

## CA Dairy Production Background reading:

California is the largest dairy producer in the United States, producing about 21% of the nation's milk and cheese. Dairy production is the largest source of agricultural income for the state, generating \$7.6 billion in 2013 (CAMB 2010). There are now 1,974 dairies and 1.7 million dairy cows in the state. The industry employs roughly 443,000 people (3% of the state's jobs) and accounts for 69 billion in economic activity after taking into account spillover impacts on other sectors and industries (CAMB 2010).

### Management profiles

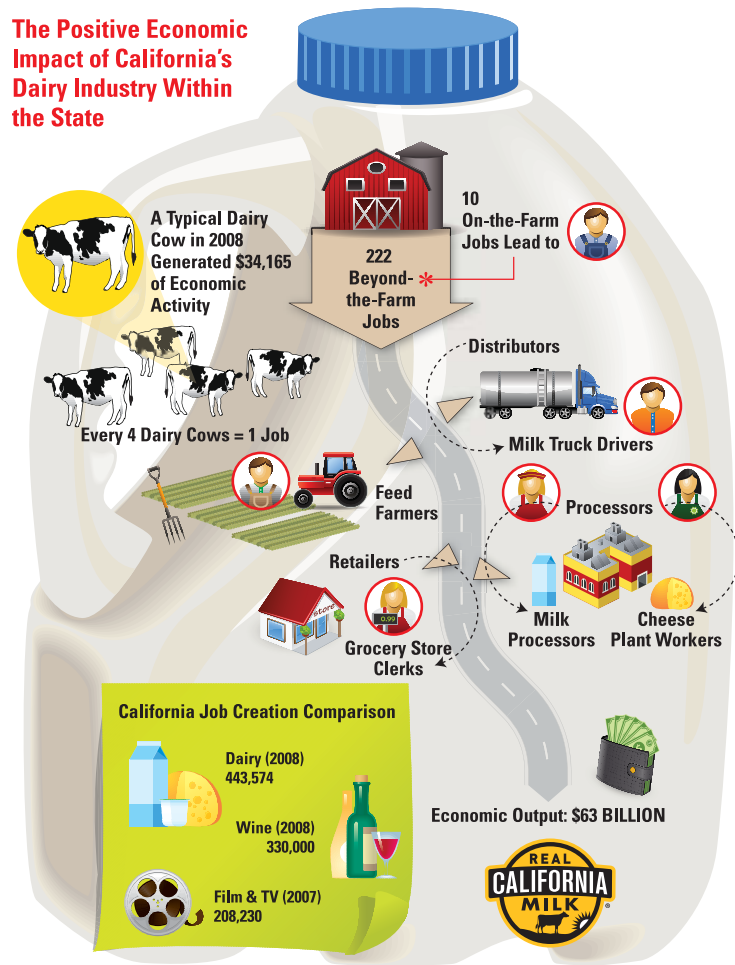
Dairy management practices in California vary widely by region.

A majority of the state's production comes from the Central Valley and Southern California regions, where a majority of the farms are considered "highly intensive" confined systems, where cows are kept in a fairly small, non-pastured area, and fed mainly grains, forage, and concentrates. Forage may be grown adjacent to farms, but grains and concentrates are mainly purchased off-farm, making farm profits highly dependent on commodity market fluctuations. Corn and alfalfa the primary feeds; alfalfa is preferred over other forages because it doesn't affect flavor.

While these systems produce large quantities of milk and meat, they also present significant challenges to environmental and public health (see Water Pollution and Rural Communities below). In the Central Valley of California, for example, where the densest 1% of farms have an average of 955 cows per hectare, the quantities of nitrogen and phosphorus produced in confinement systems vastly exceed the natural recycling capacity of the region (Powell, Russel, and Martin 2010). Larger, higher density systems produce 96.7% of the state's milk (CDFA 2013).

Smaller, pastured systems – including organic production – are more common in the North Coast area. Farms in this region produced around 900 million pounds of milk in 2013 (2.2% of state milk production). A typical herd size is 401 cows (CDFA 2013). These systems are limited in other regions of California due to a lack of adequate rainfall and high temperatures, which influence both pasture productivity and cattle health.

### The Positive Economic Impact of California's Dairy Industry Within the State



Source: California Milk Advisory Board

### *Water pollution*

The growth of confinement systems has created large local manure management problems, resulting in the pollution of local waterways and the reduction of local air quality (Powell, Russel, and Martin 2010).

