Opportunities to sustain "greener" farming: comparing impacts of water quality regulations in two catchments: Lake Taupo (NZ) and Tomales Bay, California (USA)

S. BARRY[1], W. KING[2], S. LARSON[1] and M. LENNOX[1]
[1]*University of California Cooperative Extension, 1553 Berger Drive, San Jose, California, 95112 USA*
[2] *AgResearch, Ruakura Agricultural Centre, Private Bag 3123, Hamilton*
sbarry@ucdavis.edu

Abstract
Livestock farming in New Zealand and the United States is increasingly being scrutinised for its environmental impact. In some regions regulations intended to reduce non-point source pollution have been introduced. Regulations can impact agricultural sustainability and may have undesirable consequences including land use change. Livestock farmers in two catchments, Lake Taupo and Tomales Bay (California) were interviewed regarding the impacts of new water quality regulations on farm sustainability. The interviews identified motivations for farming and incentives for farms to improve water quality. The impact of a market-based strategy to reduce and cap N leaching in the Lake Taupo catchment seems to be resulting in fewer but more intensive farms. Concerns of future sustainability have driven some farmers in the catchment to sell their farms. The Tomales Bay catchment strategy, which requires self-assessment of farm water quality impacts, is resulting in most farmers initiating new conservation practices with little impact to farm sustainability. Regulations that go beyond market-based incentives and include substantial technical assistance and cost-share incentives may be more effective at providing opportunities for sustaining less intensive farms.
Keywords: cap and trade, total maximum daily load (TMDL), livestock farming

Introduction
Intensification of agricultural land use in New Zealand over the last two decades has lead to increased concerns about surface and groundwater quality (Mfe 2007). In the Lake Taupo catchment a market-based regulatory strategy is being implemented to control farming's intensification with the objective of protecting the lake's water clarity by reducing nutrient inputs (Young & Kaine 2009). Similarly, in the Tomales Bay catchment in California new regulatory requirements to minimise non-point source faecal coliform pollution from farms have been put in place with the objective of protecting the Bay's water quality for shellfish production and recreational use (Ghodrati & Tuden 2005).

Regulations can impact farm sustainability. The marginal returns from some livestock enterprises may not cover the cost of compliance and farmers are not able to pass these costs on to consumers (Meyer & Mullinax 1999). In addition, quality of life objectives are often important drivers for decision-making among livestock farmers in both California and New Zealand (Huntsinger *et al.* 2010; Liffmann *et al.* 2000; Dooley *et. al.* 2005; Smeaton & Dooley 2006). These objectives can also be impacted by regulations, thus reducing farm sustainability. Regulations may be desired by the public to achieve environmental outcomes, but the results may be counter-productive if they impact farm sustainability and lead to undesirable land use change and/or non-compliance (Davidson & Elliston 2005).

This study examined the impacts of new water quality regulations on livestock farmers in two catchments: Lake Taupo (New Zealand) and Tomales Bay, California, (USA). The objective was to understand the potential impacts of the regulations on farm sustainability and identify opportunities to provide incentives for farmers to work to improve local water quality.

Methods
A set of qualitative and quantitative questions was developed for interviewing farmers in both catchments (n=13 Lake Taupo; n =11 Tomales Bay). Questions were asked about motivations for livestock farms, the influence of water quality regulations on farm and conservation goals and practices, and attitudes towards water quality regulations and their potential results. Farmers were specifically asked how the respective water quality regulations would impact each aspect of their farms' sustainability (economics, environment, and quality of life) (Table 1). Informants in each catchment including farmers, technical assistance providers, and regulators were consulted to identify other appropriate farmer participants, who would represent a diversity of farm size, type, and attitudes towards regulations. The research process followed the tenants of Glaser & Strauss (1967) on theoretical sampling; preliminary findings were used to modify interview questions and select future interviewees as new insights emerged. Despite following the theoretical sampling method, the

Table 1 Farmers responses regarding the impact of regulations on aspects of sustainability by number of responses.

	Lake Taupo	Tomales Bay
Economic (farm)*	Loss of flexibility (12) Loss of future value (9) Increase marketing opportunities or future value (3) None (1)	None (7) Infrastructure Cost (4)
Environmental (farm)	None (13)	None (6) Better on-farm water quality (5)
Quality of life (farm)	Stress (9) None (4)	None (9) Feeling hassled (2)
Quality of life (community)*	Lack of cohesiveness (12) Distrust (2) New jobs (1)	None (9) Improved environment (2)

*More than one response permitted if not "none"

Table 2 Catchment similarities.

