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The urgent need to stabilise population in light of global climate change

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Abstract

The International Panel on Climate Change (IPCC) confirms that climate change is a reality. While temperatures rose 0.7°C over the past century, the IPCC predicts warming of somewhere between 1.5° and 5.8° C over this century. A number of dire warnings about the effects of even small increases in temperature include those in a recent US Pentagon report that warns climate change could bring the planet to the brink of anarchy as a result of 'catastrophic' shortages of food, water and energy supplies. For instance, India's latest report to the U.N. Framework Convention on Climate Change (UNFCCC) warns that global climate change is likely to result in severe droughts and floods that will affect Indian agriculture and forestry, threatening livelihoods and food security. Seven million people in India alone would be displaced by a sea-level rise of one metre.

This paper addresses whether the global population that continues to grow at 1.2 per cent a year (72 million) can be fed as the world undergoes climate change. Currently, rice production must increase by one per cent annually to keep up with demand, yet global warming has already cut rice harvests by 10 per cent at the International Rice Research Institute in the Philippines. Unless modern strains resistant to rising temperatures are developed and utilised, a global temperature rise of 3.5°C could cut rice yields by a further 30 per cent. It is self-evident, therefore, that if global population (and thus demand) were to stabilise, supply would more likely meet demand.

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Introduction

World population reached 6.4 billion in 2004 and is expected to grow to more than nine billion by 2050 (PRB 2004). The pace of growth varies dramatically from one region to another, with birth rates ranging from 1.2 to eight children per woman. Countries, such as those in western Europe, with low birth rates have ageing populations though tend to be wealthy. Countries with high birth rates have young and rapidly growing populations but, with the exception of oil-rich states in the Middle East, are generally poor.

While the United Nations estimates that global population will stabilise at nine billion, others question the figure because of the very young age structure of so many developing countries, including the two largest, China and India (Pimentel and Wilson 2004). It is more likely that global population will nearly double before stabilising at 12 billion, and even that figure is dependent on universal access to contraception and achievement of the two children per family norm.

After a half century of continuous population growth in many developing countries, the demand for food, water and forest products is now beyond the capacity of local life-support systems. Food security in many regions is threatened by a combination of aquifer depletion and land hunger. These two factors, combined with the HIV/AIDS epidemic, is causing death rates to rise once again in many places (Brown 2003).

On top of this, anthropogenic climate change – a result of the build-up of heat-trapping gases such as carbon dioxide, methane and nitrous oxide in the atmosphere - now presents yet another challenge to the viability of many nations. Climate change is expected to bring increased storms, cause flooding and soil erosion, accelerate the extinction of plants and animals, shift agricultural zones and be a threat to public health through increased water stress and tropical disease (UNFPA 2001). In 1999, UN Secretary-General Kofi Annan said that the atmospheric concentration of greenhouse gases continues to increase at an alarming rate that ‘may lead to a serious negative effect on food production at the same time as a rapidly growing population’ (Annan 1999).

Likely impacts of climate change

The Intergovernmental Panel on Climate Change (IPCC) predicts that temperatures will rise anywhere from 1.4° to 5.8° by the end of the century (IPCC 2001a). It says the impacts of such warming will be both adverse and beneficial. For the most part, those in the industrialised world, usually lying in temperate regions, will enjoy the beneficial impacts while poorer countries, found largely in the tropics and sub-tropics, will be adversely affected. The beneficial impacts include increased crop yields in some mid-latitude regions for temperature increases of less than a few degrees Centigrade; a potential increase in global timber supply; and increase in water availability in some water scarce regions; a reduction in winter mortality in mid- to high latitudes; and reduced energy demand for winter space heating (IPCC 2001b). On the other hand, the adverse impacts include a reduction in crop yields in tropical and sub-tropical regions; an overall reduction in crop yields for mid-latitudes for temperature increases of more than a few degrees C; a decrease in water availability in many water-scarce countries; an increase in vector-borne and water-borne diseases; an increase in heat stress mortality; an increase in flooding from both heavier precipitation and sea-level rise; and increased energy demand for space cooling (air-conditioning, fans etc). The IPCC also warns that there will be an

increase in climate extremes, namely drought, floods, heat waves, avalanches and windstorms, the negative impact of which will fall disproportionately on the poor. On the other hand, reduced cold spells will have both positive and negative effects.

