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Budgeting and Portfolio Allocation for Biosecurity Measures (Hawkweed, FMD, RIFA, PFF)

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Budgeting and Portfolio Allocation for Biosecurity Measures

(Hawkweed, FMD, RIFA, PFF)

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Portfolio Rule

- The portfolio allocation rule requires that we allocate **each dollar** to the activity where it earns the highest additional return:
  - ✓ The approach provides a structured and transparent method to allocate investments across different invasive species or threats and biosecurity activities; investments or allocations that can be scaled according to the available budget.
  - ✓ The principle cares only about which activity has the highest extra returns, or $\Delta B/\Delta C$, rather than the ratio B/C.
  - ✓ A possible overall budget constraint also matters BUT efficient allocations also ensure that the average B/C across all activities is maximized.
  - ✓ Uncertainly matters in the model and the variance and co-variance for investments across different threats and activities needs to be considered, along with sensitivity on key parameter values.

Example portfolio problem (1)

Starting from an initial allocation, how should money be shifted to improve overall results?

Portfolio	Budget share (%)	Average B/C	ΔB/ΔC
1. Prevention	10	150.55	26.05
2. Surveillance	10	123.78	31.26
3. Eradication/Containment	10	70.15	28.65
4. Management (National Significance)	10	52.14	22.73
5. Management (Other)	60	5.87	1.54

Example portfolio problem (2)

Portfolio	Initial allocation		Optimal allocation	
	Share	Average B/C	Share	Average B/C
1. Prevention	10	150.55	30	83.03
2. Surveillance	10	123.78	30	72.20
3. Eradication/ Containment	10	70.15	20	64.57
4. Management (NS)	10	52.14	15	60.97
5. Management (Other)	60	5.87	5	50.03
Overall		43.18		71.13

The Question…

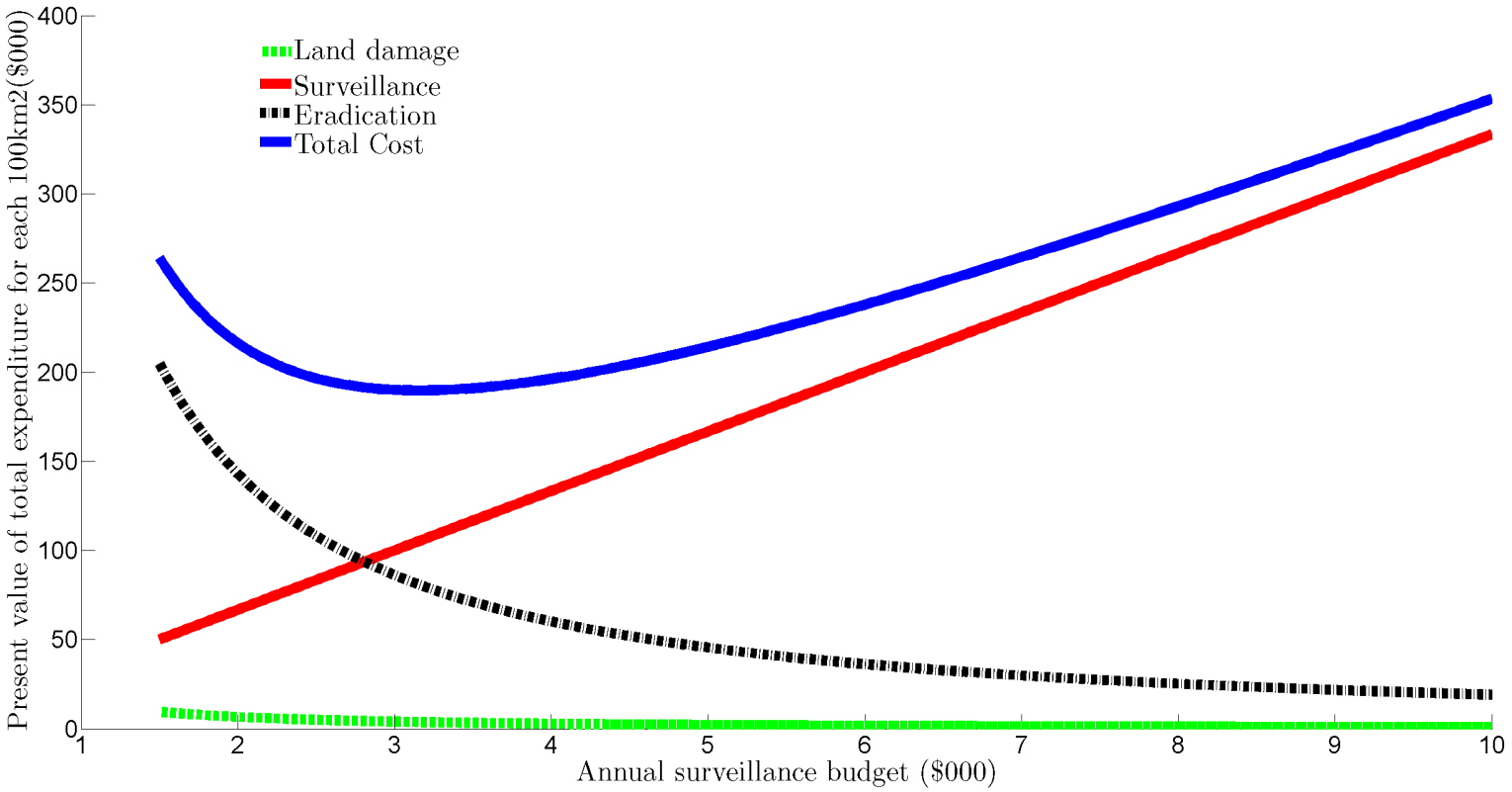
- Given current activity, what is the best way to allocate a given budget to control 4 biosecurity threats: (i) Hawkweed, (ii) Foot-and-Mouth disease (FMD), (iii) Red Imported Fire Ant (RIFA) and Papaya Fruit Fly across various activities?