Wastes from intensive dairies are collected either in ponds or lagoons. The most common methods of manure collection are flushing and scraping. Most dairy farms then use some method of separating solids from liquids, however, mechanical separation systems are quite rare. Storage or treatment ponds are extremely common (found on more than 95% of farms in the Central Valley) (Meyer et al. 2011).



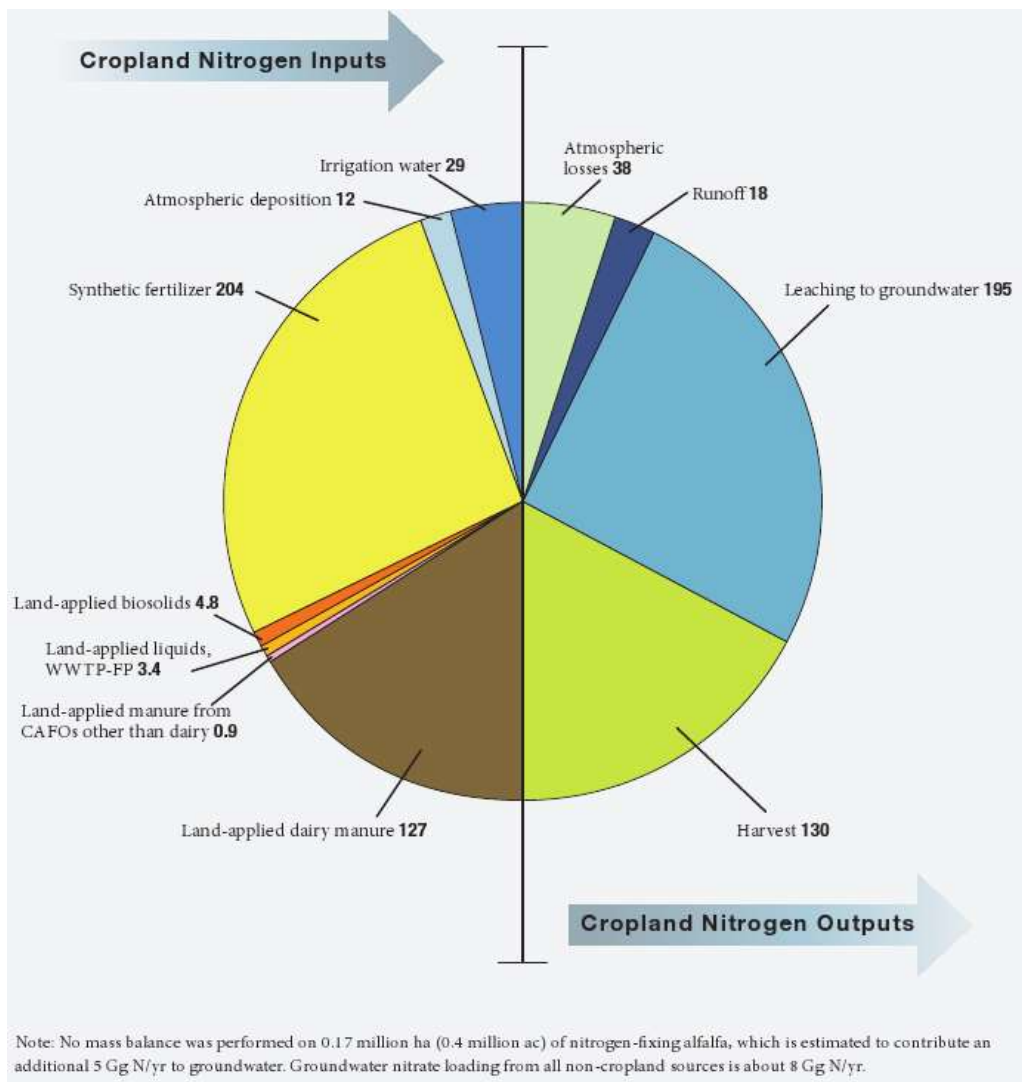
**Flushing**



**Scraping**

Of the largest dairy farms (> 2,000 cows) in the US, 26% have no cropland at all in which to apply these collected manures (McDonald et al. 2009). It is very costly to transport manure to more distant fields (Pettygrove et al. 2003). Freestalls are common housing facilities and separated waste solids and corral scrapings are commonly used as bedding in these facilities.

