An Economic Analysis of Water Infrastructure Investments, Agricultural Productivity and Climate Change in the Mekong Delta: Adapting to Increased Salinity and Sea Level Rise

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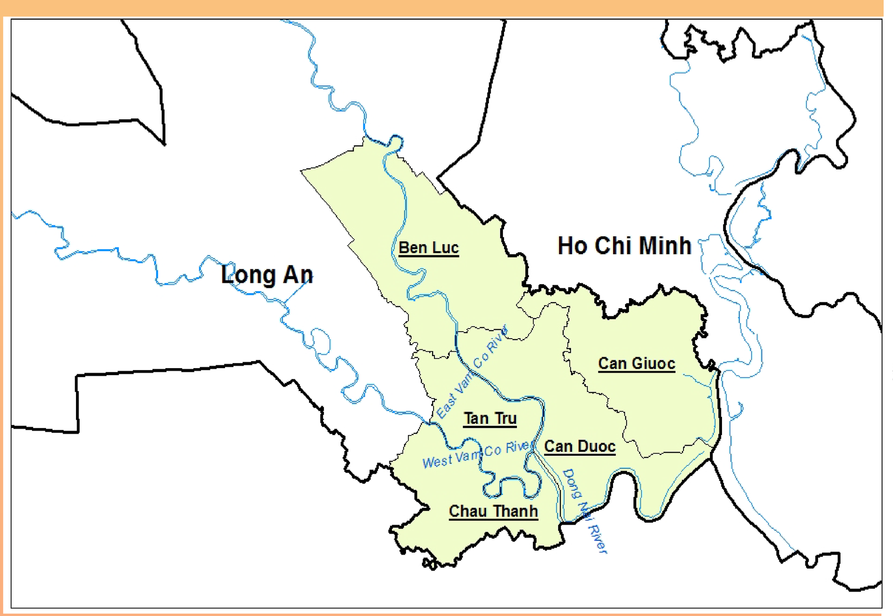
Introduction

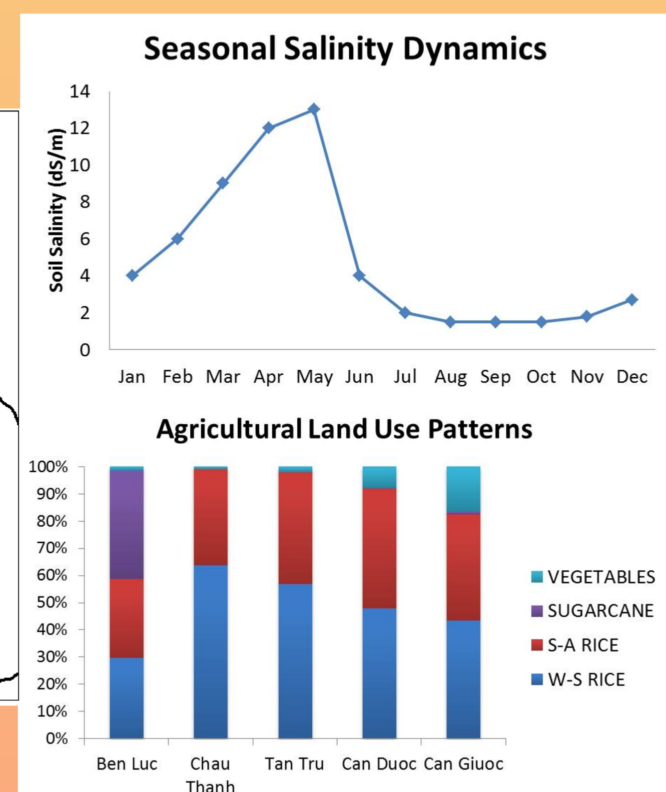
Agriculture production in the Mekong delta is currently constrained by salinity intrusion in the dry season.

Climate change will most likely increase salinity concentration levels in the dry season due to a combination of higher sea level and lower upstream river flows (Dung, 2010).

Adapting to increased salinity may involve changing cropping patterns, constructing new water infrastructure or abandoning land.

We analyze the economics of adapting agriculture to increased salinity in the coastal districts of Long An province of the Mekong Delta.





