ALL ABM Update

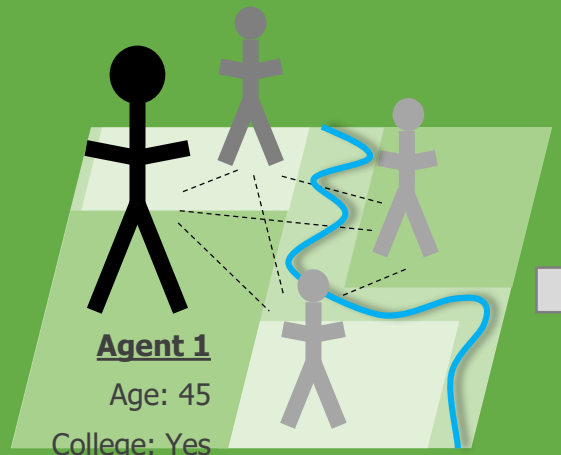
Getting to Zero P with NMPs on the Landscape

BREE 2018 All Hands Meeting

12 June 2018

E. M. B. Doran, PhD
Postdoctoral Researcher

Part I: Farms



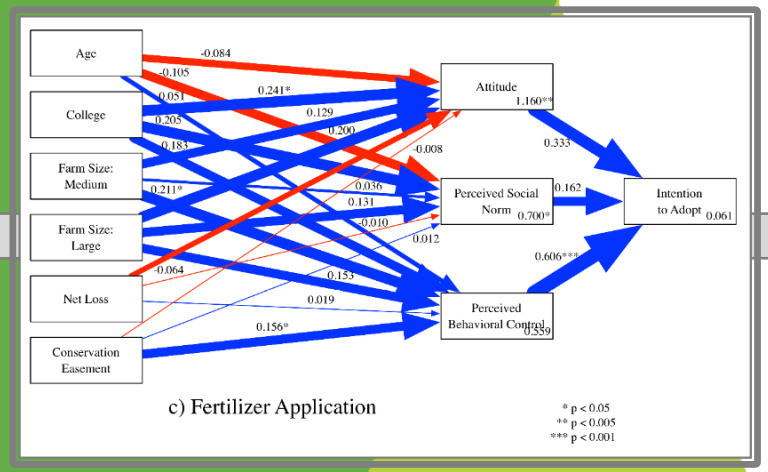
Agent 1

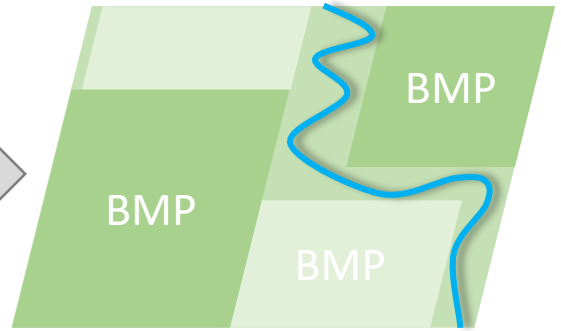
Age: 45

College: Yes

Farm Size: 14 acres

Land use type: Crop

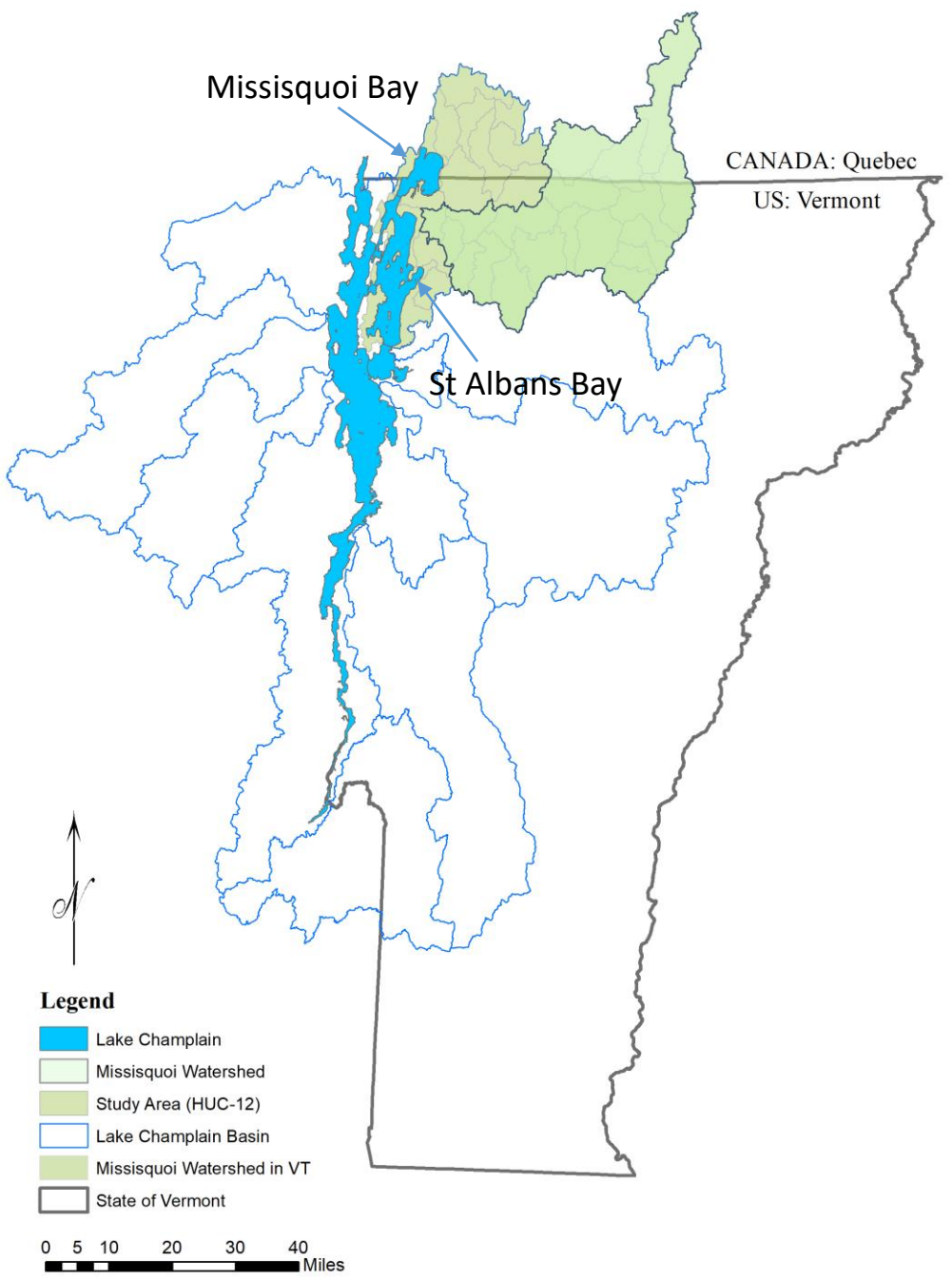




The University of Vermont

The Problem

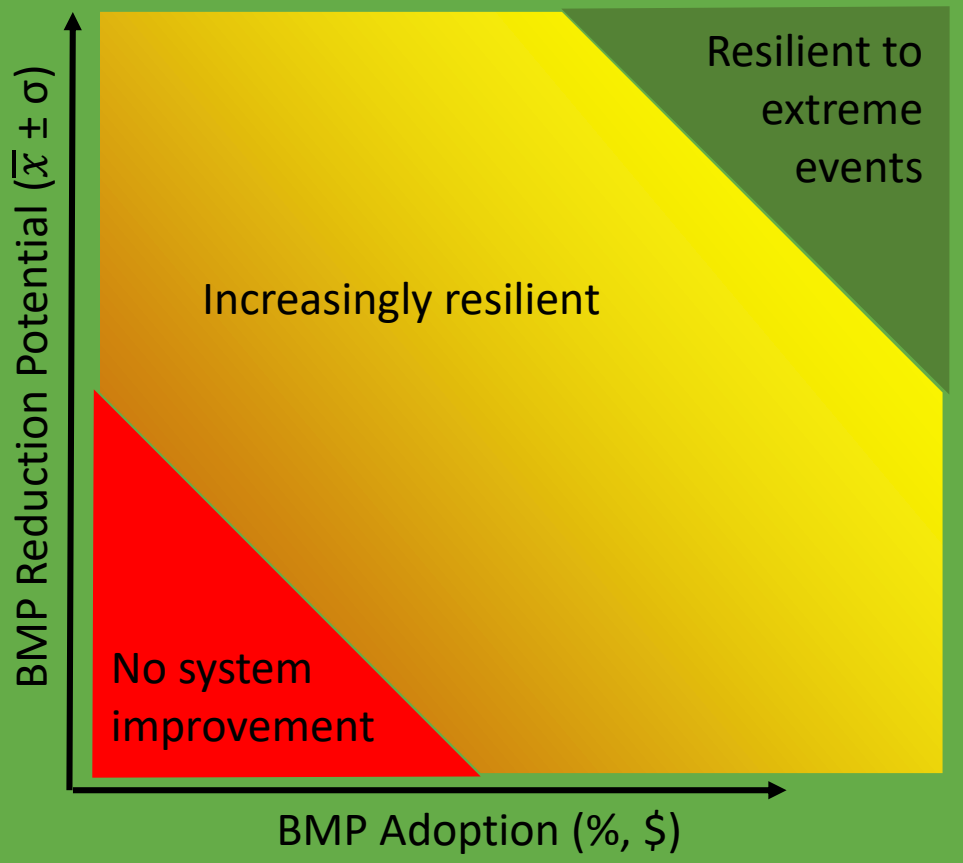
Excessive nutrient pollution (phosphorus, P) entering Vermont's rivers and water bodies leading to *harmful algal blooms* (HABs).



PC: Burlington Free Press

The Question:

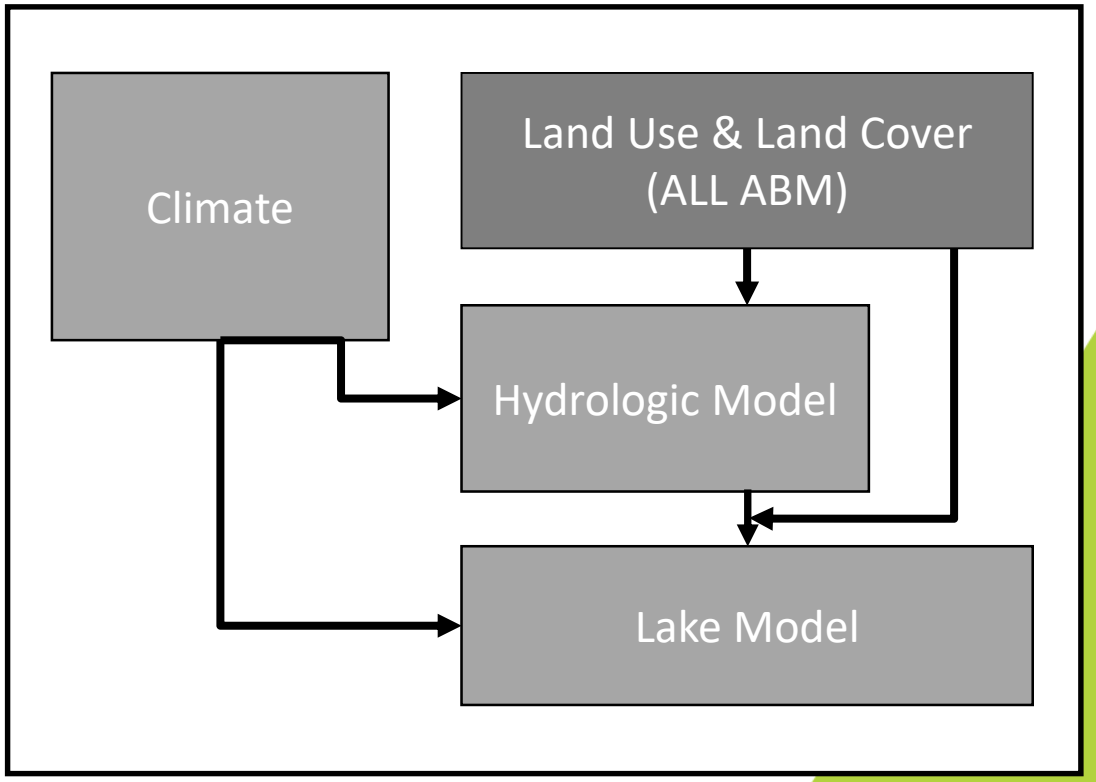
What level of efficacy and adoption of (or investment in) ***nutrient management practices*** (NMPs) by **individuals** across the landscape will lead to improved resilience in water quality conditions in Lake Champlain's impacted bays under *extreme event and future climate scenarios*?



Approach

Use an **integrated assessment model (IAM)** linking climate, land use and land cover, hydrology and lake dynamics to explore phase space of intervention and action on system resilience to extreme events and future climate scenarios.

IAM Model Cascade



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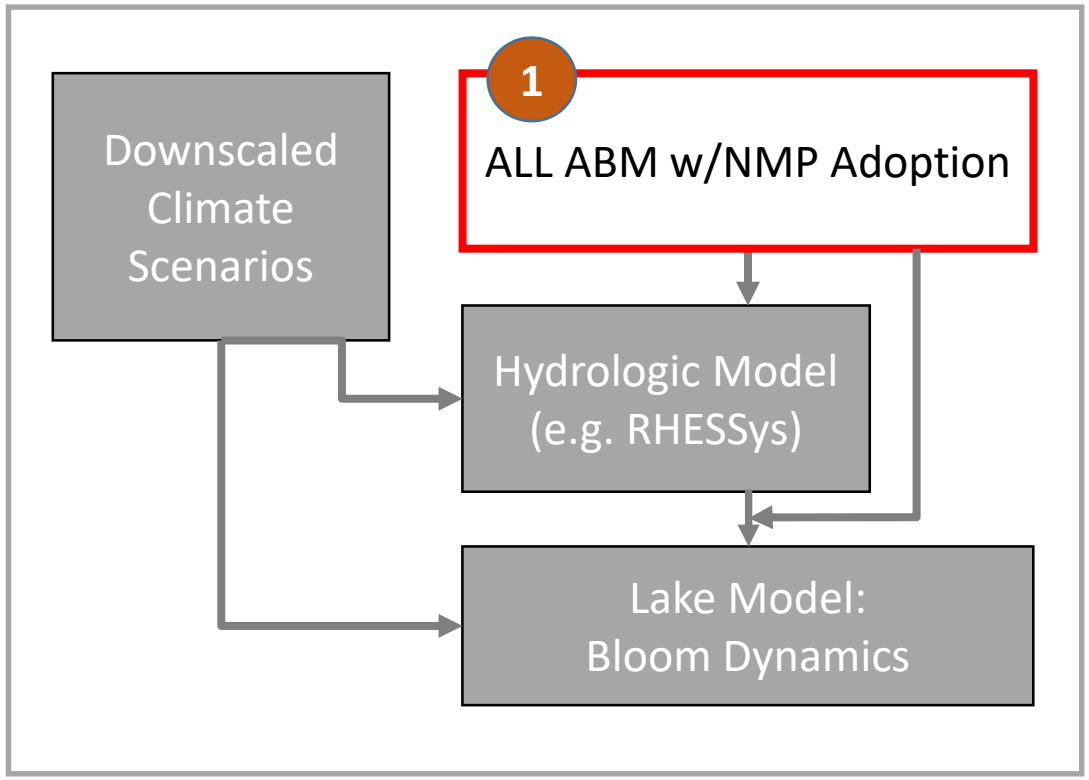
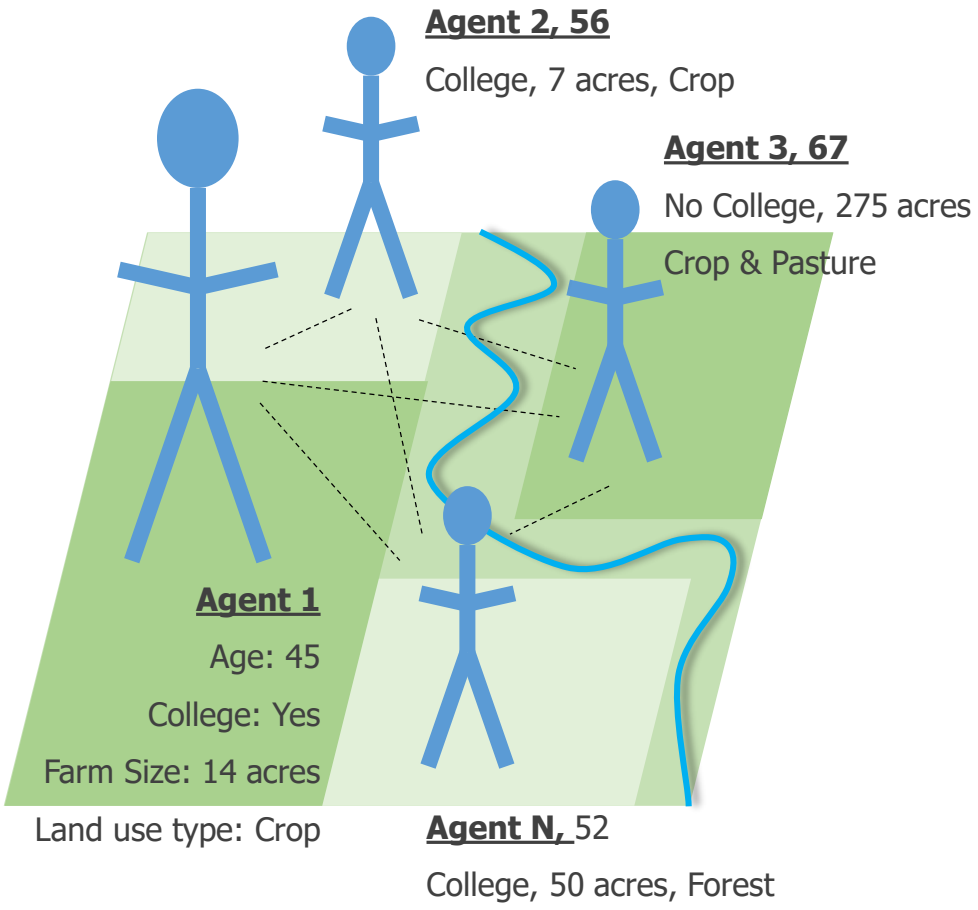


