The Challenges of Quantifying the Value of Research

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Workshop on Measuring Impacts of Federal Research

Two Facts About Research

1. It is the main source of productivity growth

2. Research findings are a <u>public good</u>

   Nonrival: One's use of research findings doesn't diminish its value to others.

   Nonexcludable: It's difficult for one who has it to keep others from using it.

Implication: Private markets will do too little research

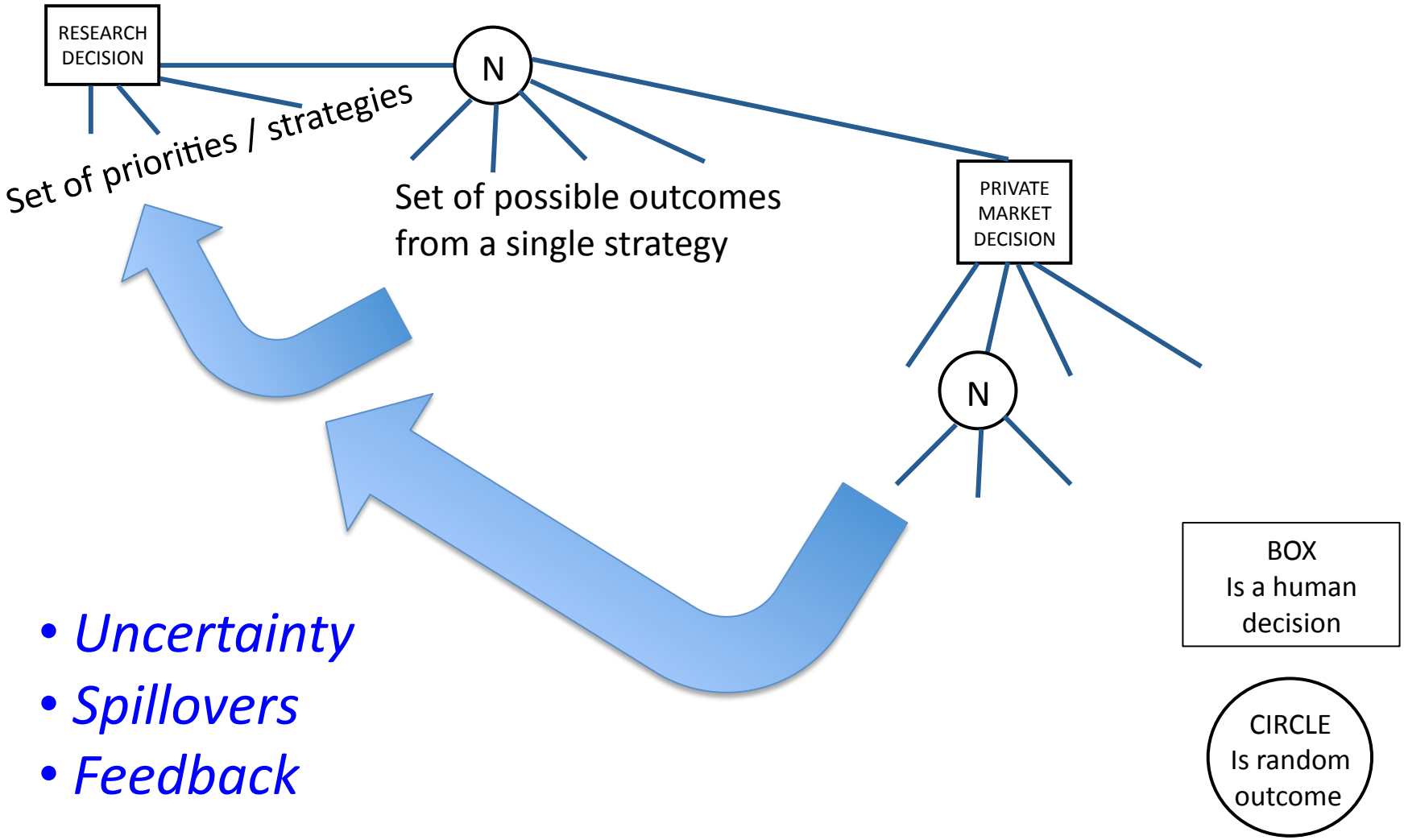
A Clear Public Role

- How large is that role?
- How to set research priorities?

