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FOR DEMOGRAPHY AND **GLOBAL HUMAN CAPITAL** 

## **Demographic Dimensions** of Sustainability Science: Humans causing the problem and serving as criteria for sustainability

The National Academies, 14 Jan 2016

Wolfgang Lutz Director, World Population Program, IIASA Founding Director, Wittgenstein Centre



IIASA, International Institute for Applied Systems Analysis

## World Population from the year 1000 to 2100







Chart 1. Historical trend and projections according to the medium scenario (SSP2) for the world population by six levels of educational attainment (see color coding). The additional lines superimposed

# Adding education to age and sex

# Education is the most important source of observable population heterogeneity after age and sex.

#### This matters because:

- Almost universally during demographic transition more educated women have fewer children, have lower child mortality, and more educated adults live longer. Changing education composition changes population forecasts.
- Education is a crucial determinant of individual empowerment and human capital, is a key driver of socio-economic development (public health, economic growth, quality of institutions and democracy, and adaptive capacity to climate change).

Education as a Demographic Dimension: What is the education/cognition effect?

We have good reasons to assume "functional causality" from cognition/education to health, fertility and behavior. Education is not just a proxy for SES (Socio-Economic Status).

- Every learning experience builds new synapses in our brains and makes us "physiologically different" (Eric Kandel)
- Enhancement of cognitive skills
  - change risky behavior
  - extend personal planning horizon
  - learn from past damage
- Better access to relevant information
- Higher income at the individual and household level

# Human Capital = POP x Education x Health

- Education: formal informal quantity quality content
- Focus on Quantity of Formal Education:
- Education Flows Policy variable
- Education Stocks Change very slowly due to great momentum
  - Mean years of schooling
  - Distribution by highest educational attainment
  - Skills: Functional literacy (IALS, LAMP)

# Singapore 1985: A society divided into two classes:



# Singapore - 1970 BP



## Singapore - 1980 BP



## Singapore - 1990 BP



# Singapore - 2000 BP



Singapore - 2010



Singapore - 2020 SSP2

![](_page_13_Figure_1.jpeg)

## Fertility by Education in Kenya Empirical (2010) and Assumed (IIASA)

![](_page_14_Figure_1.jpeg)

![](_page_15_Picture_0.jpeg)

REVIEW

# Global Human Capital: Integrating Education and Population

Wolfgang Lutz<sup>1,2,3,4</sup>\* and Samir KC<sup>1,2</sup>

Almost universally, women with higher levels of education have fewer children. Better education is associated with lower mortality, better health, and different migration patterns. Hence, the global population outlook depends greatly on further progress in education, particularly of young women.

Assuming identical education-specific fertility trends, different education scenarios make a difference of more than 1 billion people by 2050.

- CEN gives the world population trend according to the most pessimistic scenario assuming that no new schools will be built
- FT gives the most optimistic scenario assuming that countries can achieve the rapid education expansion that South Korea achieved

![](_page_15_Figure_8.jpeg)

![](_page_16_Figure_0.jpeg)

## **SCIENCE** sciencemag.org

#### ENVIRONMENT AND DEVELOPMENT

# Universal education is key to enhanced climate adaptation

Fund more educators rather than just engineers

#### By Wolfgang Lutz, Raya Muttarak, Erich Striessnig\*

ver the coming years, enormous amounts of money will likely be spent on adaptation to climate change. The international community recently made pledges of up to \$100 billion per year by 2020 for the Green Climate Fund. Judging from such climate finance to date, funding for large projthe best available information on the number of disasters and reported fatalities from around the world (5).

**EDUCATE FEMALES, REDUCE FATALI-TIES.** Because the literature on disaster vulnerability has conventionally emphasized economic growth while disregarding education, our statistical analysis focuses on the relative assessment of these two factors as measured by Gross Domestic Product (GDP) www.sciencemag.org SCIENCE VOL 319 22 FEBRUARY 2008 POLICY FORUM

#### ECONOMICS

# The Demography of Educational Attainment and Economic Growth

Wolfgang Lutz,<sup>1\*</sup> Jesus Crespo Cuaresma,<sup>2</sup> Warren Sanderson<sup>3</sup> (all IIASA)

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

2015: Sustainable Development Goal 4:

.... quality **primary and secondary** education

for all girls and boys .....

