

An aerial photograph of a mountain valley. In the foreground, a winding dirt road curves through a lush, green forested slope. In the middle ground, a small town with several buildings is nestled in a valley. The background features rugged, brownish mountains under a clear blue sky with a few wispy clouds.

# **INCORPORATING MULTIPLE BENEFITS IN WATERSHED MANAGEMENT PROGRAMS**

## **Example of Colombia**

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In collaboration with Justus Raeppe, Jorge León, Mauricio Echeverry, Carolina Aguirre  
(The Nature Conservancy)

**natural  
capital  
PROJECT**

# OVERARCHING QUESTIONS

Can investments in watershed management help Colombia reach its sustainable development goals?  
→ SDG 6 (access to water and sanitation for all)



How does a cooperative (multi-objective) approach compare to a single-sector approach in terms of return-on-investment?

*Watersheds that currently or could potentially provide surface water supply to cities with population > 100,000 people. Source: Beyond the Source report, TNC.*

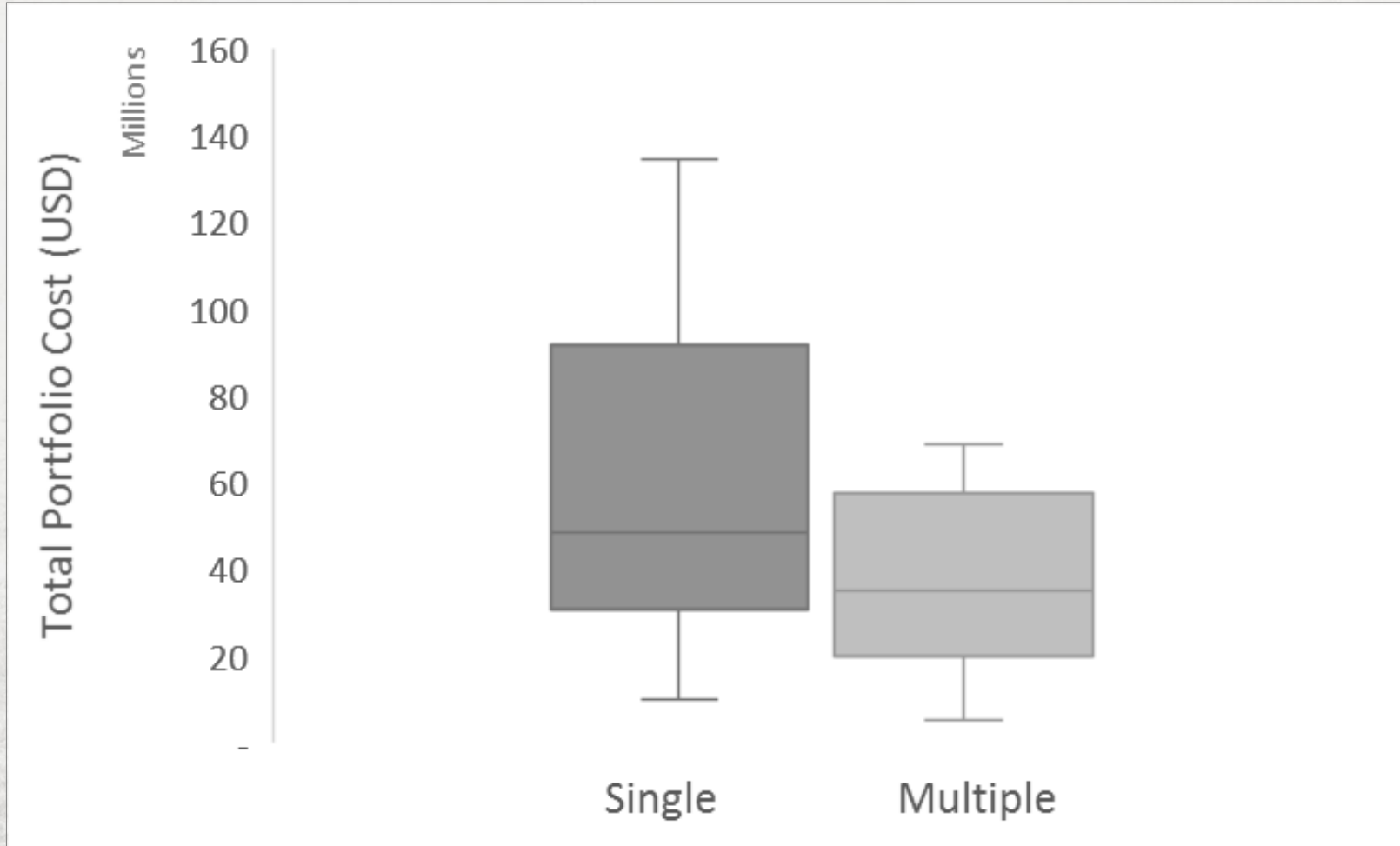
Source watershed areas by percent overlap



