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Thesis

Population dynamics and climate change: what are the links?

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ABSTRACT

Climate change has been described as the biggest global health threat of the 21st century. World population is projected to reach 9.1 billion by 2050, with most of this growth in developing countries. While the principal *cause* of climate change is high consumption in the developed countries, its *impact* will be greatest on people in the developing world. Climate change and population can be linked through adaptation (reducing vulnerability to the adverse effects of climate change) and, more controversially, through mitigation (reducing the greenhouse gases that cause climate change). The contribution of low-income, high-fertility countries to global carbon emissions has been negligible to date, but is increasing with the economic development that they need to reduce poverty. Rapid population growth endangers human development, provision of basic services and poverty eradication and weakens the capacity of poor communities to adapt to climate change. Significant mass migration is likely to occur in response to climate change and should be regarded as a legitimate response to the effects of climate change. Linking population dynamics with climate change is a sensitive issue, but family planning programmes that respect and protect human rights can bring a remarkable range of benefits. Population dynamics have not been integrated systematically into climate change science. The contribution of population growth, migration, urbanization, ageing and household composition to mitigation and adaptation programmes needs urgent investigation.

Keyword environment

Introduction

According to the United Nation (UN) World Population Prospects 2008 Revision,[1] the world population has reached 6.8 billion with 5.6 billion (82%) living in the less developed regions. It is projected to reach 9.1 billion by 2050, an increase close to the combined populations of China and India today. Most of this growth will be in developing countries, where population is projected more than to double, from 835 million inhabitants in 2009 to 1.7 billion in 2050 (Fig. 1).

There is general agreement that human industrial activity has released vast quantities of greenhouse gases, about 900 billion tonnes of carbon dioxide, 450 of which have stayed in the atmosphere. About 80% of carbon dioxide emission is caused by industrialization and the remaining by land use such as deforestation. There is strong evidence that the burning of fossil fuels since the beginning of the industrial revolution has already caused a 0.75°C rise in global temperatures and 22 cm rise in sea level during the twentieth century. During the twenty-first century, the earth's average surface temperature rises are likely to exceed the realistic target threshold of 2°C above preindustrial average temperature. The Intergovernmental Panel on Climate Change (IPCC, the leading body on climate change, comprising over 2500 international scientists) estimates that by 2100, global temperatures could rise by 1.1–6.4°C and sea level by 28–79 cm. In addition, weather patterns will become less predictable and extreme climate events, such as storms, floods, heat waves and droughts, will occur with increasing frequency and severity.

It is already clear that the impacts of climate change will fall disproportionately upon developing countries and the

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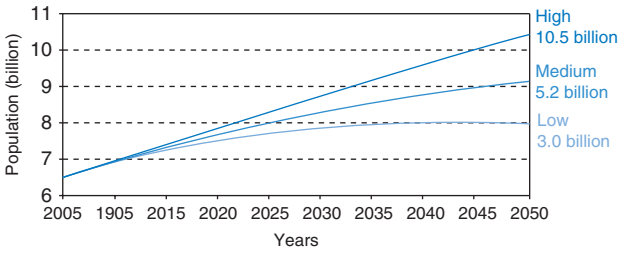
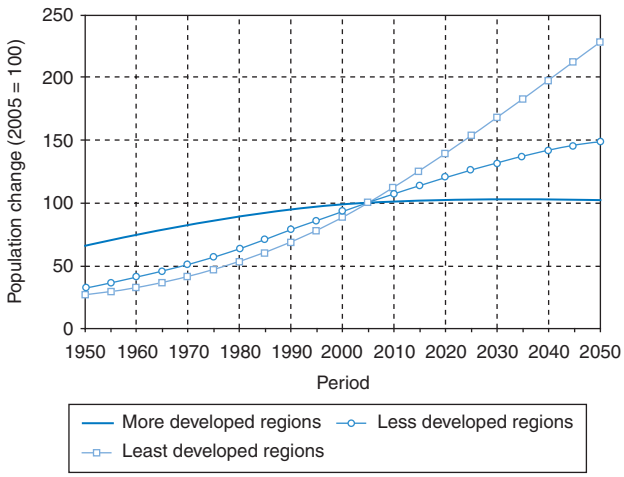


