

Background Paper on Food and Hunger:

Prepared for the Lutheran Church of Australia's *Commission on Social and Bioethical Questions (CSBQ)*.

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Introduction

The United Nations Food and Agriculture Organisation (FAO) estimated in 2008 that the number of *chronically hungry* people in the world in 2007 was 923 million, or about one person in every seven.¹ In some countries this fraction was much higher; as much as one in two. Many more suffer intermittent hunger. The 2007 number was more than 80 million higher than in 1990-1992. It was also calculated prior to both the 2008 oil price rises and the present “Global Financial Crisis”, both of which have affected poor people’s access to food, suggesting that the present figure may be even higher.

Australians are not immune from hunger. The food security of urban Australians depends largely on their economic security: those who do not grow their own food need money to buy it. The current recession raises food security concerns because of increased unemployment, lower incomes and high levels of debt.

Campaigns to “make poverty history” and “eradicate world hunger” are supported by many well-meaning people. But many of the people who attend fundraising concerts, display the slogans on bumper stickers, and wear promotional wristbands have little idea of the magnitude of these tasks. Hunger is a product of many different causes, for which there are no simple or speedy solutions. In 2008-2009, food stress has been attributed to high oil prices; smaller than usual harvests in major grain exporting countries due to adverse weather; speculation in grain, hoarding and profiteering; conversion of food crops to biofuels; and the effects of economic recession.

When facing a difficult challenge it is good to be prepared. Effective action rarely emerges out of ignorance. This paper is designed to help readers familiarise themselves with issues related to food and hunger, and hopefully plant some seeds that will germinate and bear fruit. Section 1 begins by explaining some of the terminology to do with food issues. Section 2 deals with the characteristics of complex problems like hunger. Section 3 investigates a number of important issues related to food and hunger. Section 4 discusses some of the dilemmas raised by increased awareness of these issues. Section 5 covers some key reasons for taking action. Section 6 distils out some principles to guide action on food and hunger. The final section serves as a summary.

Section 1: Explaining some key terms

The term *food security* describes people's ability to access sufficient food to prevent hunger and avoid malnutrition.² People who suffer low food security can also be said to suffer from *food stress*. Food *production* is an important aspect of food security. The more people there are, the more food we need to grow. Food *distribution* is also important. Even if there is more than enough food produced to go round, people can still go hungry if it is not shared fairly.

The term *food sovereignty* describes people's ability to make choices about their food.³ People have high food sovereignty if they have control over means of food production, like land, water and seed. People have low food sovereignty if their food choices are determined largely or wholly by others. People who don't have food sovereignty could also be said to *food dependent*. Food sovereignty obviously has to do with *power relations*.

Box 1 below demonstrates that food security and food sovereignty can clash.

Box 1: Food security and food sovereignty or food security vs food sovereignty?

Food *security* is more important than food *sovereignty*. Food security is essential for a decent life. Food sovereignty is highly desirable but not essential for a decent life. Some argue that in order to improve food security, certain people must accept reduced food sovereignty. Market economists might say that food sovereignty is an outmoded concept and modern consumers exert power over food supply by creating demand. These perspectives highlight the difficulty of "solving" food security and food sovereignty simultaneously.

The term *food safety* describes the level of risk to human health posed by food. Food safety is determined by the way food is produced, stored and handled.

The term *consumer engagement* describes the extent to which people know about and care about their food. People who are disengaged from food consume unthinkingly; they may be ignorant of the way food is produced and distributed, or they may not care as long as they satisfy their own hunger. People who are engaged pay more attention to how food is produced and distributed, and genuinely care about it. Engaged consumers consider food production, distribution and consumption to be ethical issues. Consumer engagement is a precondition for *consumer action*.

The term *consumer activism* describes the extent to which consumers are prepared to *act* in response to their knowledge about food. People score low on consumer activism if they are aware of problems with the food system, but don't

do anything about it. People score high on consumer activism if they respond to problems by facing up to them and doing something about them.

What activist consumers decide to do is called *consumer action*. Consumers can act as individuals or in groups, and their knowledge, values, experience, coordination and commitment are some of the factors that influence what they do and how effective it will be. Coordinating consumer action on food security and food sovereignty are very difficult tasks. The problems are very big and people have a tendency to have different opinions about them.

Section 2: Dealing with “Wicked Problems”

Unfortunately hunger is not a straightforward problem that can be “solved” like a mathematical equation or a crossword puzzle. It is a good example of what planning experts call a “wicked problem”.⁴ The word “wicked” here is used not in the sense of being “evil”, but rather to indicate that the problem is extraordinarily difficult, multi-faceted and tricky. It cannot be satisfactorily addressed by a single action, but requires helpful contributions on many fronts. We face many wicked problems in Australia and the world. Some examples include reaching agreement on action to counter climate change; how to create a strong and prosperous economy without destroying the environment; dealing with terrorism; what to do about the Murray-Darling Basin; and reducing alcohol and drug abuse. These problems defy simple solutions. Let’s briefly consider the characteristics of wicked problems as they apply to food and hunger.

1. Complexity

Consider the many factors that affect food production:

Soil conditions; water availability; slope; hours of sunlight; seasonality; climate; extreme weather events; pollution; pests and diseases; knowledge; skills; available labour; technology; energy; storage and transport infrastructure; market access; input prices; commodity prices; wealth of producers, number and purchasing power of consumers; incentives and subsidies; competition; land rights and access; farming intensity; trade agreements; development priorities; agricultural policies; credit and insurance arrangements; politics; gender relations; health; conflict and so on.

Some of these factors also affect food distribution. But there are other things that affect food distribution too, such as societal values like “human rights” and how well they are adhered to.

2. Interconnectedness and Uncertainty

Many of the items on the above list are connected in some way, like the strands of a spider’s web. It is impossible to intervene in one area without affecting others. Sometimes these effects are unpredictable and unintended, and once they occur are not readily reversed. For example, the use of agricultural chemicals does a lot of good, but also some bad. Sometimes it is impossible to undo bad effects.

When facing uncertainties, such as uncertain food security, it is helpful to be able to look to the past for insights into coping in the present. Sometimes situations in the past are sufficiently comparable to make valid comparisons. But the more different the present becomes from the past, in terms of climate and population for example, the harder it becomes to make valid comparisons.

3. Ambiguity

People have different cultural and educational backgrounds and life experiences. They view the same food problems through different eyes; as economists, social workers, scientists and health professionals for example. Accordingly, they will make different recommendations on how best to deal with them. Their reasoning may be highly logical according to their values and priorities, and the information on which their recommendations are based. So determining who is right and who is wrong gets confusing, because they all seem sort of right and none seem absolutely wrong. Each potential problem-solver designs strategies by viewing different but incomplete parts of the whole picture, and so taken individually, they are limited, or deficient in some way. And as none possess perfect understanding of the whole picture, their recommendations are always open to challenge. Judging recommendations as “right” or “wrong” is too black and white. In the context of the big picture, it is more appropriate to judge them as “better” or “worse”.

4. Conflict

Whatever food policies are chosen, there will always be someone who is unhappy. Individuals or groups favour action that serves their own interests rather than the interests of other people or other species. They employ various means to protect their own interests, some of which are destructive of healthy relationships. Competition continuously undermines efforts at cooperation and altruism. Putting the needs of others before one’s own is not seen as a good policy for prosperity; it may even threaten survival! Even if we were technologically proficient enough to deliver complete food security, there are sufficient grounds to believe that humanity lacks the sense of common good required to succeed.

5. Insuperability

Another characteristic of a wicked problem is that it can be viewed as a symptom of a higher problem. For example, “hunger is a symptom of poverty”. The lower problem (hunger) won’t be solved unless the problem that gave rise to it (poverty) is addressed. Addressing the higher problem is more efficient because it prevents the symptoms. But the higher problem may also be seen to be a symptom of a yet higher problem, and the higher you go, the more vague and broad and unmanageable the problems become. Eventually it becomes necessary to solve problems like “human greed”, “selfishness” and “injustice”, where there is little hope of success.

The idea that a wicked problem like hunger can be “solved” is flawed. The use of the word “solved” connotes finality; that the task can be completed, and when it is, everyone can relax. Hunger can only ever be solved “for the time being”, and efforts to win the freedom from hunger must be ongoing.

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Thinking about how to deal with wicked problems tends to make people feel small and ill-equipped for the task. Some of the dilemmas created by fear that wicked problems like hunger will prove insoluble are discussed in Section 4. In the meantime, Section 3 covers a range of issues related to food production, distribution and consumption. These are part of the “big picture” that needs to be considered in any future “food plans”.

Section 3: Issues related to food and hunger

This paper cannot cover *all* the issues related to food and hunger, nor deal with the ones presented exhaustively. Readers are encouraged to identify interconnections between issues, and to try to imagine how proposals to “fix” one problem will impact on another. The issues covered are:

- (a.) Food is a commodity
- (b.) Waste
- (c.) Over-nutrition, under-nutrition and malnutrition
- (d.) Dietary preferences
- (e.) Population growth
- (f.) Gender relations
- (g.) Climate change
- (h.) Water
- (i.) Soil and land issues
- (j.) Biodiversity and biotechnology
- (k.) Biofuels and biosequestration
- (l.) Fossil-fuel dependency
- (m.) Food politics

(a.) Food is a commodity

There are a dwindling number of people in the world who are “self-sufficient”. Self-sufficiency does not generate the production surpluses required to fund government services and large public works like roads, dams, hospitals and power supplies. Self-sufficient or *subsistence* economies are modest in comparison with market economies, and their isolation makes them more vulnerable to disasters. Most people want some degree of modernisation or *development*, believing that it enhances living standards and quality of life.

In the past couple of centuries, technological change has allowed a small number of farmers to produce lots of food. Most people in Australia and other developed countries no longer produce food. They have progressively left agricultural work for new jobs in other sectors of the economy. Now they buy their food with money.

Because food has become a commodity that is bought and sold, it tends to go where it fetches the highest prices. So, where people are wealthy, food is found in great variety and abundance. And because wealthy people are oversupplied with food, clever marketing strategies have to be employed to convince them to buy and consume more than they really need. By contrast, poorer people tend to get less choice, quantity and quality. If food becomes scarce for some reason and prices go up, there is no contest; the rich simply outbid the poor. Unless

there is a safety net in place to protect the poor, they become vulnerable to hunger, and other bad outcomes like homelessness, crime, addiction and disease.

Those who control food wield great power. The fewer hands in control, the greater the temptation for them to engage in “anti-competitive behaviour”. Food merchants can form cartels by making deals with their rivals, and conspire to hold back food to let prices rise if they think they can get away with it. Such collusion has the potential to cause famine when there is actually sufficient food to go round.

Without adequate regulation, there is strong temptation for food producers to gain a competitive edge on rivals by adopting unethical food safety practices. The Chinese milk products adulterated with melamine, and the outbreak of Mad Cow disease in the UK from feeding cattle “high protein meal” containing the remains of diseased cattle and sheep are just two examples of short cuts to profit at consumers’ expense. It is easier for unethical producers to offload tainted produce in places where people have less capacity to test it, and where price is they key determinant in purchasing decisions.

People who worry about the extent of hunger in the world often fail to understand the consequences of food being a commodity. Farmers don’t grow food unless they believe they can sell it; they can’t afford to give it away for free!

Some vegetarians argue that there would be fewer hungry people if we stopped feeding so much grain to food animals and reserved it for poor people instead. Farmers, some of whom now call themselves agribusinesses, reply that they are money-making enterprises, not charities! If there is more profit in selling grain-fed beef to rich people than in selling grain at prices poor people can afford, the industry will favour cattle and meat-eaters. The agribusinesses say that if consumers suddenly decided to all turn vegetarian, they would stop producing grain-fed beef, pork and chicken. But of course they shape consumer preferences in their own interest by spending millions of dollars promoting meat consumption, not vegetarianism.

Small food producers have a tough time competing against big food producers. They are warned to “get big or get out!” Consequently the number of farmers is decreasing and corporate control of food production increasing.⁵ As control over the market in food falls into fewer and more powerful hands, we find ourselves increasingly at their mercy. Can we rely on trans-national food companies to act in the best interests of *all people*, or only their best customers? Do we need to rethink the whole structure of our industrial-agricultural complex? Do we actually have the power to reshape it?

Despite concerns about vulnerability to big food corporations, food is actually remarkably cheap if you are rich. When you consider the fraction of earnings the

rich allocate to food, it is less than what earlier generations paid, and much less than what poor people pay. Cheap food enables the rich to satisfy their appetites for other goods and services, many of which were either non-existent in times past, or were considered rare luxuries. Food is subsidised or exempted from taxes like the GST because it keeps governments popular.

Some ecological economists (and many farmers) argue that food is *too* cheap. When farmers get paid less per unit of product, they have to produce more to earn the same income. This can lead to unsustainable farming practices and concentration of farm ownership as disillusioned and indebted farmers sell up. While higher prices *could* improve sustainability, there is no guarantee that farmers will altruistically invest in sustainable practices (as opposed to increased personal consumption). Forcing food prices higher would also be a risky move politically.

