

Climate Change and Food Security

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Climate Change and Food Security

A Briefing Paper prepared for an IPS Roundtable on *Climate Change and Food Security Issues* held on 13 November 2008

Sean Weaver¹

SUMMARY

This paper explores the global trends associated with food security and climate change and the linkages between them. This comes at a time of unprecedented international concern for global food security, against a backdrop of dramatically fluctuating world food prices. Underlying the food security issue is a trend of rapidly growing populations in many developing countries, and projected changes in food production dynamics associated with a warming and drying climate for many regions during the 21st century. This paper looks into demand and supply trends associated with world food security, in an effort to inform a coordinated policy response to this emerging crisis. The final sections of the paper explore the implications for New Zealand, and then reflect on options for a broader global policy response.

INTRODUCTION

On the 25th of September 2008 the UN hosted a high level meeting in New York on the global food crisis. Here some 30 world leaders pledged to take action to address the combined challenges of global food security and climate change. The meeting highlighted the urgent need for greater public and private sector investments in agricultural R&D and technology transfer to increase global food production in the face of escalating food insecurity.

UN Secretary-General Ban Ki-moon estimated that it will take US\$40 billion a year in additional funding between 2008 and 2012 “to alleviate the food crisis and ensure long-term improvement in agricultural production.” To this end the European Commission made a commitment to provide an additional €1 billion for urgently needed food aid and productivity inputs.

This meeting follows in the wake of the ‘High-Level Conference on World Food Security: the Challenges of Climate Change and Bioenergy’ that took place from 3-5 June 2008, at the UN Food and Agriculture Organization (FAO) headquarters in Rome, Italy. The Conference brought together over 4,700 delegates from 183 countries, including 36 Heads of State and government, representatives of governments, UN agencies, intergovernmental and nongovernmental organizations (NGOs), and the private sector.

The key outcome of this conference was a Declaration on “World Food Security: the Challenges of Climate Change and Bioenergy”.

The Declaration included the following:

Article 1. Reaffirms “the conclusions of the World Food Summit in 1996, which adopted the Rome Declaration on World Food Security and the World Food Summit Plan of Action, and the objective, confirmed by the World Food Summit five years later, of achieving food security for all through an ongoing effort to eradicate hunger in all countries, with an immediate view to reducing by half the number of undernourished

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people by no later than 2015, as well as our commitment to achieving the Millennium Development Goals (MDGs).”

Article 3. Asserts “that the international community needs to take urgent and coordinated action to combat the negative impacts of soaring food prices on the world’s most vulnerable countries and populations... There is therefore an urgent need to help developing countries and countries in transition expand agriculture and food production, and to increase investment in agriculture, agribusiness and rural development, from both public and private sources.”

Article 4. Calls upon “all donors and the United Nations System to increase their assistance for developing countries, in particular least developed countries and those that are most negatively affected by high food prices.”

Article 5. “The first line of action is to respond urgently to requests for assistance from affected countries.”

Article 6. “The second line of action is immediate support for agricultural production and trade.”

Article 7. “The current crisis has highlighted the fragility of the world’s food systems and their vulnerability to shocks. While there is an urgent need to address the consequences of soaring food prices, it is also vital to combine medium and long-term measures...”

Broadly speaking, the world food crisis is being driven by a combination of demand side and supply side trends that if left unchecked will escalate the crisis further in coming decades. This has significant implications for human well being, particularly in the lowest socio-economic sectors of the world economy to the extent that it threatens to escalate and intensify the effects of poverty and hunger. In turn this has flow on implications for regional and international security and conflict, each of which flow in the opposite direction of achieving/delivering the Millennium Development Goals.

DEMAND SIDE

On the demand side, the world population exceeded 6.1 billion individuals in 2001, and is increasing at a rate of approximately 1.3 percent annually which translates to an additional 90 million annually. Medium projections indicate a world population of 9 billion by 2050 (see Figure 1). Over sixty percent of the world’s population lives in Asia, 13 percent live in Africa and 12 percent live in Europe; the remaining 14 percent live in the Americas and Oceania (Figure 2).²

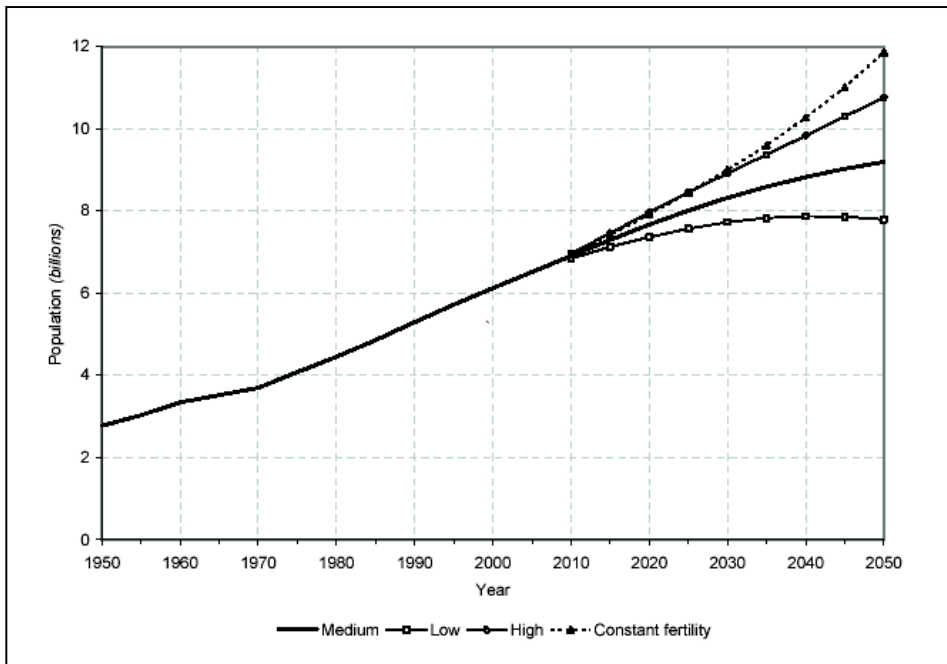
Most of the increase in world population is occurring in developing countries. This is also where food security issues are most acute, and in many regions are likely to get worse over the 21st century due to projected climate change impacts and low adaptive capacity.

The regional distribution of high population growth rates are closely linked to the distribution of high infant mortality rates and low real GDP per capita (Figures 3 - 5). This signals the relationship between population growth rates and socio-economic development long understood in population geography. Africa is a world leader in the conditions that combine food insecurity with high vulnerability to climate change impacts. Other regions of concern include Central, Southern and South East Asia (Figure 6).

² UNEP 2008. World Population Development. Available at http://maps.grida.no/go/graphic/world_population_development

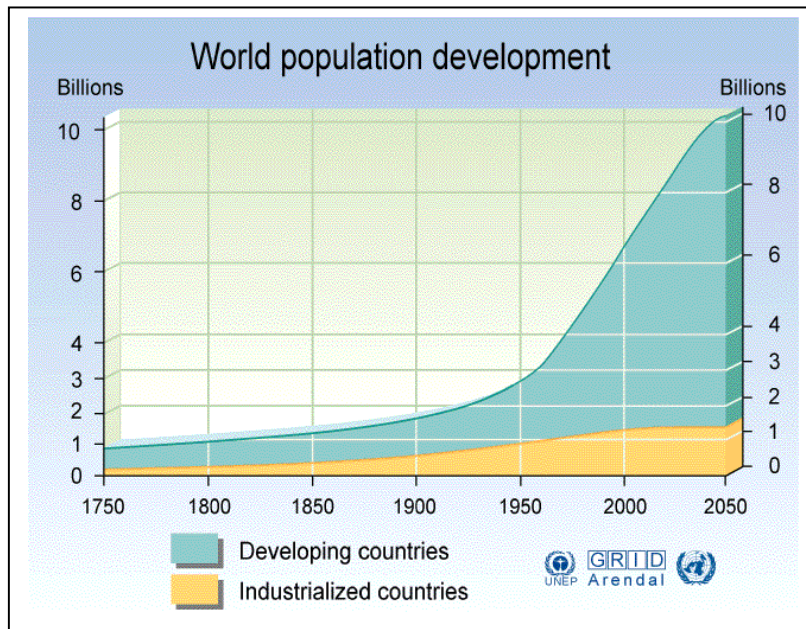
The demand side is also influenced by qualitative changes in per capita food preferences in industrializing nations (i.e. increasing per capita meat consumption) and this is increasing the resource footprint of food consumption.

