STATE OF THE TROPICS

Life Expectancy

Key findings

- Life expectancy in the Tropics increased by 22.8 years to 64.4 years between 1950 and 2010.
- Infant mortality in the Tropics fell from 161 deaths per 1,000 live births to 58 over the same period. However the rate in the Rest of the World is 33 and the rate of improvement has been greater.
- Life expectancy of women in the Tropics is higher than men, and the gap has increased in the past 60 years.
- The life expectancy gap between the Tropics and the Rest of the World has fallen to 7.7 years in 2010, compared to a gap of 12.6 years in 1950.
- The major factors contributing to improved life expectancy and lower infant and adult mortality rates include:
  - The impact of economic growth on household income and purchasing capacity - especially food;
  - Public investment in social services such as education and health; and
  - Improved water and sanitation infrastructure, and advances in medical technology.
- The prevailing environmental, political, cultural, social and economic conditions in each nation influences life expectancy, along with the capacity to implement and fund relevant policies.

A number of leading institutions from across the world have joined forces to assess and report on the critical questions facing one of the world's most important and fastest growing regions: the Tropics.

Over the past half-century the Tropics has emerged as an increasingly critical region. More than 40% of the world's population now lives in the Tropics and this is likely to be close to 50% by 2050. The region generates around 20% of global economic output and is home to some 80% of the world's biodiversity.

However, the resources to sustain larger populations and economic growth are imposing ever-increasing pressures. Issues of concern include relatively poor health outcomes, with more than one billion people suffering from tropical diseases, unacceptable levels of infant mortality and relatively low life expectancy; extreme poverty; poor educational outcomes; environmental degradation; and, in some cases, political and economic instability.

The Project

In early 2011, 12 leading institutions decided to examine the condition of life in the Tropics. The group met in Singapore in mid-2011 to scope a project, and decided to share their expertise to prepare a report assessing a broad range of environmental, social and economic indicators.

This work will culminate with the release of the ***State of the Tropics Report***, which will shine a light on the critical importance of the people and issues of the tropical world, and contribute to efforts to improve the lives of the peoples of the Tropics and their environment. During 2012 and early 2013, a series of briefings on indicators underpinning the report will be released, commencing with this one which looks at the extent of **Life Expectancy** in the Tropics, a key health indicator.

The 12 institutions initially involved in the project are: Escuela Superior Politiécnica del Litorial (Ecuador), James Cook University (Australia), Liverpool School of Tropical Medicine (England), Mahidol University (Thailand), Nanyang Technological University (Singapore), National University of Singapore, Organisation for Tropical Studies (Costa Rica), University of Copenhagen (Denmark), University of Hawaii – Manoa (USA), University of Nairobi (Kenya), University of Papua New Guinea, University of the South Pacific (Fiji). Instituto Nacional de Pesquisas da Amazônia (Brazil) has also since joined.

Background

More than 2,000 years ago Aristotle described the world as being divided into three zones – the Frigid Zone, The Temperate Zone and the Torrid Zone. He decided that the Torrid Zone was too hot for civilised habitation, and that humans could only live and work productively in the Temperate Zone. While Aristotle's Torrid Zone was not precisely defined geographically, it is clear his uninhabitable region was what we know as the Tropics.

Other ways of viewing the world have subsequently waxed and waned: north/south was a focus of attention during early European expansion; east/west as this expansion accelerated and political and economic systems developed; as we became aware of economic, social and political inequalities there was a focus on a first world/third world perspective; and, in the post-WWII environment, it has been on OECD/non-OECD or developing/developed countries dichotomies.

Each of these world perspectives generated temporally relevant insights, but also papered over Aristotle's fundamental insight – his lateral view of a world. We might expect Aristotle's three geographic and climatic zones to share common problems and challenges, and for there also to be issues unique to each zone.

The range and significance of issues facing nations and territories in the Tropics suggests it is now time to examine the world using Aristotle's insight, viewing the Tropics as a discrete region and defining its characteristics and issues. With the exception of Europe and Antarctica all continents are partly in the Tropics, and there are 144 nations and territories either fully or partly in the tropical region[1]. More than 40% of the world's population is estimated to already live in the Tropics – up from 30% in 1950.

