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Original Paper

Global Market Effects on Biodiversity and Water Quality in New Zealand

Ben Tyson[1] & Nick Edgar[2]

[1] Department of Communication, Central Connecticut State University, New Britain, Connecticut, USA

[2] New Zealand Landcare Trust, Hamilton, New Zealand

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Abstract

This paper discusses how global market pressures have negatively affected biodiversity and water quality in New Zealand, the broad impacts of this, and what the country is doing to address these issues. A version of this paper was presented at the Twelfth Global Studies Conference, Jagiellonian University, Kraków, Poland. June 27-28, 2019.

Keywords

biodiversity, water quality, market pressure, farmer engagement

1. Impacts to and from Global Markets

Driven by global market forces that result in growing demand, higher commodity prices and greater profit, there is a trend among farmers in some countries to convert traditional dry land farming operations with historically benign water quality and biodiversity impacts to high intensity irrigated farming operations that can have extremely negative impacts on water quality and biodiversity. This has been the case among many farmers in New Zealand over the past two decades (Foote et al., 2015; The Economist, 2017).

The demand for dairy products in China rose significantly over this time period. The relatively close geographic proximity of New Zealand to China and the fertile dairy industry that New Zealand has been gifted with positioned the country to be the natural supplier of products to meet this demand. In 2008, New Zealand entered into a free trade agreement with China. It was the first developed country to do so. China has the world's second largest economy. Its sizeable and growing middle class offer significant opportunities for New Zealand exporters (New Zealand Foreign Affairs and Trade, 2018).

New Zealand's two-way trade with China has increased more than three-fold in the past decade.

Two-way trade is the total value of goods and services imported and exported between two countries. This has climbed from $8.6 billion in 2007 to $26.1 billion in 2017. China has now surpassed Australia as New Zealand's largest trading partner. The main contributor has been increased exports of dairy products; i.e., milk powder, butter and cheese (Stats NZ, 2018). The value of dairy exports to China increased by over 40% from May 2016 to May 2017. This increase in export values reflects the higher world prices now being paid for milk powder (Xinhuanet, 2018).

One result of this has been that many New Zealand farmers, driven to take advantage of increased demand/pricing/profits, have converted traditional dryland sheep and beef farms to intensive irrigated dairy operations. The national dairy herd has doubled in size in the past 20 years (Warne, 2017). The result has been increased revenue for the farmers and increased agricultural export earnings for the country, but deteriorating biodiversity and water quality have been the expense.

Water quality in New Zealand pastoral catchments is on a declining trend, driven largely by agricultural intensification (Ballantine & Davies-Colley, 2009). Dairy contributes a disparate amount of nutrients to freshwater than any other land use (Foote et al., 2015). For example, dairy farms in the upper Manawatu River catchment contribute approximately half the nutrient load from roughly 17% of the catchment area (Dewes, 2012). In the Waikato Region dairying, comprising 22% of the land area, is responsible for 68% of the nitrogen and 42% of the phosphorus entering waterways (Environment Waikato, 2008).

"Nitrate, phosphate, sediment and microbes are the four horsemen of the aquatic apocalypse that now ride across the country's fresh water estate" (Warne, 2017). Muddy rivers that once ran clear, lakes and rivers clogged with algae, low levels of oxygen, the disappearance of fish and aquatic invertebrates, and high levels of E.coli bacteria are all now too common occurrences. At many sites where groundwater is monitored, test results indicate there is too much nitrate to be safe for drinking. This is happening in areas where water has historically been clean enough to drink with minimal treatment. Even more concerning is the potential for cow feces to cause microbial contamination of waterways. New Zealanders are twice as likely to fall ill from campylobacter as Britons, and three times more likely than Australians or Canadians (The Economist, 2017).

Issues have become polarized and passionate in the public sphere—ecology vs economics, individual rights vs the common good, urban vs rural—New Zealand, a nation of farming or a clean/green nation. New Zealand Fish and Game, a governmental organization active throughout the country that advocates for the rights of fishers and hunters, has run a "Dirty Dairying" campaign since 2002 that has stigmatized the sight of dairy herds as little more than environmental contaminators for many people.

