“Q3” Social, Policy and Governance: Accounting for Human Behavior and Decision Making in Modeling Watershed and Basin Wide Dynamics

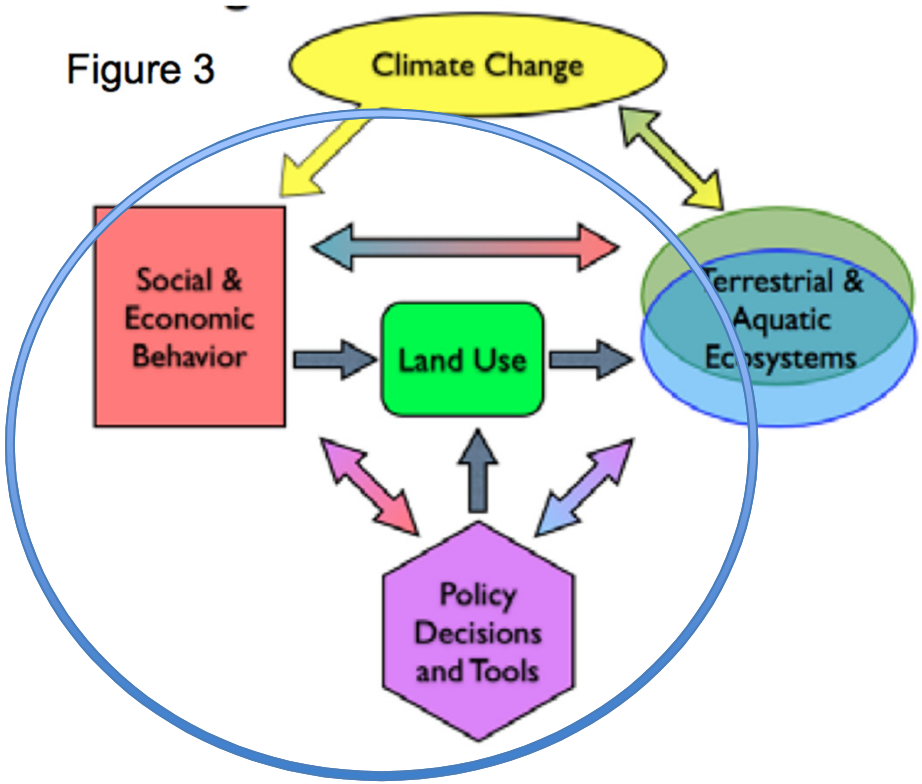
Christopher Koliba, Ph.D.
Science Leader, Research on Adaptation to Climate Change (RACC)
Professor of Community Development & Public Administration
University of Vermont

Pop quiz

- How many of you have shopped at an area box store or mall?
- How many of you have traveled on one of VT's back roads?
- How many of you have eaten food grown in VT?
- How many of you have drank BTV tap water?
- How many of you have swam in Lake Champlain?
- How many of you have thought twice about swimming in the Lake?
- How many of you have voted in a VT election?
- How many of you have based your vote on the candidate's position on water quality?

RACC
Research on Adaptation to Climate Change

In the face of uncertainties about climate change, land use and lake response scenarios, how can <u>adaptive management</u> interventions (e.g. regulation, incentives, treaties) be *designed*, valued and implemented in the multi-jurisdictional Lake Champlain Basin?



EPS 1101317

Q3: In the face of **uncertainties** about climate change, land use and lake response scenarios, how can **adaptive management interventions** be designed, valued, and implemented in the multi-jurisdictional region?

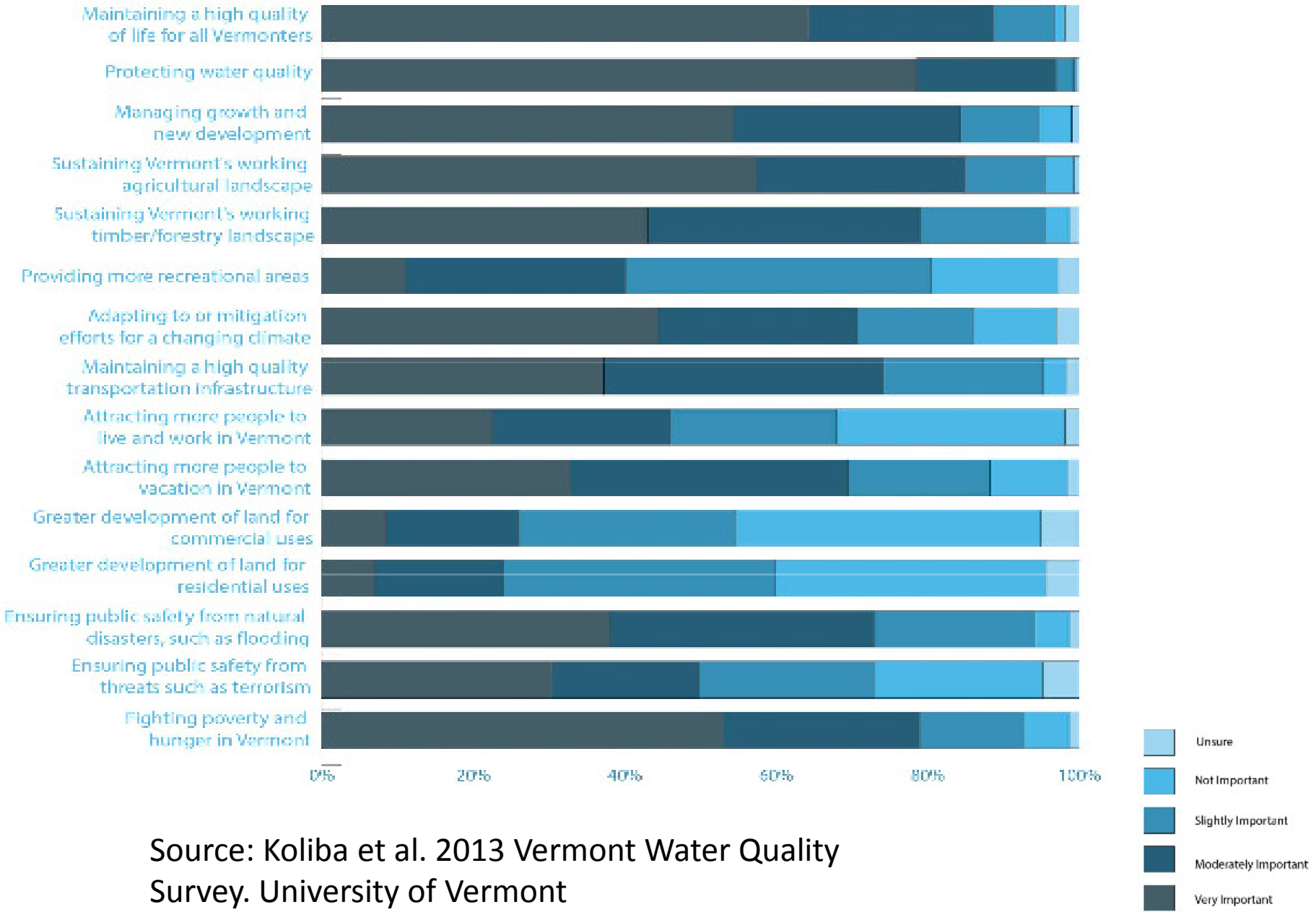
Human beings as critical agents within a watershed…

… and the decisions they make.

- How does the public feel about water quality issues?
- How is the problem framed?
- How are land use decisions made?
- How water quality is governed?
- What interventions can be put in place to address the problem?

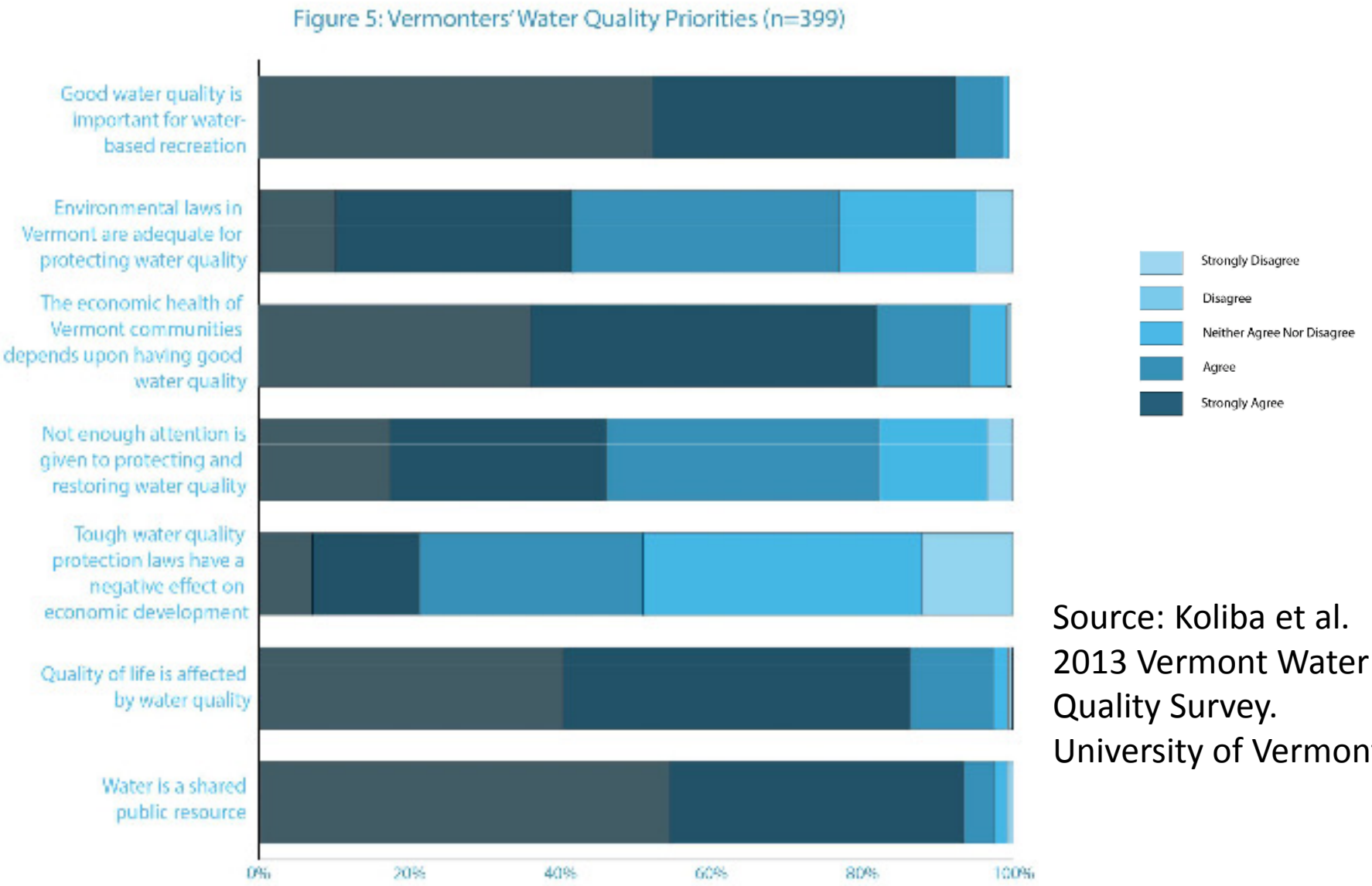
How does the public feel about water quality issues?