	Lake Taupo	Tomales Bay
Importance	Internationally known for its deep clear water and trout fishery.	Wetland of international importance (US Fish and Wildlife Service). Commercial shellfish and fish industries.
Population	16 towns, population 28000; 2.9 million visitors/year	11 towns, population 11000; 2.5 million visitors/year
Land uses	Grazing of beef, sheep, deer; 4 dairy farms, commercial forestry lands; lifestyle blocks; open space. 92 farms >100 ha	Grazing of beef, sheep; 10 dairy farms; 33 equestrian facilities; lifestyle blocks; open space (some with grazing). 151 farms >25 ha
Water quality protection efforts	Began 35-50 years ago with riparian fencing and planting, and erosion protection.	

relatively small sample size may contribute to bias in this study. The comparison of interview results between catchments identified opportunities to promote farm sustainability while meeting water quality regulations.

Catchment descriptions

Although the two catchments are quite different in size, soils, vegetation, and water quality impairments, they both have international importance, and share similar land uses and histories of water quality protection efforts (Table 2).

In both cases, regulations were a result of actions by regional authorities after several years of consultation with interested parties, and in the case of the Lake Taupo catchment, court action. Although both approaches consider an acceptable allocation of a contaminant, the approaches are different in assignment of allocation and farm requirement.

Lake Taupo nitrogen cap and trade

After 4 years of consultations with farmers, Environment Waikato (EW) announced (in 2005) a strategy to cap non-point sources of N at the farm level. Under the strategy, EW grants resource consent to a farm for 25 years after setting a cap on N leaching stated as a nitrogen discharge allowance (NDA). The cap is based on the farm's highest ND estimates (calculated by the nutrient budget model, Overseer® www.overseer.org.nz) during the benchmark years of 2001-2005. In addition, this strategy created a public fund to permanently remove 20% of the manageable N by buying land or NDA from farmers. Rules were also established so that farms can trade NDA with each other (Young & Kaine 2010).

Tomales Bay pathogen total maximum daily load (TMDL)

After 10 years of the Regional Board (RWQCB) efforts

focused on requesting livestock farms to voluntarily reduce pathogens, sediments and nutrients from runoff to the Bay, the RWQCB approved (in 2005) a regulatory strategy to reduce pathogen sources. The strategy, known as the Tomales Bay Pathogen TMDL, moved away from singling-out livestock farms and includes regulations from six potential sources: farm runoff, urban runoff, boat discharge, septic tanks, open space lands, and sewage holding ponds. The TMDL established an acceptable faecal-coliform level for the Bay and its tributaries. Under the TMDL strategy, landowners with grazing lands encompassing 20 ha or more are required to submit a "Notice of Intent", and complete a water quality plan, which identifies water quality problems on their property and outlines how and when they will address them.

Results and Discussion

Average farm size in the Lake Taupo catchment is larger than in the Tomales Bay catchment (Table 3) and stocking rates are much higher as the New Zealand climate provides for perennial forage on dryland pastures. In contrast, California's long summer drought, typical of a Mediterranean climate, supports mostly annual forage plants over a 6-7 month growing season. Farm ownership in the Lake Taupo catchment has a relatively short history with most of the pastoral lands developed 35-50 years ago by Central Government agencies.

Similarities

Farmers in both catchments share a strong interest in caring for livestock and the land. All farmers interviewed engaged in some level of land stewardship on their farm, for example, planting trees, protecting or enhancing wildlife, controlling invasive species. Long-term owner/operators (>25 years) felt like their farm represented their "life's work" or "legacy." Farmers in both catchments overwhelmingly agree that farming is an important land use, which can be carried out in a way to protect water quality. They generally accept the need for regulations to protect water quality; however, there is considerable concern in both catchments regarding the underlying science, which informed the regulations.

Differences

Farmers interviewed identified different impacts on farm sustainability in the two catchments as a result of the new water quality regulations (Table 1).

In the Lake Taupo catchment, the N cap and trade regulation has impacted production goals and practices, increasing the relative importance of production per animal, reducing costs, and seeking value-added market opportunities. To date, most farmers are unsure of how changing practices to accomplish these goals will affect their NDA as calculated by Overseer®. Without a clear understanding of farming options under their NDA cap, farmers interviewed identified loss of flexibility as the main economic impact of the regulation (Table 1).