Research Questions

The study attempts to address the following questions:

- How can agricultural production and cropping patterns adapt to increased salinity from an agro-economic point of view?
- What is the interplay between adjustments in cropping patterns and infrastructure investments such as sluice gates?
- What is the optimal timing to build sluice gates to keep saltwater out of the rivers under different climate change scenarios?
- Where should sluice gates be located to control increased salinity given the additional costs associated with building closer to the sea?

Photo taken from World Bank (2009), Vietnam Policy Brief

Photo courtesy of stock photo: http://www.123rf.com/photo_4025654_vegetable-field-workers.html

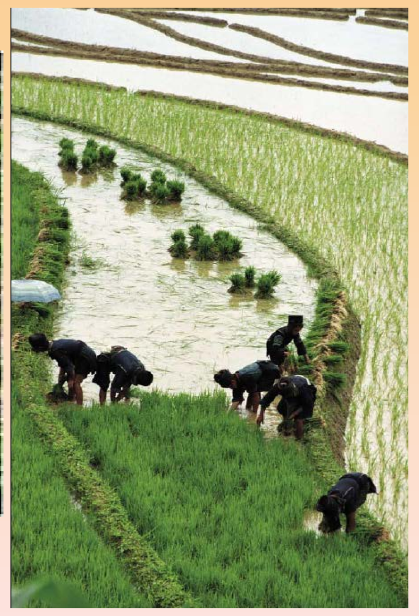
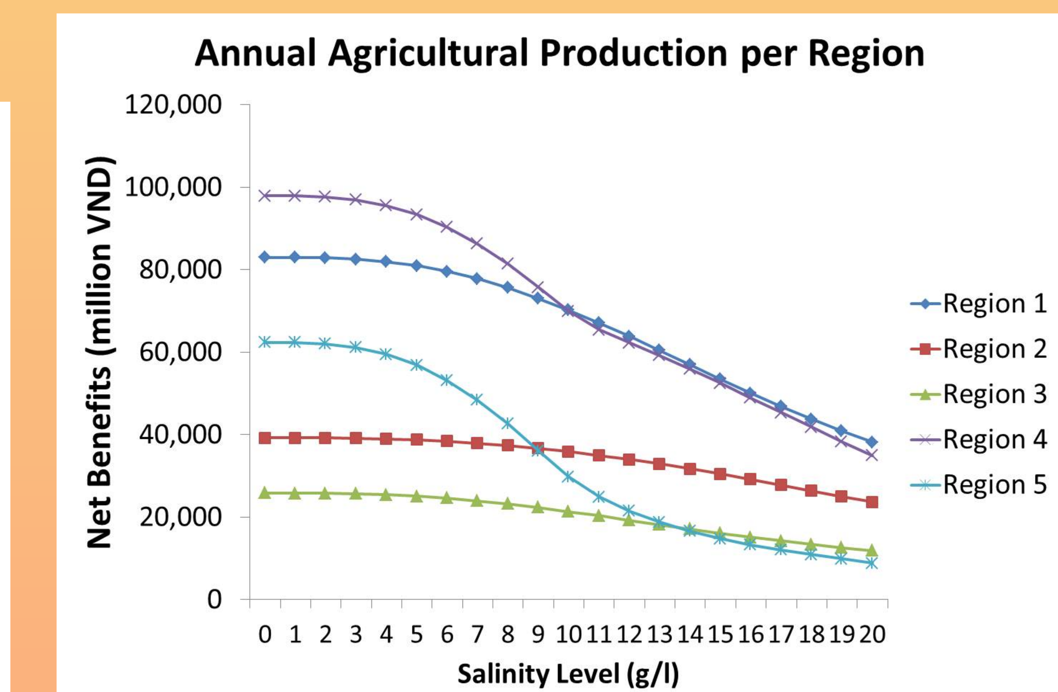