Figure 4: Vermonters' Policy Priorites (n=422)

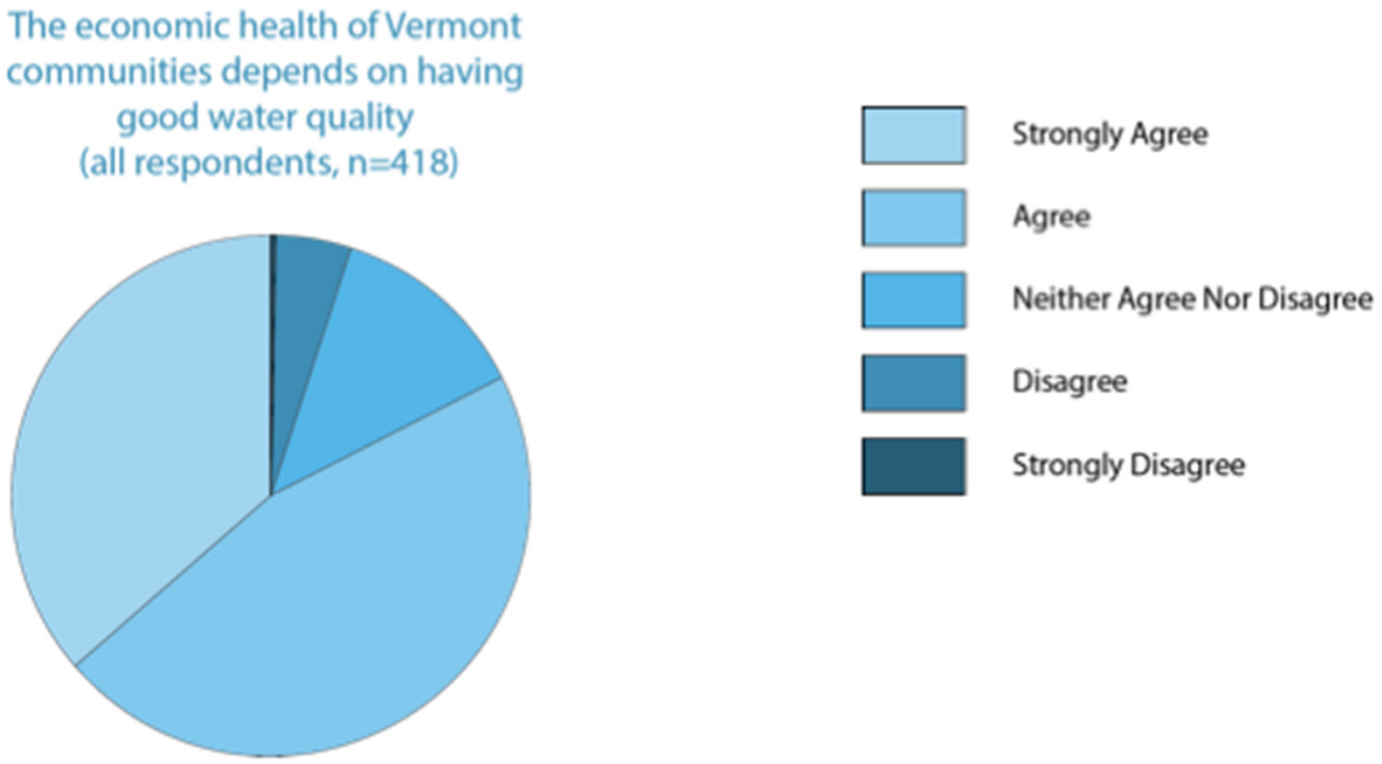


Source: Koliba et al. 2013 Vermont Water Quality Survey. University of Vermont

Water quality appears to be important to the Vermonters



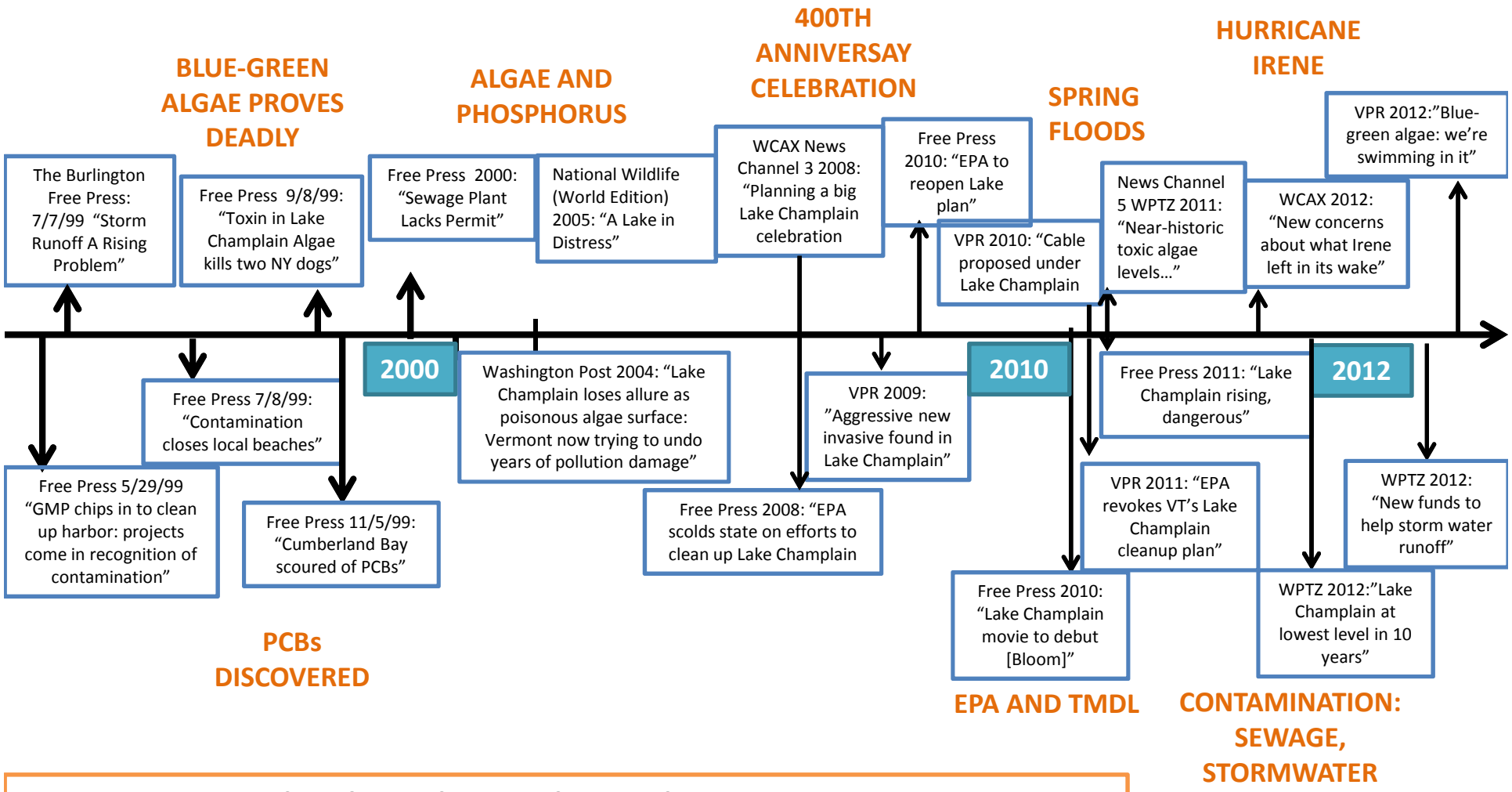
Source: Koliba et al. 2013 Vermont Water Quality Survey. University of Vermont



Source: Koliba et al. 2013 Vermont Water Quality Survey. University of Vermont

How is the problem framed?