Low overlap

High overlap

# INTEGRATED WATERSHED MANAGEMENT IS COST-EFFECTIVE



# APPROACH USED IN COLOMBIA

# STUDY AREAS

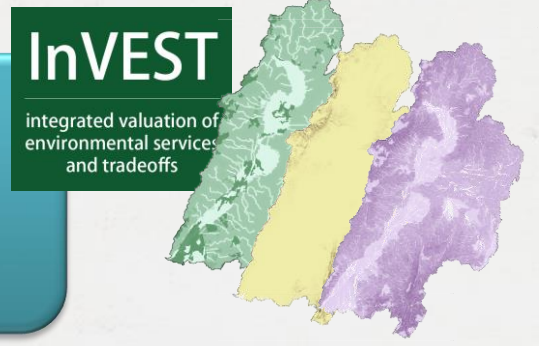
Drinking water source  
watersheds

Cities > 500,000 population\*

\*Barranquilla excluded



# OUR APPROACH



**Nutrient, Sediment, Carbon**

Impacts of activities in different places



Costs and benefits by decision unit



Maximize multiple services & Minimize cost

- Optimize for  
↓ 10% N, sed  
↑ 10% carbon

- avoid 17% of future losses to services from land degradation

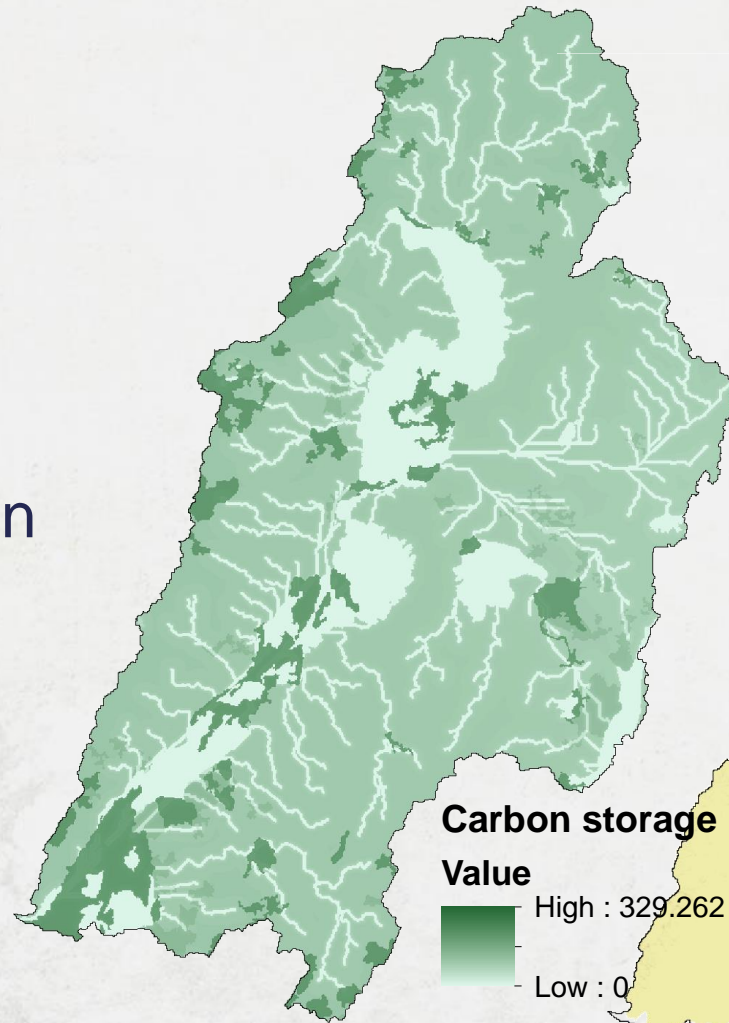


Estimate Co-benefits

# IMPACT OF ACTIVITIES ON SERVICES

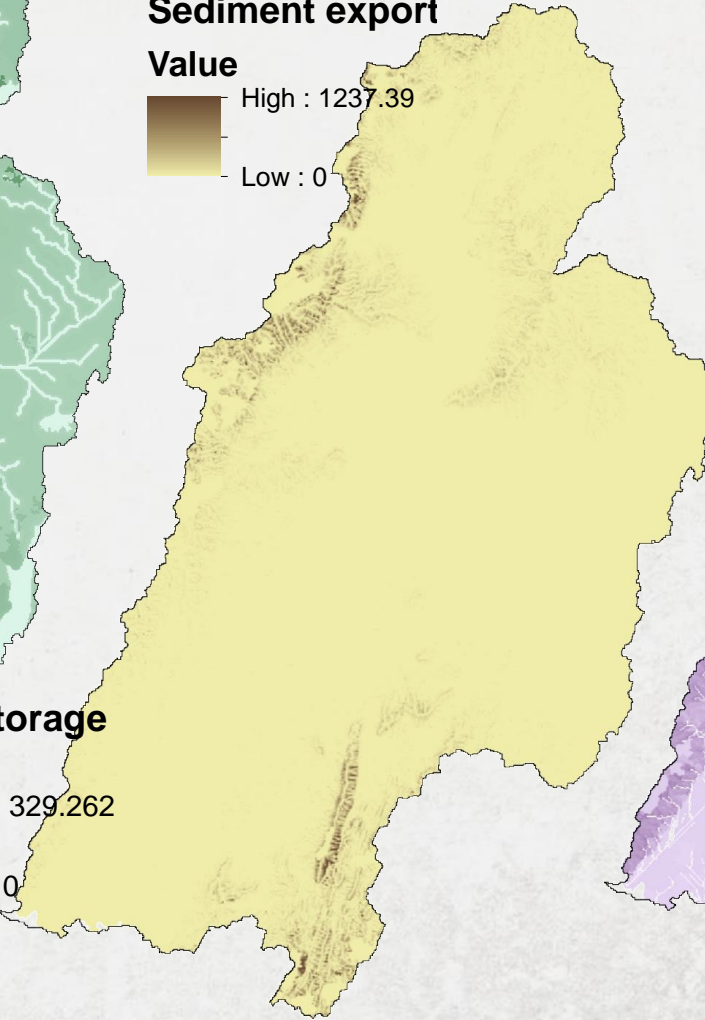
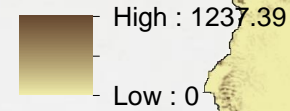
Activities:  
forest/páramo  
protection  
forest restoration,  
agricultural best  
practices,  
riparian restoration