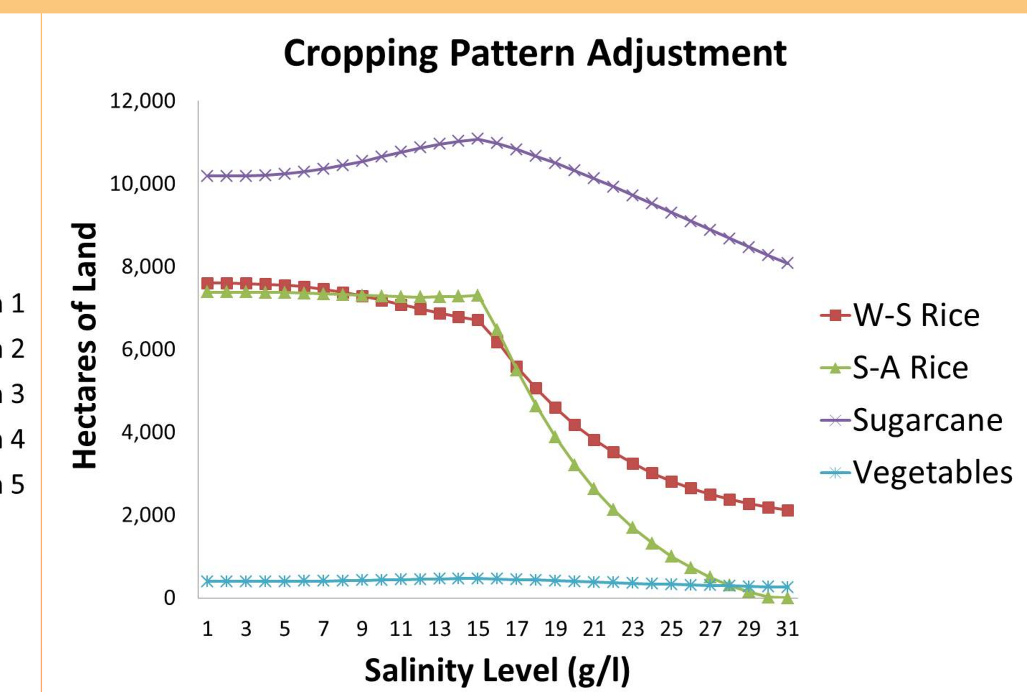
Photo taken from World Bank (2007), Accelerating Rural Development in Vietnam

Agriculture Production: Model and Results

A mathematical programming model of regional agricultural production is constructed to study the economic consequences of increased salinity. Model structure and calibration is similar to Howitt (1995) and includes salinity impacts on crop yields from Van Genuchten and Hoffman (1984).

Simulations of increased salinity levels suggest that agriculture production losses follow a non-linear pattern. From an economic point of view, production can adapt by switching from low value-low salt tolerant crops such as rice to high value-high tolerant crops such as sugarcane or vegetables for a certain range of salinity levels.