Pollution occurs when manures are discharged into the surface or groundwater through improper storage and handling. The recent California Nitrogen Assessment found that 88% of all N in California groundwater is due to leaching from cropland (Tomich et al. 2015). Among 33 crops analyzed by the Assessment, average N fertilizer rates had grown 25% from 1973 to 2005 (Rosenstock et al. 2013). In agricultural intensive regions like Salinas Valley and the Tulare Lake Basin these intensive nitrate levels have led to discussion of local policies for N management in California (Harter and Lund 2012).



**“Overview of Nitrogen Inputs and Outputs”. Source: (Harter & Lund, 2012).**

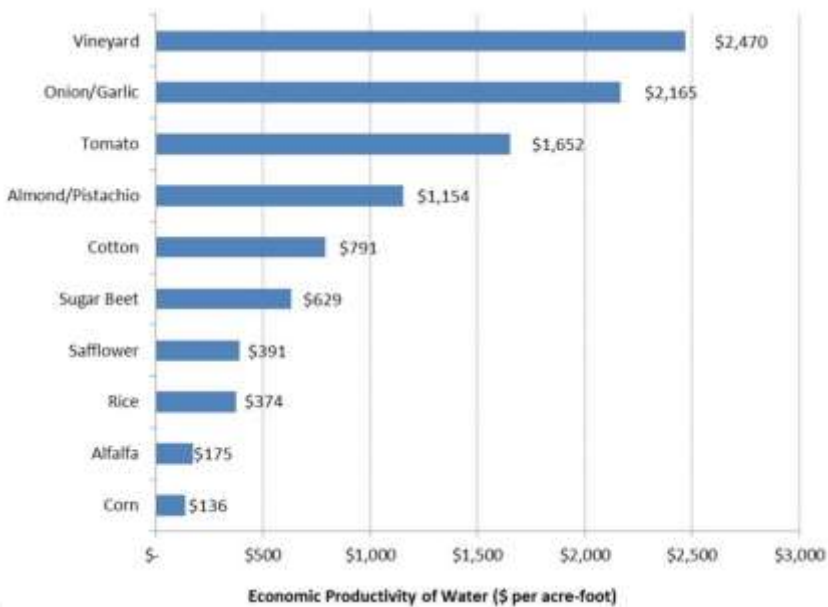
### *Air pollution*

Manure in holding pens, corrals, and lagoons emit ammonia, volatile organic compounds (VOCs), hydrogen sulfide, and particulate matter (PM) (University of California 2006). The air quality in the Central Valley is not in compliance with the Clean Air Act with respect to both ozone (a product of VOCs) and PM. Methane, a potent greenhouse gas, is also emitted through the cows digestive process and via decomposition of waste in lagoons (University of California 2006).

### *Water availability*

In California, there is a severe ongoing drought affecting more than 37 million people. As of April 2015, 93% of the state was ranked as having severe, extreme or exceptional drought (with 47% in exceptional drought) (US Drought Monitor 2015). Water availability is critically limited and the State Water Project for the first time ever delivered a zero water allocation notification in 2014 (Vogel and Thomas 2014); since then, deliveries haven’t surpassed 20% (California Department of Water Resources 2015).

These conditions are dire for dairy farmers because they exacerbate the background trend of rising and increasingly variable feed prices. However, agricultural producers are also partially responsible for the water scarcity. Alfalfa – one of the major feeds in California dairy production is the single largest agricultural user of water in the state (Hanson et al. 2008). Alfalfa covers 1 million hectares in the state and 70% is consumed by dairy cattle. After accounting for the economic productivity of dairy production, alfalfa is one of the least economically productive land uses in the state and thus one of the least cost effective uses of water.



Source: <http://www.takepart.com/article/2015/05/11/cows-not-almonds-are-biggest-water-users>

### *Feed cost challenges*

In spite of their growth in recent decades, the ongoing viability of the dairy industries in these states is threatened by rising input costs while milk prices have not kept pace in recent years. In particular, feed costs are on average 81% of total operating costs on U.S. dairy farms, highlighting the importance of minimizing feed costs through pasture and cropping productivity, reduced input costs, and the potential of on-farm feed production. From 2010 to 2013, feed costs as a portion of gross value of production in California rose from 57% to 72% (USDA ARS 2014). Simultaneously, milk prices continue to be low and volatile.

