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METHODS TO QUANTIFY INVASIVE PEST RISK AND SOCIOECONOMIC IMPACTS FOR OBJECTIVE REGULATORY DECISIONMAKING: CASE STUDIES ON AREA-WIDE-RELATED PROGRAMS

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U.S. Department of Agriculture

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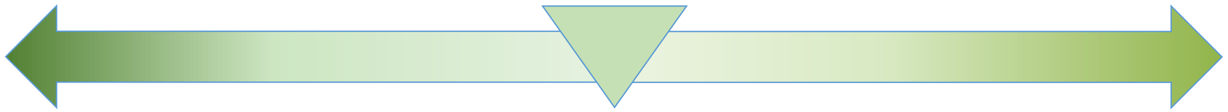
APHIS' Mission

Facilitate Commerce

SAFE COMMERCE

Protect resources



Authorize entry low-risk commodities

Exclude high-risk commodities
- Regulate
- Inspect
- Detect/respond

Issues Confronting APHIS

- What constitutes a significant pest?
- When should Federal action be taken against a pest?
- Are our actions producing the intended results?

Decision-making Objectives

1. Prioritize pests consistently across safeguarding continuum.
2. Evaluate what actions to take and where to draw the line.
3. Prioritize pest programs.

Measurement Issue

- Lack of common framework for measuring risk (expected impacts) along the safeguarding continuum
- Risk has been traditionally viewed as the likelihood of pest introduction

Risk Definition

Economic perspective on risk:

Risk implies future uncertainty about deviation from expected outcome.

Risk (or expected impact) =

Likelihood x Consequences

Analytical Spectrum

Ex-ante analysis:
Evaluation of Potential Impacts

Ex-post analysis:
Evaluation of Observed Impacts

Pests not introduced

What exotic pests should we be concerned about?

Estimate consequences and probability of introduction (entry & establishment),

Newly introduced

Should we do something?

Estimate spread and expected impacts with and without mitigations

Established/ 'limited distribution'

Should we continue?

Evaluate program effectiveness based on observed impacts

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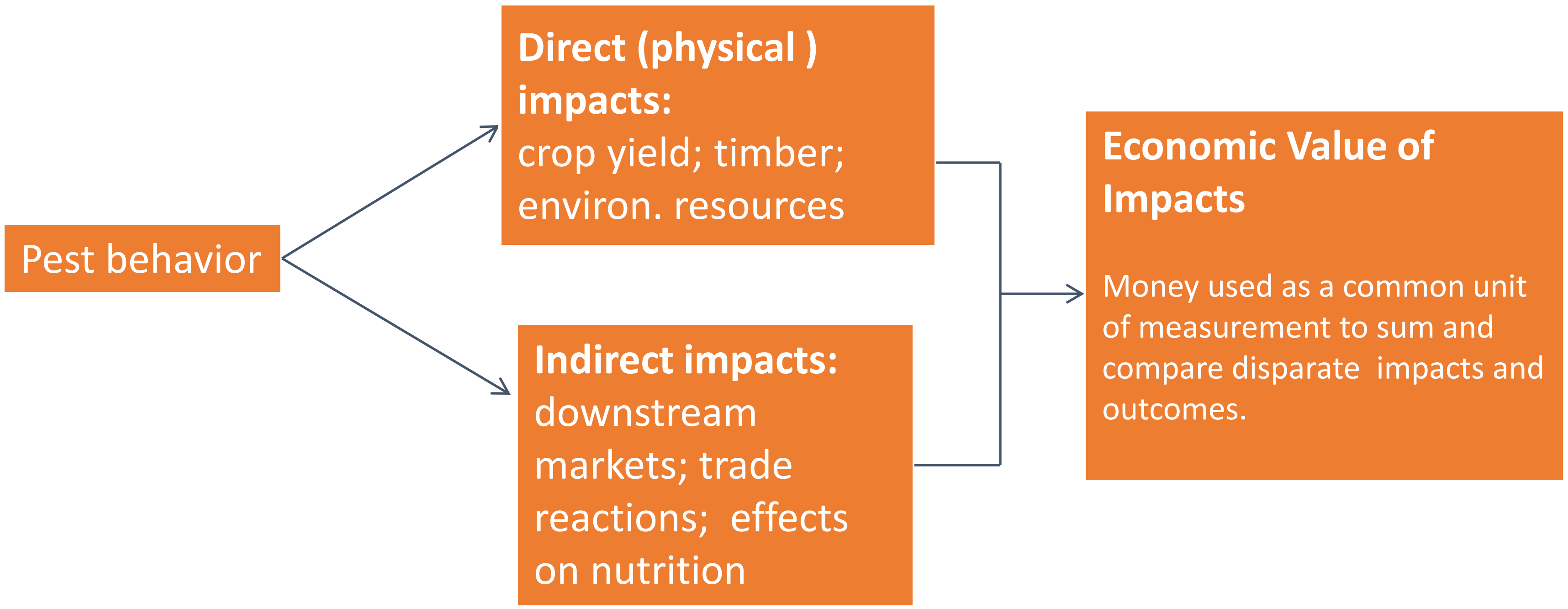
New Model for Prioritizing Pests Based on Impacts