Major model changes:

1 NMP Adoption

Land Use Agent Based Model



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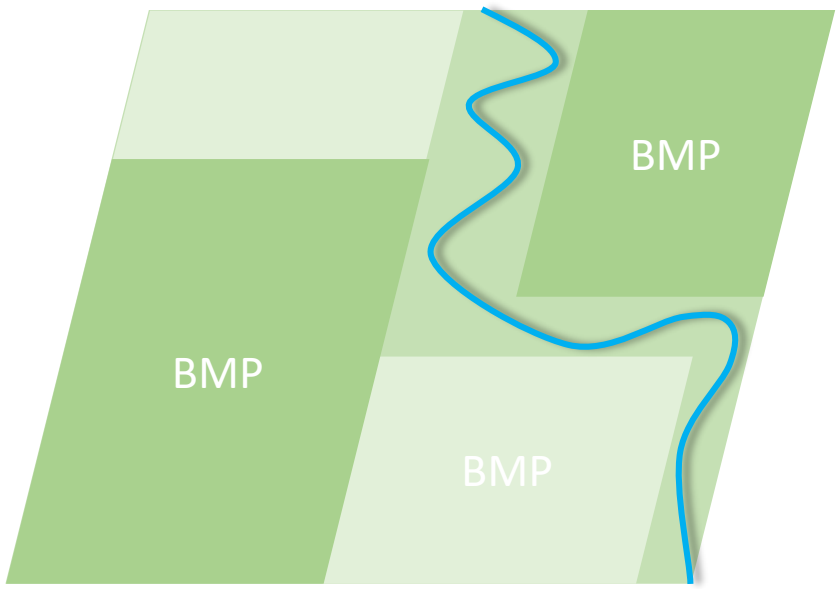
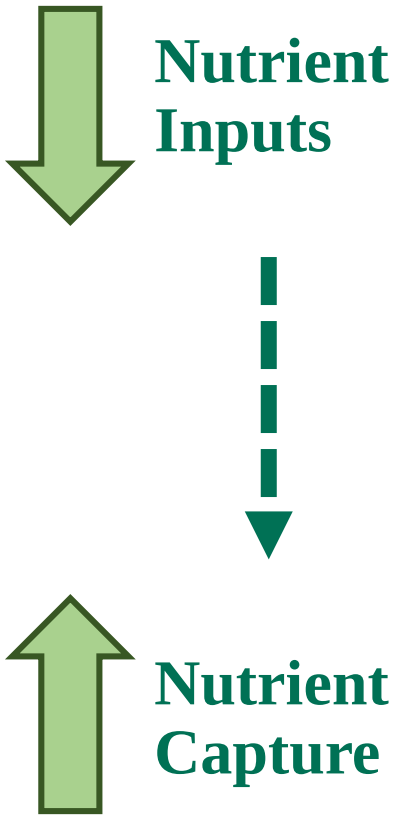


To reduce excess nutrient input to lake, suite of ***Nutrient Management Practices*** (NMPs) implemented across the watershed.



PC: VPR; St Albans Messenger;

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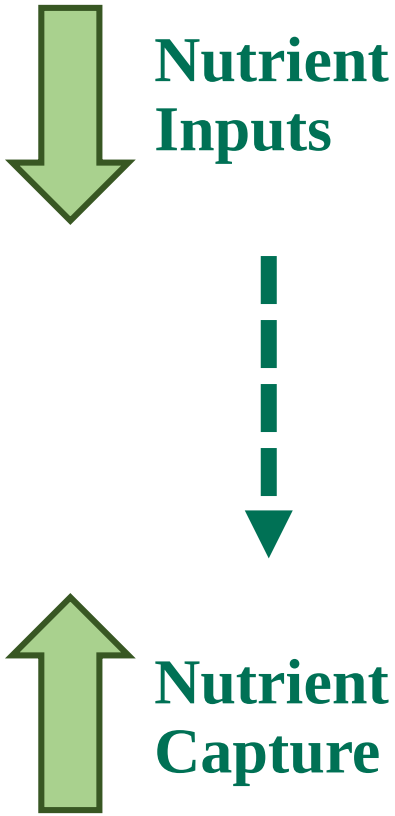
Landowner Populations

Farmers (9 BMPs)	Households (7 BMPs/GSI)	Foresters (TBD AMP)	Firms (TBD GSI)



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Nutrient Inputs

Nutrient Capture

Fertilizer application based on soil testing

Reduced Tillage

Conservation Buffers

Low P Lawn Fertilizer

Picking up dog waste

Rain Barrels

Rain Gardens

Temporary Skidder Bridge

Low/No P Lawn Fertilizer

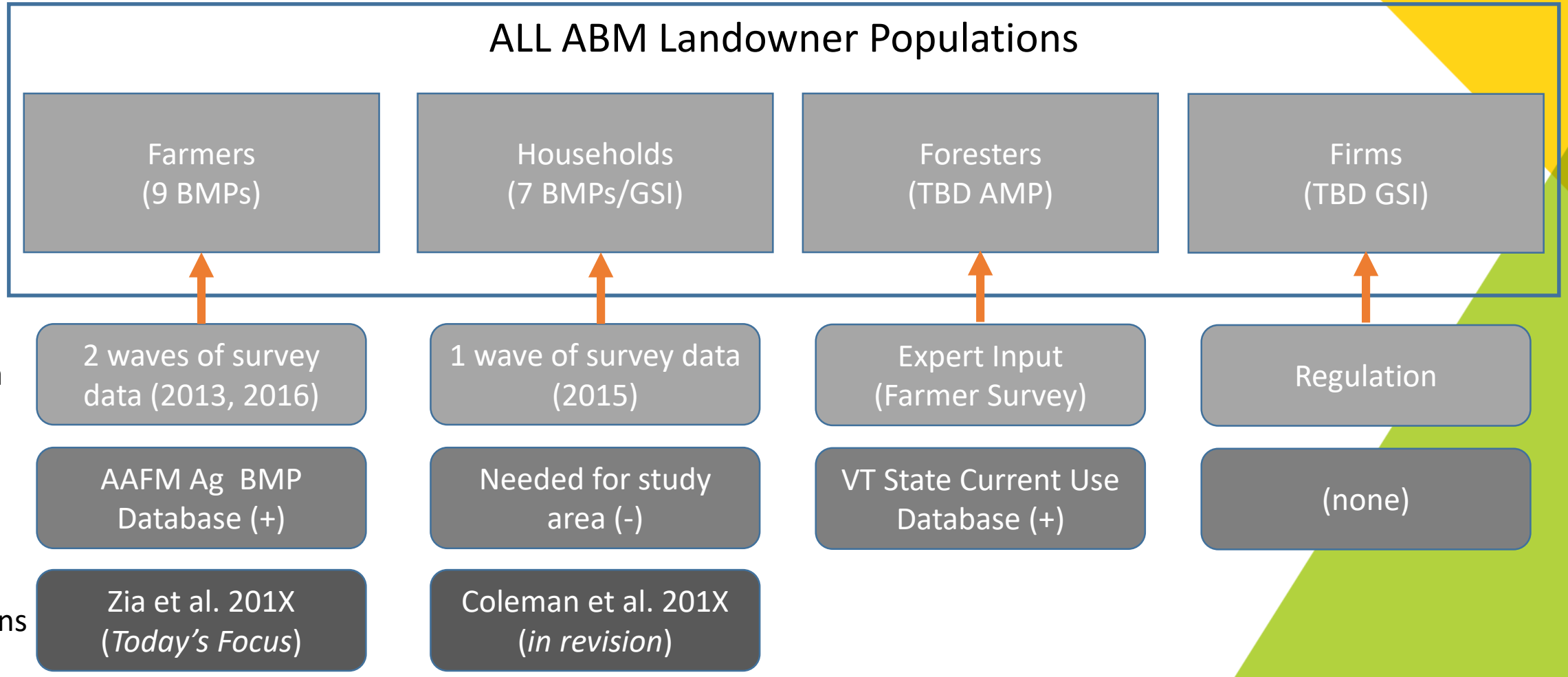
Pervious Pavement

Constructed Wetlands

Retention Ponds

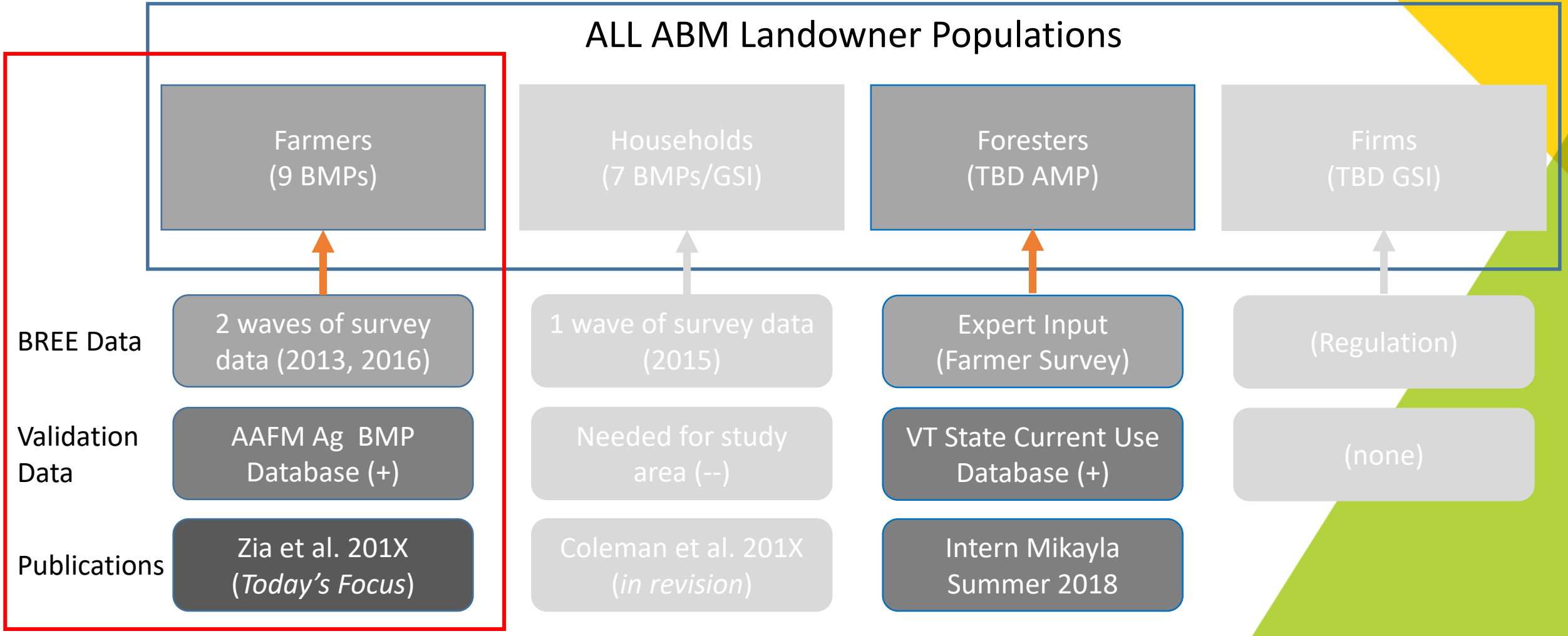
PC: VPR; St Albans Messenger;

BMP Adoption within BREE ALL ABM



Not shown: Municipal Agents in the GovNET model (19 BMP/GSI); Streams/Roads

BMP Adoption within BREE ALL ABM



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Who, and how likely are people – *farms* – to adopt specific best management practices?

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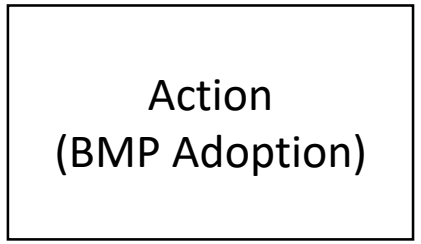
Theory of Planned Behavior (TPB) to build a model of likely adoption for *each* BMP

Theory of Planned Behavior Structural Equation Models

(Azjen, 1991)



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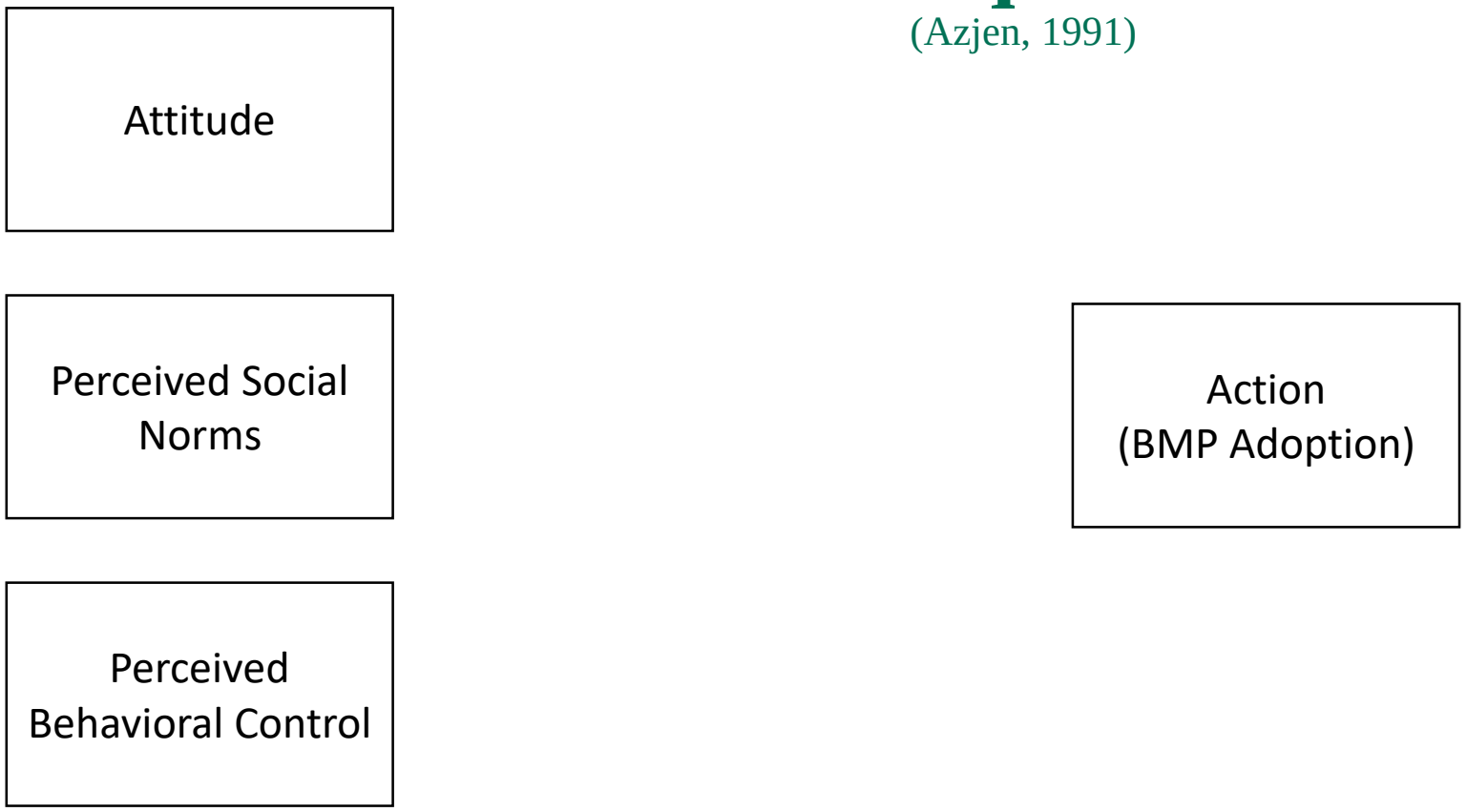