- Economists' answer:

Weigh the benefits and costs

A Challenging Conceptual Problem



- *Uncertainty*
- *Spillovers*
- *Feedback*

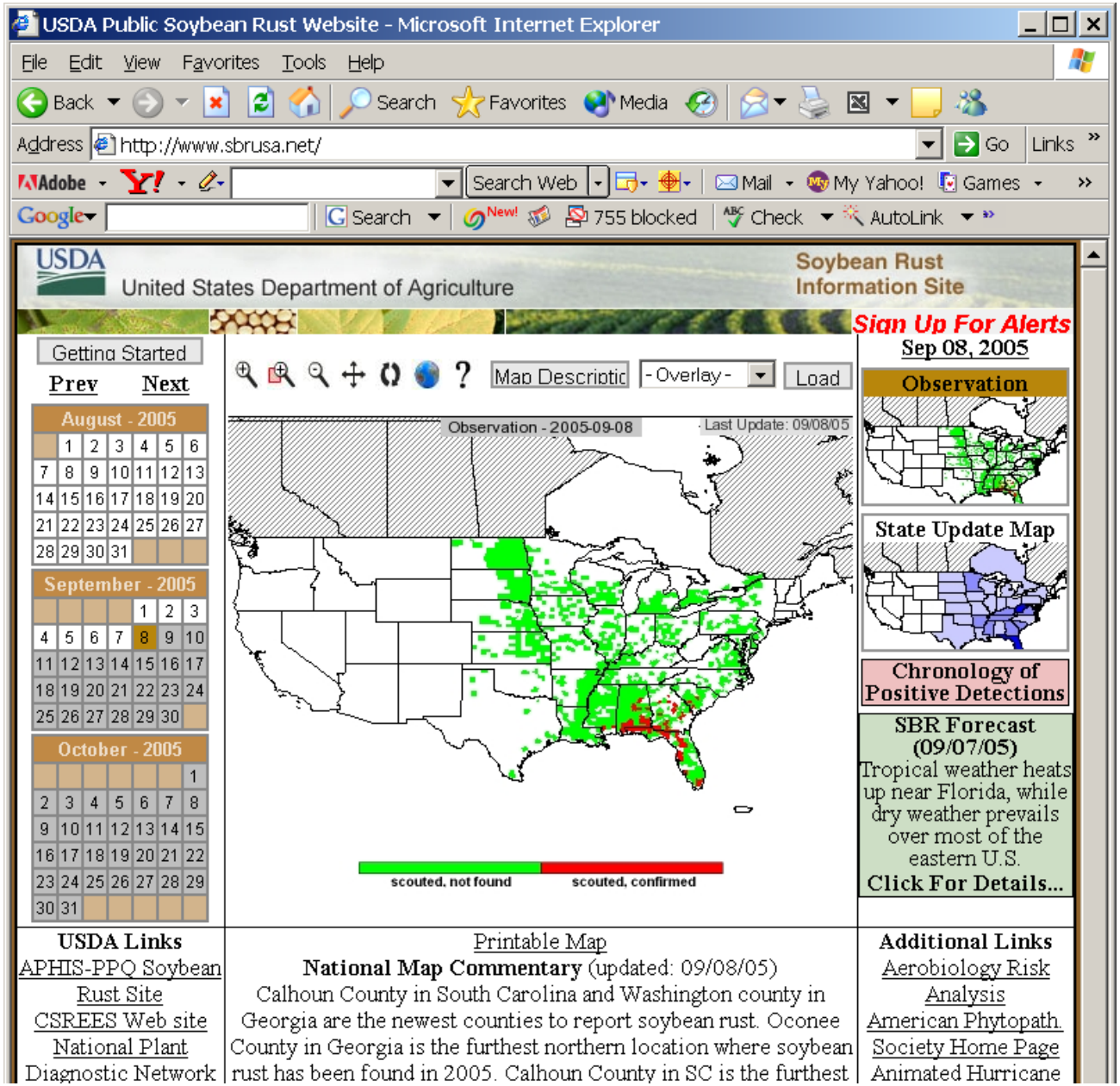
Key Challenges

1. The range of potential outcomes is large and probably unquantifiable
2. Uncertainty
3. Benefit values are fundamentally subjective

    We must assign unknowable probabilities

    (Bayesian)

Example: An Pest Forecast System



How to value benefits of public information ?