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New Model for Prioritizing Pests

Prioritizing pests based on ***predictive impacts.***

Example: Prioritizing pests for survey

Impact Potential → **Likelihood of Introduction** → Survey Feasibility & Cost Effectiveness → **Add to survey program?**

- Damage potential

*If impact is not significant no need to continue

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New Model for Prioritizing Pests

- Identified over 100 non-native arthropods and 80 pathogens that have become established in the United States

- Each pest/pathogen was analyzed ***as if it were not present in the U.S.*** using the potential questions

New Model for Prioritizing Pests

- Multiple choice yes/no questions (criteria) ***predictive of impacts***
- Selected factors considered in evaluating impacts:
  - biology (unmitigated damage; frequency/severity of outbreaks)
  - research and management
  - current production practices

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New Model for Prioritizing Pests

- Team of entomologists/pathologists & economists classified each pest/pathogen in terms of its ***observed impacts*** in the United States

New Model for Prioritizing Pests

- Statistician compared predicted results to observed impacts
- Each question were tested as to how well it predicted actual impact; non-predictive questions were removed
- Weighted each question by its predictive power

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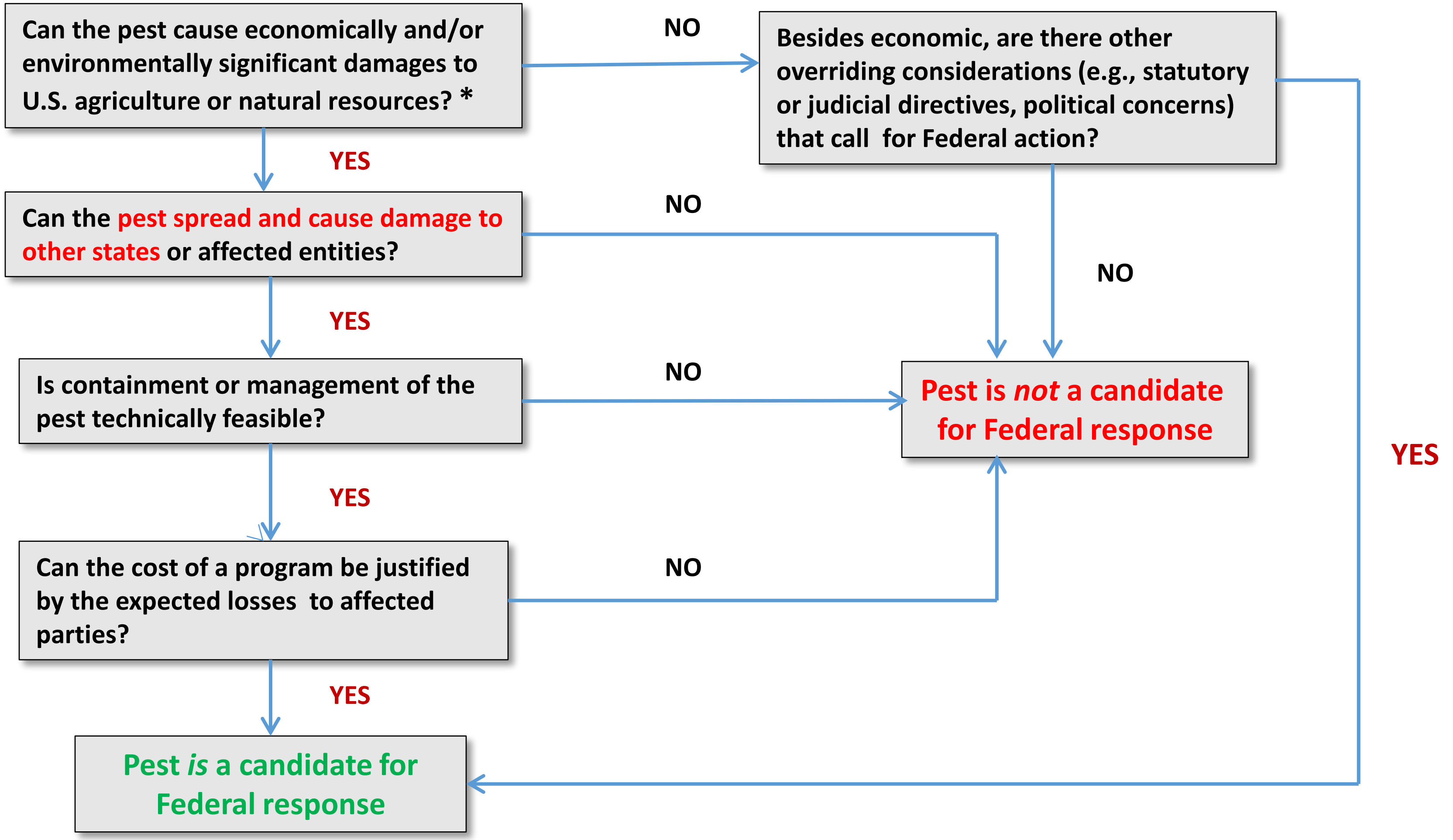
Sample Prioritized Pest List

