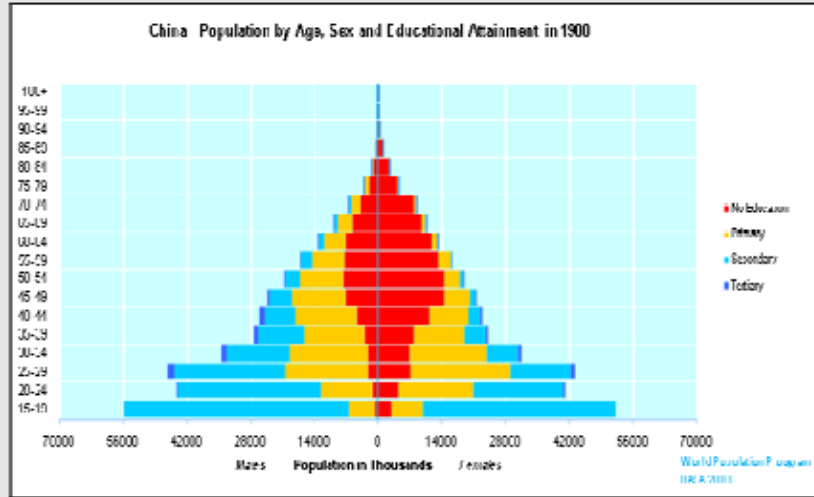


### Republic of Korea - Population by Age, Sex and Educational Attainment in 2030 - Global Education Trend - Scenario

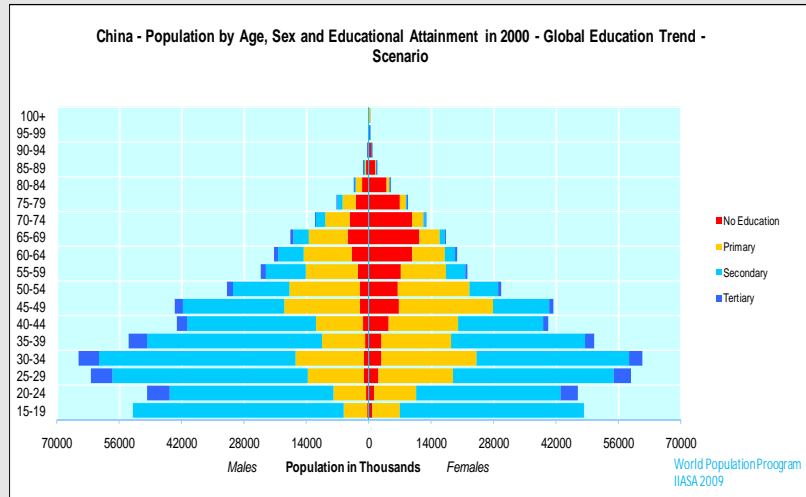


### China - Population by Age, Sex and Educational Attainment in 1970

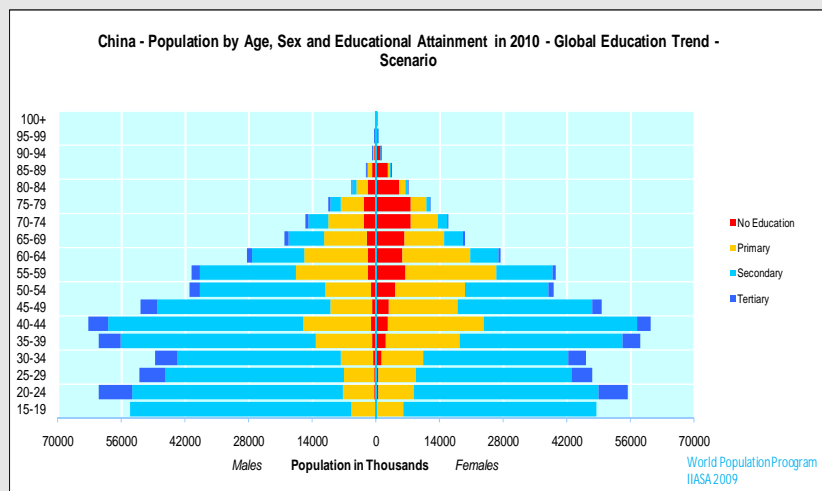




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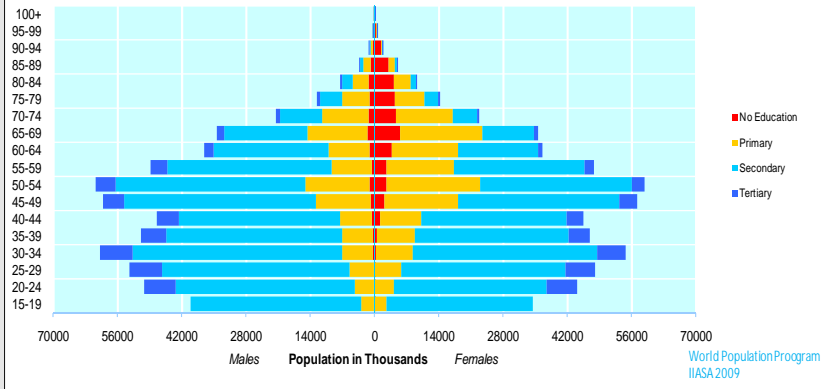