RESTORATION  
RESULTS:



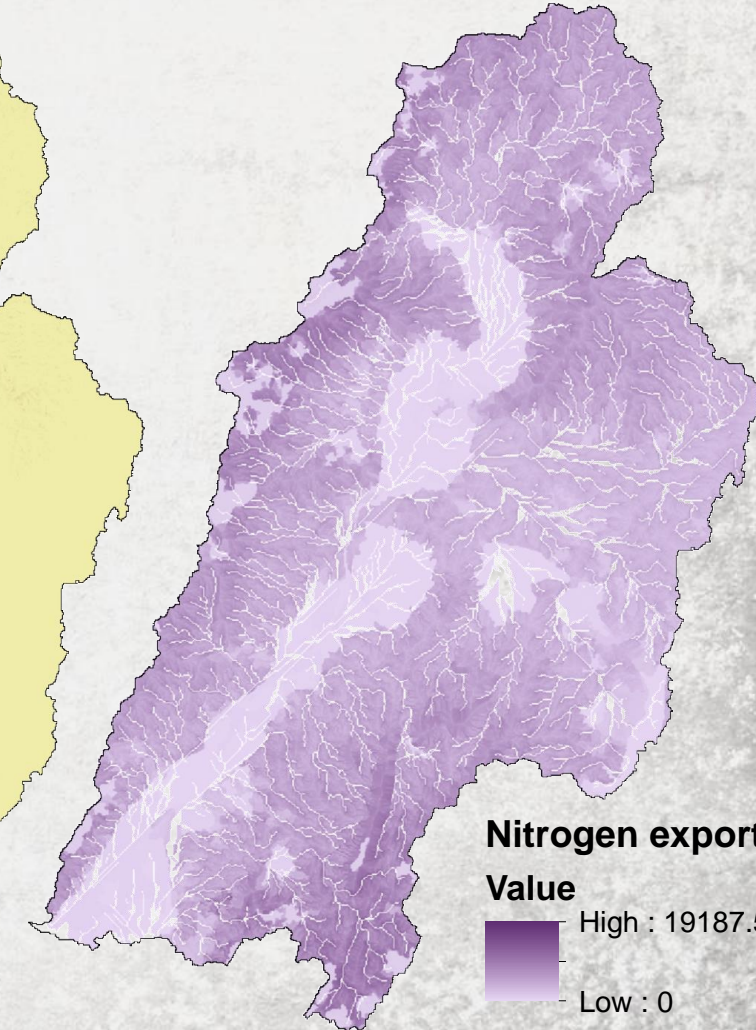
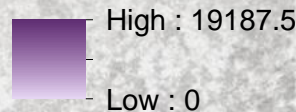
## Sediment export