### *Rural communities*

Immigrant groups (predominantly Mexican) supply most of the workers needed for agriculture California. The three top farm counties in California generate more than \$7 billion in agricultural revenues annually, but contain seven out of the ten poorest communities in the state (Krissman 1995). Many of these communities lack adequate water filtration systems and health services. The combination of high exposure with inadequate infrastructure exacerbates the health impacts of air and water pollution in these regions.



In Tulare, the largest dairy producing county in the state the average annual per capita income is \$27,897 - 60% of the state average (California Department of Transportation 2015). The two largest sectors in the county are government and agriculture, and together they account for 48% of total employment. As of 2009 the high school drop out rate was 26.1% and 18.6% of the households were below poverty line (United States Census Bureau 2014).

It is estimated that 10% of the 2.6 million people living in the Tulare Lake Basin and Salinas Valley are drinking nitrate-contaminated water (Harter and Lund 2012). These people are at high risk for health problems. High nitrate levels in drinking water are known to cause skin rashes, hair loss, birth defects and blue baby syndrome. They may also be linked to increased risk of thyroid cancer with high nitrate levels in public water supplies.

**Box 1: Impacts of water pollution on local communities**

“Sonia Lopez moved into San Jerardo with her parents and five siblings in 1987. The four-bedroom, four-bathroom house was a big improvement over the two-bedroom apartment they once shared. “This was our American dream,” she said. But something went wrong about nine years ago. Her skin became red and itchy. Her eyes burned. Her hair started falling out. Her family had the same symptoms, and she learned other San Jerardo residents were afflicted, too. “I got very concerned because some of the residents started passing away from cancers,” she said. “People were dying, and we didn’t know who was going to be next.” While they did not find a cause for the cancers, Lopez and fellow resident Horacio Amezcuita learned from health officials that nitrates in their well water had made their eyes red and their hair fall out. The community also learned that its water had been contaminated with nitrates since at least 1990; over the years, three wells had been drilled and eventually were found to be tainted. Drinking water regulations limit nitrates to less than 45 parts per million. One well measured 106 ppm, more than double the limit.”

Source: <http://californiawatch.org/dailyreport/farming-communities-facing-crisis-over-nitrate-pollution-study-says-15258>

Avoiding nitrates is very costly; utilities and citizens in Tulare Lake Basin and Salinas Valley are estimated to pay \$20 million to \$36 million per year for water treatment and alternative supplies (Harter and Lund 2012). Rural residents are at greater risk because they depend on private wells, which are often shallower and not monitored to the same degree as public water sources. Current contamination likely came from nitrogen use decades ago. That means even if nitrates were dramatically reduced today, groundwater would still suffer for decades to come. Removing nitrates from large groundwater basins is extremely costly and not technically feasible. One relatively low-cost alternative is called “pump and fertilize:” pulling nitrate-saturated water out of the ground and applying it to crops at the right time to ensure more complete nitrate uptake.

## ***Policy***

### *Price policy*

The dairy industry is supported by the state and federal government. The state establishes a minimum price that processors have to pay to producers (via milk marketing orders). However, these prices are quite low; lower than the national average. This helps California milk outcompete many other states in the country, but hurts farmers who struggle with low profit margins. Additional support is received through margin (profit) insurance available through the 2014 Farm Bill, but it is not enough to keep many dairies from going bankrupt in the state, particularly in the context of the drought (see Feed Costs above).

### *Water and Nitrogen policy*

California farmers, like all farmers nationally, are exempt from the National Pollution Discharge Elimination System (NPDES) program of the Federal Clean Water Act unless they fall under the category of a concentrated animal feeding operation (CAFO) in which case they are subject to specific effluent limits and must obtain a NPDES permit.

All California farmers are subject to the California Water Code, which theoretically influences nitrogen usage in the state by setting water quality standards. Yet, there is currently no clear overarching nitrogen policy regarding behaviors need to comply with the water code. Several scenarios are plausible.

Read this: <http://asi.ucdavis.edu/programs/sarep/research-initiatives/are/nutrient-mgmt/california-nitrogen-assessment/future-scenarios-of-nitrogen-in-california>

Regional Water Quality Control Boards act as the regulatory body for each region, exercising both quasi-executive and judicial powers. To date many California water quality regulators have tended to exempt farmers from waste discharge permits, enabling them to discharge as much pollution as they want (Dowd, Press, and Los Huertos 2008). Following a lawsuit in 2002 the California legislature forced regional water boards to reassess these practices and resulted in the development of the Agricultural Waiver Program (AWP) in 2004, which includes requirements for mandatory individual, group, or watershed-based monitoring. This voluntary agreement uses design standards (best management practices - BMPs) that guide farmers on how to manage on-farm water resources. The threat of future regulation has been the major incentive for farmers to join the program (Dowd, Press, and Los Huertos 2008).