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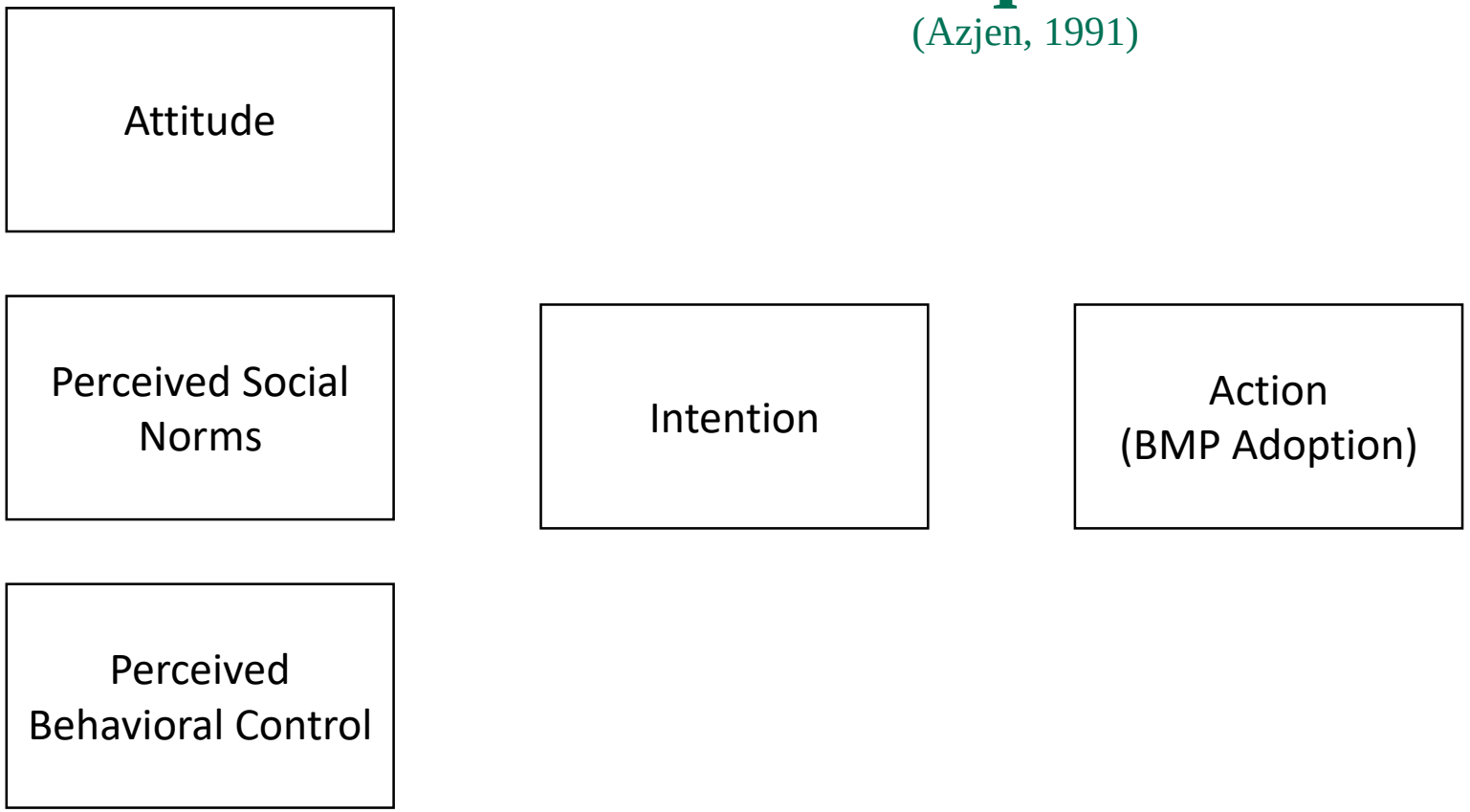

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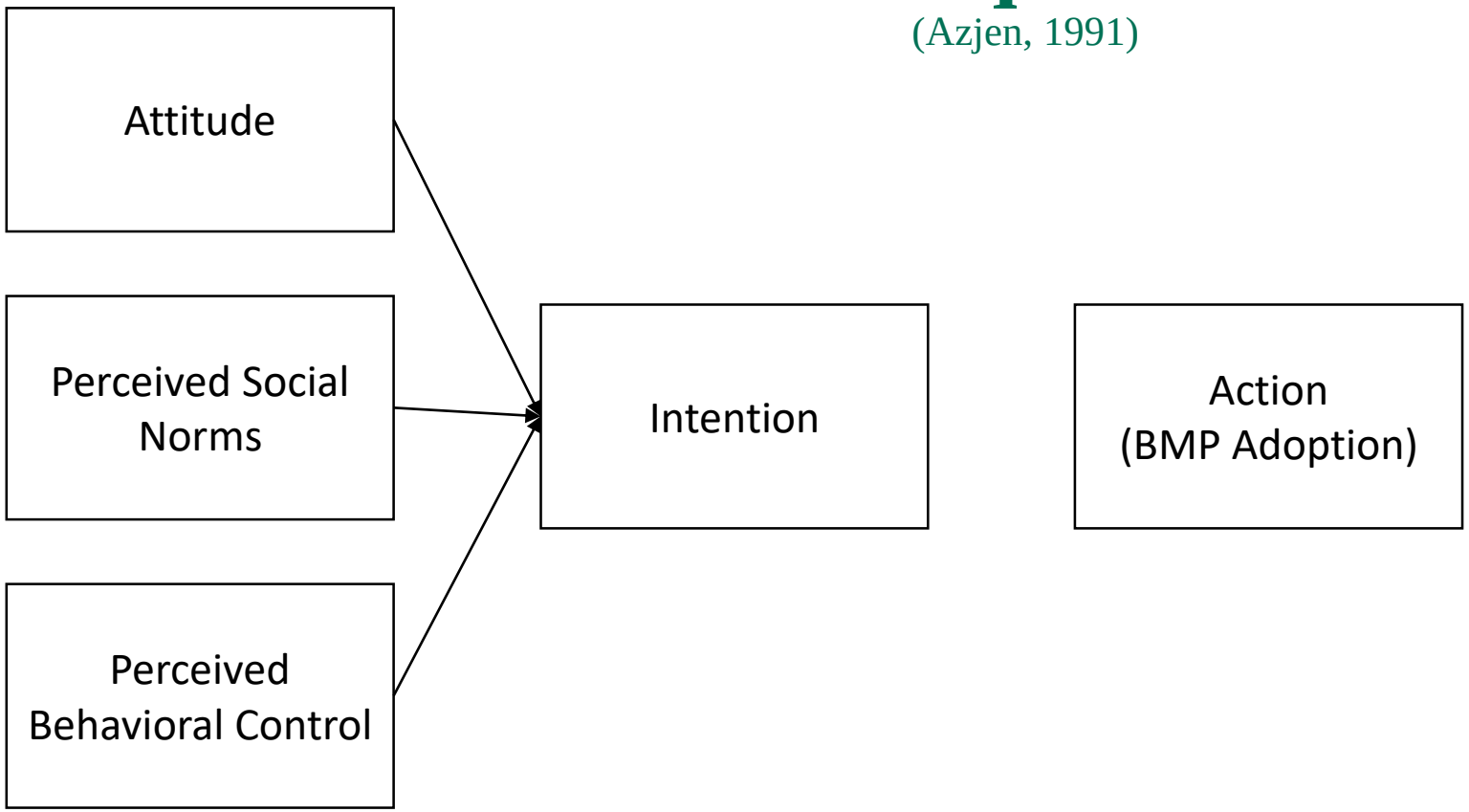

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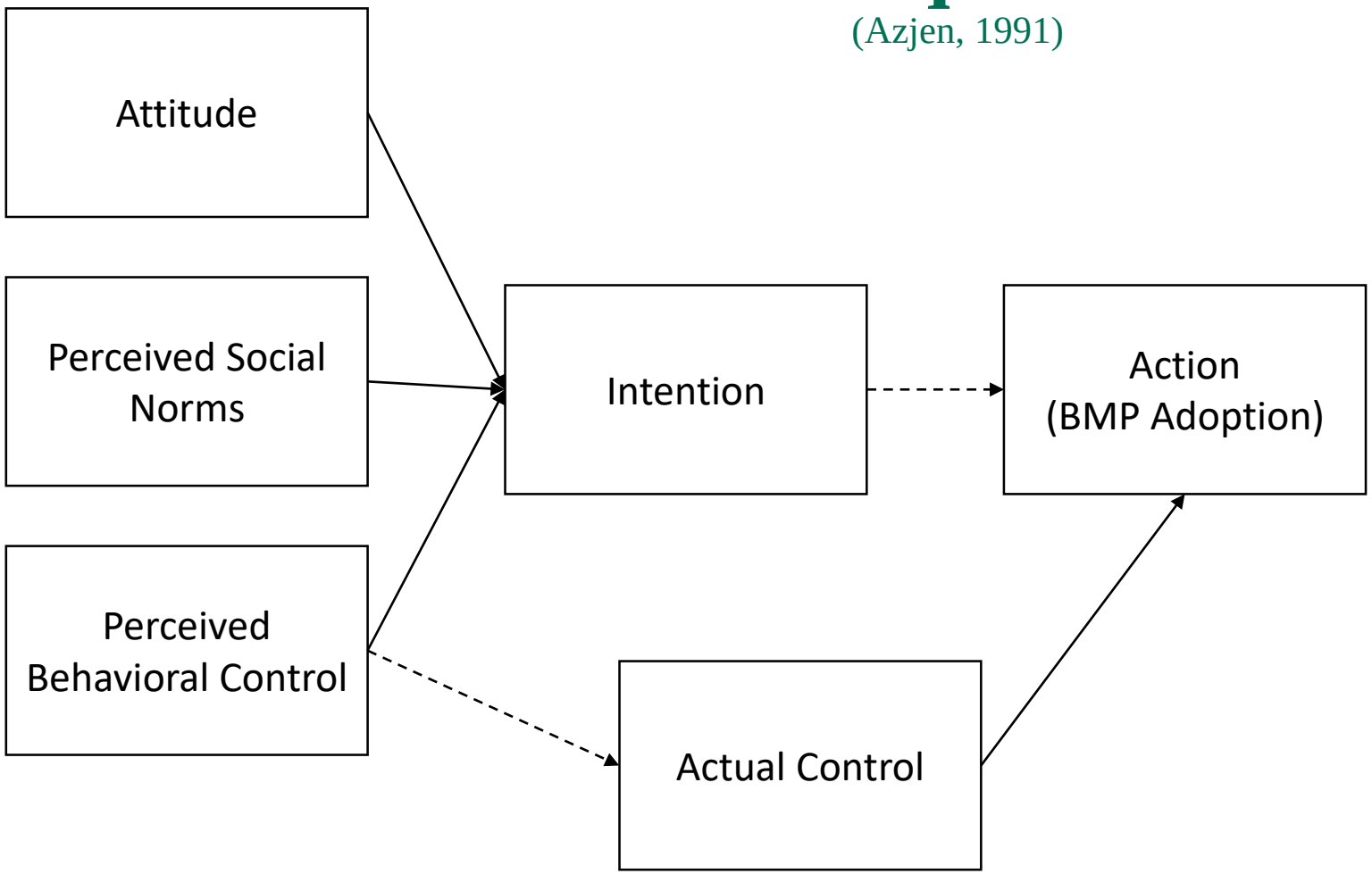