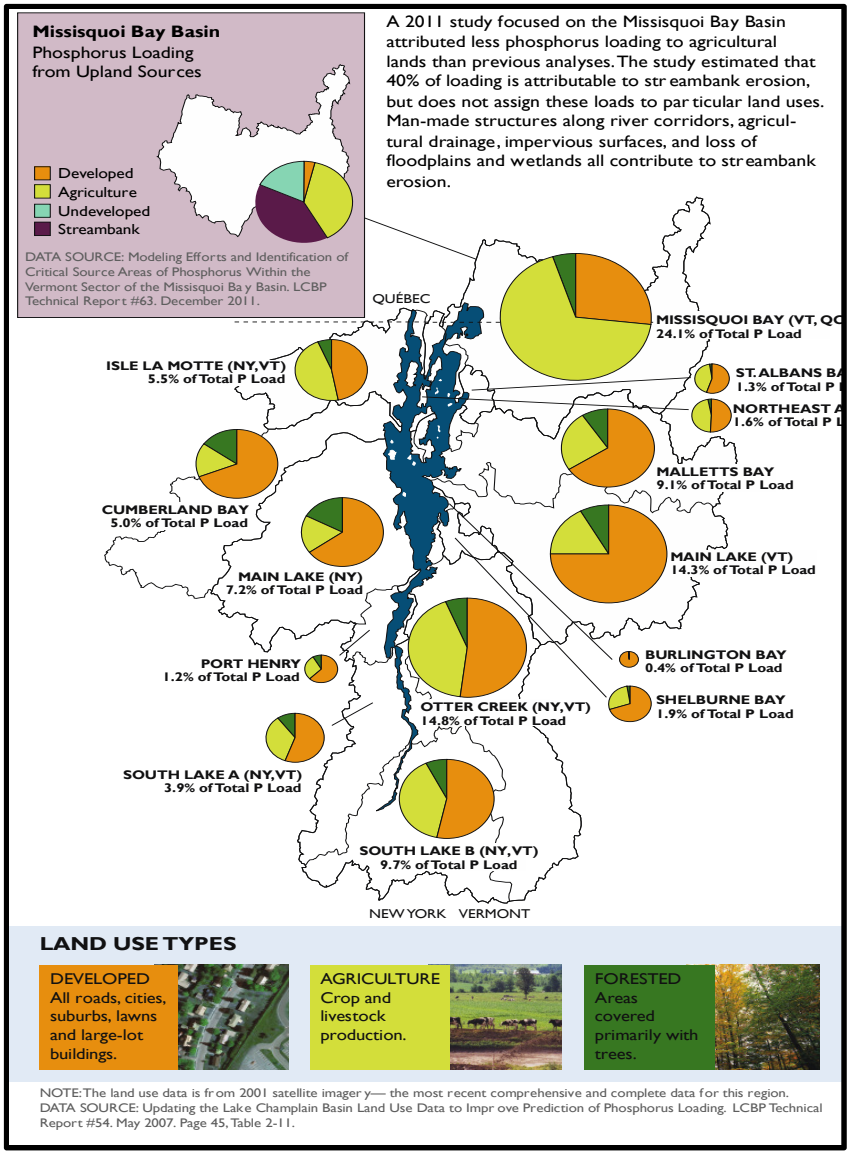
Timeline of Media Events, Water Quality Policy, Economic & Landuse Trends



Lake Champlain in the Media: 1999-2012

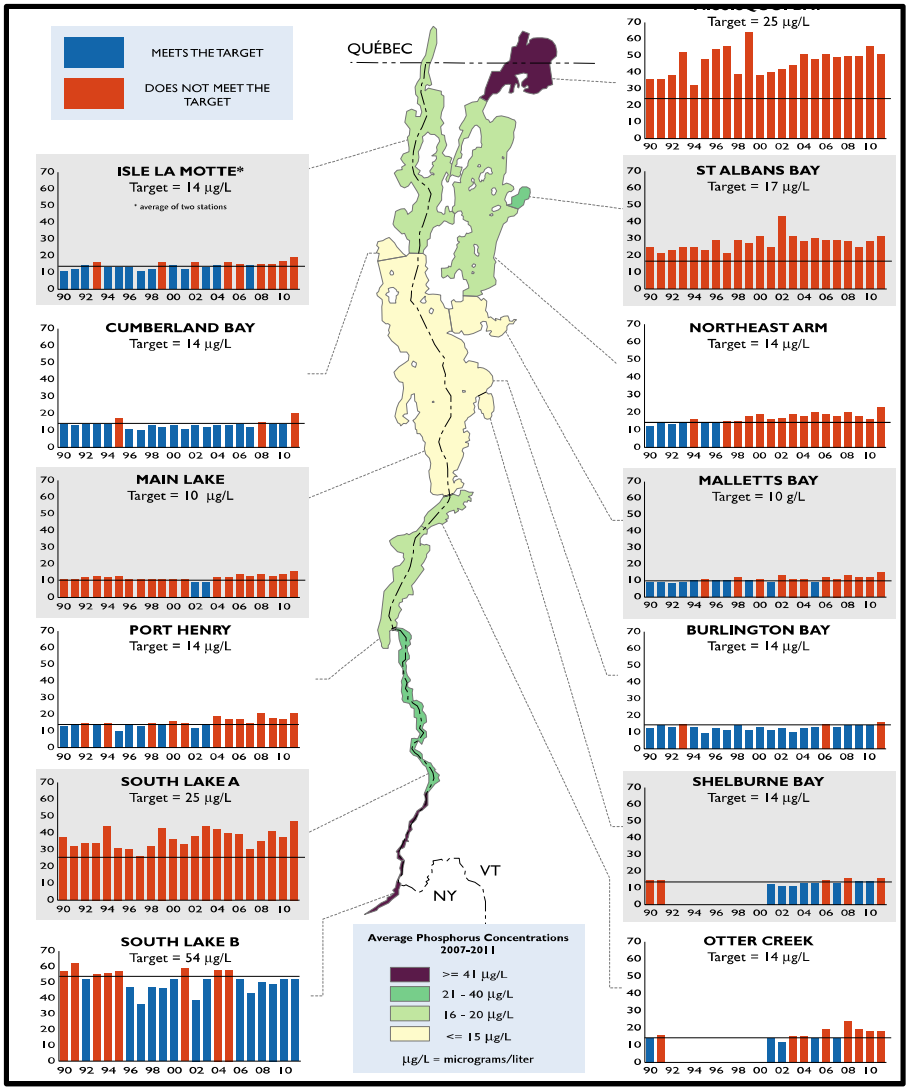
(Archives, Library Holdings, LEXISNEXUS)

Adapted from research done by Shapiro, M. 2012 (EPSCoR Summer Intern)



(SoL, LCBP, 2012, figure 7; page 9)

(SoL, LCBP, 2012, figure 3; page 6)



Interconnecting areas of impact:

AGRICULTURE

RIVER MANAG.

STORMWATER

FOREST MANG.

TRANSPORT.