Whenever food subsidies are removed, or taxes on food applied, there is a political backlash. Food riots threaten political stability, and many countries with chronic food stress are the same ones classified as “fragile” or “failed” states. Nobody wants failed states because they are breeding grounds for extremism and terrorist violence.

(b.) Waste

Because wealthy people are oversupplied with food, a lot goes to waste. What remains unsold at its ‘expiry date’ is dumped because of strict public health regulations. Price wars and cheap imports (like orange juice concentrate from Brazil) sometimes drop payments to local producers to such low levels that it is cheaper for them to destroy food than send it to market. Buyers at both wholesale and retail levels have also become so fussy that they reject slightly blemished or imperfectly-shaped but otherwise perfectly good fresh food. Portion pricing in fast food outlets encourages consumers to go “super-sized” for best value. Super-sizing encourages over-consumption and waste.

“Super-sized” portions lead to super-sized waistlines and super-sized health costs. Improvements in nutritional quality in many food outlets would be preferable to gross increases in quantity. Perhaps the “old-fashioned” idea that temperance is a virtue and gluttony is a vice needs revisiting.

It would be nice if all surplus food could magically find its way to people who need it, but it doesn’t happen. Channelling leftover food and donated food to the needy costs money, and involves a lot of regulatory hurdles and logistics. For international food relief, charitable organisations often ask for money rather than food, so that they can contribute to the regional economy by purchasing food as locally as possible.

Waste also occurs not through complacency or negligence, but where people cannot afford adequate storage facilities to protect food from spoilage. Improving food storage to protect it from pests such as mould, weevils and mice, and cool and dry enough to prevent rot, would save large amounts of food going to waste.

(c.) Over-nutrition, under-nutrition and malnutrition

People range from under-fed to over-fed. However, sometimes it is not easy to classify who fits where. Consider the eating habits of some professional athletes for example, who despite their slim appearance consume vast quantities of food, burning it off in activities that many people consider trivial.

Over-nutrition *is* more prevalent in some countries (like Australia and the USA) and under-nutrition in others (like countries of South Asia and Sub-Saharan Africa), but every single country contains *both* over-fed *and* under-fed, even the countries most prone to famine. A third category encompassing people in both those groups is the badly fed (the mal-nourished).

Some people think that if the affluent were to fast regularly (or just simply eat less), their personal sacrifice would make more food available to those who don't have enough. Fasting is part of many religious traditions, and it has a lot going for it. Jesus is known to have practised fasting! It promotes discipline and helps children learn to delay gratification. It teaches people empathy for the chronically hungry, and makes them appreciate all the more the food they have. Of course it also has drawbacks too. Cutting energy intake affects concentration and work performance; prolonged fasting causes lethargy, distractedness and irritability. People who fast can become self-righteous and judgemental. Fasting can be healthy but it can also be taken to unhealthy extremes. This harms the individuals involved and traumatises their families and friends.

There are three flawed assumptions behind the idea that fasting can relieve the hunger of others. One is that people who fast eat less food overall. Whether they do or not depends on whether their periods of self-restraint are cancelled out by larger portions during non-fasting times. Secondly, fasting doesn't magically transfer surplus food to the hungry. Thirdly, as food is a commodity; those who can't afford it miss out even if food is available.

Malnutrition and under-nutrition affect the physical and intellectual development of children, handicapping them for life. The critical periods for the developing child include maternal nutrition during gestation as well as what children are fed during the formative years after birth. Disadvantage can therefore be passed across generations, in the form of chronic ill-health and lowered IQ. Blaming children with inherited disadvantage for their situation is common but unfair.

A very common simplistic explanation for the plight of the over-fed and badly fed is that they make “bad choices”. Self-righteous well-fed people say that individuals should take greater responsibility for their own behaviour, and for what they allow their children to eat. They argue for “freedom of choice” as opposed to a “nanny state” in which government dictates choice. They downplay the toxic effect of powerful advertising on people, especially impressionable children, and the way advertising takes advantage of children’s “pester power” to nag and tantrum their parents into submission. They disregard the fact that many people, who they accuse of choosing irresponsibly, do *not* enjoy the luxury of choice, or face false choices between bad and worse. It is wise to postpone judgement until an honest assessment of the environment in which choices are made has been done.

But it is also wise to treat claims that poor choices are caused by a “toxic environment” with some scepticism. For the poorest and most vulnerable people, this excuse may be entirely valid. They may truly have no choice but to try to survive on what inadequate food is available. But apart from some notable exceptions in remote parts of Australia, most Australians *do* have the capacity to make choices about the types and amount of food they eat. They can learn from the abundant information available on good nutritional and exercise habits and thereby avoid worsening their health. If good choices are accessible but they are constantly ignored, the argument for more personal responsibility gathers strength.

Health promotion experts talk about the importance of creating “supportive environments” in which it is easy to make healthy food choices.⁶ In supportive environments healthy food is available at a reasonable price, and prepared food is offered in *sufficient* (as opposed to very large or uncontrolled) portions.

(d.) Dietary preferences

When people get richer, they make some predictable changes to their eating habits.⁷ They eat less of the old staples like rice, noodles, bread and potatoes, and more meat, fish, eggs and dairy products, and more fruits, nuts, spices and vegetables. Why does this apparently healthy change matter?

The fresh fruits, nuts and vegetables consumed by rich people attract higher prices per kilogram than staples like wheat and rice. When consumers get richer, cropland is converted from growing relatively cheap staples to growing relatively expensive specialty lines, often for export. When cropland in Africa is converted to growing flowers, strawberries or snow peas for export to Europe, local people have less access to locally-grown food. Those who continue to grow local staples can take advantage of food scarcity by escalating prices, creating hardship for

the poor. If hunger is alleviated by importing cheap food, and care is not taken to protect local farmers from unfair competition, the local farmers' livelihoods will be ruined.

Eating meat, fish, eggs and cheese and drinking milk matters when they are produced using "industrial" farming methods, in which food animals are reared on a diet derived from specially-grown grain (like wheat, maize, oats and sorghum), legumes (like soybeans, lucerne and peanuts) and root crops (like cassava and turnips). Intensively farmed chickens, pigs, feedlot cattle and aquaculture fish consume food that is grown on land (or caught in the sea) that could potentially feed people. Some of these farmed species are more efficient at "converting feed to flesh" than others.⁸ The "conversion ratio" refers to the number of kilograms of feed required for 1 kilogram of weight gain. Fish in general are about 4 times more efficient at converting feed to flesh than cattle, and poultry are nearly as efficient as fish. Much less farmland would therefore need to be devoted to crops to be converted into fish or chicken than the equivalent weight in beef. So, on efficiency grounds, there is room for argument over which species should or should not be intensively farmed. But as has already been stated, food is grown where there is a market for it. Few consumers of meat know or care about conversion ratios. They just want cheap meat, and they like variety.

Of course not all species consumed by humans spend their whole lives in sheds and feedlots consuming specially-grown high-energy feed. In Australia, most stock are pasture-fed, but many are still "finished" in feedlots prior to sale. Cattle and sheep that only eat grass – the diet nature intended for them – do not compete with humans for grain. Common wild animals like kangaroos could provide more meat than they currently do. Destructive feral animals like goats, pigs and rabbits could also be targeted, benefiting indigenous species at the same time. Most wild fish populations on the other hand are harvested at or beyond their sustainable catch limit.

So, on balance, eating meat can easily be justified (e.g. why cull animal populations and leave the carcasses to rot?), but there is a strong case for eating less meat than many of us do, especially factory-farmed, grain-fed meat. One important reason for reducing demand for cattle and sheep is their potent greenhouse gas emissions (see discussion below under the heading of climate change).

Animals are actually a key component in sustainable and productive farms. Well managed mixed farms are like healthy and productive ecosystems – plenty of symbiotic relationships where waste from one component provides feedstock for another. Cattle and sheep consume crop residues and produce manure, meat, wool, hides, and blood and bone. Manure restores fertility and provides grubs for free-range chickens and ducks, which provide eggs, feathers and manure as well as meat. Poultry also perform the bonus service of devouring snails and insect pests. In south-east Asia, farmed fish grow on human wastes. The physical

separation of cropping and animal-raising eliminates these beneficial animal services from cropping farms, replacing them with chemical fertilisers and sprays and other expensive infrastructure. Meanwhile at the factory farms, the massive volumes of animal wastes create a health hazard.

The treatment of many intensively farmed animals is morally questionable. The conditions endured by feedlot cattle, stall-fed pigs and caged hens would make many people upset if they learned more about them and spent time thinking about them. Some meat and egg producers go to great lengths to prevent adverse publicity by animal rights advocates. Why? Are they ashamed? Does the demand for cheap meat and eggs justify cruelty? These are creatures created by God (though admittedly modified by selective breeding by humans), which deserve some measure of respect.

Human health is directly affected by mistreatment of animals on factory farms. Some diseases can be transmitted from sick factory farmed animals to humans, such as avian influenza (bird 'flu) and Creutzfeldt-Jakob disease, the human form of Mad Cow Disease. Antibiotics for the treatment of human infections are increasingly ineffective because their inappropriate use as growth promoters in factory farms enables infectious organisms to become resistant to them.⁹

(e.) Population growth

In the 1920s, when the author's grandparents were children, world population reached 2 billion. If they are still living in 2012, when they will be in their early 90s, population will reach 7 billion. This is a 350% increase in one lifetime. At the time of Jesus' birth, population was estimated at 0.2-0.4 billion¹⁰. Population has increased roughly 2000% (or 20 times) since then. Recent projections estimate a world human population of over 9 billion by 2050, stabilising around 10 billion by 2200¹¹. Any subsequent slow decline to the 2009 level of 6.7 billion or less would probably take a few centuries (excluding catastrophic rises in mortality and oppressive anti-fertility measures). To free that many people from hunger for such a long time will require a revolution in sustainable, high yielding food production systems and more equitable distribution.

Population growth is a sensitive issue. Economists and politicians, who tend to focus on the short-term, generally favour it, because it increases demand for goods and services and boosts economies of scale, making things cheaper and improving living standards. They favour "growing the economic pie" ever larger, assuring us that each consumer will be able to enjoy a bigger slice.

Meanwhile, ecologists warn of the dangers of "overshooting carrying capacity" and recommend population stabilisation and eventually reduction in the interests of "conserving the life-giving powers of the biosphere". They quote studies like

the Millennium Ecosystem Assessment¹² that indicate that worldwide, the life-sustaining ability of the Earth is in decline because of human impact. The ecologists like to remind the economists and politicians that the economy operates within, and feeds upon the environment. Economic pies and populations cannot grow indefinitely because the Earth has limits.¹³ They question how the world can sustain 9-10 billion people for centuries when its capacity to support 6 billion is declining year by year. Our technology and resource limits will prevent us from a “Star-Trek” inspired mass exodus and colonisation of space.

Some food security analysts get rather annoyed when population gets brought up in relation to food supply¹⁴. They argue that adequate food *is* in fact available – it is just not distributed to those who need it. Or, that adequate food *could* be made available, if only there was the will to produce it. They argue that it is failed social systems that need fixing, to ensure that the vulnerable and marginalised in society are properly cared for. Fear-mongering about population is just a diversion from more important issues.

These analysts often claim that food stress in the least developed countries is a legacy of colonialism and corrupt development planning. Their economies have been structured to export natural resources and cash crops to rich countries to the benefit of local elites and former colonial powers rather than to improve local food self-sufficiency. Overproduction of cash crops, timber and minerals has seen prices and incomes slump, and given wealthy countries a windfall of cheap commodities. Even the food preferences of ordinary people have been manipulated by advertising to favour imported Western style food like white bread and instant noodles made from wheat over traditional staples like sorghum, root crops and rice. The old crops have become embarrassingly “primitive” and *not* consistent with “progress”.

They also argue that where poor people lack basic infrastructure like piped water, electricity, and basic health care; where their children are at high risk of dying before the age of 5; and where they do not enjoy the security of old-age pensions, having more children is actually *beneficial*, even *essential* for survival. Children provide labour, extra income, and security for parents when they become too feeble to work. They confidently predict that populations will stabilise automatically, without requiring coercive population reduction strategies when the following conditions are met: all people, especially girls and women, have greater access to education; women’s burden of work is reduced; they have careers and marry later; better health infrastructure and social safety nets are provided; children survive infancy; and industrialisation and mechanisation reduce the need for abundant unskilled labour.¹⁵

Others accept these arguments to varying degrees, but believe that population should not be sidelined.¹⁶ They cite figures indicating that the growth of world harvests is not keeping up with population growth, grain reserves are shrinking,

and many countries are increasingly reliant on food imports (we can't all be net food importers). Population growth means more urban sprawl consuming farmland, and more people moving into precious ecological zones and areas susceptible to rapid degradation and natural disaster. More carbon emitters mean deeper per capita carbon emissions reductions will be required in order to avoid tipping over into catastrophic climate change. Additionally, the effect of climate change on harvests is expected to be more negative than positive, and particularly dire for tropical areas containing some of the world's most rapidly growing developing countries¹⁷. They say larger populations are more likely to aggravate than alleviate food supply crises, and inflame rather than soothe tensions. Some prominent population commentators like Garrett Hardin¹⁸ and Maurice King¹⁹ have gained notoriety by proposing "lifeboat ethics", where populations deemed to be unsustainable should be denied assistance, leading to "natural attrition".