Figure 1. World Population 1950-2050, according to different projection variants



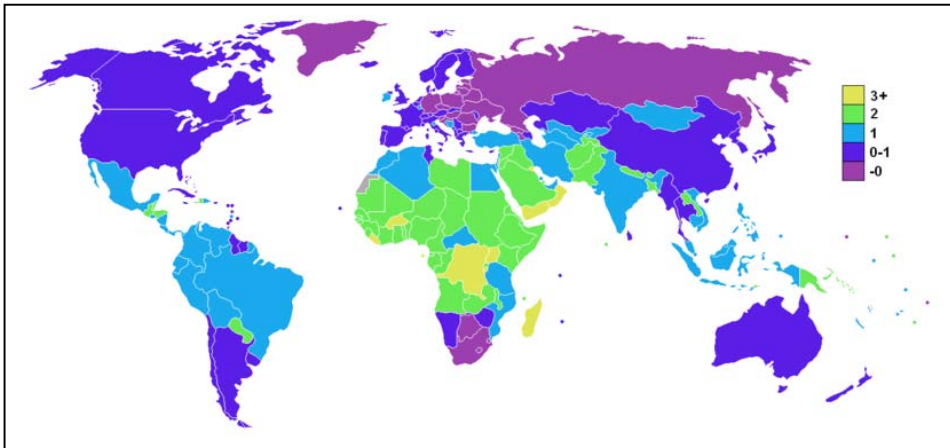
Source: Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat (2007). World Population Prospects: The 2006 Revision, Highlights. New York: United Nations.

Figure 2. Distribution of world population between developed and developing countries



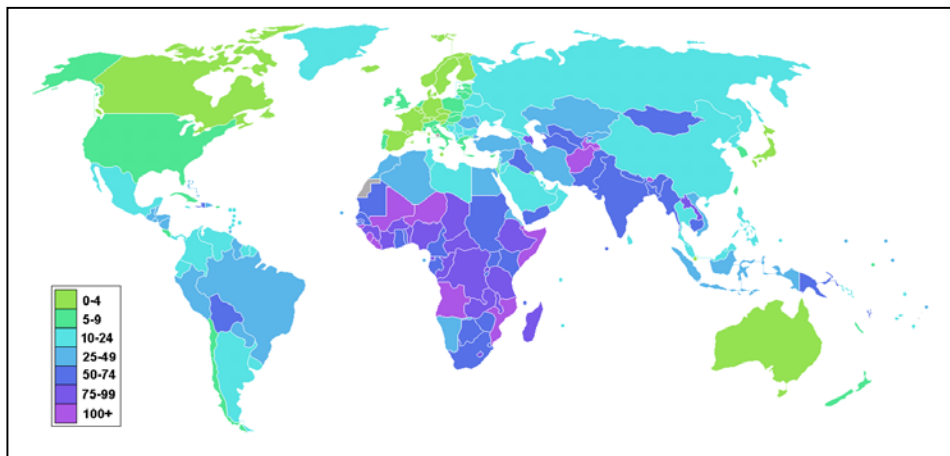
Source: UNEP. Available at: http://maps.grida.no/go/graphic/world_population_development

Figure 3. World population growth rates in percent 2006



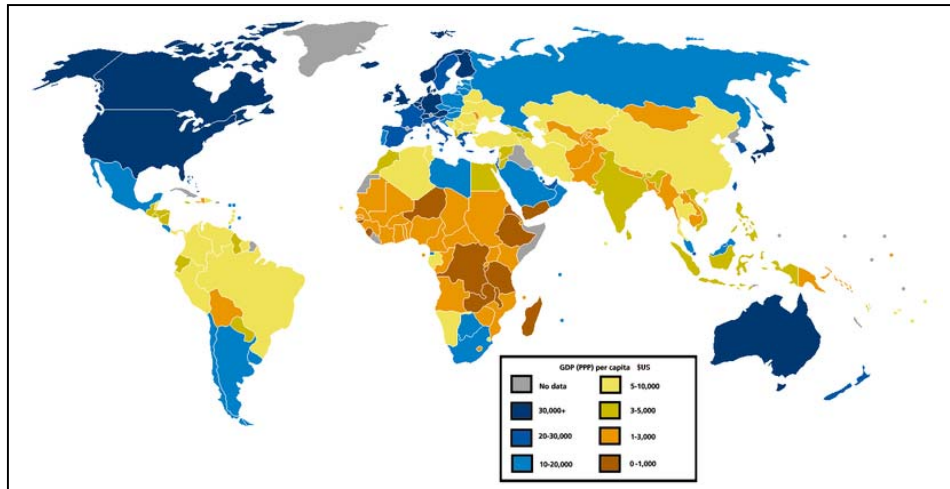
Source: Wikimedia graphic using data from the CIA Fact Book 2006. Available at: http://commons.wikimedia.org/wiki/Image:Population_growth_rate_world.PNG

Figure 4. World infant mortality rates in percentage deaths/1,000 live births 2006



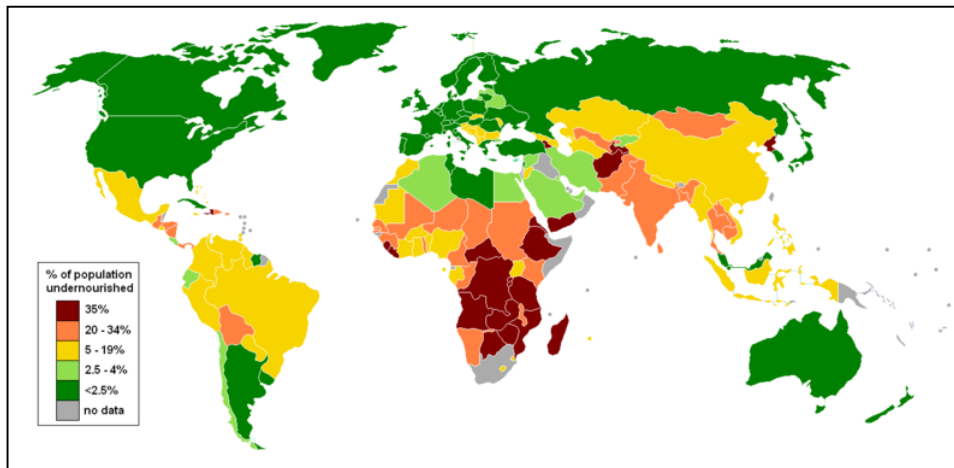
Source: Wikimedia graphic using data from the CIA Fact Book 2006. Available at: http://commons.wikimedia.org/wiki/Image:Infant_mortality_rate_world_map.PNG

Figure 5. World GDP per capita 2005



Source: Wikimedia. Available at http://commons.wikimedia.org/wiki/Image:Gdp_per_capita_ppp_world_map_2005.PNG

Figure 6. World map of undernourished people



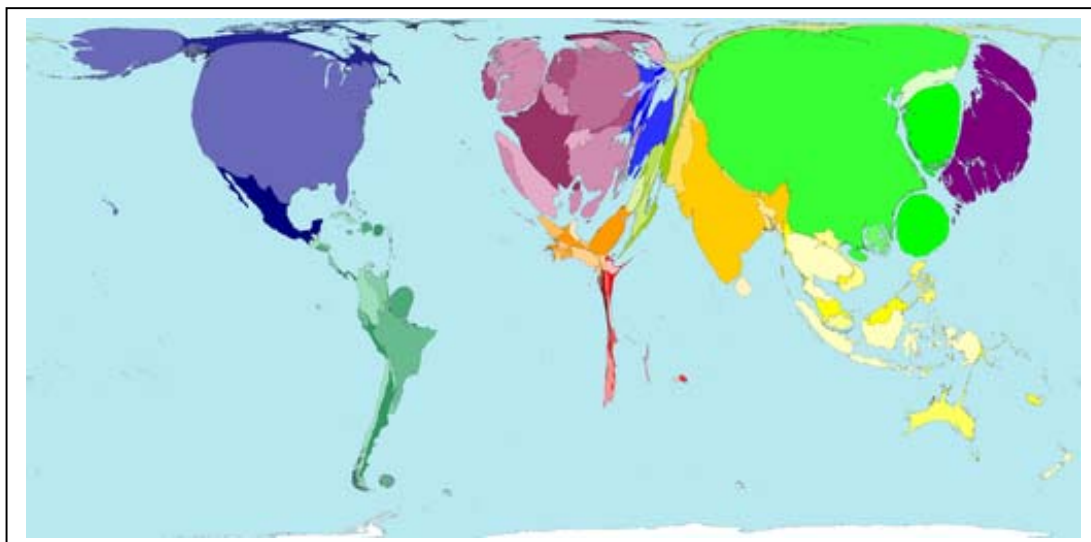
Source: Wikimedia graphic using data from the UN World Food Program and FAO State of Food Insecurity 2006. Available at:

http://commons.wikimedia.org/wiki/Image:Percentage_population_undernourished_world_map.PNG

The pattern emerging from these maps is a dynamic that will change during coming decades and in some cases (notably Africa) is likely to get worse. Figure 7 for example shows projected worldwide GDP distribution with a heavy weighting towards the northern hemisphere and a continuation of low socio-economic conditions for Africa and to some extent, South America.