WASTEWATER

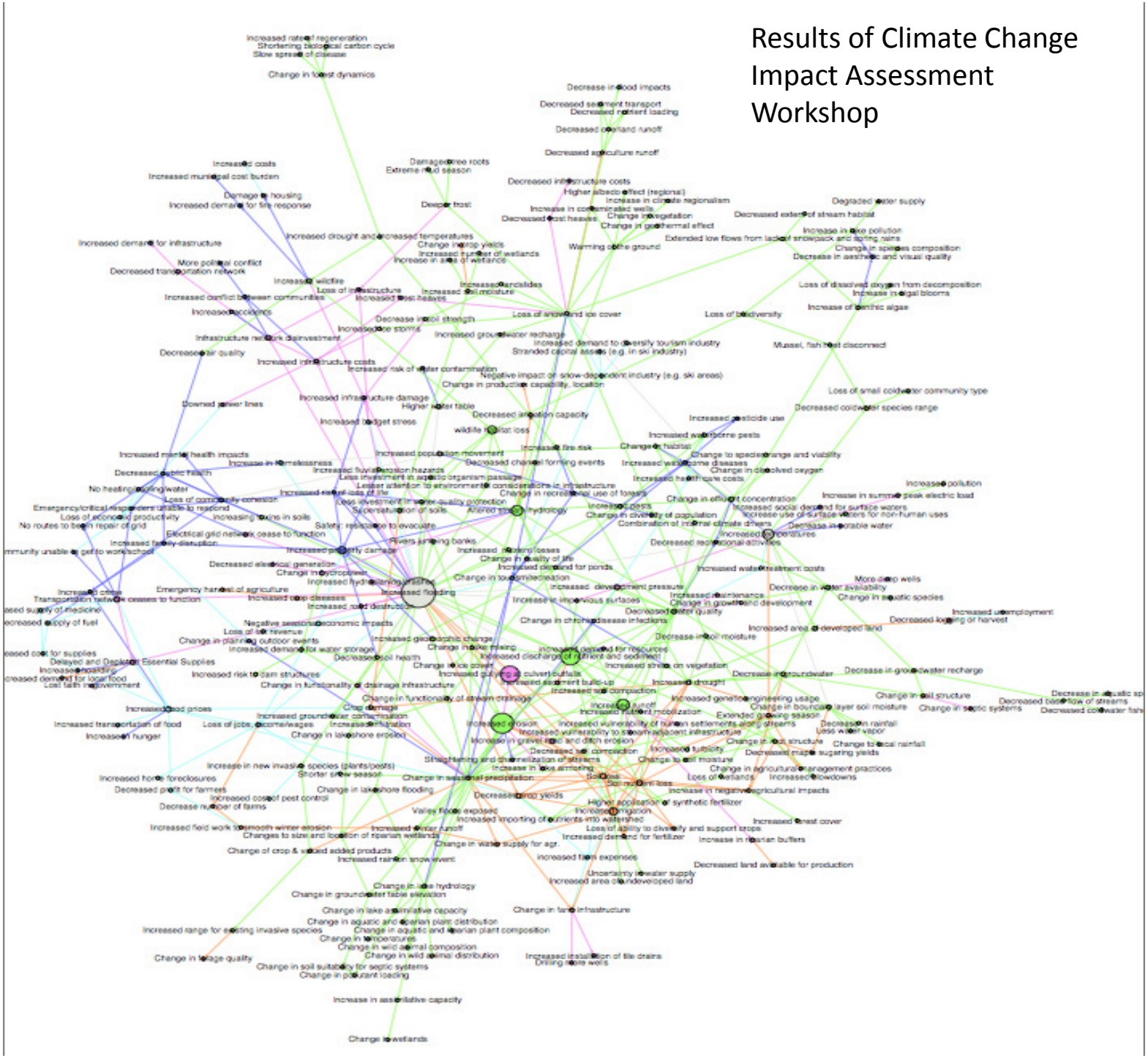
DEVELOPMENT

ENERGY

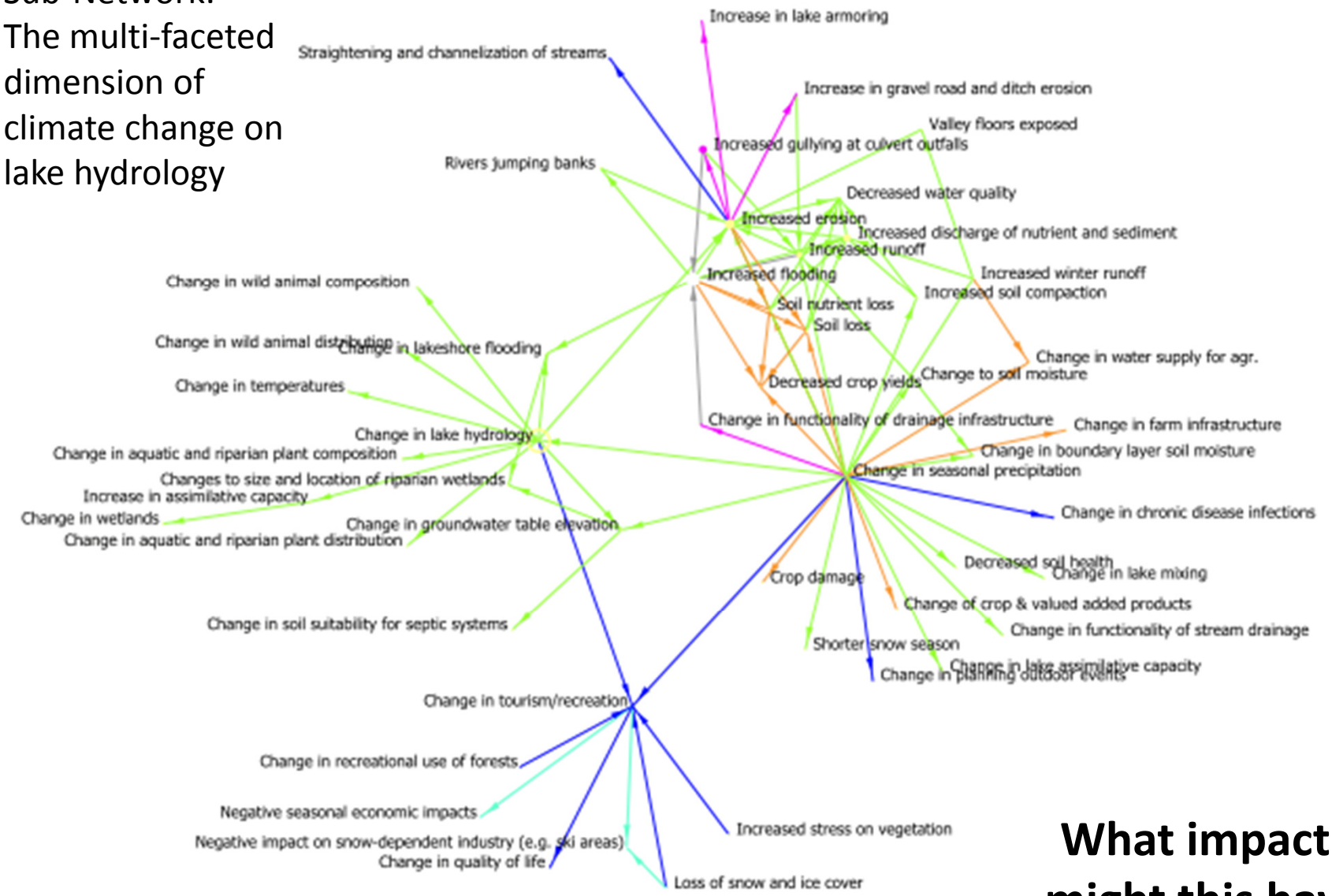
EMERG. MANG.

PUBLIC HEALTH

Results of Climate Change Impact Assessment Workshop



Sub-Network:
The multi-faceted dimension of climate change on lake hydrology



What impacts might this have on our region?

How are land use decisions made?

How are land use decisions made and modeled?

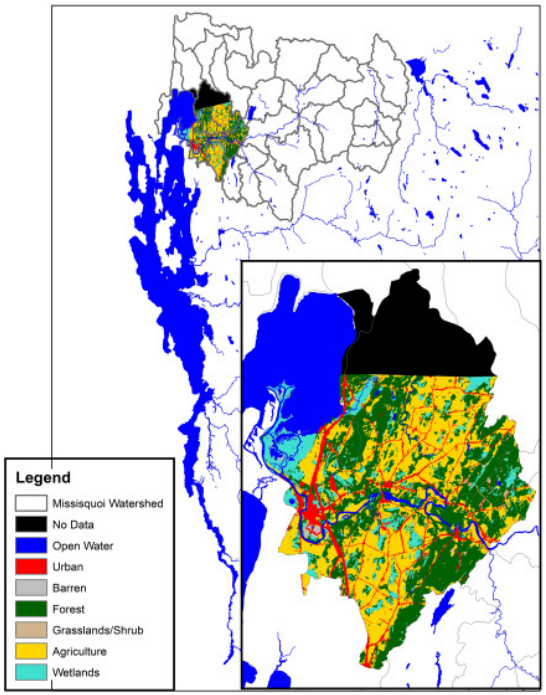


Fig. 2. The western Missisquoi Watershed (colored area) versus the entire Missisquoi Watershed. The colored area displays the observed land-use pattern of the NLCD 1992 eight-class classification system.

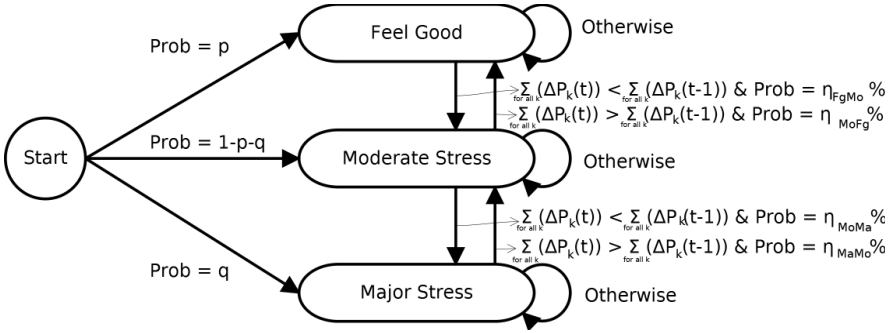
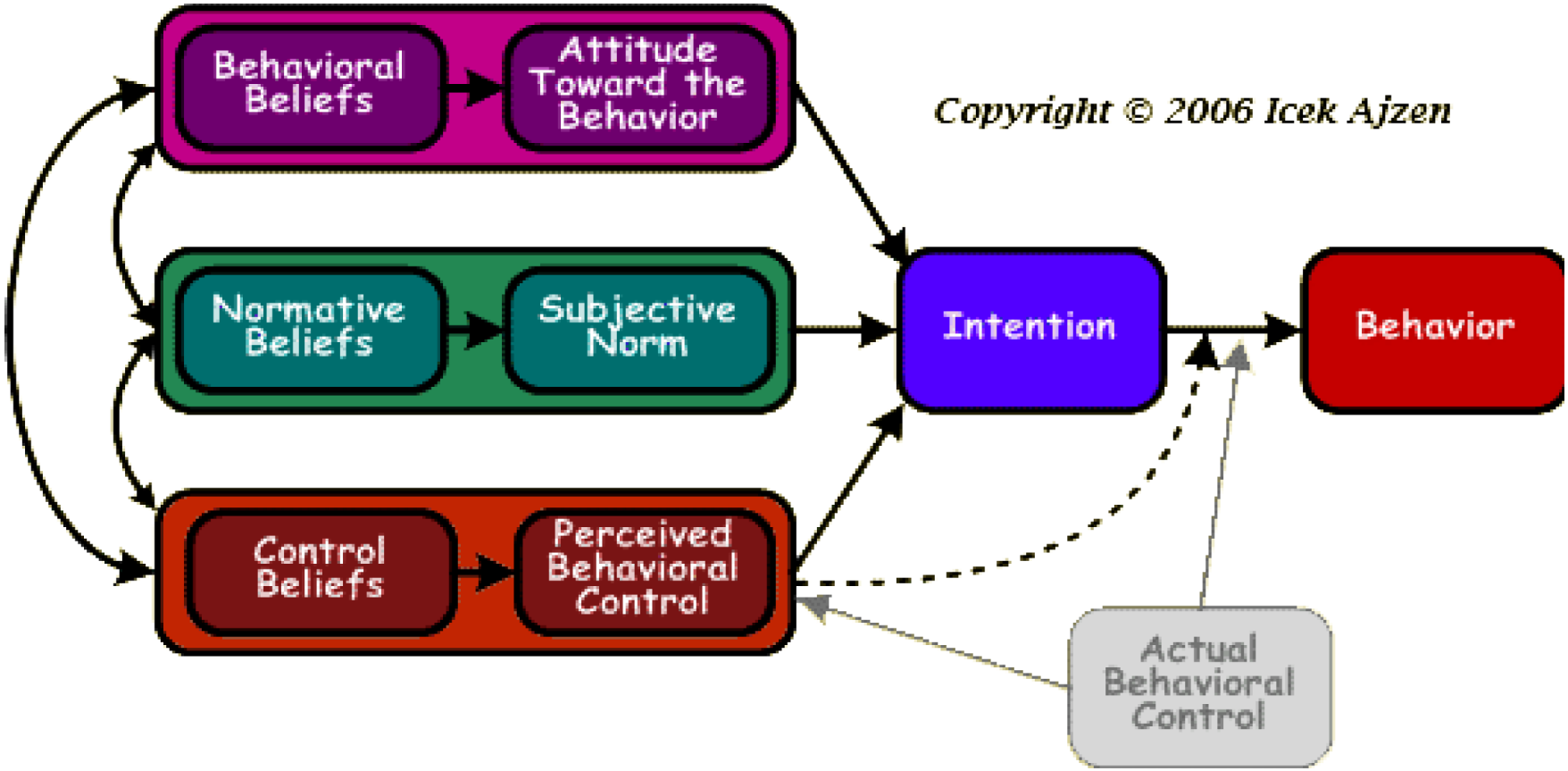