Risk Group	Scientific name	Common Name	Model	Predicted pest impact in US	Prob. pest will cause high impacts	Prob. pest will cause moderate impacts	Prob. pest will cause low impacts	95% CI of prob. high impact
Predicted to be a HIGH impact pest in the United States (low uncertainty)								
A	***'Candidatus* Phytoplasma australiense' 16SrXII-B**	Australian grapevine yellows	Pathogen	High	69.8%	27.6%	2.6%	57.50% ~ 91.48%
A	***'Candidatus* Phytoplasma phoenicium' 16SrIX-B**	Almond witches' broom	Pathogen	High	87.1%	12.0%	0.9%	68.35% ~ 93.75%
A	***'Candidatus* Phytoplasma vitis' 16SrV-C**	Flavescence dorée	Pathogen	High	88.5%	10.7%	0.8%	80.82% ~ 94.82%
A	***Cronartium flaccidum***	Scots pine blister rust	Pathogen	High	91.5%	8.0%	0.6%	88.49% ~ 96.24%
A	***Eurygaster integriceps***	Sunn pest	Arthropod	High	76.0%	20.7%	3.3%	63.72% ~ 80.50%
A	***Harpophora maydis***	Late wilt of corn	Pathogen	High	76.3%	21.8%	1.9%	71.17% ~ 91.98%
A	***Hymenoscyphus fraxineus***	Ash dieback	Pathogen	High	92.5%	7.0%	0.5%	84.62% ~ 98.39%
A	***Paysandisia archon***	South American palm borer	Arthropod	High	79.6%	17.6%	2.7%	62.47% ~ 86.97%
A	***Phytophthora alni***	Alder root and collar rot	Pathogen	High	76.3%	21.8%	1.9%	50.88% ~ 91.98%
A	***Phytophthora kernoviae***	Beech bleeding canker	Pathogen	High	82.8%	15.9%	1.3%	65.40% ~ 94.49%
A	***Raffaelea quercivora***	Japanese oak wilt	Pathogen	High	76.3%	21.8%	1.9%	72.52% ~ 95.99%
A	***Ralstonia solanacearum* race 3 biovar 2**	Bacterial wilt	Pathogen	High	66.9%	30.2%	2.9%	57.50% ~ 84.62%
A	***Thaumatotibia leucotreta***	False codling moth	Arthropod	High	67.3%	27.6%	5.0%	53.39% ~ 75.96%