Low rates of per capita GDP is likely to get worse for key vulnerable regions as evident in Figure 8, with particularly troubling circumstances for Africa and South Asia as their populations continue to rise rapidly to 2050. This will intensify the problem of food security for these regions and is also likely to intensify conflict within and around these regions.

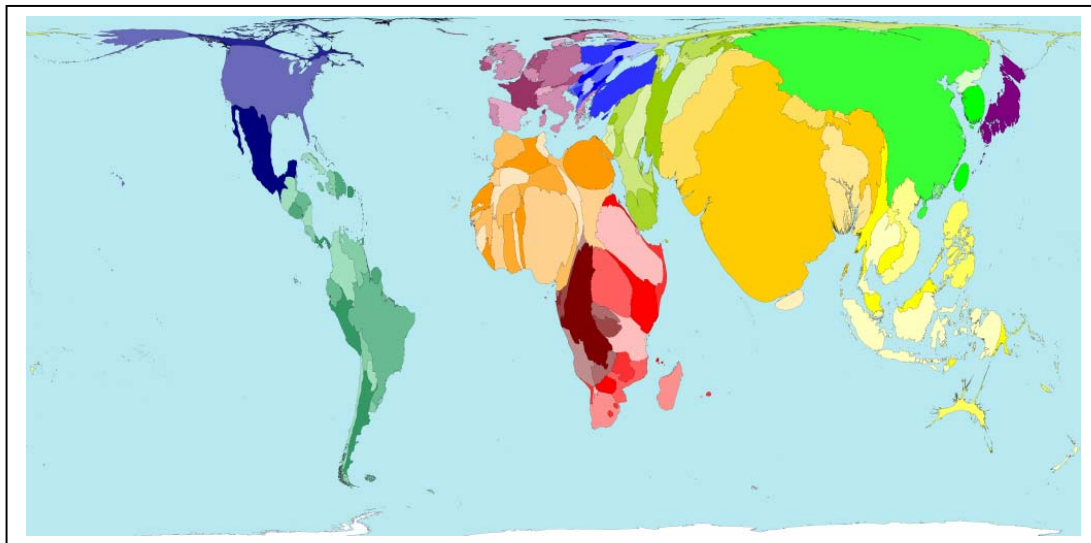
Figure 7. Worldwide GDP at 2015



Source Worldmapper (University of Sheffield, University of Michigan, The Leverhulme Trust, The Geographical Association). Territory size shows the proportion of worldwide Gross Domestic Product measured in US\$ equalised for purchasing power parity to be produced there in 2015.

<http://www.worldmapper.org/display.php?selected=2>

Figure 8. Proportional Distribution of World Population in 2050



Source Worldmapper (University of Sheffield, University of Michigan, The Leverhulme Trust, The Geographical Association) <http://www.worldmapper.org/display.php?selected=11>

SUPPLY SIDE

According to a study undertaken from the Stern Review³, around 800 million people are currently at risk of hunger with 4 million deaths annually attributed to malnutrition. Increased global temperatures of 2-3°C above 1990 temperatures are projected to increase the number of people at risk of hunger by 30-200 million as a result of climate related changes in crop productivity.

The numbers of people affected by climate change by a given time period depend on the assumed population growth rate, but under even the lowest growth rate assumption a rise in temperature by 2085 of around 2°C would increase water resources stresses for between 800 and 1800 million people, largely in Africa, Asia, Europe and South America.⁴

At 3°C warming above 1990 levels the risk increases to 250-550 million people, with most concentrated in regions that are highly dependent on local agriculture, where projected declines in yield are projected to be the greatest, and where poverty is highest (and hence the ability to purchase food is lowest). Africa and Western Asia are the most vulnerable regions.⁵

Carbon dioxide fertilization is likely to have a moderating effect on these risk factors, but at higher temperatures the drying effect will override any gains in productivity from carbon dioxide fertilization.⁶

³ Warren, R., Arnell, N., Nicholls, R., Levy, P., and Price, J. 2006. Understanding the regional impacts of climate change. Research Report Prepared for the Stern Review on the Economics of Climate Change. Tyndall Centre for Climate Change Research, Working Paper 90. Available at: www.tyndall.ac.uk/publications/working_papers/twp90.pdf

⁴ Ibid. p.4.

⁵ Stern, N 2006. The Economics of Climate Change. The Stern Review. Cambridge University Press, Cambridge: 85-86.

⁶ Ibid.

The overall supply side dynamic for global food security can be characterized by the following key themes:

- non-climate ecosystem services relating to food production
- climate change impacts
- escalating food prices
- competition from biofuels, and
- inadequate food distribution

Each of these themes will be addressed in the following pages.

Non-Climate Ecosystem Services

Climate change impacts on food production can be understood as one component of a range of challenges to food production arising from changes in global ecosystem services. The threat to human wellbeing arising from changes in global ecosystem services is taken up in the Millennium Ecosystem Assessment (MEA).⁷ The MEA identifies a range of ecosystem service types:

- Supporting services (e.g. nutrient cycling, soil formation)
- Provisioning services (e.g. food, fuel, water, wood and fiber)
- Regulating services (e.g. climate regulation, flood regulation, disease regulation)
- Cultural services (e.g. aesthetic, spiritual, recreational, educational)

The MEA provides a summary of issues related to food production in the 'Current State and Trends' volume of the MEA 2005 report. Key points include:

"Overall demand for food, fiber, and water continue to rise.

"Efficiency gains permitted by new technologies ... have tended not to keep pace with growth in demand for provisioning services (e.g. food).

"Nutrient additions on the land, including synthetic fertilizers, animal manures, the enhancement of N- fixation by planted legumes, and the deposition of airborne pollutants, have resulted in approximately a doubling of the natural inputs for reactive nitrogen in terrestrial ecosystems and an almost fivefold increase in phosphorus accumulation.

[This has implications for food productivity in aquatic systems as eutrophication can lead to toxic algal blooms and reduce aquatic oxygen levels leading to a decline in fisheries. Accordingly, although fertilizer inputs have raised terrestrial food production, this has commonly come at a cost to aquatic food production which is in significant decline globally.]

"The intrinsic capacity of cultivated systems to support crop production is being undermined by soil erosion and salinization and by loss of agricultural biodiversity...

⁷ Scholes, R., Hassan, R., and Ash, N.J. 2005. Current State and Trends: Ecosystems and their services around the year 2000. Millennium Ecosystem Assessment, 2005.

“Major inequalities exist in access to food despite the more than doubling of global production over the past 40 years. An estimated 852 million people were undernourished in 2000–02, up 37 million from 1997– 99. There are important differences in the regional trends: the number of undernourished people in China is declining, while the number in Africa continues to increase. Of the global undernourished, 1% live in industrial countries, 4% live in countries in transition, and the remaining 95% are found in developing countries” (MEA 2005:19-20).

According to the UNEP⁸ by 1990 unsustainable agricultural practices had degraded 38% of the world’s available cropland (approximately 1.5 billion hectares). Since 1990, soil degradation has continued with 5 million to 6 million hectares of cropland lost annually.

