Is dairying the real culprit?

Moves to clean up waterways are only band-aids, says soil scientist **Graham Shepherd**. The root cause of dairy pollution is too much fertiliser on farms.

While grass-fed animals are by far the cheapest form of pastoral agriculture, we are developing an increasing reliance on high cost supplements because we're not presenting the cow with high energy pastures with the appropriate nutrient content.

It is a concern that while farmers' debt levels are skyrocketing, so too is their environmental footprint.

Fish and Game coined the term "Dirty Dairying". While the dairy industry is emitting significant nutrients into our groundwater, waterways and atmosphere, it is not dairying that is the cause but the type of advice given to farmers.

As a student doing a chemistry and earth science degree in the 70s, I visited Lake Rotorua on a field trip partly because it was becoming increasingly affected by rising nutrient levels and fecal coliforms (eutrophication) due to nutrient emissions from surrounding farmland.

I said at the time that we didn't have the industrial or political will to rectify the situation and it would as a consequence get worse. Today we see some of our lakes turning red and green and a majority of our rivers are deemed unswimmable.

Various mitigating measures include increasing plantings, fencing off waterways, reducing cow numbers, and establishing initiatives like the Clean Streams Accord and Healthy Rivers.

For the most part, these are band aids that attempt to address the symptom and do little to tackle the cause of the problem, ie the excessive application of nutrients and in the wrong form.

An estimated 750,000 tonnes of urea (345,000 tonnes N) was applied in 2014 - most of it to dairy farms - a 38-fold increase from the 20,000 tonnes applied in 1983. While this of course is due in part to the increase in cow numbers, there has developed an over-reliance on nitrogen to get our pastures to grow.

It is no coincidence that the above issues coincide with the excessive application of nutrients on our farms and in particular N and P.

High cost measures have also been proposed and funded to develop vaccines to reduce gas emissions from ruminating cows into the atmosphere but again they're a band aid that enable the real cause of the problem to continue.

There are many efficient and cost effective ways of applying N, measures that ensure the plant has all the N required to enable good production and at a significantly lower cost to the farmer and the environment. These include:

- Converting the volatile N (and P) in the effluent pond to less leachable and less volatilisable organically bound forms and applying as a folia.
- Increasing the clover cover and promoting the N-fixation capability of legumes by ensuring good soil structure, good drought resistance and water-use efficiency of the pasture, and the presence of the key soil nutrients required to ensure good N-fixation.
- Promoting the drawdown of the 78 per cent free N in the atmosphere by promoting the free-living and associative nitrogen-fixing bacteria and archaea.

The above are productive smart management practices that would permit significant cost savings and are "environmentally friendly". They would also help mitigate the high loss of nutrients on the permeable soils in the Canterbury, Mackenzie Basin and North Otago areas.

Other measures include applying N as a folia in the form of an ammonium humate and dissolving sulphate of ammonia and urea in water along with a form of carbon and applying as a folia. On occasions where appropriate, N could be applied in the form of a polymer coated urea to reduce the rate of N release.

Large amounts of nutrients are being applied to our farms not because they are necessarily deficient but because their plant uptake is being suppressed by paradoxically the oversupply of some nutrients. For example, excess P will suppress mycorrhizal fungi, K, Fe, Zn, Cu and Se.

The excessive application of mineral N will suppress the ability of the soil to produce dry matter, suppress clover growth and suppress the uptake of nutrients like B. Excess N will cause the plant to luxury feed on K which in turn will suppress the utilisation of Ca and Mg.

The continuous and excessive application of N will also produce a lazy plant with a shallow limited root system because the N is readily available near the surface.

The science shows that the loss of soil condition through pugging and over-cultivation increases the potential for poor aeration, suppressing the supply of oxygen to plant roots and the uptake and utilisation of nutrients such as N, P, K, Ca, Mg, Na, S, Fe, Mn, Zn, Cu, B, Mo and Co. If we didn't suppress nutrient uptake in the first place, we wouldn't have to apply so much nutrient at considerable cost to the farmer and the environment to attain the production levels sought.

