

The Economic Impact of Water Scarcity From Climate Change in an International River Basin Context

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Introduction

This paper examines the economic impacts of increasing frequency of water scarcity due to climate change in The Netherlands. We use a General Equilibrium (GE) methodology to model the impacts on the economy as a whole, focusing on the response of market mechanisms, instead of existing partial, sectorial approaches.

For this purpose a (CGE) Computable General Equilibrium model is used called GTAP-W¹ (an extension of the GTAP² model with irrigation water explicitly included). GTAP-W is calibrated to data on agricultural production losses due to water scarcity³.

GTAP-W is then used to capture both the direct and indirect losses due to water scarcity on the economic sectors as the economy (re)adjusts to changing external circumstances which is then compared to the losses without general equilibrium (GE) adjustment. To the best of our knowledge this is the first paper examining the economic impacts of water scarcity to assess the importance of market feedbacks by directly comparing the results of a CGE to the results of a model that assumes no market feedbacks.⁴



The Rhine-Meuse river basin: www.riverbasin.org

Irrigation water scarcity in the Netherlands

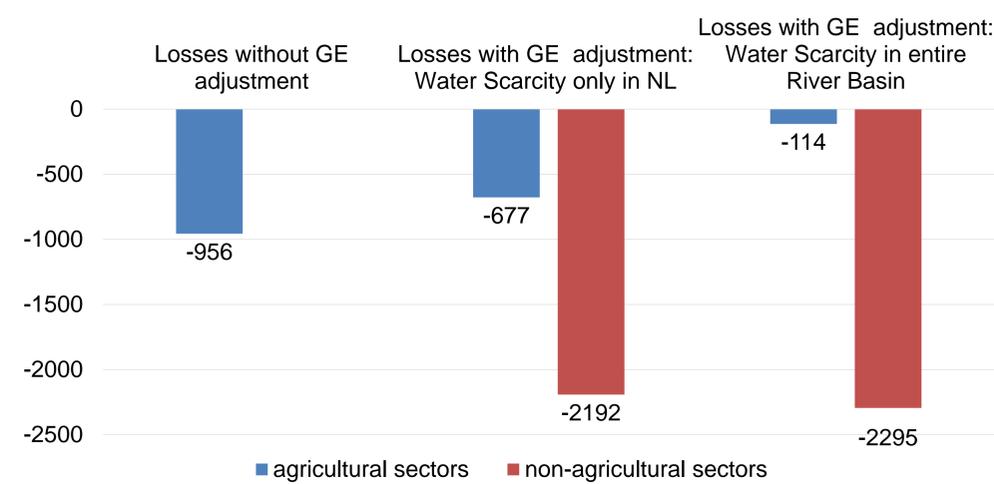
We focus on The Netherlands, a delta country that shares its two main water sources, the Rhine and the Meuse rivers, with its neighbors Germany, Belgium and France. We use information provided by Deltares³ on the direct losses to agricultural production from water scarcity from a single extremely dry year⁵ and we implement the same conditions in GTAP-W creating the scenario where this same scarcity conditions would become the expected norm over a 2 to 5 year period.

Results: Percent loss to the value of Dutch agriculture in per cropping activity

	Losses without GE adjustment ³	Losses with GE adjustment: Water Scarcity in NL only	Losses with GE adjustment Water Scarcity in entire River Basin
Wheat	-13.3	-10.9	-5.2
Cereal Crops	-13.3	-3.3	-0.9
Veg & Fruits	-8.7	-2.3	-0.2
Oil Seeds	-13.3	-2.4	-1.7
Sugar Beet	-26.2	2.2	3.0
Other Agr.	-7.0	-4.8	-0.3
Total	-8.3	-3.8	-0.2

Results: total economic losses for the Dutch economy

Loss in Million \$U.S. to the Dutch economy from water scarcity



GE = General Equilibrium; NL = Netherlands;
River basin countries = The Netherlands, Germany, France, and Belgium.

Conclusions

- Agricultural producers are compensated for loss of product by rising prices
- Total agricultural losses drop to 70 percent of direct losses when market feedbacks are considered. This drops to 12 percent when water scarcity is assumed to affect the other countries in the river basin as well.
- The total loss of economic output is slightly less in the Netherlands when the entire river basin is affected by drought compared to the scenario when only the Netherlands is affected.
- The losses to the non-agricultural sectors are 3 times as large as those to the agricultural sectors when only the Netherlands is affected by water scarcity, when entire river basin is affected the losses become 20 times as large

Results and Discussion

Market feedbacks respond to reduced supply of agricultural products with rising prices which partially compensate agricultural producers. This effect is increased appreciably when water scarcity affects the neighboring countries as well as even more supply is removed from the market. Different Dutch agricultural activities respond differently to similar water scarcity and agronomic conditions depending on market conditions. This is particularly visible in the response of sugar beets, as well as by comparing the response of cereal crops to wheat.

Non-agricultural sectors are not directly affected by water scarcity in the model yet as the graph to the left shows they are indirectly affected as consumers spend more income on agricultural products and agricultural producers purchase less intermediate inputs. Agriculture in the Netherlands is less than 1 percent of Dutch economic output so the losses of the non-agricultural sectors are very small compared with total economic output, nevertheless they make up the lion's share of total economic losses.

References

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