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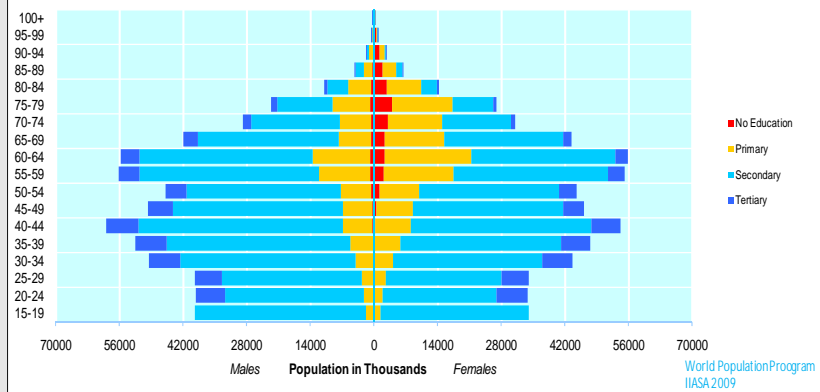
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China - Population by Age, Sex and Educational Attainment in 2020 - Global Education Trend - Scenario

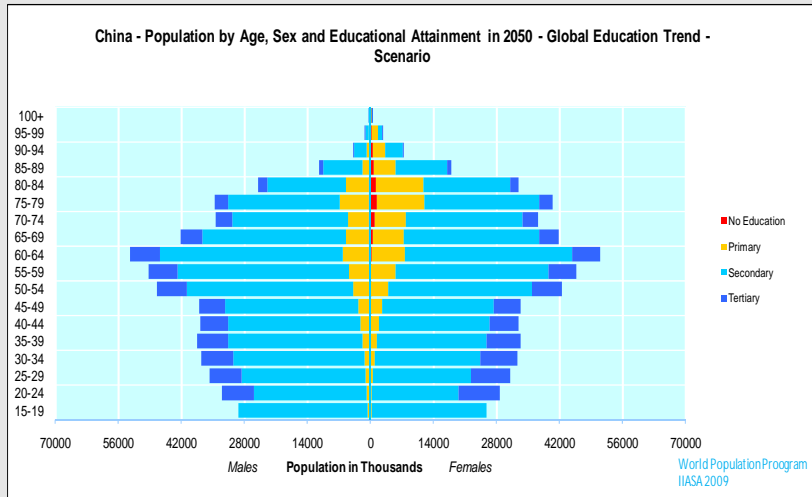


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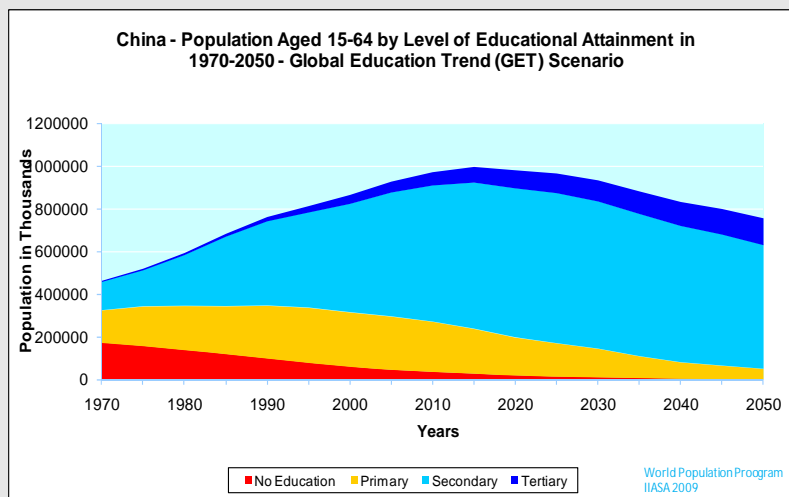
China - Population by Age, Sex and Educational Attainment in 2030 - Global Education Trend - Scenario

