

Economic Effects of Irrigation Water Pricing in New Zealand: An Analysis using the GTAP Model

Alex Kravchenko

University of Waikato

alexk@waikato.ac.nz

and

Anna Strutt

University of Waikato

astrutt@waikato.ac.nz

Abstract

The aim of this study is to analyse the effect of irrigation water pricing on the New Zealand economy using a modified version of the Global Trade Analysis Project (GTAP) model and database. The primary user of irrigation water in NZ is dairy, and since 95 percent of NZ dairy production is exported, analysis using a global general equilibrium model will contribute important insights.

While use of a global model brings significant benefits, a shortcoming of using GTAP for country-level analysis for analysis of issues such as water is the lack of regional specification within the country. Since regions of a country like New Zealand vary substantially in terms of what they produce and how much irrigated water is used, the impacts on different regions within the country may differ greatly. For example, the Auckland Region is the commercial capital, producing over a third of country's economic output, yet it produces only 2% of NZ dairy. To overcome this limitation, NZ is split into 15 regions. In the absence of the availability of detailed input-output data for regions within New Zealand, we use regional product as weights when undertaking the regional splits.

To examine the effects of irrigation water pricing, the GTAP model is further modified by splitting the land endowment into irrigated and non-irrigated for each newly region. This, again, is highly unevenly distributed: the Waikato Region is the largest single dairy producing region in the country (producing 24 percent of all dairy), but it includes less than 3 percent of all irrigated land in NZ. By contrast, the Canterbury Region comprises over 60 percent of all irrigated land in New Zealand, but produces only 18 percent of the country's dairy output. This model modification follows the approach of Calzadilla et al (2011) as used in the creation of the GTAP-Water (GTAP-W) model, however, in our work this is only implemented for the newly created sub-regions of New Zealand rather than for the whole world.

This approach allows in-depth analysis of the impact of freshwater management policies in New Zealand that will affect the price of water with particularly important outcomes for the dairy industry, including on exports to international markets.

1. INTRODUCTION

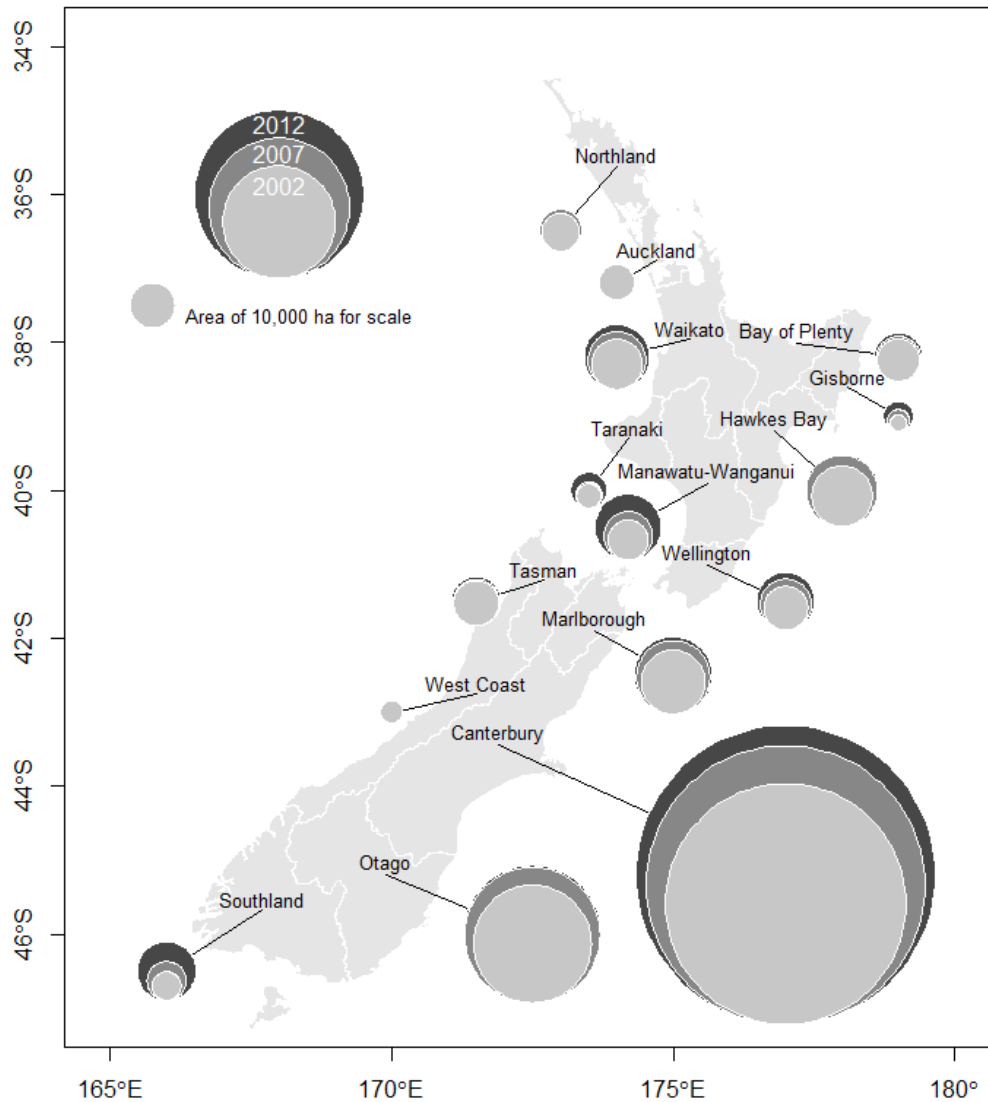
New Zealand has one of the world's highest renewable freshwater resources per capita (World Bank, 2014). The problem, however, is that most of this water needs to be maintained within freshwater bodies for the purposes of ecological, recreational and cultural values (Land and Water Forum, 2010). The portion that is available for abstraction in many catchments is nearly (or indeed, already) passed the level that is legally allowed to be allocated. The current freshwater abstraction consent allocation mechanism is in effect on a first come first served basis: whoever initially obtained this resource essentially blocks out subsequent users from gaining access to it. Indeed, cases of regional authorities denying new resource consents abound (see, for example, Williams (2009), Littlewood (2011), and Hutching (2014)).