CRITERIA FOR FEDERAL ACTION



* *Economic significancy is based on established thresholds for acceptable level of risk.*

Decision Rule for Federal Response

Federal response is efficient when:

(Losses without program – losses with program)
– program costs > 0

Non-economic Criteria for Federal Action

- Types of damages where **Federal intervention** is justifiable (e.g., environmental versus commercial pests, or multi-host versus single-commodity pests);
- Availability of control tools;
- Availability of funding from non-APHIS sources;
- Inability of industry/stakeholders to organize;
- Statutory directives.

Impacts of Pests and Management

Losses/costs of Pest X and responses considered for stakeholders (affected and unaffected producers and exporters, APHIS, and state governments):

- Direct pest damage on crop yields
- Additional treatments costs incurred by host producers
- Indirect impact on export markets due to presence of Pest X
- Federal and state program costs

Economic Commodity Models

- Partial equilibrium models of major agricultural commodities
- Vertical linkages along supply chain e.g., between fresh and processed sectors
- Consideration of producing and non-producing regions
- International and domestic trade

Economic Commodity Models

Consideration of ***market prices*** enables estimation of impacts on all affected entities in society, including:

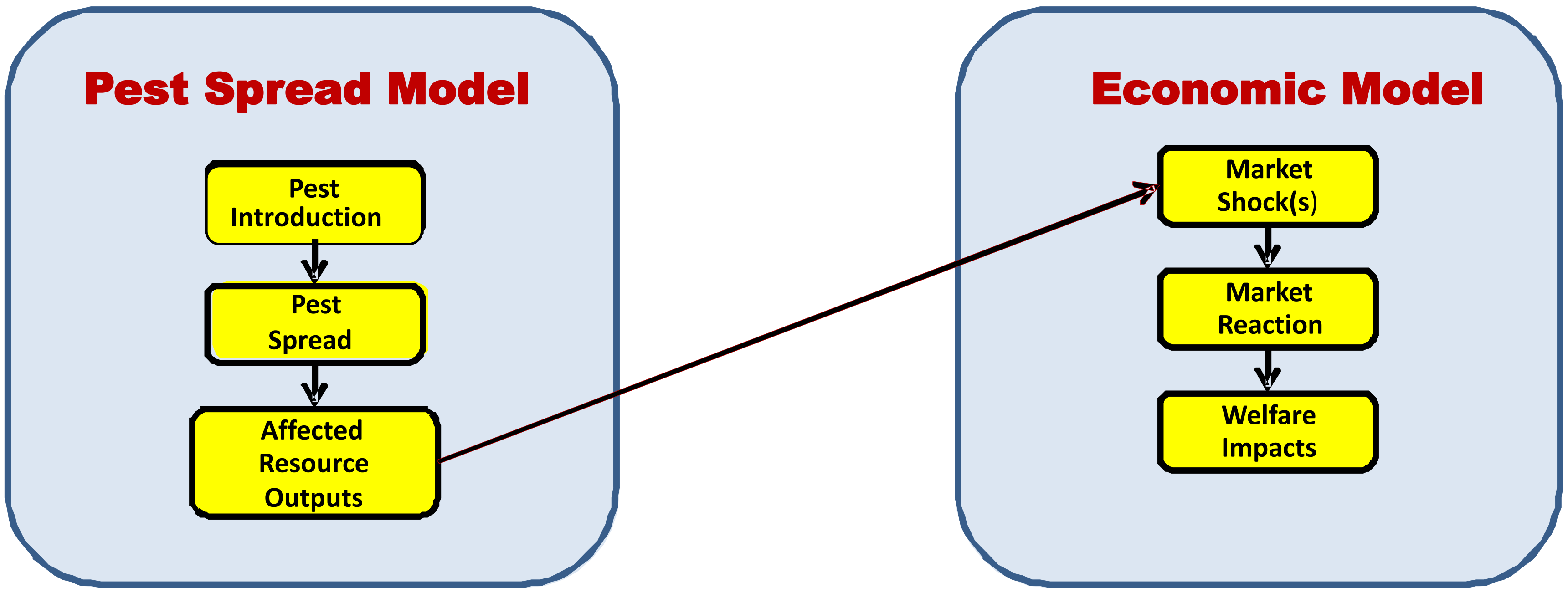
- Producers in affected areas
- Producers in unaffected areas
- Consumers
- Trade