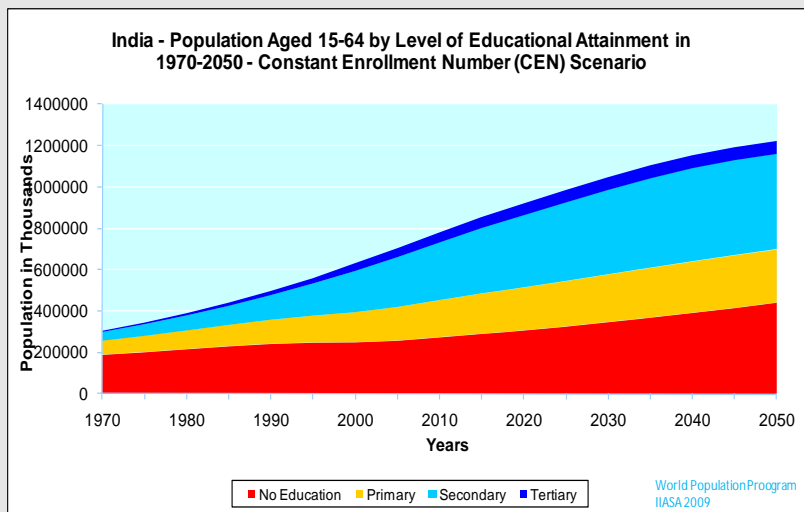
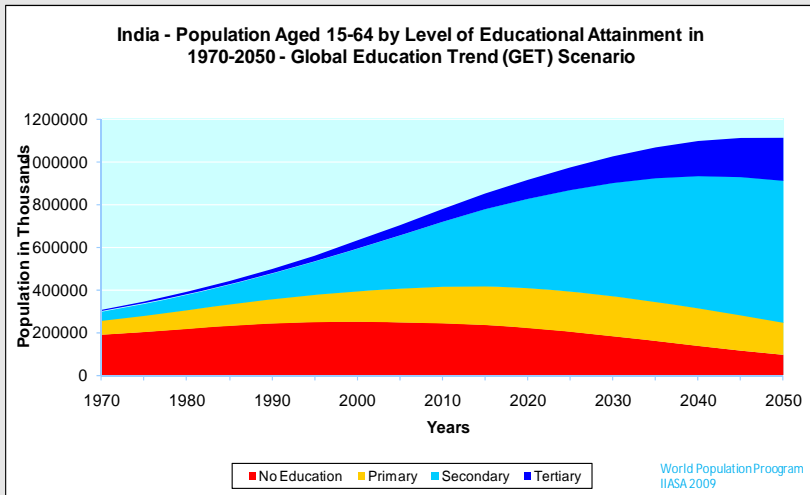