Farmers are feeling pressured. New Zealand has always been a nation of farmers. They feel they are losing the trust of the community that they had for over 150 years. Community can be conceptualized as being local, national or global. Criticism of the dairy industry is high among urban dwellers, growing among rural residents, and may be catching on globally. Many customers (including some Chinese buyers who periodically come to inspect farms in New Zealand) expect the products they

purchase to be sustainably produced. Community outrage is translating into more regulation by Regional Councils. This limits farmers' freedoms and many are reacting negatively to this. Yet regulation is often the only way to deal with such a social dilemma effectively. The dilemma is that what is profitable behaviour for the individual will be costly to the commons (the public/environment) and vice versa, what is good for the commons will cost the individual. For farmers to meet water quality targets set by Regional Councils (that are designed to conserve biodiversity), they must sacrifice either by reducing herd sizes, taking land out of production, or investing in measures to mitigate harm (e.g., fences, culverts, buffer strips). If all the dairy farmers sacrifice equally, the costs to an individual can be spread out across all the farmers in a catchment and individual losses can be kept to a minimum. But the temptation is always there for a farmer to free-ride on the efforts of others, not sacrifice, reap the benefits of that, and heighten their competitiveness. In addition, the belief that others are free riding often results in a decision by farmers to not sacrifice at all. This is the Tragedy of the Commons (Hardin, 1968) and the reason that regulation is often the most expeditious way to deal with such social dilemmas.

The issue of environmental degradation caused by increased dairying threatens not only the sensibilities of those who think that the health of the agricultural economy should not come at the expense of a healthy environment, but also threatens the viability of tourism, the country's top export earner. New Zealand prides itself on its clean green image. The brand logo for promoting national tourism is "100% Pure New Zealand." Tourism contributes 14.5 billion New Zealand dollars to the national economy each year and directly employs 188,000 people (Tourism New Zealand, 2018). If New Zealand is not careful in how they manage their dairy industry in the future, this image may be rightfully tarnished. Increased earnings from supplying global market demand for dairy products may be more than offset by the loss of revenue from a disappointed global tourism market.

2. Impacts of Dairy Farming on Biodiversity and Water Quality (Note 1)

On dairy farms, biodiversity can include microbial species, grass or pasture species, soil biodiversity, native vegetation, and other flora and fauna of the agricultural landscape, as well as introduced pests and pathogens associated with dairy production systems. Furthermore, nutrient, pesticide and sediment transported through surface run-off and groundwater can impact aquatic (freshwater) and downstream estuarine and coastal biodiversity (Morrison, Lowe, Parsons, Usmar, & McLeod, 2009). Ecosystems do not recognize man-made boundaries. Farms are connected by rivers and streams. Many are too small to be regulated under either the industry's or government's Clean Water regulations that require larger water bodies to be fenced. The impacts of farming can cross local, regional, and national borders and eventually affect our oceans and seas. Everyone lives downstream from someone.

Direct impacts of dairy farming on biodiversity often result from land clearance and conversion of land from native indigenous forest to introduced pasture grasses. Removal of forested lands causes a loss of carbon entrapment negatively affecting national and global targets for C02 emissions. Large-scale

draining and clearing of wetlands to create dairy farms is not an uncommon method for expanding dairy production (Boatman, Parry, Bishop, & Cuthbertson, 2007; Drexler, de Fontaine, & Deverel, 2009). These actions result in the most dramatic changes to biodiversity associated with dairy production (Thiere, Milenkovski, Lindgren, Sahlen Berglund, & Weisner, 2009). In addition, the growth of intensive homogenous agriculture systems often results in a simplification of biodiversity. Khumalo, Chirwa, Moyo, and Syampungani (2012) state that significant losses of biodiversity as a result of the transition from traditional mixed farming systems to modern monoculture farming, has resulted in a decline in species diversity. The consequences of this include localised degradation of many critical ecosystem services including: nitrogen fixation, pollination, soil enrichment, facilitation of nutrient uptake by plants, pest and disease dynamics, and water purification ((Moller et al., 2008; Millennium Ecosystem Assessment, 2005).

Pugh (2015) states that the impacts of dairy farming on biodiversity can include: modifying the structure and species composition of ground cover and under storey vegetation, promoting exotic plant species invasions, reductions in populations of a broad range of mammals, birds, reptiles, amphibians, fish and invertebrates due to habitat degradation, and the compacting, degrading and baring of soils which increases runoff, erosion, and the transportation of sediments and nutrients which can ultimately change the morphology of streams. In addition, the runoff of faeces and urine in and near streams can cause contamination by a range of viruses, bacteria and parasitic protozoa and have a significant negative impacting on water quality and stream biota.

The rate at which nutrients are moved through farming systems, particularly intensive dairying systems, and the associated ecological disturbance, is important in determining ecological impacts (Moller et al., 2008). Baskaran, Cullen, and Colombo (2009), report that the intensification of dairy farming in New Zealand is associated with impacts such as nitrate leaching to streams and rivers, large-scale increases in the demand for surface and groundwater for irrigation, and reduced biodiversity in pastoral landscapes. Scientist now know that it takes several decades for nutrients and farm contaminants to leach through the ground and make their way into major water bodies. Given this, it will be several decades before we see the true effects of the last 20 years of dairy intensification in New Zealand (Warne, 2017).