There are no legal ways of trading water rights,¹ and apart from the nominal consent application fee, there is no cost applied to water. At the same time, freshwater availability is very seasonal (highly dependent on rain); it is lowest during the months of summer when the demand is at its peak. It is not uncommon for regional councils (in charge of managing water resources) to institute partial or even full bans on water withdrawals during the driest periods.

While only 5% of New Zealand's agricultural land was irrigable in 2012 (as opposed to the world average of approximately 20%), irrigable land area increased by over 50% between 2002 and 2012 (Statistics NZ, 2012). Over 80% of irrigable land is in New Zealand's South Island, with Canterbury alone comprising 62% of New Zealand's irrigable land (see

¹ Water rights are inseparable from land ownership, except in private irrigation schemes where trade is possible.

Figure 1 below).



Data sources for the figure: Statistics NZ, 2002, 2007, 2012

Figure 1. Irrigable Land by Region 2002 to 2012

Agriculture is responsible for vast majority of consumptive freshwater use: of approximately 20,000 freshwater consented takes in 2010, 75% of them are for irrigation, with a further 6% for stock watering (Aqualinc Research, 2010). In addition, what is classified as “drinking” or “municipal” water intakes (8% of all consents) sometimes ends up being used for commercial irrigation as well (up to 50% in some instances). In terms of volumes of water, in 2010 78% of weekly

consumption allocation went to irrigation. Animal husbandry is the dominant sector of New Zealand's land use, utilising 97% of New Zealand farmland and 86% of irrigable land (see Table 1 below).

Table 1. 2012: Largest Farmland Users - Total and Irrigable

Land Use	Total Land	Irrigable Land
<i>Sheep Farming (Specialised) *</i>	34.4%	11.4%
<i>Sheep-Beef Cattle Farming *</i>	30.3%	3.9%
<i>Dairy Cattle Farming *</i>	17.7%	48.8%
<i>Beef Cattle Farming (Specialised) *</i>	9.3%	6.6%
<i>Deer Farming *</i>	2.2%	1.3%
<i>Grain-Sheep or Grain-Beef Cattle Farming *</i>	0.8%	5.1%
Other Crop Growing n.e.c.	1.1%	2.2%
Forestry	1.0%	0.0%
Other Grain Growing	0.7%	6.6%
Vegetable Growing (Outdoors)	0.3%	4.6%
Grape Growing	0.2%	4.2%
Apple and Pear Growing	0.0%	1.2%
Other	2.0%	4.1%

Data source: Statistics NZ, 2012

* demarks animal husbandry sectors.

1.1. Motivation

Although not currently in the legislative pipeline, establishing water markets, similar to the model of the Australian Murray Darling Basin, could potentially alleviate inefficiencies arising from demand management through bans in times of droughts and the aforementioned first-come-first-served principle of consent allocation. The first-best method of volumetric pricing and market-based allocation and reallocation have been long recognized as an optimal outcome for the New Zealand water management (Agriculture NZ, 2001; Sinclair Knight Merz, 2006). These outcomes, however, are generally viewed as politically impractical and impossible to implement

under the current legislative framework (water rights being inseparable from land rights which, in turn, are owned by the Crown or/and local iwi²). Nevertheless, even the latest taskforce charged with looking into the issues, Land and Water Forum [LAWF], explicitly stated that “price based or economic instruments can incentivise desired behaviours or create disincentives through price and market mechanisms” and should instead of the current first-come-first-served method where there is water scarcity (Land and Water Forum, 2010; Land and Water Forum, 2012).