- The Biosecurity 'portfolio' (ACROSS 4 threats and these activities):
  - ✓ 'Eradication/Containment': to contain and completely remove known threats (and consequently stop all losses/damages that are caused by these threats).
  - ✓ 'Active Surveillance': to 'early detect' unknown or possible threats (so eradication or containment can take place 'early').
  - ✓ 'Prevention': to reduce the occurrence of new (known or unknown) threats, through border and local quarantine, containment or added search for 'jumps'.

Method…

- Example: Optimal Surveillance
    - Benefit: Earlier detection and consequent action gives smaller damages over time (or more benefits). Cost: The earlier is detection the more expensive is the local surveillance program
    - Objective: Given a border quarantine measure, minimize all expenditures: damages (e.g., losses in plant and animal health, damage to the environment, trade restrictions, containment and eradication costs) plus the cost of the surveillance program itself.
- Portfolio Allocation Problem:
    - Minimize the expected value of all costs (damages, costs of the activities, etc., subject to spread rates, damage costs, probability of entry, detection, control, etc. :

Surveillance against Hawkweed…

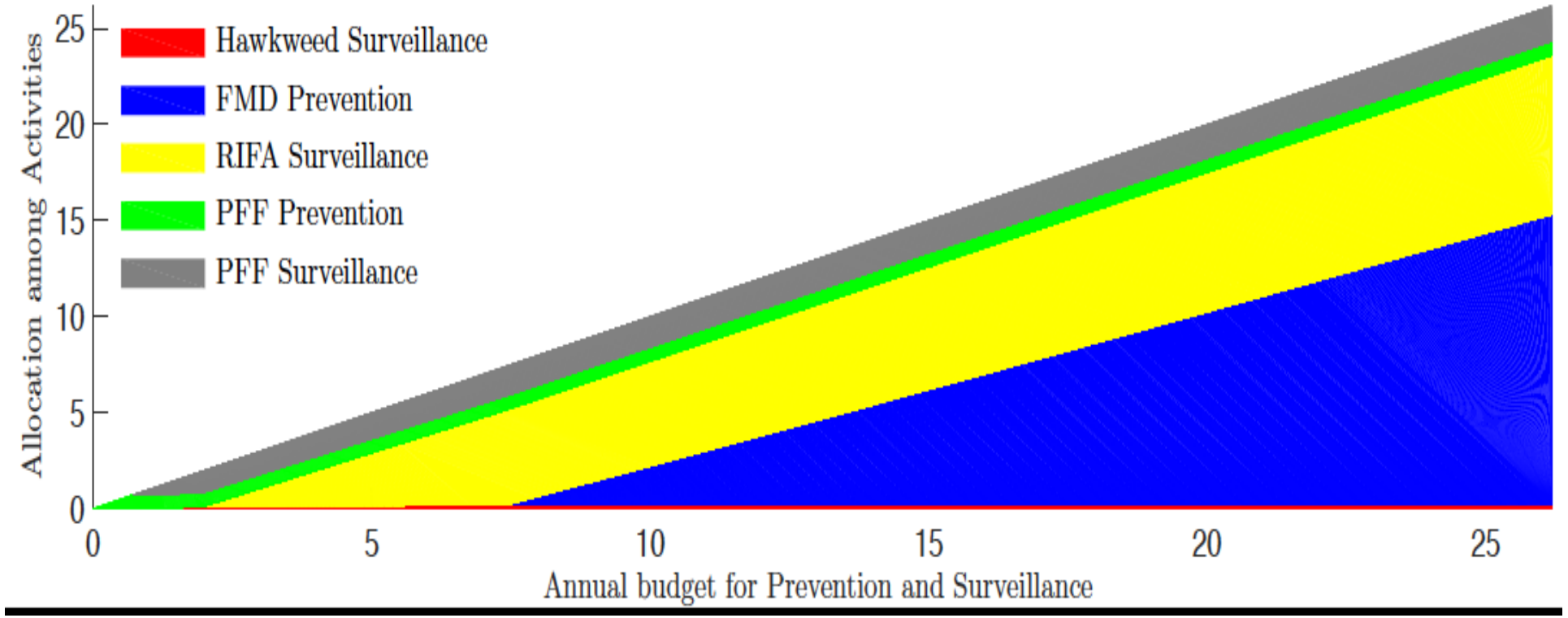


Numerical Results…

Unit: $1000	Prevention Expenditure	Active Surveillance Expenditure	Eradication Expenditure (Expected)	Total Damages (Potential)
Hawkweed	0	240	80	323
FMD	15,090	0	282	43,726
RIFA	0	8,280	4,307	12,688
PFF	750	1,860	483	3,097

($26 million budget for prevention and surveillance)

With a Fixed Budget…



Thanks for listening!

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