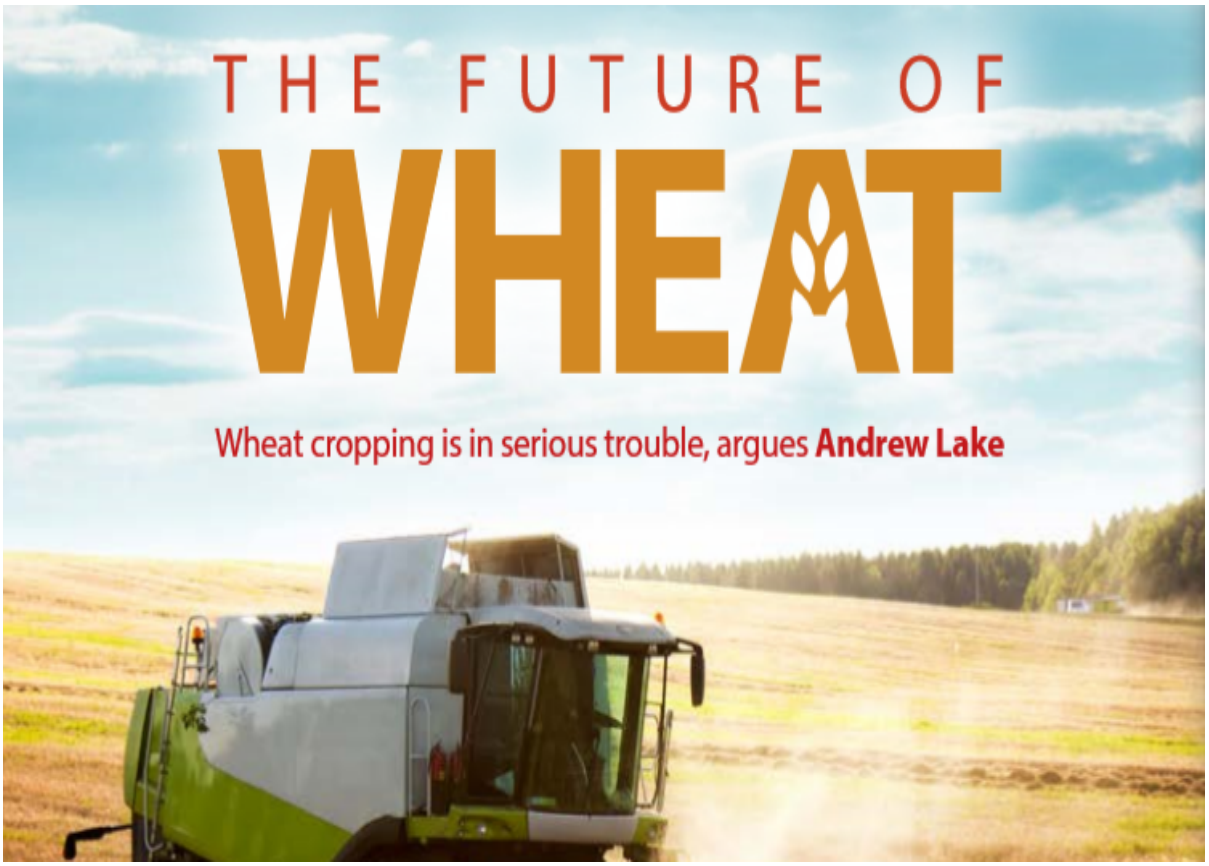

The Future Of Wheat

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This article from the November 2014 edition of the IPA Review is by CEO of Pristine Forage Technologies, Andrew Lake.

In 2013, *Groundcover*, the magazine of the Australian government's Grains Research and Development Corporation (GRDC), suggested that average farm costs in major cropping regions have exceeded income in as many as ten of the last fifteen years. There are many factors that could be causing this—overseas competition, the terms of trade and, of course, the weather. While all these are no doubt impacting on the wheat industry, there is an underlying problem which, if unchecked, could develop into crisis. The problem is literally beneath the surface. It's all in the soil.

Australian cropping is an industry which provides all of our major food staples and earns us more than eight billion in export income annually. Of all our crops, wheat is by far the most important. It accounts for about 60 per cent of total grain production and 70 per cent of export income from crops. The wheat industry spends hundreds of millions more on improved production technologies

and inputs than it did twenty years ago, but despite this massive investment it actually produces less per sown hectare (see Figure 1). The story is the same for virtually all of our major crops. Farmers continue to grow wheat despite poor yields; wheat returns are still greater than for most other crops.

The industry serially blames poor yields and lower productivity on the weather, either in the form of drought or climate change. However, we haven't had a major drought now for years, and there is not the faintest evidence to support the argument that climate change is having a negative impact on wheat yields. Even though the IPCC would have you believe otherwise, global crop yields—including those for wheat —have risen very steadily for more than 30 years. Australia matched the global trend prior to the 1990s, with wheat yields increasing at or above the global rate of 30 kilograms per hectare per year for at least the previous fifteen years. But since then, we have gone backwards.