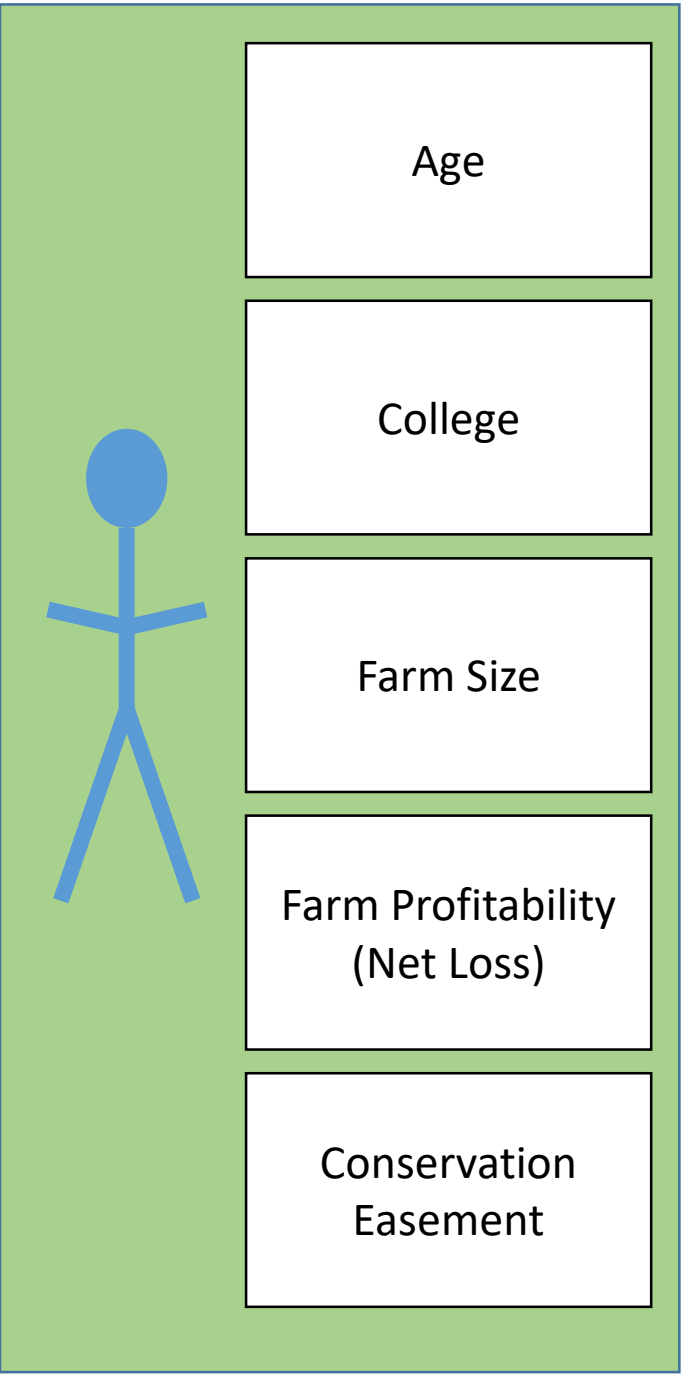

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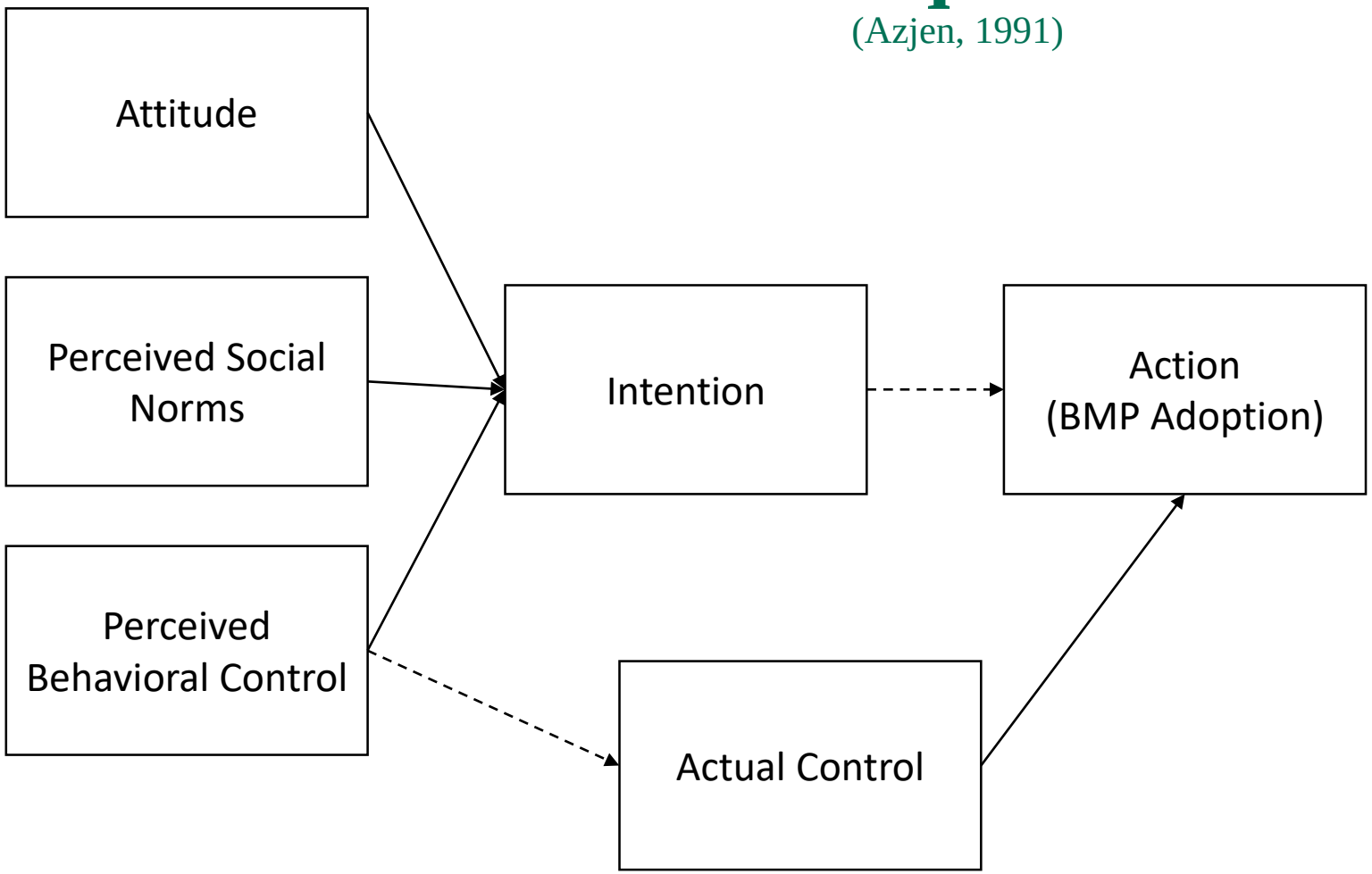

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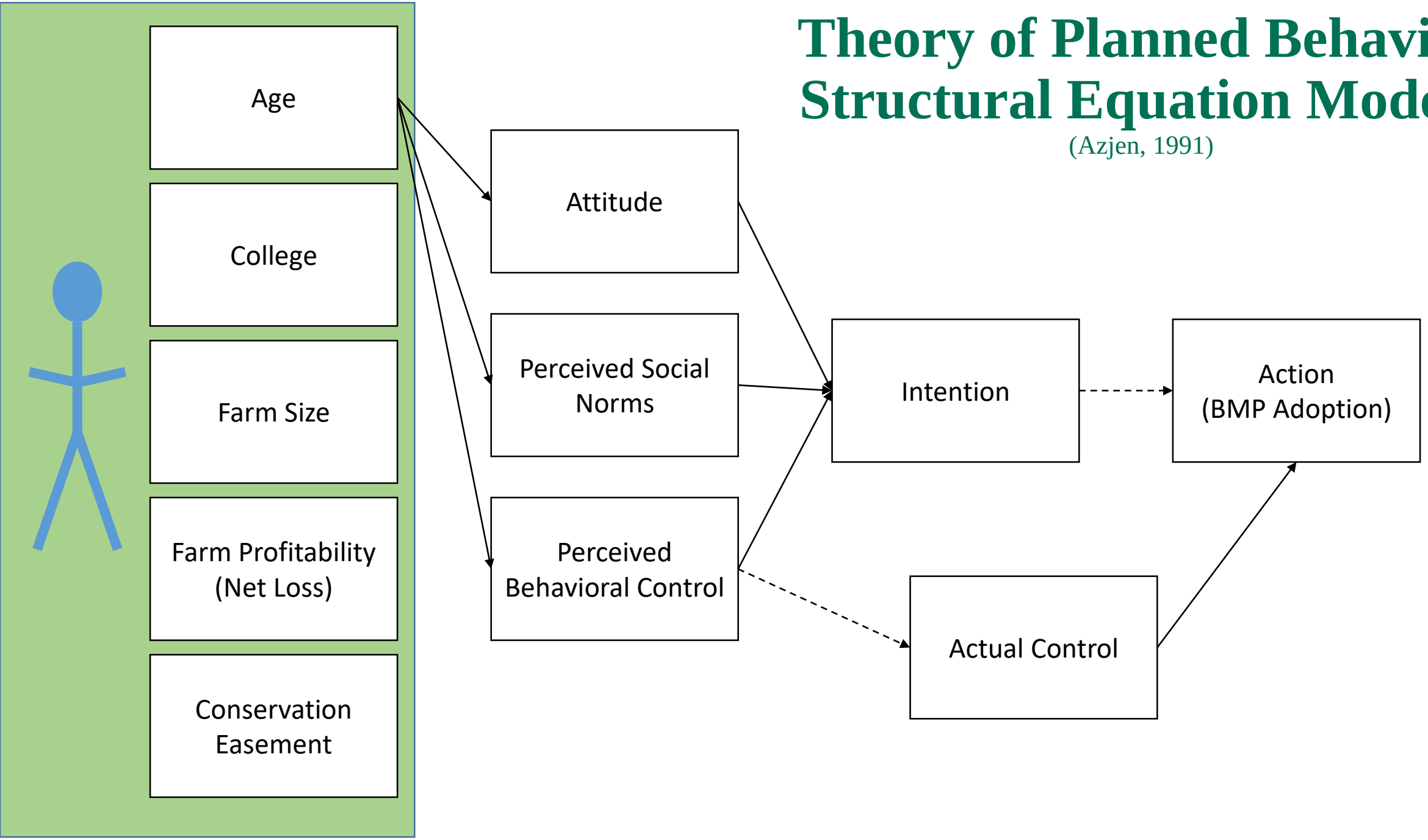

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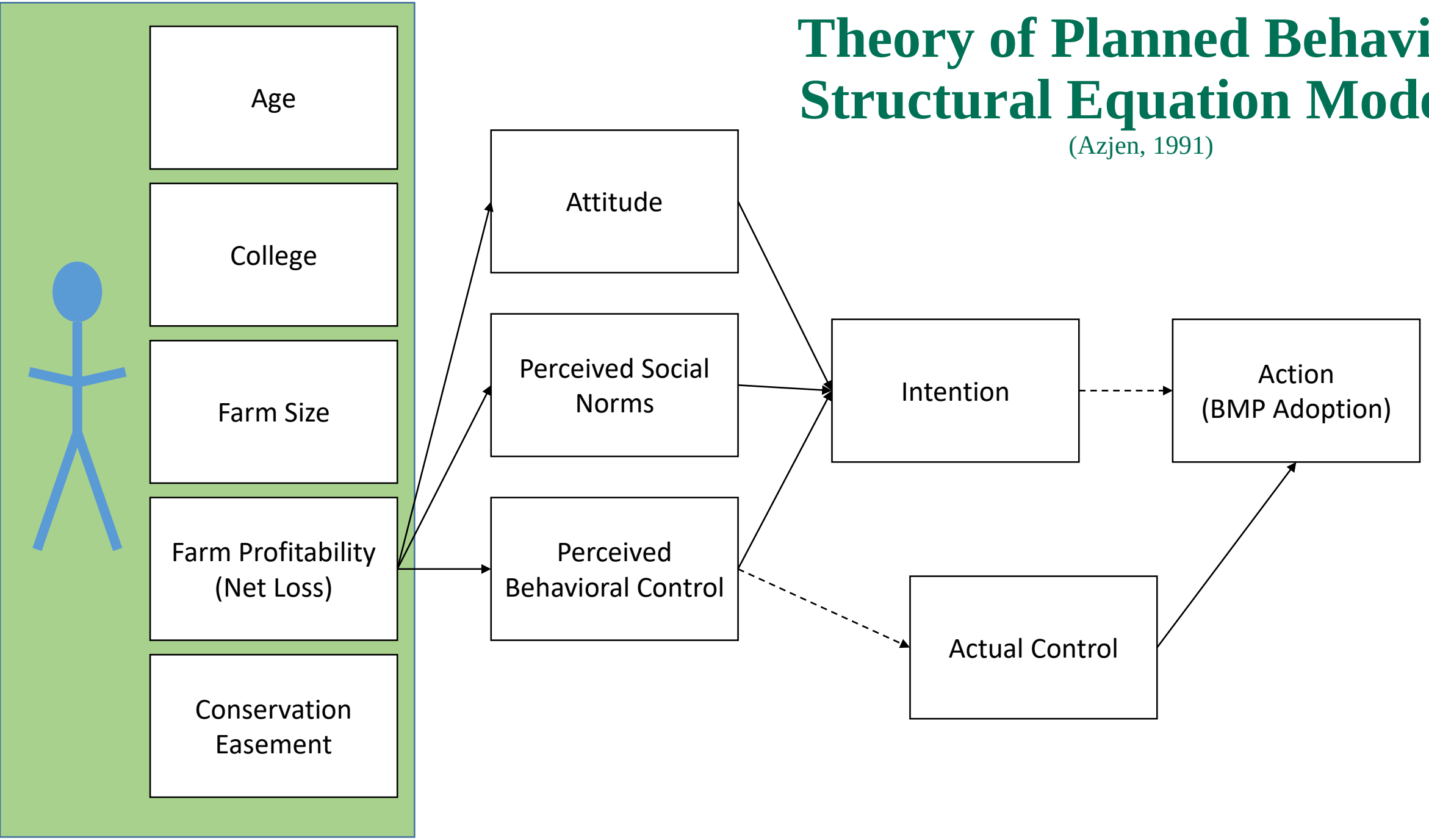

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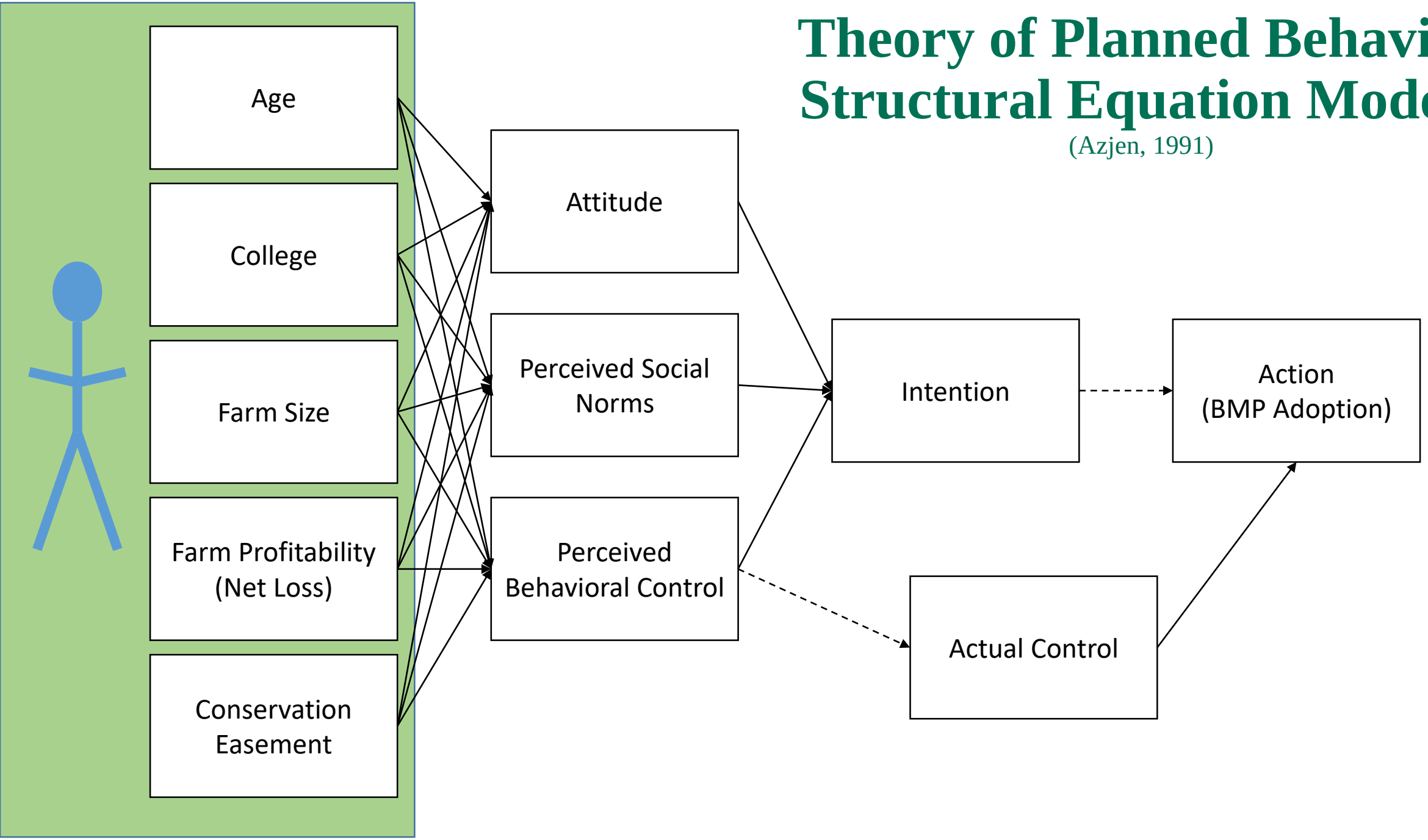

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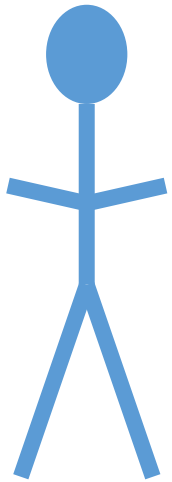


Age

College

Farm Size

Farm Profitability (Net Loss)