Fig. 1 UN 2008 World Population Projections (future population growth is highly dependent on the path that future fertility takes. In the medium variant, fertility declines from 2.56 children per woman in 2005–2010 to 2.02 children per woman in 2045–2050. If fertility were to remain about half a child above the levels projected in the medium variant, world population would reach 10.5 billion by 2050. A fertility path half a child below the medium would lead to a population of 8 billion by mid-century. Consequently, population growth until 2050 is inevitable even if the decline of fertility accelerates. UN Population Division, ibid.).

poorest sectors within all countries, thereby exacerbating inequities in health status and access to adequate food, clean water and other resources.[2] A recent Lancet UCL Commission on Managing the Health Effects of Climate Change identified climate change as 'the biggest global health threat of the twenty-first century'.[3] The principle cause of climate change is high consumption in developed countries, while the impact of climate change will be worst on poor people in developing countries. Fast population growth, fuelled by high fertility, hinders the reduction of poverty and the achievement of other internationally agreed development goals. While fertility has declined throughout the developing world since the 1970s, most of the least developed countries still have total fertility levels above 5 children per woman, resulting in rapid population growth (Fig. 2) and pressure on



Source: Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat (2005), World Population Prospectus: The 2004 Revision, Highlights, New York; United Nations.

Fig. 2 Population growth by development regions (1950–2050).

natural resources, weak infrastructures and ability to adapt to the effects of climate change. Yet, population is arguably the most neglected dimension of climate change.

How is population growth related to climate change?

Mitigation and adaptation

It is important to recognize two distinct ways in which population issues can be linked to climate change: mitigation (reducing the greenhouse gases that cause climate change) and adaptation (reducing vulnerability to the adverse effects of climate change). Few experts doubt the importance of population in relation to climate change adaptation, but the link between population and climate change mitigation is more controversial. The statement that 'people cause climate change' is often made to emphasize that climate change, as it currently unfolds, is a human-induced, rather than a natural, phenomenon. However, the principle cause of climate change is high consumption by people in developed countries where population growth has been low or negative. At national the level, therefore, there is a lack of association between growth of greenhouse gas emissions and growth of populations during the last century. It is more accurate to say that consumers, rather than people, cause climate change; there is enormous variation in greenhouse gas emissions between individuals with high consumption levels in developed nations with low fertility rates, and individuals with low or negligible consumption in poor nations with high fertility rates. In other words, climate change is driven more by consumer behaviour than simply by population number.

While acknowledging the lack of association between population growth and greenhouse gases in the past, the relation between these two dynamics in the future becomes more critical. As illustrated in Fig. 3, lower-middle income nations, such as China, with rapidly developing economies, are already contributing an increasing proportion of the growth in global greenhouse gas emissions. In simplistic terms, it is the pattern of development and consumer behaviour in such countries that will determine the nature and extent of links between population dynamics and climate change in the future. This does not detract from the view that 'larger future world populations will face greater challenges than smaller ones in achieving climate-sustainable emissions' and that 'the total human impact on the earth system scales with population'.[4] In starker terms, China has claimed that its one-child policy, which is estimated to have reduced the population of China by 500 million (from a projected 1.8 billion without such a policy to the current level of 1.3 billion) should be seen as contributing to its overall actions on climate change.

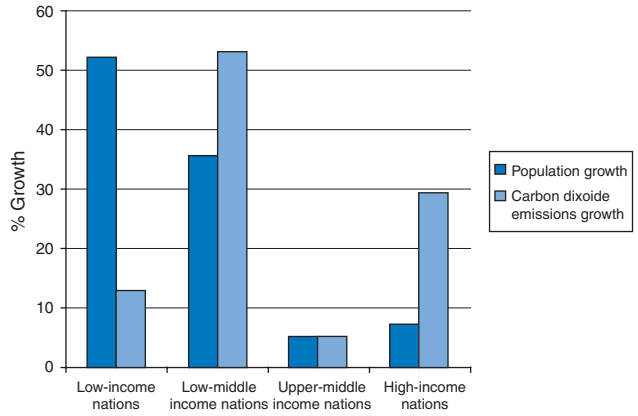


Fig. 3 Contribution to the growth in world population and CO_2 emissions by groups of nations classified according to their average per capita income levels, 1980–2005. Source: Satterthwaite, 2009.[14]