This situation was entirely avoidable and, far from being a surprise, was predicted decades ago using very simple science. The key ingredient is nitrogen.

Nitrogen is vital for all life processes. It is a fundamental component of everything from genes to proteins and enzymes, so without it, there is no life. In all crops, nitrogen is critical for plant productivity. The more nitrogen available in the soil, the faster the plant grows. Furthermore, the protein level of wheat and other cereals—its nutritional value—is also related to nitrogen levels in the soil. Wheat grain typically averages about ten per cent protein (or almost two per cent nitrogen), so every time it, or any other crop, is harvested and removed, large quantities of nitrogen are not returned to the cropped soil and are in effect lost to it.

Being naturally nutrient poor, Australian soils are particularly vulnerable to this nitrogen loss. To counter this inevitable nitrogen depletion, we developed rotation systems called legume ley breaks.

In this system, a self-regenerating legume (e.g. clover) pasture was used every few years to rest land between crop years and restore soil nitrogen levels. Properly managed, these pastures regrew from seed set in previous years. This nitrogen replenishment occurred through the legume's remarkable and unique capacity to convert atmospheric nitrogen into a plant available form that would then rot down and form part of the organic matter in the soil. Hence, while this legume pasture did not return as much cash to the grower, it ensured that soils were maintained in a productive state for future profitable wheat cropping.

Around 25 years ago, 'experts' (usually either farmers trying to make a name for themselves or those with vested interests in selling crop requirements) claimed that legume pasture breaks were unnecessary, as soil nitrogen levels could be theoretically maintained by adding a chemical nitrogen fertiliser directly to the cropped soil rather than adding it organically via a legume pasture.

However, in Australia's uniquely harsh environment, the results of adding such fertilisers have been very mixed. The relationship between nitrogen and yield quantity/quality is complex and highly seasonally dependent, as explained in *Soil testing for crop nutrition* published by GRDC in January 2014.

The supply of nitrogen needs to be closely matched to the crop's growing conditions. Too little nitrogen results in reduced grain yields, but too much is even worse. The crop grows too rapidly and sucks too much moisture from the soil before grain formation even commences. With organic nitrogen from legume and other soil organic matter, this nitrogen supply is regulated and matched to the crop's growing conditions by natural biological processes. With chemical fertilisers, however, this self-regulation is lost—and matching has proven all but impossible in our unpredictable climate. Because of the greater danger from crop 'overgrowth' and premature death, it is both safer and cheaper to under-dose the crop with nitrogen fertiliser and then rely on increasingly depleted soil nitrogen reserves to meet the shortfall and finish the crop.

Scientists of the previous generation had seen the effects of such soil nitrogen depletion first-hand, and had warned that this practice of intensive cropping brought about by nitrogen fertiliser use would lead to progressive soil degradation and consequent declines in both the yield and quality of our wheat crops. Unfortunately there were others who, for whatever reason, turned a blind eye and even joined the chorus championing more intensive cropping.

Rather than heed the warnings, the industry followed the advice of these experts. Consequently, restorative legume leys all but completely disappeared as many farmers opted for more intensive or even continuous cropping. Few realised the addictive nature of the path they were embarking on. But as predicted, residual soil nitrogen levels declined (Figure 2), yields stagnated and the challenges for wheat farmers mounted.

Without change, eventually a point will come where it will no longer be viable to grow crops and the land will be left in a state where it cannot support adequate plant life to prevent soil erosion, resulting in the total loss of that land to viable agriculture. In some regions, such as the eastern wheat-belt of Western Australia, this is already happening.

There are solutions. A good start would be to simply allow the cropped soils to benefit from the occasional legume ley break. But with farmers and industry so heavily committed financially to this intensified practice and the consequent debt of new machinery, the need for larger farm areas to remain viable, and so on, there is extremely limited financial room to turn around.

There are also some fundamental lessons that can be learned from this situation.

Firstly, we are too focussed on the present. Should the profits made today rob future generations of the capacity to grow wheat and generate their own incomes? This is not just inter-generational theft—it could also be considered inter-generational starvation. How will we answer to an Australia that has to import basic food staples to feed itself? Or to those who will starve without the food we should have been able to grow for them in perpetuity?

Secondly, we are inevitably prone to believing what we want to believe, even when basic science and rational thinking clearly say otherwise. In this case, while there may have been a logical reason to think that a nitrogen fertiliser could effectively replace soil nitrogen, sober analysis of trial data and observation indicated that this would have major pitfalls in our dry and harsh

environment. But in a delusion similar to that which says rain follows the plough, we chose to believe that either the science was wrong or that we could somehow defeat nature.

Thirdly, although it is by far the most effective means for predicting, planning and building a better future, science is nevertheless grossly undervalued. It is also extremely challenging. We need to attract our best and brightest minds into science careers so that we can have the intellectual firepower needed to unravel science's complexities and understand what it really says. That will cost, but the alternative of resorting to—or having to rely on— what some 'experts' believe can and frequently does result in a price that is immeasurably greater.