

Our Daily Bread – Food in God’s Creation

Material for study & discussion prepared by Professor R. J. Berry

The Government’s Chief Scientific Adviser has warned that we are facing a “perfect storm”:

The growing global population coming out of poverty will create an increased demand for food which will need to be produced on not much more land, using less water, fertiliser and pesticides than we have historically done. It is predicted that by 2030 the world will need to produce around 50 per cent more food and energy, together with 30 per cent more fresh water, whilst mitigating and adapting to climate change. These issues are inextricably linked. They threaten to create a ‘perfect storm’ of global events.

- ***Can 9 billion people be fed equitably, healthily and sustainably?***
- ***Can we cope with the future demands on water?***
- ***Can we provide enough energy to supply the growing population coming out of poverty?***
- ***Can we do all this whilst mitigating and adapting to climate change?***

The current world population is about 6.8 billion, of which a sixth are already going hungry and another billion lack important nutrients. In contrast, a billion people are substantially over-consuming, spawning a new public health epidemic involving chronic conditions such as type-2 diabetes and cardiovascular disease. The uncomfortable truth is that we are not coping adequately with the current demand for food, while the resources needed to produce extra food – useable land, water and oil - are steadily being depleted.

Economists have a simple answer to such problems: as goods become scarce, the price goes up. This is bad enough in this country; it is an impossible solution through much of the world where families just do not have money to pay for more food. The Chief Scientist commissioned a group of experts to examine possible ways forward. Their Report, ‘*The Future of Food and Farming. Challenges and Choices for Global Sustainability*’ was published in January 2011. The Report is lengthy (208 pages); it is downloadable: <http://www.bis.gov.uk/foresight/our-work/projects/current-projects/global-food-and-farming-futures/reports-and-publications>. It provides facts and challenges which will be unavoidable in the lifetime of many of us, and certainly during our children’s lifetime.*

The pressures described in the *Future of Food and Farming* Report are unprecedented in the whole of human history. The response, according to the Report, is that “there is now a developing global consensus, embodied in the Millennium Development Goals*, that there is a duty on everyone to try to end poverty and hunger, whether in low-income countries or among the poor in more wealthy nations.” What is our attitude to the issues raised in the Report – as individual Christians? As a Christian community? Should Christians have an involvement as part of their Christian profession? Jesus’s teaching of our responsibility for others is set out in many places, particularly in the Parables of the Good Samaritan (Luke 10) and the Sheep and the Goats (John 13). Deuteronomy

* The Food Ethics Council (<http://www.foodethicscouncil.org/>) publish useful summaries of many of the issues raised in the Report, including an analysis of the Report itself, which they criticize as relying too much on ‘market forces’

* Eight international development goals to be achieved by 2015 were adopted at a UN Millennium Summit in 2000. Goal 1 was to “eradicate poverty and hunger”, Goal 7 was to “ensure environmental sustainability” For details, see <http://www.un.org/millenniumgoals/>

8:12ff warns us “when you have plenty to eat... do not become proud and forget the Lord your God”. The very first command given to us in the Bible was “*to till and look after the garden*” (Genesis 2:15). Calvin commented on this verse:

“The custody of the garden was given in charge to Adam, to show that we possess the things which God has committed to our hands, on the condition, that being content with the frugal and moderate use of them, we should take care of what shall remain... Moreover, that this economy and this diligence with respect to those good things which God has given us to enjoy, may flourish among us, let everyone regard himself as the steward of God in all things which he possesses.”

The *Future and Farming Report* concluded:

I. The global food system faces formidable challenges that will increase markedly over the next 40 years from a larger and on average wealthier global population in a world increasingly experiencing climate change and ever-greater competition for land, water and energy.

II. However, producing enough food in the world so that everyone can potentially be fed is not the same as ensuring global access to food and ending hunger. There needs to be changes to the food system and the broader development agenda to ensure the very poorest people enjoy food security:

- More food must be produced sustainably through the spread and implementation of existing knowledge, technology and best practice, and by investment in new science and innovation, and the social infrastructure that enables food producers to benefit from all of these.
- Demand for the most resource-intensive types of food must be contained.
- Waste in all areas of the food system must be minimised.
- The political and economic governance of the food system must be improved to increase food-system productivity and sustainability.
- Citizens must develop an understanding of failing to plan ahead; make strategic choices when purchasing food to help incentivise desirable behaviour in the food system; minimise personal food waste; support governments in making difficult choices to improve food system sustainability; and support charities and other NGOs working to stimulate poverty reduction and food production in low-income countries.