Rapid population growth has a negative impact on human development, provision of basic services and poverty eradication; these effects are magnified and become more urgent in the context of climate change. Reducing the *rate* of population growth has long been a development goal because of the detrimental effect of rapid population growth on economic development. No country, barring a few oil-rich states, has risen from poverty while still maintaining high average fertility. In developing countries, where birth rates have successfully declined (particularly Asia and Latin America) by 25–40%, the resulting economic growth can be directly attributed to fertility decline.[5,6] The link between slowing population growth and enhanced economic development is well documented[7,8] particularly at the micro level.

Rapid rates of population growth in sub-Saharan Africa are impeding its ability to even contain the number of people living in extreme poverty. Although there has been a significant reduction in the percentage (from 45% in 1990 to 41% in 2004), the actual number of people living in extreme poverty continues to rise (by more than 55 million) due to population growth.[9] High population growth, fuelled by high fertility, impedes progress towards achievement of the Millennium Development Goals (MDG) and sustains poverty,[10] the central phenomenon underlying vulnerability to climate change.[11] This situation is illustrated by a series of developing country-led reports, the National Adaptation Programs of Action (NAPAs), which document the most pressing vulnerabilities to climate change impacts and the most urgent adaptation priorities. Nearly all (37 of 40) NAPA reports refer to population growth as a significant factor that exacerbates the harmful impacts of climate change.[12] They describe the impact of population growth on fresh water availability; on land degradation and soil erosion through over-grazing; deforestation and migration to coastal areas that are vulnerable to rising sea levels, floods and cyclones. In brief:

- Rapid population growth acts in tandem with climate change to deplete key natural resources, such as water, fuel and soil fertility;
- Rapid population growth can cause a significant increase in demand and often mismanagement of natural resources that are compromised and in decline due to environmental variability and climate change;
- Population growth heightens human vulnerability to climate change in numerous ways and may force people to migrate to areas that are either environmentally marginal or more at risk to the negative impacts of climate change. For example, population growth in Ethiopia is resulting in soil degradation, dwindling land holdings and low agricultural productivity, which increases pressure on poor people to move either to environmentally marginal or urban areas. This leaves them more vulnerable and more likely to exploit new resources in an unsustainable way, leading to a vicious cycle of poverty and degradation (see Box 1).

Box 1 Research priorities.

Climate change adaptation research

- Documentation of the experiences of people affected by climate change, including coping strategies and the role of family planning.
- Quantitative analysis of how demographic factors (e.g. growth rates, composition, spatial distribution and education levels) affect the adaptive potential of populations.
- Exploration of the effects of rapid population growth in poor countries under different scenarios (involving, for example, population structure, water availability, food and shelter requirements and labour markets) to support better adaptation strategies.
- Mapping characteristics of migrant flows, including seasonal patterns, duration and destination to aid adaptation strategies.
- Mapping availability of water according to spatially vulnerable groups over time, to identify adaptation strategies.
- Examination of effect of population pressure on equity and distribution of water pricing, and agricultural growth and distribution.

Family planning research

- Evaluation of efforts to integrate family planning and environmental activities to secure environmental sustainability.
- Evaluation of cost-effectiveness of family planning integrated with primary care or other HIV/AIDS services.

- Identification of factors influencing demand for family planning/smaller family sizes (e.g. mass media, social marketing, community-based distribution of contraception).

Policy research

- Examination of the role, and accountability, of global, regional and national institutions in supporting (or blocking) adaptation policies, strategy-development and funding.
- Assessment of workable alternatives to the current carbon-based growth and development paradigm.

Methodological research

- Development of robust measures of vulnerability to climate change.
- Building demographic research capacity in the south to support local climate-change impact-modelling and adaptation development.