In this study, we build a model which simulates the economy with water-pricing imposed, to study the impacts including flow-on effects from irrigated farms to the rest the economy. We introduce water as an explicit factor of production for the New Zealand economy within the Global Trade Analysis Project (GTAP) computable general equilibrium (CGE) model. We also split the New Zealand economy into a number of sub-regions.

The structure of this paper is as follows. First, we present a brief overview of water-related literature using CGE methodology. We then outline the procedure for splitting the GTAP database into regions within New Zealand, followed by the procedure to introduce water as an explicit factor of production. Following model modification, we are able to obtain shadow price of irrigation water. We are then able to introduce constraints to water availability, contrast the scenarios with and without water trade and examine the effect of water pricing. We then analyse our results before making some tentative conclusions.

² Iwi is roughly translated as “tribe” from Maori. According to the Treaty of Waitangi, 1840, the ownership of water resources is an inherent right of the local iwi.

Works Cited

- Agriculture NZ. (2001). *Economic Efficiency of Water Allocation: MAF Technical Paper*.
- Aqualinc Research. (2010, October). *Update of Water Allocation Data and Estimate of Actual Water Use of Consented Takes 2009-10*. Retrieved May 5, 2011, from Ministry for the Environment: <http://www.mfe.govt.nz/publications/water/water-allocation-2009-10/update-of-water-allocation-data-and-estimate-of-actual-water-use-of-consented-takes.pdf>
- Hutching, C. (2014, July 23). *Ngai Tahu denied giant dairy farm*. Retrieved 2014, from National Business Review: <http://www.nbr.co.nz/article/ngai-tahu-denied-giant-dairy-farm-ch-159592>
- Land and Water Forum. (2010, September). *Report of the Land and Water Forum: A Fresh Start for Fresh Water*. Retrieved October 29, 2010, from Land and Water Forum: www.landandwater.org.nz/land_and_water_forum_report.pdf
- Land and Water Forum. (2012). *Third Report of Land and Water Forum: Managing Water Quality and Allocating Water*.
- Littlewood, M. (2011, July 05). *Dairies denied river consent*. Retrieved 2014, from The Timaru Herald: <http://www.stuff.co.nz/timaru-herald/news/5232330/Dairies-denied-river-consent>
- Littlewood, M. (2011, November 24). *Dairy water plans denied*. Retrieved 2014, from The Timaru Herald: <http://www.stuff.co.nz/timaru-herald/news/6023682/Dairy-water-plans-denied>
- Sinclair Knight Merz. (2006). *Options to Improve Water Allocation Outcomes*.
- Statistics NZ. (2012, June 30). *2012 Agricultural Census tables*. Retrieved April 1, 2015, from Statistics New Zealand: http://www.stats.govt.nz/browse_for_stats/industry_sectors/agriculture-horticulture-forestry/2012-agricultural-census-tables/land-use.aspx
- Stats NZ. (2004, December 15). *Hectares Used and Farms by Land Use by Region*. Retrieved May 15, 2013, from Statistics New Zealand: http://www.stats.govt.nz/browse_for_stats/industry_sectors/agriculture-horticulture-forestry/2002-agricultural-census-tables/~media/Statistics/browse-categories/industry-sectors/agriculture-horticulture-forestry/census-tables-2002/1-land-farm.xls
- Stats NZ. (2007, June 30). *Irrigable Land by Region and Type*. Retrieved May 1, 2010, from NZ Statistics: http://www.stats.govt.nz/methods_and_services/access-data/tables/2007-agricultural-census-tables/~media/Statistics/Methods%20and%20Services/Tables/2007-agriculture-census/land%20treatments/7agprod-irrigable-land-by-region07.ashx
- Williams, D. (2009, February 13). *Water consent denied in South Canterbury - hallelujah*. Retrieved 2014, from Greens - Green Party of Aoteroa New Zealand:

<https://home.greens.org.nz/factsheets/water-consent-denied-south-canterbury-hallelujah-0>

World Bank. (2014). *Renewable internal freshwater resources per capita (cubic meters)*.

Retrieved April 8, 2015, from World Bank Data Bank:

http://data.worldbank.org/indicator/ER.H2O.INTR.PC?order=wbapi_data_value_2013+wbapi_data_value+wbapi_data_value-last&sort=desc