Conservation Easement

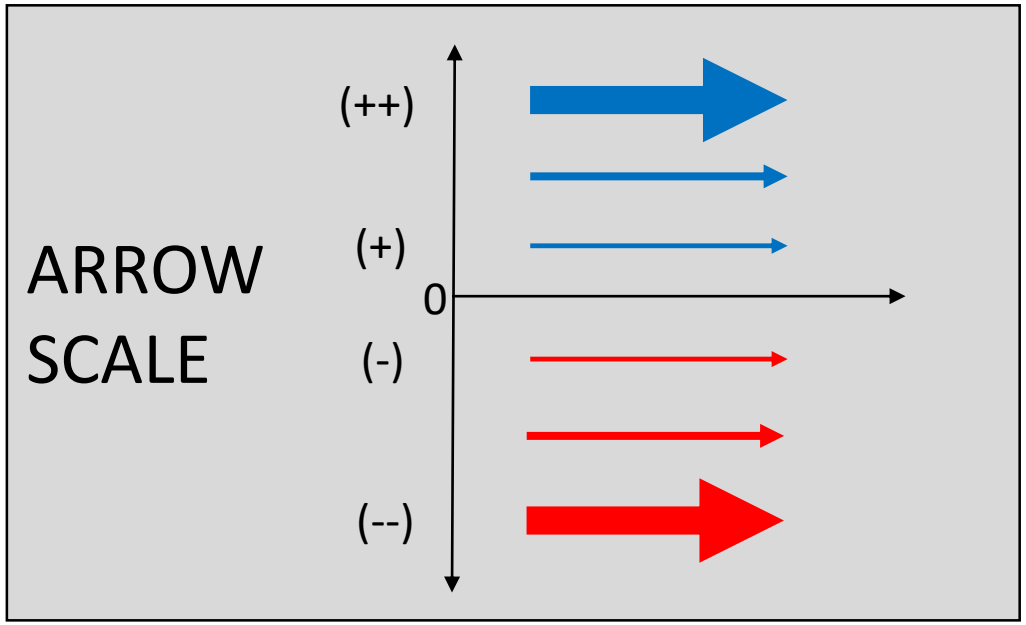
Attitude

Perceived Social Norms

Perceived Behavioral Control

Intention

Action (BMP Adoption)



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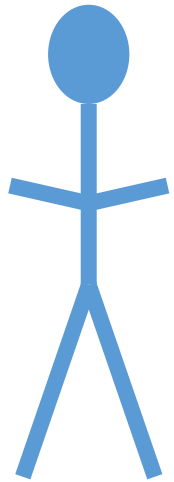

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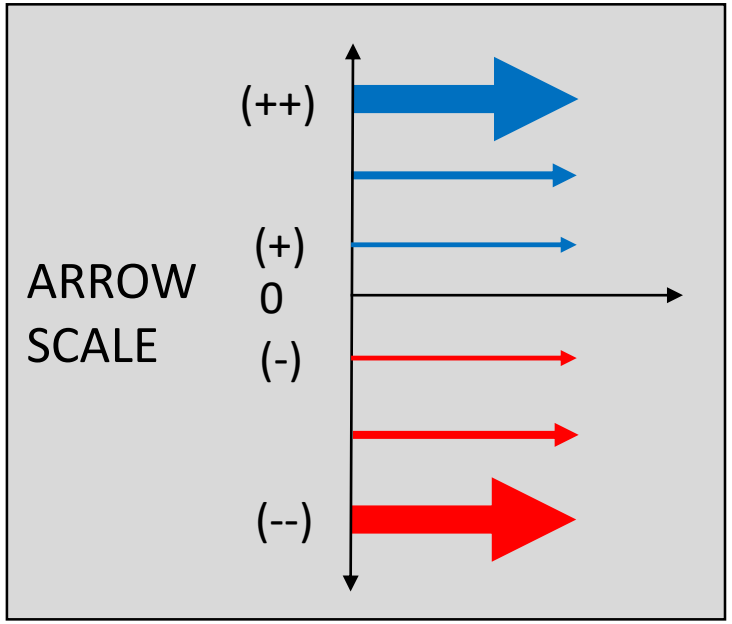
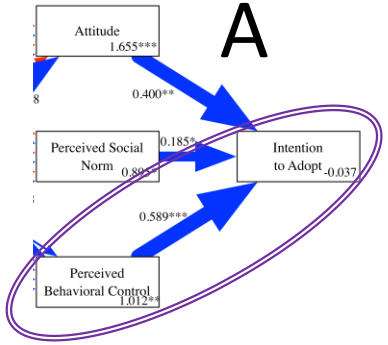
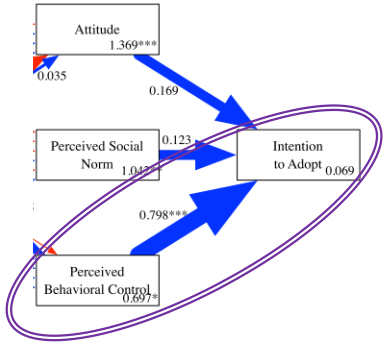


Nutrient Inputs

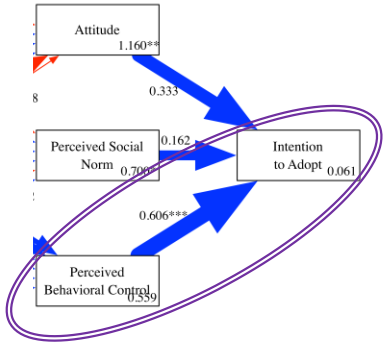
A



a) Soil Testing



b) NPK Application

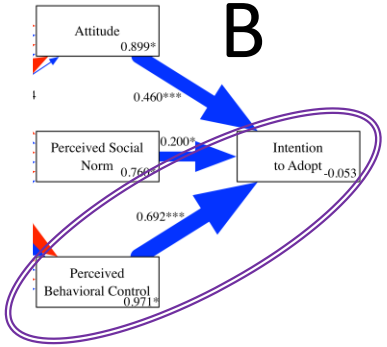


c) Fertilizer Application

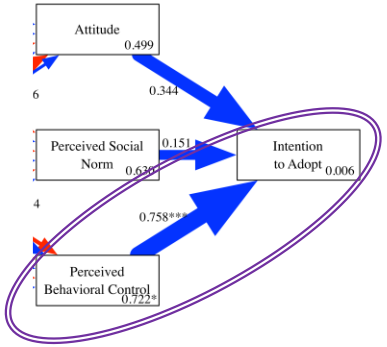
P. Behavioral Control

Cropping Practices

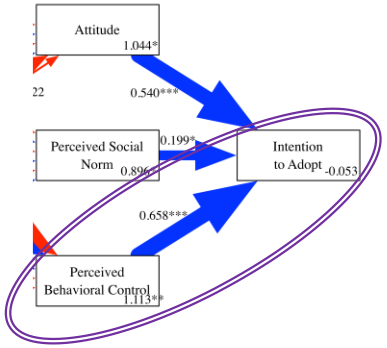
B



a) Planned Crop Rotations



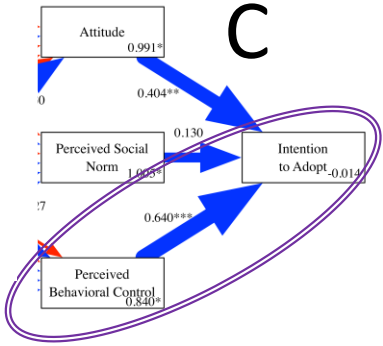
b) Strip Cropping



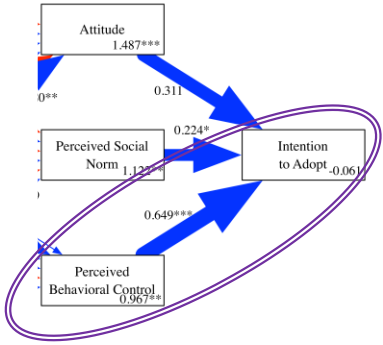
c) Cover Cropping

Nutrient Capture

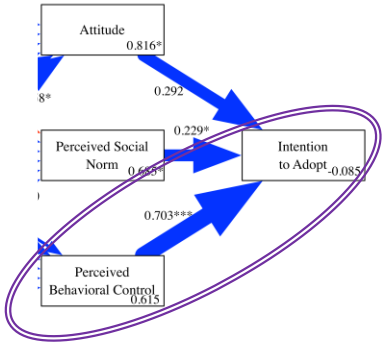
C



a) Reduced Tillage



b) Conservation Buffers



c) Manure Setbacks

* p < 0.05
** p < 0.005
*** p < 0.001

FIVE High Level Take Aways

1: ***Perceived Behavioral Control*** is the **largest and statistically significant** driver of farm intention to adopt for *all* BMPs measured.

2. Holding a ***Conservation Easement*** is a **statistically significant** (x4 BMPs) **positive** influence on ***Perceived Behavioral Control***.

3. Being a ***Large Farm*** and having a ***College Education*** each have a **positive** influence on adoption.

4. Experiencing a ***Net Loss*** in the last three years each have a **negative** influence on ***Attitude*** about all BMPs

5. Increased ***Age*** has a **negative** impact on Perceived Social Norms around BMP adoption.

Two General Observations

1: Cropping practices (x3) have similar patterns of influence

2: **Manure Setbacks BMP** has different pattern of influence compared to all the other BMPs measured

Theory of Planned Behavior
Structural Equation Models

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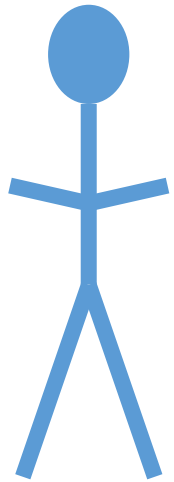

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Intention

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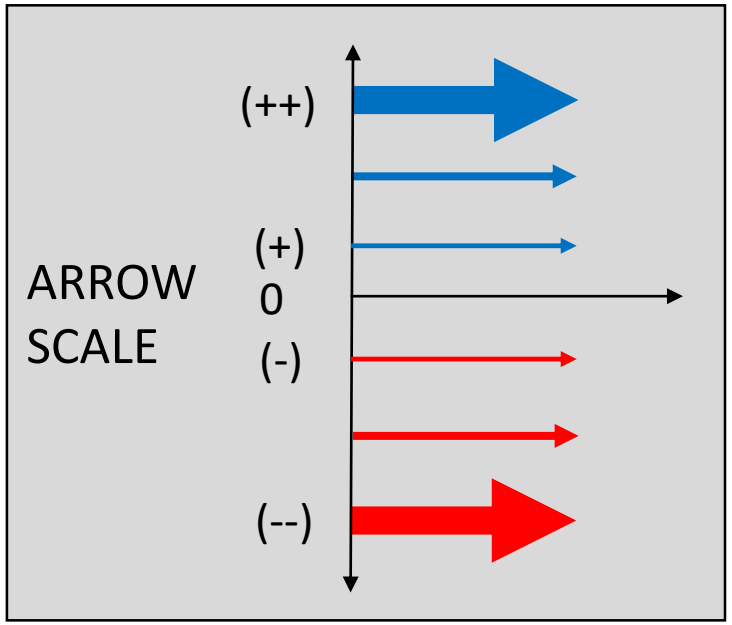

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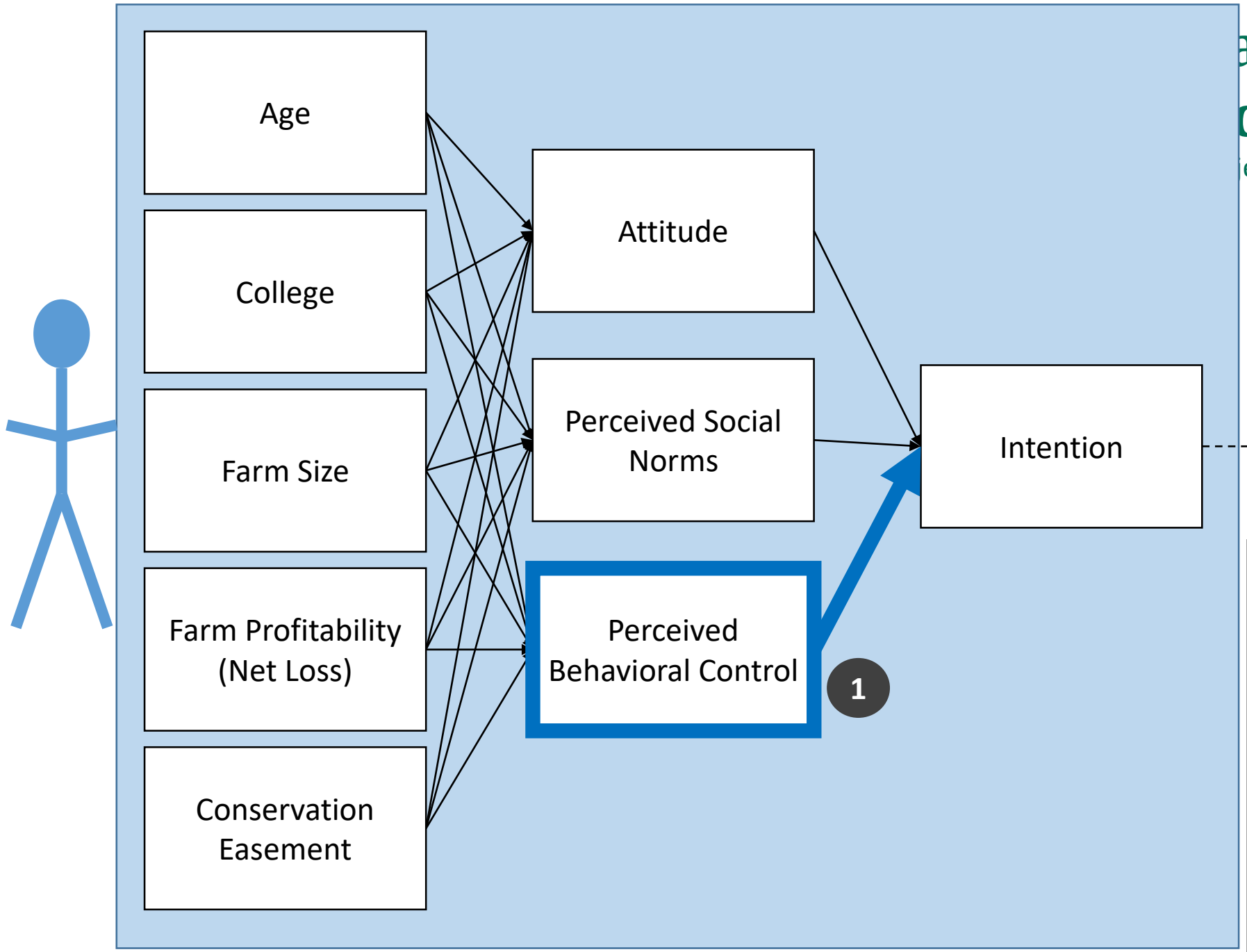