A study by the International Food Policy Research Institute (IFPRI) and the World Resources Institute suggests that soil degradation has already had significant impacts on the productivity of about 16% of global agricultural land. The biggest problem areas include Central America where almost 75% crop land is seriously degraded, Africa (20% degraded), and Asia (11% degraded).⁹

The Millennium Ecosystem Assessment summarises trends in freshwater resources as follows:

“Human modification to ecosystems...has stabilized a substantial fraction of continental river flow, making more fresh water available to people but in dry regions reducing river flows through open water evaporation and support to irrigation that also loses substantial quantities of water. Watershed management and vegetation changes have also had an impact on seasonal river flows. From 5% to possible 25% of global freshwater use exceeds long-term accessible [supply]. Between 15% and 35% of irrigation withdrawals exceed supply rates.”¹⁰

Fisheries provide an important source of protein, particularly in rural communities in developing countries. The Millennium Ecosystem Assessment summarises the baseline case for fisheries globally:

“Harvest pressure has exceeded maximum sustainable levels of exploitation in one quarter of all wild fisheries and is likely to exceed this limit in most other wild fisheries in the near future. In every ocean in the world, one or more important targeted stocks have been classified as collapsed, overfished, or fished to their maximum sustainable levels, and at least one quarter of important commercial fish stocks are over harvested (high certainty).”¹¹

Climate Change Impacts

Climate change is projected to produce a combination of positive and negative impacts on food production depending on the scale of temperature rise in the coming century and the region.

⁸ UNEP 1997, *Global Environment Outlook* (Oxford University Press, New York, 1997, p. 236.

⁹ International Food Policy Research Institute <http://www.commondreams.org/news2000/0523-01.htm>

¹⁰ Scholes, R., Hassan, R., and Ash, N.J. 2005. Current State and Trends: Ecosystems and their services around the year 2000. Millennium Ecosystem Assessment, 2005. p 22.

¹¹ Ibid, p 25.

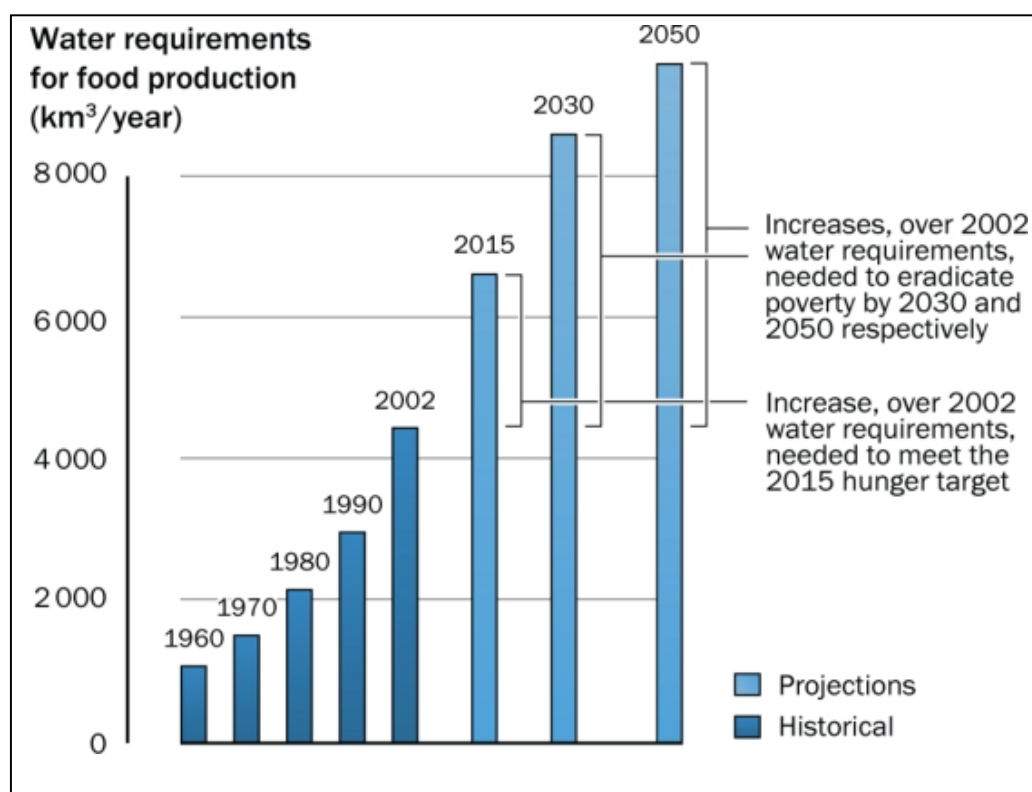
The key climate change impacts likely to influence global food production include:

- Freshwater availability
- Crop productivity
- Impacts on coastal food supply regions
- Ocean food resources¹²

Freshwater resources

The first Millennium Development Goal is to eradicate extreme poverty and hunger, and in particular 'halve, between 1990 and 2015, the proportion of people who suffer from hunger. In order to achieve this there will need to be a significant increase in water supplies to agriculture in developing countries (see Figure 4).

Figure 4. Water requirements for food production 1960-2050



Source: Stockholm Environment Institute. 2005. Sustainable Pathways to Attain the Millennium Development Goals - Assessing the Key Role of Water, Energy and Sanitation. (The data has been calculated for developing countries with minimum set of calories.)
<http://www.sei.se/SustMDG31Auglowres.pdf>

In terms of water supply, projections for the 21st century by the IPCC's Fourth Assessment Report (2007) indicate that water availability will decline in some key food

¹² IPCC, 2007: Summary for Policymakers. In: *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 7-22, p 11.

supply regions. Although annual average water availability is projected to increase for high latitude areas and in some parts of the wet tropics, the IPCC's projections show a 10-30% decrease in water availability in dry regions in the mid latitudes and dry tropics. This is likely to increase the incidence of drought in many areas. Furthermore, warming temperatures are projected to reduce water storage capacity in snow and ice in many mountainous regions, and change the timing of melting and hence downstream water availability in melt-water catchments.

This projected reduction in water availability for some regions arises from two phenomena associated with global warming:

- a. projected shifts in precipitation patterns where a warming climate translates (in some regions) to a dryer climate, and
- b. shifts in soil water availability due to changes in the distribution of precipitation resulting from higher temperatures in some regions. Here mean annual rainfall may remain the same or increase as a result of greater evapo-transpiration, but rainfall distribution will tend to be concentrated in more extreme rainfall events (e.g. storms and cyclones) resulting in greater runoff and consequentially lower water retention in agricultural soils.

Crop Productivity

Warmer temperatures in high latitudes combined with CO₂ fertilization are projected to increase crop productivity for temperature increases of 1-3°C.¹³ Beyond this temperature range, crop productivity is likely to decline. On the other hand, crop productivity is likely to decline at lower latitudes even with a 1-2°C increases in local temperatures. This is relevant for seasonally dry and tropical regions. At a global scale, increases in local mean temperatures of 1-3°C are projected to increase the potential for food production (provided water is not limiting), but is likely to decline above this temperature range. Subsistence sectors in tropical regions are particularly susceptible to declines in crop productivity resulting from an increase in the frequency of flooding and droughts.

Coastal Regions

Some of the key climate change challenges for food production in low latitude coastal regions relate to the combined effects of projected sea level rise and flooding (associated with storm events). This is particularly important for densely populated low-lying areas in delta regions of Asia and Africa (e.g. Bangladesh and the Mekong Delta in Asia).

While the direct effects of flooding are variable, indirectly food production is challenged in flood events that damage crops and degrade agricultural infrastructures in the short term.

Ocean Food Resources

The Millennium Ecosystem Assessment emphasizes the unsustainable use of ocean resources for food production which provides a backdrop to the impacts of climate change on ocean food production systems. Two areas stand out in terms of climate change impact: ocean acidification, and temperature driven coral bleaching, both of

¹³ IPCC 2007. Ibid. Information on crop productivity, coastal regions is taken from the IPCC AR4 Working Group II Summary for Policy Makers – full reference in previous footnote.

which can adversely affect marine ecosystem productivity, marine food chains, and consequentially the fisheries sector.