While annual economic growth has been around a full percentage point higher than the Rest of the World over the past 30 years, the disparity between population (40% of the world's population) and economic output (20% of global economic output) means that, for the Tropics as a whole, people are less wealthy compared to other latitudes.

Many tropical nations face relatively greater and more imminent exposure to some of the most critical issues of our time, most notably the impacts of climate change on human and food security, such as rising sea levels and declining crop yields.

A significant proportion of the estimated 80% of the world's biodiversity that exists in the Tropics is also under threat, and climate change is likely to have a greater impact in the Tropics where many species are thermal specialists, and do not tolerate changes in climate as well as those species accustomed to more significant changes in seasonal conditions.

The Tropics

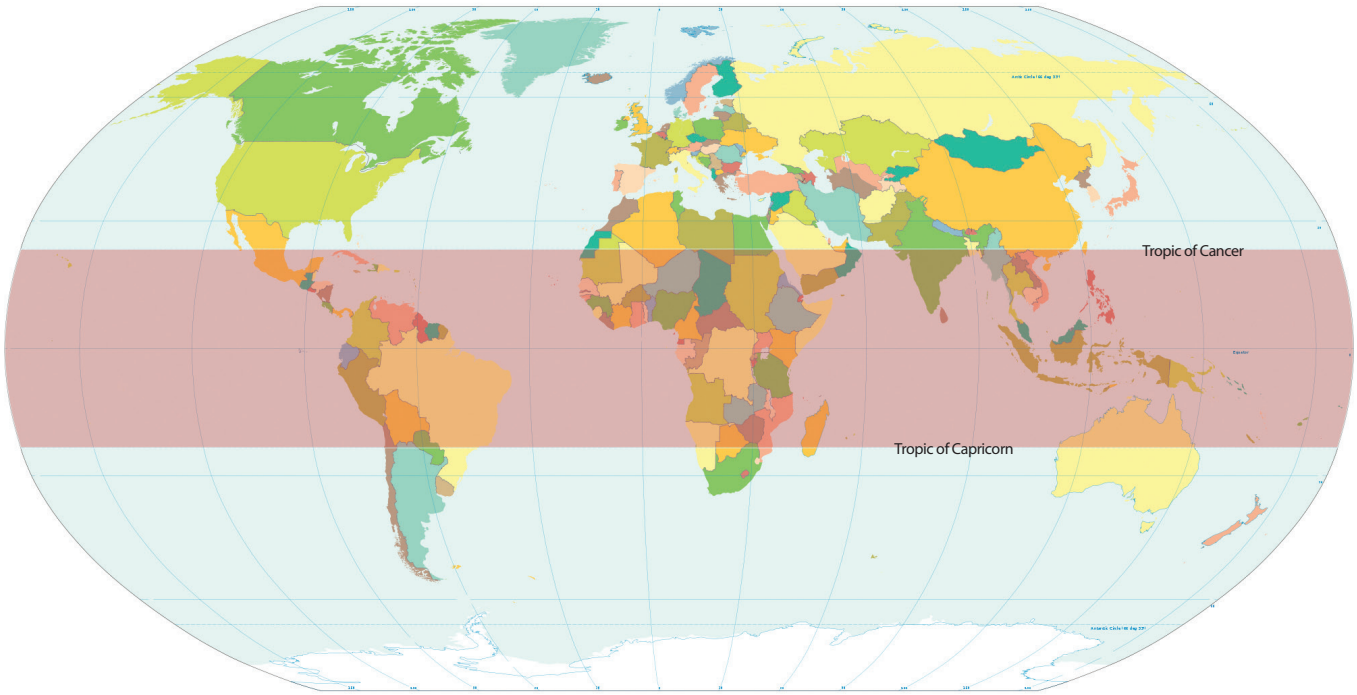
The Tropics is commonly defined as the region of the Earth surrounding the Equator within the latitudes of the Tropics of Cancer and Capricorn at +/– 23.5 degrees (see Figure 1). With its origins in astronomy, these latitudes are the limit of where the Sun reaches a point directly overhead at least once during the solar year, and are used to define the Tropics in this paper.