Three key components:

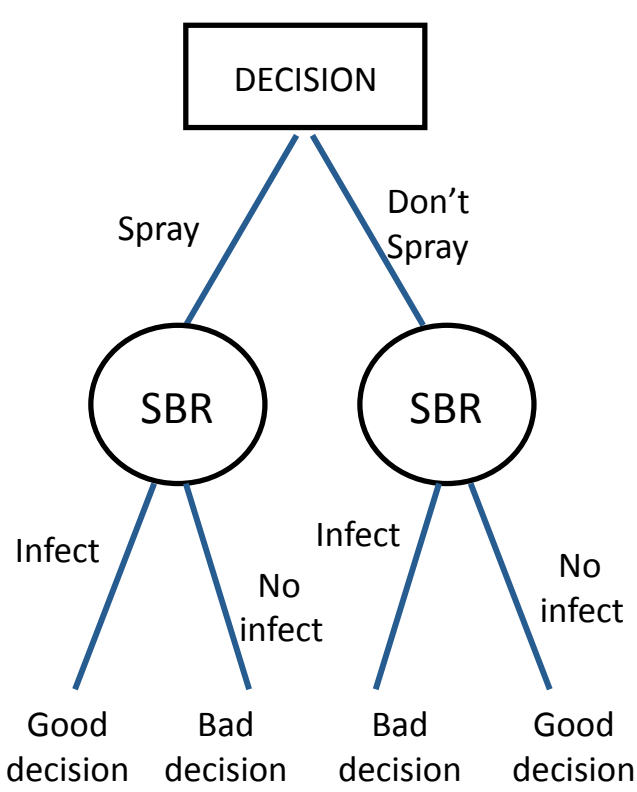
1. Prior beliefs about the amount of risk

2. The amount of preventable losses

3. How well the information system resolves uncertainty

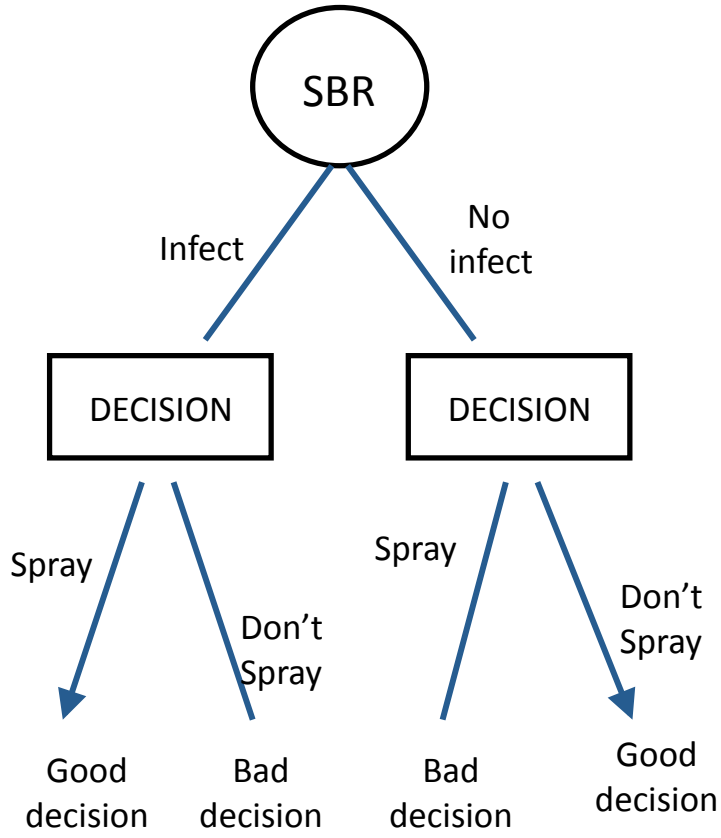
System creates value by improving decisions

No Information



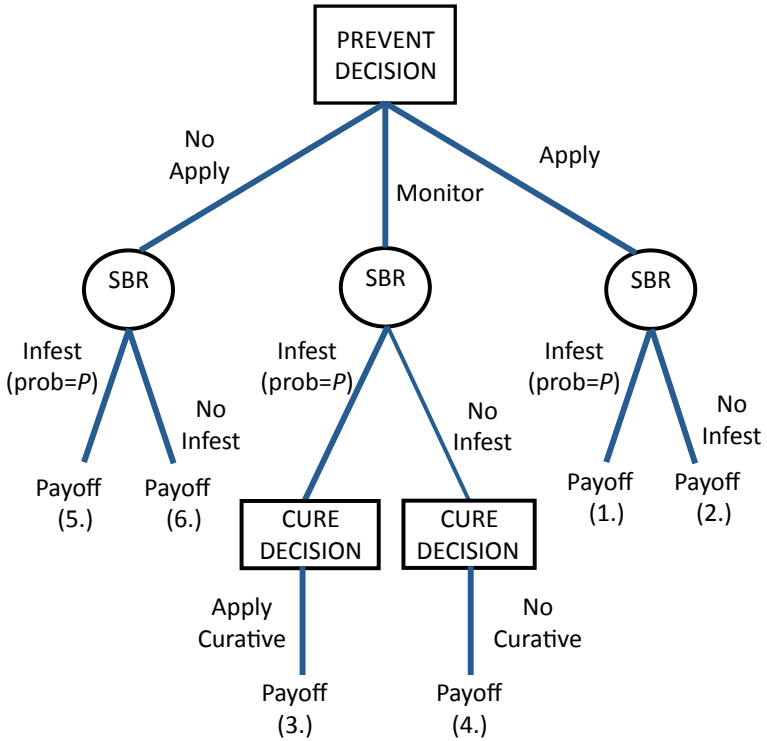
Without information, farmers will sometimes spray when unnecessary, or not spray when needed