California maintains a comprehensive permit system for allocating surface water rights based on historical appropriation. California has new groundwater policies but they may take decades to come into force. The most recent is the California Sustainable Groundwater Management Act, which was signed into law in 2014. Prior to the passage of this Act, groundwater was largely unregulated.

## The SGMA

The Sustainable Groundwater Management Act (SGMA) gives local agencies the authorities to manage groundwater in a sustainable manner and allows for limited state intervention when necessary to protect groundwater resources. The SGMA requires the creation of groundwater sustainability agencies to develop and implement local plans allowing 20 years to achieve sustainability. The SGMA provides a state framework to regulate groundwater for the first time in California history.

The SGMA specifically:

- Establishes a definition of sustainable groundwater management
- Establishes a framework for local agencies to develop plans and implement strategies to sustainably manage groundwater resources
- Prioritizes basins with the greatest problems (ranked as high- and medium-priority)
- Sets a 20-year timeline for implementation.

The SGMA includes provisions to promote engagement by interested parties in the formation of a GSA and development and implementation of a GSP. GSAs have to identify key parties and maintain records that spell out plans on how to include their interests in GSA operations and GSP development. The Act requires the GSA to provide this information to DWR.

The GSA is the primary agency responsible for achieving sustainability within the timeframe. The SGMA includes many new authorities and tools for GSAs. For example, in developing a GSP, a GSA may opt to conduct investigations, measure and limit extraction, require registration of wells or impose fees for groundwater management. Under the Act, DWR has the lead role in working with local agencies in implementing its provisions. DWR is available to provide technical assistance to GSAs.

Source:

[http://www.watereducation.org/sites/main/files/file-attachments/groundwatermgthandbook\\_oct2015.pdf](http://www.watereducation.org/sites/main/files/file-attachments/groundwatermgthandbook_oct2015.pdf)

The Water Management Planning Act of 2009 is also a recently important piece of legislation. The Act requires that applicable agricultural water suppliers adopt an agricultural water management plan and update their plan every five years after that. Districts that do not comply with planning requirements and deadlines may not be eligible for state grants and loans. The Act applies in the first instance to larger agricultural water suppliers, specifically those with at least 25,000 irrigated acres, and will apply to districts that are 10,000 to 25,000 irrigated acres when additional funding is available.

Source: <http://www.nrdc.org/water/files/ca-agricultural-water-planning-IP.pdf>

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## New Zealand Dairy Production Background Reading

### Overview

New Zealand is a global powerhouse of dairy production. Globally, New Zealand has the largest surplus of milk production, relying nearly entirely on export markets for dairy sales. In 2014 dairy production in



Figure 1. Pasture based dairy cows in New Zealand.

New Zealand totaled more than \$18 billion- its largest agricultural commodity by far. As well, there were 4.9 million dairy cows in New Zealand- more than the human population (4.3 million). New Zealand dairy farmers are largely cooperative- with the majority (more than 90%) part of the cooperative Fonterra. Fonterra was formed in 2001 following dairy industry deregulation and immediately became the world's largest dairy export company (Dairy NZ 2014). Today, Fonterra is the fourth largest dairy company in the world (Food Product Design 2015).

### Management Profiles

The majority of dairy production in New Zealand is pasture-based, though there are a growing (albeit small) number of confinement dairy systems in New Zealand. The average herd size as of 2013 in New Zealand was 402 cows. Farmers rely on pasture for their cows for the majority of the year and New Zealand's climate is uniquely appropriate to enable this as grass production for many regions is possible for most months. However, as

dairying has expanded in New Zealand to colder climates that do experience snow and winter temperatures many farmers will "winter" their cows on other farms, put them on "sacrificial pasture" (pasture that will become muddy and compacted as a result of the cows being in the space, but will help to preserve the other pastures in the farm), or will feed them in situ on crops in a field. These



Figure 2. Dairy cows in Canterbury, South Island, New Zealand being "break fed" (fencing moved each day so that the cattle get a new break of crop) fodder beet while wintering off the pasture. Photo credit: M. Niles

crops may include kale, brassicas, beets or rutabaga. While many dairy farmers will grow their own feed and pasture, one additional input is common on New Zealand dairy farms- palm kernel oil (known as PKE). New Zealand dairies have relied on the feed addition to help them produce more milk and have greater herds on their current land base. However, PKE has been controversial as it presents a biosecurity threat to New Zealand, which is very sensitive to such risks given its international market. There have also been environmental campaigns against PKE for its impact on forests. In 2015, Fonterra

announced new recommendations to limit PKE on farms suggesting that not more than 3 kg of PKE should be fed to dairy cows daily (Farmers Weekly 2015).