Migration

Migration is a crucial aspect of the link between population and climate change. Large-scale population movement is likely to intensify as changing climate leads to the abandonment of flooded or arid and inhospitable environments. The resulting mass migration will lead to many serious health problems both directly, from the various stresses of the migration process, and indirectly, from the possible civil strife that could result from chaotic movement of people.

Millions of people now living in low-lying coastal areas may need to leave their homes if sea levels rise as predicted by most climate-change experts. Protracted and severe droughts may drive more farmers from rural areas to cities to seek new livelihoods. Residents of urban slums in flood-prone areas may migrate to rural areas to escape danger. And in some instances, gradual environmental degradation may erase income-earning opportunities, driving some across national boundaries. The reasons for which people migrate or seek refuge are complex, making it hard to forecast how climate change will affect the future of migration. Nonetheless, climate change seems likely to become a major force for future population movement, probably mostly through internal displacement but also to some extent through international migration, particularly for small island states.

The majority of environmental migrants have so far come from rural areas within the least developed countries. But in the future, there may indeed be unprecedented levels of environmentally induced migration out of urban areas, as rising seas threaten to inundate densely populated coastal areas, where 60% of the world's 39 largest metropolizes are located, including 12 cities with populations of more than 10 million.[13] One third of the world's population currently lives within 60 miles of a shoreline. There is an urgent need to encourage the growth of cities in climate-safe areas.

It is not only rapid population growth but rapid urbanization that is causing problems for the poorest countries.[14] While fertility in urban areas is generally much lower than in rural areas, in-migration can be high and by 2050 it is estimated that 80% of the world's population will live in urban areas, putting huge pressures on infrastructures important for health (water, sanitation, health services) as well as employment opportunities. Social support networks in urban areas are often weak as rural family bases are weakened. Informal urban settlements are growing and people living in them are often faced with severe health problems. Climate change could exacerbate these problems by increasing in-migration to urban areas from rural agricultural land that is threatened by climate change, or by increasing migration from very poor to moderately poor countries, thus increasing pressure on their infrastructures, as well as by direct impacts on the populations of coastal mega cities.

Migration is a coping strategy employed by many rural communities.[15] Migration associated with environmental decline is usually characterized by short distance and long-term movements, and while there are dire predictions for huge numbers of environmental refugees, these very high figures are unlikely to materialize. However, migrant groups are more vulnerable to a range of stressors including impacts from climate change and poor access to health care.

Why is discussion of population and climate change a sensitive issue?

Links between population dynamics and climate change are complex and often controversial. It is politically and ethically important that any discussion of the links between the two recognizes that Northern countries with low population growth are overwhelmingly responsible for climate change, and that Southern countries with high population growth have so far contributed very little to climate change.

Sensitivities in discussing 'population' at government or international levels have persisted since human rights concerns were raised in the 1960s and 1970s over aggressive 'population control' policies, notably in India and China. In 1994, the landmark International Conference on Population and Development, sought to dispel notions of coercive family planning by promoting a broad rights-based approach to sexual and reproductive health. Nevertheless sensitivities remain and discussion of family planning and 'population'