Stakeholders

Commodity Models Developed

- **Small grains** – wheat, soybean, corn, sorghum, barley, oats, rice, forage
- **Nursery stock**
- **Seed** (grains)
- **Non-citrus tree fruits** – pear, apple, peach, plum, sweet cherry, tart cherry
- **Citrus fruits** – orange, grapefruit, tangerine, lemon
- **Potato**

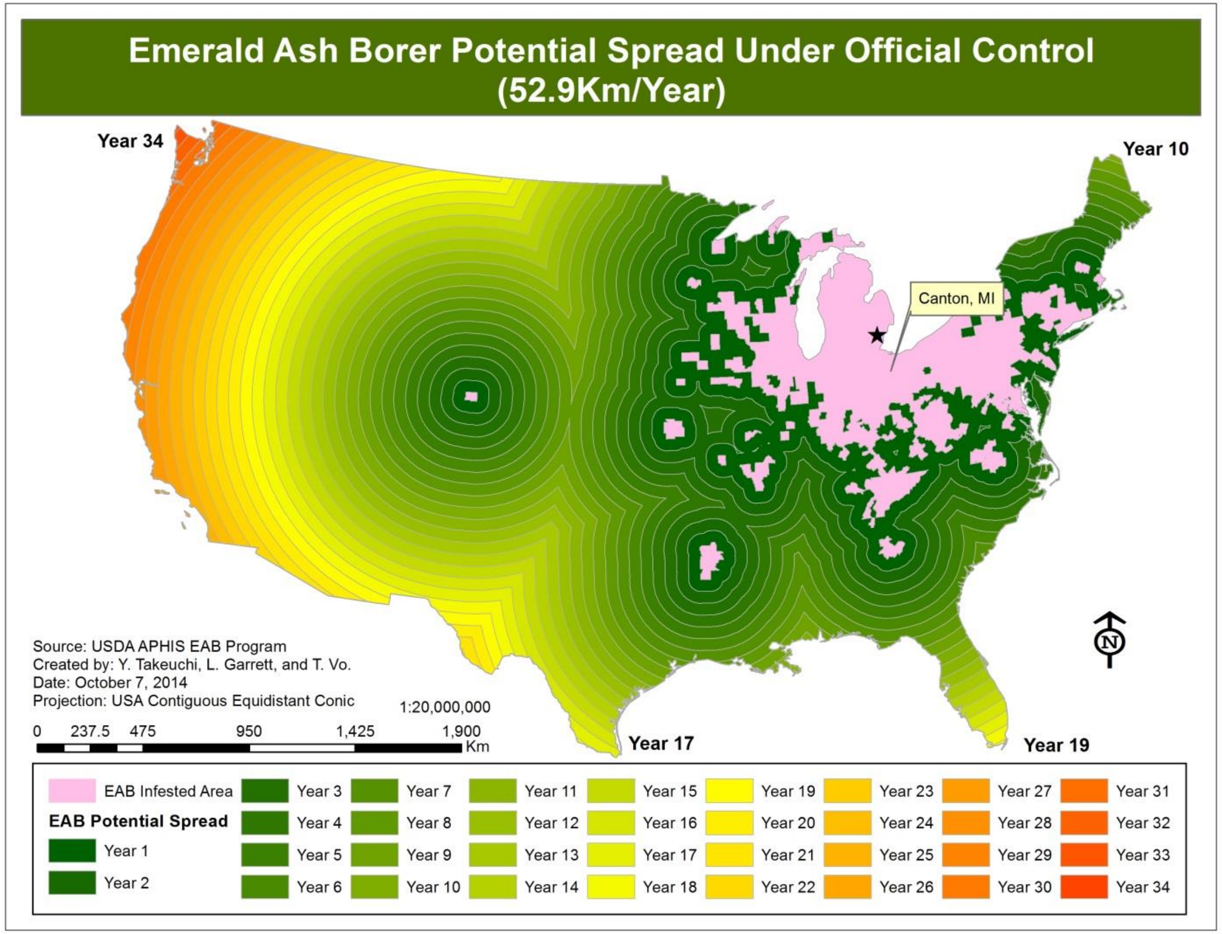
BioEconomic Framework



Sample output – Welfare Impacts of False Codling Moth Outbreak in CA Orange Sector, Alternate Management Scenarios[1/]

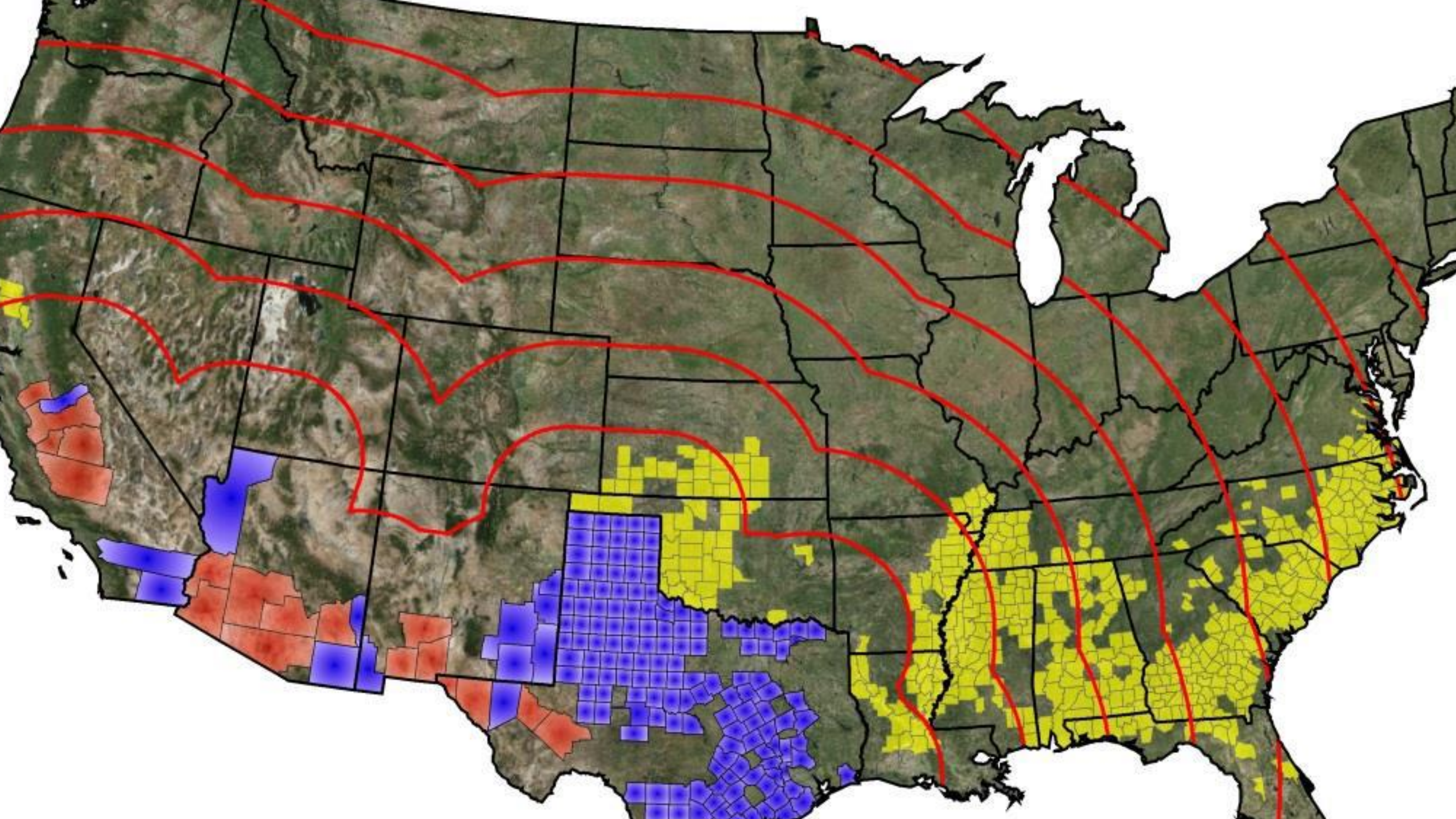
Economic Sectors	Region	No Mitigation ($ million)	Pesticides treatment ($ million)	Pesticides & cultural control ($ million)	Area-wide eradication ($ million)
Consumers - fresh oranges	All	-507	-32	-11	-0.4
Consumers - processed oranges	All	51	-2	-0.8	0.1
Retail - fresh oranges	All	-1,553	-97	-33	-1
Retail - processed oranges	All	35	-1	-2	-0.2
Wholesale - fresh oranges	All	-299	-26	-11	-2
Wholesale - processed oranges	All	-9	-10	-4	-0.1
Orange growers	All	1,043	91	-16	0.1
	CA	1,063	74	-23	-1
	AZ-TX	-3	3	2	0.9
	FL	-17	14	5	0.1
TOTAL WELFARE IMPACT	**ALL**	**-1,240**	**-75**	**-77**	**-4**