This year, the Indian Government reported to the UN Framework Convention on Climate Change. It expects a warming of 2°C to 4°C by mid-century and says severe droughts and floods will affect their country. It anticipates that most major river basins will get drier resulting in constant, and sometimes acute, water shortages. Altered rainfall patterns will significantly affect agriculture and forestry as dry areas get drier and wet areas wetter. Coastal areas will be at risk of more frequent tropical cyclones and, should sea levels rise by one metre, seven million people will be displaced. Severe floods will badly affect infrastructure such as roads and railways (Padma 2004).

Current food production

Although there is enough food in the world to feed them, the poorest segments of the populations in poor countries simply lack the purchasing power to buy food on the world market. There are around 800 million seriously and chronically undernourished people, although the World Health Organisation says as many as three billion people – half of humanity – are malnourished. This means they are deficient in calories, protein, iron, iodine and/or Vitamins A,B, C and D. (Pimentel and Wilson 2004). Despite the availability of viable technologies to increase food production, many poorer countries are unable to be self-sufficient in food (Gebremedhin 2000).

Worldwide, agricultural production tripled in the last four decades largely because of increased yields. Total calorie production kept pace with population, largely because of expansion of calorie-rich oil crops (McMichael and Butler 2004). Production of grain has, however, been falling behind population growth for twenty years, that is, kilograms per capita has fallen from about 380 to 330 kgs. This is a matter of concern as cereal grains account for 50-60 per cent of world food energy, either consumed directly or via its conversion to beef, chicken or pork.

While yields continue to increase, the rate of increase is falling off, and arable land area per capita has fallen from 0.5 hectares in 1960 (with global population at three billion) to 0.23 hectares (global population 6.4 billion). In other words, as more land is brought into production (through deforestation), about as much land is lost to human infrastructure such as cities and roads, or to abandonment of degraded land. Every year about 10 million hectares are lost to soil erosion (Pimentel and Wilson 2004). Another 10 million hectares are lost to salinisation, usually from poor irrigation practices. Indeed, nearly a quarter of useable land has undergone reduced productivity from soil erosion, water-logging or salinity of irrigated land, affecting about a billion people.

In China, falling water tables, drying rivers and polluted water sources have caused declining annual grain harvests every year since 1998. Because its population is still growing by 0.6 per cent a year, farmland is being absorbed by the vast expansion of industrial parklands, roads and railways, so is unlikely to reverse the decline in domestic production. The deficit in grain production compared with demand this year is expected to be about 37.5 million tonnes and the Chinese Government is again importing food to feed its 1.4 billion people. In the first half of this year, it imported \$US14.35 billion worth of farm produce. Lester Brown of the Earth Policy Institute anticipates China will be

importing between 30 and 50 million tonnes of grain annually, more than any country and putting pressure on the world market (Kynge 2004).

About 70 per cent of water removed from its sources is used for irrigation. Food can be produced in arid regions if there is sufficient water from rivers or aquifers, and energy to move water around. Much of this energy is based on fossil fuels, particularly oil. The world is now approaching 'Peak Oil', however, where demand will begin to exceed supply and prices will rise, sometime between now and 2035 (Peak Oil 2004). Higher energy prices will affect agriculture in other ways as well since industrialised agriculture is heavily dependent on fossil energy for running machinery. In addition, producing nitrogenous fertilisers is dependent on natural gas, another fossil fuel though one that will peak later than oil.

Much of recent food production has been dependent on 'fossil water', namely aquifers, and these have been drawn down at an unsustainable rate. In other words, current levels of food production in many places are simply unsustainable. Increasing demand for food over the next century will worsen water scarcity, with severe implications for the 1.1 billion people who already lack access to safe water supplies, and the 2.4 billion who lack adequate sanitation (McMichael and Butler 2004).

