Submission from Dr Hugh Jellie Ata Land Ltd

Commissioners,

Thank you for the opportunity to present to this forum

I am a veterinarian and have worked for over 40 years in agriculture in NZ with a main focus on dairying. My currently work is to change farming methods and land use to improve ecological, social and economic outcomes for the benefit of NZ environments, communities, farmer producers and the NZ economy.

I work with the Savory Institute a global foundation leading the way in the implementation of Regenerative Agriculture globally. I am the only accredited Field Professional for Savory Institute in NZ and have now established the first Savory Hub in NZ which is part of the Savory Global Network of Hubs. The Savory Institute, in collaboration with leading scientists and agriculturalists from around the world, has developed Ecological Outcome Verification, an internationally recognised tool to measure if land under management is regenerating or degenerating.

I submit that focusing only on nitrogen, phosphorus, sediment and microbial pathogen losses from land and the heavy dependence on Overseer will restrict the ability of Plan Change 1 to meet its stated objectives. It is restoration of soil health and the reduction of the harmful impact of industrialised farming on soil health which will be the major factor in clean up of the water ways. Monitoring, measuring and reporting needs to be taken beyond Overseer and include other tools which are better measures of ecological health than Overseer alone.

I am concerned that change will not be a consequence of the plan as it relies too heavily on Overseer to demonstrate change yet has no way of measuring if positive progress is being made. It also does not address the issues leading to the current position or recognise the importance of degradation of soils and the management of resources as key contributors and how these need to change to meet the vision.

Farming is both the Problem and the Solution

The Problem

Current faming systems have normalised practices which are destructive to soils with consequent risks to animal health, human health, water quality and the economy.

Examples include high use of synthetic fertilisers and in particular inorganic nitrogen, heavy use of pesticides and herbicides which are destructive to soil microbiome, cropping practices which damage the integrity of soils and leave bare soil exposed for long periods of time and grazing practices which reduce biodiversity and exacerbate carbon and water loss from soils.

New Zealand dairy is largely based on low-diversity, shallow-rooted, short-lived ryegrass and clover pastures. Low plant diversity and poor root structures contribute to poor soil function, high rates of carbon and water loss, erosion, susceptibility to floods and droughts and dependence on harmful chemicals to support productivity.

Over two hundred million tonnes of soils as sediment are lost from New Zealand to the ocean every year from erosion. This sediment contains about 2.4% organic C, this means a total of 4.8 million tonnes of C is exported to the ocean from New Zealand farmland each year equivalent to 70% of New Zealand's total use of C through the burning of fossil fuels in 1990. (Landcare Research)

Inorganic N

In 2017 NZ farmers applied approximately 800,000 tons of inorganic N to its agricultural land at a cost of about $400 million. Inorganic N is highly inefficient, highly polluting and a key problem for ecosystems; only 10% to 40% of the applied quantity is actually taken up by plants with much of the remaining 60% to 90% is returned to the atmosphere as ammonia or nitrous oxide or leached into water ways as nitrate.

In well-functioning soils, 85-90% of plant nutrient uptake is microbially mediated, this includes N which is rapidly converted to amino acids in healthy soils. The application of high rates of inorganic N inhibits the microbial communities formed by associative diazotrophs and mycorrhizal fungi that fix and transport atmospheric N creating even higher dependence on inorganic N inputs and further degeneration of soil. (Dr Christine Jones Farming Profitably within Environmental limits)

Inorganic N cause deterioration of soil structure and affects the water holding capacity of soil. Soil is potentially one of the greatest stores of fresh water, loss of water holding capacity significantly reduces the resilience of soil to flood and drought and causes loss of soil carbon into the atmosphere further increasing greenhouse gas production.

Glyphosate

Glyphosate is patented both as an herbicide and an antibiotic. Application of glyphosate kills beneficial soil bacteria and fungi critical to a healthy ecosystem with consequent detrimental impact on the ecosystem functions of energy flow, mineral cycle, water cycle and community dynamics.

Because of the short persistence of the modern ryegrass species pastures are often replaced every four years which means approximately a quarter of a farm as sprayed out annually with glyphosate or a similar herbicide.

