Farming and its high environmental impact: Are farmers the culprit?
By Graham Shepherd

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 dairying and to a lesser degree dry-stock farming has and are emitting significant nutrients into our groundwater, waterways and atmosphere, it is not the pastoral farming per se that is the root cause of the problem but the type of advice given to farmers.

As a student doing a chemistry and earth science degree in the 70’s, 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 un-swimmable. Various mitigating measures include increasing plantings, planting wide grassy strips along streams to trap fertilizer runoff, fencing off waterways, reducing cow numbers, developing rumen vaccines, 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, i.e. 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 which to dairy farms), a 38 fold increase from the 20,000 tonnes applied in 1983. While this of course is due in part of 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% free N in the atmosphere by promoting the free-living and associative nitrogen-fixing bacteria and archaea
- encouraging good grazing management

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 and the efficiency of nutrient cycling is being suppressed by paradoxically the oversupply of some nutrients. For example, excess N and P will suppress biological biomass, diversity and activity; excess P will suppress K, Fe, Zn, Cu and Se. Research has shown the biological fraction regulates the chemical and physical condition of the soil, a fraction that is the 'engine room' of the farm. Regrettably we have traditionally ignored this at our economic and environmental cost.

The excessive application of mineral N will also suppress the ability of the soil to produce dry matter, suppress clover growth and suppress the uptake of nutrients like B. Excess N will further 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.

New Zealand's greenhouse gas emissions increased 54% between 1990 and 2014. While it is nitrous oxide (N_2O) emissions 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 GHG's - carbon dioxide (CO_2) and methane (CH_4). While there are many contributors to the high CO_2 levels in the environment, CO_2 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 CO_2 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 CO_2 levels have and are increasing to alarming levels. Carbon dioxide should be seen as a valuable resource, able to be sequestered as stable soil C by the activity of soil microbes.

Methane is rapidly broken down in the atmosphere by hydroxyl free-radicals photo-oxidising CH_4 to CO_2. Moist air above pastures can photo-oxidise 100 times more CH_4 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 CH_4 from the atmosphere.

While the government is currently 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% 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.


Cows grazing high quality energy rich pasture

The emissions of NO_2 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% of the protein in the herbage is utilised while 80% converts to ammonia which is subsequently emitted as N_2O 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 (COP21), the Emissions Trading Scheme (ETS) and the development of the Environmental Authorities Regional Plans etc., do we have the will to implement effective change or will vested interest groups and unawareness continue to compromise the profitability and the environmental footprint of dairy and dry-stock farmers by selling them nutrients they do not need and in the wrong form?? While the govt. has committed to reducing our GHG's emissions to 30% below 2005 levels by 2030, it and the farming industry will continue to fail to meet these commitments unless they address the cause and not the symptoms of dairying's high environmental imprint. This includes the continued use and promotion of the highly soluble forms of fertiliser. Moving to slow release forms of fertilisers and the activation of the micro-life in the soil will go a long way to enable the government to meet its COP21 commitments.

The govt. 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 CO_2 to stable soil carbon and reduce many of those imposed 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 more profitable (including improving dollar margins per ha, the farm working expenses and the break-even milk prices) whilst 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 address the symptom, empowering 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 and in so doing reduce the debt levels of farmers and their environmental footprint?

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 those many options that are already available to us.

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