Water quality, biodiversity and recreational pursuits that require a healthy environment are in crisis in many areas of New Zealand due to many of these factors—factors directly attributable to the increased number and size of dairy operations in recent years (Warne, 2017). Farmer are aware. Several studies by the NZLT in recent years in the Pomahaka River catchment, Kakanui River catchment, Upper Buller River catchment, and the North Canterbury catchment attest to this (Tyson, 2014-2018). Farmers (primarily dairy farmers) in these locations agree that the most important issues that farms in the catchment need to address affect water quality and biodiversity-namely sedimentation, erosion/runoff control, runoff/leaching from animals/fertilizer, riparian zone protection, effluent management, and cattle in waterways. When asked what they consider to be the most important benefits of these

measures, they agree this includes improved water quality, improved recreation (swimming and fishing), improved reputation (for agricultural exports and tourism), protecting aquatic life/environment, and sustainable farming in a healthy ecosystem.

3. Measures for Protecting Biodiversity and Water Quality

As stated, for farmers to meet water quality targets set by Regional Councils (that in turn affect biodiversity), they must sacrifice either by reducing herd sizes, taking land out of production, or investing in measures to mitigate harm. The menu of mitigation measures includes: erosion control (minimal tilling, road/path maintenance, construction of fences, culverts and bridges), trapping sediment runoff (development and maintenance of buffer strips and riparian plantings), controlling runoff and leaching of fertilizers and effluent (soil testing, soil moisture monitoring, judicious irrigation practices, effluent capture and prudent timing of field applications), riparian zone protection (invasive species control, native species plantings, construction of artificial wetlands to filter runoff), and keeping cattle out of waterways (fencing). Biodiversity can be enhanced by maintaining hedgerows, shelterbelts, riparian habitat, agro forestry blocks, wetlands and remnant native forest areas on farms and creating greater connectivity between these areas and across farms on a landscape scale. All of these measures come at a cost to the farmer.

As it stands now New Zealand farmers are required to pay these costs. Questions have been raised about the fairness of this and the viability of paying farmers to produce in a more sustainable fashion; i.e., the viability of subsidizing environmental protection as they do in Europe. In addition, the New Zealand brand is based on purity and pristineness—as relates to both agriculture products and tourism products. Arguments have been voiced that New Zealand needs to move away from being an exporter of mainstream commodities to being a supplier of premium products. The issue is not how to enhance productivity (though the government set a goal of doubling exports by 2025), but how to enhance value – how to get customers at home and globally to pay more for products produced more sustainably so that the incentive to produce is not a function of return based on volume but of return based on quality (Warne, 2017).

4. Strategies for Engaging Farmers in Biodiversity and Water Quality Enhancement (Note 1)

The importance of working on both a farm and landscape scale to solve issues affecting biodiversity has led to the realization that remedial efforts must adopt a community-driven perspective (Curtis et al., 2014; Lees, Robertson, Garvan, Barnett, & Edgar, 2012). Considerable attention is now being focused on methods to enhance the participation of communities in solving natural resource conservation issues. One of the most significant challenges to these community driven approaches is developing effective methods to convince individual farmers to work together to solve these landscape-level problems (Tyson, Edgar and Robertson, 2011). An important aspect of this is identifying the determinants of effective community engagement and participation in managing natural resources (Lees et al., 2012).

Reviews and case studies of successful community based natural resource management projects has helped to identify critical success factors (Tyson, Edgar, & Robertson, 2012). Understanding the enablers and barriers to effective community engagement is fundamental to planning, implementing and evaluating education and communication initiatives with farmers.

An exercise in 2011 led by the NZLT to identify these key enablers and barriers drew on one primary source (Newman & Robertson, 2010) and two secondary sources (Agrawal, 2002; Tyson, 2009). The primary source was a report based on results of a national workshop conducted by the Upper Taieri Water Resource Management Project in 2010 (Newman & Robertson, 2010). Workshop participants represented 14 diverse community-led resource management initiatives from across New Zealand, five regional authorities, and seven governmental or nongovernmental agencies. A list of "essential enablers and challenges" to successful community-led resource management was generated collaboratively by participants at the workshop. The two secondary sources are credible efforts to reconcile available literature on a) determinants of successful common property resource management groups (Agrawal, 2002) and b) determinants of behaviour change in an environmental context (Tyson, 2009). As would be hoped, there was overlap across the three sources. The list below is the result of an effort to reconcile the various concepts into a set of ten factors.

Community characteristics (i.e., small size, interdependence among group members, homogeneity of identities and interests/community cohesiveness, shared norms in community, high level of dependence on resource, users reside near the resource/sense-of-place).

Collaboration process (i.e., confidence that community-led collaborative management process will work/community efficacy, process of developing plans has been inclusive of all stakeholders from the community/community interaction, process has had effective facilitators/coordinators/leaders, process has had champions from various age groups).