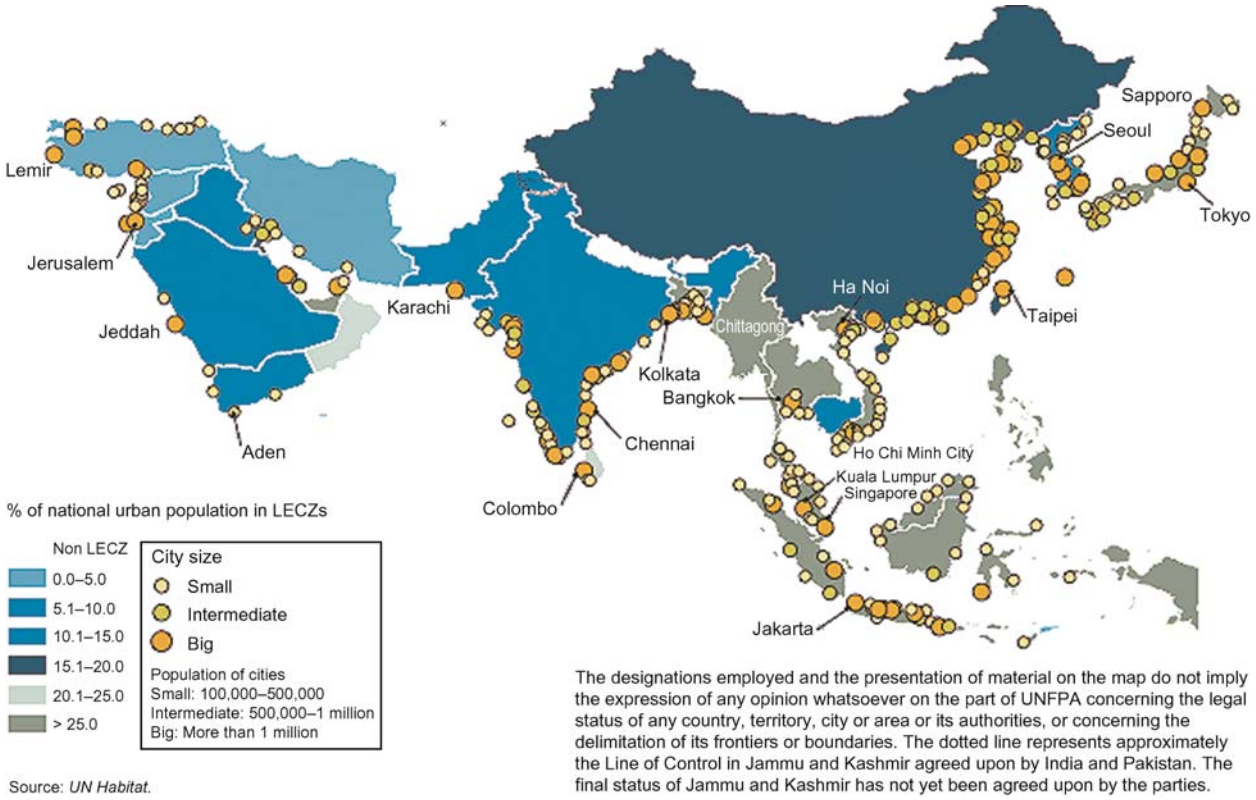


Fig. 4 Map of cities at low-elevation coastal zones (LECZ).

in the context of development has only re-emerged in the last couple of years.

At the community level, the legacy of 'population control' programmes casts a long shadow. There is frequently suspicion about the motivation of those who seek to put in place family planning programmes, particularly in developing countries where cultural, social or religious practices oppose 'artificial' or 'foreign' methods of reducing fertility. Barriers to the acceptability of family planning take many forms, including religious opposition, particularly from the catholic church, adverse political influence, including the US administrations of recent Presidents Bush and Regan, and legal and policy prohibitions, despite convincing evidence that maternal mortality and morbidity can be significantly reduced by increasing access to family planning services.

The complexity and sensitivity of the issues make it imperative that debate is rights-focused and constructive. If the present scenario continues, in which the industrialized North does not radically reduce its carbon emissions, then advocating reduced population growth in the South risks appearing to blame the victim, i.e. blame climate change on population growth in the South, instead of acknowledging that the South will suffer most from climate change caused by consumption in the North. Recent publicity on links between population growth and climate change has tended to polarize the issue, with advocates for significant reductions in carbon emissions identifying population growth as, at best, a distraction from the main issue, and, at worst, an attempt by the 'population control' lobby to attract climate change funding for their work. In fact, very few organizations deny that reductions in both consumption in the North, and global population growth are important; it is often a question of which they emphasize more.

What can be done now to improve the situation?

Discussion of strategies to reduce carbon emissions is beyond the scope of this article. However, one strategy, contraction and convergence,[16] must be highlighted because population is a key factor in its chance of success. Contraction and convergence seeks to reduce overall carbon emissions to a sustainable level, according to an equal share of emissions per person globally. Industrialized countries would dramatically reduce their emissions while developing countries would increase theirs up to an internationally agreed 'ceiling' level, to allow

for, and stimulate, development and poverty reduction. Population is the major denominator of this model and a major determinant of whether a globally feasible and equitable per capita emission figure can be achieved.