[1/] Over 30 years, undiscounted


Emerald Ash Borer Potential Spread Under Official Control
(52.9Km/Year)
Year 34
Year 10
Canton, MI
Year 17
Year 19
Source: USDA APHIS EAB Program
Created by: Y. Takeuchi, L. Garrett, and T. Vo.
Date: October 7, 2014
Projection: USA Contiguous Equidistant Conic
1:20,000,000
0 237.5 475 950 1,425 1,900 Km
N
EAB Infested Area
EAB Potential Spread
Year 1
Year 2
Year 3
Year 4
Year 5
Year 6
Year 7
Year 8
Year 9
Year 10
Year 11
Year 12
Year 13
Year 14
Year 15
Year 16
Year 17
Year 18
Year 19
Year 20
Year 21
Year 22
Year 23
Year 24
Year 25
Year 26
Year 27
Year 28
Year 29
Year 30
Year 31
Year 32
Year 33
Year 34

Results of Impact Analysis of the Emerald Ash Borer Program

Estimated damages, losses, and program costs	With Program (40.6 km) 44 years until colonization	With Program (52.9 km) 34 years until colonization	Without Program (240 km) 8 years until colonization
	Present values in US$ millions		
Damages from newly infested area until colonization	3,707	3,820	6,224
Avoided losses (without program – with program)	2,517	2,404	-
Program cost until colonization	692	619	0
Net benefit (avoided losses – program cost)	1,825	1,725	-
Benefit-cost ratio	3.6	3.9	



Results of Impact Analysis of the Pink Bollworm Program in the United States

Estimated values	With Program	No Program
	Present value over 33 years (US$1,000)	
Losses (AZ, CA, NM, TX)[/1]	24,270	186,709
Avoided losses (with program – without program)	162,439	
Program costs	159,597	
Net benefits (avoided losses – program cost)	2,842	
Benefit-cost ratio	1.02	

