Australia is the sixth largest country in the world and also the driest inhabited continent on earth, with the least amount of water in rivers, the lowest run-off and the smallest area of permanent wetlands of all the continents. Its ocean territory is the world's third largest, spanning three oceans and covering around 12 million square kilometres. One third of the continent produces almost no run-off at all and Australia's rainfall and stream-flow are the most variable in the world. Australia also has some of the oldest land surface on earth and while rich in biodiversity its soils and seas are among the most nutrient poor and unproductive in the world. This is due mainly to the country's geological stability, which is a major feature of the Australian land mass, and is characterised by, among other things, a lack of significant seismic activity. Only six per cent of the Australian landmass is arable. As a result agricultural yields are low compared to other nations, German farms produces over 9 metric tonnes/ha compared to Australia's 2 Tonnes. Australian soils are highly dependent upon vegetation cover and insect biomass to generate nutrients and prevent erosion. It is the native vegetation's long root systems that help break down the sub soil and bring nutrients to the surface while insects, bacteria and small animals reduce ground litter and add nitrogen. Land clearing, water extraction and poor soil conservation are all causes of a decline in the quality of Australia's soils, now the collapse of insect populations adds another blow.

https://www.vox.com/energy-and.../2019/.../insects-extinction-bological-conservation

The two most significant direct causes of land degradation are the conversion of native vegetation into crop and grazing lands, and unsustainable land-management practices. Other factors include the effects of climate change and loss of land to urbanisation, infrastructure and mining. However, the underlying driver of all these changes is rising demand from growing populations for food, meat and grains, as well as fibre and energy. This in turn leads to more demand for land and further encroachment into areas with marginal soils. Market deregulation, which has been a trend since the 1980s, can lead to the destruction of sustainable land management practices in favour of monocultures and can encourage a race to the bottom as far as environmental protection is concerned. The 2016 State of the Environment report noted that;

Current rates of soil erosion by water across much of Australia now exceed soil formation rates by an order of magnitude or more. As a result, the expected half-life of soils (the time for half the soil to be eroded) in some upland areas used for agriculture has declined to merely decades.

The carbon content of Australian soils, which is a measure of fertility, is now some five to 10 times lower than when measured in 1845. The UN has warned that there could be as little as 60 harvests remaining before the world's soils in places like Australia reach the limits of agricultural production.

To keep up with global food demand, the UN estimates, six million ha of new farmland will be needed every year. Instead, 12 million ha are lost every year through soil degradation. Australia lost 36 million ha of agricultural land in just the 4 years from 2005 till 2009. Some of this lost land has occurred because of urban sprawl which is swallowing up some of our best soils close to cities that used to supply the fresh fruit and vegetables.

theconversation.com/urban-sprawl-is-threatening-sydneys-foodbowl-55156

Despite this agricultural products presently accounted for 15 per cent of Australia's total exports in 2015-16, and the gross value of farm production was more than $63 billion largely because we currently have around 2 ha of arable land per person, one of the highest rates in the world. However 40% of that production came from the Murray Daring irrigation area which had high production based on historic over allocation of water, something that has now come back to bite us. A scathing report by the Royal Commission has gone as far to accuse the Murray-Darling Basin Authority (MDBA) of negligence and being "incapable of acting lawfully" apparently because they overestimated the amount of water returned to the river by a factor of ten.

With our highly variable surface water supply, groundwater resources are critical for many Australian communities and industries. In some cases, groundwater is the only reliable water supply available to support towns, agriculture and the resources sector. Australia is a very dry country so groundwater is extensively used right across the continent. Perth relies heavily on the Gnangara Mound aquifer for its water supply, but the water table has been dropping for the past 40 years or more because of reduced rainfall, increased extraction, and decreased recharge . The Great Artesian Basin (GAB), underlying about 1.7 million square kilometres of Australia, contains about 65,000 km3 of water, but it is a "Fossil water" being up to 2 million years old so extract is far faster than replenishment. It is not widely understood that vegetation and many streams and rivers are supported by the availability of groundwater, either as discharge into streams and rivers or through groundwater uptake by plant roots directly. In the NT Palm valley has an average rainfall of only 200mm but spring fed pools allow its unique flora to survive. The same applies for the Doongmabulla Springs Complex, a one-square-kilometre expanse of nationally important wetlands near the proposed site of the Carmichael coal mine which would probably be destroyed if Adani is allowed to extract the water it needs. As the pressure in the GAB has declined and the water table drops, mound springs (where groundwater is pushed to the ground surface under pressure) have begun to dry up in South Australia and Queensland. Associated paperbark swamps and wetlands are also being lost and it gets more and more expensive to extract the groundwater for irrigation and other commercial applications. On average, rates of groundwater extraction across Australia has increased by about 100 per cent between the early 1980s and the early 2000s, reflecting both our increased

population size and the associated commercial usage of groundwater stores.

We are also putting these resources at risk from pollution, already there have been many incidences of ground water being polluted by petroleum products, chemicals, fertilizers, pesticides, salt and even nuclear waste. However the main aquifers are being put at risk from fracking, acid leaching of minerals like uranium and underground coal gasification. Converting the aquifer's recharge area into farmland is likely to increase the level of nitrogen compounds while the large blasting used in open cut mining is fracturing rock formations deep underground allowing contamination of water from above or intermingling with salty water. Underground mining leaves cavities that eventually collapse creating fissures that drain surface water, the Dendrobium underground mine between the Avon and Cordeaux dams is believed to be diverting 3 million litres a day into its workings. All of which explains why scientists have been warning us for years that we cannot continue to grow without doing great damage to our fragile nation, but they are continually ignored by politicians obsessed with economic theories that defy even the basic laws of mathematics.

https://www.sciencedaily.com/releases/2019/03/190304121543.htm

After the smoke clears.....