Trust (i.e., there is fair and accurate media coverage, there is trust in regional authorities, community perceives broader public opinion of them as being positive, community has developed social capital through experience/trust in one another to follow rules/norms of reciprocity,

Communication (i.e., information is widely shared to build broad knowledge, various communication channels to inform stakeholders are used, community has access to effective communication technologies).

Training (i.e., community members have received adequate training/self-efficacy/community efficacy, community members have received adequate training concerning governance issues)

Science (i.e., community has ability to commission scientific studies, community has access to science/decisions made by community are informed by science, scientific studies are not seen as conflicting and manipulative.

Water quality (i.e., common concern for water quality/perceived severity and susceptibility of threat, systems are in place to monitor and manage water quality.

Regulations, monitoring, enforcement (i.e., rules are clear and simple, rules are locally devised, rules

are easy to enforce, those who monitor conditions can be held are accountable, graduated sanctions for noncooperation are considered fair, costs of adjudicating cases of noncooperation are low).

Infrastructure/Technology (i.e., low cost technology exists, there will be long-term multigenerational impacts for infrastructure improvements, costs of investments in infrastructure are spread across multiple generations that will benefit).

Government policies (i.e., government policies that do not undermine local efforts)

As stated, understanding the enablers and barriers to effective community engagement is fundamental to planning, implementing and evaluating education and communication initiatives with farmers. Initial audience research conducted prior to planning a project that assesses current perceptions regarding these ten factors will help determine how to prioritize the use of project resources. Facilitating enablers and alleviating barriers will increase odds that individual farmers will work together to solve biodiversity and water quality issues on both a farm and landscape scale.

5. Conclusion

It is clear that increased demand for dairy products (particularly from China) has convinced many farmers in New Zealand to expand their dairy operations and that this has had extremely negative impacts on water quality and biodiversity. This environmental degradation not only threatens the sensibilities of those who think that the health of the agricultural economy should not come at the expense of a healthy environment, but also threatens the viability of tourism, the country's top export earner. The New Zealand brand to date has been *Clean, Green, and 100% Pure*.

Issues have become polarized and passionate in the public sphere pitting ecology vs economics, individual rights vs the common good, urban vs rural. Trust is slow to light but quick to burn. Farmers feel they are losing the trust of the community that they maintained for over 150 years. Community can be conceptualized as being local, national or global. Community outrage is translating into more regulation by Regional Councils. For farmers to meet water quality targets set by Regional Councils, they must sacrifice either by reducing herd sizes, taking land out of production, or investing in measures to mitigate harm.

The impacts of farming can cross local, regional, and national borders and eventually affect our oceans and seas. It will take a concerted effort on the part of farmers to avoid a tragedy of the commons scenario. For the most part, farmers are aware that they need to address issues such as sedimentation, erosion/runoff control, runoff/leaching from animals/fertilizer, riparian zone protection, effluent management, and preventing cattle from waterways. Their motivations for doing this include improved biodiversity and water quality, improved recreation (swimming and fishing), improved reputation (agricultural exports and tourism), protecting aquatic life/environment, and a more sustainable farming system.

As it stands now New Zealand farmers are required to pay the costs of environmental mitigation/protection. Questions have been raised in government circles about the viability of helping

farmers with these costs by subsidizing environmental protection practices as they do in Europe. In addition, the New Zealand brand has been based on purity and pristineness—as relates to both agriculture products and tourism products. This is special and needs to be maintained. Some say New Zealand needs to move away from being an exporter of mainstream commodities to being a supplier of premium products, that the issue is not how to enhance productivity but how to enhance value based on the realities underpinning this brand image. Increased value should lessen production pressure, which should help mitigate environmental degradation, which should help safeguard the brand. There is global demand for both New Zealand's high quality dairy and tourism products because of this brand image, but meeting the increased demand for dairy products in recent years has caused considerable harm to biodiversity and water quality and this threatens the honesty of the brand. Increasing the value of dairy products and tourism associated with the realities of maintaining a clean green environment may be a way for global markets to actually help maintain what they too desire.

As stated, it will take a concerted effort on the part of farmers to avoid a tragedy of the commons scenario. The importance of working on both a farm and landscape scale to solve issues affecting biodiversity and water quality has led to the realization that remedial efforts must adopt a community-driven perspective. Everyone lives downstream from someone. The key determinants of effective community engagement and participation in managing natural resources have been documented. These factors are fundamental to effective planning, implementation and evaluation of education and communication initiatives with farmers. Facilitating enablers and alleviating barriers will increase odds that individual farmers will work together to solve biodiversity and water quality issues on both a farm and landscape scale.

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Note

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