Although topography and other factors contribute to climatic variation, tropical regions are typically warm and experience little seasonal change in day-to-day temperature. An important feature of the Tropics is the prevalence of rain in the moist inner regions near the equator, and that the seasonality of rainfall increases with distance from the equator[2].

In the Köppen-Geiger[3] climate classification the Tropics is dominated by 'equatorial' and 'arid' climates, with the balance of the world being primarily 'warm temperate', 'snow' and 'polar' climates.

Equatorial climates have a mean temperature for all months above 18°C (64°F), and arid zones are defined with reference to both temperature and rainfall, but are characterised by a lack of water which inhibits plant and animal life.

Figure 1: The Tropics



Life Expectancy

Life expectancy is the average number of years a person can expect to live given existing mortality patterns, and considers the most fundamental health question: "How long can I expect to live?"

As a measure of health, life expectancy has the key advantage of being readily comparable across nations and regions. As such, life expectancy, and especially life expectancy at birth, is one of the most commonly used indicators of a population's general health status.

Nonetheless, it should be recognised that life expectancy is a measure of length of life rather than quality of life, as it does not account for the full burden of illness and disability. Development of indicators such as 'disability-adjusted life years' and 'healthy life expectancy' is progressing, though time series data are generally not available as yet.

Many factors have contributed to improvements in health and life expectancy outcomes, and it has been recognised for some time that the social determinants of health play a critical role[4]. The social determinants of health are the conditions in which people are born, grow, live, work and age, and include aspects such as nutrition, sanitation, water supply and living conditions as well as the health system. These factors are shaped by the distribution of money, power and resources at global, national and local levels, which are themselves influenced by policy choices. Advances in medical technology have also been important, especially in the past 50 years[5].

Trends

Since 1950 the life expectancy gap between the world and the Tropics has narrowed from 6.1 years in the period 1950-1955 to 3.5 years in 2005-2010[6] (see Figure 2).

However, the proportion of global population living in the Tropics has steadily increased from around 30% in 1950 to 41% in 2010. That is, the Tropics itself has a significant impact of on global outcomes.

Excluding the impact of the Tropics on the global outcome (i.e. comparing the tropical zone with the 'Rest of the World'), the life expectancy gap in 1950-1955 was 12.6 years, falling to 7.7 years in 2005-2010. This is a significant improvement in health outcomes in the Tropics over the past 60 years, though at 7.7 years the current gap indicates that a major health deficit still persists in the Tropics.

The relatively larger improvements in life expectancy in the Tropics reflect a number of factors including a lower starting point. Other factors include improvements in the social determinants of health including systems for accessing potable water and sanitation facilities along with improving public health infrastructure, and the broad introduction of vaccines. These factors contributed to life expectancy across the Tropics increasing by 55% in the 60 years to 2005-2010 compared to 33% in the Rest of the World.

Unlike the narrowing of the life expectancy gap between the Tropics and the world, the gap between the various regions of the Tropics is quite broad and, has generally been increasing over time (see Figure 3).

For example, in 1950-1955 the Caribbean region reported the highest life expectancy at birth at 53.3 years and North Africa & Middle East region the lowest at 36.6 years – a gap of 16.7 years. In 2005-2010 the Central America region reported the highest life expectancy at birth at 75.0 years, and Central & Southern Africa the lowest at 52.8 years – a gap of 22.2 years.

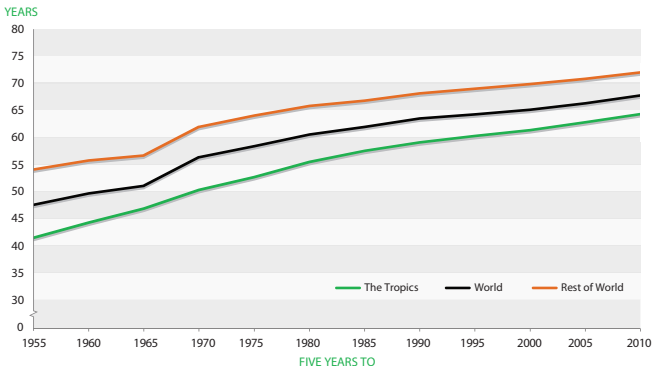
This variation reflects the heterogeneous nature of the regions of the Tropics in terms of the mix of ecological, economic, social, political, historical and genetic characteristics, and the fact that health and, by extension, life expectancy is a derivative of these characteristics.