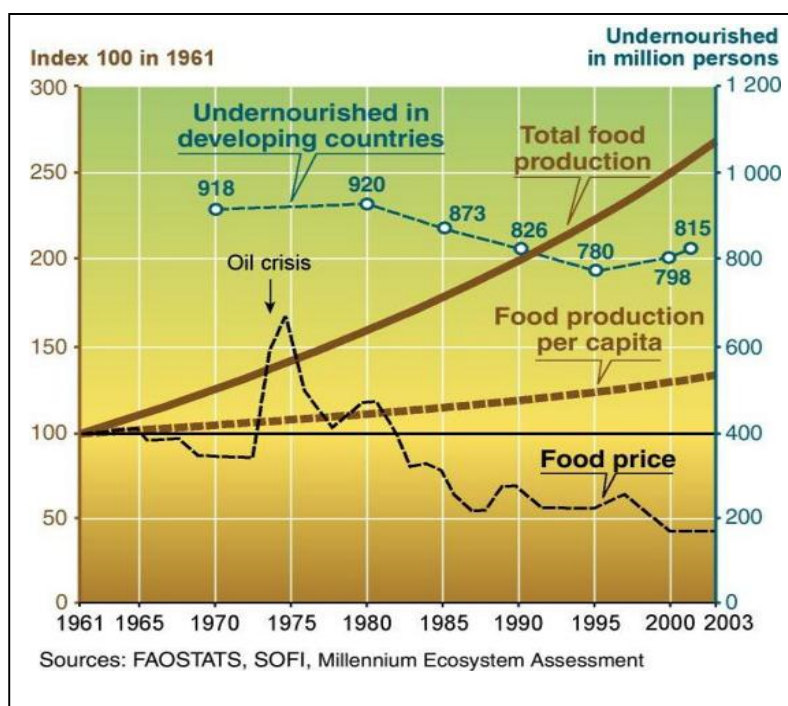
Ocean acidification is the result of an increase in atmospheric CO₂ concentrations, which leads to an increase in oceanic sequestration of CO₂ followed by a rise in the concentrations of dissolved inorganic carbon, which is converted to carbonic acid in surface waters. This chemical process is leading to an increase in the acidity of ocean waters which directly affects calcifying species of plankton and bottom dwelling invertebrates (those with shells), and indirectly affects the food webs of which they form integral components. Important calcifying species in shallow tropical seas (which are important food supply ecosystems in many developing countries) include the corals which are adversely affected by acidification.

As a double blow, many coral reefs are also threatened by increases in sea surface temperatures because they have low adaptive capacity and are vulnerable to thermal stress. The IPCC summary of coral science indicates that an increase in sea surface temperature of 1-3⁰C will result in widespread coral mortality and consequently more frequent coral bleaching events.

Escalating Food Prices

Global trends associated with food production and food prices present a range of challenges to food security in coming decades. The Millennium Ecosystem Assessment provides a global overview of food production and prices from 1961 to 2003. Data from the MEA indicates that food production more than doubled between 1961 and 2003. Over this period, production of cereals—the major energy component of human diets—has increased almost two and a half times, beef and sheep production increased by 40%, pork production by nearly 60%, and poultry production doubled. In spite of this, the number of undernourished in developing countries has declined only slightly whilst the global population has more than doubled during that time.

Figure 5. Global Production, Prices, and Under-nourishment. Source – Millennium Ecosystem Assessment 2005.



According to FAO data, global food prices increased by 30% since February 2007 reaching a peak in June 2008 (see below). For example, cereal prices (e.g. wheat, rice and corn) have increased by 50% in this time period, with oils, fats, and dairy products increasing by an even greater margin (see Figure 6).

Figure 6. FAO Food Price Index: February 2007 - January 2008. Source: FAO 2008

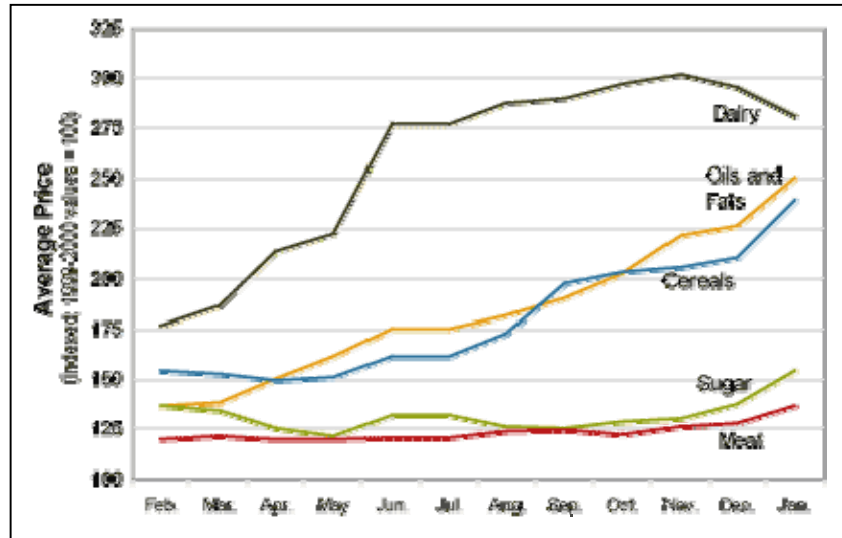
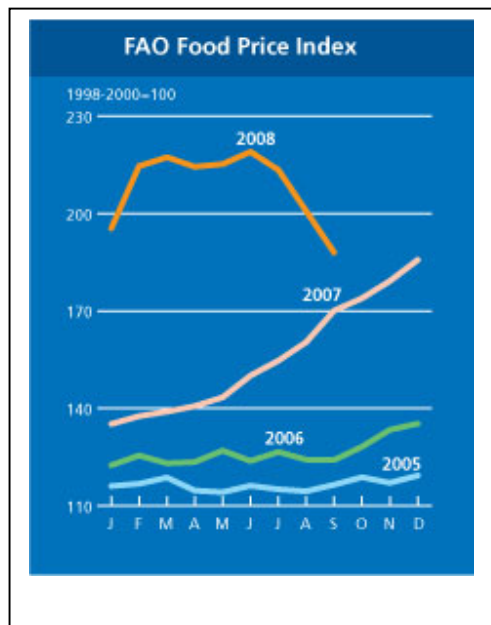


Figure 7. FAO Food Price Index 2005 to 2008



International prices for major food commodities increased significantly in 2007 producing a record shift in the FAO Food Price Index (FFPI). The annual average of 157 points encompassed an increase of 23% compared with 2006, and a 34% increase above 2005 levels. The Food Price Index averaged 184 points in December 2007, the highest recorded monthly average since the start of the index in 1990. In 2008 the FFPI reached a record 219 points in June. Thereafter it continued to decline but by September was still up 11 points compared with September 2007 (and 51 higher than September 2006). Source: FAO <http://www.fao.org/worldfoodsituation/FoodPricesIndex/en/>

World commodity prices have been volatile during 2008, with large price variability as seen with corn and oil prices (Figures 8 & 9). Agricultural prices have been highly variable across the board with prices at 30th October showing a continued drop following the June peak (Table 1). The financial crisis of October 2008 has impacted considerably on commodity prices but with medium and long term implications remaining uncertain.

Figure 8. World Corn Price: US\$/bushel 30th October 2008.



Source New York Times <http://markets.on.nytimes.com/research/markets/commodities/commodities.asp>

Figure 9. World Oil Price: Light sweet crude US\$/barrel 30th October 2008.



Source New York Times <http://markets.on.nytimes.com/research/markets/commodities/commodities.asp>

Table 1. World agricultural commodity prices 30 October 2008.