Perfect Forecast



With perfect information, farmers will always make the right decisions.

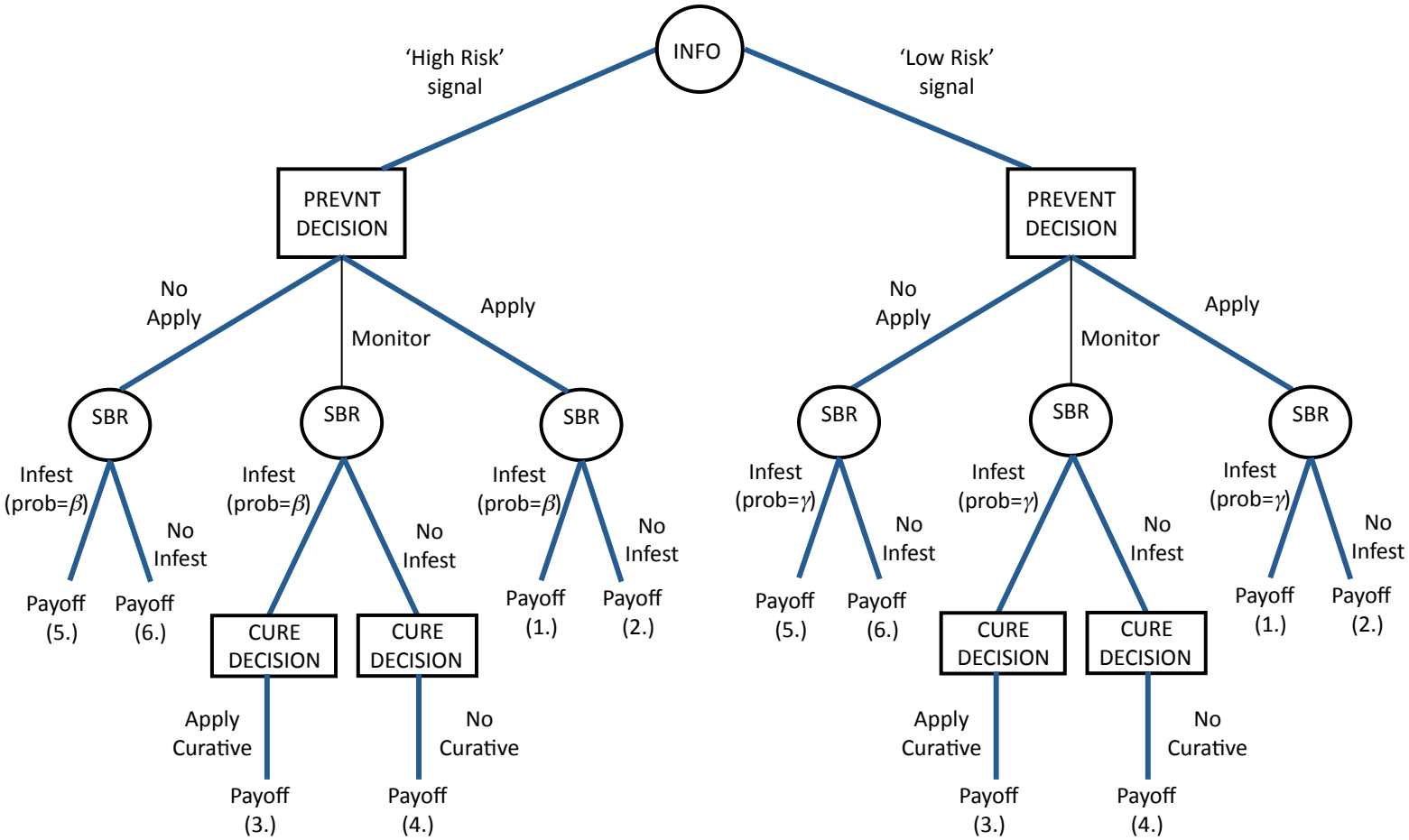
No Information



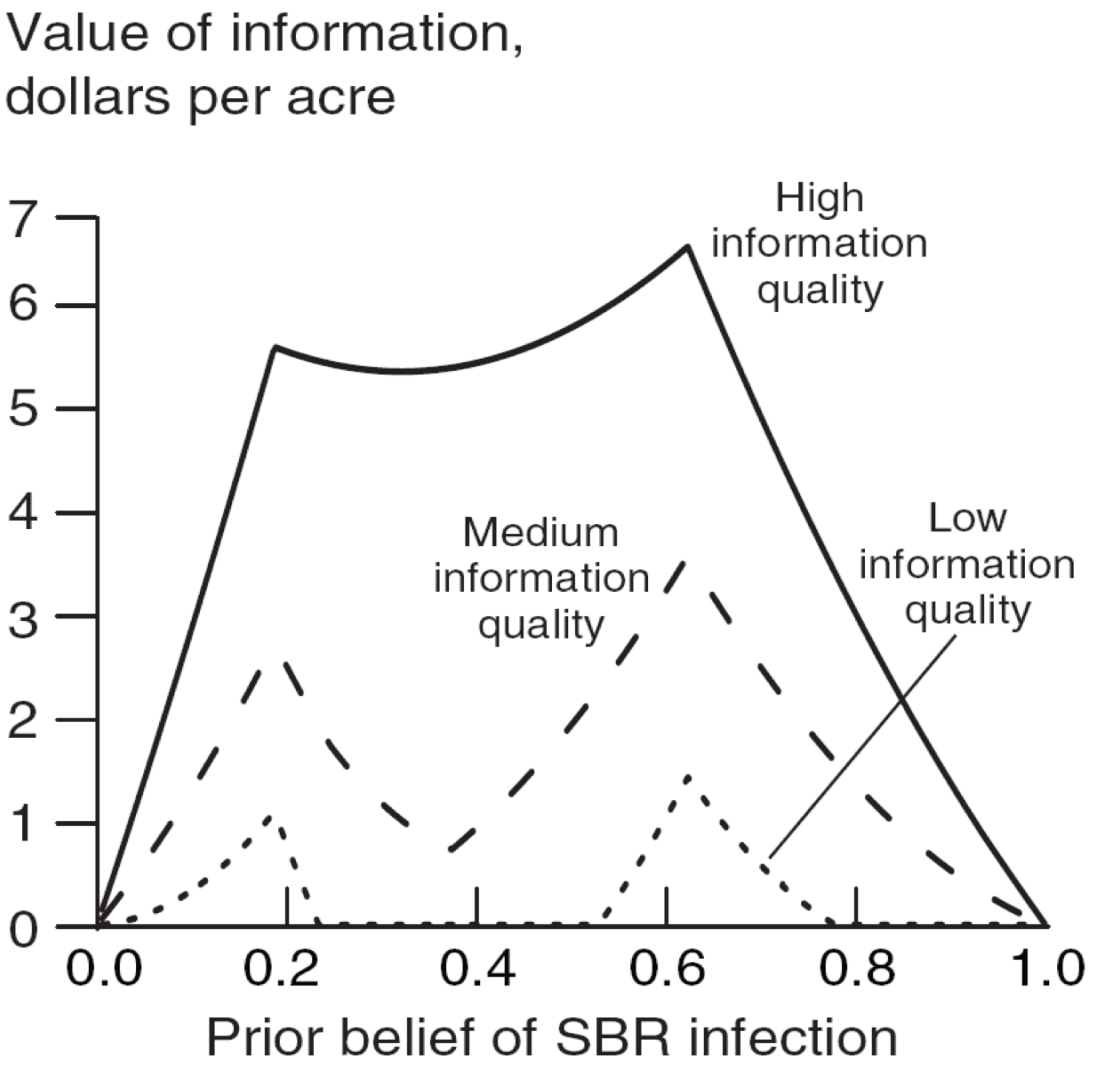
Possible Outcomes

Decision	SBR Event	
	Infestation	No Infestation
Apply Preventative Treatment	(1.) 1% Yield Loss Cost of $25.63/Acre	(2.) Cost of $25.63/Acre
Monitor Fields and Apply Curative Treatment if SBR	(3.) 7% Yield Loss Cost of $20.52/Acre	(4.) Cost of $6.71/Acre
No SBR Management	(5.) 25% Yield Loss	(6.) Base Return

