

## Royce Abbey Memorial Oration, 2022

# Water, food and peace

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Australia has certainly been a lucky country when it comes to food security. We enjoy abundant access to relatively cheap, highly nutritious food and, if we choose, a balanced diet. We owe a lot to our farmers in this regard. Australian farmers have displayed incredible innovation in the face of physical and economic challenges. In 2017, our exports fed (at least in part) 36.6 million people outside Australia. If we add that to our domestic population, 61 million people ate Australian food in 2017. However, living with food insecurity and poor nutrition is still an issue for over 900 million people worldwide. Periodically, factors combine to exacerbate access to food for the global poor and, as a consequence, we have seen famines, food riots and political insurrections such as the 2007-08 food crisis and the Arab Spring uprisings that followed soon after. Currently, factors have conspired to create a new food crisis and now we are facing the 3 Cs, Covid, climate change and conflict, the ultimate impacts of which remain uncertain. We have also seen the impacts of some of these factors in Australia including fires and floods, vegetable price increases, rising fuel prices and Covid caused labour shortages.

The premise of this oration is that food security promotes peace. I will present evidence as to why this is the case and will also examine some of the causes and impacts of food and nutrition insecurity. This is an area where we can certainly learn from history and one whose successes the global agricultural and farming community can certainly be proud of. However, the 3Cs mentioned above indicate that the current situation is finely balanced with Covid disruption, climate change and the war in Ukraine as well as pest and disease outbreaks, water scarcity and competition for land, once again jeopardising global food supply and access to cheap food for all. I will start this oration by focusing on how we fed a rapidly increasing global population via the Green Revolution. This will be followed by discussion of six key issues relevant to food security and peace:

- Water and food security
- The water, food energy nexus
- Water wars
- The role of food insecurity in social unrest
- Threats to food security
- How we can all contribute to a food secure world

## The Green Revolution

In 1798, the Reverend Thomas Malthus, an English cleric, scholar and economist, postulated that whilst food supply grows at an arithmetic rate, population growth follows a geometric rate of increase thus causing famine, or war and consequent depopulation. However, this hypothesis was largely rejected based on post World War 2 events. In 1950 the global population was approximately 2.5 billion. By 2020 it was 7.9 billion. Whilst there were some signs that population growth in the 1950s and 1960s resulted in increasing famines and malnutrition, the Green Revolution intervened. This revolution saw amazing improvements in agricultural productivity based on the breeding of new varieties and irrigation. The Green Revolution was led in the Americas by Dr Norman Borlaug, who whilst working at CIMMYT (International Centre for Maize and Wheat Improvement) in Mexico developed semi-dwarf, high yield, disease resistant wheat varieties. In Asia, M.S. Swaminathan played a similar role, particularly in India. The breeding technologies applied to wheat were subsequently applied to rice (at the International Rice Research Centre and maize (at CIMMYT). Some authorities suggest that Norman Borlaug may have saved a billion lives from death by starvation, and he was awarded the Nobel Peace Prize for his work.

The impact of the Green Revolution has still passed some people by. By 1980 the global proportion of hungry people was about 1 in 9, a figure that remains similar today. These are the world's real poor, who often go to bed hungry and whose children suffer from malnutrition and consequent physical stunting and slowed mental development. It is a medical maxim that nutrition for the first 100 days following conception is critical for an individual's physical and mental development. It also demonstrates that it is not just having access to enough calories that is important, but that the food available must also be nutritious, providing the necessary minerals and vitamins for healthy growth.

Whilst the Green Revolution clearly allowed the world to keep pace with population growth, it also enabled a lot of smallholder farmers to climb out of poverty and raise their standard of living. This also enabled their children and particularly girls to get a basic education and thus further opportunities in life. Furthermore, the World Bank has demonstrated that for the world's poorest countries, there is a strong correlation between improving agricultural productivity and national gross domestic product.