Actual change to date as a result of the regulation appears limited to change in land and livestock base with farmers buying, selling, and leasing land within and outside of the catchment, buying NDA in the catchment, and changing stock ratios and classes. One farmer estimated that 10 % of the farms (11 properties) had changed ownership since the announcement of the N cap strategy in 2001. This is in addition to LandCorp, a state owned enterprise, which put eight properties up for sale as a result of perceived loss of value due to the N cap (Yerex 2009). While most farms were sold with concerns about their future sustainability and value, farmers acquiring these farms bought them because they saw economic opportunities from discounted farm prices and certainty from future water quality regulations.

Interviewees believe that the recent changes in land ownership and the mechanism in the Lake Taupo strategy that allows for trading N among farms in the catchment is leading to a concentration of the total catchment allocated NDA across fewer hectares. Although this mechanism was put in place to provide flexibility for farmers, most farmers interviewed (10 out of 13) do not think they can benefit from trading. Ironically, farmers of two of the "greenest" farms in terms of N leaching felt that they will require more oversight and technical assistance than farms with higher N leaching caps to remain viable under the new N cap and trade regulation. Additional technical assistance could bridge the current gap in farmers understanding of the N cap and trade which is leading some farmers to see opportunity while others see despair (Table 1).

In contrast, production goals have not been impacted by the TMDL strategy in the Tomales Bay catchment and there have been no changes in land or livestock base. However, as a result of the strategy, there has been some change in conservation goals among farms in

Table 3 Farm description by catchment.

	Lake Taupo	Tomales Bay
Ave. farm size	909 ha	377 ha
Typical stocking rate	10-16 SU/ha	1-1.5 SU/ha
Ave. length of land ownership	17 years	65 years

the Tomales Bay catchment. Several farmers mentioned greater awareness regarding erosion and manure sites. Most farmers have committed to new conservation practices like improved grazing management, riparian protection and erosion control, most with cost-share funding support (8 out of 11). Despite the cost-share funding, some farmers still identified the cost of infrastructure as a main economic impact of the new regulation (Table 1). Low returns from pasture land in the Tomales Bay catchment, based on rental values, $105 USD/ha/year (Marin County Department of Agriculture 2009), are not adequate to cover the cost of most conservation practices. Without cost-share programs paying for up to 90% implementation costs, few conservation practices would be implemented (N. Scolari pers. comm.). The long-term economic viability of these farms remains in question as production revenues fail to cover the "real" costs of land ownership and stewardship.

Opportunities

Future regulatory schemes to allocate and cap contaminants might have better long-term environmental and community outcomes with a mix of incentives. Farmers in the Tomales Bay catchment have committed to new conservation practices in part to avoid further regulation and support a community initiative (Larson *et al.* 2005). These farmers have also received public recognition, technical assistance and opportunities for cost-share funding to construct conservation infrastructure and/or adapt new management strategies. This cost-share funding has been shown to be successful in New Zealand as well, for example, Clean Stream Fund, QEII Trust (J. Young pers. comm.). Cost-share funding typically requires a substantial investment from the farmer, providing for a sense of ownership.

An effective approach may also be to create additional value for the "greenest" livestock farms, those with the least impact to water quality. The traditional avenue for New Zealand livestock farmers to meet rising production costs has been to intensify. While some farmers may enjoy the challenges of intensifying their operation (Dooley *et al.* 2005), others may be content farming as they had been if they can meet their financial obligations and their farm can maintain its value. Value may come from "green" farming incentives, for example, reduced tax rates and opportunities for value-added marketing through business-farmer partnerships, including the marketing of branded and local products.

Throughout California, including in the Tomales Bay watershed, there is growing community support for local agriculture, including its heritage value and contribution to a desired rural landscape. Agricultural landowners in much of the state may pay reduced property taxes in exchange for a contract agreeing to keep land in agricultural land use; however, this program is threatened by the current economic crisis. Similar reduced tax rates could be provided for New Zealand farmers who farm with less intensification. Currently, community recognition of the value of farming beyond food production is poorly developed. The recent visioning process in the Taupo District only mentioned farming as a primary source of N leaching and an industry which the community should look beyond for future economic growth (Lake Taupo District 2009). Although communities in both New Zealand and California seem to be able to unite behind environmental goals such as clean water, developing shared community goals to support catchment landscapes which include "greener" farms seems elusive.

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