Underlying all these issues are questions about sustainability – what sort of world am I handing on to my children? Or, as Mrs Thatcher put it, “we do not hold a freehold on our world; but only a full repairing lease. We have a moral duty to look after our planet and hand it on in good order to future generations.”

The Report lists five challenges:

- Food security – balancing sustainable supply as the global population approaches nine billion
- Food supply and price stability – particularly for the most vulnerable
- Ending world hunger (which is not the same as food security)
- Protecting food supply as climate changes
- Maintaining biodiversity and ecosystem services

These last two recognize that food production already dominates much of the global land surface and water bodies, and has a major impact on all the Earth's environmental systems.

The challenges are not separate from each other. Climate change and population affect all of them. Nevertheless, the five challenges represent different emphases and can be used as a basis for five discussions. The following text gives information to stimulate such discussions. An alternative could be to build a single discussion session around the crucial question of sustainability.

The Report describes sustainability as:

“The use of resources at rates that do not exceed the capacity of the earth to replace them. Thus the sustainable use of water means it is consumed in water basins at rates that can be replenished by inflows and rainfall, greenhouse gas (GHG) emissions are balanced by carbon fixation and storage, soil degradation and biodiversity loss are halted, and pollutants do not accumulate in the environment. Capture fisheries and other renewable resources must not be depleted beyond their capacity to recover. Sustainability also extends to financial and human capital: food production and economic growth must create sufficient wealth to maintain a viable and healthy workforce, and skills must be transmitted to future generations of producers. Sustainability also entails resilience, such that the food system, including its human and organisational components, is robust to transitory shocks and stresses. In the short- to medium-term non-renewable inputs will continue to be used, but to achieve sustainability the profits from their use should be invested in the development of renewable resources.”

Christians and Sustainability

Is sustainability a Christian aim? We are told ‘to take no thought’ about tomorrow (Mat 6:34), but we should not assume that this gives us licence to treat our world as if our attitude towards it did not matter. St Paul faced the same question in another context (“Shall we sin that grace may abound?” Rom 3:8). He had no doubts: “God forbid!” God has given us dominion over creation (Gen 1:26), but we must note that the pattern for dominion in ancient Israel was a caring servant (Ps 72, Is 53:4-11, Phil 2:5-8). To quote Calvin on Genesis again:

“Let every one regard himself as the steward of God on all things he possesses. Then he will neither conduct himself dissolutely nor corrupt by abuse those things which God requires to be preserved.”

Some Christians regard the practice of sustainability as indicating a lack of faith, arguing that this world will disappear when the Lord comes again. Jesus repeatedly warned his followers to be prepared for the coming of ‘the kingdom’. Peter wrote that “the heavens will disappear with a great rushing sound, the elements will be dissolved in flames, and the earth and all that is in it will be brought to judgement” (2 Pet. 3:10). Such a ‘pre-millennarian’ interpretation of catastrophe remains common in North America, but has largely been replaced in Europe by a- or post-millennarianism, mainly as a result of looking afresh at the scriptures. When Our Lord spoke about not being anxious about tomorrow, his message was God’s overriding and controlling providence. In the same passage, he says God feeds the birds and “clothes the grass”. Just before Peter writes about the heavens disappearing and the elements melting he tells us, “the first world was

destroyed by water, the water of the flood” (2 Pet. 3: 6). Now it is apparent that the first world was not **destroyed** by Noah’s flood, or we would not be here now; what happened is that God purged the earth through the flood, and it is reasonable to assume that he will use fire to purge our current world, just as Paul says he will (1 Cor. 3: 13). Moreover, we will not “go up” to heaven; the New Jerusalem will come down **from** heaven, so that the dwelling of God will be with his fellow creatures. We are told that in due course heaven and earth will not be separated, but in being renewed, will be integrated with each other. The great claim of Revelation 21 and 22 is that heaven and earth will finally be united.

This is not the place to enter into the debates about a coming judgement and conflicting interpretations about the Millennium, Armageddon and the Apocalypse. The need is to seek what God wants from us in our present existence. And there can be little doubt that God has given us a job in this world to care for it and nurture it. He has appointed us as his agents (or ‘stewards’ or trustees); we will be held accountable to him for our treatment of that which he has entrusted to us (Matthew 25:14-30). For his part, God made an ‘everlasting covenant’ to maintain “all living creatures” (Gen, 9:8-17), long before the covenant he made with Abraham and his descendants (Gen. 17: 9). We must beware any interpretation which separates the the Old Testament covenant from the New Testament one (Luke 22:20; Heb. 8:6); Christ’s death on the cross “reconciled *all things* to him [God] - *all things*, whether on earth or in heaven” (Col. 1:20). Salvation extends beyond humankind to all creation. Creation care involves sustainability, and is part of our response to God – who is creator, redeemer and sustainer.