Value



## Nitrogen export

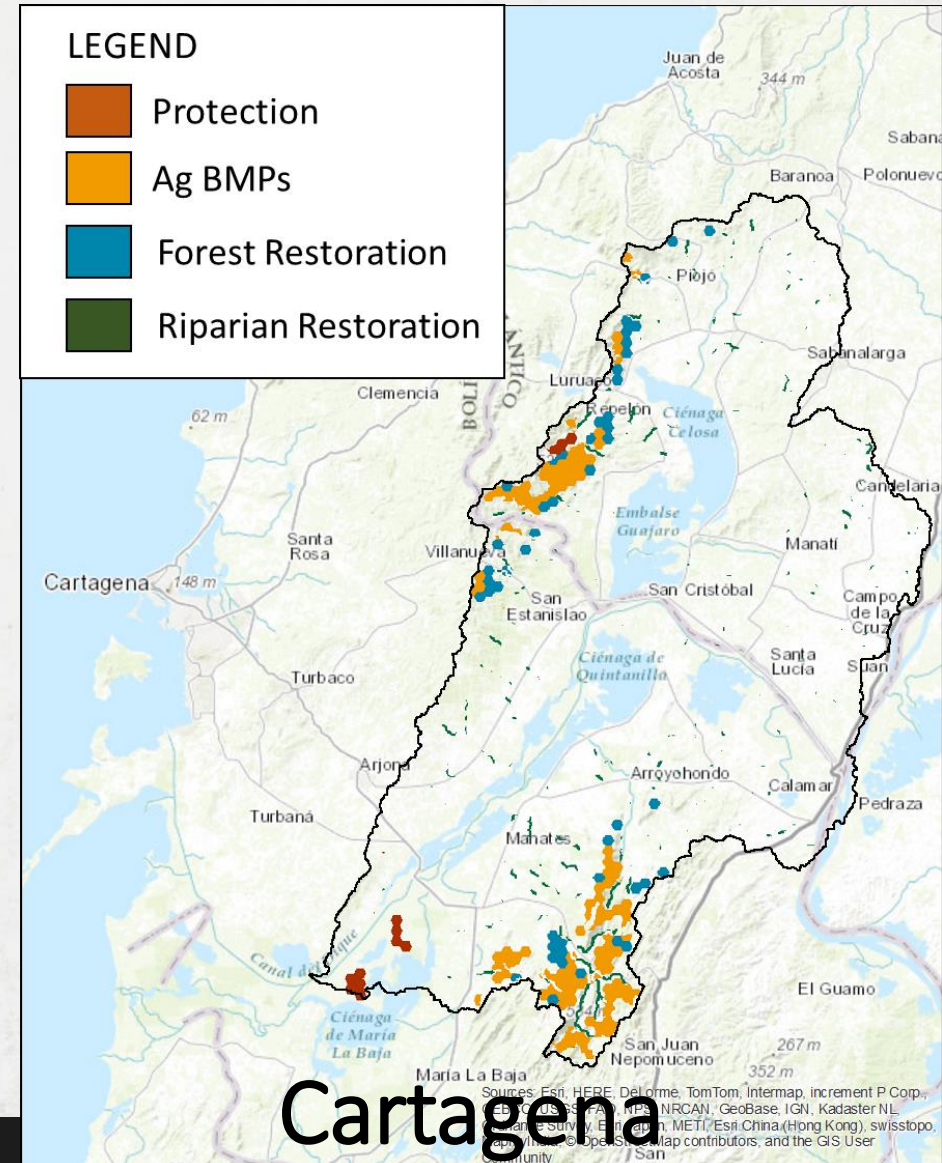
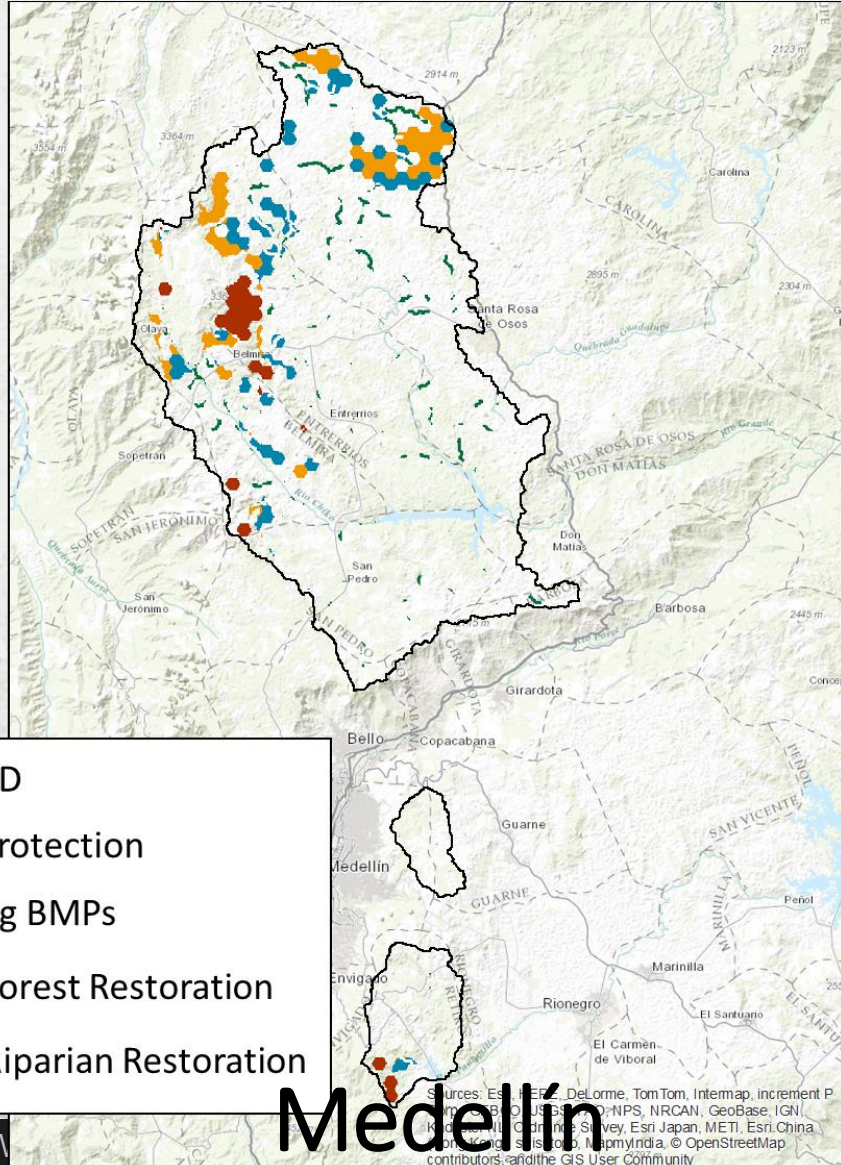
Value



# OPTIMAL SCENARIOS

Cost = 26.5 M USD

Cost = 43.3 M USD





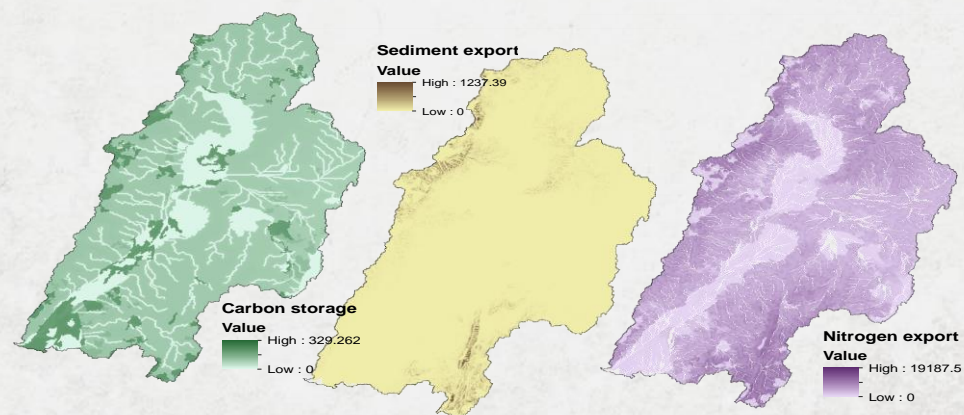
# EFFECT OF RESTORATION ON MAIN OBJECTIVES