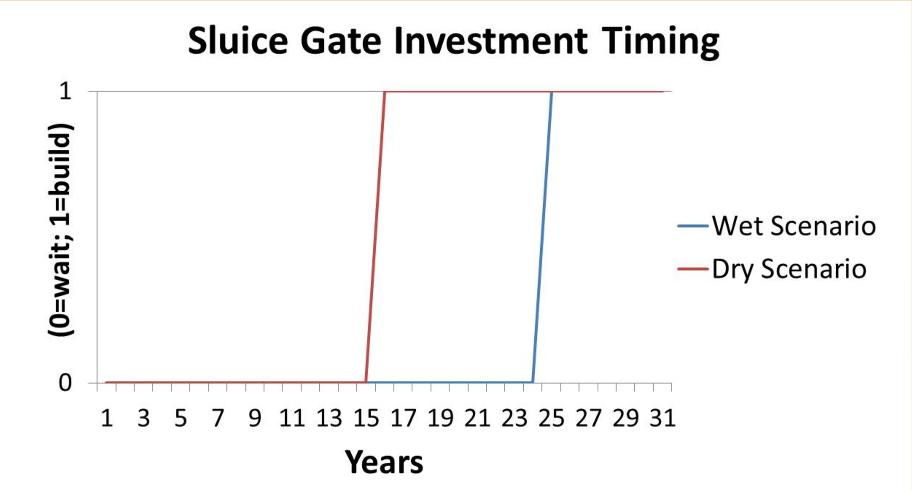


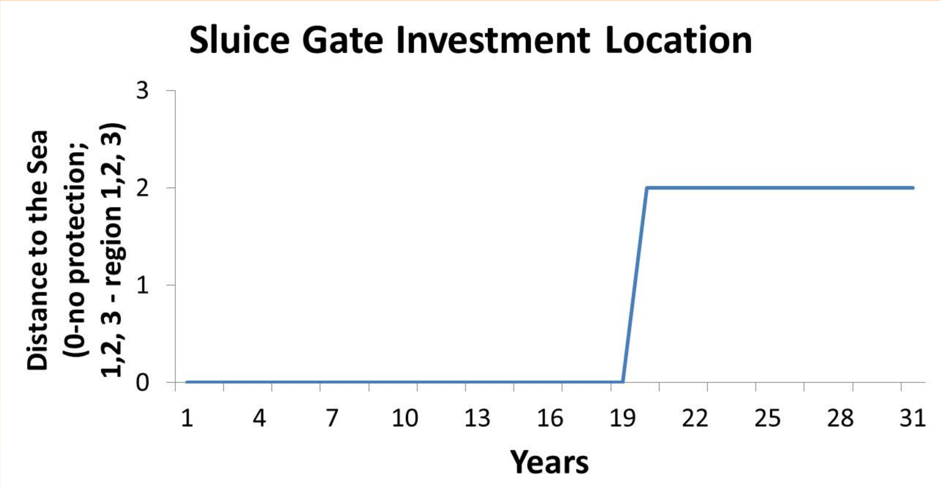


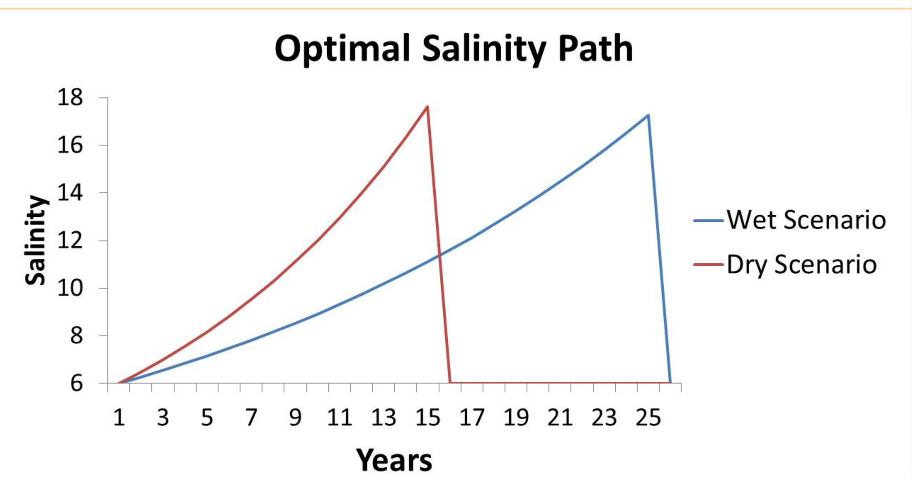
Water Infrastructure: Model and Results

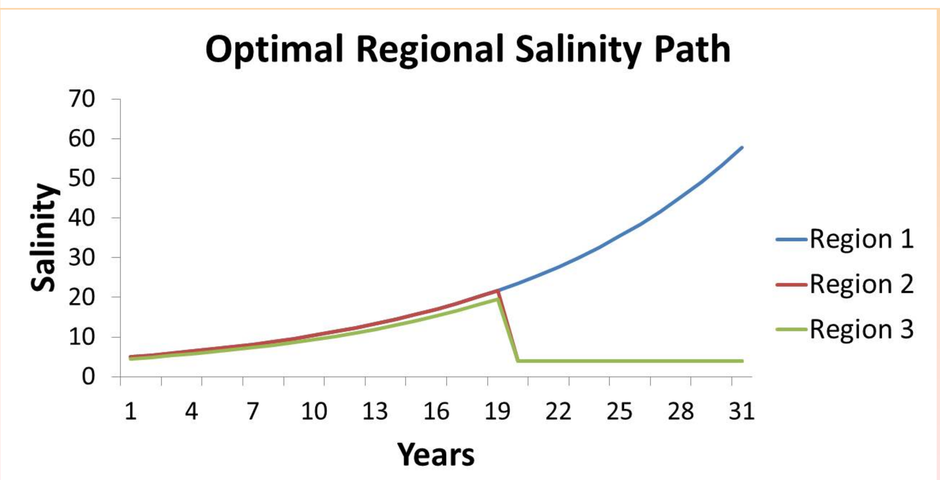
A dynamic programming model of infrastructure investment is used to evaluate the timing and location of sluice gate construction in the delta. The model maximizes the net present value of agricultural land having salinity as state variable and sluice gate construction and operation (Nguyen, 2009) as a control variable. Simulation results suggest that:

- Optimal sluice gate construction happens earlier under a scenario where salinity levels increase faster (dry scenario).
- It is not economically viable to protect areas that are too close to the sea given their lower productivity and higher protection cost.