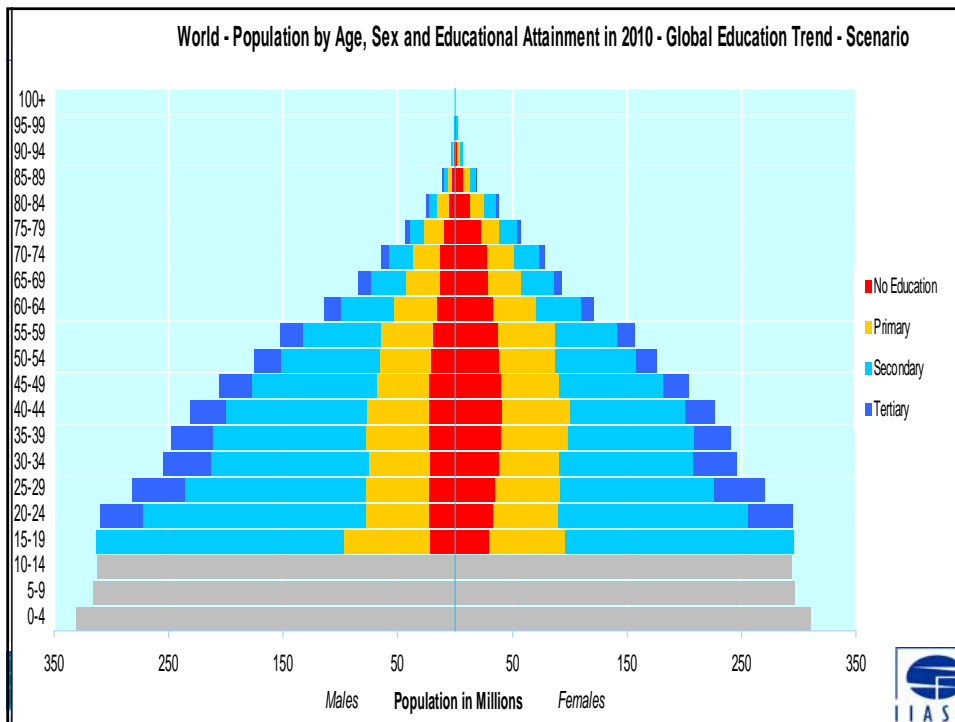
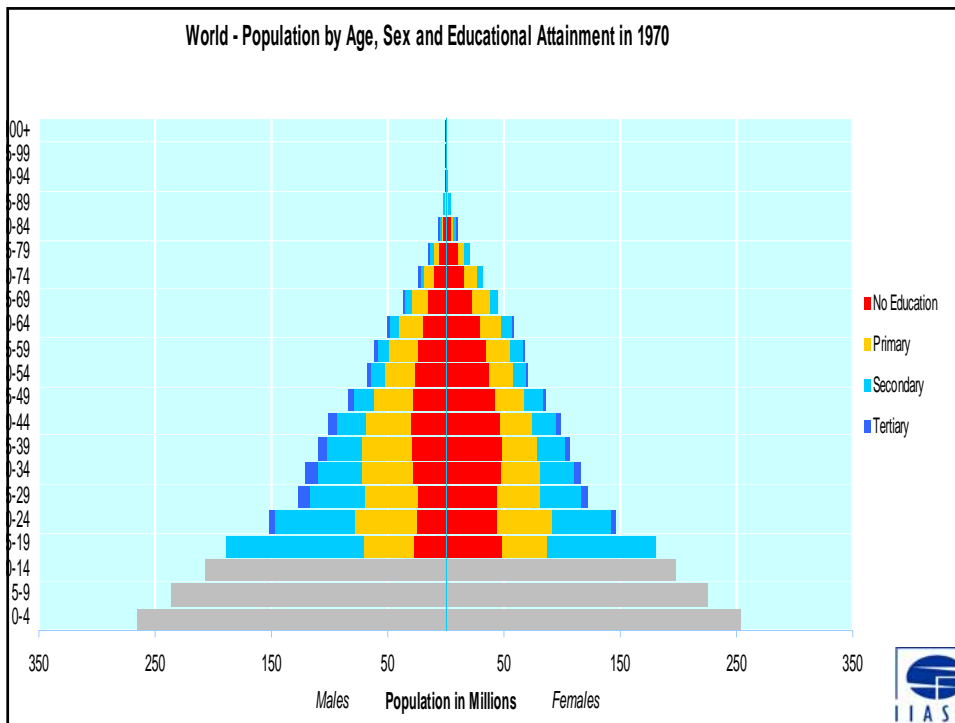
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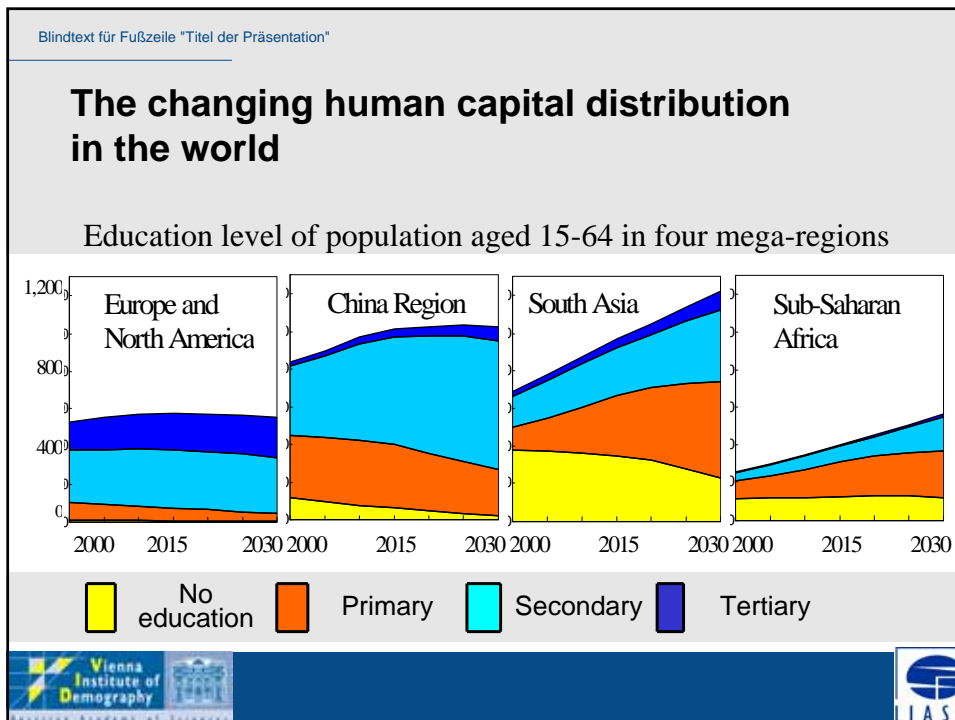
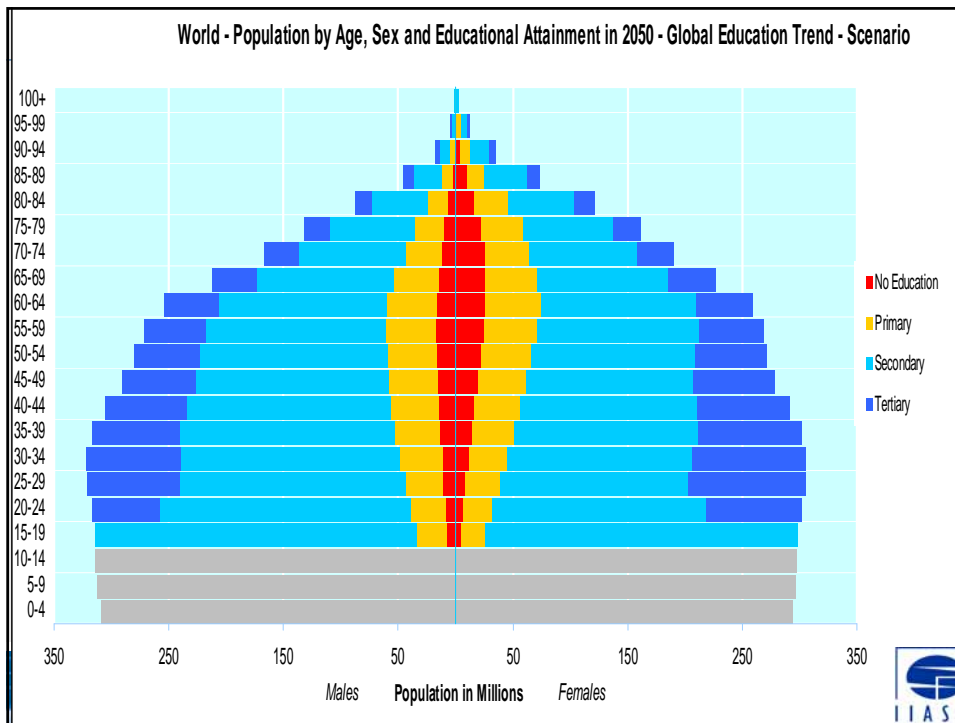