## Optimization portfolio results for six Colombian cities and their source watersheds

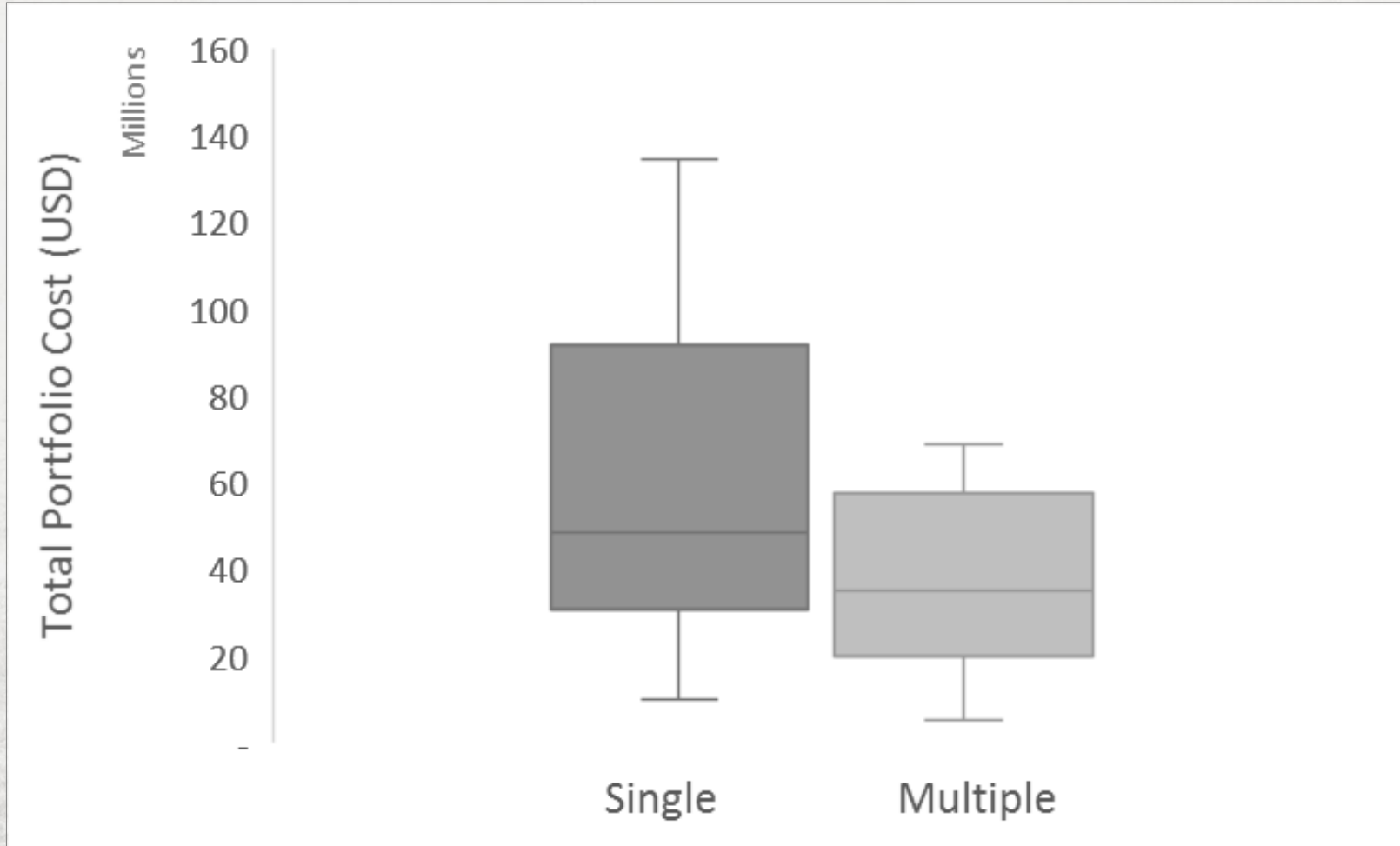
City source watershed	Hectares in portfolio	Percent of total watershed area	Percent improvement from baseline (through restoration and agricultural BMPs)		
			Carbon storage	Nitrogen reduction	Sediment reduction
Cartagena	17,832	7	26	-10	-34
Medellín	12,032	10	15	-10	-14
Cali	2,491	14	9	-11	-12
Bogotá	21,888	8	10	-10	-15
Bucaramanga	11,831	16	9	-10	-14
Cúcuta	41,642	17	10	-10	-15

**Table 5.1.** Results based on restoration targets of 10 percent reduction for sediment and nutrient loads and a 10 percent increase in carbon storage (with results reported as percent change). Protection targets were 17 percent avoided damages to these services (with results reported as percent of future degradation avoided). Results are based on InVEST models using national-level datasets.