For almost all human history, we have assumed that the world’s resources are effectively inexhaustible. In theological terms, the belief has been that God provides lavishly and unstintingly for humankind, singling us out because he loves us as those alone made in his image. There have been repeated reasons to doubt this assumption: China alone has had around 2000 famines in the last 2000 years; overpopulation and land scarcity have led to successive mass emigrations - the Beaker Folk, Teutons, Vikings, and New World colonizers have all spilled from the western seaboard of Europe. Mis-management has often produced disastrous consequences: the early Polynesian population of New Zealand depended on the large flightless Moas for food, but managed to drive them to extinction within 600 years; over-extension of irrigation was a major factor in the collapse of the ancient Babylonian empire; Sicily was once the granary of Italy but less and less corn is grown there as the soil deteriorates under excessive cultivation and goat browsing; the ecological implosion of Easter Island is well documented. Actually, the assumption that God will always provide without limit is unfounded: the Bible is explicit that his bounty is conditional on our obedience.

CHALLENGES

Food security

Food prices have remained low in recent decades because growth in agricultural productivity has kept pace with rising demand. However, this growth is now slowing in both high-income and low-income countries. Nevertheless, there still is substantial potential to increase global food production through better use of existing skills and applying existing scientific knowledge and technology. It has been estimated that the application of existing knowledge and technology could increase average yields two to three fold in many parts of Africa and two fold in the Russian

Federation. The principal challenge is not to produce more food but to do so sustainably.

- It is often claimed that organic agriculture can achieve the sustainability and equitability goals highlighted in the Report. However, production costs are higher and yields from organic agriculture in high-income countries are typically lower than those from other production systems (implying that significantly more land will be needed to produce the same amount of food as conventional agriculture).
- The availability of advice to increase the skills and knowledge base of food producers (often women) is critical to achieving sustainable increases in productivity in both low-income and high-income countries. Uncertain rights to land and natural resources, such as water, fisheries and forests are a major disincentive to investment in food production in many low-income countries. Reforms to land tenure in China have given farmers far stronger rights over their land and have been a major factor in this country's very substantial increase in agricultural production.
- Agriculture and food production will need to adapt to a changing world with a higher likelihood of extreme and volatile weather events. Globally, agriculture currently consumes 70% of the withdrawals from rivers and aquifers. Demand for water for agriculture could rise by over 30% between 2000 – 2030, perhaps doubling by 2050, and will compete with pressures from industry, domestic use, and the need to maintain environmental flows. Freshwater fisheries are greatly threatened by water extraction and water quality degradation, and coastal fisheries and aquaculture are affected by increasingly nutrient-rich terrestrial run-off. In some arid regions of the world, several major non-renewable fossil aquifers are being progressively depleted– for example, in the Punjab, Egypt, Libya and Australia. The water for irrigation used extensively by India and Pakistan may decrease at the same time as supplies of groundwater are diminishing.
- Maize is the most widely grown staple crop in Africa – more than 300 million Africans depend on maize as their main food source – and it is severely affected by drought. The African Agricultural Technology Fund (AATF) is leading a five-year (2008–13) public-private partnership to develop drought-tolerant African maize using conventional breeding, marker-assisted breeding, and biotechnology. The varieties developed through the project will be distributed to African seed companies through AATF without royalty and made available to smallholder farmers. Research is required to maintain productivity at current levels because weeds, pests, diseases and pathogens continually evolve.
- Intensification increases the opportunity for diseases to spread, while globalisation heightens the risk that these agents are transported around the world.
- Up to 50% of all food grown worldwide may be lost or wasted before it reaches the consumer. Grain is lost from spillage, poor separation and drying, contamination and consumption by rodents, insects and fungal and bacterial diseases. If stored long enough under poor conditions it may become inedible. In high-income countries, the greatest losses are incurred by the food services industry and the consumer. In the UK, for example, as much as 25% of purchased food is wasted in the home. A family in a high-income country such as the UK could save around £680 a year by managing its food better. Halving the total amount of food waste by 2050 should be a realistic target.
- In addition to increasing supply, reducing waste, and improving the efficiency of the global food system by strengthening governance, the balance between supply and demand can also be influenced by measures aimed at influencing demand – changes in people's diets. For example, the high feed conversion rate of ruminants means that approximately 7kg of

feed grain is consumed for every 1kg of beef produced; the average 'water footprint' of 1kg of beef has been calculated at 15,000 litres, as compared to 250 litres for 1kg of potatoes. Improving food-literacy and food-craft skills, and promoting better diets at all levels of school education are important. But the solution is not necessarily to switch to a vegetarian diet. In many low-income countries there are pastoral and other communities where food derived from livestock is nutritionally and culturally critical. Much livestock is maintained on grasslands that are unsuitable for arable crops.