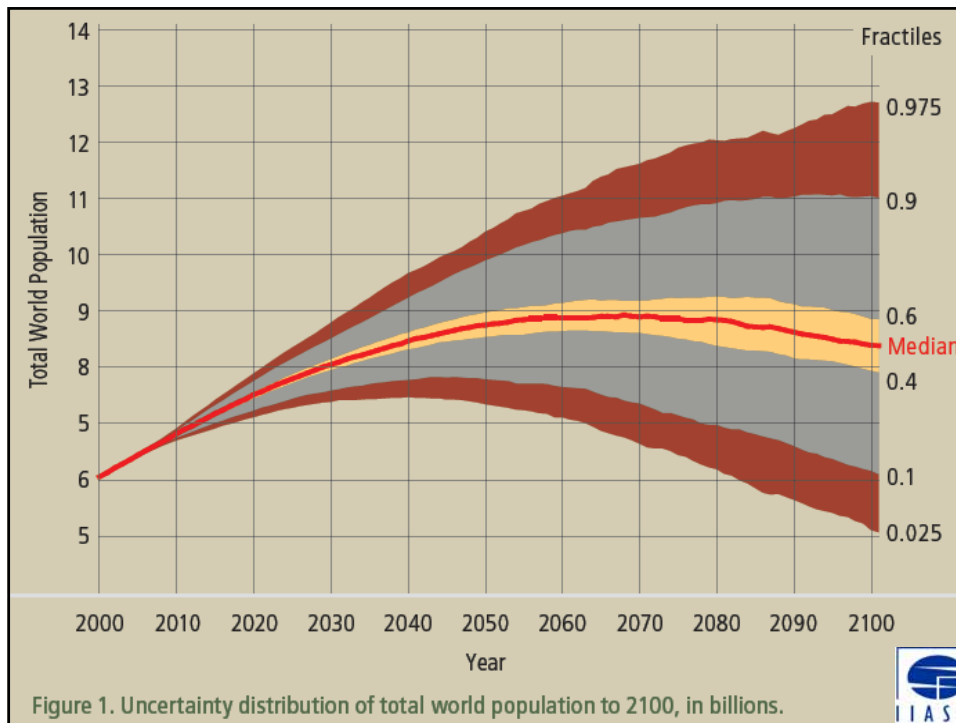
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## How “dangerous” will Climate Change be for Human Wellbeing?

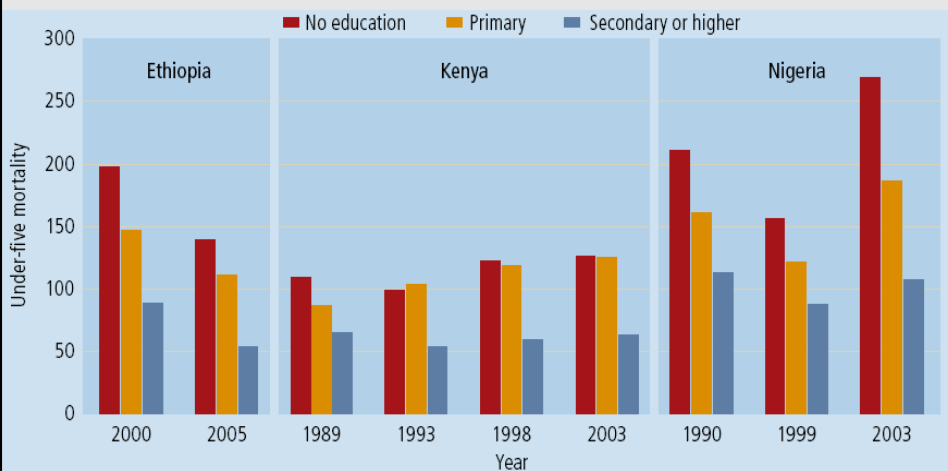
How to assess the likely Impacts of Climate Change on Human Health

Many estimates – for instance of additional malaria deaths due to climate change – assume that future climate conditions (e.g. in 2050) will affect populations that will be at a similar stage of socio-economic development and hence have similar public health capabilities as these societies have today.

WHO Report on Climate Change and Human Health says on adaptive capacity: “In general, countries with more “human capital” or knowledge have greater adaptive capacity. Illiteracy increases a population’s vulnerability to many problems.”