Food security and climate change

Climate change will inevitably raise additional challenges to an already challenged world food system (O'Neill et al 2001). As noted above, global warming of a few degrees will see an increase in crop yields in temperate regions although a decrease in yields with a large rise in temperature. There will be a drop in yield in the tropics, however, even with a small rise in temperature, and an even worse drop in yields if higher temperatures are combined with a decline in rainfall.

Increased CO₂ levels have a fertiliser effect in the laboratory, but it remains to be seen what the effects will be in the field. Other unknowns include potential losses from crop and animal pests, spatial variability in crop responses, and the effects of extreme climate events on crops and livestock.

The IPCC believes that climate change will lower the incomes of vulnerable populations, probably increase the number of people at risk of hunger, and worsen food security in Africa.

Higher minimum temperatures are beneficial to some crops but detrimental to others. For instance, a team at the International Rice Research Institute in the Philippines, using data over 25 years and harvests over 12 years at the Institute's farm, has found that global warming has already cut rice harvests by at least 10 per cent (Aglionby 2004). The team members are concerned that this will impact on the world's poorest people. Rice production has to rise by one per cent annually to keep pace with world demand, yet rice yields may fall by over 10 per cent for every 1°C in night-time temperatures. A rise of 3.5°C this century would see yields hit by another 30 per cent. While they fear the effect may be even worse in the field, they are hopeful that modern strains of rice will be more resistant to rising temperatures.

The fact that rice yields have fallen already due to climate change may explain why there has been a fall-off in overall grain production per capita over the past two decades. Climate modelling at the Hadley Research Centre, UK Meteorology Office and the European Commission Hamburg Centre has found that while there will be marked differences in the impact of climate change on local cereal production around the world, climate change is likely to cause a “modest” net decline in total global yield (McMichael and Butler 2004).

Rising seas will also affect food production. A half-metre rise by 2100 would double the number of people affected by flooding from 50 to 100 million. Some coastal arable land and fish-nurturing mangroves would be damaged (McMichael and Butler 2004). Indeed, it may be the oceans most profoundly affected by climate change with significant implications for fish stocks which supply so much of the world’s protein. Changes in wind strength and ocean circulation could affect reproductive and migration patterns, as well as ecosystem relationships (O’Neill et al 2001).

Rapid climate change

Most countries, even poor ones, are likely to cope with a gradual and small rise in temperature even where food security is affected. There is, however, the very real possibility that temperatures will rise to a point where the thermohaline circulation – the ocean currents that transfer heat around the world – will be weakened, leading to rapid cooling in some regions. Europe is most at risk since the Gulf Stream that brings warm, salty water from the Caribbean to the western edge of Europe, may be ‘shut down’ by excess fresh water flowing into the North Atlantic from the partial melting of the Greenland ice-cap. The denser salty water of the Gulf Stream would be driven down to lower depths, depriving Europe of its warmth.

In a ground-breaking report commissioned by the United States Pentagon last year, the authors found that such a scenario above would lead to sharply reduced soil moisture, and more intense winds in certain regions that currently provide a significant fraction of the world’s food production (Schwartz and Randall 2003). With inadequate preparation, they argued, there would be a significant drop in the human carrying capacity of the Earth’s environment. Abrupt cooling has occurred at least twice since the end of the last Ice Age with a 5-10° F. (2.8 – 5.5°C) in one decade. The ocean conveyor collapsed 8,200 years ago and cooled the planet for 100 years. The Younger Dryas, beginning 12,700 years ago, lasted 1000 years.

This Pentagon report found that such abrupt cooling could destabilise the geo-political environment leading to resource skirmishes and even wars because of food shortages, decreased availability of fresh water, and disrupted energy supplies. It would lead to nations with resources building fortresses around their countries, and nations without resources initiating struggles for access to food, water and energy. The authors warn that global warming has already reached a threshold where the thermohaline circulation could be significantly impacted. Already the North Atlantic is being freshened by melting glaciers, increased precipitation and freshwater run-off. They recommend that the risk of abrupt climate change be elevated to a national security concern (Schwartz and Randall 2003).