The positive outcomes of the Green Revolution are not without opposites. By the year 2000, the 900 million malnourished and poor were being outstripped by a growing number of over-nourished individuals. Access to plentiful, calorie dense foods particularly by those whose jobs and lifestyles were essentially sedentary had led to an epidemic of obesity and its associated lifestyle diseases that impose a heavy burden on health services. Dr Ismail Serageldin, a Vice President of the World Bank (1992-2000), and Chairman Consultative Group on International Agricultural Research (CGIAR 1994–2000) commented at a meeting in London in 2008, that the world was not only facing the issue of the bottom billion, but also the problem of the billion fat bottoms! That latter figure is now closer to two billion overweight and obese people.

It is also uncontested that the successes of the Green Revolution have come at the cost of the environment. Clearing of native vegetation and reduced biodiversity, increasing use of water resources, land and soil degradation, pollution from fertiliser overuse, agrochemicals and food wastes are all now critical issues that we have to deal with. In Australia about 20% of our greenhouse gas emissions are the result of agricultural production and this figure increases when land clearing is also taken into account.

A further consequence of the increase productivity gains of the Green Revolution has been the shift of populations from rural areas to large cities. Whether this is beneficial to agriculture is debatable given that there is a much-reduced pool of available labour, but it may discourage further fragmentation of already small land holdings in some countries.

### **Water and Food Security**

The value adopted internationally for the amount of water to simply cope with basic human needs is 50 L/day. In less developed countries, individuals use, on average, about 200 litres of water per day and this figure is significantly higher for developed countries like Australia and the US. However, when we add the amount of water used per person in the production of goods, and particularly food, this figure rises to as much as 5,000 L /day given that to produce a calorie of food requires 1 litre of water. Given that the average person requires 2500 calories per day, this requires 2500 litres of water to produce it. Of course, where this water comes from depends on how much diets depend on rainfed agriculture versus irrigated cropping. Estimates indicate that currently the world uses just over 2500 km<sup>3</sup> water per year for all agricultural, domestic and industrial uses. This is forecast to climb to somewhere between 3000 – 7000 km<sup>3</sup> per year depending on the rate of population and economic growth.

However, much of the world is already water scarce, just like our own Murray Darling Basin. This scarcity is seen in the form of closed basins where rivers no longer flow into the ocean, falling groundwater tables and associated ecological declines. For example, in Israel, often renowned for its transformation of the desert into a food bowl, flows into the Dead Sea have reduced by about 90% from pre 1950 up to today. In northwest India measurements showed that groundwater tables are lowering by about 4 cm per year. In the Murray Darling Basin, water diversions to agriculture increased from about 2,000 GL/year in 1920 to over 12,000 GL/year by the year 2000, precipitating the cap on further diversions. Some areas still exist where there are untapped water resources, but these may require significant capital investment to be developed or are in places which are unsuited for agriculture or are protected environmentally.

Put bluntly, there is considerable scientific concern that we do not have enough available unused fresh water resources to produce the required amount of additional food to feed 8 billion people on a business as usual basis. This is compounded by the increasing competition for water resources from industry and domestic users, not to mention more likely droughts and floods that will occur with climate change. We thus have a paradox of how do we grow more food with less water? I will come to some solutions later in this talk.

### **The water-food-energy nexus**

Water and energy are inexorably linked. Energy as electricity and liquid and gaseous fuels available when and where needed, require water to produce them. Water of sufficient quality and pressure, available when and where needed, requires energy to produce it. It was estimated that in 2009 in the US, 13% of the total energy supply was consumed by collecting, treating, storing and distributing water. Conversely, the EU Environment Agency calculated that 44% of Europe's water is used by the energy sector. The demand for electricity in South East Asia has seen the construction of more than 100 dams on the Mekong tributaries and two on the Mekong Mainstream in Laos. A further 100 are already under construction or planned! However, much of the water used in the energy sector may be subsequently released back to rivers or lakes and may be available for use in agriculture.

The key issue is whether releases from hydropower dams are made at a time suitable for farmers. This is not always the case as was demonstrated in Central Asia where water released

from dams in Kyrgyzstan was predominantly in winter and has been allowed to flow into artificial wetlands in Uzbekistan, rather than being productively reused, either in agriculture, or to help maintain the levels of the Aral Sea. We have a somewhat similar situation in the Murray Darling Basin where storing the winter run-off and spring snow melt from the eastern ranges has seen a system now dominated by summer flows, which have significant environmental impacts.