Sustainability

Factors behind the outstripping of supply by demand in the years leading up to the price spike in 2007-08 included the following:

- A combination of population growth and economic growth in low-income countries; and increasing demand for animal protein in transitional and emerging economies (notably the so-called BRIC countries [Brazil, Russia, India, China])
- Bad weather leading to poor wheat harvests in 2006 and 2007.
- Biofuels: the use of grains, especially maize in the United States, has grown significantly in the last 10 years, leading to
- A major loss of forest or cultivable land. In Indonesia alone, 38,000km² of forest has been cleared since 1996 for biofuel plantations; US use of maize for bioethanol has resulted in a 60% rise in price.

All climate models agree that the frequency and severity of extreme weather events will increase as the world warms. This will be one of the first manifestations of climate change. Without the impact from climate change, grain prices are likely to rise between 30–80% from 1990 to 2050; climate change is estimated to increase prices by a further 50–100%.

The single external commodity that has the greatest effect on food prices is oil; it is also one of the most volatile.

Protection of the most vulnerable groups from the worst effects of food price volatility should be a priority, especially in low-income countries where market and insurance institutions are weak. There is a strong case for establishing an emergency food reserve and financing facility for the World Food Programme to be able to help low-income countries facing sudden increases in bills for food imports when price spikes occur.

Many systems of food production are unsustainable, putting at great risk future food production. There are widespread problems with soil loss due to erosion, loss of soil fertility, salinisation and other forms of degradation; rates of water extraction for irrigation are exceeding rates of replenishment in many places; over-fishing is a widespread concern; and there is heavy reliance on fossil fuel-derived energy for synthesis of nitrogen fertilisers and pesticides. In addition, emissions to air and water from food production systems are frequently in excess of the levels considered environmentally benign. Livestock and nitrogenous fertiliser are major sources of emissions of the greenhouse gases methane and nitrous oxide, while losses of nitrates and phosphates from soil cause loss of water quality.

Ending hunger

Hunger is the antithesis of human development. Hunger interacts with food insecurity and undernutrition in complex ways. The first Millennium Goal was a commitment to halve the proportion of people who are 'undernourished' from 16% in 1990 to 8% in 2015. China achieved this goal in the early 2000s, but many countries in Africa and South Asia are unlikely to meet this target. In the regions where hunger is most chronic – South Asia and sub-Saharan Africa – agriculture can make the biggest contribution to alleviating it.

- Production is essential for the physical access to food. Technologies, institutions, infrastructure and information that support increases in the productivity of agriculture that are both sustainable (i.e. involve manageable amounts of risk for farmers and which do not degrade the environment) and equitable (i.e. are desirable, available and practical for the poorest farmers to adopt) can increase the supply of a diverse and locally desirable food bundle, at affordable prices.
- These technologies, institutions, infrastructure and information sources can improve economic access for all by raising farm income, generating employment on and off farm, and reducing food prices.
- Production can address issues of social access by deliberately empowering women and other socially excluded groups.

Protecting food supply as the climate changes

Greenhouse gas (GHG) emissions from different parts of the food system constitute a substantial fraction of all emissions; they have to be a key component of efforts to mitigate climate change. GHGs released during conversion of land to food production are a particularly important component of global emissions. Agriculture, including fertiliser production, directly contributes 10 – 12% of GHG emissions; and this figure rises to 30% or more when land conversion and costs beyond the farm gate are added. Moreover, agriculture contributes a disproportionate amount of high impact GHGs - approximately 47% and 58% of total anthropogenic emissions of CH₄ and N₂O respectively.

The EU has enacted legislation to reduce emissions by 20% by 2020 (taking 1990 as the base) while the UK has set the legally binding target of reducing emissions by at least 34% by 2020 and at least 80% by 2050 against a 1990 baseline (Scotland's targets are 42% and 80% respectively with the same baseline), while global energy demand is predicted to increase by 45% by 2030. These ambitious goals to reduce carbon emissions cannot be achieved without the food system playing an important part. Agricultural production uses 4% of global fossil-fuel energy (560 GW or 17.7 EJ) of which about 50% is required for nitrogen fixation in fertiliser production. Incentives that encourage more efficient use of water and fertilisers (including recycling) may both reduce emissions and increase value per resource unit, and also have other benefits, such as reducing nitrogen leaching and run-off, with positive effects for the environment and ecosystem services.

