ESSAY

It’s more than just the fruit
Consequences of climate change on Australian agriculture
Robin E Roberts

MANGOES ARE DEEPLY embedded in my childhood. Even now the smell or taste of the fruit connects me instantly to hot summers in Brisbane. I can see myself as a seven-year-old sitting under the sprinkler with mango juice running through my fingers, fighting my siblings for the seed. Sweet, sticky mangoes signalled that summer had begun, school was over and holidays had started. Mangoes just seemed to arrive – and in abundance. How that happened, of course, meant nothing to me. Looking back, I think my lifelong passion for mangoes began to bud in that time.

For over a decade, I have been working with mango industries as a social scientist to understand purchasing attitudes towards mangoes in Australia, Hong Kong, China and, more recently, across five South-East Asian countries. While consumer demand for mangoes is increasing across the region, and my work with the industry sector is dynamic, it’s not all good news. Farmers have been struggling to manage the impacts of a changing climate on annual mango crops that have already resulted in fewer mangoes for the Australian season. I see this when I go into a supermarket, an independent grocer or a farmers’ market: mangoes are not arriving with the abundance they did when I was a child. If I was unaware of the mechanics of mango supply as a child, the issue is now front and centre for me.

The mango is considered by many as an essential summer fruit, and its popularity continues to grow in Australia and South-East Asia. However, this
‘king of fruits’ is under threat from the effects of climate change. Mangoes prefer tropical climates where cool, dry, frost-free winters bring on flowering, and humid, hot summers produce fruiting. The emergence of fruit on trees in Australia follows the arrival of summer across the continent in the later months of the year, first in Darwin, then in northern Western Australia, and then North Queensland and down the eastern seaboard. These three regions are characteristically Australia’s major mango regions.

Typically, tiny pink flowers, known as panicles, appear on mango trees across tropical and subtropical Australia in late May and June each year. For farmers, this signals the start of the pre-season. In the lead-up to flowering, a farmer in far northern Australia growing Kensington Pride or R2E2 mangoes will be preparing their orchard. Around this time, fertilising soil – which ensures healthy flowering rates – takes up much of the farmer’s day as the weather begins to cool.

In the last decade, these flowers have been appearing later, and at a lower rate, than usual. As overall temperatures increase due to climate change – and hotter weather arrives earlier in the year – we might expect the mango season to start earlier. But mango production also depends on the cooler weather in winter months to induce tree flowering – and cooler weather is arriving later, and lasting for shorter periods, in northern Australia. The increase in average temperatures in northern Australia – indeed, across the world on average and in some equatorial locations especially – means that summer is arriving earlier, and winter is arriving later. Mango flowering is induced by low temperatures at night and can be inhibited by high temperatures during the day. Which means that if cool durations are not long enough, trees can produce vegetative growth instead of flower panicles. This year, in the north-west of Australia, flowering did not occur until August.

Impacts from such climate changes are significant. Yields are decreasing, production costs per mango are rising and overall farm productivity is greatly reduced. Many farmers are now questioning the economic viability of their mango orchards. The loss of industry and livelihoods is driving significant change, impacting the varieties farmers grow, new genetics, micro-environmental manipulation and the location of orchards across Australia. For instance, farmers in the Top End of Australia are losing out as mango farming begins to migrate south to align with the required climate
conditions. We’re now seeing production in areas previously considered warm temperate regions, such as Gingin, one hour north of Perth, and Harvey, two hours south of Perth (at 33 degrees south of the equator, roughly on par with Sydney) in southern Western Australia, with ideal growing conditions. There, the climate is described as Mediterranean (warm temperate) with hot, dry summers and mild, wet winters. Fifteen years ago, a farmer here planted 250 trees and for the last six years the trees have fruited – to everyone’s surprise. This farm is now a viable mango producer.

But these apparent successes in new growing regions do not mitigate the overall negative consequences of a changing climate. CSIRO researchers studying climate change and horticulture in northern Australia have been monitoring increases in the rate and range of temperature change for a number of years. One of their priorities has been to identify the temperature triggers for mango flowering and fruit set in order to understand the variability of fruit growth. Now, mango growers are working with this research to plan for and respond to the increasingly variable seasons. New varietals are being developed and climate projected threshold data sets are being used to inform the geographical relocation of orchards.

SUCH RESEARCH WORK and changes in farming practices are playing out across agricultural industries in Australia and around the world. As temperatures fluctuate and become more extreme, natural disasters are becoming more likely and more devastating, and the all-important resource for producing food – water – is becoming scarce. This has significant impacts on when and where we can produce food, and how much is available to service regular supply lines.