Cropping and winter management

The recent publicity regarding cropping and winter grazing of dairy cows serves as a stark reminder as to how destructive these practices are to environment and animal health.

https://www.stuff.co.nz/business/farming/114607024/cows-in-mud-new-images-stir-up-cropping-concerns-once-more

Grazing/monocultures

Monocultures and intensively managed systems are not more profitable than diverse biologically-based systems. Diversity at all levels creates complexity and resilience; monocultures and low diversity pastures simplifies soil microbiome and open soils and pastures up to pests and disease. Monocultures need to be sustained by high and often increasing levels of inorganic fertiliser, fungicide, insecticide and other chemicals that inhibit soil biological activity. The result is an increasing dependence on agrochemicals to control the pest, weed, disease and poor fertility that result and greater risk to environment and health.

The greater the diversity of plants, the greater the diversity of microbes and the more robust the soil ecosystem. More carbon and water are retained in soils which support high microbial diversity.

Professor Louis Schipper (Large losses of soil C and N from soil profiles under pasture in New Zealand during the past 20 years) recorded soil carbon losses averaging 21tonnes per hectare in the top one metre of soil at 31 sites on flat to rolling pastoral land in New Zealand. These losses were associated with an intensification of land use and commonly extended to depths of one metre or more.

Global issues and NZ perspective

The market is changing. NZ has a unique position in the global market for agricultural produce in that the majority of what we produce is exported. The global consumer has more influence than the domestic consumer and we often miss market signals as our producers are buffered behind the processors.

There are strong market signals from Europe and the US that the consumer trend is towards produce from farms where land is regenerating and animal welfare standards are high. If NZ is to profit from these changing consumer trends we need to change our farming practices.

Farming as the solution

Regenerative practices are based on;

- Optimise photosynthesis – green is good all year
- Diversity in and above ground including plants
- Regenerative grazing management
- No tillage of soils
- No bare soils with the use of cover crops as part of cropping regime
- No chemicals

A move to Holistic Management and regenerative farming practices provides a solution to the harm which is being caused by extractive reductionist faming methods. With regenerative farming practices the focus is on healing soil and restoring a healthy microbiome and soil structures which support healthy ecosystem processes.

With the soil priming effects of multispecies crops and pastures many farmers around the world have been reported as able to significantly reduce or even eliminate the need for inorganic fertiliser.

In comparison to ryegrass/white clover pasture, diverse swards containing herbs such as chicory, plantain, lucerne and red clover under regenerative management have been shown to not only improve animal health and provide a more even distribution of the quantity and quality of feed through the year, but also significantly reduce the excretion of urinary N while maintaining – or often improving - milk production. Reductions in urinary N between 20% and 50% have consistently been reported for dairy stock consuming mixed pasture swards in New Zealand. (Woodward, S.L., Waghorn, G.C., Bryan, M.A., and Benton, A. (2012). Can diverse pasture mixtures reduce nitrogen losses? *Proceedings 5th Australasian Dairy Science Symposium 2012*, pp.463-464. http://www.adssymposium.com.au/inewsfiles/ADSS_Final_Proceedings.pdf; Woodward, S.L., Waugh, C.D., Roach, C.G., Fynn D. and Phillips J. (2013). Are diverse species mixtures better pastures for dairy farming? *Proceedings New Zealand Grassland Association* 75: 79-84. https://www.grassland.org.nz/publications/nzgrassland_publication_2532.pdf; Totty, V.K., Greenwood, S.L., Bryant, R.H. and Edwards G.R. (2013). Nitrogen partitioning and milk production of dairy cows grazing simple and diverse pastures. *J. Dairy Sci*. 96: 141–149. http://dx.doi.org/10.3168/jds.2012-5504; Box, L.A. Edwards G.R. and Bryant R.H. (2016). Milk production and urinary nitrogen excretion of dairy cows grazing perennial ryegrass-white clover and pure plantain pastures. *Proceedings of the New Zealand Society of Animal Production*; 76: 28-31.)

In summary, enhanced above and below-ground diversity …..

1. creates a robust soil microbiome and supports common mycelial networks
2. increases soil carbon sequestration and carbon storage capacity
3. improves aggregate stability, soil structure and function
4. enhances the capacity of the soil to act as an effective bio-filter
5. evens out feed availability throughout the year
6. maintains or improves herbage yield and milk production
7. reduces urinary N excretion by 20 to 50%
8. reduces reliance on high-analysis N and P fertilisers, herbicides, insecticides and fungicides
9. optimises soil, plant, animal, and human health, water quality and farm profit.