Fig. 4. The dynamics of the farmers' financial conditions over time. η_{FgMo}%, η_{MoFg}%, η_{MoMa}% and η_{MaMo}% are probabilities that a farmer's financial conditions change from one state to another in year t. (change Produtivity(t) to sum(P_i(t))

	Percentage of A Land-use Type			
	2001		2006	
Land-use Code	Observed	Baseline Simulation (Minimum, Mean, Maximum)	Observed	Baseline Simulation (Minimum, Mean, Maximum)
3, Barren	0.580723	(0.6259332, 0.6475989, 0.6657306)	0.663492	(0.6412154, 0.6730534, 0.7029810)
4, Forest	37.87183	(37.99822, 38.00752, 38.01924)	38.18089	(37.99791, 38.01631, 38.03675)
5, Grass	0.936353	(0.8819100, 0.8868767, 0.8949636)	1.186195	(0.8605786, 0.8687928, 0.8819100)
6, Ag	37.92213	(37.52448, 37.54203, 37.55663)	36.98164	(37.49932, 37.52588, 37.54549)

TABLE III. Comparison of the percentages of land-use types 3: Barren, 4: Forest, 5: Grass/Shrub, and 6: Agriculture resulting from the baseline scenario to the observed land-use percentages.

Theory of Planned Behavior



[Updated Source: Fishbein and Ajzen (2010) *Predicting and Changing Behavior*]

How are best management practices (BMPs) adopted?

Table 2: Weighted OLS Regression Models Predicting Farmer Intention to Adopt Nutrient Management Practices in Missisquoi and Lamoille Watersheds (N=80)

	Planned Crop Rotations	Soil Test at least every three years	Strip Cropping	N, P & K Applications at rates recommended by soil tests	Buffers at field edges
Past Practice	0.6889** (0.2182)	0.1248 (0.2407)	0.9137** (0.4307)	-0.0274 (0.2103)	0.7296** (0.3449)
Attitude	-0.2184 (0.1663)	0.1425 (0.1330)	-0.2848 (0.2388)	0.1429 (0.1389)	-0.3071* (0.1797)
Perceived Social Norm	Omitted due to MC	Omitted due to MC	Omitted due to MC	0.1556* (0.0890)	0.1854 (0.1259)
Perceived Behavioral Control	0.9077*** (0.1378)	0.7750*** (0.0924)	0.8056*** (0.2437)	0.8672*** (0.0936)	0.7883*** (0.1034)
Constant	0.7445** (0.2467)	1.0419** (0.4376)	0.3423** (0.0932)	0.7392** (0.2663)	0.7616** (0.3064)
R^2 and (BIC)	0.7354 (343.70)	0.6984 (338.98)	0.8163 (264.53)	0.7909 (321.23)	0.6522 (372.31)

Source: Zia at al, 2013 Farmer BMP Survey, University of Vermont

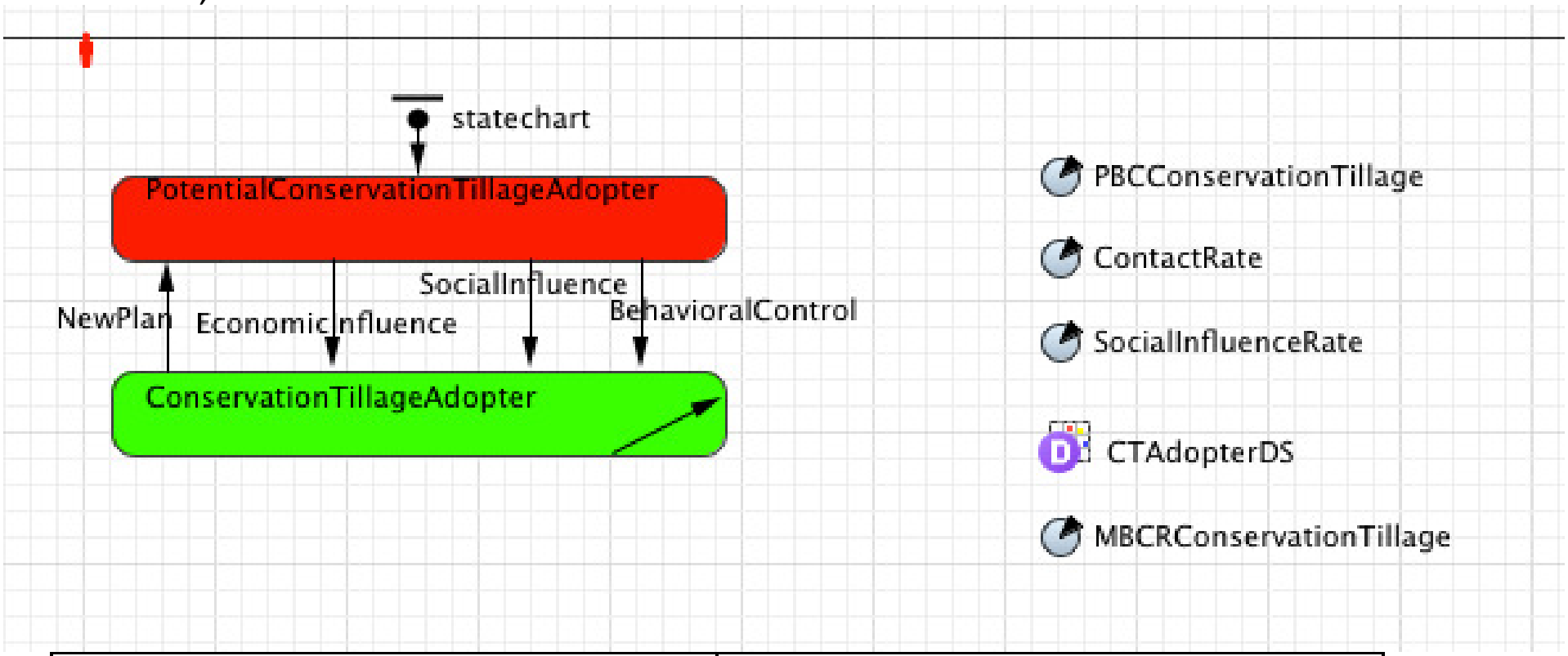
	Cover Cropping	Reduced Tillage (strip, zone and no)	Applying fertilizer at recommended rates and times	Incorporating manure and fertilizer as quickly as possible after application	Manure spreading setbacks (from water bodies and private/public wells)
Past Practice	0.7609** (0.2590)	0.3709** (0.1407)	0.1471 (0.2499)	0.4115** (0.1754)	0.2553** (0.1158)
Attitude	-0.0522 (0.1884)	0.3152** (0.1412)	-0.0267 (0.1732)	-0.0396 (0.0768)	-0.0821 (0.0823)
Perceived Social Norm	0.2960** (0.1422)	0.1543* (0.0872)	0.3507** (0.1441)	0.1388 (0.0878)	0.1830 (0.0971)
Perceived Behavioral Control	0.6145*** (0.1716)	0.5615*** (0.1247)	0.7171*** (0.1145)	0.8013*** (0.1252)	0.9167*** (0.0944)
Constant	0.4697** (0.2076)	0.0767 (0.1288)	1.2703** (0.4244)	0.7623* (0.4455)	0.3407 (0.2402)
R^2 and (BIC)	0.6960 (351.46)	0.8322 (286.98)	0.5676 (384.53)	0.6678 (370.70)	0.7575 (349.75)

Coefficients with * are significant at p>0.01; ** at p>0.05; and *** at p>0.001. Standard Errors are in Brackets.