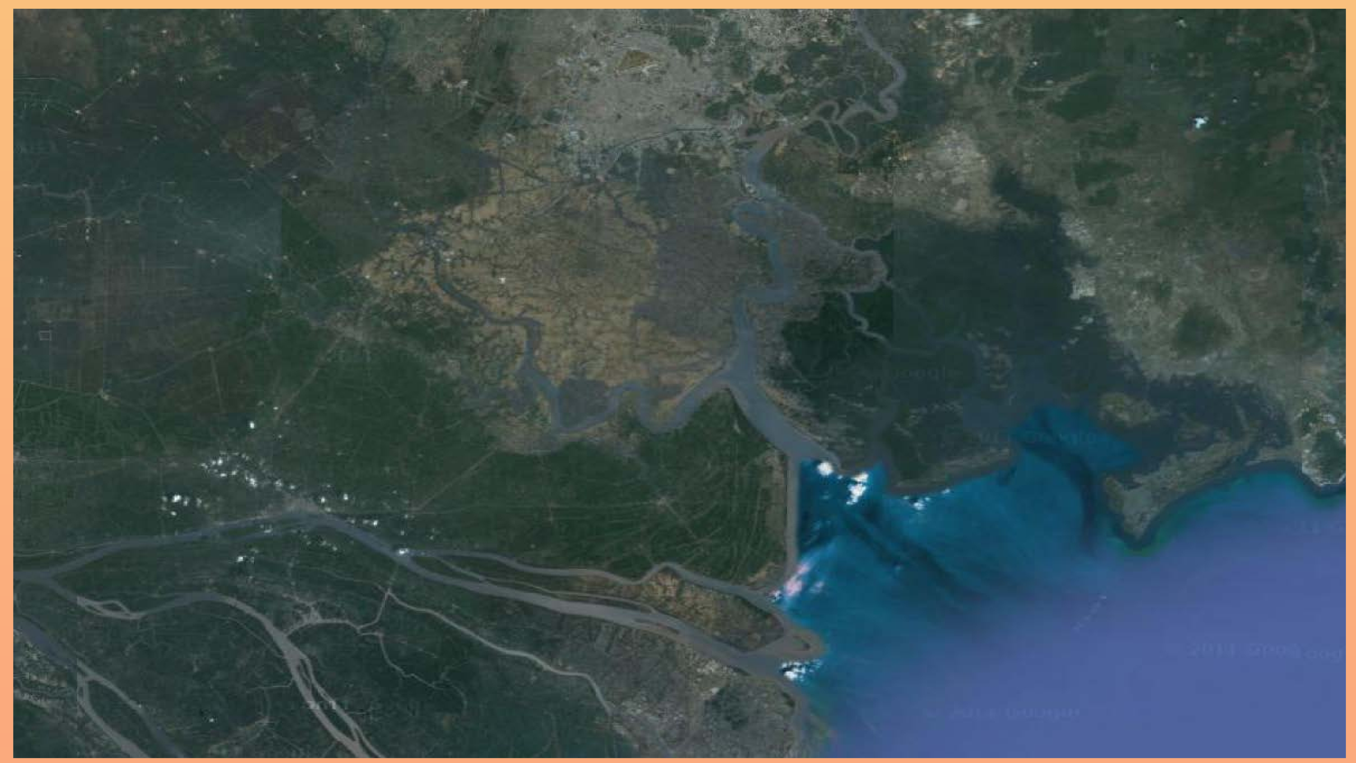
Conclusions and Discussion

Economic analysis of agricultural adaptation to increased salinity in the Mekong Delta suggest the following:

- Productivity losses can be alleviated by shifting to high value and more salt-resistant crops.
- The timing of investment in infrastructure depends on the rate of increase in salinity levels.
- There is a tradeoff between protecting upstream areas versus areas that are closer to the sea.

The current analysis can be extended as follows:

- Improve the characterization of available agricultural technology such as new rice varieties or shrimp farming.
- Incorporate the possibility of upstream reservoir operations that release freshwater and decrease salinity concentration.



Satellite image obtained from Google Maps™ on May 2nd 2011

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FURTHER INFORMATION

Please contact dcorderi@primal.ucdavis.edu for more information. The views expressed are those of the authors, all errors are our own. Results are preliminary, do not cite without permission.

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