Future	Date	Open Interest	Price	Change		Low	High
Corn Chicago Board of Trade	Dec '08	419,845	4.10	-0.1125	Daily	4.02	4.17
			S/bushel		Lifetime	2.60	7.96
Soybeans Chicago Board of Trade	Nov '08	24,651	934.00	-3.25	Daily	920.00	944.00
			c/bushel		Lifetime	622.00	1,635.50
Wheat Chicago Board of Trade	Dec '08	145,512	538.00	-23.25	Daily	531.00	560.00
			c/bushel		Lifetime	430.00	1,280.00
Oats Chicago Board of Trade	Dec '08	5,923	239.50	0.00	Daily	237.25	250.00
			c/bushel		Lifetime	219.50	486.00
Rough rice Chicago Board of Trade	Jan '09	3,671	15.56	-0.075	Daily	15.40	15.88
			S/CWT		Lifetime	12.77	21.88

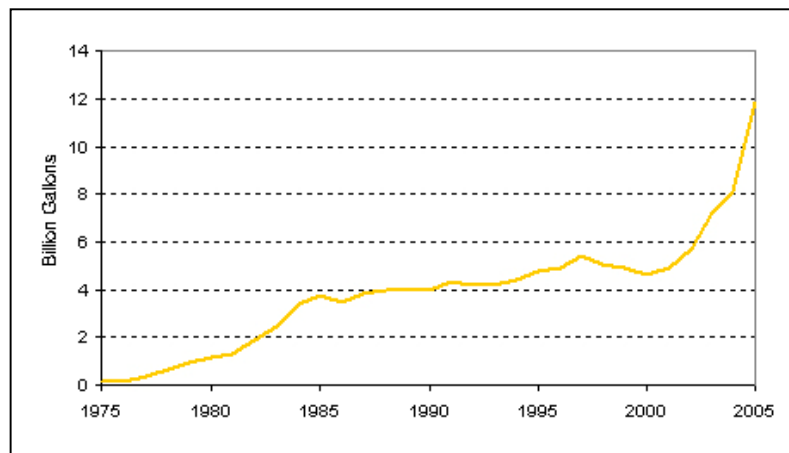
Source New York Times <http://markets.on.nytimes.com/research/markets/commodities/commodities.asp>

Causes of Food Price Inflation

Prior to the onset of the crisis in world financial markets in October 2008 the FAO and the European Bank for Reconstruction and Development had identified what they considered the root causes for food price inflation in 2007:¹⁴

- Agricultural subsidies in developed countries that make more efficient production in developing countries unprofitable;
- Decreases in food stocks;
- Rising fuel prices;
- Increased demand for some products, such as meat, particularly in rapidly emerging markets such as China and India;
- Growth in biofuels production (see Figure 10); and
- Speculation in agricultural commodity markets.

Figure 10. World Ethanol Production, 1975-2005.



Source: Source: EarthTrends, 2007 using data from Earth Policy Institute, 2006.
<http://earthtrends.wri.org/updates/node/292>

Biofuels

There is much controversy surrounding the role of biofuels in global food price inflation. Oxfam, for example, argues that biofuel production policies in developed nations are driving up global food prices¹⁵. They argue that this arises from the diversion of more and more food crops and agricultural land into biofuel production. They point to a study “published in the journal *Science* which calculates that the emissions from global land-use change due to the US corn-ethanol program will take 167 years to pay back.” Furthermore, they assert that “European Union (EU) biodiesel consumption is driving spiraling demand for palm oil both for use in biodiesel, but also to replace rapeseed and other edible oils diverted into the European biofuel program. Oxfam estimates that by 2020, the emissions resulting from land-use change in the palm-oil sector may have reached between 3.1 and 4.6 billion tones of CO₂ – 46 to 68 times the annual saving the EU hopes to be achieving by then from biofuels.”¹⁶

¹⁴ ERBD 2008. “Rising Food Prices: Causes, consequences, and policy responses.” Office of the Chief Economist, European Bank for Reconstruction and Development, Discussion Paper, 10 March 2008, London. Available at: www.fao.org/newsroom/common/ecg/1000808/en/FAOEBRD.pdf

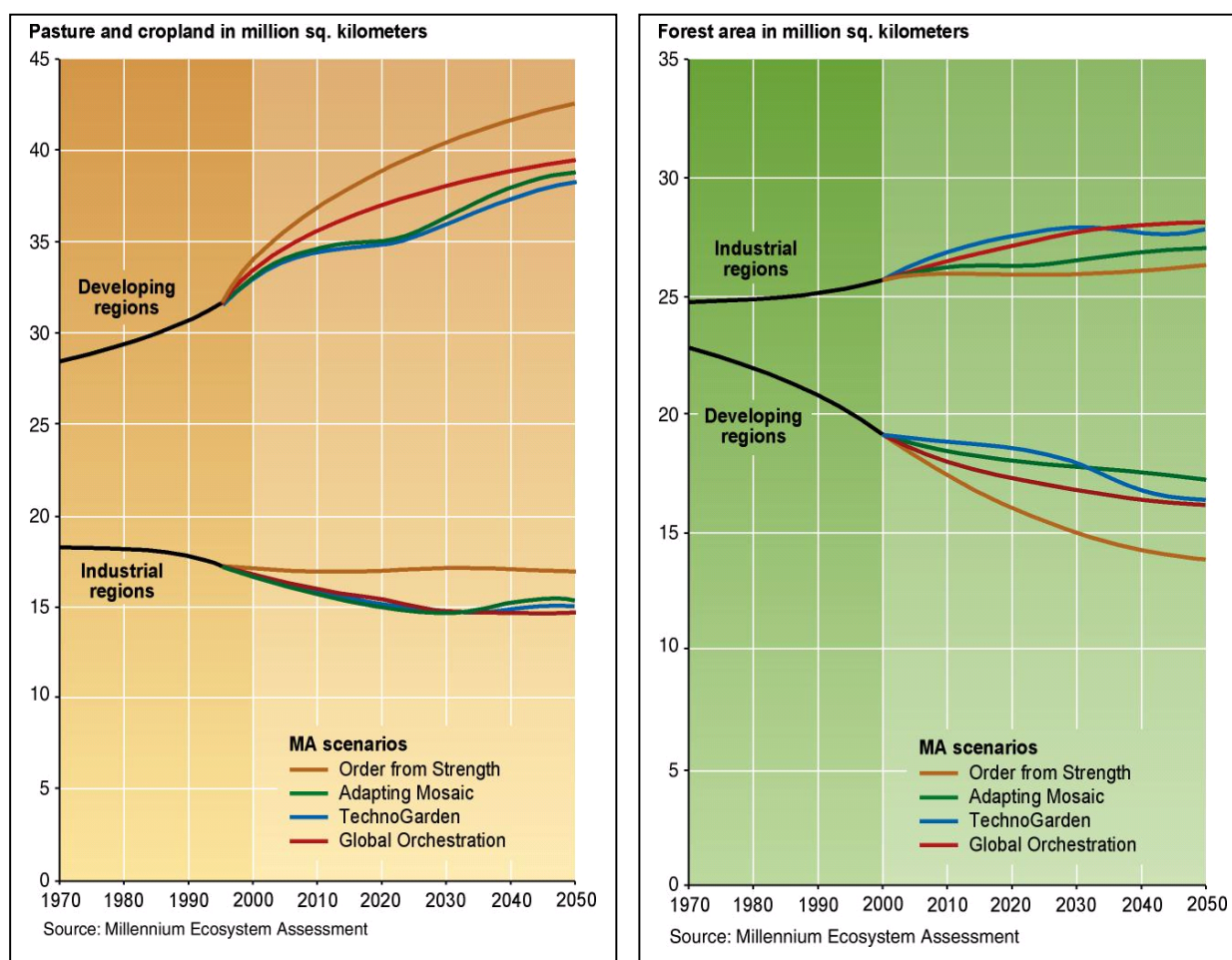
¹⁵ Oxfam 2008. Another Inconvenient Truth. How biofuel policies are deepening poverty and accelerating climate change. Oxfam International Briefing Paper 114, June 2008.

¹⁶ Ibid.

The Oxfam view matches the trends observed by the Millennium Ecosystem Assessment which shows the inverse relationship between cropland and forest area in developing countries (Figure 11).

This trend has significant implications for the global carbon balance and is beginning to be addressed at the UNFCCC policy development process under the theme of 'reducing emissions from deforestation in developing countries' (REDD). However, policy development in the REDD sector is facing challenges from the financial (including carbon market) incentives to convert forest lands to biofuel plantation crops in some developing countries. This was a prominent issue at COP13 in Bali (December 2007) with a lot of attention from NGOs, research agencies and the UNEP focusing on the conversion of South East Asian peatlands for oil palm plantations. According to a report by the Global Environment Centre (involving a collaboration with the UNEP, the Convention on Biological Diversity, Wetlands International and the Global Environment Facility), peatlands store 10 times more carbon per hectare than other ecosystems, and the clearing and burning of peatlands (common practice for oil palm plantations in Indonesia) emits over 3 billion tons of carbon dioxide into the atmosphere annually.¹⁷

Figure 11. Global Trends / Scenarios for Pasture and Forest Lands (MEA 2005).