Figure 3. Greenpeace campaign poster against Fonterra's use of PKE.

### Water Pollution and Policy

Agriculture is the second largest contributor to New Zealand's GDP, second only to tourism. The tourism industry is often built around a "clean and green" image of New Zealand. Dairy has been growing steadily in New Zealand and continues to grow. Between 2007 and 2013 the dairy cow population increased 23% (New Zealand Government Statistics 2013). Growth in the dairy industry in the previous decades has been fueled by an expansion of dairy in regions where irrigation has become more prevalent, particularly Canterbury. With the expansion of dairy production, there are increasing challenges to water quality.

In 2002, New Zealand Fish and Game, an environmental and conservation organization, began a campaign called "Dirty Dairying" aimed at highlighting the extent of river pollution across many New Zealand regions, especially the Waikato- a major region of dairying on the North Island. This campaign came on the heels of the concentration of two large dairy cooperatives, which formed Fonterra. The campaign was

effective in that it led to an Accord signed by Fonterra, Ministry of Agriculture and Forestry, Ministry of the Environment and Regional Councils to put in place rules to reduce water pollution from dairy. The Clean Streams Accord was intended to achieve the following:

- Dairy cattle excluded from 50% of streams, rivers and lakes by 2007, 90% by 2012
- 50% of regular crossing points have bridges or culverts by 2007, 90% by 2012
- 100% of farm dairy effluent discharges to comply with resource consents and regional plans immediately
- 100% of dairy farms to have in place systems to manage nutrient inputs and outputs by 2007
- 50% of regionally significant wetlands to be fenced by 2005, 90% by 2007

Despite these efforts, targets fell short and media attention grew. A new "Sustainable Dairying Water Accord" was signed in 2013, which expanded the reach of partners to



Figure 4. Example of a recent cartoon depicting dairy and water pollution challenges.

include all major milk production companies, fertilizer companies, government and industry partners (see <http://www.dairynz.co.nz/media/932599/water-accord-summary.pdf>) . This accord includes additional and updated targets including stock exclusions from waterways, stock crossings bridged or culverted (e.g. no passing through water), riparian management plans, and nutrient management plans.

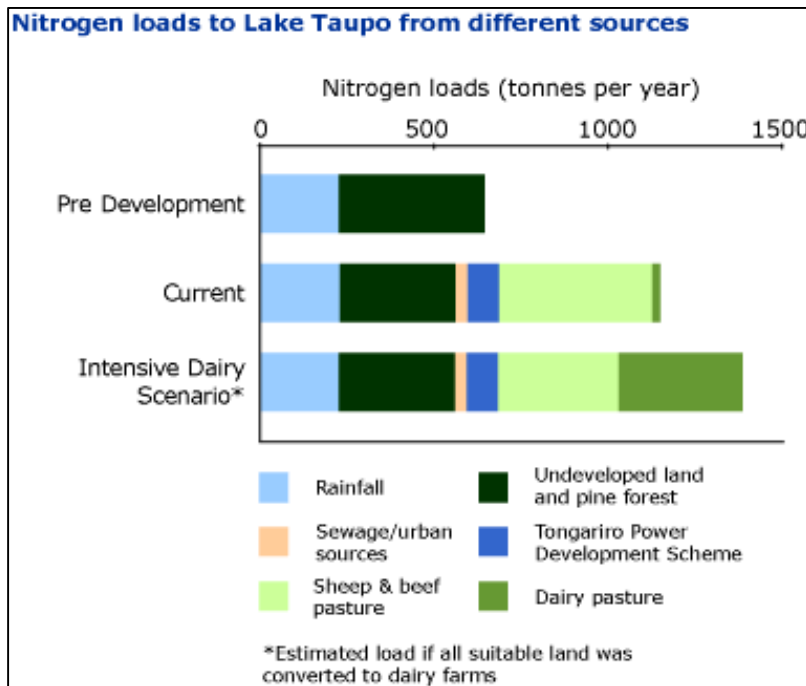


Figure 5. Estimated and current nitrogen loadings to Lake Taupo. The Regional Council implemented a mandatory nutrient trading scheme beginning in 2005 to control for nitrogen inputs including the rising expansion of dairy in the region. The council estimated that if dairy had developed on all potential land within the region (Intensive Dairy Scenario above) it would increase nitrogen loadings to the lake by 20%. Source: Waikato Regional Council