Source: Zia at al, 2013 Farmer BMP Survey, University of Vermont

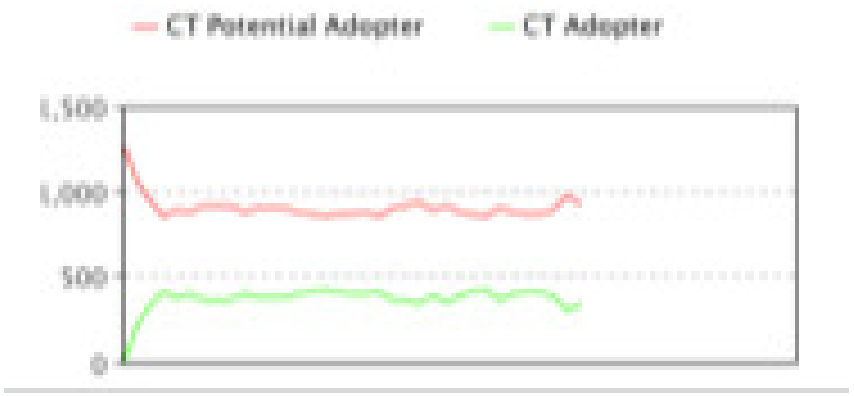
Conservation Tillage Adoption Behavior ABM Design and Calibrated Parameters

Zia et al., 2014

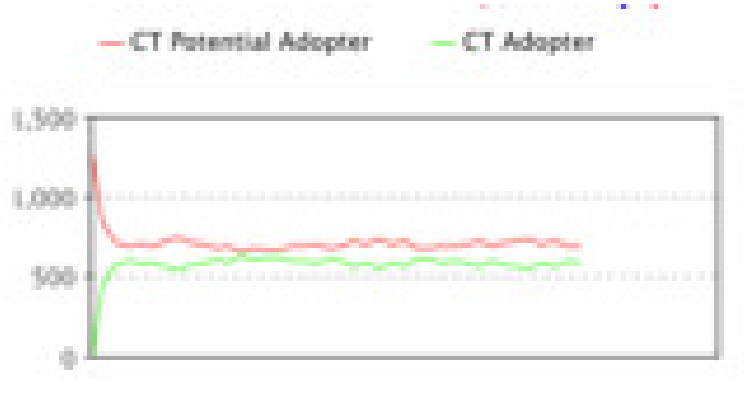


Parameters	Calibrated Scenario Value
PBC (Conservation Tillage) Rate	0.08 per year
Contact Rate	Uniform (20-60)
Social Influence Rate	`triangular(0.005,0.1, 0.01)`
MBCR (Conservation Tillage)	`triangular(0.01,0.08,0.04)`
New Plan	`triangular(0.2,2,1 )`

Scenario development from BMP ABM: Technical assistance is a driver of BMP adoption.



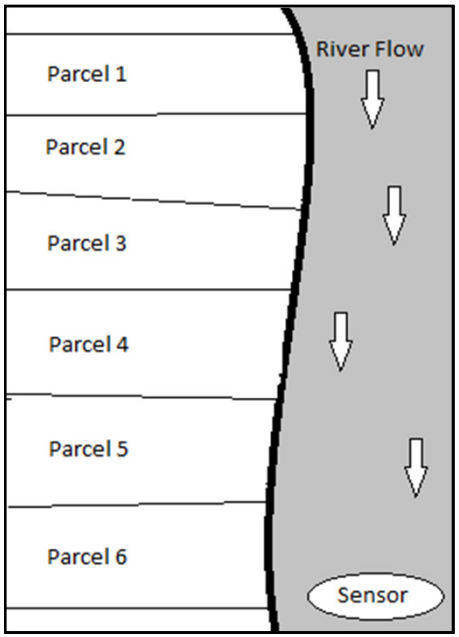
Business as usual

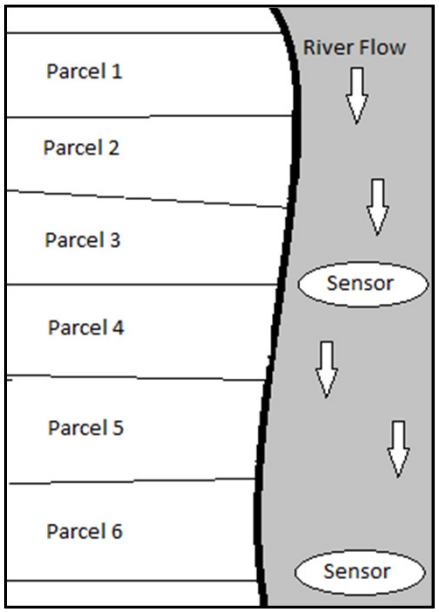


Double $ for technical assistance

Zia et al., 2014

How are choices made using experimental economics?





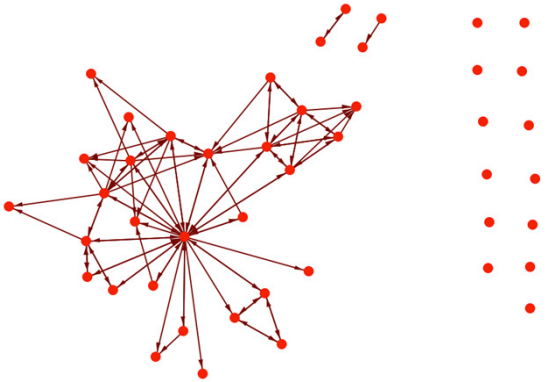
NEWRnet

Delaware • Rhode Island • Vermont

North East Water Resources Network

How is water quality governed?

Q3's interests:



Governance

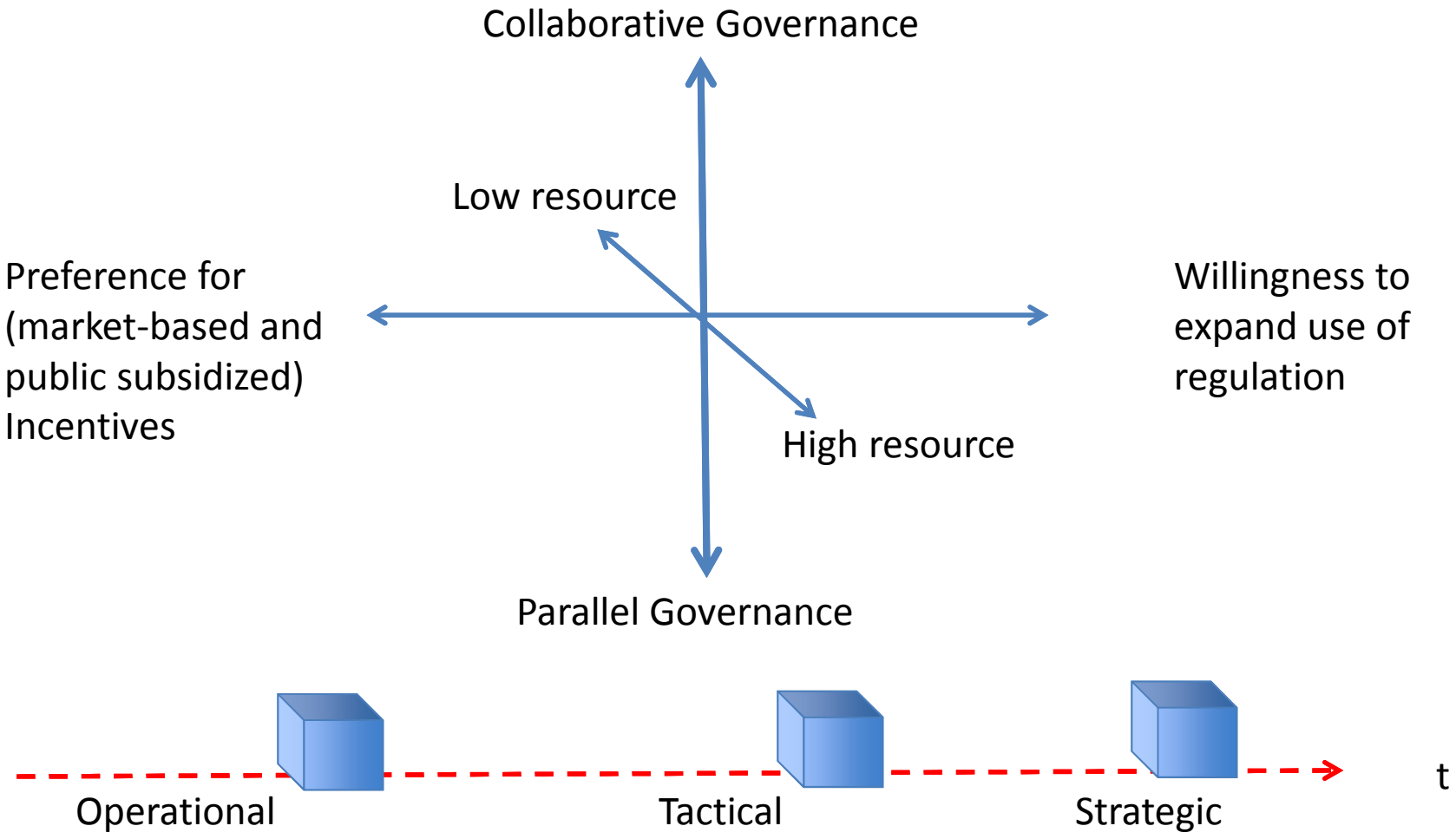
Money

Carrots & Sticks

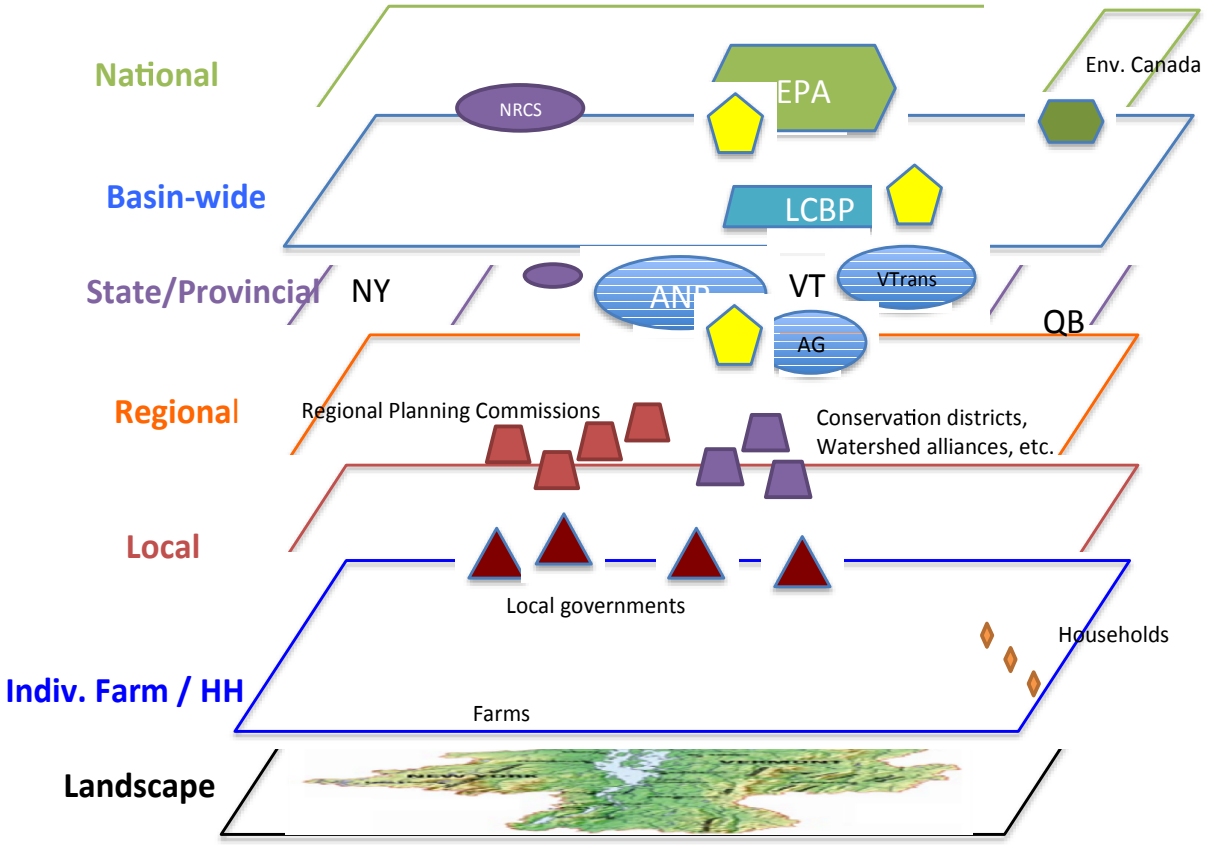
Mediated Modeling Workshop Framework:

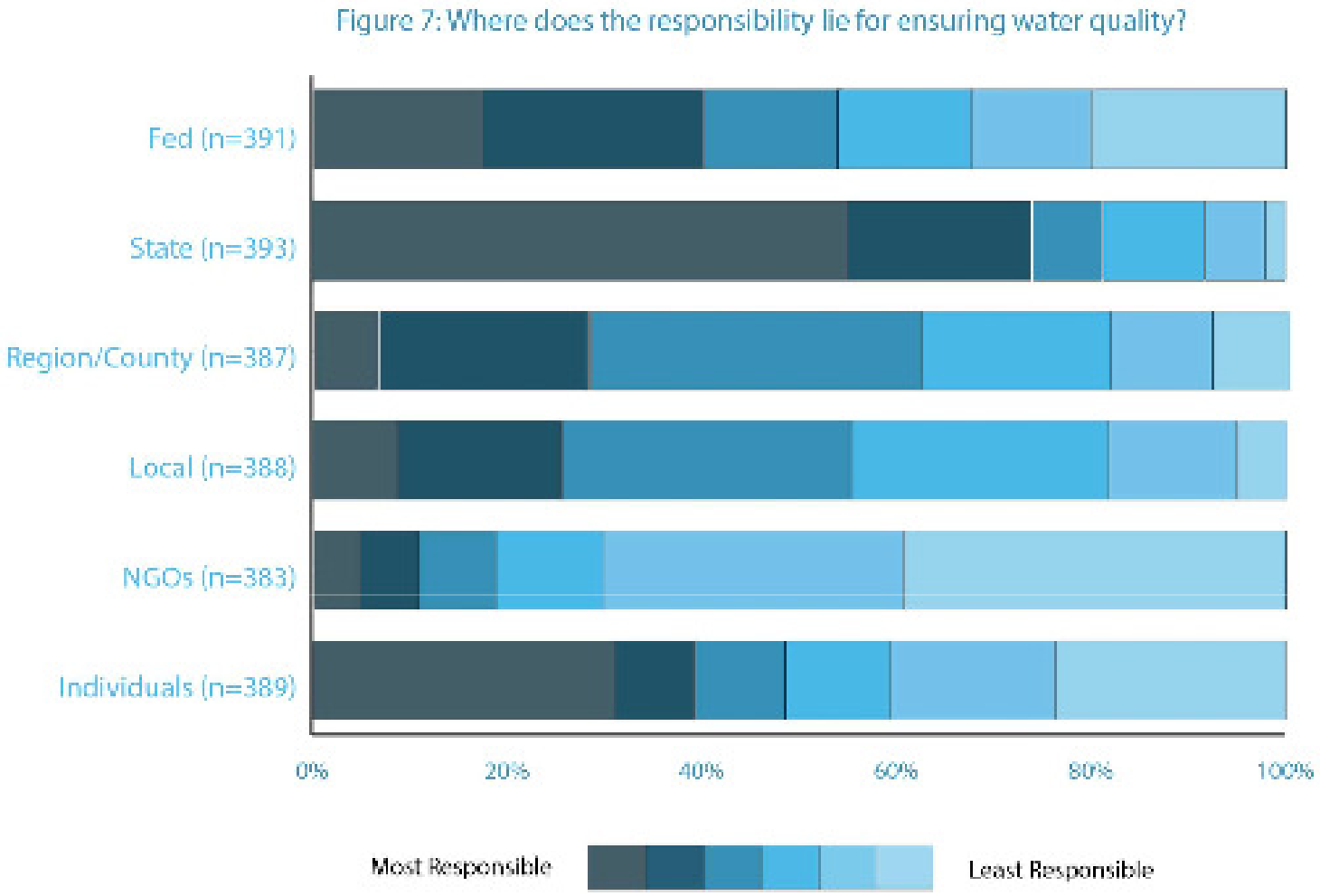
Cllimate forecasts	Finacial Resource Avaliability	Goverance framework	Policy framework	Interventions	State of the Lake
• Worst case	• R(0) Low • R(1) High	• G(0) State and local government "parallel play" • G (1) Regionalized collaborative governance	• P(0) Strong prefernce for market and voluntary action • P(1) Strong prefernece for regulation and law	• I (1) • I (2) • I (3) • I (4) • I (5)	• Water quality preserved