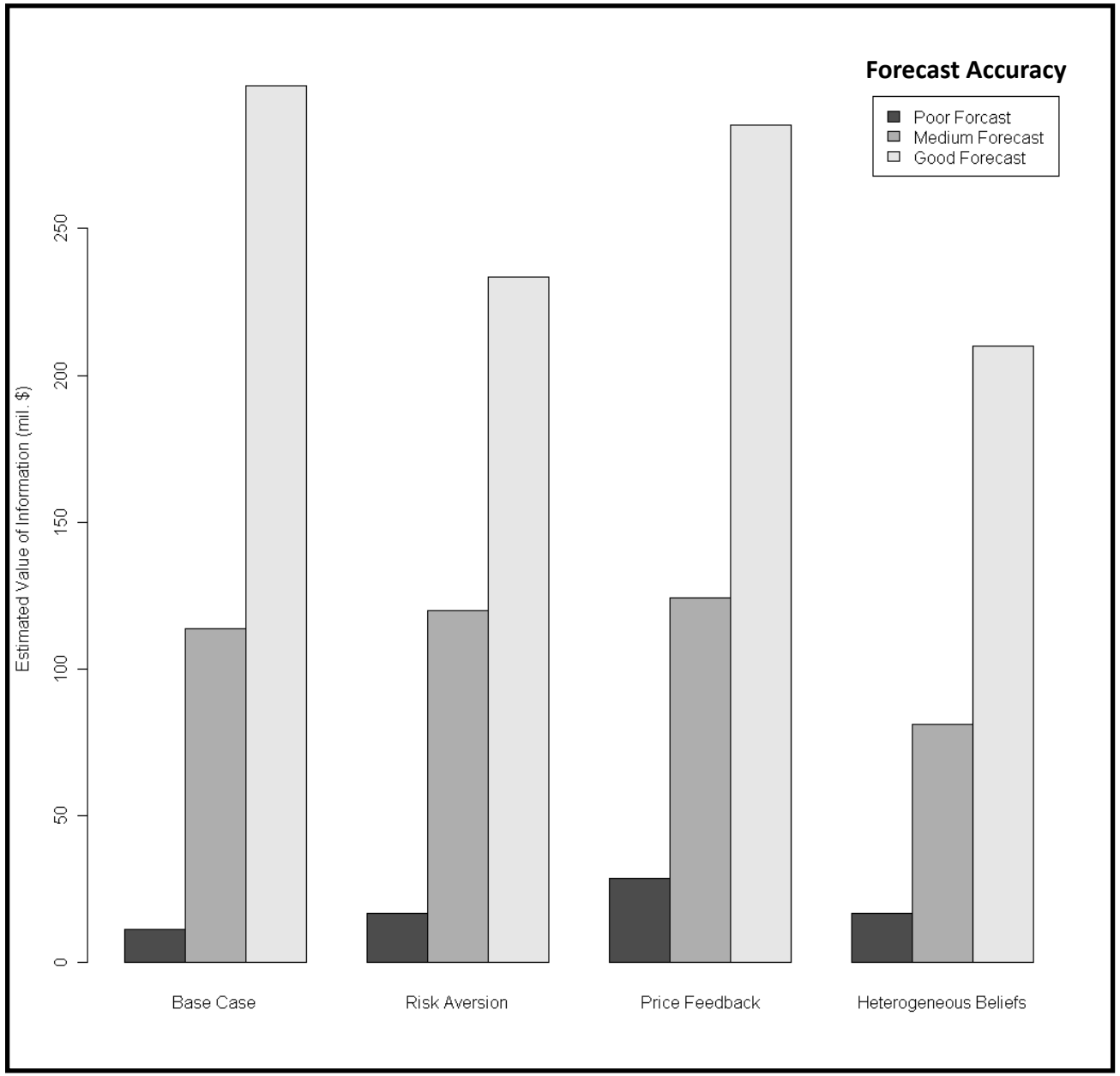
Partial Information



Range of Information Values in the Corn Belt



Aggregate Results



A highly stylized example

- Extraordinary simplification of reality
- Strong (heroic?) simplifying assumptions
- Far more tangible than most research projects

Yet…

A broad range of potential benefits tied to

- Beliefs about underlying risk (or opportunities)
- Potential to resolve subjective uncertainties