### Nitrogen Policies

Despite the national level accords (which are not legislation) to address water quality issues, nitrogen remains a challenge in New Zealand across many regions known for dairying. As a result, regional councils have begun to implement regional level legislation to control for nitrogen and phosphorus pollution. The first of its kind in New Zealand was implemented beginning in the early 2000s in the Lake Taupo region. As a result of deteriorating water quality in the lake (important for both tourism and cultural significance) the regional council began to implement a plan to reduce nitrogen from non-point agricultural sources (the majority of identified pollution). As a result, Lake Taupo implemented the world's only non-point source

trading program for nitrogen. Other regional councils in New Zealand have followed suit to implement nitrogen policies of varying designs including Canterbury, Southland, and Horizons Regional Council.

### Water Use Policies

Water use including takes for irrigation and on-farm use are regulated under the Resource Management Act of 1991. As such, farms that want to use surface and groundwater in New Zealand are required to obtain a resource consent (permit) from their Regional Council. Water is allocated on a first come first serve basis. As a result, many farms have consents for water that they may not always use, but would "lose" if they didn't have a consent for its take. Resource consents are usually given for 5-35 years and typically re-evaluated at 5-15 years (New Zealand Parliament 2011). Since many farmers ask for water they may not always use, many rivers are "over-allocated" in New Zealand, meaning that more water has been given out through the consent process than is available for irrigation and farm purposes. Policymakers have to balance a mix of farmer needs with environmental needs for proper river flows and ecosystems.