Dams also have a very significant impact on fish migration and breeding cycles. Where large numbers of people depend on fish protein, as is the case in the Mekong, their impact can be potentially catastrophic unless measures are taken to ensure fish can migrate past dams.

A further water-food-energy nexus issue is that conventional agriculture depends on major use of fossil fuels for fueling its machinery and distribution networks, as well as for the production of ammonium-based fertilisers. As we are currently aware, any increases in these costs affect the price of agricultural commodities in the shops. These price increases can be borne more easily in richer countries with social safety nets, than in many developing countries.

### **Water wars**

Politicians and journalists sometimes refer to water wars. Major conflicts resulting from water scarcity have so far been rare. Certainly, there are many examples of sub-national and national conflicts that have occasionally become violent but are, more often than not, solved by political and legal means. The earliest conflicts go back as far as 2500 BC in Mesopotamia, when various rulers diverted water supplies and damaged wells as a means of inflicting hardship on their enemies. Similarly, cutting off water supplies to besieged towns, poisoning water supplies, diverting rivers and damaging dykes have also been used as military strategies since before and after Roman times.

On other occasions there have been instances of mobs destroying reservoirs in the USA and India because of perceived health impacts and targeting of hydroelectric dams in World War Two. In Australia, squabbling over the Murray Darling waters is almost a national sport. Similarly in the USA, concerns over how the Colorado's water were to be divided up led to litigation between states and ultimately to a series of ongoing river management agreements between the parties.

Elsewhere, military skirmishes did break out between Israel and Jordan and between Egypt and Sudan in the 1950s over water use of the Jordan and Nile Rivers respectively. Whilst the Nile and Jordan still remain water hot spots, there are few, if any examples of full-blown wars occurring because of water scarcity. Similar concerns also occur with Turkey's control of the headwaters of the Tigris and Euphrates Rivers in the Middle East.

Remarkably, the water sharing agreements developed after the separation of India and Pakistan have held since 1949. So, the general picture is one of water resources being targeted during wars, but generally not the principal reason why wars have started. However, given the increasing concerns caused by water scarcity and climate change impacts, it is uncertain if this will be the case into the future.

### **Food insecurity and social unrest**

The impact of food insecurity on social unrest has been most marked in recent years following the 2008 world food crisis. This crisis resulted from poor harvests in several countries coinciding with depleted levels of food storages. At the same time, some European countries, Brazil and the USA were increasing biofuel production at the expense of food. Whilst there was always

enough food available to feed everyone, access to it was impacted in some countries and price rises impacted the poor. Food riots occurred as a result in several countries including Egypt. The situation in 2008, was further exacerbated by some food exporting countries stopping their exports and stockpiling commodities such as rice.

Combined with social resentment of authoritarianism and exploitation by corrupt governments, these events led to the overthrow of several governments in North Africa. Starting in Tunisia, the protests then spread to five other countries: Libya, Egypt, Yemen, Syria, and Bahrain. Collectively these uprisings were referred to as the Arab Spring.

Food crises, whether triggered by drought, floods or energy price increases can thus trigger for social unrest in the world's poorer countries. These events can lead to significant numbers of refugees and the problems experienced in absorbing them in wealthier countries. It has been argued that the severe drought caused by climate change in Syria between 2006-10, sparked the mass migration of rural workers into Syrian cities before the 2011 uprising. The relevant study was one of the first to implicate global warming from human activities as one of the factors that played into the Syrian conflict which is estimated to have claimed more than 190,000 lives. The severity of the 2006 to 2010 drought, and more importantly the failure of Bashar al-Assad's regime to prepare, or respond to it effectively, exacerbated other tensions, from unemployment to corruption and inequality, which erupted in the wake of the Arab Spring revolutions. Furthermore, it was not only the war in Syria that saw significant flows of refugees, but that once again, these flows were also the result of major drought between 2013-15.

### Threats to Water and Food Security

Whilst we do produce enough food to feed 8 billion people, we are getting increasingly closer to a point where our natural resources cannot continue to support more production. The impacts of agriculture have been incredibly significant globally in terms of the use of land, water, agrochemicals and fuels. We are now living in what has been termed the Anthropocene era, an era in which human activities are significantly influencing the entire planet. Many commentators have asked whether we can continue to feed a growing population without wrecking the environment.