### **Shared Socioeconomic Pathways (SSP) Logic**

Socio-economic challenges for mitigation

![](_page_19_Figure_2.jpeg)

Socio-economic challenges for adaptation

![](_page_20_Picture_1.jpeg)

### EXECUTIVE SUMMARY

![](_page_20_Picture_3.jpeg)

![](_page_20_Picture_4.jpeg)

#### DEDICATED TO THE MEMORY OF NATHAN KEYFITZ ON THE OCCASION OF HIS 100TH BIRTH YEAR, 2013.

# WORLD POPULATION & HUMAN CAPITAL IN THE TWENTY-FIRST CENTURY

EDITED BY WOLFGANG LUTZ | WILLIAM P. BUTZ | SAMIR KC Oxford University Press 2014

1056 pages, 26 lead authors, 46 contributing authors, 550 expert assessments, 191 country tables

![](_page_21_Figure_1.jpeg)

![](_page_22_Figure_1.jpeg)

![](_page_23_Figure_1.jpeg)

![](_page_24_Figure_1.jpeg)

## Bill Clark on Sustainability Science at IIASA Conference 2012

- Formalizing Brundtland's "meet the needs…":
  W = f(C<sub>i</sub>, I, K)
- W is 'human well-being' (intra- and inter-generational)
- C<sub>i</sub> are 'Capital assets' (from which services flow)
  - C<sub>m</sub> is 'manufactured capital' (factories, homes, roads)
  - C<sub>h</sub> is 'human capital' (population, health, education)
  - C<sub>n</sub> is 'natural capital' (ecosystems and their services)
- I is 'Institutions' (laws, rules; norms, expectations)
- K is 'knowledge' (scientific, practical; innovation)
- Challenge:
  - Measure, evaluate sustainability of "alternative worlds"

# What should be the indicator for "W" and the sustainability criteria ?

- Different people have different values and preferences and views about what is desirable.
- Does this mean that there cannot be any broadly agreed criteria of what is a desirable development and what is to be avoided? Is complete relativism the only option?
- Alternatively, one can confine the criteria to the basics: Survival, i.e. being alive, is undisputably a basic prerequisite for enjoying any quality of life.
- But mere survival is mostly not considered enough. For this reason I propose an indicator called Empowered Life Years (ELY).

## Possible survival and empowerment based indicator: ELY (Empowered Life Years)

- Healthy life expectancy
- Literate life expectancy
- Out-of-poverty life expectancy
- Happy life expectancy

#### ..... or a combination of them

![](_page_27_Picture_6.jpeg)

### Literate Life Expectancy: Years a person is expected to be alive and able to read. Example of men in rural Egypt 1986

Age (years)	Regular life table		Literate life table					
	$m_x$	$l_x$	$L_x$	$e^0_x$	$PL_x$	$LL_x$	$LT_x$	$Le_x^0$
<1	1.041	100,000	93,340	58.60	0.00	0	2,382,889	23.8
1-4	0.081	90,105	353,413	64.00	0.00	0	2,382,889	26.4
5-9	0.017	87,232	434,130	62.06	0.42	183,203	2,382,889	27.3
10-14	0.010	86,494	431,434	57.57	0.84	364,130	2,199,686	25.4
15-19	0.012	86,062	429,077	52.84	0.68	290,485	1,835,556	21.3
20-24	0.017	85,548	426,000	48.15	0.78	333,558	1,545,071	18.1
25-29	0.021	84,824	421,991	43.54	0.48	202,978	1,211,513	14.3
30-34	0.027	83,938	416,986	38.97	0.48	200,570	1,008,535	12.0
35-39	0.032	82,812	410,905	34.46	0.38	156,966	807,964	9.8
40-44	0.035	81,498	404,094	29.98	0.38	154,364	650,999	8.0
45-49	0.069	80,084	393,900	25.46	0.30	118,170	496,635	6.2
50-54	0.121	77,368	375,934	21.26	0.30	112,780	378,465	4.9
55-59	0.240	72,824	344,335	17.43	0.25	85,051	265,684	3.6
60-64	0.252	64,580	304,529	14.32	0.25	75,219	180,633	2.8
65-69	0.572	56,925	250,441	10.89	0.20	50,088	105,415	1.9
70-74	0.682	42,681	183,565	8.66	0.20	36,713	55,327	1.3
75+	1.625	30,247	186,136	6.15	0.10	18,614	18,614	0.6

Source: I utz (100//05)

![](_page_29_Figure_0.jpeg)

**S** 

Possible criterion: Indicator should not decline over time in any sub-population.

This is work in progress.

The choice of sustainability indicator will also depend on the ability to model the feed-backs from changes in the rest of the system onto the indicator.

The choice will also have to be discussed at different levels including stake holders.

![](_page_30_Picture_4.jpeg)