Greater temperature extremes mean more frequent and longer-lasting heatwaves, which impact the agricultural sector in a number of ways. One prominent recent example is the impact of bushfires and heatwave conditions on milk supply in Victoria in 2019–20. Record-breaking temperatures and extended periods of severe drought amplified that series of mega-fires across southern Australia, and milk supplies during this period were severely compromised. Apart from the loss of stock, the fires destroyed fodder and farm infrastructure. Cows have to be fed and cows have to be milked, sometimes twice a day. In these catastrophic conditions, some cows were not milked for up to sixty hours, damaging cow health and halting supply – and
during this period milk supplies very nearly ran out in Gippsland, Victoria and on the south coast of New South Wales.

Mangoes are another organism that’s sensitive to temperature. After flowering has been triggered at the required minimum temperature, an orchard needs to avoid extreme heat or the trees will not fruit. Climate change projections suggest traditional mango-growing regions will get a lot warmer in the coming decades.

Of course, rising temperature also affects rainfall and water distribution. Dorothea Mackellar famously described Australia as a land of ‘droughts and flooding rains’ – this is as true as ever; however, the length and nature of these droughts and rains are changing with the temperature. Progressively higher temperatures in Australia are directly linked to climate change and extreme weather events. Climate modelling projections show, although not conclusively, that heavy rainfall events – including torrential downpours and hail storms across the country – will increase in the next twenty years.

As a consequence of climate change, droughts will be more regular, perhaps longer in duration and apply more broadly across the country. This will mean that farmers and those living in rural areas are likely to experience drought more often. Some communities that have been living with drought over several generations will live to see it intensify. Given that the impact of drought is directly linked to farm productivity and profitability, the consequences are dire for farming, businesses and communities.

In the mid-2000s, the CSIRO research program Water for a Healthy Country advanced the national conversation on the impacts of climate-change-induced water scarcity on agricultural production. They found that changes in water scarcity would directly affect food security due to variable supply of fresh produce to domestic and export markets, changes in availability, and changes in prices paid by retailers and consumers. The effects of this have already been particularly evident in Australia’s key wheat- and rice-producing areas in the southern parts of the country. In winter/spring periods, crops in these regions are dependent on seasonal rains. But as the climate warms, these regions have effectively dried out, as seasonal rainfall patterns have altered. In particular, this has been evident in south-west Western Australia, where annual rainfall decreases of approximately one fifth (compared with the previous seventy-year period) have been observed.
since the 1970s. In 2018, this decline increased to more than a quarter. Core cereal regions – once significant commodity producers – are now in a downward spiral.

Another particularly notable impact of climate change on food production – and on the environment more generally in Australia – is the worsening of bushfires. Unplanned, out-of-control fires, such as those that made international headlines in summer 2019–20, have a devastating impact on Australia’s wilderness and wildlife. bushfires shock natural ecosystems and biological communities, change plant composition, and reduce growth and the carrying capability in the next season. Specifically, the impacts on pasture will differ with the intensity of the heat, fertility of the soil and subsequent rains. Researchers categorise pasture recovery against three levels of fire intensity that explore how hot a fire was and for how long. In cool–moderate burns, most plant material is burnt with some seed and subterranean clover surviving. In hot burns, all plant material and many seeds are burnt, with the topsoil usually presenting as charred. Finally, in very hot burns, the soil is – for all intents and purposes – sterilised. All plants and seeds are destroyed along with the top organic matter layer of the soil. In the long term, in very hot burns, a pasture does not gain any additional nutrients as a result of the fire. Original density has to be returned – paddocks need to be heavily harrowed to unearth buried seed and improve germination, sow new pasture seed and leave off livestock for a season – to improve recovery.

In addition to these obvious effects, other unanticipated and more novel consequences emerge from such unprecedented disasters. The 2019–20 Australian bushfires produced incredible amounts of smoke, which at their peak travelled as far as Chile and Argentina. Locally, the smoke drastically worsened air quality, even in urban areas untouched by the flames. It also affected grape growers and wine producers across the country. While the total loss of vines to fire was diminutive (less than 1 per cent), the extent of the smoke damage to grapes was widespread and significant (as at January 2020, this equated to 4 per cent – or 60,000 tonnes – of the national grape crop). In fact, bushfire smoke travelled to, and lingered on in, wine-growing regions as far-spread as the Huon Valley, Tasmania, and New Zealand. Smoke adversely affects the quality and taste of grapes by interfering with the sugars and compounds of the fruit, and this will result in wines with the notably undesirable flavour profile of an ashtray.
It is beyond question that these issues – water scarcity in particular – will drive national agricultural productivity downwards, and this will directly impact regional and, ultimately, global food trade. However, broad economic and political engagement with these effects is worryingly low, a consequence of improved commodity pricing, changes in supply chains, and financial support for irrigators that currently allow the management or reduction of climate change impacts to improve productivity. While these short-term fixes have provided some relief for a struggling industry, refusing to acknowledge and address ongoing underlying issues, including changes in rainfall patterns and water allocations, poses substantial medium- and longer-term threats to agribusinesses nationally and, consequently, to trading and food security issues in domestic and regional markets.