The fact is that even if every single country in the world suddenly achieved a birth rate at replacement value (2 children for every 2 adults), the youthfulness of many poorer countries would still see the momentum of population growth continue well into the future. After all, people don't immediately die when they have children! Many now survive to see grandchildren and even great-grandchildren. We will only see population reduction when death rates exceed birth rates. Because on average the world is populated by young people, mostly in developing countries, reduction will only happen in the short term if the Horsemen of the Apocalypse – war, famine, disease and wild animals – start carrying off more and more of the young.²⁰

(f.) Gender relations

Women and children (particularly girls) suffer to a greater extent than men from food insecurity, and the morbidity and mortality associated with under-nutrition and malnutrition. In many countries, men maintain control over land, what crops are grown, and how income is spent. Although women supply much of the labour for growing food, and retain primary responsibility for feeding their families, and caring for them when they are sick, they do not have the right to participate in important decisions that affect the family, nor do they hold the purse strings.

Attempts to shift some power to women are really struggling in some of the most heavily populated, food insecure countries where women's empowerment is most urgently needed. Fundamentalist religion enshrines male power, and preference for sons in many cultures means that allocation of household income favours sons over daughters, meaning that educational opportunities and positions of responsibility and influence are denied to girls and women. The female role models needed to normalise gender fairness cannot emerge in these circumstances.

(g.) Climate change

In its most recent (2007) report²¹, the Intergovernmental Panel on Climate Change (IPCC) states that the trend of global warming over the past 100 years is now “unequivocal”. The 2007 IPCC report also states that the observed warming “is very likely due to the observed increase in anthropogenic (human-caused) greenhouse gas concentration”, with a probability of greater than 90%. In signing the Kyoto Protocol²², the governments of all signatory countries have expressed confidence that this science is sound.

But there are a vocal minority who continue to dispute the science. Although most sceptics now concede that warming is happening, evidenced by trends in glacial and icecap melting for example, they continue to reject the link with human activity. They are determined to propagate the belief that climate change has nothing to do with emissions of “greenhouse gases”, but is part of a “natural” cycle, due perhaps to the sun or to volcanic activity. These alternative explanations have yet to persuade the majority of climate experts.

Box 2 below looks at possible reasons why sceptics are adamant that they are right and the world’s leading climate scientists are wrong.

Box 2: Why deny that humans are responsible for climate change?

The most obvious reason for denying the link between emissions and warming is vested interests. Major industries such as petroleum, coal, steel, aluminium, tourism and beef feel threatened by emissions-reduction policies. Many people (employees, shareholders, political parties, consumers) see favourable treatment of these industries as being in their own interest. If climate change is “natural”, they can conduct their business as usual without a guilty conscience, and evade any responsibility to prevent it. Deniers fear that acknowledging the link will oblige them, for the sake of fairness, to accept that their emissions are damaging, to accept onerous cutbacks, and to compensate those who suffer adverse effects of climate change. Denial allows them to feel comfortable about energy intensive lifestyles, and offers a convenient excuse for not helping the victims of climate change.

Climate change manifests itself in a variety of ways detrimental to food security²³.

Effects on fresh water

Warmer temperatures in alpine regions are melting ice caps and glaciers, which may increase water runoff in the short term, but leave large populations, especially in South and East Asia and the Andean countries of South America in severe water stress in the future. Food cannot be grown in the absence of water! Just in Asia alone, the Himalayas and Tibetan plateau give rise to huge river systems that currently provide sustenance to billions of people: the Indus, Ganges/Brahmaputra, Irrawaddy, Yellow, Yangtze, and Mekong River systems.

Drought, and higher temperatures and evaporation rates in our own Murray-Darling basin in South-eastern Australia are already causing anxiety over water allocation and arguments over which crops are sustainable and which are not. Two likely scenarios are those of increased conflict over scarce water resources, and increased people movements as “climate refugees” search for the means to survive.

Effects on oceans

The greenhouse gas emissions responsible for climate change also affect the world's oceans. Warming reduces water oxygenation (sea life is oxygen dependent) and raises sea levels via thermal expansion and ice cap melting in Antarctica and Greenland. The addition of fresh water from melted ice, together with warming, affects ocean currents. The Gulfstream current in the North Atlantic Ocean makes Europe much warmer than Canada, which lies at the same latitude. A stalled Gulfstream would make Europe much colder, and badly affect its agriculture (the stalled Gulfstream scenario was depicted rather sensationally in the film *The Day After Tomorrow*). Currents also distribute nutrients throughout the oceans. These nutrients provide food for tiny organisms like plankton, which are the basis of the oceanic food chain. Warming also affects temperature-sensitive species, such as coral, the very foundation of healthy and productive reefs. The increased carbon dioxide dissolved in sea water increases its acidity, affecting shellfish and corals and all other species that produce external skeletons, and consequently, all other species that in turn are dependent on them. Many fertile river deltas and large population centres are vulnerable to inundation from rising sea levels and coastal erosion from stormy seas. All these effects of climate change threaten the productivity of the planet's fisheries, and the homes, livelihoods and food supplies of many millions of people.

Effects on species mix

Climate change alters the usual mix of species in an area. Ones that are more sensitive and have difficulty adapting will suffer, diminish in number, migrate or even die out. Others will be more resilient and manage to survive or even thrive in the space left by the departed. Pests and disease-causing organisms will spread to previously unaffected areas. Predicting the new mix is very difficult. Because of the interconnections between people, plants and animals, change can be surprisingly wide and deep.

Extreme weather events

More extreme weather events associated with climate change, like heatwaves (and the fires that accompany them), droughts, heavy rain and floods, damaging winds and hail increase the degree of unpredictability and risk of farming as a livelihood.

How food production affects the climate

Agriculture in Australia contributes more to the greenhouse effect than the whole transport sector²⁴. One reason for this surprising fact is its emissions of the potent

greenhouse gases methane and nitrous oxide. Methane is emitted mainly by cattle and sheep, and is 20 times more potent than carbon dioxide as a greenhouse gas. Nitrous oxide is released by excessive fertiliser application, and by the decomposition of the urine of cattle on high-protein feed.²⁵ Nitrous oxide has 300 times the greenhouse potency of carbon dioxide. Intensive, chemical dependent cropping and ploughing also decompose organic matter in the soil, meaning that the carbon that used to be stored in the soil is now in the atmosphere and dissolved in the ocean.

The challenge for farmers

Farmers are told they will have to become more resilient in the face of more challenging conditions; acquiring new knowledge, new skills, and new cultivars bred for heat, drought and salt tolerance. Farmers will not be able to acquire all these things without help. It would actually be unfair to expect them to shoulder all the responsibility when food is everyone's problem. Many farmers are already on the brink of survival, and added burdens and costs combined with tougher times could put them over the edge.

The response of agriculture to climate change is twofold: it has to adapt, while keeping production growing in line with the population; and it has to change, to mitigate its contribution to global warming.²⁶

(h.) Water²⁷

Food production is dependent on water; water of good quality in adequate quantity at the right time. Clean water is essential for drinking and hygiene, to avoid a range of infectious diseases. Water is also often used for sanitation and is a key input in many industries.

Water security is a serious issue even without factoring in the impact of climate change. Fresh water supplies are increasingly over-allocated (sometimes for trivial recreational purposes like backyard swimming pools and golf courses) and polluted. Where surface water is now scarce, groundwater is being pumped, frequently at unsustainable rates. Sewage and pollutants from farms and industry create underwater dead zones, often in areas like estuaries and shallow coastal waters that would otherwise be amongst the most productive ecological zones. Technologies for cleaning up polluted water, extracting water from deep aquifers, and desalinating seawater are energy intensive and unattainable and unaffordable for most people.

Water requires effective regulation. Fresh water sources are vulnerable to misuse by individuals or corporations seeking to advantage themselves at the expense of other users. The regulatory solution currently in favour in Australia and around the world is to price it. Alternative models of water distribution other

than the privatisation, cap-and-trade and user-pays schemes recommended by economists are becoming uncommon. Commoditising water, as with commoditising food, serves the interests of those with more money.

Shared water resources are possible flashpoints for future conflict. Rivers like the Nile, the Jordan and the Tigris and Euphrates have already seen violent disagreement over allocation of their waters. In south-eastern Australia, downstream users often bitterly complain about the “greed” of upstream users. Many kinds of “development” affect the natural flows of river systems and have the potential to provoke conflict, e.g. logging in catchments; tree planting in catchments; building dams for water storage and hydroelectric power generation; and irrigation schemes.

In many places action is underway to use water more carefully and efficiently. Some examples include rainwater and stormwater harvesting; reducing evaporation from ponds and channels; delivering water to crops more efficiently (e.g. via drip irrigation); investigating ways of reducing water use in industry and human waste management (e.g. ecological sanitation methods); and researching natural methods of cleaning up contaminated water bodies (called bioremediation). These initiatives need support.

(i.) Soil and land issues²⁸

Soil, along with water, sunlight and air, is indispensable for food production on the scale required to feed humanity. Soil conservation is very important because hydroponics is too energy and water-intensive for widespread application.

Arable land is being covered at a rapid pace by roads, car parks and houses, and converted to non-productive recreational uses like golf courses, tracks for horse-racing and motor racing circuits. Plantations for biofuels and biosequestration (“carbon offsetting”) have also been blamed for reducing the area of land devoted to food (see next section below). There are now very few places left in the world for humans to expand into that are well suited to intensive food production.

Uncovered soil is prone to erosion from wind and water. Fertility that can take hundreds or thousands of years to build up naturally can be blown or washed away in minutes. Exposing “naked” soil by overgrazing and tillage releases carbon from the soil to the air through the decomposition of organic matter, and reduces its water holding capacity. If too many trees are removed, or land is over-irrigated, water tables rise, bringing salt to the surface and rendering soils toxic. In many parts of the world, desertification is spreading because of land pressure, poor soil management and climate change. The “Fertile Crescent” in the Middle East, site of the biblical Garden of Eden, has been extensively de-

vegetated and degraded over thousands of years. Parts of Australia have been extensively degraded over *decades*.

Every nutrient exported from a farm in food for sale is lost from the system, and must be replaced by nutrient inputs. *Carbon* is free, taken from carbon dioxide in the air, and legumes like clover and peas fix atmospheric *nitrogen*. Where farmers no longer practice crop rotation with legumes to maintain soil nitrogen, they typically apply artificial nitrogen fertiliser. Artificial nitrogen fertiliser is produced from natural gas, which is also in demand as a source of energy. Some of the major mineral nutrients required for plant growth are *phosphorus*, *potassium*, *calcium* and *sulphur*.

The loss of phosphorus from farms is the greatest concern from a sustainability point of view. High quality phosphate-bearing ores are a finite resource. They are slowly being exhausted, forcing a turn to lower yielding phosphate ores contaminated with higher levels of heavy metals²⁹. It makes little sense to mine phosphate, use it to grow things, and then flush it into the sea where it disperses and cannot be easily recovered.

The use of manure as a source of nutrients and soil conditioner has fallen with the disappearance of animals from many farms. And except in a few places, the nutrients in human waste are not reapplied to agricultural land, mainly for cultural reasons and concerns about hygiene.

The amount of energy required to recover dispersed nutrients like phosphorus is very high. Unless an abundant and cheap energy source can be found to replace dwindling reserves of fossil fuel, it will be prohibitively expensive. A smarter system that recovers and recycles valuable nutrients like phosphorus is necessary for truly sustainable food production.

Farmers are more likely to practice good soil conservation when they enjoy secure land rights. Those who fear that at any time their land could be stripped from them have less incentive to husband their resources wisely.

Australian farmers generally do enjoy security of land tenure. Here it was the historical abundance of land that reduced the incentive to look after it. As happened in America, pioneer graziers and farmers saw great expanses of “empty” land, and the “boundless plains” provided little incentive to husband the land carefully.³⁰

In many of the former colonial countries, land ownership is very lopsided, and land tenure secure only for the rich and powerful. Elites in places like Brazil, South Africa, India and Indonesia hold large tracts of the best land, often under-utilising it, while peasants and indigenous people struggle to eke a living from fragile and marginal land. The elites concentrate on cash crops for export rather than food crops for local consumption, and by mechanising they leave landless

people without work and incomes. Through political power, creating dependency, and intimidation, they suppress land reforms that could offer more people the chance to feed themselves.³¹

A new and disturbing trend in land investment is emerging. Rich individuals or companies are buying up parcels of productive farmland in poor countries such as Sudan and Madagascar, to shore up food security for rich consumers³². This neo-colonialism both contributes to political instability in those countries, and takes advantage of it.

