

# Sustainability, a change of thinking.

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## Abstract

In New Zealand the use of nitrogen fertiliser has in past 25 years increased 600% while dairy production, where much of the nitrogen fertiliser is used, has increased by 270%. The unintended consequences of the excessive use of nitrogen have been a cost to the overall environment.

A paradigm shift is needed to achieve sustainable farming systems. Much of the science to support this shift has been published and it is time to dust off these research papers re-educate and share the established knowledge with industry leaders taking responsibility.

Sustainability is a journey. It is about the People, the Planet and Profit. Practices must change to ensure they meet today's needs while ensuring future generations have the ability to meet their needs.

## Key Words

Agriculture, intensification, ecosystem, control release nitrogen, environments, water, leaching.

## Introduction

This paper aims to highlight the importance of historical research in understanding the changings which need to be made in achieving sustainable farming systems. Sustainability in itself needs to be defined and a paradigm shift is required from all stakeholders in agriculture.

## Discussion

Sustainability concerns are driven by the unintended consequences of practices adopted in the quest to meet economic interests.

New Zealand's milk production has increased from 7 billion Litres to 19 billion Litres over the last 25 years – that's 270% increase. Driving this increase in production has been the conversion of farm land to dairy and the intensification of production from dairy farms. Farms are producing more dry matter / ha, to feed more stock, on more land. This has led to an increase in nitrogen fertiliser usage from 50,000 tonnes to 360,000 tonnes. That's a 600% increase. This increase in applied nitrogen fertiliser is the single largest culprit to a nitrogen overloaded farming ecosystem, resulting in the degradation in the health of the fresh water environments of our rivers and lakes. It could take 50-60 years before the effects of today's excessive nitrogen use to appear in our waterways.

The circumstances driving the culture of excessive use of nitrogen fertiliser

- It is readily available at affordable prices
- It provides rapid results in plant growth
- Its use is openly promoted and encouraged
- Its growth is fuelled by commercial interests

There is no silver bullet to stop or reverse this over-use practice. It will take leadership rolling down from central government and industry leaders through the chains of product distribution to the individuals.

This multilevel fix does not need multi-millions of dollars for science research, rather a disciplined approach, utilising historical knowledge. There has been plenty of research published in the last four decades outlining the environmental consequences of excessive nitrogen application in agriculture.

It is now time to stand up and dust off those science papers, re-educate and share the established knowledge in a responsible manner.

The complexity of the nitrogen cycle is well understood and the challenge is in applying this knowledge to the changing dynamics of farming, where traditional boundaries are blurred and the urbanised world intertwines with crop and animal production.

The underlying desire of society is sustainability which is the leading edge of disruption that is changing agriculture.

The planet is under increasing pressure with an eight billion population forecasted for 2050 yet current agriculture practices are unsustainable. A paradigm shift is required defining sustainability in agriculture along the lines of “meeting today’s needs without compromising the needs of future generations”.

It is a conundrum. With intensification of the world’s population - there is a requirement for increased and intensification of food production. The challenge is to achieve this with sustainable agriculture with the efficient use of nitrogen fertiliser.

Many of today’s farming practices have adopted the excessive use of nitrogen fertiliser to maximise production.

Dairy farming in New Zealand has in many cases been systemised (McDonald’ised as one large farmer described it). Nitrogen fertiliser is applied on a regular basis to maximise pasture growth as this is the lowest cost dry matter for livestock which drives farm gate output.

A common way of thinking is to use the lowest cost of nitrogen to achieve the maximum dry matter (DM) yield.

DM = milk solids (MS) = Dollars in vat. Little consideration is given the unintended consequence to the overall farming environment. All parties associated with farming need to consider the complete net return at the farm gate. In a simply dairy example the conversation would include DM & metabolised energy (ME) grown = MS = Dollars in the vat, less all operational, people and environmental costs.

There is the need to retreat to go forward. In the 1970-80’s Professor TA Walker at Lincoln University was publishing research papers highlighting the damage applied nitrogen would have on clover based rye grass pastures. Numerous research papers through the 90’s confirmed Prof Walker’s initial findings. Today it can be observe that dairy ryegrass pastures receiving regular nitrogen applications, contain a very low percentage of clover.

The value of clover in a rye grass pasture is lost when discussing only DM yield. But research shows

- Clover has a higher ME per kg / DM than rye grass
- MS production is optimised when the dairy pasture contains 60% clover
- Clover produces up to 200 kg / ha of nitrogen
- The plants water use efficiency is greater in a rye clover pasture than straight rye grass pasture

The “urine patch” is the largest contributor to nitrate leaching in the dairy system. Research demonstrates how applying urea nitrogen at 25 units of N / ha results there is a spike in the plant herbage N at around 21 days coinciding with the common rotation day for dairy grazing. This additional N consumed in the herbage is surplus to the cows needs elevating the nitrate levels in their urine and when excreted increases the nitrate level in the urine patch.

Therefore the unintended consequence of applied nitrogen fertiliser may well be increased nitrate leaching from the urine patch.

Equally crop farming needs a paradigm shift and a holistic consideration of all the facts.

Heavy rates of applied nitrogen in arable and horticultural crops contribute to elevated nitrate levels of both ground and open waterways.

A typical cereal crop will take up only 30-50% of the nitrogen supplied in fertiliser. While soil microbes compete for some of the remaining nitrogen, a significant amount is either released into the atmosphere as nitrous oxide, a major greenhouse gas, or simply leached into the ground water in the form of nitrates.

Research shows plants with high herbage N are less tolerant to pest and disease attack.

Farming must maximise production within the capacity of that land to be farmed sustainably.

New Zealand Regional Councils are implementing regulations to manage nitrate levels to achieve sustainable farming systems. The methodology and tools needed to develop and manage the regulations around nitrogen, requires on going investment to become fully effective. This is a positive start.

Fertiliser companies are challenged to promote practises and products that improve the efficient use of nitrogen. Producing more with less nitrogen requires a business model that reduces sales in certain markets but increases sales in others. A strategic rethink. Distributors to farmers play a critical role in marketing innovation of new products and services that ensures sustainable farming practices.

Innovation is occurring in application of fertiliser and new products.

Applications of fertiliser on hill country using technology in GPS, hyperspectral imaging and computer controlled precision aerial application, ensures the fertiliser is applied to areas of need rather than a blanket cover.

Control release nitrogen fertiliser is being trialled with promising results.

DA Edmeades 2015, demonstrated in pasture trials up to 52% increase in nitrogen use efficiency using control release nitrogen over uncoated urea.

Field assessment of control release nitrogen fertiliser in sweet corn and potatoes demonstrated similar results can be achieve with timely applications and reduced rates of applied nitrogen.

These new technologies support sustainable agriculture addressing the needs of the environment, people and profit. Agriculture needs to implement these innovations requiring a change in thinking through all stakeholders in the industry. To achieve a paradigm shift it is important to have education, knowledge sharing, and industry leaders taking responsibility.

## **Conclusion**

Sustainability is a journey. It is about the People, the Planet and Profit and involves all parties associated with agriculture. The value of knowledge gained from past research and practices needs to be taken seriously with changes made to ensure today's needs are met, while ensuring future generations have the ability to meet their needs.

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