Optimizing Pollution Tax Policies in Rural China

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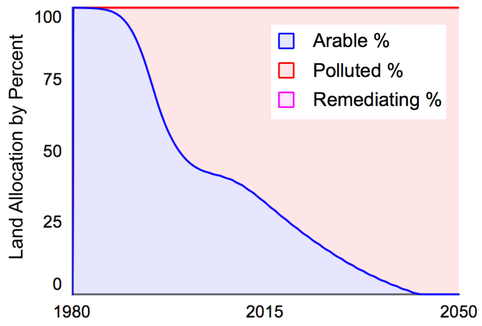
Context

- Through tax benefits and lax environmental standards, local governments incentivize the building of factories to grow their economy[1,2,3,4]
- The resulting factory pollution contaminates land via wastewater[3,5,6]
- Polluted land becomes infertile and uninhabitable, killing residents and the local farming industry[1,5,7]

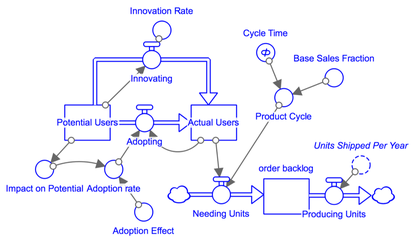
What is the most effective intervention to reduce pollution while maintaining economic growth?

Base Case



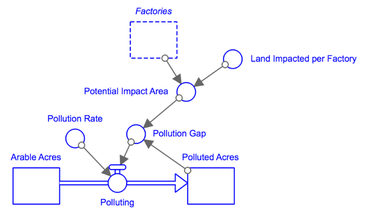
- Using historical smartphone sales[8], we generated demand for a hypothetical smartphone product
- We developed a supply chain in a fictitious village to fulfill the demand, and modeled the resultant pollution's effect on the land

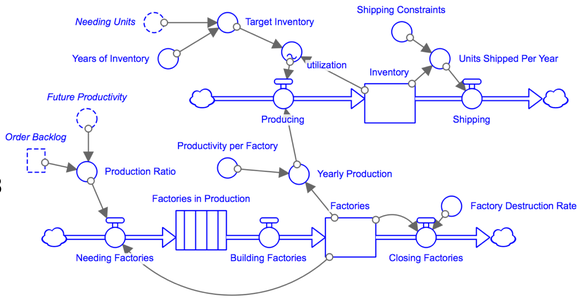
Modeling Approach



1. Generate smartphone demand growth to equilibrium with oscillations using a Bass Diffusion Curve[8] and a sinusoidal product cycle

2. Create supply chain dynamics using stock-generated flows focusing on factory building and inventory management

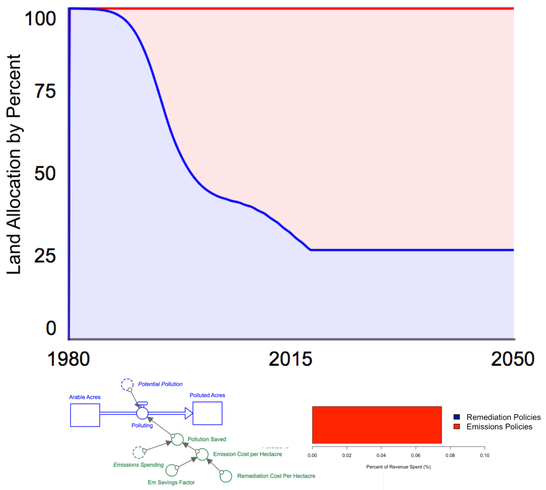




3. Model pollution on the land with main chain of arable and polluted land driven by a stock adjustment process

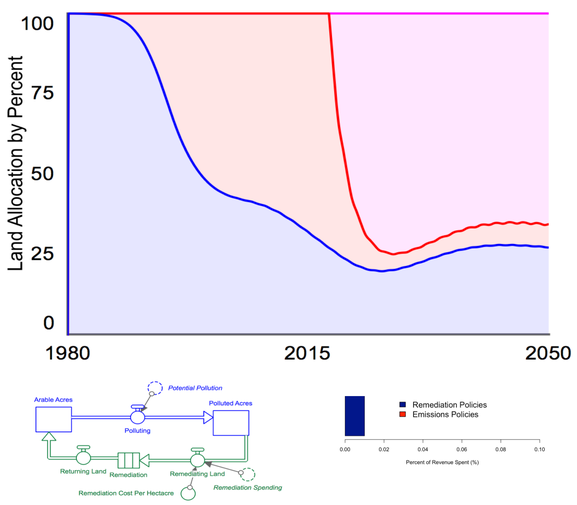
Emission Policies Only Halt Further Pollution

Scenario A: In 2018 a pollution tax is 100% allocated toward Emission Reduction Policies



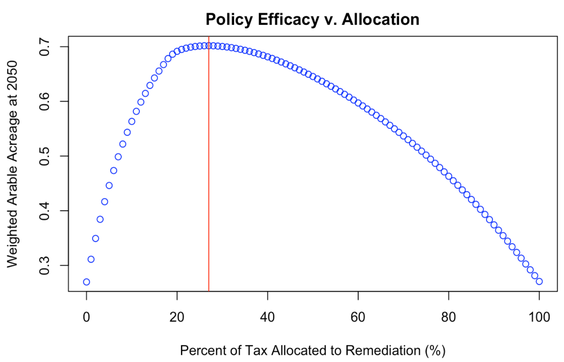
Remediated Land Quickly Repolluted

Scenario B: In 2018 a pollution tax is 100% allocated toward Remediation Policies



Optimizing Policy Combination

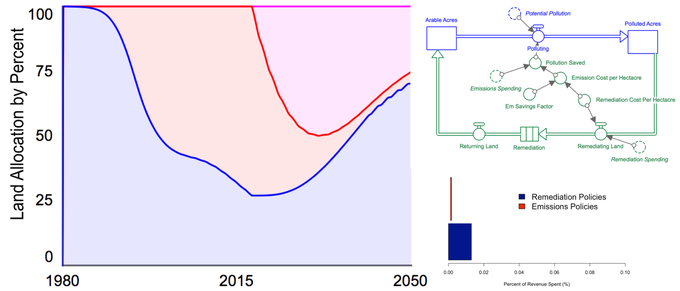
Test: Maximize arable acres with minimal tax cost by testing different combinations of spending on Remediation Policies v. Emission Reduction Policies beginning in 2018



$$\text{Weighted Arable Acreage} = (\%\ \text{Arable}) \frac{\text{Revenue - Taxes}}{\text{Revenue}}$$

Optimal Tax Policy

Scenario C: In 2018 a pollution tax is 28% allocated toward Remediation Policies and 72% toward Emission Reduction Policies



Conclusions

- Instituting a single-focused pollution policy is neither effective nor cost-efficient
- Most hybrid policies that both halt further pollution and fix polluted land are stable long-term solutions
- Further research into precise remediation and emission reduction costs would enable us to remove assumptions and further fine-tune the optimal policy balance

References and Acknowledgments

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