While it is nitrous oxide (N2O) with its high global warming potential and close association with dairying that should be our focus in terms of greenhouse gas emissions, I wonder if we are given entirely the right messages about the other two GHGs - carbon dioxide (CO2) and methane (CH4).

While there are many contributors to CO2 in the environment, CO2 is a molecule necessary for photosynthesis. Its removal from the atmosphere is however significantly reduced by the extensive removal of forests in SE Asia, Brazil, Central America, Central Africa, etc.

The reduction of atmospheric CO2 is also lessened by the reduction of the photosynthetic capacity and photosynthetic rate of pastures by overgrazing and by limiting the dry matter production on farms, and we wonder why CO2 levels are increasing.

Methane is rapidly broken down in the atmosphere by hydroxyl radicals photo-oxidising CH4 to CO2. Moist air above pastures can photo-oxidise 100 times more CH4 than what is able to be produced by the soil or animals grazing that area. Methane is also a necessary requirement of methanotrophic bacteria in the soil which take up and oxidise CH4 from the atmosphere.

While the Government is spending millions of dollars a year on research and projects to counter agricultural emissions to reduce GHG emissions, methane emissions for example can be slashed by up to 99 per cent by simply adding seaweed (Asparagopsis taxiformis) to the cow's diet.

Methane emissions for example can be slashed by up to 99 per cent by simply adding seaweed (Asparagopsis taxiformis) to the cow's diet.

This highlights the importance of diet in mitigating GHG emissions, something that is not given the recognition and funding it deserves.

The emissions of NO2 can also be significantly reduced by reducing the nitrate-nitrogen/crude protein content of pasture and increasing its energy level (sugar/carbohydrate content), providing the rumen microbes with the energy required to convert the ingested feed into milk, meat and fibre.

While grass-fed animals are by far the cheapest form of pastoral agriculture, we are developing an increasing reliance on high cost supplements because we're not presenting the cow with high energy pastures with the appropriate nutrient content.

As a consequence, only 20 per cent of the protein in the herbage is utilised while 80 per cent converts to ammonia which is subsequently emitted as N2O into the atmosphere and as N-rich urine into the groundwater and waterways. The N conversion efficiency (kg MS per kg N leached) is very poor.

This is something we could easily fix by simply ensuring the soil and plant has a good nutrient balance including having good levels of the key sugar-making elements.

With the pressures coming from the Paris Agreement on Climate Change, the Emissions Trading Scheme and the development of the Environmental Authorities Regional Plans etc, do we still have the will to implement effective change or will vested interest groups continue to compromise the profitability and the environmental footprint of dairy farmers by selling them nutrients they do not need?

The Government has also committed to reversing the loss of soil carbon which is laudable given the many associated farm and environmental benefits.

But again this is not going to happen until we enable the effective draw-down (sequestration) of atmospheric CO2 to stable soil carbon and reduce many of those mechanisms that cause soil C to be lost. While the intention is good, this cannot happen under our current widespread management practices.

There are effective ways to make farming profitable while achieving good environmental outcomes.

There is much that we can do to put in place effectual measures to reduce the application of such large amounts of nutrient and in particular N and P, and to apply them in bio-friendly and less water-soluble forms.

The question is, do we continue to apply band aids to empower the continued application of excessive amounts fertiliser and in the wrong form at high cost to the farmer and the environment. Or do we put in place measures that will actually address the cause of the problem?

The bottom line is we need to protect our environment and "clean green image", our tourism and recreational industry, and ensure our farmers are profitable with secure markets producing quality food products. We can we do this by acting smarter and implementing the many options available.

Graham Shepherd of BioAgriNomics is a soil scientist and farm consultant and author of the widely commended Visual Soil Assessment method (www.BioAgriNomics.com).