Climate change: the animal connection

MOST Australians love the sea. I recall spending countless happy hours in the waves when nominally studying for my high school exams.

Snorkelling and scuba diving became my gateways to miraculous underwater worlds. I explored ancient ship wrecks, had close encounters with inquisitive sharks and majestic sting rays, and swam over pieces of coral the size of small cars, on the Great Barrier Reef.

ANDREW KNIGHT believes that reducing the production of meat could help solve one of the world's major problems

It was clear to me that coral reefs are one of the wonders of the world. Home to an estimated 1-3 million species, including more than a quarter of all marine fish species, they are the most biodiverse of all marine ecosystems. I was, therefore, profoundly disturbed to learn at Australia's Minding Animals Conference last July that the world's coral reefs are dying *en masse*.

According to the Southern Cross University's Dr Peter Harrison, around 30% of all coral reefs have now been seriously damaged from bleaching, pollution, fishing, invasive alien species (such as coral-eating starfish), and disease.

Of greatest concern are oceanic temperature increases that kill the fragile unicellular algae symbiotically residing within coral polyps. The latter then lose their colour, resulting in characteristic bleached reefs. Increased CO_2 dissolution also acidifies sea water, hindering regeneration.

Current scientific consensus is that stabilising atmospheric CO_2 levels above 350ppm will not prevent the catastrophic loss of coral reefs globally. Levels are currently at 387ppm and rising, and it is expected that 60% of all coral reefs worldwide could be lost by 2030.

Rising sea levels and temperatures

As they die, however, the world's coral reefs are sending us a warning about the health of our planet. Since 1970, the earth's average surface temperature has increased by 0.6ºC, and the Intergovernmental Panel on Climate Change (IPCC) projects temperature rises of up to 6ºC this coming century.

The subsequent melting of the Greenland and West Antarctic ice sheets, combined with thermal expansion of the oceans, could raise sea levels by up to six feet. Rises of only half that level would devastate the rice-growing river deltas and floodplains of Asia, on which hundreds of millions of people depend for food.

Similarly, the Himalayan and Tibetan glaciers that sustain the major rivers of India and China during the dry season, and the grain irrigation systems that depend on them, are rapidly melting. The vast populations dependent on these glaciers make their melting the greatest threat to food security ever faced by humanity.

During the coming three centuries, worst-case scenarios project sea rises as high as 80 feet, which would drown much of Great Britain and Ireland, as well as coastal cities such as Washington DC and New York. Although we are set to successfully replace coral reefs with the bones of drowned cities, the biodiversity levels and aesthetic aspects will, of course, be profoundly different.

Demographic changes increasing hunger

For each 1ºC temperature rise, wheat, rice, and corn yields decline by 10%. The strains on our food supplies are further exacerbated by our inexorably rising population and, particularly, by the desire of much of that population to adopt more consumptive lifestyles.

There are currently around 6.8 billion of us, which will rise to nine billion by 2040. Around three billion are increasingly affluent developing world consumers who are enthusiastically adopting the lifestyles of richer countries.

Jungle burned for agriculture in southern Mexico (photographer: Azari Nicks).

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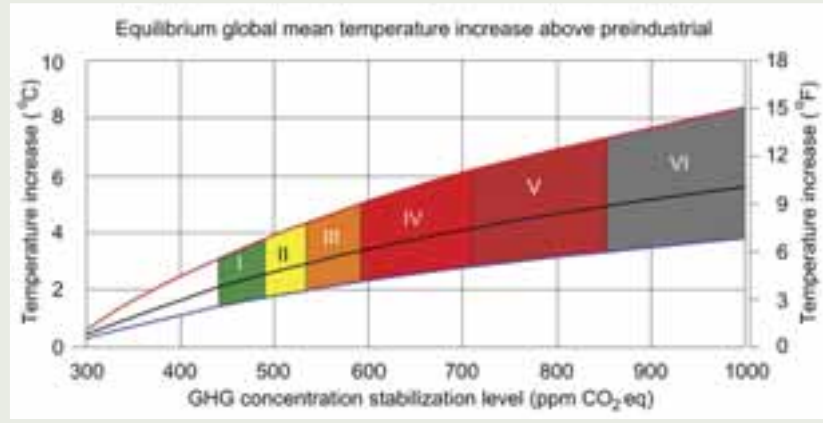


Projected temperature increase for a range of stabilisation scenarios (the coloured bands). The black line in the middle of the shaded area indicates "best estimates"; the red and the blue lines are the likely limits. From IPCC AR4 (illustration from Wikimedia Commons).