Land degradation is also the result of economic pressures. When farmers are in debt and prices are low, it is tempting to reduce or eliminate fallow periods, abandon the principle of crop rotation, and to sow the most profitable crop repeatedly, or to add more stock, overtaxing the land. Short term needs override good long term management. It's also tempting to push the land harder when prices are good, in order to "get ahead".

It is easy to be critical of our predecessors and the consequences of their actions when we have the benefit of hindsight and up-to-date scientific knowledge. But it is unfair to blame them in their ignorance for following "normal" practices of the times. The important lesson for the present and the future is to learn from the past and avoid repeating its mistakes, and try to repair the damage.

Fortunately people with good ideas, who can demonstrate their effectiveness, are not rare, and are being taken seriously. No-till and minimum-tillage farming, integrated pest management, and organic production are increasingly in the mainstream. Other ideas formerly treated with scepticism are being reconsidered in light of their performance over time: Peter Andrews³³, the pioneer of "Natural Sequence Farming", has gained extensive publicity recently in Australia; and Permaculture³⁴ has now been taught around the world to small farmers for thirty years. However, there are still plenty of critics of mainstream agricultural education, who consider the influence of commercial interests to be pernicious.³⁵

(j.) Biodiversity and biotechnology

In this section, discussion of (the very large topic of) biodiversity is limited to just two aspects of biodiversity that are crucial to long-term food security.

The first of these is the "hidden" biodiversity present in healthy soil. Healthy soil is alive with small, tiny and microscopic organisms, all working together in a "soil community" or "soil ecosystem".³⁶ Each of these tiny species plays a role in the process of converting lifeless weathered rock and volcanic ash into the basis of all living things. They dig and mix; aerate; transport nutrients; decompose and recycle; add manure; form mutually beneficial relationships with plants, and so

on. Their activity saves human gardeners and farmers from a lot of extra work. Destroying these communities of hard-working and beneficial soil organisms is short-sighted.

All living creatures depend on the soil. The book of Genesis tells how God made the first man from soil, and named him *Adam*, meaning “earth” or “soil”. It is a mistake to think that because soil organisms are small they are unimportant. Soil is not simply a “substrate” or a “growth medium”. Soils lose fertility and become compacted and dry and dusty when they are not treated with respect. They lose their ability to support life.

The second aspect of biodiversity for consideration is diversity of food species. There many different species suitable for use as food. There is also diversity *within* each of these species, allowing that species to prosper in a variety of different zones.

Growing a range of different species is a good policy. It offers insurance against disaster. Agricultural ecologists point out the risks and high costs of large scale monocultures compared to the diversity and inherent resilience in mixed farms (or “polycultures”).³⁷ They like to quote the old proverb about “not putting all your eggs in one basket”. When facing an uncertain future in regard to climate and energy supply, they feel it is more prudent to opt for diverse systems that offer reasonable yield stability.

Within-species diversity is very important. There are many varieties of wheat, potatoes, rice, lentils, apples, bananas, cattle, sheep and pigs in the same way as there are many breeds of domestic dog. Each has been bred over time by small farmers in different places, with properties that make them particularly suited to the diverse areas in which they are grown. These traditional varieties (or landraces as the plant varieties are known) may not be particularly high yielding, but they are often resilient and reliable, and tolerant of conditions that would kill newer hybrid varieties (like extreme heat, drought, frost, damp and salt) or resistant to common pests and diseases. The biotechnology companies that develop high yielding food-crop varieties are constantly on the search for new genetic material in landraces that they can incorporate into their new strains. This search for new genetic material is called “bio-prospecting”.

Unfortunately, there are some problems with biotechnology – the modern system of crops research – and its dissemination. The more these new hybrid strains find their way to farmers all over the world, the more the lower yielding traditional varieties are abandoned and lost, along with their special properties that are so sought after. Much more uniform production results, where a few strains are being grown rather than hundreds or thousands. If farmers abandon their old varieties and then change their minds, the option of going back may no longer be available. The bio-prospectors from seed companies and scientists from seed banks have not managed to collect and preserve every possible landrace as

insurance for the future. Farmers may be shocked to find that where they freely donated traditional seed to seed companies, they have to buy it back.

Other problems arise with biotechnology. The hybrid varieties marketed by seed companies are claimed to be “high yielding”. This is true only when farmers are able to provide these seeds with the high inputs needed for them to fulfil their potential. They are more accurately termed “highly *responsive varieties*” because they grow rapidly in the presence of abundant water and fertiliser, storing nutrients in large seed clusters rather than in long stems and lots of leaves. If a poor farmer cannot afford all the necessary inputs of fertiliser, water, herbicide and pesticide, the highly responsive variety won’t achieve its full potential. If a disappointing output doesn’t earn enough to cover the cost of inputs, the farmer goes into debt. Small farmers who find themselves with worsening debt problems suffer stress and depression. Often they end up selling out to wealthier farmers, and become landless labourers or job-seekers in the city. Many thousands of farmer suicides in India have occurred in recent years due to indebtedness linked to the entry of trans-national seed companies into the Indian economy.³⁸ Many more have resorted to selling their kidneys to make ends meet. Depression and suicide in Australian farmers is increasingly significant too.³⁹

Intellectual property laws give seed companies the right to patent their new hybrids, even though the genetic materials embedded in them are more truthfully the accumulated work of generations of small farmers all over the world. This theft of collective intellectual heritage is called “bio-piracy” by its critics. Farmers must pay the companies for the privilege of buying the new varieties, and risk prosecution for violating intellectual property laws if they try to save seed for replanting, or if cross-pollination from neighbours’ hybrid crops contaminates their non-hybrid crops with ‘patented genes’. Mostly the hybrids are unstable after the first generation and subsequent generations fail to yield well anyway. Once this system is adopted, it is not easy to abandon. Seed companies actively recruit farmers to this system, helpfully selling the seed and chemical inputs in a package. They say it simplifies farming and improves prospects of above-average yields. They reject the allegations of small-farmer advocates around the world that they deliberately seek to create dependency.

Some people concerned about food security are calling for a new “Green Revolution” of genetically engineered high yielding crops suited to marginal conditions like drought-prone areas and saline soils. There are a number of problems with this. First, there is the familiar argument that the vast majority of research and development funding and effort goes into the crops that offer the highest potential returns; that is, the ones grown on the best land by the richest farmers, not the ones struggling on the margins. Second, many crops are already reaching their physical limits of productivity.⁴⁰ If they had larger and more plentiful seeds, but skinnier stems and fewer leaves, they would be just too fragile for real world conditions. They would collapse under their own weight. Third, there is the argument that highly responsive varieties are simply greedy and thirsty, and offer

a false economy; while they can be astoundingly productive, their input requirements are just as astounding, with astounding financial and environmental consequences. Fourth, those concerned about population pressure argue that supposing a new Green Revolution were to substantially increase food availability, it would just “feed” a further burst of population growth, and in a few years we’d be back to square one again! The other major concern of consumers is the safety of genetically engineered species, and whether we can trust the assurances of their proponents.

Supporters of genetically modified crops often accuse their detractors of consigning poor people to starvation; as if genetically modified organisms (GMOs) are the only possible solution to hunger. This is a cynical and self-interested claim according to some critics.⁴¹ Biotech companies’ reputations have been tarnished because, like many businesses, they put profits and shareholders ahead of the poor and the environment.

(k.) Biofuels and Biosequestration

*Biofuels*⁴²

Biofuels have been touted by some as a “carbon neutral” and “sustainable” method for powering motorised transport that currently runs on petrol and diesel. Ethanol is a biofuel typically distilled from wheat, corn or sugarcane. Biodiesel can be produced from a range of oily seeds and beans like oil palm, coconuts, sunflower seeds, canola and soybeans. *All these biofuel crops are also food crops.*

The assertion that biofuels are carbon neutral and sustainable is examined in Box 3 below.

Box 3: Are biofuels carbon-neutral and sustainable?

Conventional petrol and diesel (derived from oil) and natural gas are all “carbon positive” because they are extracted from underground and burnt so that carbon dioxide and other wastes end up in the air. Biofuels are claimed to be “carbon neutral” because during their growth phase they soak up atmospheric carbon, later releasing it as the fuel is burnt. This claim of carbon neutrality is highly misleading, and involves very dodgy accounting. A biofuel can only be truly carbon neutral if it grows and magically turns into fuel in your tank!

The reality is that in the land clearing, cultivation, fertilising, harvesting, processing and transportation of biofuels, much additional energy is expended, releasing extra carbon emissions. Biofuels therefore contain hidden energy (and carbon) subsidies that are fraudulently discounted by their proponents. If all carbon emissions associated with biofuel production are accounted for, they actually take more energy to produce than they provide. Their “carbon debt” goes even higher when they are shipped around the world.

Some argue that biofuels do not displace food if grown on virgin land. This is true, but much of this virgin land was formerly rainforest, which is felled and burnt. As we know, rainforests are the ecosystems that support the planet's greatest biodiversity. They also contain a very large amount of planetary carbon that goes up in smoke. Additionally, "unoccupied" virgin land is in reality often land appropriated from indigenous peoples whose rights of customary ownership are ignored, and they end up losing their homes and livelihoods. Finally, converting food into fuel that might be used for trivial purposes like motor racing, riding a jet-ski or blowing leaves while people starve for lack of food *must* be considered a moral issue. It is simply an affront to those people if biofuels are used to prop up overindulgent lifestyles.

We should be careful though before rejecting the idea of biofuels completely. Not all biofuels are derived from food crops or require land for planting. Biogas (methane) is a by-product of composting organic wastes, including human wastes. If it can be done without creating a health hazard, it makes eminently good sense to compost human wastes to recover nutrients to return to the soil (instead of flushing them out to sea), and to capture energy as a bonus.⁴³

*Biosequestration (carbon-offsetting)*⁴⁴

We have heard a lot in the news recently about "carbon trading" and "carbon offsetting" schemes. One way in which people and businesses that need to burn fuel can "offset their emissions" is by "biosequestration", that is, paying someone to plant trees. Over time the trees grow and accumulate carbon, paying off that carbon debt. Farmers are one group interested in the business of carbon offsetting. Depending on the price of carbon, they could find it more profitable to grow trees than food. The faster the trees grow, the more carbon they store and the more money they make. Of course trees don't grow quickly in deserts or on rocky, poor soil. Like food crops, trees grow most rapidly where water, sunlight and nutrients are present in favourable proportions. If farmers calculate that they can earn a better living from agro-forestry than agriculture, they may abandon food production, until growing food becomes more profitable again.

Box 4 below highlights another flaw of biosequestration; that of "carbon leakage".

Box 4: Carbon leakage: the big weakness of tree planting schemes to offset carbon emissions

Anyone who takes money for sequestering carbon should guarantee its perpetual safe storage. If carbon "leaks" back into the air, the correct amount of money should be refunded. This is the honest thing to do and is necessary to keep the carbon budget balanced. Unfortunately, preventing carbon leakage is impossible. The simple fact is that trees grow old and die; they are prone to burning in bushfires; and they sometimes succumb to heatwaves, droughts, diseases and pest attacks. What insurance companies would be bold enough to cover them? If growers were compelled to compensate for leakage with new plantings, they would have to find suitable land, and plantations would soon be found everywhere. This is clearly implausible.

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Carbon leakage could also occur through corruption. The same trees could potentially be sold to more than one buyer, allowing unscrupulous operators to multiply their money. Consequently, whatever enthusiasm currently exists for market-based carbon biosequestration projects is likely to wane when the challenges of accurately monitoring and regulating them become apparent.

(I.) Fossil-fuel dependency

It was no coincidence that the food riots during 2008 broke out after oil prices soared over US\$100 per barrel. The price of oil affects the price of food because oil is a crucial input in the industrial food system. The industrial food system evolved thanks to cheap oil and the other two major fossil fuels, gas and coal. It is dependent on them from paddock to dinner plate. Crude oil forms the basis for fuels, agricultural chemicals, plastics and refrigerants; gas is the basis for artificial nitrogen fertiliser and industrial cooking; coal powers the steel and aluminium industries that provide the metals for machinery, and it also generates much of the world's electricity. Industrial food could therefore be described as being "steeped in fossil fuel". The longer the list of ingredients in an item of processed food, the more the oil, gas and coal consumed in its production.

The energy (measured in calories or kilojoules) gained from eating industrial food can be much less than the energy expended in producing, processing, packaging and transporting it, especially if the producer and consumer are on opposite sides of the world. This is highly inefficient in energy terms. Food systems in which food is grown locally for local consumption using few external inputs are more energy-efficient, and more appropriate in light of dwindling conventional oil reserves.