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## Mortality under age 5 by mothers' education (Source: DHS)



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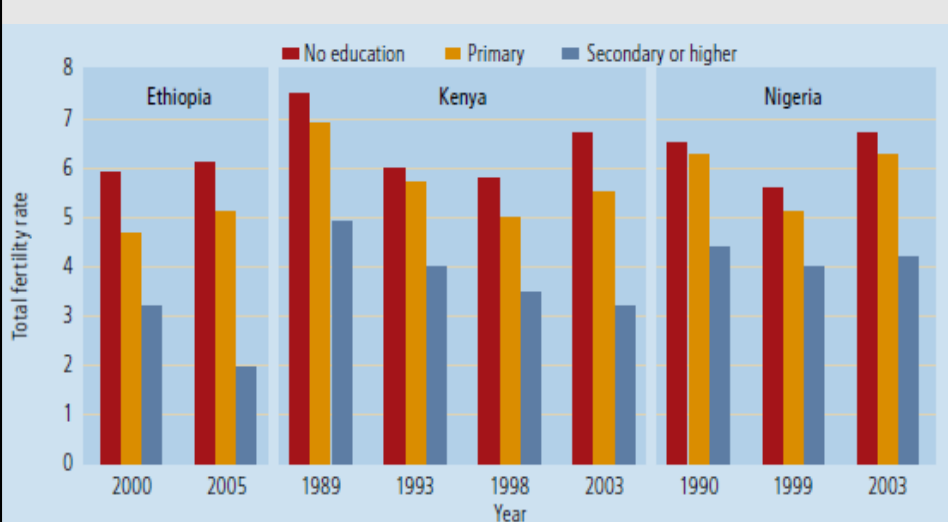
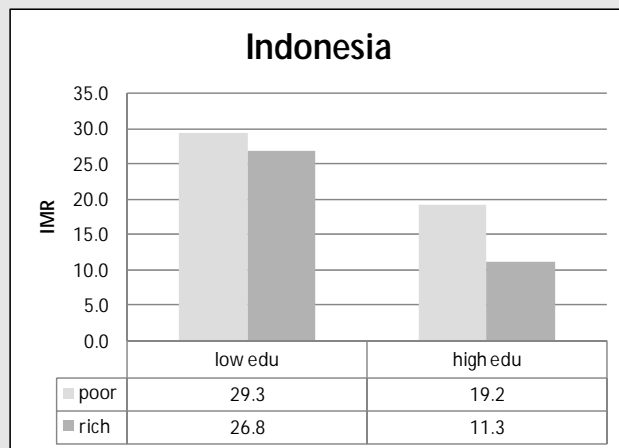
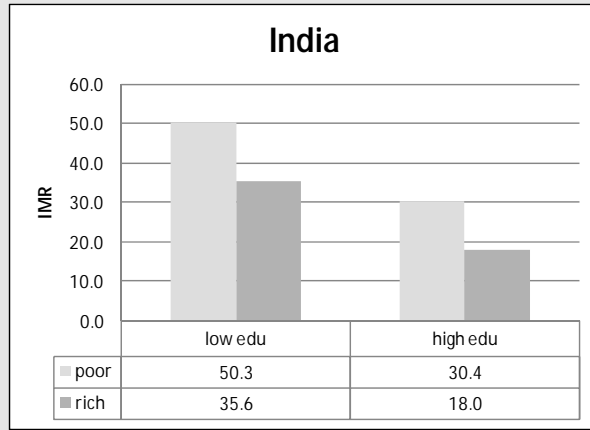
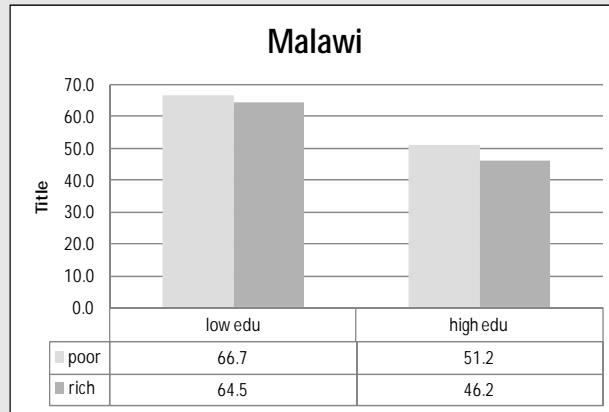


FIGURE 2 Total fertility rates by level of educational attainment. (Source: Several DHSs)







Based on the new **IIASA-VID Educational Attainment data set** for 120 countries for 1970-2000 previous (inconclusive) economic growth regressions could be re-estimated and finally showed consistently significant positive effects of improving educational attainment.

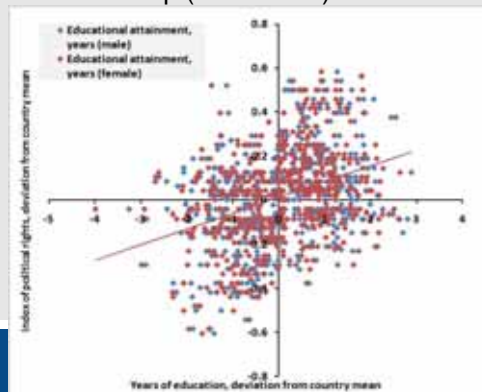
For poor countries it is the combination of universal primary with broad based secondary education that results in significant economic growth. - The current MDG goal is not sufficient.

## The Demography of Educational Attainment and Economic Growth

Complementing primary education with secondary education in broad segments of the population is likely to give a strong boost to economic growth.