Figure 3 shows that in 1950-1955 life expectancy in the Central & Southern Africa (36.8 years), Northern Africa & Middle East (36.4 years) and South Asia (38.9 years) regions was less than 40 years. In 2005-2010 these regions still had the lowest life expectancy in the Tropics though South Asia has significantly outperformed the African regions, reporting an increase in life expectancy of 25.8 years (to 64.7 years) compared to Central & Southern Africa's increase of 16.0 years to 52.8 years.

In 2005-2010 Central & Southern Africa and Northern Africa & Middle East were the only tropical regions to report life expectancy of less than 60 years. The devastating impact of HIV/AIDS has been a major contributor to this poor outcome, especially in Central & Southern Africa where in the worst affected nations HIV/AIDS accounted for more than 60% of deaths in 2002[7], and contributed to life expectancy at birth falling by more 15 years.

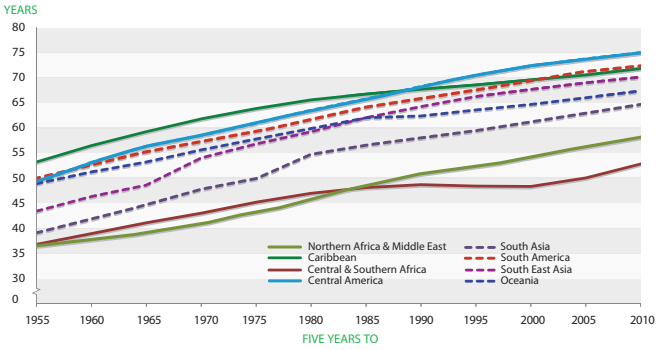
Over the 60 years to 2005-2010 the South East Asia region experienced the greatest increase in life expectancy (26.7 years), followed by Central America (25.9 years), South Asia (25.8 years) and South America (22.6). These four regions currently represent two-thirds of population in the Tropics (down from around three-quarters in 1950) and were major contributors to the overall improvement in life expectancy across the Tropics over the past 60 years.

Figure 2: Life Expectancy at Birth



Source: Estimates based on United Nations, *World Population Prospects, the 2010 Revision* and census data

Figure 3: Life Expectancy at Birth, Tropical Regions



Source: Estimates based on United Nations, *World Population Prospects, the 2010 Revision* and census data

Men and Women

Women in the Tropics tend to live longer than men, and this is reflected in differences in life expectancy. In the Tropics and across the world generally, this gap has tended to increase over the past 60 years, though it has widened more rapidly in the Tropics (see Table 1).

In 1950-55 a female baby born in the Tropics could expect to live an additional 1.3 years compared to a male baby (42.3 years compared to 41.0). By 2005-2010 the gap had increased to 3.5 years, with female life expectancy at birth increasing by 57% to 66.3 years and, for males, by 53% to 62.7 years. In the Rest of the World the gap increased from 3.5 years in 1950-1955 to 4.6 years in 2005-2010. Interestingly, in the South Asia region it was not until 1980-1985 that female life expectancy at birth exceeded that of males. In the 60 years to 2005-2010 the increase in life expectancy at birth for females in the South Asia region (at 28.2 years) was stronger than for females in the broader Tropics (24.0 years), and significantly stronger than the 18.5 years increase for the Rest of the World.

Table 1: Gap in Life Expectancy at Birth (Female minus Male)