Implication: Quantifiable benefits difficult and sensitive to assumptions

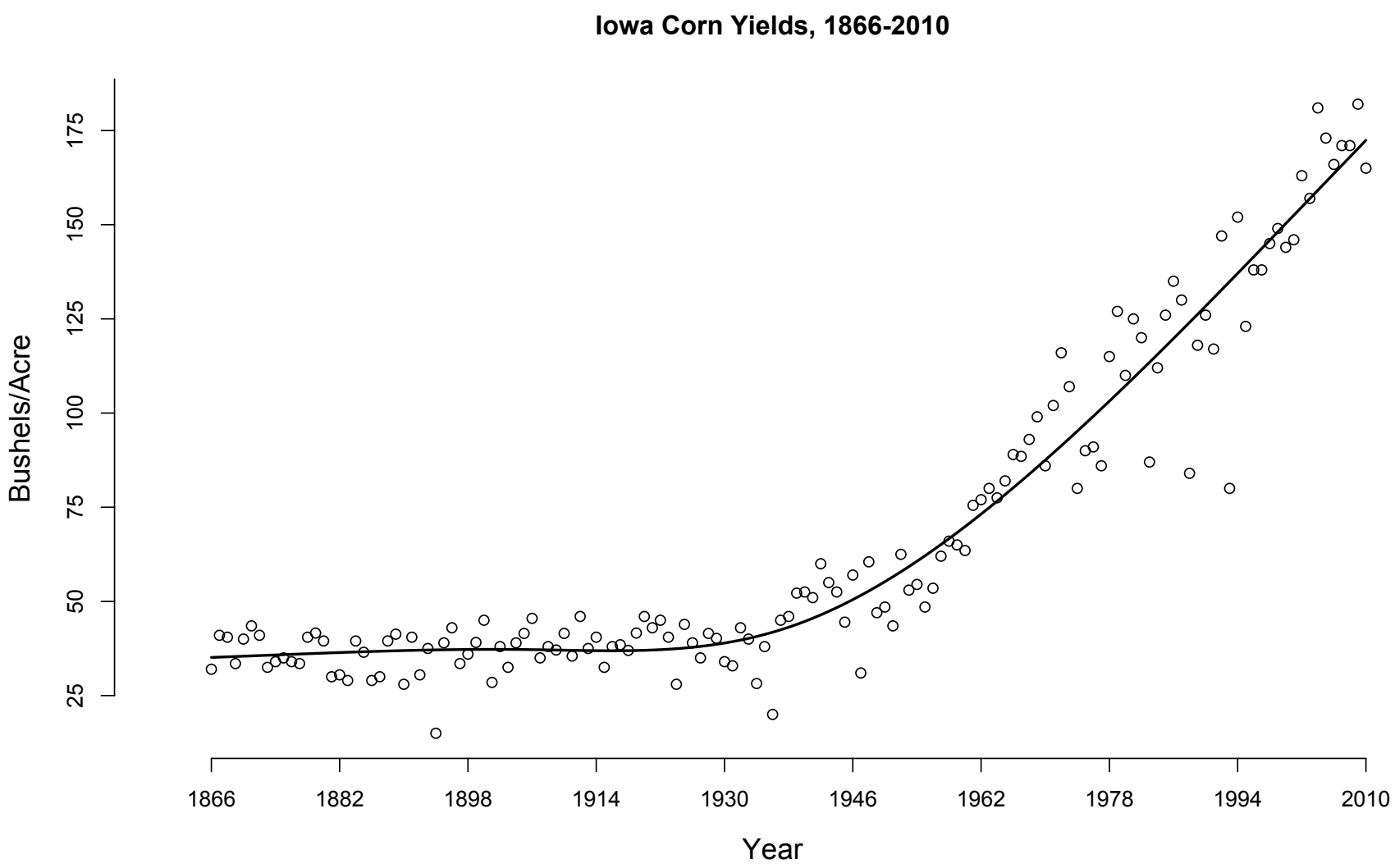
What is Possible?

- Valuing individual research projects seems untenable

<u>Other strategies</u>

- Value research programs?
- Value canonical examples?
- Value projects and programs ex post, & adjust research priorities accordingly?

A Great Discovery: Hybrid Corn



What's the Value of Hybrid Corn?

- Where would we be were it not for Donald Jones and funding of the Agricultural Experiment Station in New Haven, Connecticut ?

- If not Donald Jones, then perhaps another discoverer at another time, probably at another publicly funded experiment station or university.