In particular, these people are buying more animal products – which require far greater inputs of grain. At the top of this food chain are the United States and Canada, where people consume an average of 800kg of grain annually, most of it indirectly as beef, pork, poultry, milk and eggs. Near the bottom is India, where people have less than 200kg each, and thus must consume nearly all of it directly, with little margin for conversion to animal protein, which is inherently inefficient.

Fuelled by such unprecedented demands, world prices of wheat, rice, corn, and soya beans roughly tripled from mid-2006 to mid-2008, and are set to continually increase as demands inexorably rise. Inevitably, therefore, hunger among those least able to afford such increases is spreading. In the mid-1990s, 825 million people suffered from hunger and malnutrition. The total now exceeds one billion and rising.

Impacts of the livestock sector

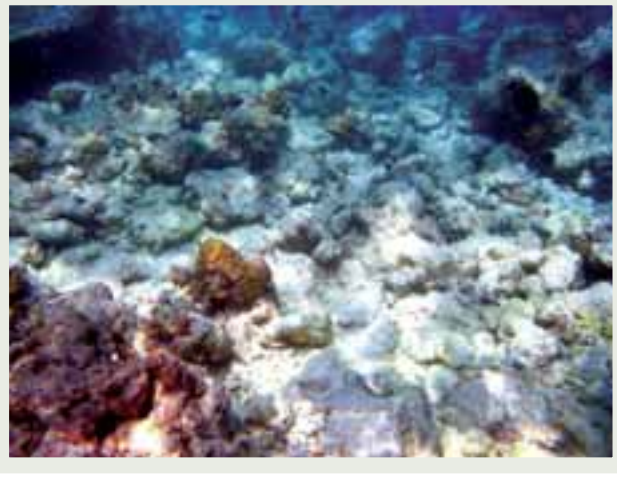
The devastating climatic impacts of our heavy social and industrial reliance on fossil fuel combustion is well understood. In comparison, however, awareness of the contribution made by the livestock sector remains infantile.

In 2006 the United Nations Food and Agriculture Organisation (Steinfeld *et al.*) calculated that 18% of worldwide greenhouse gases (GHGs) when measured as CO_2 equivalents (CO_2e) – totalling 7,516 million tons annually – are attributable to the production of cattle, buffalo, sheep, goats, camels, horses, pigs and poultry.

This includes emissions resulting from clearing land to graze livestock and grow feed, from the livestock themselves, and from processing and transporting livestock products. In contrast, all forms of transportation combined worldwide produce around 13.5% of global GHGs.

The 18% contribution to worldwide GHGs is comprised of CO_2, methane, nitrous oxide and ammonia emissions. The livestock sector is responsible for

A healthy coral reef at Port Ghalib, Egypt (photo by J. Hutsch); below: a part of Moofushi coral reef in the Maldives, strongly hit by 1998's El Niño; almost no live coral is now visible (photographer Bruno de Giusti).



9% of anthropogenic CO_2 emissions, that is emissions attributable to human activity, mostly resulting from deforestation caused by the encroachment of pastures and feedcrops.

Livestock production occupies 30% of the Earth's land surface, and ever-increasing production is a key driver of deforestation, particularly in Latin America. Seventy per cent of previously-forested Amazonian land is now occupied by pastures, with feed crops covering a large part of the remainder.

Additionally, livestock emit 37% of anthropogenic methane – which exerts 72 times the global warming potential (GWP) of CO_2 over a 20-year time-frame, mostly from enteric fermentation by ruminants. They also emit 65% of anthropogenic nitrous oxide – with a staggering 296 times the GWP of CO_2, the great majority of which is released from manure. Finally, they emit 64% of anthropogenic ammonia, which contributes significantly to acid rain and subsequent ecosystem acidification.

"The environmental impact per unit of livestock production must be cut by half, just to avoid increasing the level of damage beyond its present level." – Steinfeld *et al.*

In November 2009, Goodland and Anhang released the results of a study demonstrating that at least 3,000 million tons of CO_2e attributable to livestock production were misallocated, and at least 22,048 million tons were entirely uncounted, by Steinfeld and colleagues.