Action to address climate change must prioritise food security (see above). No democratic government will be able to introduce measures to reduce GHG emissions if they have significant effects on their citizens' access to food. This could be a particularly acute issue in low- and middle-income countries, where increased use of nitrogen fertiliser for expanded food output could add to GHG emissions.

Energy use is a better measure of GHG production than food-miles (i.e. the distance food travels

between producer and consumer). For example, Spanish tomatoes transported to the UK have a lower carbon footprint than UK tomatoes dependent on heated greenhouses; NZ lamb meat is four times more energy efficient than UK sheep despite their transport costs because of lower fertilizer and food concentrate use.

Maintaining biodiversity & ecosystem services

The Millennium Ecosystem Assessment* report identified the essential constituents of human well-being as requiring access to the basic materials for existence (such as food, shelter and clothing), sound health, good social relations, security, freedom of choice and action. It focussed on four categories of “ecosystem services”:

- *provisioning services* such as food, water, timber, fibre;
- *regulating services*, affecting climate, flood control, disease, waste and water quality;
- *cultural services*, providing recreation, aesthetic and spiritual benefits;
- *supporting services*, such as soil formation, photosynthesis and nutrient cycling.

Raising agricultural yield has often come at the expense of different ecosystem services.

Agriculture currently consumes 70% global fresh water; domestic and industrial use are increasingly competing for water. Optimising arable productivity may involve the elimination of all non-crop species and hence a reduction of biodiversity. It may also involve an increase in the application of nitrogen fertiliser, and hence a reduction in the ability of the agro-ecosystem to provide pure water (an ecosystem service) and a rise in nitrogen run-off and greenhouse gas emissions (which harm ecosystem services). Some of the most threatened and diverse habitats on earth exist in very low-income countries, and interventions that make farming more wildlife-friendly, fishing less damaging, or that set land aside as reserves, may impact on the livelihoods of the very poorest people.

Kenyan beans provide valuable income for a poor country, but at the expense of a progressive over-use of water. Overall, exported food accounts for 16-26% of total water used in food production world wide.

The potential for bringing more land into agricultural use is limited, and has to compete with urbanisation, desertification, salinisation and degradation. It is estimated that about 24% of the vegetated land on earth has undergone human-induced soil degradation, mostly through erosion.

On top of all this, about 75% of all diseases emerging during the last two decades have been zoonoses (diseases that can be transmitted from animals to humans); they have been identified as a highly important future disease risk. Wild animals and plants are crucial to many agricultural communities: the Food and Agriculture Organization (FAO) estimates that about one billion people use wild foods in their diet. Bushmeat and fish provide 20% of protein in at least 60 low-income countries. This is a possible source of zoonoses, while trade and markets can create the pathway for

* The Millennium Ecosystem Assessment was a five year study (2001-05) by a worldwide group of ecologists to assess the implications of ecological change for human well-being. It concluded that the overall effect has been substantial net gains in human well-being and economic development, but at growing costs in the form of the degradation of many ecosystem services and the exacerbation of poverty for some groups of people. Food production has more than doubled since 1960 and its price has dropped, but 25 percent of commercial fish stocks are being over-harvested (the marine fish catch has been declining since the late 1980s).

disease transfer and evolution. Although it is difficult to quantify, the illegal trade in wildlife is estimated to be worth more than US\$8 billion. Recent research suggests that about 270 tonnes of potentially contaminated illegal bushmeat may be passing unchecked through a single European airport each year.

The political reality is that sustainability cannot be pursued in the absence of food security, and the fact that food production requires ecosystem services provided by both farmed and non-farmed land, means that policy in these two areas needs to be developed and properly connected at global, national and landscape scale; food security and environmental protection are interdependent. Production subsidies, trade restrictions and other market interventions used by high-income countries have become of huge significance because of the financial and political powers of the nations involved. This political significance has allowed subsidies and barriers to trade in agricultural markets to assume levels far in excess of those applied in any industrial sector. In the EU, for example, the average of tariffs applied across all agricultural goods is around three times higher than the average across industrial goods. Future reform of international institutions such as the World Trade Organization will have to include issues of sustainability and climate change.

Much of the land around the globe that could be brought into agriculture is currently covered by tropical rainforest. Pressure from expanding agriculture has been a major factor leading to recent tropical deforestation, especially in South America (where conversion to soybean and cattle ranching is the greatest pressure) and South East Asia (due to oil palm conversion). There needs to be a greater realisation that market failures exist in the food system that, if not corrected, will lead to irreversible environmental damage and long-term threats to the viability of the food system. Moves to internalise the costs of these negative environmental externalities are critical to provide incentives for their reduction.

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