	1950-1955	1955-1960	1965-1970	1975-1980	1985-1990	1995-2000	2005-2010	Change in 'Gap' 1950-1955 to 2005-2010
The Tropics	**1.3**	**1.5**	**1.7**	**2.5**	**3.0**	**3.3**	**3.5**	**2.2**
Central & Southern Africa	2.8	2.8	2.9	2.9	3.0	2.4	2.0	-0.8
Northern Africa & Middle East	2.4	2.4	2.5	2.4	2.2	2.4	2.4	0
South Asia	-1.5	-1.6	-1.3	-0.2	0.3	1.7	2.9	4.4
South East Asia	2.0	2.4	2.7	3.6	3.8	4.0	4.1	2.1
Caribbean	3.1	3.3	3.6	3.7	4.3	4.6	4.5	1.4
Central America	3.4	3.6	4.1	6.1	6.3	5.3	5.3	1.7
South America	3.3	3.5	3.8	4.6	6.6	7.0	6.8	3.5
Oceania	4.0	4.1	4.2	4.6	5.5	5.0	4.6	0.6
Rest of World	**3.5**	**4.0**	**3.8**	**4.8**	**4.9**	**4.7**	**4.6**	**1.1**
World	**2.0**	**2.5**	**2.8**	**3.9**	**4.3**	**4.4**	**4.4**	**2.4**

Source: Estimates based on United Nations, *World Population Prospects, the 2010 Revision* and census data

Infant mortality

Lower life expectancy in developing countries, including in the Tropics, is usually associated with a higher burden of disease, including higher rates of infant mortality (see Box 1).

Since 1950-1955 infant mortality rates have fallen significantly. In the Tropics, the infant mortality rate (deaths per 1,000 live births) fell from 161 in 1950-1955 to 58 in 2005-2010, a fall of 103, or 64% (see Figure 4). In the Rest of the World the rate fell from 117 to 33 over the same period, a fall of 84 (72%). In absolute terms, improvements in infant mortality have been far greater in the Tropics, in part reflecting its relatively worse starting point.

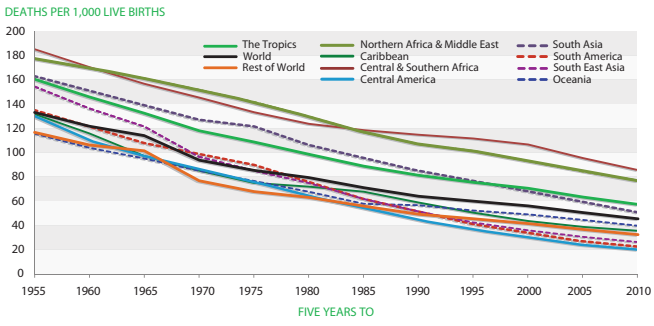
Many factors are contributing to lower infant mortality rates, though they can be broadly grouped into factors associated with economic growth and poverty reduction, and expanded social services including improved standards and access to health care. Recent analysis suggests that in developing nations, household income and a mother's education level are key factors determining infant and child mortality rates[8]. Increased immunisation rates are also an important factor, especially for measles.

Nonetheless, the infant mortality rate in the Tropics as a percentage of the Rest of the World actually increased from 138% in 1950-1955 to 177% in 2005-2010. This reflects that in the 55 years to 2005-2010 the infant mortality rate in the Tropics decreased at an average rate of 1.9% per annum, compared to 2.3% per annum for the Rest of the World. That is, taking into account relative starting positions, improvements in health and social care affecting infant mortality have been considerably greater in the Rest of the World. While absolute changes are of real interest to individuals benefiting from the health improvements, the widening in the relativity suggests there is still considerable scope for infant mortality rates in the Tropics to improve.

The correlation between infant mortality and life expectancy can be seen in Table 2. As a general rule, regions that have experienced large falls in the absolute infant mortality rate also report large improvements in life expectancy. The exception is Central & Southern Africa, where although infant mortality rates have fallen significantly, high mortality rates in the non-infant population, largely attributable to HIV/AIDS, have constrained overall improvements in life expectancy (see Box 2).

Of the 21 nations for which HIV/AIDS accounted for more than 10% of deaths in 2008, 17 were in the Central & Southern Africa region, with the proportion of deaths higher than 40% in two nations in this region[9]. Crude death rates in these nations were substantially higher than globally.

Figure 4: Infant Mortality Rates



Source: Estimates based on United Nations, *World Population Prospects, the 2010 Revision* and census data

Box 1: Burden of Disease Impacts

Health outcomes are a complex mix of ecological, economic, social, historical and genetic characteristics of the population. In the Tropics the burden of disease is considerably higher, with health outcomes significantly better in the temperate zones, even after controlling for the level of GDP per capita.