¹⁷ Parish, F., Sirin, A., Charman, D., Joosten, H., Minayeva, T., Silvius, M. and Stringer, L. (Eds.) 2008. Assessment on Peatlands, Biodiversity and Climate Change: Main Report. Global Environment Centre, Kuala Lumpur and Wetlands International, Wageningen. Available at: <http://www.gecnet.info/index.cfm?&menuid=48>

This forest carbon issue (a subset of the overall biofuel issue) poses an interesting challenge for high level policy development in the run up to the UNFCCC post-2012 agreement due to be finalised at COP-15 in Copenhagen in December 2009.

In terms of policy responses to the challenge posed by biofuels, Oxfam¹⁸ calls on developed nations to:

- remove biofuel production incentives by introducing a freeze on the implementation of further biofuel mandates, and carry out an urgent revision of existing targets that deepen poverty and accelerate climate change;
- dismantling subsidies and tax exemptions for biofuels and reduce import tariffs; and
- tackling climate change and fuel security through safe and cost-effective measures, prioritizing regulation to enforce ambitious vehicle-efficiency improvements.

The FAO has also undertaken a study into the issue of biofuels in an effort to provide a basis for a policy response to this challenge and apparent contradiction in climate change policy instruments. In 2008 the FAO released a report entitled “The State of Food and Agriculture. Biofuels: Prospects, risks and opportunities” which explored the relationship between food security and biofuel production systems. The report aimed to address questions concerning the full environmental and social impact of biofuels against a backdrop of a stressed agricultural resource base.

The key messages arising from this report are as follows:¹⁹

- “Demand for agricultural feedstocks for liquid biofuels will be a significant factor for agricultural markets and for world agriculture of the next decade and beyond.
- Rapidly growing demand for biofuel feedstocks has contributed to higher food prices, which pose an immediate threat to the food security of poor net food buyers in both urban and rural areas.
- In the longer term, expanded demand and increased prices for agricultural commodities may represent opportunities for agricultural and rural development.
- The impact of biofuels on greenhouse gas emissions – one of the key motivations underlying support to the biofuel sector – differs according to feedstock, location, agricultural practice and conversion technology.
- Harmonized approaches for assessing GHG manacles and other environmental impacts of biofuel production are needed to achieve desirable outcomes.
- Liquid biofuels are likely to replace only a small share of global energy supplies and cannot alone eliminate out dependence on fossil fuels.

¹⁸ Oxfam 2008. Another Inconvenient Truth. How biofuel policies are deepening poverty and accelerating climate change. Oxfam International Briefing Paper 114, June 2008.

¹⁹ FAO 2008. “The State of Food and Agriculture. Biofuels: Prospects, risks and opportunities.” FAO, Rome, 2008.

- Production of liquid biofuels in many countries is not currently economical without subsidies, given existing agricultural production and biofuel-processing technologies and recent relative process of commodity feedstocks and crude oil.
- Policy interventions, especially in the form of subsidies and mandated blending of biofuels with fossil fuels, are driving the rush to liquid biofuels.
- Ensuring environmentally, economically and socially sustainable biofuel production requires policy action in the following broad areas:
 - Protecting the poor and food insecure
 - Taking advantage of opportunities for agricultural and rural development
 - Ensuring environmental sustainability
 - Reviewing existing biofuel policies
 - Making the international system supportive of sustainable biofuel development.

Distribution

The food justice movement spearheaded by the NGO sector argues that an important dimension of food insecurity is inadequate distribution of existing food supplies and accessibility of existing food production. This view is based on the notion that there is sufficient food in the world to meet demand (even in many famine situations), but price and distribution barriers obstruct the accessibility of food to low socio-economic sectors of the world economy, thereby contributing to food insecurity.

A prominent advocate of the need for improved systems of food distribution is the Institute of Food and Development Policy which promotes farmer and local community led agricultural development as a centre piece for efforts to deliver food sovereignty and food security in developing nations.

The issues of food distribution are very broad and beyond the scope of this briefing paper, but form part of the overall equation of world food security and would need to be considered as a dimension of any policy response to the current world food crisis.

IMPLICATIONS FOR NEW ZEALAND

The global situation relating to the intersection of climate change and food security has direct and indirect implications for New Zealand. The direct effects relate to the domestic conditions of food supply and demand and associated influences of climate change on this. Indirectly, New Zealand is connected to the rest of the world bio-physically, economically and politically. As such, New Zealand cannot avoid this situation through a sense of isolation.

Direct Impacts

The New Zealand population is projected to increase (taking account of natural increase and in/out migration) from 4.1 million in 2004 to 5.05 million in 2051.²⁰ This population

²⁰ Statistics New Zealand, 2005b: *National Population Projections 2004-2051*. Statistics New Zealand, New Zealand Government. <http://www.stats.govt.nz/datasets/population/population-projections.htm>

pressure is not likely to produce a dramatic increase in demand-side challenges for food security for New Zealand as is the case for most industrialized nations.

The IPCC projections of climate change for New Zealand²¹ include:

- Water resources are likely to become increasingly stressed in some (particularly eastern) areas, with rising competition for water supply.
- Regional reductions in rainfall in eastern New Zealand are likely to make agricultural activities particularly vulnerable.
- Increasing coastal vulnerability to tropical cyclones, storm surges and sea-level rise.
- Increased frequency of high-intensity rainfall, which is likely to increase flood damage.
- The spread of some disease vectors is very likely, thereby increasing the potential for disease outbreaks, despite existing biosecurity and health services.

NIWA²² have summarised the likely impacts of climate change on agriculture for the coming century as follows:

- Likely increase in pasture production and forestry in cooler areas where water not limiting
- Longer growing seasons, less frost risk
- Higher temperatures produce more favourable conditions for livestock pests and diseases
- Increased drought risk in the east
- Subtropical pastures spread south reducing productivity
- Irrigated agriculture in the east more vulnerable

NIWA²³ also provide a summary of projected impacts on fisheries:

- Local extinctions of fish species on edges of ranges
- Slowing of meridional overturning reduces nutrient upwelling
- Colder water species productivity may be reduced in subtropical waters and the distribution of spawning areas and fisheries and may be affected;
- The ability of colder water species to extend their range further southward towards the poles is likely to be limited by the lack of availability of suitable habitat;
- Warmer water species productivity may be enhanced in subtropical waters;
- The distribution of more tropical species may expand southward within the EEZ.

The most significant direct impacts of climate change on food security for New Zealand are likely to be associated with losses in crop productivity in eastern regions that become warmer and dryer, regions that are likely to suffer from increased incidence of flood damage, and coastal regions that are vulnerable to sea level rise combined with storm surges during cyclone events. Adaptive capacity for agricultural productivity is considerably greater than in many other parts of the world including Australia.

²¹ Hennessy, K., B. Fitzharris, B.C. Bates, N. Harvey, S.M. Howden, L. Hughes, J. Salinger and R. Warrick, 2007: Australia and New Zealand. *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 507-540.

²² Sallinger, J. 2008. Climate Change and Food: Agricultural Land & Ocean Fisheries. Presentation to the Climate Change and Business Conference, Auckland August 2008. Available at:

<http://www.climateandbusiness.com/program.html>

²³ Ibid.

On the fisheries front there is less certainty but one potentially significant direct challenge arises from acidification of surface ocean waters and its potential effect on the marine food chain (of which the fishing industry forms a component part).

Indirect Impacts

Because of New Zealand's economic and political connectivity to the rest of the world it is highly likely that this country will experience flow-on effects of climate change and its impacts on food security (and economic and national security) occurring in other nations. This is linked through global commodity prices and the role of New Zealand as an importer and exporter of food products. For example, grain prices that rise as a result of drought in Australia push up the price of staple foods in many grain importing nations including New Zealand. Furthermore, as the demand for global food resources rises in developing countries (where world population increases will be the highest), this will increase competition for food commodities and likely influence prices as a function of the supply/demand dynamic.

Other indirect impacts include the relationship New Zealand has with its Pacific Island neighbours in terms of the likely increase in demand for aid and migration opportunities for small island nations experiencing significant climate change impacts. Some possible examples:

- More frequent droughts in the western Pacific resulting from the projected eastward shift in precipitation associated with changes in the El Niño – Southern Oscillation climate pattern²⁴
- Sea level rise combined with salt water intrusion of ground water in coastal and atoll communities
- More frequent cyclone damage
- Coral bleaching degradation of coastal fisheries and impacts on to tourism industry
- Tourism industry decline and associated unemployment due to oil price increases.