Dr. Norman E. Borlaug

March 25, 1914 – September 12, 2009

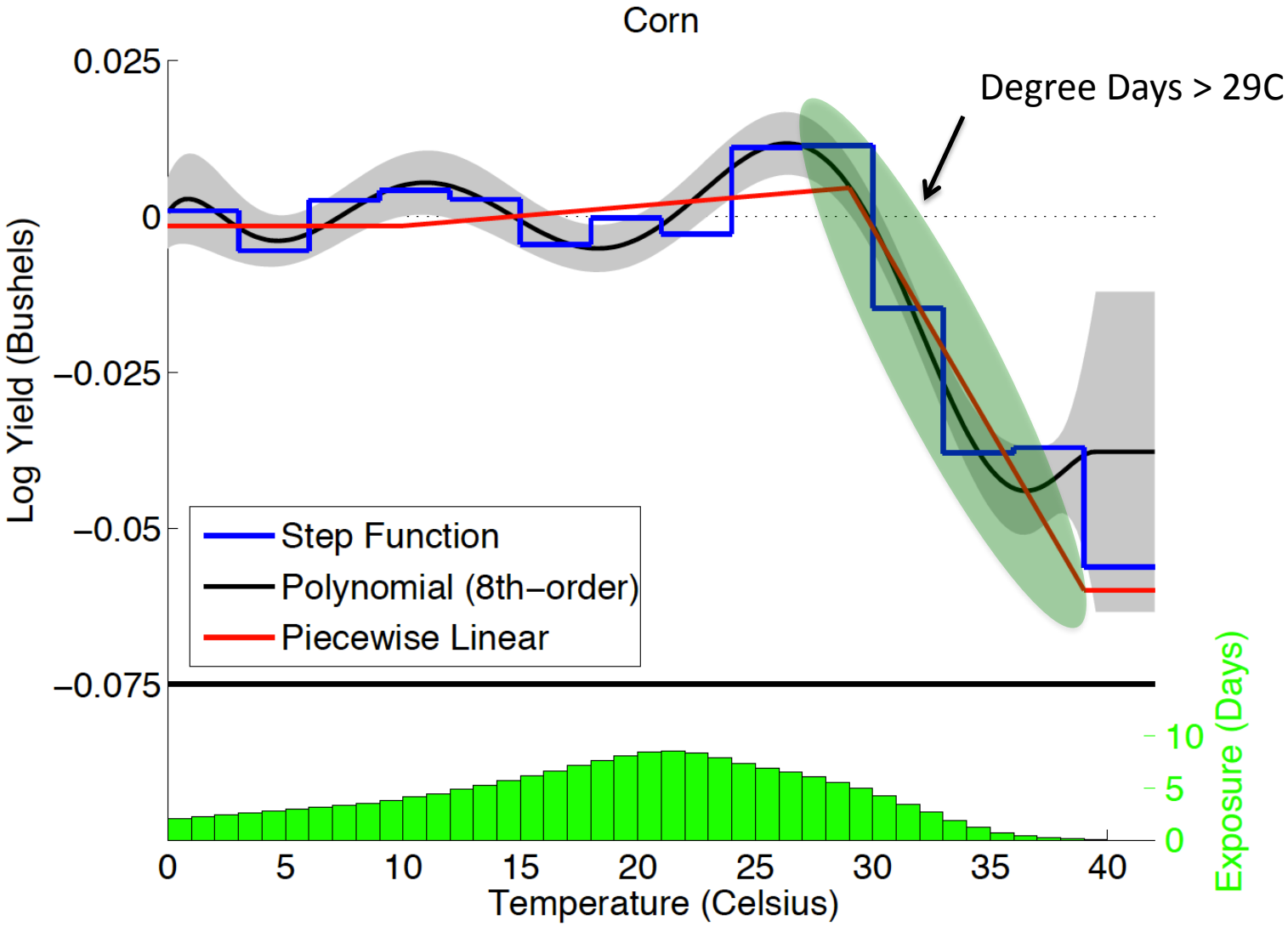
"Dr. Norman Borlaug's remarkable lifetime efforts to feed millions of less fortunate around the world will continue to inspire all those concerned with hunger and malnutrition. His legacy includes billions of lives saved from the misery of starvation and the education of thousands of scientists worldwide who carry on his work today."

http://www.normanborlaug.org/

Marginal Value of a Discovery

How do we assign the marginal value of one discovery separate from all its descendent discoveries?

Extreme Heat Matters Most for Corn Yields



Research as an Early Warning?

"….the research conducted by these authors [Schlenker and Roberts] acts as an "early warning" indicator and this allows us to escape [adverse effects of climate change]."

--Matthew Kahn, *Christian Science Monitor*, Feb. 17, 2011

Professor of Economics, UCLA & author *Climatopolis*

Fat Tails?

- Weitzman shows the value of preventing climate change could be infinite
- Uncertainty with “fat tails” often work out that way
- We must make strong distributional assumptions to obtain finite expectations.
- Does public research have uncertainty with “fat tails”?