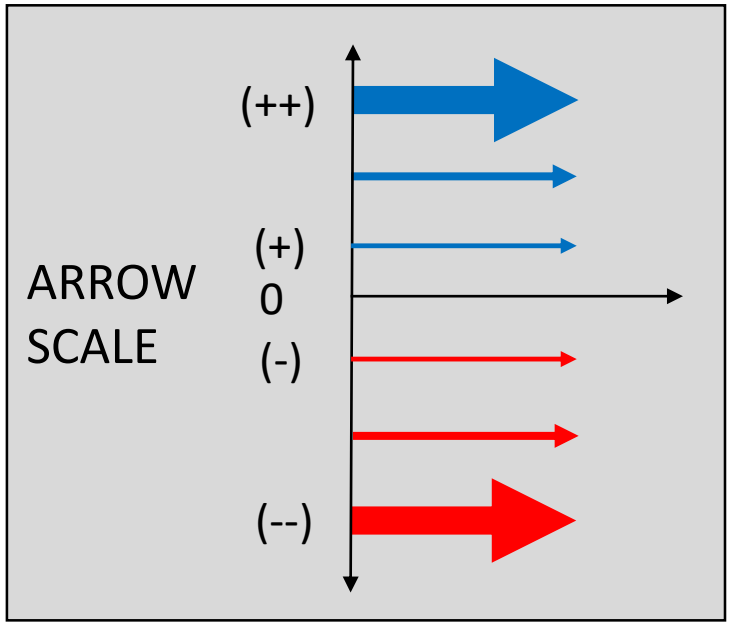

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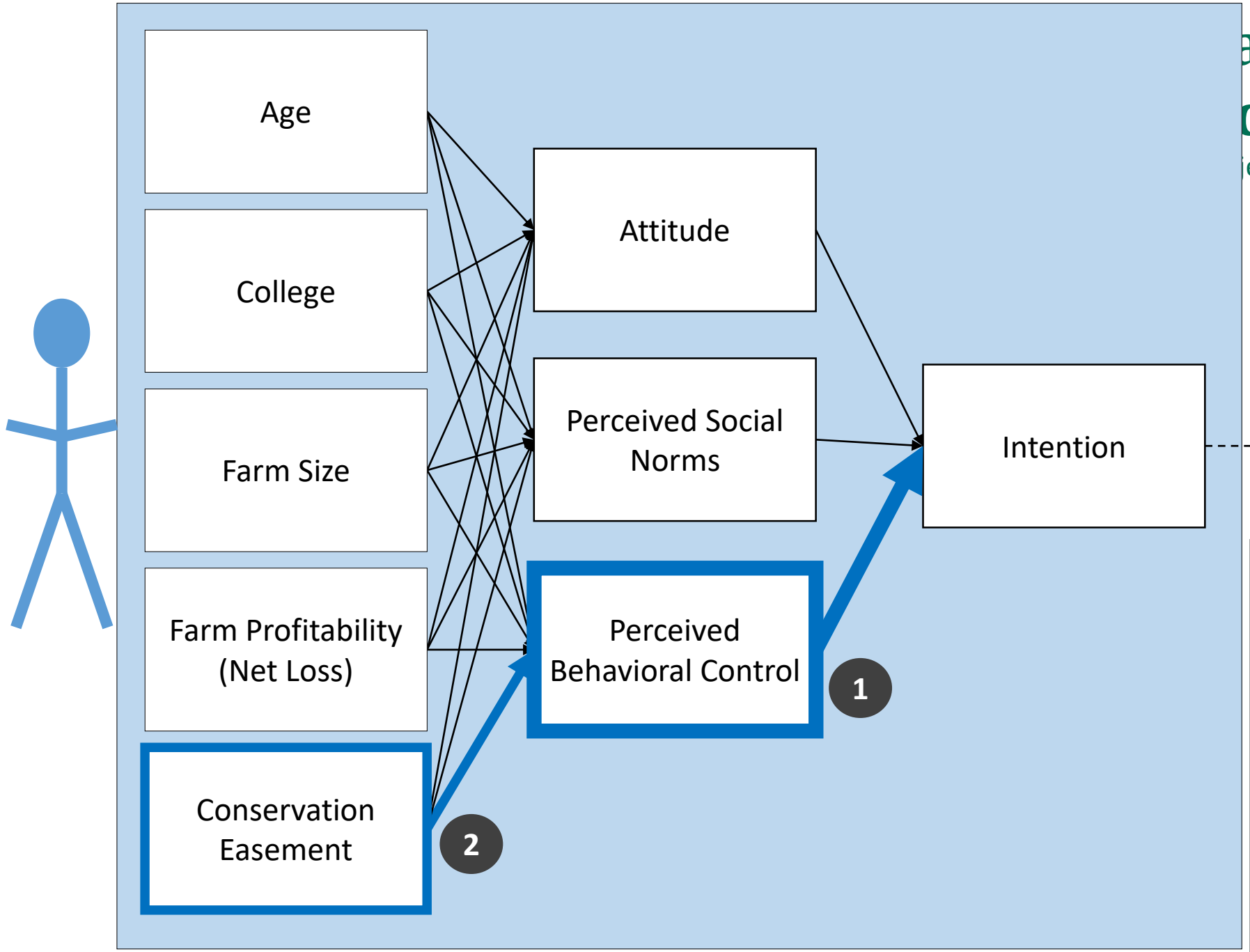

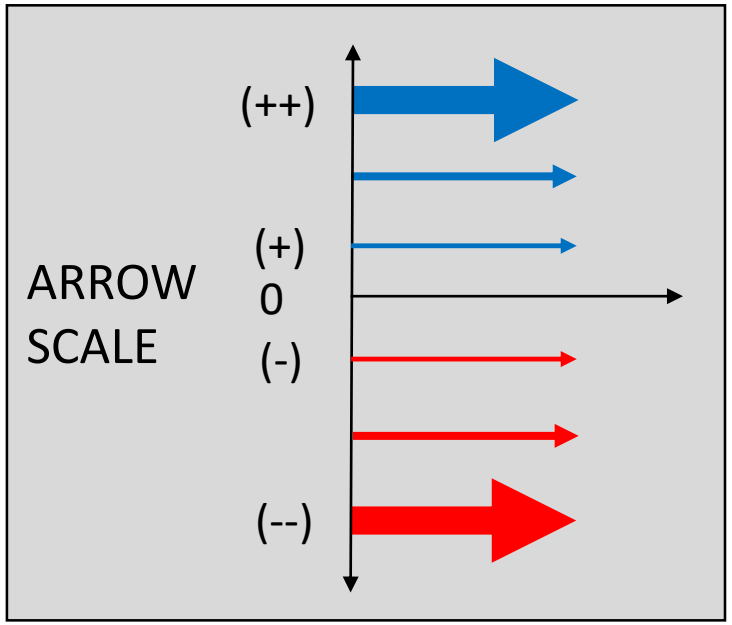

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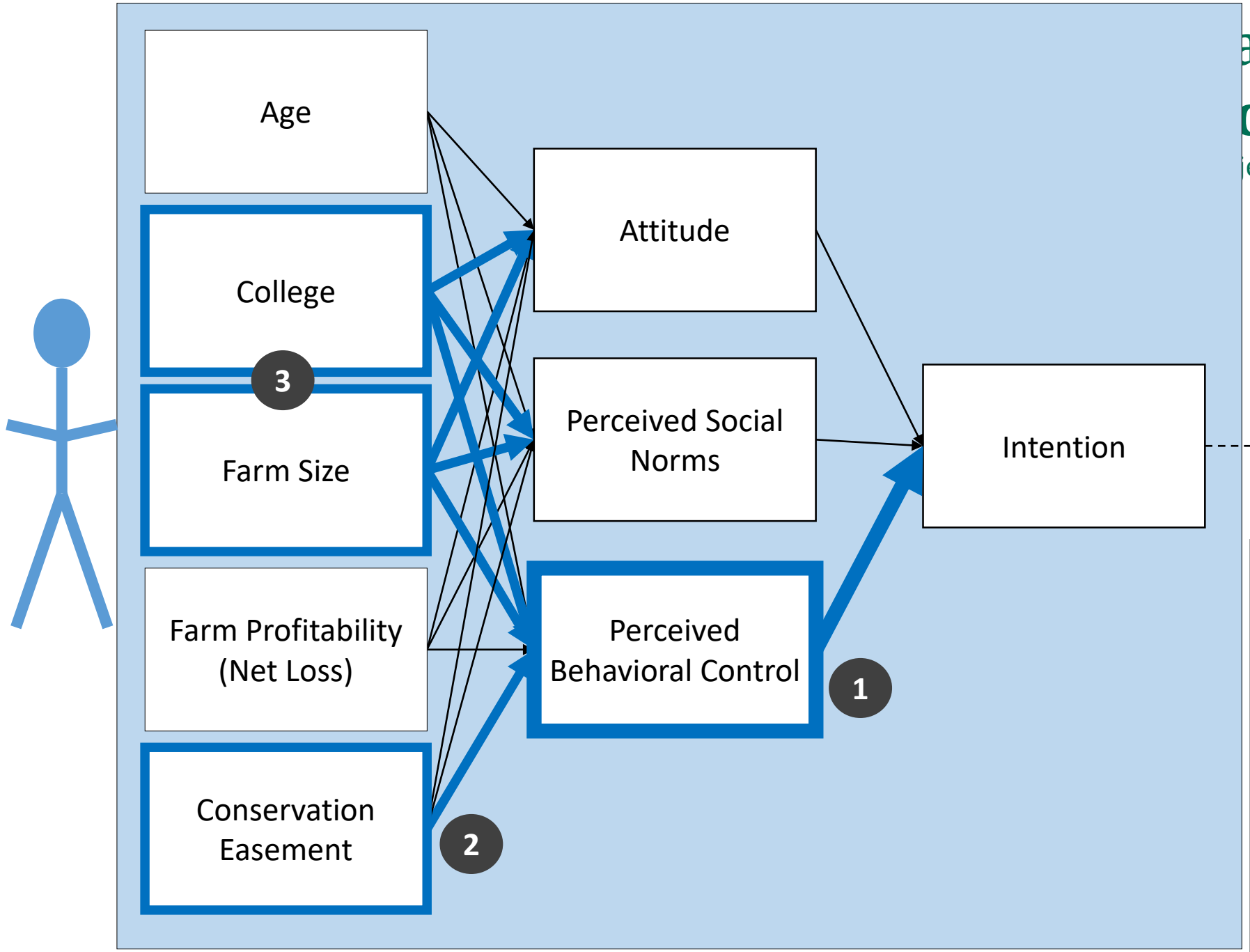

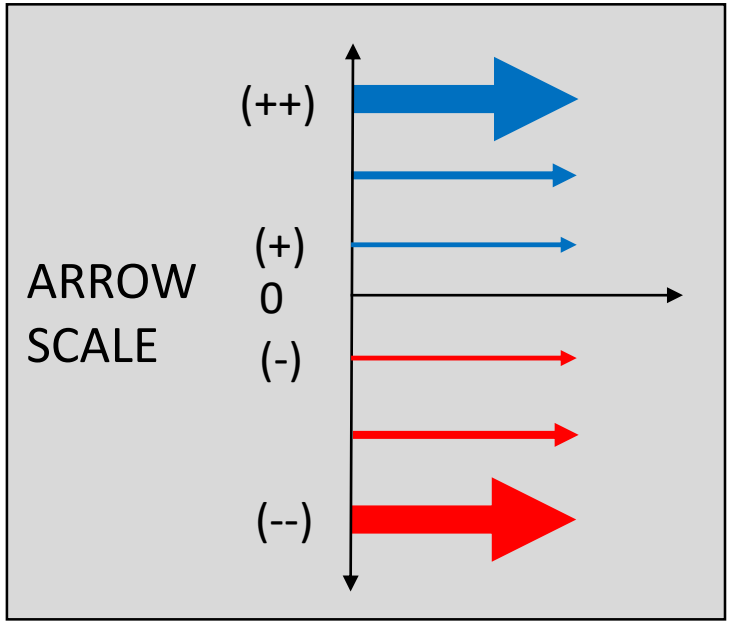

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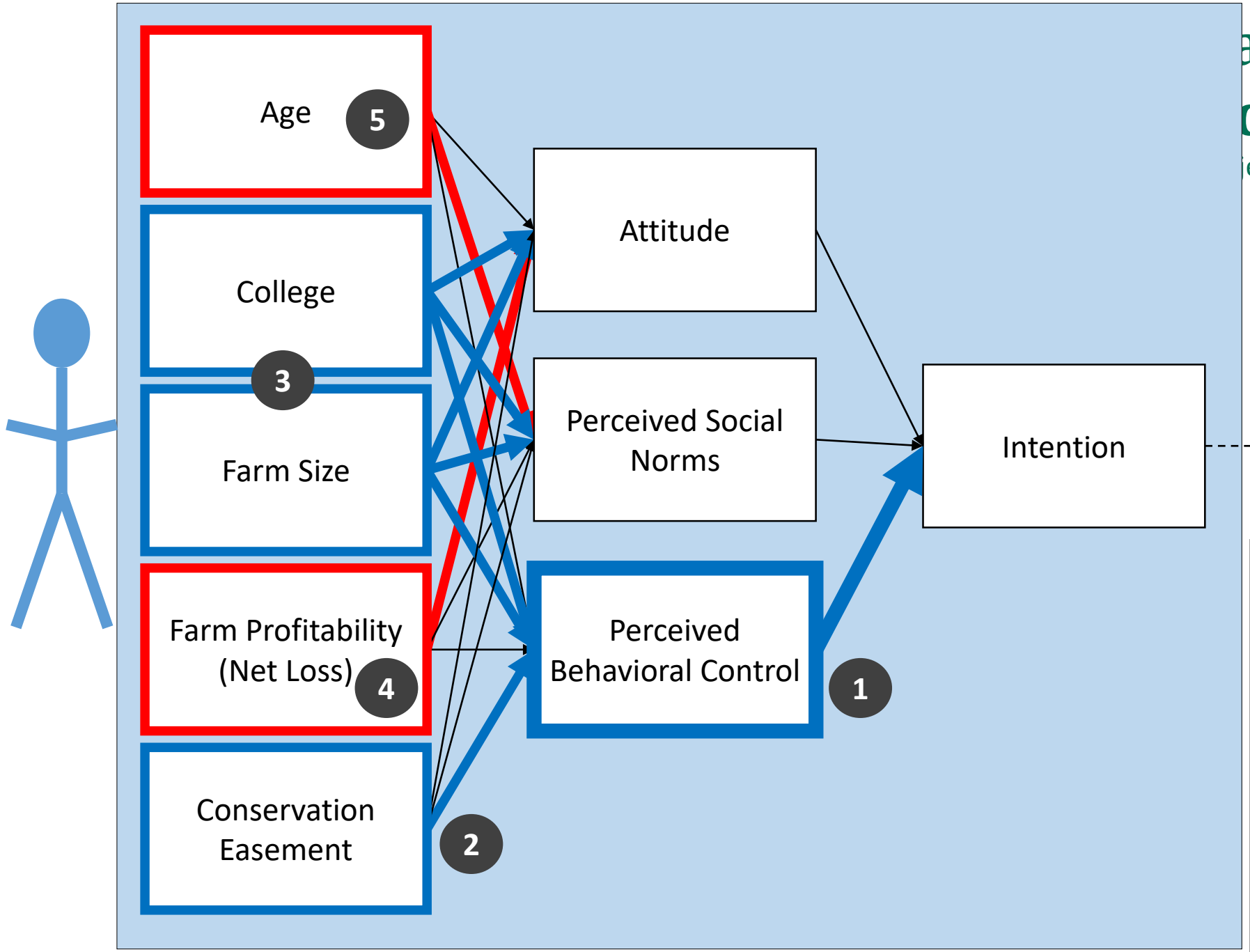

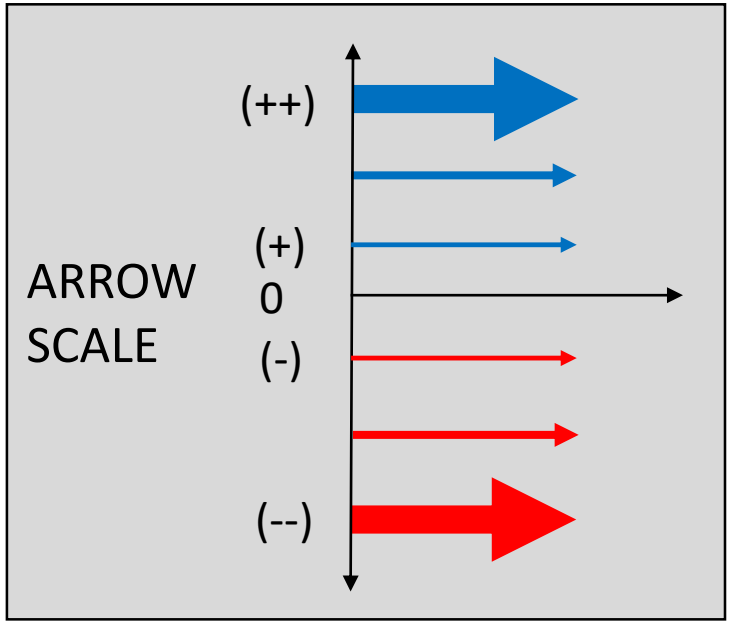

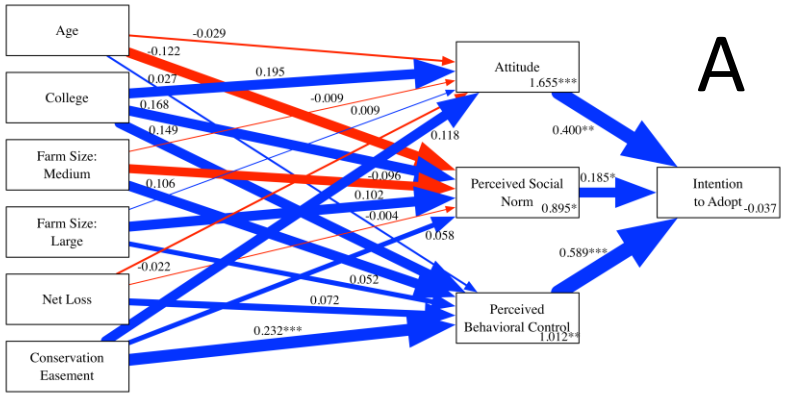

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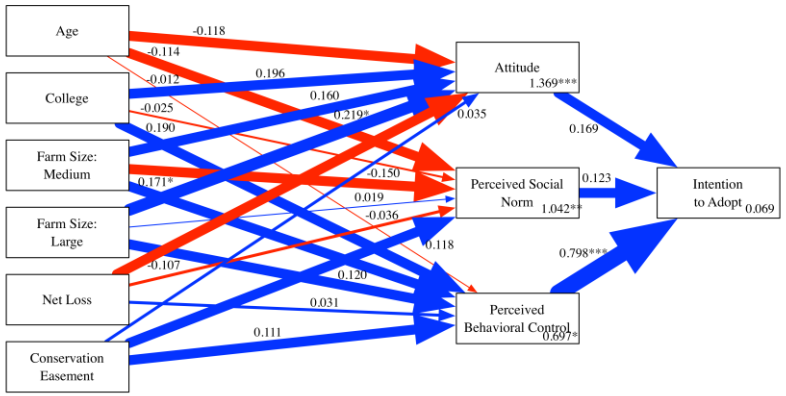