Uncounted sources included livestock respiration, deforestation and methane under-estimates. When these 25,048 million tons are included, the CO_2e attributable to livestock production rises to 32,564 million tons, and the total global inventory of atmospheric GHGs rises from 41,755 to 63,803 million tons. Hence, Goodland and Anhang concluded that livestock production actually accounts for at least 51% of worldwide GHGs, and probably significantly more.

The flatulence of cows is only a small portion of cows' methane release. Cows also burp methane due to the physiology of their digestive systems (photo from the Agricultural Research Service, the research agency of the United States Department of Agriculture).

Reducing livestock impacts

Strategies to reduce methane emissions from ruminants through dietary management, nitrous oxide emissions through manure management, and to decrease deforestation and encourage carbon sequestration through improved pastoral management, are important in combating climate change.

However, global meat and dairy consumption is expected to double by 2050. Hence, as observed by Steinfeld and colleagues (2006), "The environmental impact per unit of livestock production must be cut by half, just to avoid increasing the level of damage beyond its present level." Yet, significant reductions in present levels are actually necessary, rather than maintenance of the *status quo*, if we are to have any hope of avoiding catastrophic climate change.

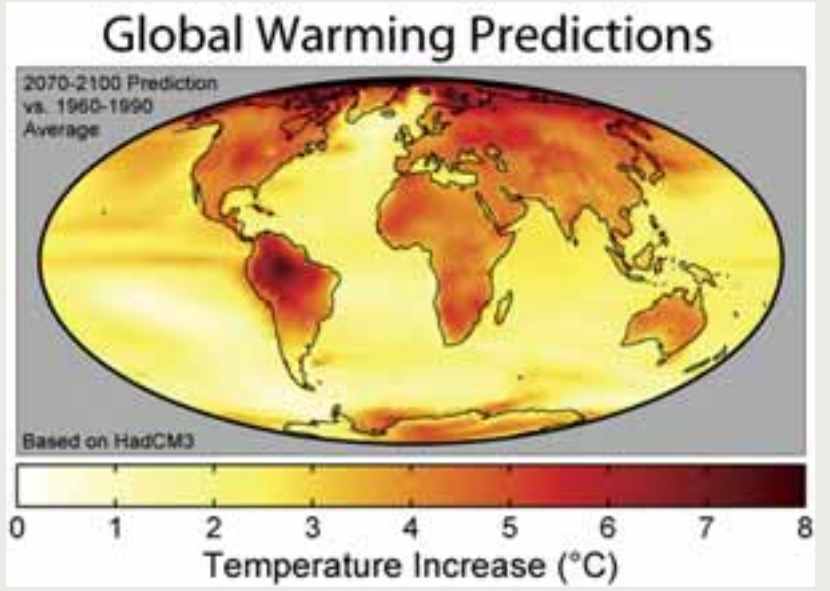
Hence, mitigation of the emissions resulting from our existing patterns of consumption will be far from sufficient. Considerable changes in consumption patterns will also be required. As concluded by Goodland and Anhang (2009), and Stehfest and colleagues (2009), replacing livestock products with alternatives is the best strategy for reversing climate change.

Implementation of such policy would have far more rapid effects on GHG emissions than replacement of fossil fuels by renewable energy sources. Of all available options, decreasing consumption of livestock products would bring the most immediate benefits, for the lowest cost, and would not require the development of any new technologies.

When receiving the Nobel Peace Prize for the IPCC's work in 2007, IPCC head Dr Rajendra Pachauri asked the world to "Please eat less meat," and has since repeated and strengthened this call. To this must similarly be added a call to consume less dairy products and eggs, given the severe adverse impacts of these sectors on both climate change and animal welfare.

Fortunately, however, as Stehfest and colleagues (2009) observed, such a diet low in animal products would not only substantially decrease the adverse impacts of climate change, but would simultaneously provide profound benefits for public health, public finances, and global land availability.

The solution to our problems could hardly be simpler; it is the wisdom required to implement it that appears beyond our collective reach



The geographic distribution of surface warming during the 21st century calculated by the HadCM3 climate model if a business-as-usual scenario is assumed for economic growth and greenhouse gas emissions. In this figure, the globally averaged warming corresponds to 3.0°C (5.4°F) (illustration from Wikimedia Commons).

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