Implications

This global situation raises several policy questions for New Zealand going forward. Such questions include:

1. *What are the potential opportunities and/or risks to New Zealand arising from global food price inflation? As an exporter there are potential gains to be made as food commodity prices rise, but there is also a downside as we are also a food importer. This rise in international food prices may be coupled with (and partly driven by) rising production costs (e.g. oil price) in which case the net benefits to New Zealand may not be very significant. Further detailed analysis of this question would be helpful.*
2. *Should New Zealand take precautionary measures to forestall risk exposure arising from likely increasing production costs (e.g. driven by longer term trends in oil price) in agriculture and fisheries? This presents an opportunity to explore ways to design a future that is less dependent on rising oil prices through perhaps a combination of fuel switching where possible, and an increase in domestic food self sufficiency (thereby lowering food import costs).*

²⁴ Solomon, S., D., et al, 2007: Technical Summary. In: *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. P 73.

3. *Are there opportunities to minimise future risk associated with highly variable international commodity prices?* The New Zealand economy relies on primary production exports. There may be reason to invest in diversifying the economy to lower the risks associated with a high primary production export base.
4. *Is there potential to export agricultural production innovations to developing nations in most need of assistance to increase their food security from local production?* New Zealand may wish to play a proactive role in building solutions to the food security crisis by providing some of the services called for in the 'Declaration on World Food Security: the Challenges of Climate Change and Bioenergy'.
5. *Is there an opportunity for New Zealand to play a leadership role in international policy in this area?* New Zealand stands along side many developing nations in international policy forums (e.g. WTO) that seek international trading infrastructures and rules that help such exporters gain access to markets in wealthy nations. There may be a role for New Zealand to participate as an active collaborator with developing nations to consolidate a policy platform that would help to deliver the trading ideals sought in the World Food Security Declaration.

INTERNATIONAL POLICY IMPLICATIONS

The combined global issue of climate change and food security presents a multidimensional challenge arising from the intersection of a number of keystone global trends. This may prove to be the defining challenge for international relations for the first half of this century, given the near term risks arising from current food insecurity in some regions (as a legacy from the 20th century), together with

- a. rapidly increasing demand from high population growth rates in those same regions
- b. constraints to adequate supply-side growth in production and distribution of food commodities, and
- c. risk of continuation of food price inflation, driven partly by oil price dynamics (influencing all prices dependent on petroleum energy) associated with geological and geographical supply challenges
- d. a climate-affected security environment that forces political leaders in many parts of the world to cope with multiple security challenges simultaneously.²⁵

The opportunity for this situation to generate conflict within and between nations is significant, and this poses a challenging immigration and national security risk scenario for nations not directly affected by these trends. Even if relatively wealthy nations seek to operate out of self interest alone, it seems logical that diminishing national security and immigration risks at their source, provides sufficient grounds for the domestic political economy to invest in addressing the causes of this challenging situation. Add to this the compassionate concerns of some constituencies (usually a significant minority) and we have a potentially solid (e.g. multi-partisan) mandate for major contributions towards coordinated global action.

²⁵ This issue (d) was taken up in a recent IPS working paper: Sinclair, E. 2008. The Changing Climate of New Zealand's Security: Risk and Resilience in a Climate Affected Security Environment. Institute of Policy Studies, Victoria University of Wellington, Working Paper 08/11. Available at: <http://ips.ac.nz/publications/publications/show/239>

The responsibility for action cannot be restricted to the public sector – indeed it is too great a challenge for governments to be capable of addressing on their own - but instead clearly needs to arise from the combined efforts of public sector, private sector and community capabilities. The key challenge for interested players in developed countries, therefore, is to help create the policy conditions to enable this to occur. These policy conditions need to be capable of directing investments towards innovative solutions to this fundamental global resource management problem. To be politically sustainable in the developed countries, innovative financing options should be capable of generating returns in both micro and macro economic terms, as well as provide an opportunity for on-going effective philanthropy. The microeconomic returns can be the domain for the private sector and the macroeconomic returns (e.g. serving the interests of national security, intergenerational considerations, filling the gaps arising from market failure, and providing grants as an aid donor) can be the primary responsibility of governments. Public sector, private sector and community grant programs will clearly continue to play a central role in philanthropic support.

The financing and then design and implementation of rolling innovations for meeting a common challenge of this scale will also benefit from the coordination of information systems and communication infrastructures. A key role for developed country governments, therefore, can also be to foster the most favourable conditions to motivate innovation and investments of this kind. Another important role for governments is to facilitate multi-stakeholder dialogue (including with developing country stakeholders) to assist with the effective coordination of smart program design, implementation, monitoring, evaluation, and redesign in an on-going adaptive cycle.

Carbon markets provide an interesting model for engaging the private sector (in both compliance and voluntary capacities), in making contributions to the delivery of outcomes for which there has been market failure in the past (viz. climate change mitigation services). This broad market model could conceivably be adapted in some way to help meet this food security challenge. For example, project-based carbon trading generates carbon units that arise from methodologies that need to meet certain quality assurance criteria in both the compliance and the voluntary carbon markets. The more stringent the quality assurance process, the higher the value of the units. It may not be very difficult to include food security solutions as a component of carbon project design criteria as is already taking place in the voluntary carbon market with the development of boutique carbon products such as those certified by the Climate Community and Biodiversity, and Social Carbon standards.²⁶ Furthermore, on the demand side, the voluntary carbon market includes buyers who are more interested in buying climate friendly outcomes than tradable units of carbon, and these buyers (purchasing corporate social responsibility 'certificates'), and their customers represent a potential market for global food security outcomes.

The overarching goal here is to generate the most effective and politically sustainable synergies between market and non-market mechanisms to deliver a shift in the underlying conditions the generate global food insecurity. In terms of addressing these conditions, we can benefit from the lessons of geography and history that show strong links between socio-economic conditions and population growth rates.²⁷ History has commonly shown that as socio-economic conditions improve in a community we get a reduction in infant mortality rates (and other indicators of improved conditions including female literacy and longevity). Then, following a generational lag period, we see a

²⁶ Hamilton, K. et al 2008. Forging a Frontier. State of the Voluntary Carbon Markets 2008. New Carbon Finance and Ecosystem Marketplace. Released 8 May 2008.

²⁷ This refers to the Demographic Transition Model. See O'Meill et al 2005. Population and Climate Change. Cambridge University Press, Cambridge. P 44-48.

decline in birth rates and a consequent slowing of population growth rates. This produces something of a “chicken and egg” situation because of course, food insecurity will generate the exact conditions leading to high population growth rates (until starvation and conflict take a significant toll on the population). Clearly, therefore, to lower the conditions of global food demand we need to improve food security (and other socio-economic indicators) among those communities that are suffering the most already (which is consistent with the Millennium Development Goals). Doing so is possible when we raise the standard of living in these communities.

Raising the standard of living in any society is usually accompanied by an increase the per capita ecological footprint of consumers in these societies. So, to avoid global resource overshoot it is important that the type of consumption patterns be designed for a low ecological footprint (particularly in energy resources) in LDCs. This will require a significant transfer of technological innovation and capability to these societies by means of North-South partnerships in the common global interest. It can also come about through a net reduction in the per capita ecological footprint of those in the North simply as a matter of arithmetic – as there are not sufficient global resources to support a world population with an aspiration for ubiquitous per capita consumption rates common in developed countries.

The Kyoto Protocol has been designed partly as a means of facilitating such a partnership (e.g. no initial requirement on developing countries to take on binding targets) but a more ambitious intergovernmental policy framework may be necessary. A Post-2012 climate agreement could potentially go some way towards this, but the issue is bigger than climate change alone. One option is better coordination between keystone global policy forums such as the UNFCCC, the Millennium Development Goals, the WTO, and the G8. There may even be room for an overarching international agreement that develops a coordinated policy framework focusing on the core issues faced by the global community in the 21st century (e.g. food security, energy security, climate change, international trade, and national security). A country like New Zealand, with its reputation as an innovator, peace-keeper, and environmental leader, would be in a good position to support or even initiate intergovernmental dialogue in this area.