The UK Chief Scientist, Sir John Beddington, postulated in 2009 that we were facing by 2030 "The Perfect Storm" of food shortages, scarce water and insufficient energy resources that threaten to unleash public unrest, cross-border conflicts and mass migration as people flee from the worst-affected regions. We are already experiencing these events. Whilst some of them are catastrophic, such as the recent flooding in Pakistan, others are more subtle, such as increasing night temperatures impacting the flowering of wheat and thus reducing its ultimate yield in sub-tropical environments in South Asia. Increasing drought frequency and more intense summer storms are other impacts of climate change that we will have to deal with in parts of Australia. In Asia, increasing snow and ice melt in the Himalayas may have profound impacts on stream flow in some of the world's most important rivers and their irrigated lands.

Elsewhere, land clearing, often illegal, continues to destroy biodiversity and vast areas of tropical forests. Similarly, the extensive agricultural use of major river deltas and land reclamation for urban areas have destroyed coastal habitats critical for fish reproduction and feeding sites for migratory birds. Furthermore, the loss of coastal and estuarine mangrove habitats is also exposing the vast number of people who live on deltas and flood plains to higher risks from rising sea levels. Additionally, agriculture has degraded large areas of productive land due to soil erosion, non-replenishment of nutrients, soil acidification, salinisation and soil structural decline. Consequently, it is often argued that in many areas agriculture has "mined" the land of its fertility.

Competition for water resources between sectors of our economy is also putting further pressure on agriculture. Security of domestic and industrial water supplies is often put ahead of agricultural water, just as high- quality agricultural land is often used for urban development.

As global population continues to grow, food demand will continue to increase. However, as GDP and economic development grow, there is a concomitant demand for more “sophisticated” diets, which are higher in meat and dairy products. The increased numbers of pigs, cattle and chickens needed to supply these animal-based proteins consume considerable amounts of grain, much more than is required to sustain people on simpler, mainly vegetarian diets. This is why the FAO stated in 2012 that we would need to double food production to feed an increase in population from 7 to 10 billion mouths. However, investment in global “public goods” research and development in agriculture has significantly decreased this century. It was R&D that led to the Green Revolution and that has subsequently enabled an average annual increase in crop productivity of up to 1.5%. We are now at a point where investment in R&D is not sufficient to maintain required levels of productivity increases to feed a growing global population.

Conflict has been and continues to be a major concern for food security. The current war in Ukraine has dramatically reduced the export of grains and oilseeds from that country. Ukraine supplies up to 16% of the world’s corn exports and more than 40% of the world’s sunflower oil. A recent BBC report noted that Egypt and Bangladesh each get about one-quarter of their wheat from Ukraine exported from its Black Sea ports. Moldova, already suffering from Russian occupation and the war’s fallout, gets *over 90%* of its wheat from Ukraine. What isn’t receiving enough attention is what stranded Ukrainian grain means for the world’s poorest and most vulnerable. Egypt is currently suffering again due to the impact of the war in Ukraine on access to grain. **The price of wheat in Africa is up by 45%**, reports the African Development Bank. In a recent **UN Security Council debate**, World Food Program Executive Director David Beasley stated, *“Failure to open those ports... will be a declaration of war on global food security... And it will result in famine and destabilisation and mass migration around the world.”* Whilst some progress has been made with allowing exports from Ukraine to resume, the conflict demonstrates the sensitivity of the world’s food supply chains.

As well as the fallout from the Russia-Ukraine conflict, there are concerns that current geopolitical developments could lead to a breakdown in the post-World War2 liberal, rules-based order that has essentially allowed trade to flourish over the last 70 years. This is potentially a real threat to trade in commodities and once again it will be the poorer, food scarce countries who stand to suffer the most.

Finally, it would be remiss not to mention the threat to food security imposed by pests and diseases. Currently, there is a major outbreak of foot and mouth disease in Indonesia, East Asia has been severely impacted by African swine fever, and Varroa mite, that can decimate bee populations, has got a toehold in NSW. This mite could not only devastate the honey industry, but the loss of bees as pollinators could seriously affect other crops. Additionally, we have seen the impact of Covid 19 on humans and its flow on effects with respect to labour supply, trade, education and so on. We expect not only the regular emergence of new strains of pests and diseases affecting agriculture, but also that new zoonotic diseases like Covid 19 will be of increasing frequency, partly because of the greater proximity of animals and humans and also because of the ease that such diseases can be transmitted in our interconnected world.