Second, increased investment in family planning is urgently needed for achievement of both development and climate change goals. Family planning offers a unique solution among medical interventions. It reduces poverty, and maternal and child mortality; increases primary schooling, and women's education and empowerment; increases environmental sustainability and mitigates the effect of climate change through stabilization of global populations.

Recent evidence[17] indicates continued high levels of unmet need for family planning and other reproductive health services. Despite gains in recent years, an estimated 215 million women who want to avoid a pregnancy are not using an effective method of contraception. Some countries have experienced little recent change in the use of modern family planning, and others continue to have very low levels of use. In Bangladesh, Kenya and Pakistan, the use of modern methods appears to have stalled at about 47, 32 and 20%, respectively, among married women of reproductive age. In a number of West African countries, such as Niger and Nigeria, fewer than 10% of married women practice modern contraception.[18]

The impact of family planning in reducing maternal mortality, unsafe abortion, infant and child mortality, makes it an extremely cost-effective investment,[19–21] as confirmed by the latest figures.[17] If all women needing modern contraceptives were to receive them, the cost of family planning services would increase from the current level of $3.1 billion to $6.7 billion, but substantial savings would accrue. For example, reducing unintended pregnancies by meeting family planning needs would save $5.1 billion that would otherwise be used to care for pregnant women and newborns. The cost of providing a package of family planning, maternal and new-born services to all women in developing countries who need them is equivalent to an average yearly cost of $4.50 per person ($3.30 for maternal and newborn care and $1.20 for contraceptive services). This cost compares favourably with other cost-effective health interventions such as anti-retroviral therapies and childhood immunizations.

Despite the evident need for family planning services, their contribution to achievement of the MDGs and their cost-effectiveness, there is a lack of global investment in family planning.[22] The decline in funding for family planning over the last 15 years must be reversed. Although there was global agreement following the International Conference on Population and Development (1994) about the value of sexual and reproductive health and rights for a wide range of international development priorities, funding for family planning services has declined over the last 15 years. This has, in part, been due to the lack of visibility of sexual and reproductive health and rights in the MDGs framework—an omission that was partially addressed in 2005 by the addition of target 5B, under the maternal health goal, to achieve universal access to sexual and reproductive health by 2015. Substantial evidence exists to demonstrate the contribution that sexual and reproductive health and rights can make to the MDGs.

Recommendations for action on population and climate change

Increased investment in family planning to address unmet need, promote rights-based development and contribute to climate change adaptation.

Increased investment in female education to enable control of fertility and develop a skilled labour force to maximize potential demographic dividends.

Effective leadership to ensure that population and its importance in relation to climate change is discussed at the most influential levels, nationally and internationally, to bring about joint action.

Expansion of successful, locally-led action on climate change, including the National Adaptation Programmes of Action, to ensure that climate change adaptation reflects local knowledge, skills and expertise.

Forward planning in relation to services, housing, land and property to accommodate expected changes in migration patterns in response to the effects of climate change.

Stronger initiatives to encourage development of cities in 'climate-safe' areas.

What are the major gaps in knowledge about population dynamics and climate change?

Population dynamics have not been integrated systematically into climate change science. Research is urgently needed to clarify the contribution of population growth, migration, urbanization, ageing and household composition to effective climate change mitigation and adaptation programmes.

Relatively little research has been conducted to explore the links between population dynamics and climate change.[5] The most comprehensive modelling analysis to date[19] using climate forecasts from the IPCC[23] identifies population growth, economic growth, technological change and changes in patterns of energy and land use as the major driving forces of CO_2 emissions. However, the treatment of population in the models has been questioned. While the modelling generally shows positive

associations between population size and emissions outcomes, other important variables such as urbanization, ageing and household size have not been adequately taken into account.[24] Thus far, the IPCC has not addressed population dynamics, or the potential policy implications in relation to climate change in any depth.[25,26]

Further research priorities are summarized in Box 1.

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