(Weigelt, A., Weisser, W. W., Buchmann, N. and Scherer-Lorenzen, M. (2009). Biodiversity for multifunctional grasslands: equal productivity in high-diversity low-input and low-diversity high input systems. *Biogeosciences*, 6: 1695-1706, doi:10.5194/bg-6-1695-2009; Bullock, J.M., Pywell, R.F. and Walker, K.J. (2007). Long-term enhancement of agricultural production by restoration of biodiversity. *Journal of Applied Ecology*: 44: 6-12. DOI: 10.1111/j.1365-2664.2006.01252; Hungate, B. A., Barbier, E. B., Ando, A.W., Marks, S.P., Reich, P.B., van Gestel, N., Tilman, D.,Knops, J.M.H., Hooper, D.U., Butterfield B.J. and Cardinale, B.J. (2017). The economic value of grassland species for carbon storage. *Science Advances.* http://advances.sciencemag.org/content/advances/3/4/e1601880.full.pdf)

When the entire farm functions as a riparian buffer, catchment health and water quality are vastly improved. In addition to supporting a raft of ecosystem services, healthy soils underpin high-yielding agricultural production, farm profit and the wealth of the nation.(

Measuring and Monitoring

Overseer has been identified as having serious limitations as a tool to monitor improvement in ecological health so there is no need to discuss this further in this submission. (Parliamentary Commissioner for the Environment).

If we are to more effectively measure ecosystem health, we need to consider the indicators of change. The four ecosystem functions include;

- Energy flow
- Water cycle
- Mineral cycle and
- Community dynamics

Ecological Outcome Verification (EOV) is one tool which effectively monitors ecosystem functions. These are monitored at the soil surface through a series of indicators which respond directly to impact of management – 'leading indicators'. These include;

- Live canopy abundance
- Living organisms
- Functional groups of plants
- Contextually desirable indicator species
- Contextually undesirable indicator species
- Plant litter
- Litter incorporation
- Dung decomposition
- Bare soil
- Soil capping

- Wind erosion
- Water erosion

These leading indicators are supported by 'lagging indictors' indicators which respond more slowly to changes in management

- Water infiltration
- Soil carbon
- Soil equivalent fixed mass
- Soil organic matter

EOV is farmer focused, simple and cost effective and when used alongside Overseer would give a broader indication of changes in ecological health towards the goals of this Plan Change. If we are to consider regenerative farming as a solution we need to be able to effectively maeasure the impact, Overseer can not do that. There are other tools also available.

Recommendations

Regenerative agriculture needs to be recognised as a serious solution to improve water health. A clear research opportunity exists in implementing regenerative and sustainable agriculture systems as tools to reduce environmental impacts in primary production systems without compromising the economic impact of agriculture to regional and national economy.

Interest in regenerative agriculture in New Zealand (NZ) is increasing as result of pressure to reverse ecosystem degradation and the opportunity to reduce water quality impacts, increase soil carbon, build farmer resilience and enhance connection to consumer and markets. Initiatives like the '4 per 1000' (https://www.4p1000.org) have placed the spotlight on regenerative agriculture (and specifically soils) in terms of the critical role they can have in delivering multiple benefits such as food security, achieving sustainable development goals, and climate change mitigation.

Measurement of rate of change of ecological health needs to extend beyond Overseer which has serious limitations. I propose Ecological Outcome Verification (see attached) as a solution.

Note on Phosphorus in support of submission by Robin Boom

Overseer has been identified as over estimating the level of P which is required to sustain or improve production. It doesn't factor into the equation whether the farm has already achieved its biologically optimum levels for P.

The Olsen P test which is the 'go to' test for soil P in NZ is not an appropriate test for our mainly acidic soils. There are more suitable more modern tests available and I would recommend the Mehlich III test which is a much better predictor of determining a phosphate response and is now the most common assay used on acidic soils worldwide and also the favoured method used in the international scientific literature. The use of Olsen P as a test tends to encourage application of P when it is not required leading to contamination of waterways.