[1/] At the mean

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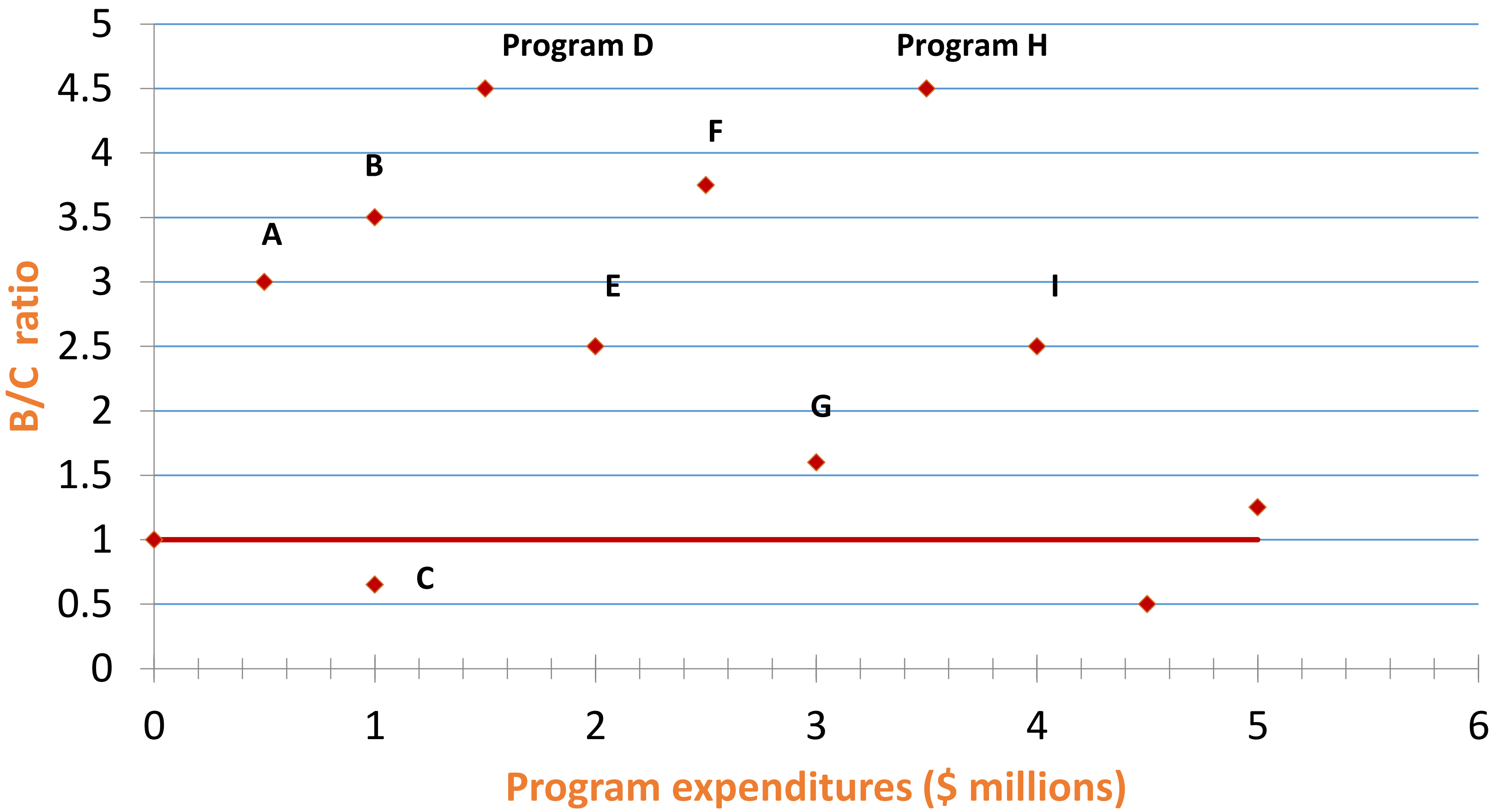
How Measures are Used for Prioritizing Programs



Thank you!

QUESTIONS or COMMENTS, send to:

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