## Education and Democracy

Using the Freedom House Indicator of Democratic Rights as dependent variable, similar panel regressions show that higher human capital is associated with more democratic rights. In particular a reduction in the male-female education gap has a highly significant effect. – There is no question about the direction of causation because education (the flow) must have happened long before the relationship (adult stock) is assessed.



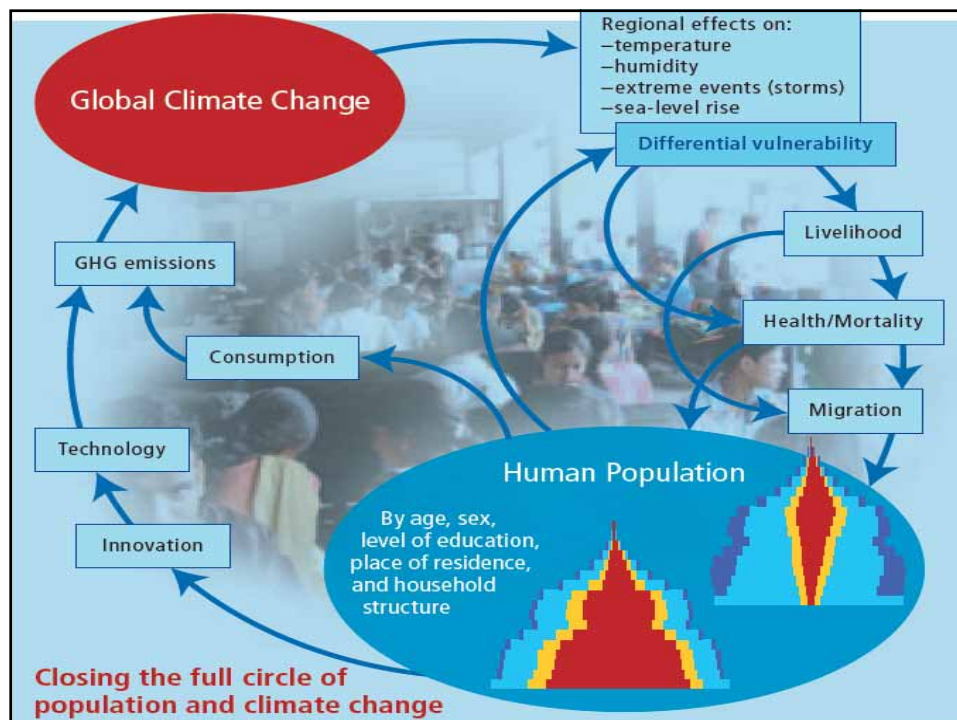
## Systems Models (Integrated Assessment)

Multi-sectoral computer models with systems of non-linear equations and feed-backs trying to capture real world interactions as comprehensively as possible are the best way for testing which factors are primary drivers and which are intermediate ones.

- **World 3:** The 1972 "Limits to growth" study did not explicitly consider education stocks.
- **PDE (Population-Development-Environment)** in depth case studies by IIASA: Mauritius, Cape Verde, Yucatan, Namibia, Botswana, Mozambique. All explicitly include human capital (by age and sex and 3-5 education categories) as part of comprehensive multi-sectoral systems models. Extensive sensitivity studies showed in all cases that investing in education is key to success.
- **PEDA (Population-Environment-Development-Agriculture)** Models by UN-ECA included literacy by age and sex in the model. Also turns out to be key to sustainable food security in seven African countries.

## National Success Stories

- The story of Finland in the 19th and 20th century
- The Story of Germany 1945-1970
- The Story of Mauritius 1960-1990
- The Story of South Korea 1970-2000
- The Story of Iran 1980-