Oil experts estimate that humans have used up approximately 50% of known conventional oil deposits, with the rate of consumption increasing year by year.⁴⁵ The search for alternatives to oil is motivated by concerns about the consequences of diminishing oil supply and fears about climate change. The contention over biofuels demonstrates that finding substitutes will not be easy, especially ones that do not produce adverse social and environmental effects. Known reserves of oil may increase slightly if some powerful countries achieve their aim of drilling under the Arctic seabed and in Antarctica, but given the costs of extracting polar oil, it will not be cheap.

Some "technological optimists" assume that human ingenuity will deliver new, clean, abundant and affordable alternatives to oil. Others are less optimistic that such solutions are possible, though they hope to be proven wrong, and willingly support research and development into energy efficiency and alternatives to fossil fuels. They recommend as a precaution, early preparation for an era of lower energy availability and much higher energy costs.⁴⁶

Ideas for energy-efficient food systems

Some recommended actions for food systems that are energy constrained include producing food locally for local consumption to the greatest extent possible, and making every attempt to conserve and recycle soil nutrients and water. Ecological approaches to agriculture attempt to integrate agriculture into the environment, in contrast to industrial agriculture's model of exploiting and battling the environment.

These ideas sometimes challenge the popular notion of progress, and may in some ways be reminiscent of some of the humbler methods of the past and of traditional farmers in poorer countries that have been dismissed during the current era of oil-based affluence. There is no shortage of prescriptions for sustainable food systems, with varying degrees of plausibility and applicability.

Incorporating agriculture into cities is a consistently popular proposal, but it has not been revived to any significant extent in Australia due to factors such as increasing urban density, smaller blocks and "time-poverty". Cuba introduced organic urban agriculture with considerable success after the collapse of the Soviet bloc, when subsidised food and fuel imports suddenly stopped.⁴⁷ However, it seems that it is still politically taboo to praise a "communist" initiative.

(m.) Food politics

Individuals, groups, corporations and nations use food and "food policies" to advance their own interests. Here is a list of ways of controlling food in order to achieve some political goal, followed by a very brief discussion of some of them:

Destruction of, or control over food infrastructure; blockades; sieges; trade sanctions; free trade agreements; freedom of foreign investment ; World Trade Organisation regulations; tariffs; "non-tariff barriers" like quarantine regulations; quotas; subsidies; incentives; advertising; bias in agricultural education; providing development assistance only to schemes that accord with the donor's "national interest"; agricultural land reforms and food aid.

Threats and violence

Food is frequently used as a bargaining chip or a weapon. The means of food production and distribution are common targets in conflict: crops are burnt; animals and harvests stolen; water supplies poisoned; irrigation dams, canals, bulk stores, roads, bridges, railways and ports destroyed. While famine can contribute to conflict, the reverse is also true – conflict can contribute to famine. Sieges, blockades and trade sanctions use food restrictions to punish others and force them into submission.

Trade and investment policies

Threats and violence are not always necessary to control food; there are more subtle ways to achieve strategic goals.

Foreign investment rules give the rich access to land in many countries, improving their food security and enlarging their “food footprint” at the expense of landless people in those countries.⁴⁸

“Free trade” rules (as opposed to *fair trade*) favour producers who enjoy subsidised inputs and greater economies of scale – typically agribusinesses with political influence in wealthy countries. If they can gain entry into new markets, they can undercut and bankrupt local farmers by dumping subsidised food and establish a permanent (and dependent) consumer base there. Uncritical agribusiness shareholders who only care about the bottom line will applaud the business growth! The “Doha Round” of the World Trade Organisation negotiations have been stalled for some years now over the issue of anti-competitive farm subsidies in the US and European Union.

Food aid

The public relations spokespeople for powerful food producers and biotechnology companies know how to cultivate popular support by applying the right “spin” to their activities. For example, they may issue press releases exaggerating food insecurity in poor countries, demanding urgent food aid or “technical assistance” for the poor “in the interests of human rights”. The people for whom the aid is intended may find the conditions of the assistance objectionable, but they risk being labelled ungrateful, or their leaders cruel, if they refuse aid. It usually does not suit the interests of these companies to ask needy people what they really want.

Sometimes it is necessary for countries to restrict cheap imports and “humanitarian aid”, in the interests of saving their local food economy from collapse, and avoiding dependency. Many non-government organisations (NGOs) that provide emergency food assistance now also have a policy of improving longer-term self-sufficiency.⁴⁹

Development policies

Proponents of agribusiness, with its high external inputs, large production surpluses and extensive trade, assure governments that it is the key to rapid economic growth. Low external input agriculture with an emphasis on local production for local consumption will never produce the revenue required for “development”.

It is tempting for governments to channel agricultural development money (e.g. for consultancy, education, research, extension work, subsidies and incentives) towards production of the most profitable crops, particularly crops that rich people want, since rich people pay more. Countries providing development

assistance often attach conditions to the money they give, so that the activities they fund are to a large degree self-serving. Dictating the development of poorer countries allows richer countries to ensure that poorer countries develop in a manner that does not threaten their own national interests.

Land rights

In some countries land reforms in the interests of fairer distribution would be desirable, but history shows that the powerful do not surrender “their property” graciously. The longer the powerful can manage to hold onto land and isolate people from food production, the more the people will lose their farming knowledge and skills. Redistributing land to people who have lost their farming knowledge and skills inevitably entails some years of inefficient and chaotic efforts before a reasonable level of competency is regained. Even then there is the risk that the more talented farmers will end up taking over from the less talented, and the problems of inequality will start over again!

Section 4: Dilemmas

In Section 2, hunger was described as a “wicked problem”. Section 3 introduced a number of issues related to food and hunger that are wicked problems themselves, such as population growth, rising inequality, climate change, and the condition of land and water. The interconnections and interactions between all these wicked problems are often not well understood, making it impossible to predict outcomes with absolute certainty. Attempts to “fix” one wicked problem can reverberate through the web of “wicked problem interconnections” to produce unpredictable and unintended consequences. Sometimes flow-on effects *are* predictable and preventable, but no action is taken to prevent them. Those whose interests are served by *not* doing anything might even explain them away as “the price you have to pay”.

Analysis of progress in tackling wicked problems is not encouraging. The Millennium Development Goals (MDGs), set in the year 2000, aimed to give impetus to action on wicked problems. Many countries will fail to achieve their MDGs by the target date of 2015⁵⁰. Last year World Bank President Robert Zoellick called the first MDG (a pledge to reduce hunger and malnutrition by half) “the forgotten MDG”. State of the Environment reports indicate that the future is being plundered to supply the present, eroding faith in the potential of “sustainable development”.⁵¹ Suffering in the present is being deferred, in the hope that technology or some other saviour will come to the rescue in the future – essentially gambling that more and more will somehow be able to be produced with less and less. Some forecasters predict a breakdown in world order if current trends continue.⁵²

While the rich and powerful may be able to defer their day of reckoning, it has already arrived for many marginalised people. In many places around the world, there are groups of people linked by class, caste, ethnicity or religion whose means of survival are being stripped away. They are made to feel redundant, inconvenient and a burden to others. They are often persecuted and under pressure to “disappear”.

This section briefly looks at four dilemmas raised by a holistic “wicked problems analysis”.

Scarcity

Social justice campaigners like to believe that the Earth is an abundant provider with plenty for all to share. But environmental State of the World reports challenge this assumption by describing how the Earth’s abundance and fertility are being drained by overexploitation, and replaced by scarcity and barrenness.

Important social justice work could be threatened by challenges to the cherished belief in abundance.

Scarcity, whether real or imagined, creates insecurity, especially amongst those who are accustomed to abundance. Insecure people worry more about protecting their own interests and the interests of those they care about than being generous to people they don't know. Their "radius of concern" and their definition of "who is my neighbour?" tighten. Charitable giving falls away, especially to strangers, to those who won't be able to return the favour, and to those who are powerless to strike back. Scientist Richard Dawkins says such behaviour is the product of "the selfish gene", a survival mechanism ingrained in human nature.⁵³

Pressure on social justice activists to *extend* their radius of concern comes from a number of sources: the integrated and interdependent global economy; the "global village effect" of modern communications; aid agencies with names like "World Vision"; the Universal Declaration of Human Rights; and the Bible. Awareness of the extent of global injustice has never been higher, and the number of worthy causes is countless.

Circumstances of absolute scarcity test the commitment of social justice campaigners to their ideals. If the size of the pie cannot be enlarged, what is the fairest way to divide it up? Who should make the greatest sacrifice?⁵⁴ Must dreams of prosperity for all give way to modesty or even poverty for all? These are much tougher options than calling for a bigger pie.

To what extent should good "global citizens" care about or be responsible for all people everywhere, both now and in the future? For many people, the concept of a global citizen is still incomprehensible or absurd, and, in circumstances of widespread scarcity, irrelevant. Scarcity compels people to make decisions about who or what takes priority.

Triage

Moral questions get harder in environments of scarcity. The notion of "triage" is particularly upsetting for people who prefer to believe in a world of abundance. Triage involves prioritising some people's needs above others and rationing care. To even contemplate triage seems to be an admission of defeat. Hope is lost.

In situations of resource scarcity, a well formulated and implemented triage system is desirable from the point of view of fairness. Without a system to control resource allocation, the powerful and the belligerent will win out over the rest.

Those who implement triage are frequently subjected to abuse by those who feel discriminated against. However, the incidence of abuse can be reduced if people

understand the reasons for triage, have some say in the formulation of triage guidelines and accept that they are fair.

Health care providers use triage systems to ensure that those whose needs are more urgent get treatment before those whose needs are less urgent. They are necessary because doctors, nurses, dentists and operating theatres are not available in sufficient abundance to treat all patients at the same time. The ability to escape the offensiveness of triage is a luxury available only to the privileged who can command resources whenever they like.

There is no doubt that triage is unpleasant, and regrettable judgements are often made. But people involved in triage are not necessarily heartless or vindictive or deliberately negligent. Triage work is often stressful and distressing. It may look like “dirty work” to the righteous on the sidelines, but it is better to have triage than no rationing formula at all. Those who criticise triage systems are obligated to reform them. Calling for them to be abandoned is to replace order with “natural selection” on the basis of threats, violence and corruption.

The idea of applying triage to food is particularly troubling. It goes against the human rights principle that all people have an equal right to food.⁵⁵ Essentially triage for food is equivalent to making judgements about whose lives are worth saving and whose are not, because the consequences of allocating people “low food priority” are so serious. It is obviously vastly more preferable for people to *voluntarily* sacrifice themselves than to make decisions on their behalf. As appalling as these decisions are, they are made every day in places where there is genuine scarcity of money, food and medicine. Those who have never had to make such decisions or justify them may like to reflect on how privileged they are.

Triage is unsettling because it is a “slippery slope” concept. It is corrosive of compassion. Triage is easier to sustain when one is cool, dispassionate, impartial, and immune to the pleas of individuals. It is easy to envisage becoming desensitised to and disengaged from the suffering of others.

What do we tell the children?

The idea of “progress” is deeply embedded in modern society. People expect things to get better over time: technologies, government services, job opportunities, remuneration, living standards generally. Not having “progress” is inconceivable.

As families on average have fewer children, they invest more in each child – emotionally as well as financially. Parents want to believe that their children face a bright future.

News of multiple interacting wicked problems that defy easy solutions casts a pall over the future. Parents worry that children who already face competitive school and employment environments will not be emotionally resilient enough to handle such news. It is tempting to distract children with entertainment, music lessons and sport and keep them innocent of problems that could crush their hopes. Parents worry about their children becoming depressed and withdrawn and shutting out reality via alcohol, drugs or suicide.

This raises a real dilemma. Denying that problems exist in the interests of protecting children's innocence and hopes deceives them, yet engaging them with the issues places burdens on them that we don't wish them to carry. How do we strike the right balance?

Those who wrestle with this dilemma should ask themselves a few more questions: Are children really that blind to the world's problems? Are worried adults overplaying the fragility of children and underestimating their resilience? Might the children have something important to contribute? What does reluctance to discuss these issues with children say about the older generation?

Premillennialism

Projections of social, economic, climatic and environmental breakdown resulting from unresolved wicked problems risk causing despair, anxiety and paralysis. If they come to the attention of some Christian groups, they might give oxygen to premillennial beliefs. Throughout history, periods of turmoil have led many to believe they were living in the "end times" foreshadowing the glorious return of Christ.

Premillennial beliefs promote apathy toward the state of the Earth. "End-timers" see the world as corrupted and facing condemnation. Instead of trying to reverse the process of environmental degradation, they might even attempt to hasten it in order to hasten their salvation and entry into paradise. Premillennial beliefs also promote apathy or judgementalism towards others, as "the elect" focus their attention on themselves and away from others (the "left behind"), who are destined for eternal damnation.