I can only describe the production-side impacts of climate change on agriculture in Australia very briefly here. These issues are most often the focus of political manoeuvring and media coverage; they feature in environmental assessments and government reports. Less discussed are the ways climate change is impacting the experience of consumers, in terms of which products are available to consumers and how consumers’ decisions are affected by an understanding of climate change and its impacts.

The economic – as well as environmental and social – impact of climate change is profound and undoubted. An increasingly variable climate impacts the confidence of consumers – and, therefore, their buying choices and spending patterns. Consumer confidence in services and goods is also being put to the test. As climate change is now considered a financial risk, the growing demand for services provided by publicly listed companies to disclose the risks that climate change poses to businesses and consumers is critical. Consumers are increasingly aware of sustainability (such as sourcing local products and energy-saving initiatives) and give preference to businesses that adopt initiatives that seek to reduce or prevent the impact of climate change. The implication of this is that consumers reward businesses with loyalty if they deem that business to be ethical.

Though most of us might not be aware of it, the impacts of climate change can already be felt in supermarket grocery aisles. The volume of the mango crop available during summer is already declining as regions warm up and experience increasingly varied rainfall events. This decrease in
volume, as with any consumer product, leads to an increase in price – which, for mangoes, is amplified as the season progresses from October through to March. Other iconic and staple foods are also already affected, including beef and lamb, other seasonal fruits, and red and white wines. In 2006, Severe Tropical Cyclone Larry made landfall in Far North Queensland, wreaking widespread destruction – including to almost 90 per cent of the country’s banana crops. This resulted in a 500 per cent price increase and affected supply for almost a year. While cyclones are a common seasonal occurrence in Queensland, they are also another weather event predicted to become more frequent and more severe with the changing climate.

Intense droughts are also reflected in food prices. In the first three months of 2020, consumer prices in Australia rose 0.3 per cent, but annual food prices went up 2.2 per cent – to a five-and-a-half-year high. A combination of supply challenges (drought, bushfires and cyclones) and consumer hardship (rates of unemployment and increased price points due to the COVID-19 pandemic) saw April 2020 register as one of the worst retail periods in history. By late March, the shutdown of non-essential services and enforced trading restrictions due to the pandemic revealed a strikingly different story in the jobs and labour market statistics. Unemployment had increased to 13.7 per cent (1.8 million people) and the collective unemployed and underemployed had risen to 19.9 per cent. Fall in consumption was notable in food categories – with the exception of the ‘meals out and takeaway’ category.

The sharpest price rise in agriculture products was seen in vegetables. For instance, broccoli and green beans – staple food items in many households – experienced a 9.1 per cent increase over the first quarter of 2020, putting their pricing well beyond the means of many consumers during a period of economic hardship. Everyday fresh fruit prices rose 2.4 per cent, while beef and lamb rose 3.5 and 2.8 per cent, respectively.

While consumer preferences and behaviours are being altered by forces beyond their control, some of the key drivers for these changes are personal. As purchasing habits change, there is increased awareness of issues including food waste in supply chains and dietary health.

In 2018, the ABC series War on Waste provided an important source of coverage for the many avenues of consumer waste, sparking moral outrage at our collective apathy and a renewed interest in reducing, reusing and recycling. But that apathy wasn’t total: the Australian Government’s
National Food Waste Strategy – in place since 2017 – aims to halve the nation’s food waste by 2030 by ensuring sustainable consumption is linked directly to production. This strategy is explicitly connected with the United Nations’ program Transforming Our World: 2030 Agenda for Sustainable Development and speaks to Australia’s obligation to reduce greenhouse gas emissions under the UN Framework Convention on Climate Change. The plan aims to divert food waste away from landfill and, nationally, to develop a sophisticated and technologically supported approach to food waste that links to production, processing, supply and retailing of fresh and processed food products. As well as the development of tools to make better choices for producing, purchasing and consuming, food rescue charities and like-minded groups have redirected food products into channels that provide productive and affordable sources of supply for those more vulnerable in our communities.