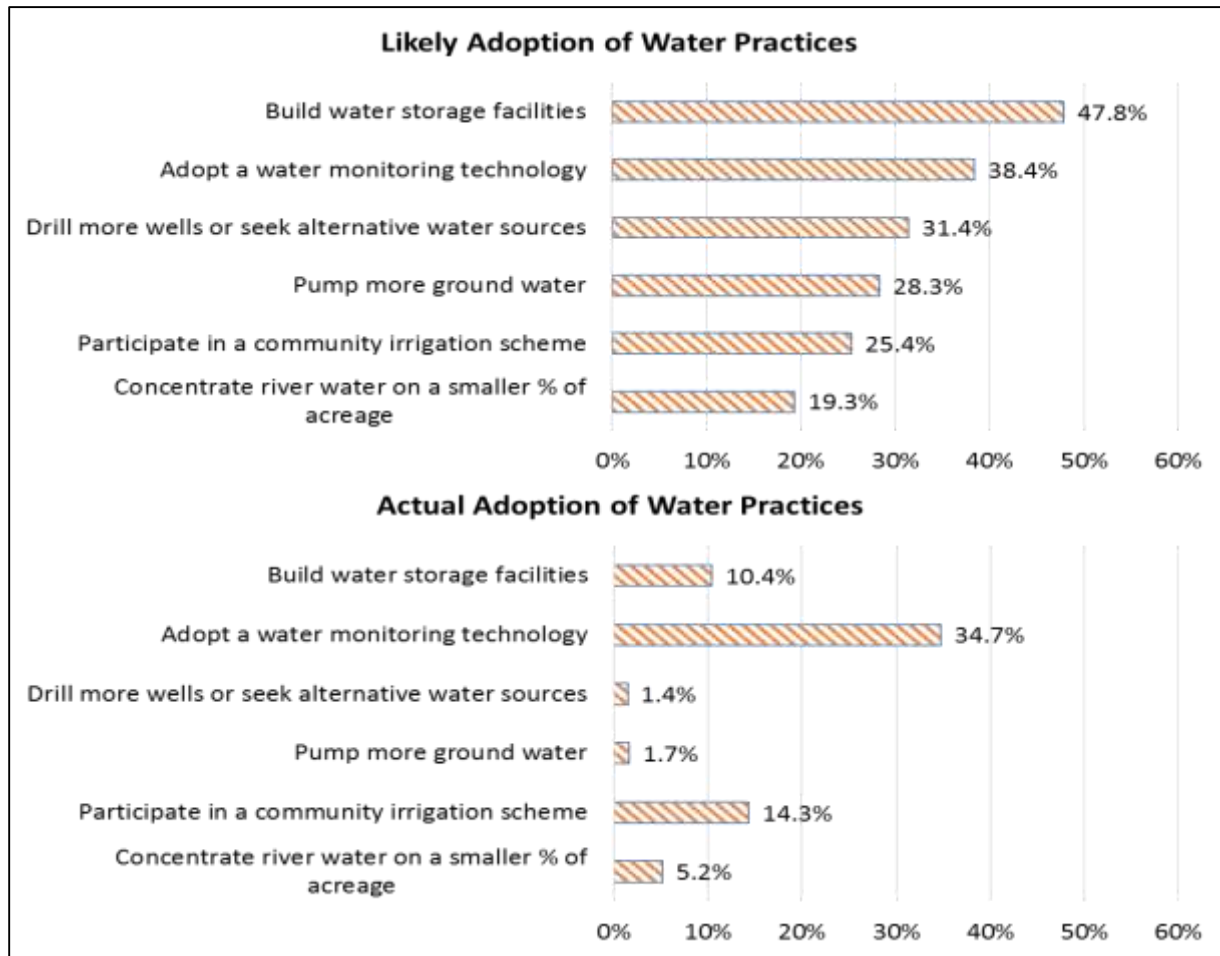


Figure 5. Actual and likely farmer adoption of water-related practices in New Zealand. Data reflects a survey (n=490) conducted in 2012 in Marlborough and Hawke’s Bay New Zealand. Figure adapted from Niles et al. 2015.

One recent development has been the increase in water storage in recent years. Water storage is seen by many farmers as an opportunity to expand their productive capacity on farm by enabling storage of water when it’s available (during times of high precipitation) that can be used at later times when water is limited. Water storage in New Zealand comes in varying sizes- ranging from large scale dams with significant impacts and investment such as the Ruataniwha Dam in Hawke’s Bay all the way down to on-farm small-scale storage tanks and ponds for individual farms. At least in some regions, data suggest that about 10% of New Zealand farmers have adopted water storage facilities with nearly 50% likely to do so in the future. Simultaneously, about 1/3 have adopted water monitoring technologies to help reduce water use with 38% likely to do so in the future (Niles et al. 2015) (Figure 5).

Community Irrigation Schemes are also another unique feature of many parts of New Zealand agriculture and water use. Irrigation in New Zealand dates back to the late 1800s in the Southern half of the South Island in which the government began financing irrigation schemes built upon the former infrastructure for mining. By 1935, 12 schemes had been built in this region and the government began expanding efforts elsewhere up until the 1970s. Government constructed schemes were concentrated on the South Island with 40 total and 9 in the North Island. Government motivation for building schemes were driven by goals of employment gains and Depression era economic development. Later



scheme development with government assistance was largely because of the fact that individual farmers couldn't afford the infrastructure to build schemes. More recently, CIS were seen as tools for agricultural intensification and economic development (Ministry of Works and Development 1987).

After New Zealand eliminated subsidies to farmers in the mid-1980s they also began to sell off their investments in CIS. In 1988, the central government began transferring ownership to farmers. Then, in 1991, under the nation's crowning environmental legislation- the Resource Management Act- the central government devolved responsibility for approving new CIS and monitoring and permitting water use of CIS to local regional councils. This de-centralized system means that today schemes are farmer owned, privately held, or in some combination of both, rather than central government owned (Irrigation New Zealand). Through Crown Irrigation, the government still plays a role in financing CIS in part with farmers and private industry. Community Irrigation Schemes are important for water use and water policy because if a farmer participates in a scheme, it is the scheme that receives a Resource Consent for water use and nutrient monitoring. Schemes then divvy up water and nutrient loads within their own individual farmers.

### **Price Policies**

New Zealand, unlike many other developed countries, has no agricultural price supports or major agricultural subsidies or insurance for its farmers. While these subsidies previously existed, the government restructured their farm support system in 1984, phasing out subsidies by the end of the decade. Today, there are no major sources of government funding for agricultural production- a fact that makes farmers very concerned about price and risk averse. As a result, many farmers try to minimize inputs, particularly livestock farmers, who often grow the majority of feed on their own farm.

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