The Tropics are subject to a higher burden of disease for many interacting reasons: a physical ecology that supports a high level of infectious disease transmission; poor nutrition resulting from the low productivity of food production; and multiple feedbacks through poverty (illiteracy, lack of access to medical care, sanitation etc). Poorer health outcomes directly and indirectly impair economic performance: directly through reduced labour productivity due to lost workdays and reduced physical and cognitive capacities, and also indirectly through effects of high burdens of disease on fertility rates, population age structure, and overall population growth rates.

Significantly, many tropical diseases are proving difficult to control.

Source: Sachs J (2000). *Tropical Underdevelopment*. CID Working Paper No. 57.

Adult Mortality

Disease burden among adults is increasing in many countries due to increases in life expectancy (i.e. population ageing) and the associated health transitions which are contributing to increased incidence of non-communicable diseases (NCDs). Rising income in some countries also appears to be increasing the prevalence of risk factors for NCDs such as high blood pressure and obesity. Smoking also continues to play a large role in NCD rates throughout the world. Nonetheless, in many developing nations, and notably in the Tropics, communicable diseases remain a significant health burden.

Nonetheless, in many developing nations, and notably in the Tropics, communicable diseases remain a significant health burden. Recent research also indicates the spread in adult mortality rates across the best and worst performing nations has been increasing over time, unlike child and maternal mortality where the gap has been narrowing, and with major progress since 1970[10].

For every 1,000 people in the Rest of the World that survived to the age of 15 years in 2005-2010 it is estimated that 154 would die before reaching the age of 60, compared with 240 in the Tropics.

Despite the significant deficit that persists in the Tropics the gap has fallen marginally, from 92 in 1995-2000 to 86 in 2005-2010 (see Table 3). In absolute terms adult mortality rates in the Tropics, Rest of the World and total world declined by roughly the same between 1995-2000 and 2005-2010, at 23, 17 and 20 respectively. Nonetheless, as with infant mortality, a higher starting point means the rate of decline has been considerably slower in tropical regions than in the Rest of the World.

In the Tropics, adult mortality rates are particularly high in Central & Southern Africa (377 in 2005-2010), and to a lesser extent in Northern Africa & Middle East (270), Oceania (234) and South Asia (215).

There are a broad range of factors influencing regional variations, with armed conflict, malaria and HIV, contributing to higher rates of adult mortality in Central & Southern Africa, while in Oceania cardiovascular diseases are a major contributor to higher rates of adult mortality. Of particular note are the adult mortality rates in Central America, which are lower than in the Rest of the World.

Table 2: Change in Selected Indicators, 1950-1955 to 2005-2010

	Life Expectancy in Years	Infant Mortality Rate* No.
The Tropics	**22.8**	**-103**
Central & Southern Africa	16.0	-100
Northern Africa & Middle East	21.7	-100
South Asia	25.8	-112
South East Asia	26.7	-128
Caribbean	18.6	-96
Central America	25.9	-110
South America	22.6	-113
Oceania	18.5	-76
Rest of World	**17.9**	**-84**
World	**20.2**	**-88**

Source: Estimates based on United Nations, *World Population Prospects, the 2010 Revision* and census data
* Deaths per 1,000 live births.

*Table 3: Adult Mortality Rates**

	1995-2000	2000-2005	2005-2010
The Tropics	**263**	**255**	**240**
Central & Southern Africa	413	414	377
Northern Africa & Middle East	313	288	270
South Asia	243	228	215
South East Asia	201	185	174
Caribbean	199	190	176
Central America	147	137	127
South America	188	176	162
Oceania	273	253	234
Rest of World	**171**	**164**	**154**
World	**196**	**189**	**176**

Source: Estimates based on United Nations, *World Population Prospects, the 2010 Revision* and census data
* Deaths under age 60 per 1,000 alive at age 15.

Box 2: HIV Incidence

The global HIV incidence rate (the number of new infections over a certain period of time, usually a year) declined steadily between 2001 and 2009, falling by nearly 25%. However, there were substantial regional differences. While the incidence rate fell significantly in sub-Saharan Africa and Southern Asia, it increased in Eastern Europe and Central Asia.