The 2019–20 bushfires were unprecedented in their extent and intensity, with the burnt ground in New South Wales covering 5.5 million hectares. Scientists have been collecting information on its impact since the fires began but the science of understanding what happened is still going on and will take many years to fully understand the effects of these fires. One early report is available from a bushfire expert brief;

Soil Conditions After Bushfires,

published July 2020 by the Australian Academy of Science.

Professor Alexander McBratney. Academy Fellow Professor Alexander McBratney,

“The bushfires severely damaged millions of hectares of land, not just above ground but the soil beneath us. This has clear implications for soil fertility, Australia’s agricultural productivity and the recovery of native vegetation,”

Much was already known, the carbon content of our soils which is a measure of their fertility, has been declining by 1% a year before the big fires. Catastrophic bushfires are the result of increased temperatures, wind speed and reduced humidity with fuel load and vegetation type being of lesser importance than originally believed. Land clearing has resulted in higher wind speeds at ground level drying the soil so rapidly it has created a phenonium called “flash droughts” where land can go from green to brown – and more fire prone - in a matter of days. Fires have occurred in grass lands, wheat fields, vineyards and in rainforests some of which have never been burnt before. As a result, there can be no doubt that climate change with higher temperatures and drier land has increased fire severity and will do so more often.

There were 1 billion native animals lost and for some species immediate extinction. The UK Met office reported that the fires could account for 1 to 2% increase in the carbon dioxide in the planet's atmosphere and smoke pollution would remain for 6 months spreading as far as south America. The smoke was made up of the burnt remains of organic matter and the nutrients that are now lost from our soils.

Cooler fires, like those that occur in scheduled burns during winter cause less damage because soil biodiversity (apart from fungi) recovers quickly with nutrient levels (apart from Potassium) and organic matter increasing after a prescribed fire as the fire accelerated their release from ground litter. However hotter fires have a detrimental effect on microorganisms and can alter the chemical structure of soils locking up essential nutrients and making the soil water repellant. The combination of fire and heavy rain as occurred after Australia’s big fires can prevent regeneration and lead to permanent land degradation. The water run off carries ash and

nutrients into water ways killing fish and creating alga blooms which make the water unsuitable for consumption.

During a bushfire, the surface organic matter and upper layers of the soil profile, which are often the most nutrient abundant, are generally the most affected. Thermal decomposition of organic matter begins at 200–250°C, and complete degradation occurs around 460°C. Fire can cause severe mineral alterations to soil, which includes the permanent conversion of some minerals into new forms that are less able to support vegetation. During severe bushfires, clay soils with high organic matter form hard, ceramic-like porous fragments within ashy material. Extremely high temperature fires have also been shown to melt very saline acid sulfate soils to form masses of glassed groundmass. These solid masses affect the chemical, physical and biological characteristics of soil condition. Similarly, burnt bone from humans, livestock and wild animals will also permanently transform the availability of phosphorus and therefore further reduce soil condition. Soil can be further damaged if heat from a fire is transferred to underlying soil profiles which can occur in peat which may then smolder on for weeks afterwards.

This is particularly bad in Australia because unlike other countries our continent has the oldest land surface (and seas) which while rich in biodiversity are the among the most nutrient poor and unproductive in the world with only 6% of its land mass being arable and much of this was hit by the recent fires. It is also the driest inhabited continent with one third producing almost no run of because low rainfall. In large parts of the nation the evaporation rate exceeds the amount of rainfall. Tennant creek in the NT has an average rainfall of only 386mm but the evaporation rate is almost 10 times that with the result that Australia has very little permanent surface water, a problem compounded by farmers draining wetlands in order to increase cropping area. This means that soil fertility is very dependent on insects, small animals and bacteria biomass as well as native vegetations long root systems – Jarrah roots can travel 40m down helping to break down the sub soil and aiding bacteria growth.

https://www.vox.com/energy-and.../2019/.../insects-extinction-bological-conservation

In 2008 the Garnaut Climate Change Review, which examined the scientific evidence around the impacts of climate change on Australia and its economy, predicted that without adequate action, the nation would face a more frequent and intense fire season by 2020. The warning was ignored as was many others on climate change because they challenged our economic reliance on growth. No wonder then that Tim Flannery who as an internationally acclaimed scientist, Australian of the year in 2007 and outspoken environmentalist has been harshly attacked by the Murdoch media for his climate related warnings. His best-selling book, (he has

written 30 as well as 130 peer reviewed scientific papers) The Future Eaters detailed how we have been using up ecological resources, an analysis that got up the noses of politicians and alarmed the public. But what really upset them was his prediction that the combined effect of higher temperatures, water shortages, diseases, declining soil fertility and increased storms means that Australia's carrying capacity will be limited to between 12 to 15 million. His prediction has some precedents, in the past few thousand years 12 other dry land masses in the Pacific subjected to El Nino climate variability have seen societies collapse sometimes disappearing altogether. We are in for a rough trip.

Don Owers