Section 5: Motivators for Action

This section looks at why food and hunger and other wicked problems related to them deserve our attention. It aims to provoke readers to think about these issues, and to discuss them with each other. Engaging in dialogue with others broadens our exposure to different views and promotes critical thinking. Critical thinkers expect those who hold different views to be able to defend them. Critical thinking and rigorous debate contribute to wise action.

Humans are Earthlings

People of many religions, including Christians, believe that humans were created in the image of God. But unlike God, humans cannot exist apart from the Earth. Humans are Earthlings. The atoms and molecules comprising the foods we eat come from the air, soil and water. We are totally dependent for our survival on the Earth providing us with stable and reliable conditions for cultivating the plants and rearing the animals we use for food.

Homo sapiens means “wise man”. In order to live up to this name, humans need to learn to live in ways that are mutually beneficial; for themselves and for the Earth.

“Capacity constraints” and “Management failures” throughout history

The current generation is not unique in contending with wicked problems. Food and hunger, degradation of resources, and a scarcity of creative solutions have stressed societies for thousands of years. Some of these past societies survived difficult periods while others went into decline.

There are a range of theories that attempt to explain why past civilisations such as the Mesopotamians, the Romans, the Maya of Central America and the Easter Islanders collapsed.⁵⁶ One theory that is particularly relevant to the present situation is that they suffered a debilitating incapacity to manage the increasing number and complexity of their problems. They lacked the knowledge, the creativity, the energy, the money and the physical resources to sustain their societies. Rising pressures cracked their commitment to preserving the whole, and they fragmented, fought, contracted and simplified.

What of the societies that survived? What principles underpinned their transition from struggle to survival? Did they solve their problems purely by applying technological ingenuity, or was social ingenuity such as cooperation, restraint and self-sacrifice involved?

Equity

Equity, fairness, righteousness and justice are all synonymous. They are important for building strong relationships and stable societies. It is difficult to imagine a strong community without something as crucial as an equitable system of food production, distribution and consumption.

An equitable system of food production would ideally improve both food sovereignty and food security. Present trends show food production resources concentrating in the hands of powerful people and corporations. These powerful groups are profit-oriented, growing food for customers who pay the highest prices.

Loss of control over food production resources is a serious problem for the poor. Their low purchasing power creates inequalities in food distribution. Poverty, poor health and low educational attainment entrench poverty across generations.

Each serve of food has its own “ecological footprint”.⁵⁷ Food grown using high-input “industrial” methods and transported around the world has a much larger ecological footprint than food grown and consumed locally using low-input organic methods. Australians rank very high on the list of people with the largest ecological footprints.

Inter-generational equity

People who have children and grandchildren often express the desire that their children should enjoy a life that is at least as good as their own. Making this wish come true requires the older generation to hand over the essential resources needed by the younger generation. It would be rather cruel to bequeath a cookbook if the children could not produce the ingredients.

In order to hand the world over in good condition, the older generation must understand the effects of their lifestyles and act responsibly to change aspects that are harmful. Applying this to food means honestly assessing the sustainability of our current agricultural systems, and implementing changes for the better.

Leaving an equitable world does not necessarily mean leaving it unchanged. Equitable is not the same as “equal” or “identical”. An equitable world can be different, but its capacity to supply the essential needs for a good life must be undiminished.⁵⁸

Ecological footprint analysis indicates that the global human footprint already exceeds the capacity of the Earth to sustain.⁵⁹ Instead of restricting ourselves to

consuming the “interest” the Earth yields each year, we are consuming the “principal”. In effect this means the present is borrowing from the future and not paying it back (i.e. stealing).

Respect for God’s other creatures

Every species, according to Christian tradition, is a work of God’s hands. Humans have the right to make use of other species to serve their own interests, but this right is not unconditional. There is a line that differentiates respectful animal husbandry from ruthless exploitation and cruelty. People can express their concern over the treatment of food animals by seeking meat, eggs and dairy products that come from animals that are treated with respect.⁶⁰

Enlightened self-interest

While it is natural to be concerned about one’s own food supply, it should also be apparent that it is prudent to take an interest in one’s neighbours’ food supplies. Disregarding the welfare of one’s neighbour is not neighbourly and can sour previously cordial relations. Being concerned with neighbours’ welfare and acting to secure it promotes peace and security in the neighbourhood.

If a neighbour seeks, ignores, or takes advantage of another’s misfortune, that neighbour risks what is now commonly called “blowback”. Blowback is the result of ill-conceived action originally intended to promote one’s own interest. Blowback can take a variety of forms, such as being publicly shamed, physically attacked, or forced to cope with refugees fleeing a preventable disaster.

The best neighbours don’t keep a score. They give until it hurts, and give even when they don’t expect anything in return. This is the model of neighbourliness exemplified in Jesus.

Section 6: Guiding Principles

Sections 1-5 above provide a lot of “food for thought”. The introduction to Section 5 suggests that thinking before acting is a good idea, because it produces action that is “wiser” than it would otherwise be. However, too much thinking and discussion can increase anxiety about all that could possibly go wrong, raising the possibility that we end up not doing anything at all! Endless study of the issues doesn’t actually achieve anything.

It is difficult to judge the merits of proposals for action when they have never been tried before in the context in question. But the task is not so impossible that we are forced to resort to trial and error. Wise judgements are determined on the basis of a variety of considerations, including the following (in no particular order)⁶¹:

- a set of guiding principles for good conduct
- a vision of the common good
- social and environmental impact statements
- cost-benefit analyses
- relevant case studies
- scientific evidence
- history and experience
- critical reasoning
- common sense
- intuition
- creative inspiration

The focus of this section is on creating a set of guiding principles to govern action on food and hunger. The principles are derived from a vision of the common good that is inclusive of people in both the present, and in the future. A sample vision of an idealised food future is attached as an appendix on page...

The principles are divided under four main headings: production principles, distribution principles, consumption principles and governance principles. Some principles could sit under more than one heading.

GUIDING PRINCIPLES FOR ACTION ON FOOD AND HUNGER⁶²

A. Principles relating to Food Production

1. *Environmental sustainability or Sustainable stewardship of Creation*

- **The food production system values its *ecological assets* and *ecosystem services*.** Some important *ecological assets* include living soil, clean fresh water, trees, insect pollinators, wild fish stocks, healthy reefs, predators that control pest species and a stable climate. Some important *ecosystem services* include soil microbes' role in decomposition and conserving soil fertility, e.g. by fixing nitrogen; plants' role in protecting soils and purifying water; insects' role in pollination; and biological pest control. **A food production system that values its assets *properly accounts for them*.**
- **The food production system aims to be *ecologically efficient*.** Nutrients are effectively recycled (no waste), and pests are managed biologically or organically, reducing the need for external inputs of fertilisers and pesticides; inputs are not applied excessively and allowed to escape to cause pollution problems elsewhere.
- **The food production system aims to be *energy efficient*.** Farms are designed for energy efficiency, reducing the need for fossil fuel inputs and/or intensive labour. Ecological efficiency and energy efficiency reduce the *ecological footprint* of food production.
- **The food production system *protects and promotes diversity*.** Diverse plantings (polycultures) use nutrients, light and water more efficiently; diversity provides protection from pests and disease; diversity promotes good nutrition; and diversity protects genetic resources.
- **The food production system *protects and promotes stability*.** The system is responsive to changes in the environment. It is characterised by *persistence* (the tendency to produce the same over time), *resistance* (the capacity to withstand disturbance) and *resilience* (the ability to recover in the event of disturbance).
- **The food production system takes a *cautious approach to new technology*.** The onus is on the proponents of new technology to demonstrate that it is safe before it is released, not on the community to demonstrate that it is unsafe.

2. Social justice

- **The food production system *promotes smarter and healthier people*.** Participation in food production gives people opportunities to learn valuable life-skills, acquire positive values, improve personal health and contribute to greater community well-being.
- **The food production system is *socially sustainable*.** People involved in food production can earn a sustainable and equitable livelihood.

3. Economic viability

- **The food production system is *economically viable*.** External inputs are low, keeping costs down, improving affordability and making participation in food production attractive. Producers get a fair price and consumers pay a fair price, meaning that profit-taking by middlemen is markedly reduced.

4. Respect for animals

- **The food production system *treats animals with respect*.** Animals in the food production system are not subjected to cruel and unnatural practices. In recognition of their sacrifice, livestock are treated with respect. Consumers are well informed about the prevailing animal husbandry and slaughtering techniques.

5. Food sovereignty

- **Wherever possible, the means of food production are *in the hands of local communities, not distant corporations*.** Land ownership laws favour local ownership for local production and consumption; preventing concentration in the hands of a rich few, and preventing large-scale foreign ownership with an emphasis on exports. Similarly, control of water and seed is in the hands of local communities.

6. Food safety

- **The food production system delivers *safe and nutritious food*.** Safe practices guide production, storage, handling and preparation, in the interests of population health.

7. Free distribution of information and technology

- **The food production system is *free of usurious intellectual property rights*.** Any information or technology that could help a neighbour achieve improved food security is freely shared. Research and development are publicly funded and the fruits of this work are *public domain*, not patentable.

8. Rigorous and “appropriate” science

- **The food production system is *supported by high quality research and development*.** Research efforts are publicly funded and free of commercial bias. Research is prioritised on the basis of need.
- **Research and development efforts favour “*appropriate technology*”.** Technology takes into account issues such as social impact (e.g. on employment), ecological impact, and local capacity to maintain and renew it.

9. For the common good

- **The food production system is biased *in favour of the common good*.** Individuals are free to pursue activities in their own self-interest, but only up to a certain point. The principles of social sustainability and free distribution of information and technology place caps on private accumulation. Cooperation is necessary to avoid degrading or depleting the community’s capital stocks – natural *and* social.

B. Principles relating to Food Distribution

10. Neighbourliness

- **The food distribution system is *in accordance with neighbourly values*.** Instead of values like conditionality, self-interest and national interest, the food distribution system operates on values such as openness, honesty, trust, generosity, compassion, reciprocity, forgiveness and love.

11. Fair trade

- **The system of trade in food is *equitable*.** Trade is not used self-interestedly to undermine others’ capacity for food sovereignty. Trade in food or in any other goods does not compromise the social and/or environmental sustainability of food production.

C. Principles relating to Food Consumption

12. Sufficiency

- **Consumers *know when enough is enough*.** Consumers' demands are modest, and they are conscious of social and environmental reasons to live within certain limits.

13. Positive Discrimination

- **Consumers *buy ethically*.** Consumers support ethical food production and distribution by discriminating in favour of goods that meet high ethical standards.

14. Nothing is wasted

- **There is *no such thing as waste*.** All leftover food and food residues from production, processing, marketing and consumption is "reborn" in the most useful way, never just dumped. For example, it may provide food aid, food for stock, materials for compost, and be a potential source of biofuel.

D. Principles relating to Food Governance/Policy

All the principles listed above are applicable to governance, plus the following:

15. *Cross-sectoral engagement*

- **Food issues are *everybody's business*.** Leaders engage widely on the issue of food, not just with the most obvious groups. "Food impact assessments" are conducted prior to signing off on new policies, programs or developments, given that food is so critical to well-being.
- **Responses to food issues are *holistic and integrated*.** In recognition that food and hunger are linked in some way to most, if not all areas of governance, food is not limited to a single portfolio, although leadership is necessary to avoid it becoming "everyone's problem but no-one's responsibility". Food planning discussions incorporate environmental, social justice and economic perspectives to produce fairly balanced, sustainable strategies for food security.

16. *Local knowledge is valued*

- **Local, indigenous and traditional knowledge are appreciated.** Leaders recognise the considerable expertise held by people with close ties to particular environments, including them and valuing their contributions in any decisions of significance regarding those environments.

17. Adaptive management

- **Leaders recognise the need to be *responsive in a changing environment*.** This is a delicate balancing act requiring courage, an understanding of history, the ability to source good advice, the respect and support of the community, and an appropriate degree of prudence and humility. Where they have forewarning of changing circumstances that are likely to bring adverse consequences for food production, they also need the means to implement effective *preventive measures*.

Section 7: Summary and Conclusion

Food is an important issue right now

The United Nations Food and Agriculture Organisation (FAO) estimated in 2008 that the number of *chronically hungry* people in the world in 2007 was 923 million, or about one person in every seven.⁶³ In some countries this fraction was much higher; as much as one in two. Many more suffer intermittent hunger. The 2007 number was more than 80 million higher than in 1990-1992. It was also calculated prior to both the 2008 oil price rises and the present “Global Financial Crisis”, both of which have affected poor people’s access to food, suggesting that the present figure may be even higher.

Australians are not immune from hunger. The food security of urban Australians depends largely on their economic security: those who do not grow their own food need money to buy it. The current recession raises food security concerns because of increased unemployment, lower incomes and high levels of debt.