Mitigating climate change through changes in consumption, energy use and technology

By 2050, were all nine billion global citizens consuming the same energy as the average in a high consuming country like Sweden (still only 70 per cent of the average in the US), energy use in the developing world would increase eight fold and in the world as a whole five-fold. Fossil fuels are simply unable to meet such a demand and, anyway, GHG emissions would send climate change into flip-mode fairly quickly. If the poor are to be lifted out of poverty, however, they deserve a fairer share of global energy supplies. Thus, a three-fold effort to move to a renewable energy economy, reduce consumption in the industrialised world and implement energy efficiency measures, will be necessary for the poor have their needs met without sabotaging the atmosphere.

Mitigating climate change by stabilising population numbers

The International Institute of Applied Systems Analysis (IIASA) suggests that slowing population growth can also help mitigate climate change by reducing greenhouse gas emissions in the long-term (O'Neill et al 2001). It is not the most effective means of addressing climate change in the short-term, however, since reductions in greenhouse gas emissions will only be achieved by cutting per capita emissions through changes in consumption and improvements in technology. Thus, population policies must be seen as part of a broad range of policies to mitigate and adapt to climate change.

Stabilising population numbers as a means of improving resilience to climate change

The IIASA says, however, that slowing population growth in developing countries will improve their resilience to the anticipated extreme impacts of global warming such as hurricanes, storm surges, floods and prolonged drought (O'Neill et al 2001). As a foretaste of possible future scenarios, in mid-2004, 30 million Bangladeshis were victims of flood. Should sea-levels rise by one metre, half of Bangladesh's rice-lands would be flooded, forcing millions to migrate. The country's population is already 144 million and is expected to rise to 265 million by mid-century (UNFPA 2001). If population growth can be contained, however, the potential number of displaced people will be less.

But much of the resilience would come through the balance between supply and demand. As this paper has noted, much of population growth will be in the developing world, in countries with very young age structures. These are the very countries that will be most adversely affected by global warming (though perhaps not by rapid climate change where Europe and North America would bear the brunt). Already, many in these countries are malnourished, if not downright hungry. Scores of nations are not self-sufficient in food and many are too poor to buy food on the world market. Affordability will only worsen as China buys a large fraction of world exports and pushes up prices. Even without climate change, many countries, particularly in sub-Saharan Africa, will find it difficult to maintain calorie levels on a per capita basis as their populations grow. If the Hadley Research Centre's and other models conclude that 'climate change is likely to cause a "modest" net decline in total global yield' of food, then how are we to feed the existing 800 hungry, never mind another three or even six billion people? Even withdrawing significant amounts of grain away from grain-fed animals, particularly cattle, are unlikely to meet future demand for food if populations grow as anticipated.

Conclusion

Climate change from human-enhanced greenhouse gas emissions is already with us. The world can expect temperature rises of between 1.4 and 5.8°C this century though there is a small possibility that the climate may ‘flip’ if the thermohaline ocean currents are affected resulting in cooling in the northern hemisphere. The effects on food production will be variable with temperate regions experiencing longer growing seasons, and higher productivity, and the tropics a shorter season. This will exacerbate inequalities between industrialised countries (usually in the temperate areas) and developing countries that are more often than not in the tropics. Many of these poorer countries will be vulnerable to an increased incidence of tropical cyclones and hurricanes. If current trends continue, the world will experience at least another 3 billion people before numbers stabilise, yet 99 per cent of this growth will be in the developing world. While the number of calories per person has kept pace with population growth until now, there has been a decline in cereal grains per person for the past two decades. Eight hundred million people are chronically undernourished and about half the world are malnourished to some extent. With the possibility that food production may fall in the developing world under climate change and that their populations will be increasingly vulnerable to extreme climate events, it is clearly desirable that population growth end as soon as possible.

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