In 2009, an estimated 2.6 million people were newly infected with HIV, and 33.3 million people were living with the virus. Sub-Saharan Africa remains the most heavily affected region, accounting for 69% of new HIV infections, 68% of all people living with HIV and 72% of AIDS deaths.

Source: United Nations (2011). *The Millennium Development Goals Report 2011*. United Nations, New York.

Looking Forward

Global initiatives to address lower life expectancy in the developing world have been building over the past two decades. Progress is being made in many areas, and our understanding of the factors contributing to improved life expectancy and lower infant and adult mortality is increasing. A key factor affecting health outcomes and life expectancy is economic growth and its impact on household income and purchasing capacity, especially for food. Public investment in social services such as education and health are also essential, as well as improving access to clean water and sanitation. However, environmental, political, cultural, social and economic conditions within countries determine the level of access that various groups of people have to these resources. There is growing acknowledgement that focussing development efforts on improving the health of vulnerable populations benefits economic growth, worker productivity and poverty alleviation, while persistent ill-health undermines economic development and efforts to reduce poverty[11].

Directing efforts to improve health in the Tropics will ensure that investment is targeted to people who are among the poorest in the world, increasing life expectancy and, in so doing, generating pathways out of poverty and enhancing global productivity and wealth.

Notes

1. A two stage process was undertaken to assess which nations are classified as being in the Tropics for reporting purposes – a population-based stage and a data availability stage. For large nations that straddle the Tropics analysis and reporting is for sub-national provinces primarily in the Tropics. These nations are Australia, Bangladesh, Brazil, China, India, Mexico, Saudi Arabia and the United States. The reporting covers 109 of the 144 nations fully or partially in the Tropics. More information on the nations and regions included in the report is available at: www.stateofthetropics.org
2. Isaac J, Turton S. (2009). *Expansion of the Tropics: Evidence and implications*. Retrieved on 5 March 2012 from: www-public.jcu.edu.au/news/current/JCUPRD_048832.
3. The system is based on the concept that native vegetation is the best expression of climate. Climate zone boundaries reflect vegetation distribution, and are defined with reference to a combination of average annual and monthly temperatures and precipitation, and the seasonality of precipitation. The five main climate groups are Equatorial, Arid, Warm Temperate, Snow and Polar.
4. 4. CSDH (2008). *Closing the gap in a generation: health equity through action on the social determinants of health. Final Report of the Commission on Social Determinants of Health*. Geneva, World Health Organization.
5. Australian Bureau of Statistics (2004). *Measures of Australia's Progress 2004*. ABS Cat. No. 1370.0, ABS, Canberra.
6. Earliest available data are for 1950-1955 and is the basis for this being the starting point. For nations that straddle the tropical zone, figures are based on national life expectancy estimates and the proportion of the national population living in the Tropics. Tropics-specific life expectancy modelling for these nations results in a minor downward adjustment of 0.2 years to overall life expectancy in the Tropics in 2005-2010 and an upward adjustment of 0.1 years in the Rest of the World. Impacts are in South Asia (-0.5 years in 2005-2010), South East Asia, including China (-0.3 years), Oceania (-0.1 years) and South America (+0.2 years).
7. World Health Organisation (2004). *Estimated total deaths, by cause and WHO Member State, 2002*. Table accessed on 21 August 2012 at: www.who.int/healthinfo/statistics/bodgbddeathdalyestimates.xls.
8. United Nations (2011). *The Millennium Development Goals Report 2011*. United Nations, New York.
9. World Health Organisation (2011). *Deaths estimates for 2008 by cause for WHO Member States*. Table accessed on 10 November 2011 at: www.who.int/healthinfo/global_burden_disease/estimates_country/en/index.html.
10. Rajaratnam JK, Marcus JR, Levin-Rector A, Chalupka AN, Wang H, Dwyer L, Costa M, Lopez AD, Murray CJL. (2010). *Worldwide mortality in men and women aged 15–59 years from 1970 to 2010: a systematic analysis*. The Lancet. 2010 April 30; 375:1704–20.
11. World Health Organisation (2001). *Investing in Health: A Summary of the Findings of the Commission on Macroeconomics and Health*.

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