Food will continue to be important issue into the future

On the basis of present trends in world hunger, many countries will fail to achieve the first Millennium Development Goal of halving hunger by 2015.⁶⁴ The prospects of success are being hampered on a number of fronts; many different issues affect food security. The commoditisation of food, rising inequality, unfair trade, population growth, land degradation, over-exploitation of fisheries, water stress, adverse climate change, the diversion of agricultural land to biofuel crops, and a number of other issues discussed in more detail in Section 3 combine to make hunger a “wicked problem” – one that is highly resistant to being solved.

Food problems are so interconnected, so unpredictable in scope, and so entrenched that conquering them looks impossible. Even if by some miracle, technology and human capacity were to blend wonderfully to win momentary freedom from hunger, the struggle would not be over. A victory over hunger can only ever be temporary.

Simplistic solutions are unhelpful

This paper highlights a number of dimensions of food insecurity: food production, food distribution, patterns of consumption, and the way in which the food system is governed. Hunger is complex, not simple. Responses should reflect that complexity. They must be holistic and multi-pronged, not simplistic.⁶⁵

It is wrong to judge how well problems like hunger are being managed on the basis of the *average state* of issues that affect hunger. Many issues are too critical to be concealed in averages. Averaging the assessment just hides critical weaknesses. For example, it is obviously illogical to say that “because we are making good progress on soil conservation, it will make up for the fact that our water situation is deteriorating”, because water is critical for food production. Failure on *any single issue of critical importance* will bring down the effort to reduce hunger as a whole. Therefore the stakes are rather higher than some people believe.

Alternative ways of responding

In the face of big, complex problems like hunger, many say the task is impossible: that people’s natural instinct is to prioritise their own interests and the interests of their kin ahead of the interests of strangers. Neighbourliness breaks down under pressure. This is the perspective of radical individualism, Social Darwinism and survivalism. Survivalist policies however, are a bad option. Survivalism destroys relationships and increases violent conflict over the remaining viable sources of sustenance. Survivalist policies increase insecurity generally. Erecting fortresses does not deliver the powerful the security they seek.

The alternative to individualist, survivalist policies on hunger is to agree that the interests of *all* people are better served by cooperation rather than competition. Cooperative, collaborative or communitarian approaches acknowledge powerful human instincts for self-preservation, but emphasise the ability of humans to override their selfish genes by the choices they make. Proponents of cooperation cite successful examples, frequently involving compromise, restraint and personal sacrifice, leading to outcomes that enhance the common good. Christianity based on the life and teachings of Jesus emphasises the good that that comes out of controlling one’s own appetites and lifting up the lowly.

The cynics are of course correct to say that it is impossible to turn selfish humans into pure altruists, always ready to trust each other, forgive the wrongs each has done to the other, and cooperate in spite of what has happened in the past. But the alternative of rejecting cooperation will produce hell on earth, so try we must.

Focusing effort

It is easier to maintain and build enthusiasm by looking for opportunities to make a difference on a scale that is realistic. Small-scale action is more manageable than large scale action. Although small-scale actions don’t amount to much individually, multiple small-scale actions do produce large scale effects. In order

to get small-scale actions to multiply, they must be well thought-out and successful.

Naturally, there will always be some uncertainty over the outcome of actions, because information and modelling is never perfect, and people don't always behave predictably. However, it is clear that the better the information and the better designed the action, the more likely the action will have the desired effect.

A set of Guiding Principles for Action on Food and Hunger is put forward in Section 6. It is inspired by a vision of the common good that is inclusive of people in both the present, and in the future.

Appendix

An idealistic food future vision

Let's envision an ideal "global system of food sufficiency". Here's a list of possible characteristics:

1. It is capable of producing enough good quality, nutritious food for everyone.
2. People are satisfied with sufficiency. They disapprove of greed and conspicuous consumption.
3. Food production is achieved sustainably. What we produce and the way we produce it support the life-giving powers of the Earth. They do not diminish or degrade them.
4. Decisions about food are made fairly and democratically, guided by sound ethics and science.
5. Nobody feels dictated to or oppressed by food production.
6. Nobody feels dictated to or oppressed by food distribution.
7. Everyone has the ability to access sufficient good food and participate in its production.
8. People delight in and take pride in their ability to create good food, from field and garden to dinner plate.
9. People delight in developing interesting and tasty cuisines based on foods that are especially suited to their local climate and soils.
10. Leftover food is never wasted. It re-enters the food chain as stock feed or compost for food plants.
11. Food concerns do not dominate life. People have time to rest and relax; play sports; do all kinds of work that have nothing to do with food; learn, experiment, study and teach; enjoy un-cultivated landscapes and wild animals; create art and music; give thanks to God; and enjoy the company of one another.

Notes

1. FAO (2008).
2. See FAO (1998) for the comprehensive definition, including a definition of food *vulnerability*.
3. Food First Institute for Food and Development Policy (2002).
4. See Australian Public Service Commission (2007) for a good summary of the challenges of “wicked problems”. The term “wicked problem” was originally coined by Rittel and Webber (1973).
5. This is not a new phenomenon. Lappé and Collins (1977) documented it over 30 years ago. See especially *Chapter 23: Multinational Food Companies and Feeding the Hungry*.
6. See the World Health Organisation (1986).
7. Smil (2000), pp. 8-11 refers to a *dietary transition* that accompanies increasing wealth.
8. Smil (2000), *Chapter 5: Rationalising Animal Food Production* discusses conversion ratios.
9. The Sierra Club (2008) provides a fully referenced fact sheet on the issue of antibiotic use in factory farming.
10. US Census Bureau (2008).
11. United Nations Department of Social and Economic Affairs (1999).
12. Millennium Ecosystem Assessment (2005).
13. See Daly (1996) and Meadows et al (2005) for example.
14. For books with a strong focus on the social causes of hunger, see Lappé and Collins (1977 and 1986) and George (1986). Here the focus is on inappropriate production and inequitable distribution of food.
15. “Fertility transition theory” states that these development indicators are prerequisites for a transition from high to low fertility. Their accomplishment will, according to the theory, lead to a “demographic transition”, with a reduced ratio of children to adults. See Kirk (1996) for an account of Demographic Transition Theory. Many developing countries are considered to be “stuck in transition”, continuing to grow while not achieving the development required to complete the transition.
16. Lester Brown from the Worldwatch Institute believes the importance of population should not be underestimated. See for example Brown (2005). Paul Ehrlich is another writer who some consider “alarmist” on population issues. *The Population Bomb*, written in 1968 gained worldwide attention. His recent books such as Ehrlich and Ehrlich (2004), written with his wife Ann, acknowledge issues of distribution and inequality to a much greater extent than his earlier work.
17. UNDP (2007).
18. Garrett Hardin (1915-2003) was an American ecologist best remembered for two controversial articles: *The Tragedy of the Commons* (1968), with its dim view of human nature, and *Lifeboat Ethics: the Case Against Helping the Poor* (1974), for its unashamed Social Darwinism.

19. Maurice King, an academic at the University of Leeds in the UK is a former public health worker in tropical Africa. He authors a website <http://www.leeds.ac.uk/demographic.disentrapment/> devoted to the topic of “demographic entrapment”.
“A community is demographically trapped if: (a) At practicable levels of technology it exceeds the carrying capacity of its local ecosystem (too many people for the land to support), (b) it has no new land to migrate to, and (c) it has too few exports to exchange for food and other essentials. The end result is the direst poverty, stunting (chronic malnutrition), starvation, and often violence”. King is strongly of the opinion that there is a conspiracy of silence over demographic entrapment. He considers much of Africa “trapped” and public discussion on the topic is taboo because it’s such a “political hot potato”.
20. See Susan George’s devastating satire *The Lugano Report: On Preserving Capitalism in the 21st Century* (2003) for a horrifying but believable plan for the winners in the “globalisation game” to ensure a comfortable future for themselves.
21. For a description of the composition of the members of the IPCC, and the rigorous process by which their reports are produced, see the IPCC website, <<http://www.ipcc.ch/about/index.htm>>; for a summary of the latest climate change assessment report, see IPCC (2007).
22. See United Nations (1998), article 2, in which signatories to the Kyoto Protocol accept the validity of the link between atmospheric greenhouse gas concentration and global warming.
23. See UNDP (2007) for a thorough examination of the risks of climate change and possible responses. Food production and water security are key issues discussed in the report; the United Nations Environment Program’s 4th Global Environmental Outlook Report GEO-4 (UNEP 2007) devotes its whole second chapter to the atmosphere: to climate change, pollution and ozone loss.
24. See the National Greenhouse Gas Inventory (2005) for the relative greenhouse contributions of different sectors in the Australian economy.
25. Flannery (2008).
26. Flannery (2008). 2008 Australian of the Year, Dr Tim Flannery offers ways in which agriculture could become more climate-friendly in his *Quarterly Essay* ‘Now or Never: A Sustainable Future for Australia?’ He discusses the use of pyrolysis, a “slow cooking” of crop residues to produce biofuel and “bio-char”, charcoal to be used as a soil conditioner.
27. See UNEP (2007) Chapter 4 for a report on the status of the world’s water resources.
28. See UNEP (2007) Chapter 3 for reporting on intensification of land use, land degradation and desertification.
29. Steen (1998) warns that high-grade phosphate reserves are a finite resource. Lower grade ores are more expensive to extract and likely to be plagued by heavy metal contaminants, such as cadmium. Tiessen (1995)

- recommends agricultural practices that recover phosphate for long term sustainability.
30. Jared Diamond devotes Chapter 13 to Australia in his book *Collapse: How Societies Choose to Fail or Survive* (Diamond 2005). In it he describes how early settlers were fooled by lush vegetation into believing that the soil was fertile. Only later, following declining harvests and low quality regrowth did they realise that Australian soils weren't like European ones. Nevertheless, for a few decades there was abundant land for the taking, so it didn't seem to matter if land was used up and abandoned.
 31. Frances Moore Lappé and Joseph Collins (1977) and (1986) claim that food insecurity in many ex-colonies is a legacy of the colonial period, in which peasants were dispossessed and enslaved on cash crop plantations. At Independence, land was handed over to elites who to this day fight to retain their privilege by forestalling land reforms.
 32. See Evans (2009) p. 46 for further examples of this trend.
 33. See Andrews (2006).
 34. See Mollison (1988) and Holmgren (2002). These two authors are the co-origina-tors of the concept of Permaculture.
 35. See for example Berry (1977), and Tudge (2003).
 36. See Suzuki (1997) *Chapter 4: Made from the soil*.
 37. Dover and Talbot (1987).
 38. Newman (2007) reports on this phenomenon in the northern Indian state of Punjab. Prominent Indian scientist and activist Vandana Shiva has also written and spoken extensively about the downsides of the Green revolution.
 39. See Beyondblue: the national depression initiative, and Page and Fragar (2002): one Australian farmer in the latter years of this study committed suicide on average every four days, a level significantly higher than in the general population. Indebtedness and declining terms of trade feature prominently in the causes of suicide.
 40. Smil (2000), from *Chapter 2: Photosynthesis and crop productivity*.
 41. Shiva (2000), pp. 11-13; Barker (2007), p. 36; UNEP-UNCTAD (2008), p. 36.
 42. This section on biofuels draws heavily on Santa Barbara (2007).
 43. WHO (1989); Winblad and Simpson-Hébert (2004).
 44. Downie (2007) compares tree-planting carbon offsetting schemes to alternative schemes such as investments in "renewable energy" and energy efficiency.
 45. Heinberg (2003); Leggett (2005).
 46. David Holmgren (Holmgren 2002) calls the decline of fossil fuels "energy descent".
 47. Rosset (1998).
 48. Evans (2009) p. 46.
 49. Organisations like the United Nations International Fund for Agricultural Development (IFAD), the Lutheran World Federation's Department for World Service, CARE and Oxfam all operate on the principle that

- humanitarian aid should be balanced with assistance to achieve sustainable livelihoods, with food security a priority.
50. World Bank (2008). World Bank President Robert Zoellick called the first of the Millennium Development Goals, the pledge to reduce hunger and malnutrition by half by 2015 “the forgotten MDG”.
 51. See Millennium Ecosystem Assessment (2005) and UNEP (2007). Lovelock (2006) says the human impact on the Earth is so severe that the only salvation will be in adopting a policy of “sustainable retreat”.
 52. For a recent update on the famous and controversial 1972 Club of Rome *Limits to Growth* report, see Meadows et al (2005). Other recent commentaries include Homer-Dixon (2006) and Lovelock (2006). Raskin et al (2002) describe a range of possible future scenarios.
 53. Dawkins (1989).
 54. Various opinions on the moral obligation to address world hunger can be found in Aiken and La Follette (1977).
 55. United Nations (2008-2009) *Universal Declaration of Human Rights: Article 25*.
 56. See Diamond (2005), who focuses heavily on resource management competency as a contributing factor to societal stability. Tainter (1988) puts forward the slightly broader hypothesis that societies tend to collapse under the costs of dealing with growing complexity.
 57. Wackernagel and Rees (1996) drew on earlier work to develop the concept of “ecological footprint”. “Food miles” is a concept with links to ecological footprint. It takes into account the greenhouse gases emitted in transporting food from where it is grown to its place of purchase. A more comprehensive “food footprint” analysis would take into account other environmental impacts not factored into a “food miles” calculation, such as the ecological costs of providing all the inputs used for growing the food, and the ecological costs of wastes associated with food production.
 58. See Max-Neef (1991) for a comprehensive analysis of human needs.
 59. See Wackernagel et al (2002) for evidence of “ecological overshoot”. He and his colleagues estimate that since the late 1970s, humans have been taking more from the Earth than the Earth can regenerate, in effect creating a growing “ecological debt”.
 60. See Pollan (2006) for a balanced look at the topic of “eating ethically”.
 61. This list compiled with reference to Somerville (2006).
 62. Principles developed with reference to Schumacher (1973), Taylor (1975), Dover and Talbot (1987), Chambers and Conway (1992), Earth Charter (1992), UNCED (1992) *Chapter 14: Promoting sustainable agriculture and rural development*, Daly and Cobb (1994), Daly (1996), Trainer (1996), Holmgren (2002), McDonough and Braungart (2002), Ikerd (2006) and Korten (2006).
 63. FAO (2008)
 64. World Bank (2008).
 65. See Rittel and Webber (1973) and Australian Public Service Commission (2007).