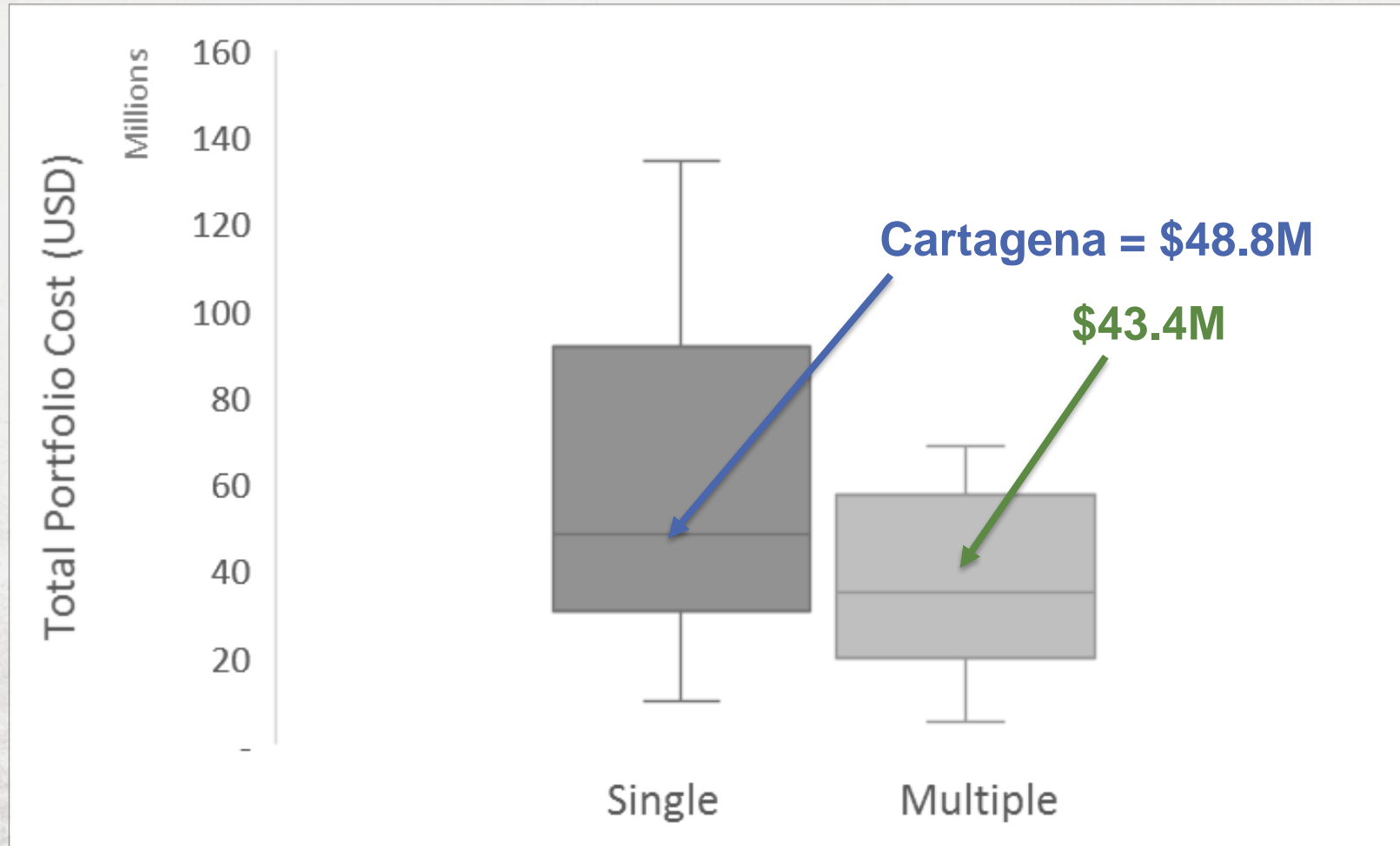
# BENEFITS OF COLLECTIVE ACTION



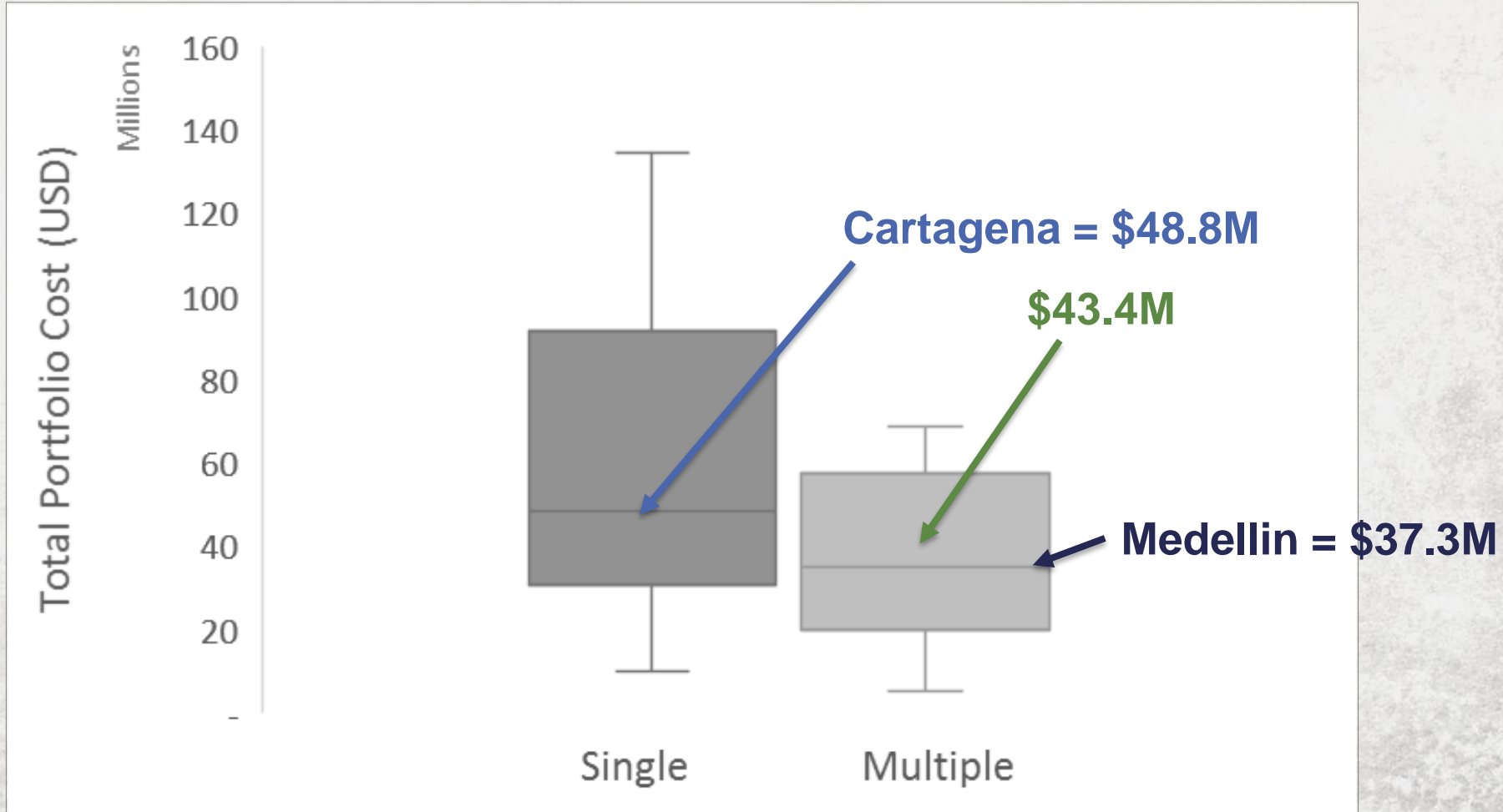
# THE BENEFITS OF COLLECTIVE ACTION



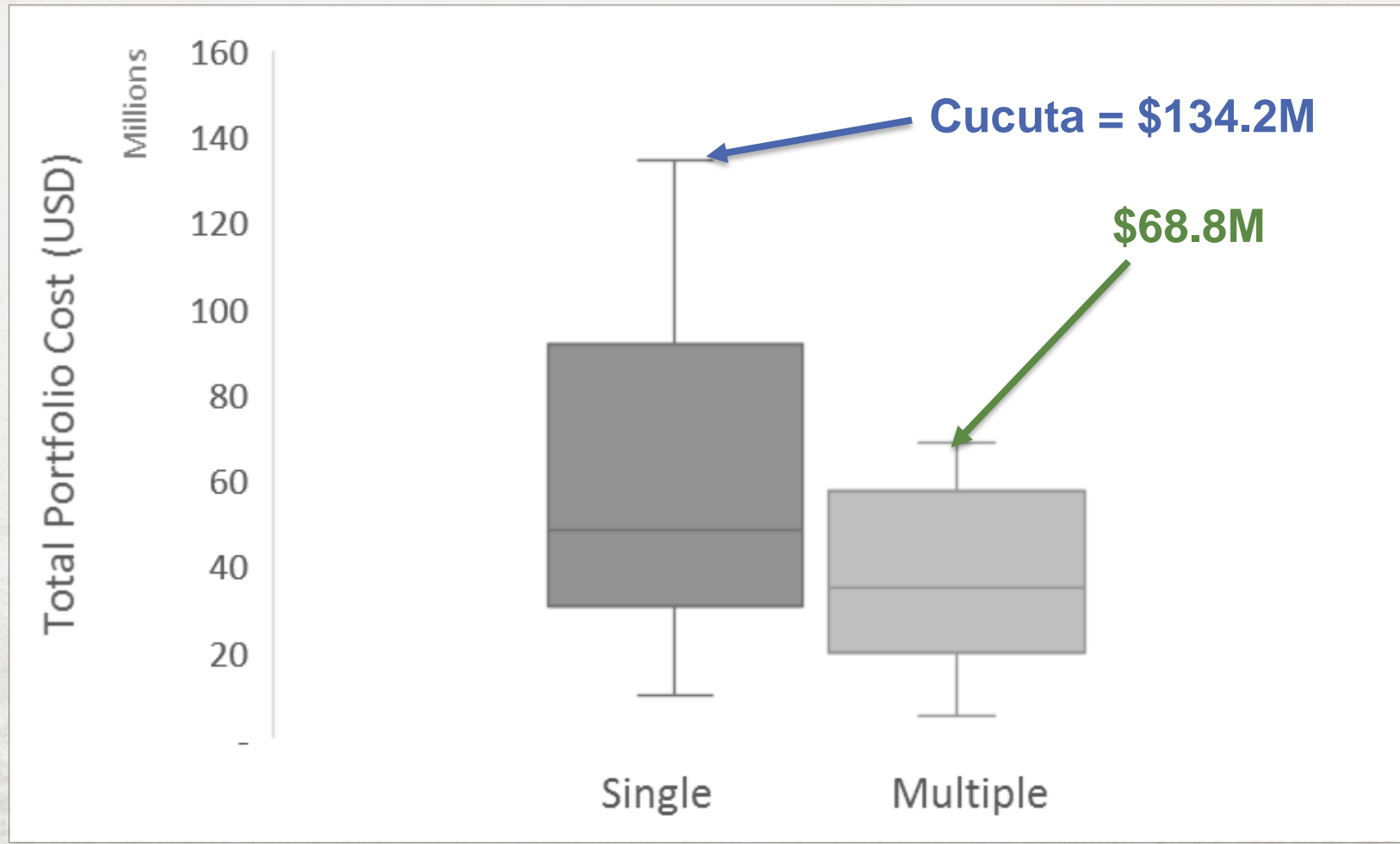
# THE BENEFITS OF COLLECTIVE ACTION



# THE BENEFITS OF COLLECTIVE ACTION



# THE BENEFITS OF COLLECTIVE ACTION



# WHAT COULD BE IMPROVED?

- **Biophysical models:**
  - National level data for legitimacy and comparability between sites