### How we can all contribute to a food secure world?

In the light of the preceding evidence, it would be easy to be pessimistic with respect to both feeding a growing global population and the negative impact on the environment of increasing

food production. However, there are several simple things that we can all contribute to that will make agriculture more sustainable. These include:

- Reducing food losses and waste: there are many ways that food losses can be reduced between paddock and plate, particularly in developing countries. These include provision of improved storage facilities on-farm, and better transportation to market. However, the critical issue with respect to food waste is that in western countries we throw out over 200kg per person of edible food per year. The majority of this ends up in land fill and thus contributes to greenhouse gas emissions. We have to become less wasteful! Using even a small proportion of this wasted food will save water, nutrients and greenhouse gas emissions. It was estimated by a Swedish scientist in 2010, that global food waste was the equivalent of losing 1,300 km<sup>3</sup> of water. This amount of water is close to the additional amount needed to grow the food required to feed our growing population!
- Reuse and recycling: on an individual and local basis we need to be recycling food waste as compost. We also need to be treating and recycling waste water for reuse in agriculture and the environment rather than pumping it out to sea.
- Don't assume organic agriculture is the answer: yes, it can be a good choice for some, but yields are often lower than in systems using artificial fertilisers and it takes considerable skill. Sri Lanka recently went organic overnight, and this resulted in massively reduced yields and the need to import food previously produced at home, causing a further drain on the countries depleted foreign currency reserves and the breakdown of law and order.
- Use water wisely: this goes without saying particularly in drought years.
- Practise sustainable intensification of agriculture: this means growing more off less area and making sure that water productivity is high, and thus reducing pressure on the environment. This also involves closing yield gaps. Yield gaps are the difference between potential biological yield and actual yield. Even in relatively sophisticated agricultural systems average yields are often only half potential yields and in poor countries a lack of knowhow, fertilisers, pest, disease and weed control and mechanisation result in very low yields.
- Eat sustainable diets: western diets are highly consumptive of resources including water and nutrients. By reducing our intake of meat and dairy products even marginally and eating more wholegrains, vegetables and fruit, we can reduce environmental pressure and also help ourselves by becoming healthier!
- Encourage agricultural innovation including sequestering carbon in soils, electrify machinery to reduce fossil fuel use, and regenerate degraded soils, water and vegetation.
- Support sensible policy making mechanisms that encourage wise use of our natural resources, and community participation in their management and ongoing investment in agricultural R&D at home and abroad.

## Conclusions

This oration has demonstrated the critical links between water and food security and social unrest and what we have to do to maintain production and access to food for all. I am optimistic that, based on knowledge, science and goodwill, we can achieve a food secure world and one in which agriculture is seen as efficient and in harmony with the environment. We clearly have the scientific knowledge to achieve this based on an exceptional track record over the last 50 years.

I have also highlighted actions including behavioural change that we can take individually and collectively to help sustainability.

However, we need to recognise that ongoing investment from governments and the private sector is needed to achieve food security and environmental goals. Australia is a leader in this area based predominantly on the role of the Australian Centre for International Agricultural Research (ACIAR), and supported by the Crawford Fund. ACIAR invests about \$100 million a year on bilateral and multilateral aid. What is often not understood is that this investment returns a figure ranging between \$3 to \$10 for every dollar invested. Furthermore, our farmers benefit directly as well via free access to new crop varieties developed in the system of international agricultural research centres (CGIAR).

Similarly, our universities, scientists and students benefit from direct collaboration in ACIAR projects with overseas counterparts which helps our understanding and preparedness to deal with new threats and adopt new technologies. Our support of natural resource management and environmental projects overseas helps contribute to the UN Sustainable Development Goals. Additionally, our agricultural development assistance increases our global standing as a good neighbour and has significant diplomatic and soft power outcomes. In my view this is money well spent given that if we can contribute to food security, it is a major step in creating more prosperous, peaceful and harmonious societies.