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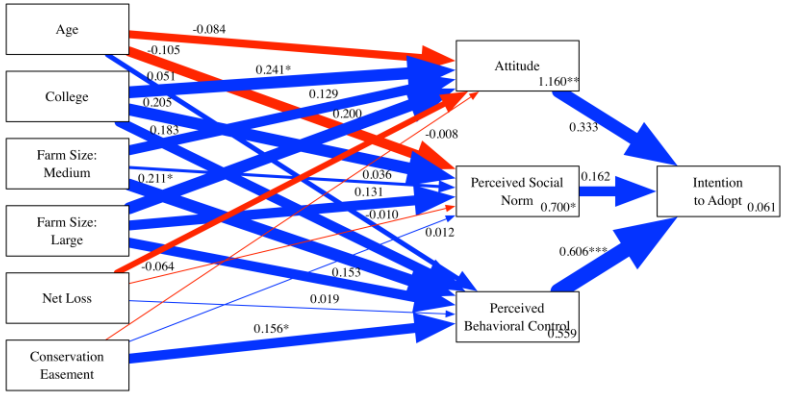

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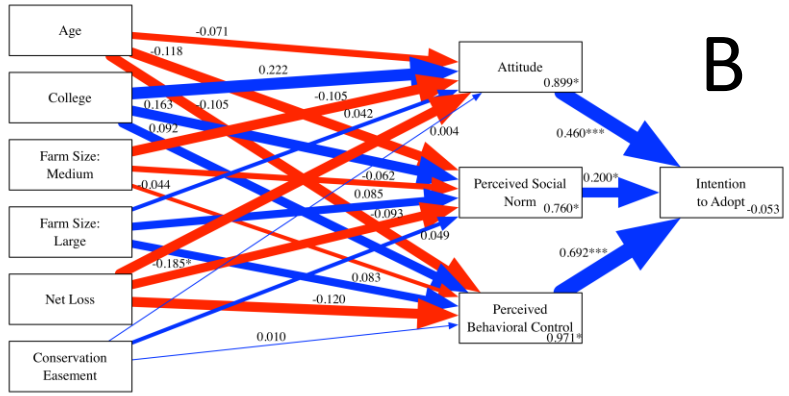
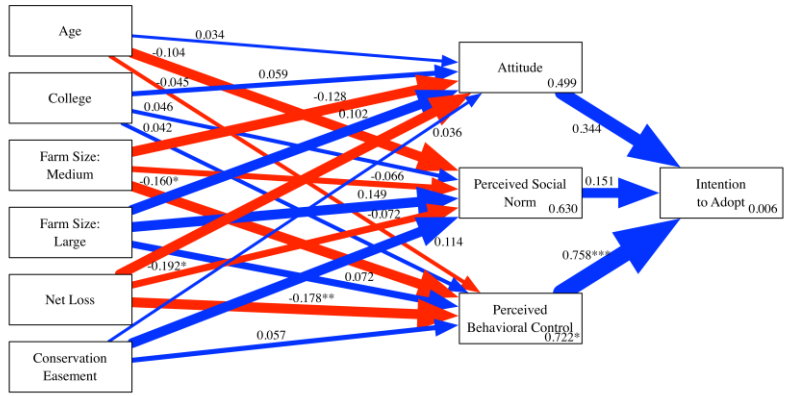
** p < 0.005
*** p < 0.001



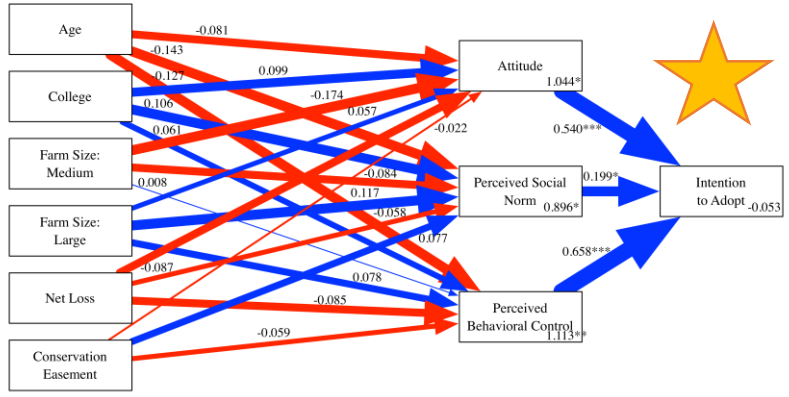
a) Planned Crop Rotations

* p < 0.05
** p < 0.005
*** p < 0.001



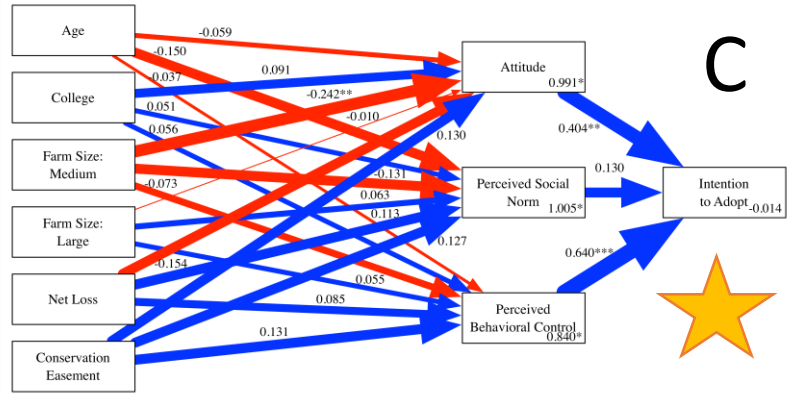
b) Strip Cropping

* p < 0.05
** p < 0.005
*** p < 0.001



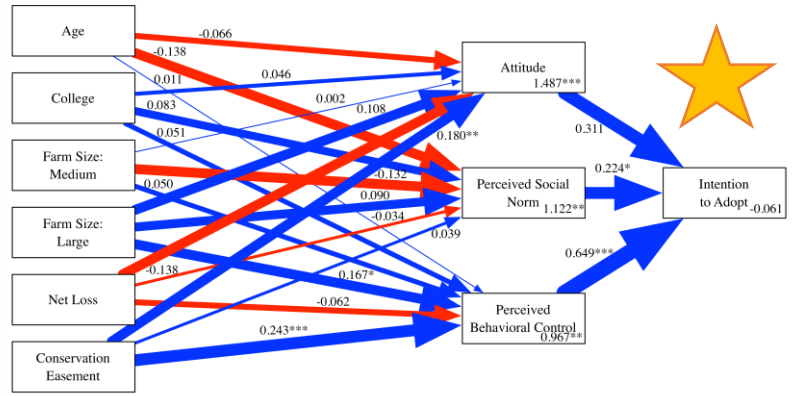
c) Cover Cropping

* p < 0.05
** p < 0.005
*** p < 0.001



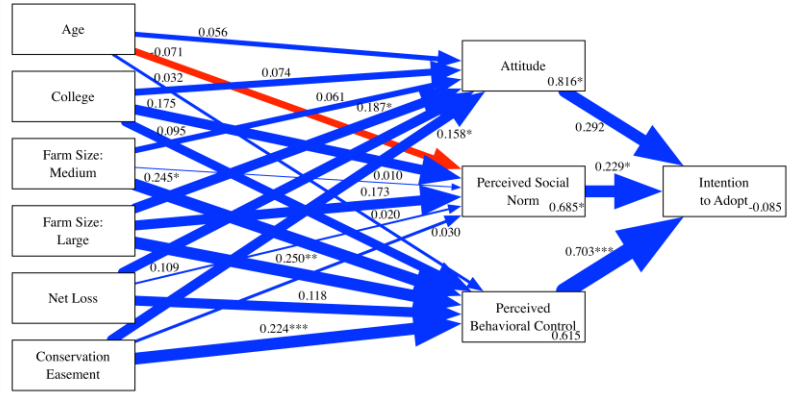
a) Reduced Tillage

* p < 0.05
** p < 0.005
*** p < 0.001



b) Conservation Buffers

* p < 0.05
** p < 0.005
*** p < 0.001



c) Manure Setbacks

* p < 0.05
** p < 0.005
*** p < 0.001

FIVE High Level Take Aways

1: ***Perceived Behavioral Control*** is the **largest and statistically significant** driver of farm intention to adopt for *all* BMPs measured.

2. Holding a ***Conservation Easement*** is a **statistically significant** (x4 BMPs) **positive** influence on ***Perceived Behavioral Control***.

3. Being a ***Large Farm*** and having a ***College Education*** each have a **positive** influence on adoption.

4. Experiencing a ***Net Loss*** in the last three years each have a **negative** influence on ***Attitude*** about all BMPs

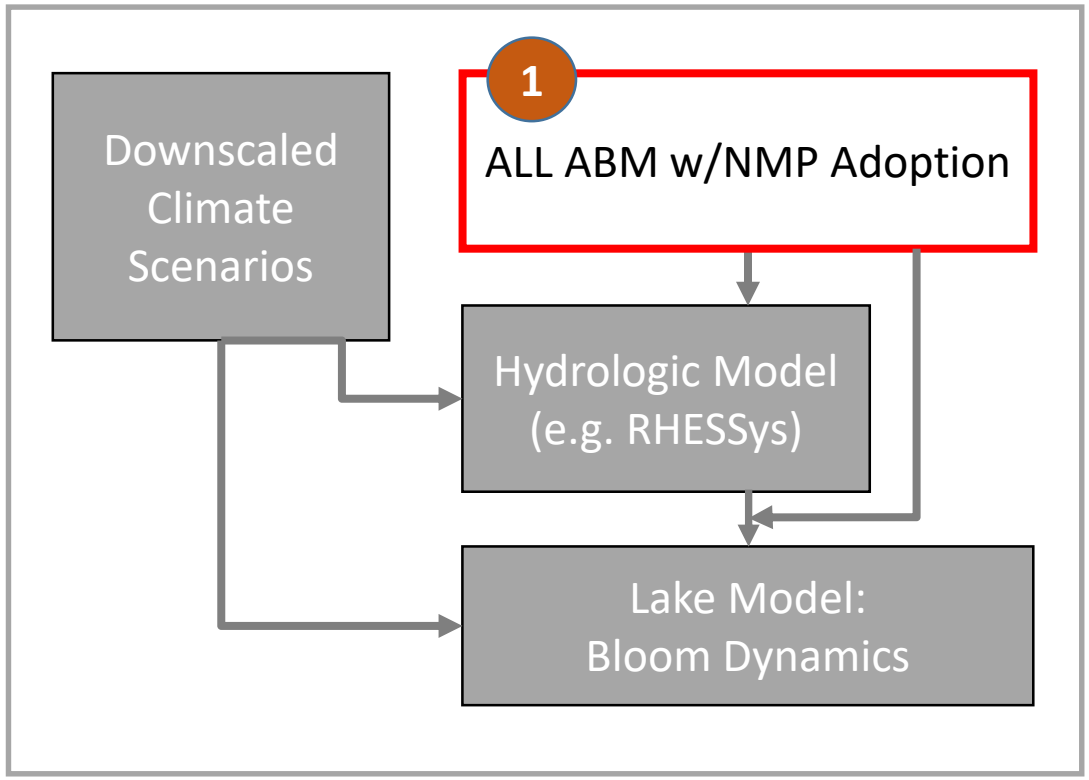
5. Increased ***Age*** has a **negative** impact on Perceived Social Norms around BMP adoption.

Two General Observations

1: Cropping practices (x3) have similar patterns of influence

2: **Manure Setbacks BMP** has different pattern of influence compared to all the other BMPs measured