  - No calibration of model results → relative changes only
- **Economic models:**
  - Average costs across the whole country, some cost components not included (e.g., negotiated cash compensation to landholders)
- **External drivers:**
  - Degradation estimates do not incorporate risk of conversion/threat
  - Climate change

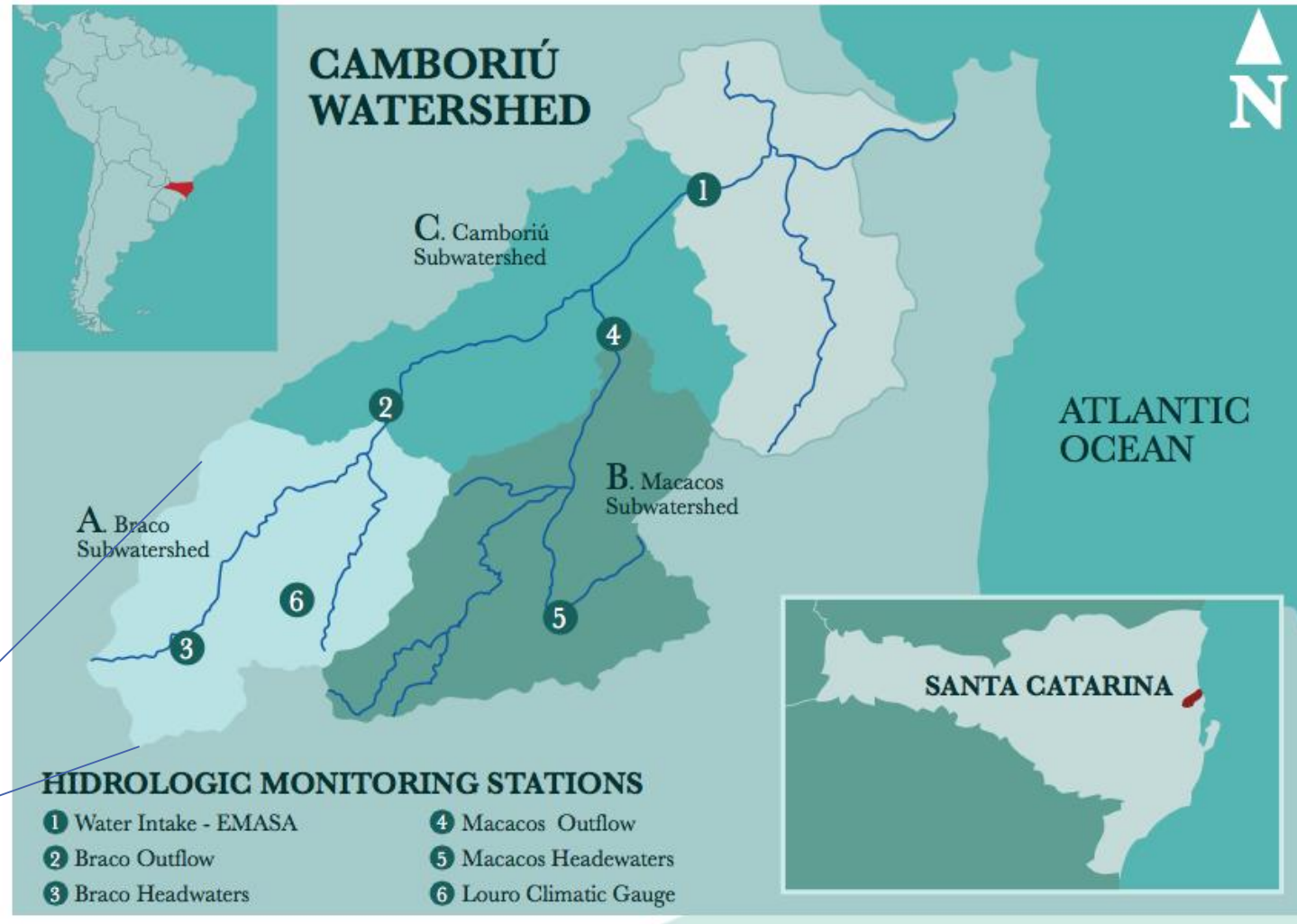
# ONGOING SCIENTIFIC EFFORTS



Evaluating the current effectiveness of Investments in Watershed Services, now and under future climate







# TAKE HOMES

- **“System thinking”**: Multisectoral approach should be promoted to meet global commitments
- **Role of science**: Optimization models are useful to communicate on synergies and trade-offs
- **Role of boundary organizations**: Leveraging local and regional efforts and identify research questions that contribute to meeting global commitments.



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