References

- Aiken, W and La Follette, H 1977, *World Hunger and Moral Obligation*, Prentice-Hall Inc, New Jersey.
- Andrews, P 2006, *Back from the Brink: How Australia's Landscape can be Saved*, ABC Books, Sydney.
- Australian Public Service Commission 2007, *Tackling Wicked Problems: A Public Policy Perspective*, Australian Government.
- Barker, D 2007, *The rise and predictable fall of globalised industrial agriculture*, The International Forum on Globalisation.
- Berry, W 1977, *The Unsettling of America: culture and agriculture*, Sierra Club Books, San Francisco.
- Beyondblue: the national depression initiative, viewed online 10th April 2009, <http://www.beyondblue.org.au/index.aspx?link_id=105.898&oid=773>.
- Brown, L 2005, *Outgrowing the Earth: The Food Security Challenge in an Age of Falling Water Tables and Rising Temperatures*, Earthscan, London.
- Chambers, R and Conway, G 1992, *Sustainable Rural Livelihoods: Practical Concepts for the 21st Century*, Institute for Development Studies Discussion Paper 296.
- Conway, G and Pretty, E 1990, *After the Green Revolution: Sustainable Agriculture for Development*, Earthscan Publications, London.
- Daly, H 1996, *Beyond Growth: The Economics of Sustainable Development*, Beacon Press, Boston.
- Daly, H and Cobb J 1994, *For the Common Good: redirecting the economy toward community, the environment and a sustainable future*, 2nd edn, Beacon Press, Boston.
- Dawkins, R 1989, *The Selfish Gene*, Oxford University Press, Oxford.
- Diamond, J 2005, *Collapse: How Societies Choose to Fail or Survive*, Allen Lane, Melbourne.
- Dover, M and Talbot, L 1987, *To Feed the Earth: Agro-ecology for Sustainable Development*, World Resources Institute, Washington DC.

Downie, C 2007, *Carbon Offsets: Saviour or Cop-out?* Research Paper No. 48, The Australia Institute.

Earth Charter 1992, viewed 7th April 2009,
<<http://www.earthcharterinaction.org/>>.

Ehrlich, P and Ehrlich, A 2004, *One with Nineveh: politics, consumption and the human future*, Island Press, Washington.

Evans, A 2009, *The Feeding of the Nine Billion: Global Food Security for the 21st Century*, The Royal Institute for International Affairs, Chatham House, London.

FAO 1998, *Committee on World Food Security: Twenty-fourth session. Guidelines for National Food Security and Vulnerability Information Mapping Systems (FIVIMS): background and principles*, FAO, Rome, viewed 7th April 2009, <<http://www.fao.org/docrep/meeting/w8500e.htm>>.

FAO 2008, *The State of Food Insecurity in the World 2008: High food prices and food security – threats and opportunities*, FAO, Rome.

Flannery, T 2008, *Now or Never: A Sustainable Future for Australia?* Quarterly Essay 31, Black Inc, Melbourne.

Food First Institute for Food and Development Policy 2002, *Food Sovereignty: A Right for All*, viewed 7th April 2009,
<<http://www.foodfirst.org/progs/global/food/finaldeclaration.html>>.

George, S 1986, *How the Other Half Dies: The Real Reasons for World Hunger*, Penguin Books, London.

George, S 2003, *The Lugano Report: On Preserving Capitalism in the 21st Century* (2nd Ed), Pluto Press.

Goldie, J, Douglas, B and Furnass B (eds) 2005, *In Search of Sustainability*, CSIRO Publishing, Melbourne.

Hardin, G 1968, "The Tragedy of the Commons", *Science*, vol. 162, pp. 1243-1248.

Hardin, G 1974, "Lifeboat Ethics: the case against helping the poor", *Psychology Today*, vol. 8, pp. 38-43.

Heinberg, R 2003, *The Party's Over: Oil, War and the Fate of Industrial Societies*, New Society Publishers, Gabriola Island, BC, Canada.

Holmgren, D 2002, *Permaculture: Principles & Pathways Beyond Sustainability*, Holmgren Design Services, Hepburn, Vic.

Homer-Dixon, T 2006, *The Upside of Down*, Text Publishing, Melbourne.

Ikerd, J 2006, *Agricultural Policies for Food Security*, viewed 16th March 2009, <<http://web.missouri.edu/ikerdj/papers/Ottawa%20-%20Agriculture%20Canada.htm>>.

IPCC 2007, *Climate Change 2007: Summary Report: Synthesis for Policymakers*, Intergovernmental Panel on Climate Change, Geneva.

Kirk, D 1996, 'Demographic Transition Theory', *Population Studies*, vol. 50, pp. 361-387.

Korten, D 2006, *The Great Turning: From Empire to Earth Community*, Berrett-Koehler, San Francisco and Kumarian Press, West Hartford, Connecticut (Co-publishers).

Lappé, FM and Collins, J 1977, *Food First*, Abacus, London.

Lappé, FM and Collins, J 1986, *World Hunger: Twelve Myths*, Grove Press, New York.

Leggett, J 2005, *Half Gone: Oil, Gas, Hot Air and the Global Energy Crisis*, Portobello Books, London.

Lovelock, J 2006, *The Revenge of Gaia: How the Earth is Fighting Back- and How We Can Still Save Humanity*, Basic Books, New York.

Max-Neef, M 1991, *Human Scale Development*, The Apex Press, New York.

McDonough, W and Braungart, M 2002, *Cradle to cradle: remaking the way we make things*, North Point Press, New York.

Meadows, DH, Randers, J and Meadows, DL 2005, *Limits to Growth: The 30-Year Update*, Earthscan, London.

Millennium Ecosystem Assessment 2005, *Ecosystems and Human Well-being: Synthesis*, Island Press, Washington DC.

Mollison, B 1988, *Permaculture: A Designers' Manual*, Tagari Publications, Tyalgum.

National Greenhouse Gas Inventory 2005, viewed 16th March 2009, <<http://www.climatechange.gov.au/inventory/2005/pubs/inventory2005.pdf>>.

- Newman, B 2007, 'A Bitter Harvest: Farmer suicide and the unforeseen social, environmental and economic effects of the Green Revolution in Punjab, India', *Development Report No. 15*, Food First Institute for Food and Development Policy.
- Page, A and Fragar, L 2002, "Suicide in Australian Farming, 1988-1997", *Australian and New Zealand Journal of Psychiatry*, vol. 36, pp. 81-85.
- Pollan, M 2006, *The Omnivore's Dilemma: a Natural History of Four Meals*, Penguin Books, Melbourne.
- Raskin, P, Banuri, T, Gallopin, G, Gutman, P, Hammond A, Kates, R and Swart, R 2002, *Great Transition: The Promise and Lure of the Times Ahead*, Stockholm Environment Institute, Boston.
- Rittel, H and Webber, M 1973, 'Dilemmas in a General Theory of Planning', *Policy Sciences*, vol. 4, pp. 155-169.
- Rosset, P 1998, 'Alternative Agriculture Works: The Case of Cuba', *Monthly Review*, vol. 50, no. 3, pp. 137-146.
- Santa Barbara, J 2007, *The false promise of biofuels*, The International Forum on Globalisation and the Institute of Policy Studies.
- Schumacher, EF 1973, *Small Is Beautiful: Economics as if people mattered*, Harper Perennial, New York.
- Shiva, V 2000, 'Introduction: Why is biodiversity so important?' In: *Tomorrow's Biodiversity*, Thames & Hudson, London.
- Shiva, V 2000, *Stolen Harvest: The Hijacking of the Global Food Supply*, Zed Books, London.
- Sierra Club 2008, *Abuse of antibiotics at factory farms threatens the effectiveness of drugs used to treat disease in humans*, viewed 12th April 2009, <<http://www.sierraclub.org/factoryfarms/factsheets/antibiotics.asp>>.
- Smil, V 2000, *Feeding the World: a challenge for the twenty-first century*, MIT Press, Cambridge, Massachusetts.
- Somerville, M 2006, *The Ethical Imagination: Journeys of the Human Spirit*, Melbourne University Press, Melbourne.
- Steen, P 1998, 'Phosphorus availability in the 21st Century: management of a non-renewable resource', *Phosphorus and Potassium* vol. 217, viewed 1st

November 2007,
<<http://www.nhm.ac.uk/mineralogy/phos/p&k217/steen.htm>>.

Suzuki, D 1997, *The Sacred Balance: Rediscovering our place in nature*, Allen & Unwin, Sydney.

Tainter, J 1988, *The Collapse of Complex Societies*, Cambridge University Press, Cambridge.

Taylor, JV 1975, *Enough is Enough*, SCM-Canterbury Press, London.

Tiessen, H (ed) 1995, 'Phosphorus in the global environment: transfers, cycles and management', *Scope 54*, Wiley, viewed 1st November 2007, <<http://www.icsu-scope.org>>.

Trainer, FE (Ted) 1996, *Towards a Sustainable Economy: the need for fundamental change*, Envirobook, Sydney.

Tudge, C 2003, *So Shall We Reap: What's gone wrong with the world's food- and how to fix it*, Penguin Books, London.

United Nations 1998, *Kyoto Protocol to the United Nations Framework Convention on Climate Change*, viewed 16th April 2009, <<http://unfccc.int/resources/docs/convkp/kpeng.pdf>>.

United Nations 2003, *Water for People: Water for Life*, The United Nations Water Development Report, Executive Summary.

United Nations 2008-2009, *The Universal Declaration of Human Rights*, United Nations Office of the High Commissioner for Human Rights, Geneva, viewed 13th April 2009, <<http://www.un.org/Overview/rights.html>>.

UNCED 1992, *Agenda 21*, United Nations Conference on Environment and Development, Rio de Janeiro, Brazil.

UNDP 2007, *Human Development Report 2007-2008: Fighting Climate Change: Human Solidarity in a Divided World*, United Nations Development Program.

United Nations Department of Social and Economic Affairs 1999, *The World at Six Billion*, United Nations, New York.

UNEP 2007, *GEO 4: The 4th Global Environmental Outlook: Executive Summary for Journalists*, United Nations Environment Program.

UNEP-UNCTAD 2008, *Organic Agriculture and Food Security in Africa*, UNEP-UNCTAD Capacity-building Taskforce on Trade, Environment and Development, United Nations, New York and Geneva.

US Census Bureau 2008, Historical Estimates of World Population, viewed 25th March 2009, <<http://www.census.gov/ipc/www/worldhis.html>>.

Wackernagel, M and Rees, W 1996, *Our Ecological Footprint: Reducing Human Impact on the Earth*, New Society Publishers, Gabriola Island BC, Canada.

Wackernagel, M et al 2002, "Tracking the ecological overshoot of the human economy", *Proceedings of the National Academy of Sciences*, vol. 99, no. 14, pp. 9266-9271.

Winblad, U and Simpson-Hébert, M 2004, *Ecological Sanitation: revised and enlarged edition*, Stockholm Environment Institute, Stockholm, viewed 30th October 2007, <http://www.ecosanres.org/ES2_download.htm>.

World Bank 2008, *Global Monitoring Report 2008: MDGs and the Environment: Inclusive and Sustainable Development*, World Bank, Washington DC.

World Health Organisation (WHO) 1986, *The Ottawa Charter for Health Promotion*, view online at <http://www.who.int/hpr/NPH/docs/ottawa_charter_hp.pdf>.

World Health Organisation (WHO) 1989, *Guidelines for the safe use of wastewater and excreta in agriculture and aquaculture*, World Health Organisation, Geneva.