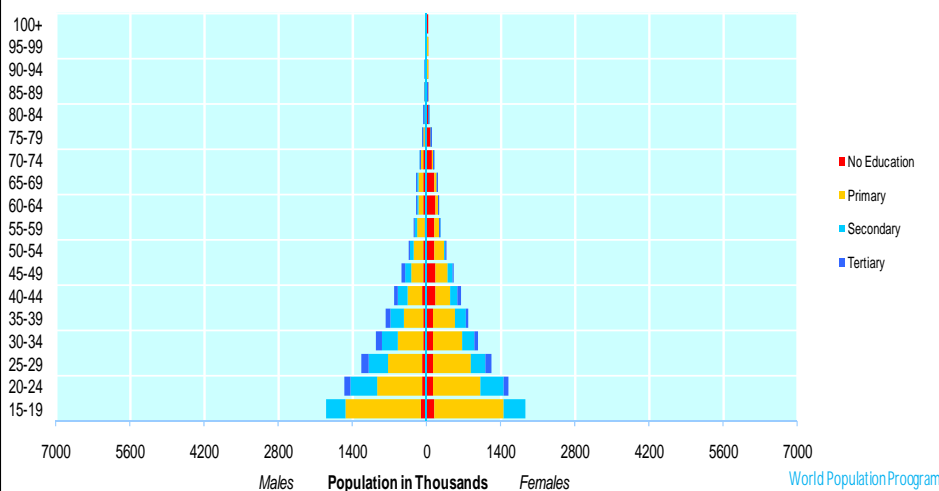


**Example of a specific question:**

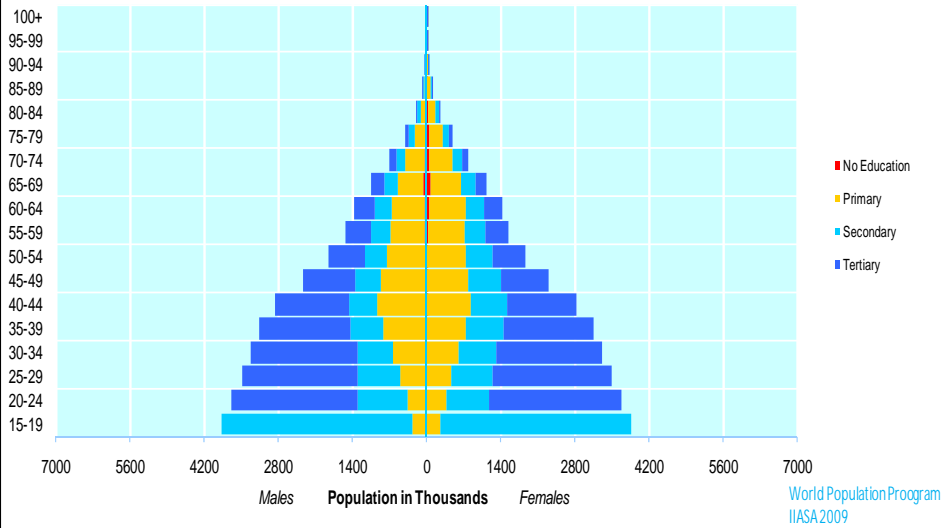
**Will climate change in Kenya by 2050 lead to many more Malaria deaths?**

- We need to have information about range of likely future climate conditions for Kenya from GCMs
- We know that vulnerability to Malaria has both elements of individual differential vulnerability and of social capital and governance – public health capabilities.
- We know that some populations could get rid of Malaria despite of very adverse climate conditions (Singapore 1978-82, Mauritius, Florida).
- We assume that differential vulnerability and public health capabilities depend on human capital – Test!
- We can study alternative human capital projections.

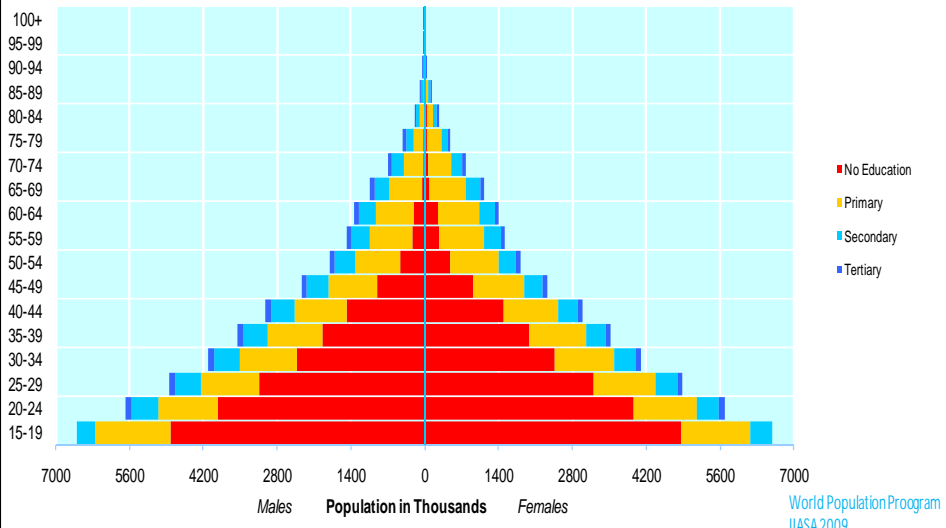
Kenya - Population by Age, Sex and Educational Attainment in 2000 - Global Education Trend - Scenario



Kenya - Population by Age, Sex and Educational Attainment in 2050 - Fast Track - Scenario



Kenya - Population by Age, Sex and Educational Attainment in 2050 - Constant Enrollment Number - Scenario



## ***Sola schola et sanitate - Hypothesis:***

### ***Human capital is the root cause of international development and should become its priority***

- **New data** on education by age and sex for most countries for 1970-2050 allow **new global level assessments** of the importance of human capital on economic growth, health, quality of governance etc.
- Historical case studies illustrate the overriding importance of early investments in human capital.
- Only a **comprehensive systems dynamics approach** (including feedbacks and non-linearities) can help to assess the relative importance of some forces over others.
- **So far the evidence is quite convincing – but more testing and discussion is needed**

## **What about the third hypothesis?**

**Under conditions of uncertainty** about the exact climate changes to be expected for certain places **Human Capital Development** (general empowerment to self help and to flexibly react to the still unknown challenges as they arise) is the **most effective investment** in longer term adaptive capacity.

This is better than “no regrets“

How to test this hypothesis? It seems plausible.

It is falsified if you can come up with a more effective investment than Human Capital Development in terms of adaptive capacity.