In 2020, Australia’s food waste and loss were estimated at over $20 billion a year and near 1.3 billion tonnes. With the disposal of food stuffs in landfill clearly linked to the production of greenhouse gas emissions, opportunities to repurpose or avoid waste have emerged in new studies of the ‘circular economy’. One illustrative example came with grapes damaged by the 2019–20 bushfires. Smoke taint affected the fruit for two to three months following the bushfires, which led to significant losses for many growers. However, in the Huon Valley in Tasmania, the Hartzview Vineyard picked their smoke-tainted fruit and removed the skins, usually kept for soaking and fermenting to bring about the rich pinot colour. Removing the use of sulphur, the usual compound for distillation, they raised the alcohol level to 18 per cent per volume and applied a fortifying approach. The base was stable, providing time to consider the type of product that could be produced. The outcome was a rosé brandy, a delightful fortified product, repurposed for sale.

While individual action is important, significant short-term changes to the practice of food production require new and innovative strategies. A top-down approach, backed by government policy, is needed not only to spur the process along, but also to contribute to raising public awareness of the quantity and value of food waste.

Consumer preference is also impacted by the intersection of personal and planetary health. In *Our Food in the Anthropocene: Healthy Diets from Sustainable Food Systems*, Professor Walter Willet from the Harvard School of Public
Health argues that by 2050 we will need to double our consumption of fruits, vegetables, nuts and legumes, and reduce our red meat and sugar consumption by more than half. A diet that is rich in plant-based foods, with fewer animal-sourced foods, will directly improve our environment and our health.

Unhealthy diets now pose a greater risk to life than alcohol, drug and tobacco use, collectively. In developed countries, the shift towards healthier diets is occurring more rapidly, driven by government initiatives, dietary trends, community health and lifestyle programs, and consumer preferences for non-animal protein alternatives. The Food and Agriculture Organization of the United Nations has estimated that more than a quarter of the world’s population will require access to plant-based proteins by 2050.

Plant-based proteins are not only valued for their nutritional qualities and their ability to repair nitrogen and enhance soil health, but also for their potential to deliver profitability in an ailing grains sector. Australia produces, on average, 2.6 million tonnes of pulses, which equates to $3.6 billion for the national economy. The new Australian Government ten-year pulse protein project seeks to raise the country’s value chain from production on-farm through to consumers by building new capabilities across this food sector for Australia.

THE PULSE PROJECT is just one of a variety of adaptations required in our food systems that will generate changes in our food consumption patterns and lifestyles. These adaptations will be widespread and complex in the agricultural sector in Australia and globally, impacting the types of food products available. This not only affects farmers and their communities as well as local, national and global trade; it will also affect Australian culture, as foods that once marked seasons and times of celebration become increasingly difficult to produce.

The mango industry has been observing these changes for some time, and there have already been efforts to ensure the continuation of supply in Australia. Given that common Australian mango varieties, such as Kensington Pride, are sensitive to the changing climate, a joint venture between CSIRO, Western Australia, the Northern Territory and Queensland has worked together under the National Mango Breeding Program since the mid-1990s to cultivate new, more resilient varieties with climate-adaptive traits. These new varieties, at an early stage of development, are known only by
their numbers –1243, 1201 and 4609 – but commercial names will emerge when their branding phase is complete. The traits of these new mangoes will provide opportunities to grow early-season and late-season varieties, as well as varieties with a more robust capacity to travel to domestic and international markets undamaged, ensuring our traditional ‘taste of summer’ doesn’t disappoint.

Mangoes are not the only fruit that needs to change. A study by the University of Melbourne revealed that by 2030 the winters in places including Manjimup, Western Australia, and Applethorpe, Queensland, may be too temperate to support current apple and pear production. Consequently, some growers are adapting orchards to cope with significant sun damage during days of extreme heat. New varieties are being bred, such as Golden Delicious apples, which require fewer cooler days. Without enough cooler weather, spring flowering will be limited, and this in turn will mean less availability in-store and less profitability for the farmer. Conversely, increasing heatwaves have seen a variety of the traditional Royal Gala apple bred to withstand the January and February summer season.

Adaptive practice, industry and policy support, coupled with consumer awareness: all are required in the face of an inexorably changing climate. Inaction against climate change is leading us to a catastrophe – well beyond my own enjoyment of mangoes or the chance for future generations to appreciate this iconic Australian fruit, in all its new varieties, as part of the flavour of summer life.

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