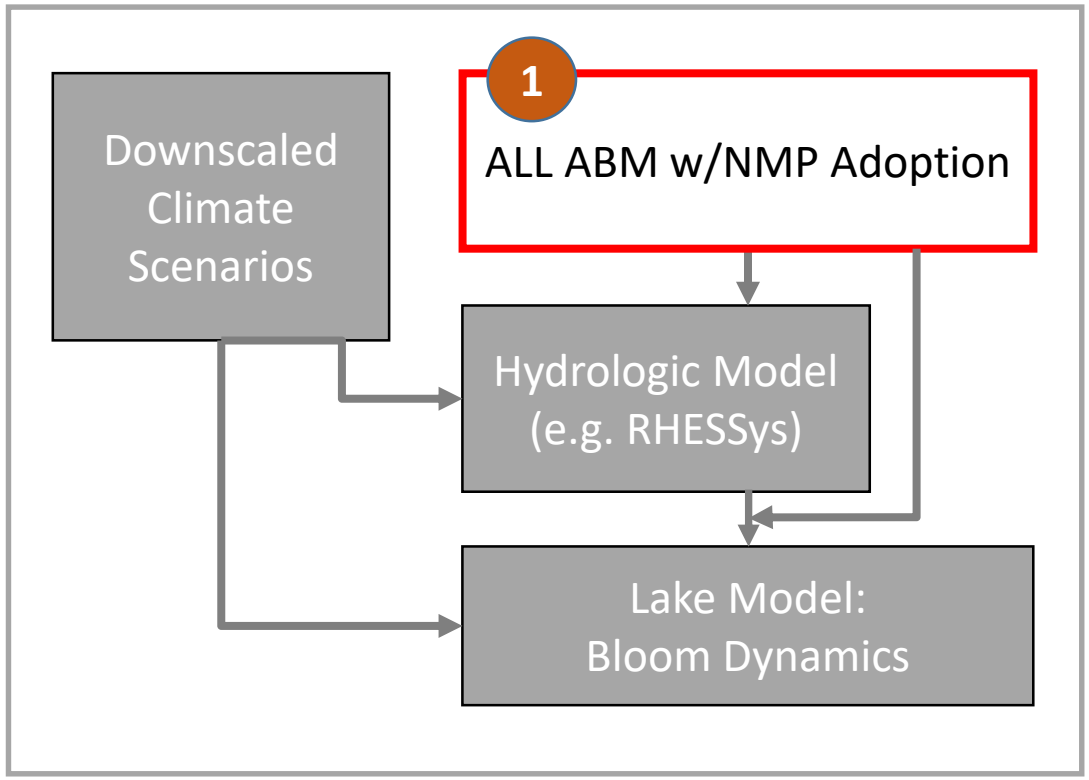
IAM Model Cascade

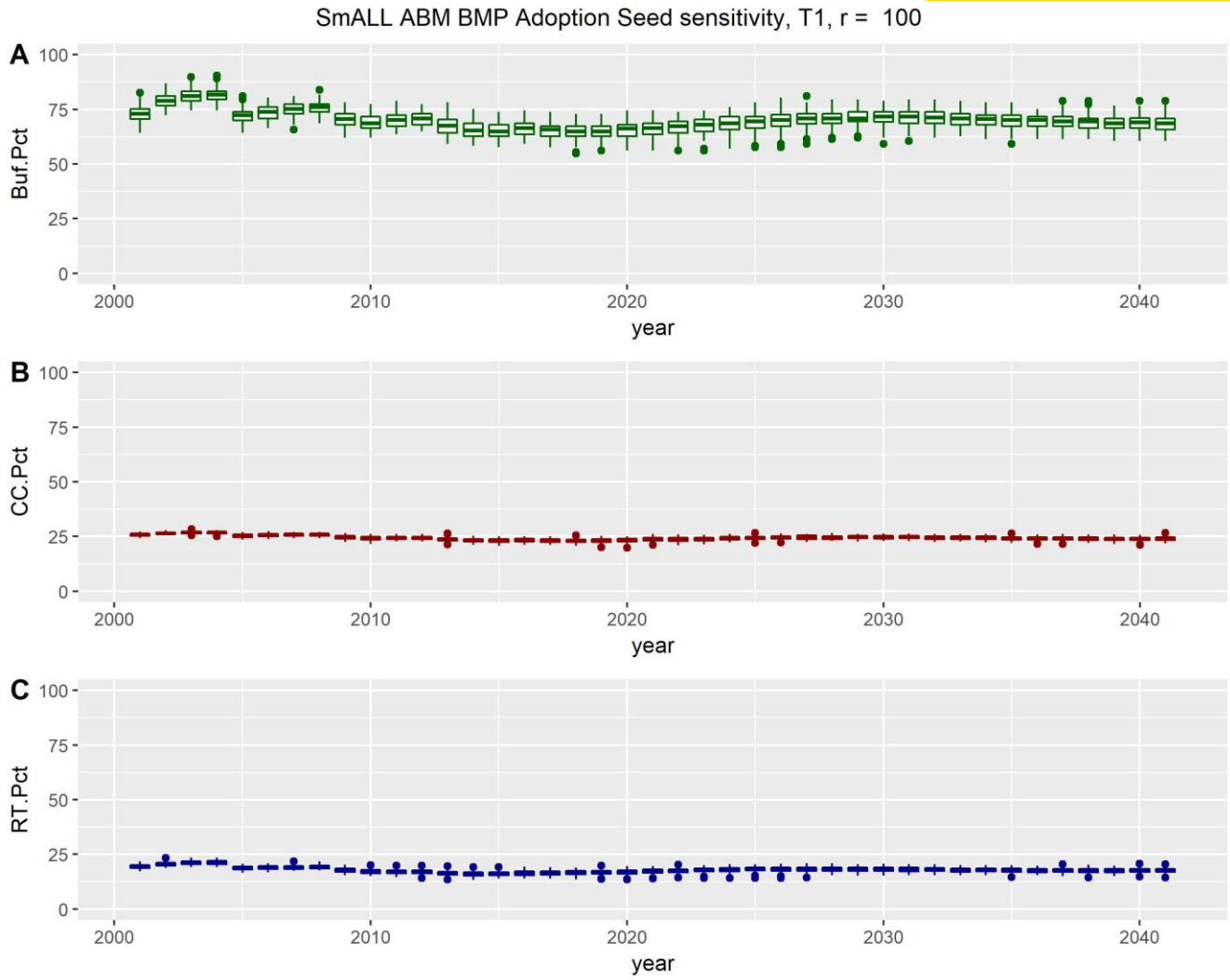


Major model changes:

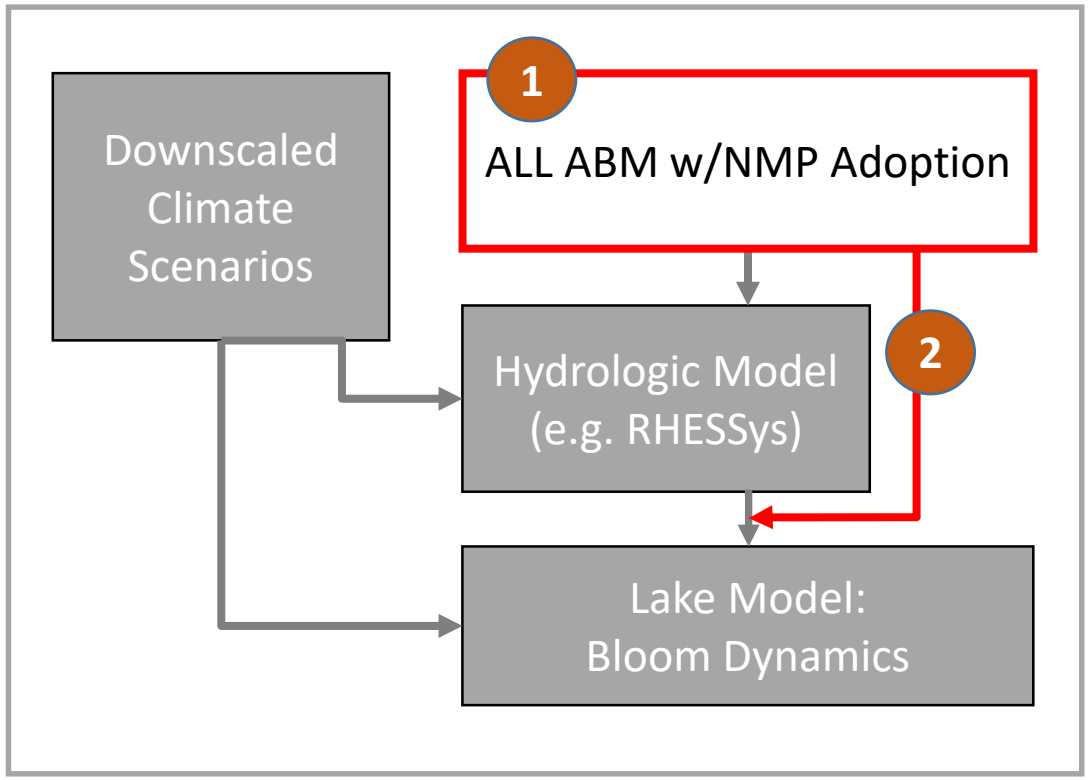
1 NMP Adoption

IAM Model Cascade





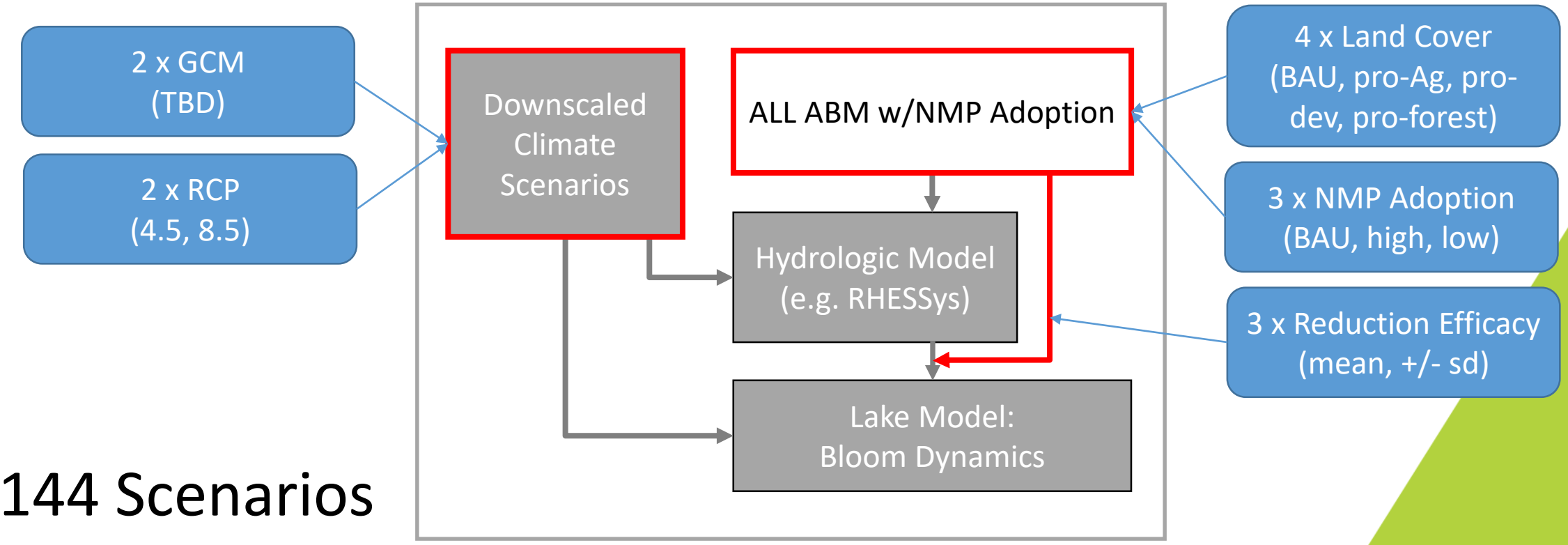
IAM Model Cascade



Major model changes:

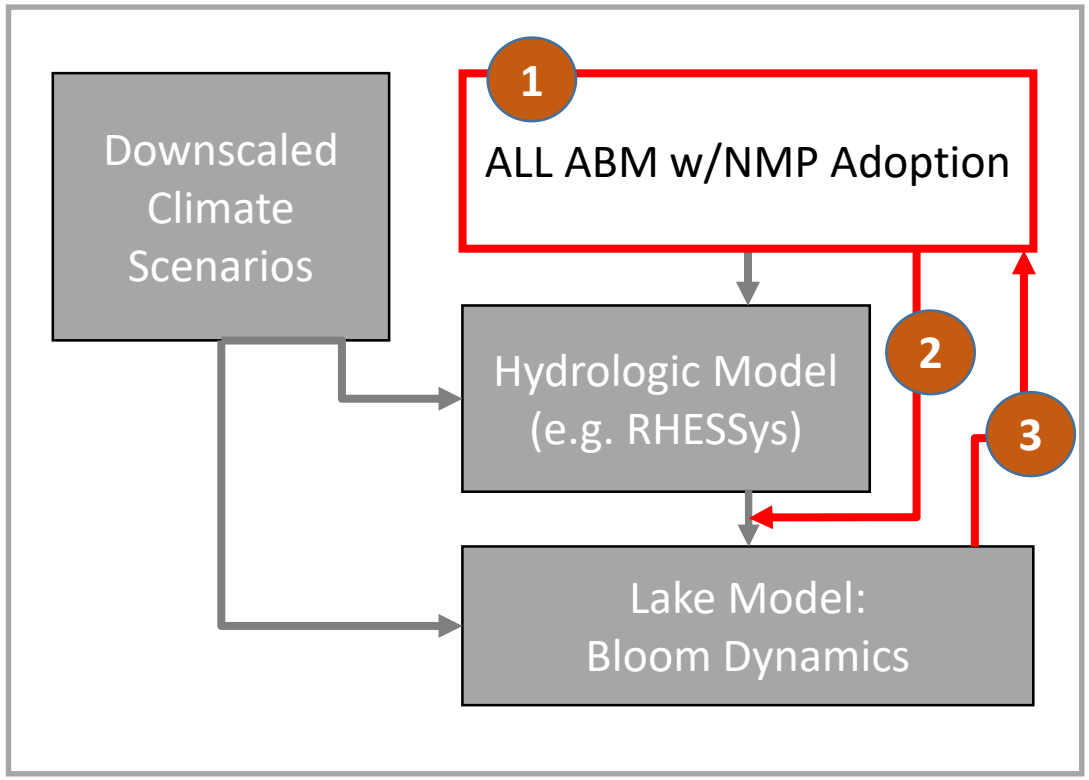
1. NMP Adoption
2. Downstream impact of NMP adoption in lake nutrient loading

IAM Model Scenarios: Farm Nutrient Management



144 Scenarios

Up Next… How does feedback from the Lake affect adoption?



Major model changes:

1. NMP Adoption
2. Downstream impact of NMP adoption in lake nutrient loading
3. Lake water quality feedback to regulator agent

BREE Post-doc & Graduate Student Seminar Report

Frequency: Met once weekly during 2017 Fall and 2018 Spring Semester

In Attendance: All BREE Post-docs & Grad Students

Activity: 1. Mini-Talks on Professional Skills Topics (e.g. How to give a good presentation, Elevator Pitch/jargon, Surviving the Constant Information Deluge)

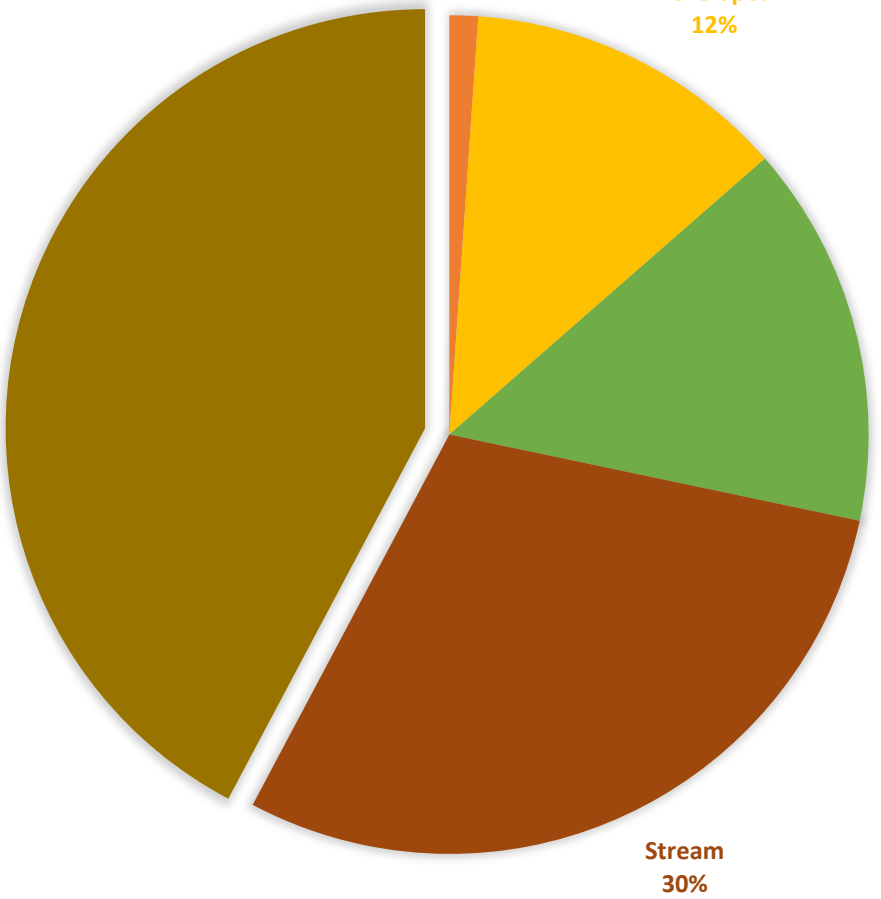
2. Research Talks – updates and practice talks in a peer environment

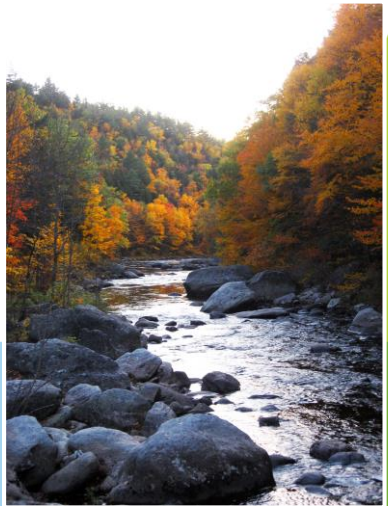
Future: Plan to add guest speakers in fall on topics of both research & professional interest

Questions

The University of Vermont

MISSISQUOI BASE LOAD





Base loading based on SWAT model used in U.S. EPA TMDL
PC: VPR; St Albans Messenger; MacLennan Farm, VT Beachcomber
Wonderlustforone.com

Alternative Question Framing: To what extent can individual action across the landscape – i.e. adoption of *nutrient management practices (NMPs)* – address the problem of excess nutrient availability in the lake system under uncertain and extreme climate scenarios?