

Economic & Environmental Costs of Greenhouse Gases for Cotton Farming

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Greenhouse gases and agriculture

Industrialisation and agriculture have substantially increased the levels of greenhouse gases above natural levels

It is widely accepted that human activities which produce greenhouse gases are contributing to Australia's changing climate. It is expected that surface temperatures will rise, intensity of storms will increase and rainfall patterns will alter, although an increase in overall rainfall is not expected.

The predicted rises in temperature are illustrated in Figure 1. Using similar climate modelling it is considered that the number of summer days over 35°C in Narrabri will rise from the present average of 21 to between 36 and 48 days by 2030.

Loss of N, in addition to being a pollutant, is also a direct cost to growers

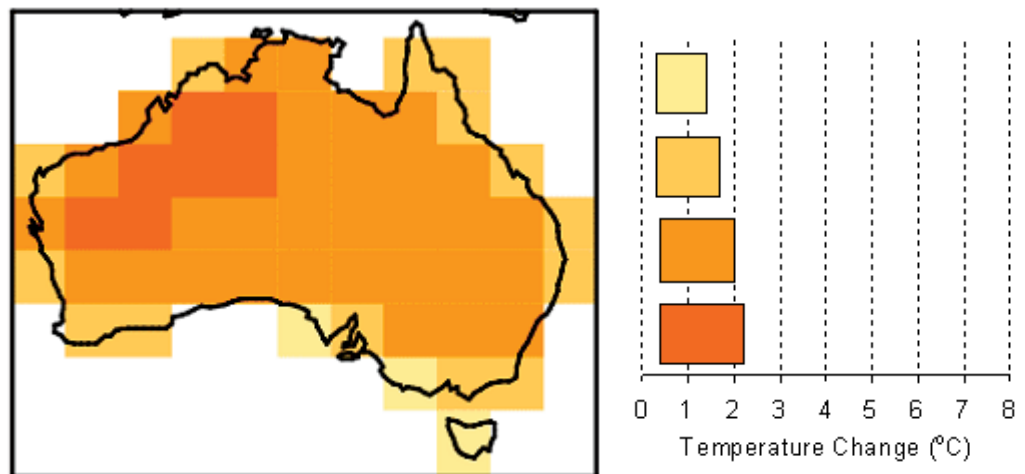


Figure 1 Expected Australian temperature increases by 2030 courtesy P. Whetton & R. Jones

On average 1/3 of applied N is lost. A cost to industry of \$32 M per season.

As a result, hotter dryer conditions in the cotton areas are expected and this may have economic effects through reduced yields. There is concern that historically the onset of climate changes can be quite quick.

The principal greenhouse gases are carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O). These three gases are part of natural global cycles and much of the N₂O emitted is from natural ecosystems. Bushfires in particular increase N₂O emissions. However, industrialisation and agriculture have substantially increased the emissions of these gases. Hence, humans can modify their impact by better managing their industrial processes and agricultural operations.

Control strategies are available to reduce N loss

Agriculture is the country's second highest emitter of all greenhouse gases and the largest emitter of N₂O. This gas is emitted from soils receiving mineral nitrogen (N) fertilizers and animal manures and to an extent through transport and industrial processes. The equipment used to measure soil N₂O emissions is shown in Figure 2.

All major greenhouse gases are produced during cotton production, and include;

- Carbon dioxide (CO₂) from tillage and from fuel use (during planting, cultiva-

tion, harvesting, chemical applications and pumping)

- Methane (CH₄) from prolonged waterlogging.
- Nitrous Oxide (N₂O) which is associated with high input irrigated agriculture, particularly where high rates of N fertilizers are used.

Nitrogen in cotton farms

Cotton farms are considered potentially high risk agricultural systems with respect to losses of N. Nitrogen contributions from cotton farms are a significant greenhouse issue partly as:

- The cotton industry uses up to 100 000 tonnes of fertilizer N per year.
- The warming potential of N₂O is estimated to be 300 times that of CO₂.
- Since 1990 there has been a 130% increase in N₂O emissions in Australia, and this increase is predominantly from fertilizer application.
- N fertilizer losses may exceed 100kg/ha each season of which 98% is returned to the atmosphere as N₂ and 2% as the greenhouse gas N₂O through the process of denitrification (which can occur when soils are flood irrigated or saturated). The atmosphere normally comprises 78% N₂.
- Any N that is applied in excess of crop demand is more likely to be returned to the atmosphere, rather than leached into the groundwater (which also poses a health risk).

Environment and economics

As well as the environmental concerns, there is a significant monetary cost in losing N from farms:

- Around 80 000 tonnes of N is applied across the cotton industry per season
- Cost of ~\$1200 per tonne of N = \$96M.
- On average, one third of applied N is lost (say 60kg of the 180kg/ha that is a common application rate) = \$32M loss across the industry per year
- ~1 000 growers = average loss of \$32000 per grower-per year.

Control strategies

Reduction of N loss to the atmosphere has major environmental and cost control benefits. There are several major control strategies available based on managing or avoiding denitrification.

- Consistent return of crop residue to the soil will promote a carbon and nitrogen store, as well as promoting the slow release of nutrients to the soil.
- Appropriate irrigation management and drainage, and fertilizer management; by reducing water logging which produces anaerobic conditions conducive to the emission of greenhouse gases.

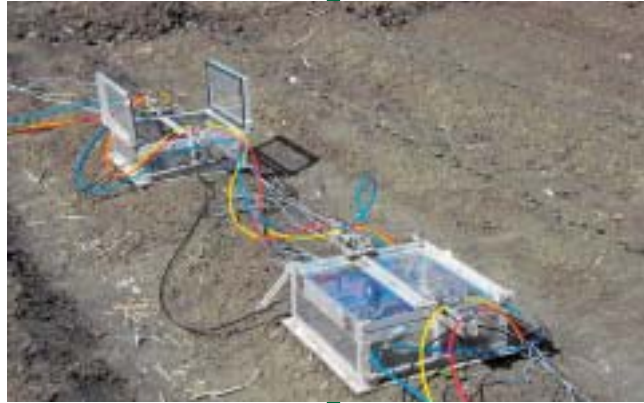


Figure 2. Measurement of N₂O emissions in cotton fields.

- Legume cropping, this allows for a reduced N fertilizer requirement for cotton (emissions of N₂O from a vetch-cotton system may be reduced by two thirds, relative to a wheat-cotton system having 180kg/ha of N applied).

- Metered N fertilizer or the use of slow release green manure as a form of slow release N fertilizer.

- Increased soil carbon levels.

Another strategy that has been researched extensively but is not recommended is the use of nitrification inhibitors. These chemicals can reduce N loss by up to 24% and increase the N recovery in the plant/soil system. However, this approach has been abandoned as most of these chemicals are highly toxic.

Conclusion

There are more environmentally beneficial methods for supplying N to cotton crops than adding fertilizer at the start of the season. These include; matching plant demand with fertilizer applications, or preferably, fixing N biologically through the use of legume crops and growing those legume crops specifically for green manuring where there is high demand for N. Additionally, avoidance of water logging through good water and drainage management and re-circulation systems can yield a significant reduction in N losses. Importantly, healthy soils with an active biological component require less fertilizer.

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