Framework for thinking about today's scenario development exercise



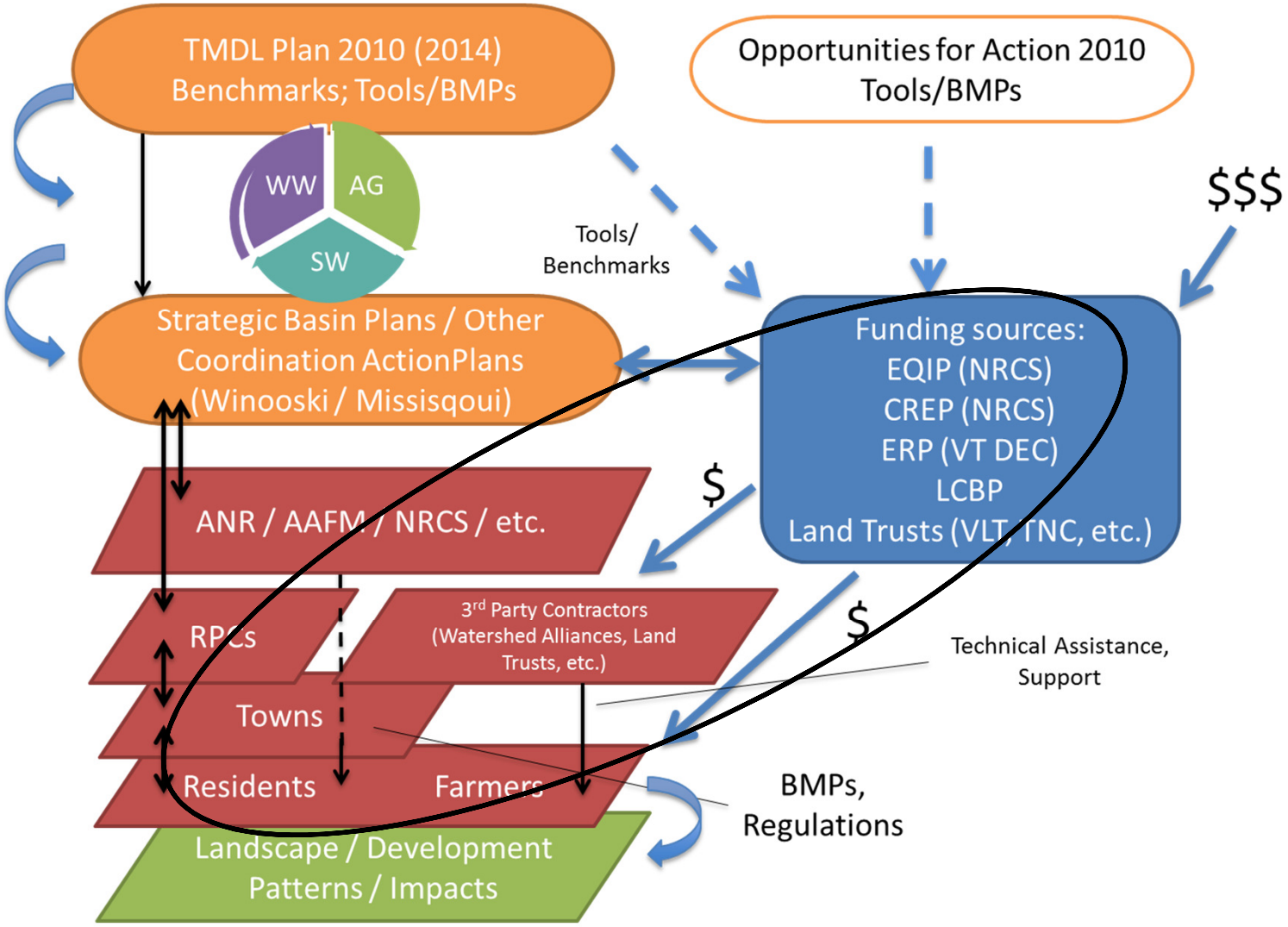
Watershed Governance





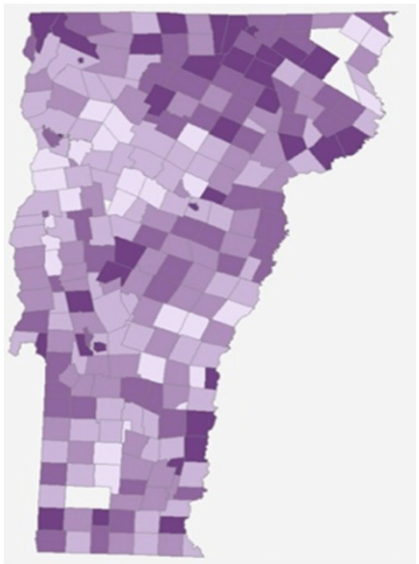
Source: Koliba et al. 2013 Vermont Water Quality Survey. University of Vermont

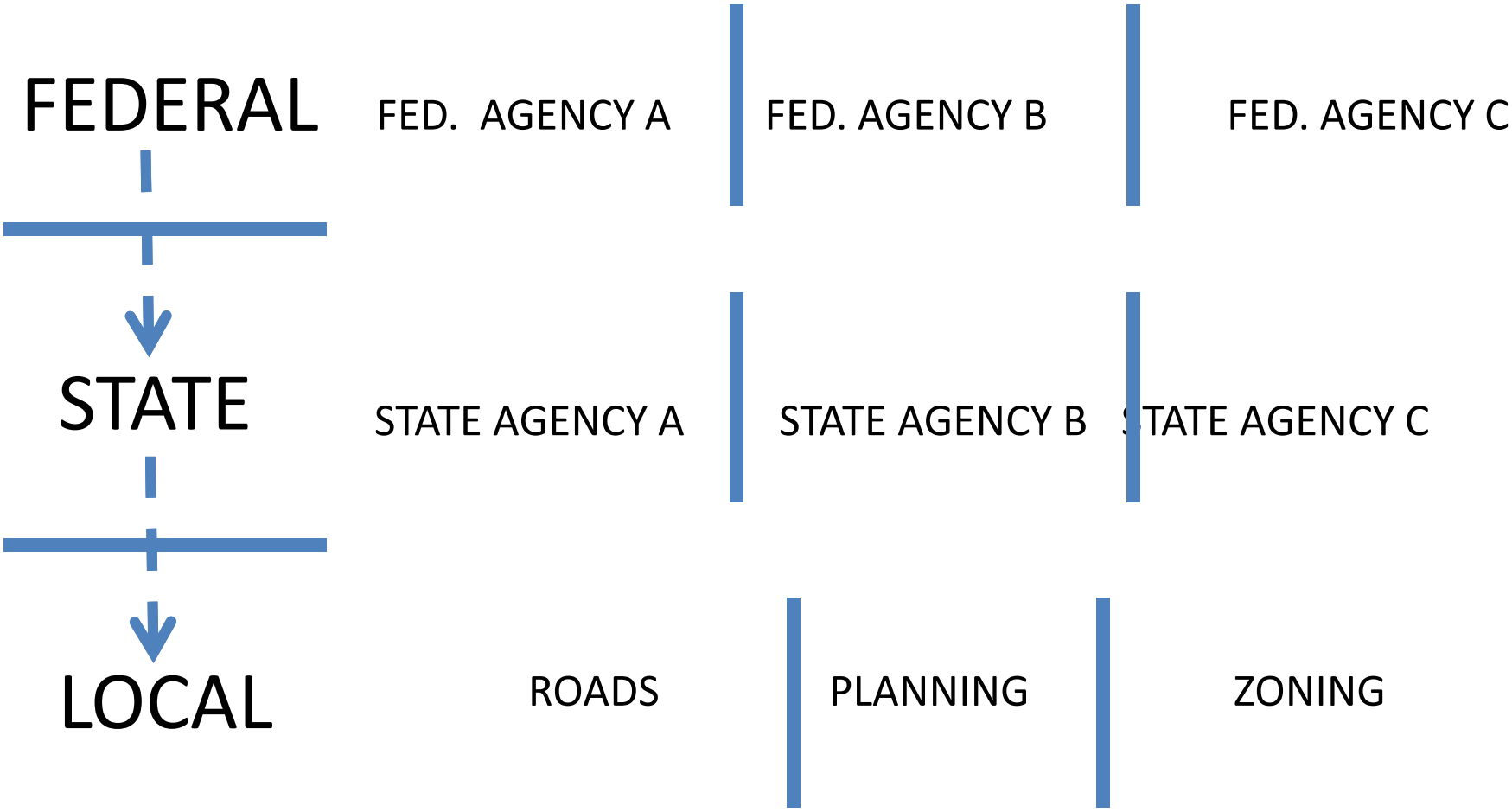
We are deepening our understanding of how water quality governed



Business as Usual (BAU) governance scenario for the LCB: **Parallel Governance**

- "Parallel play"





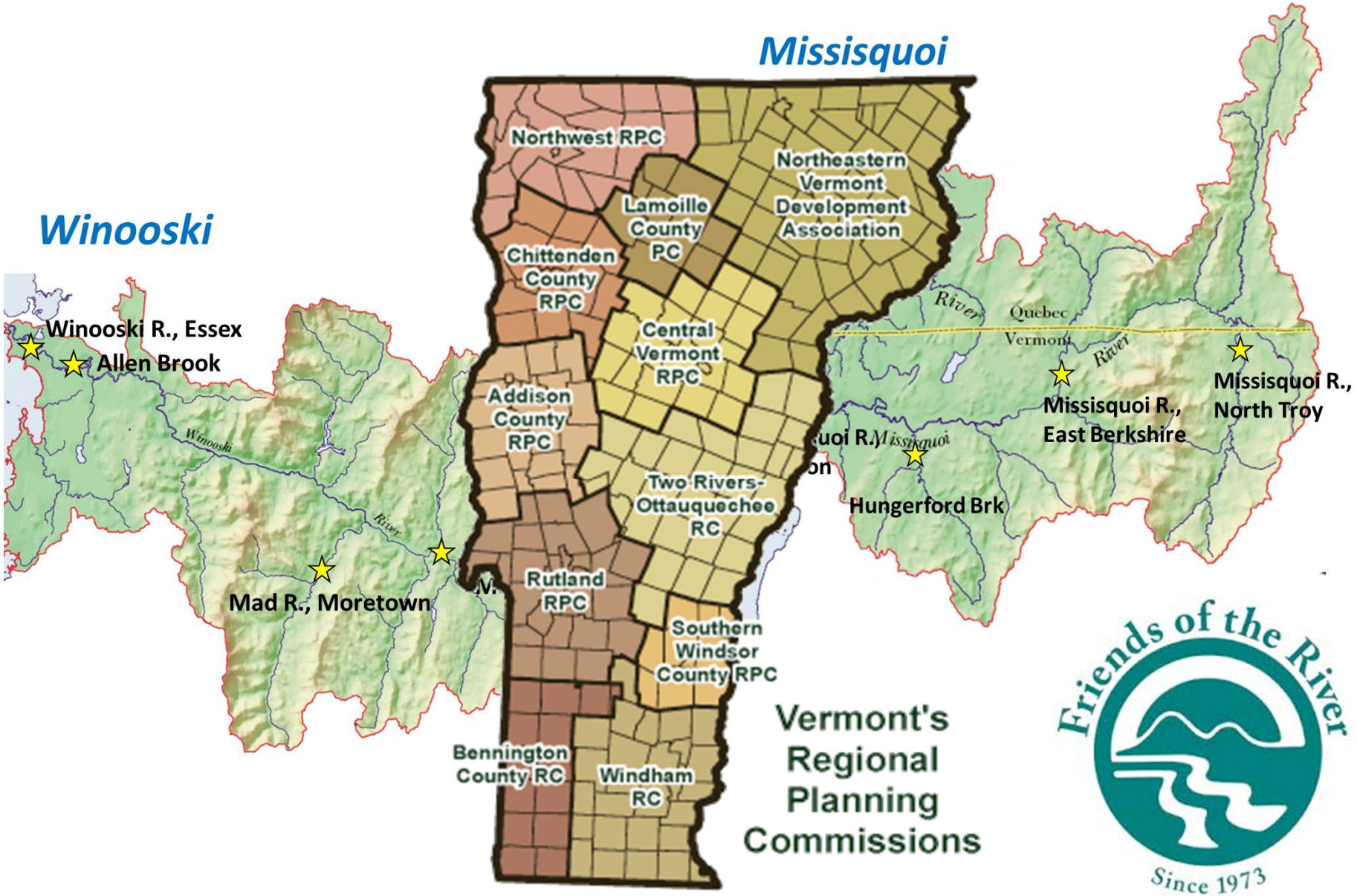
Lines of parallel governance

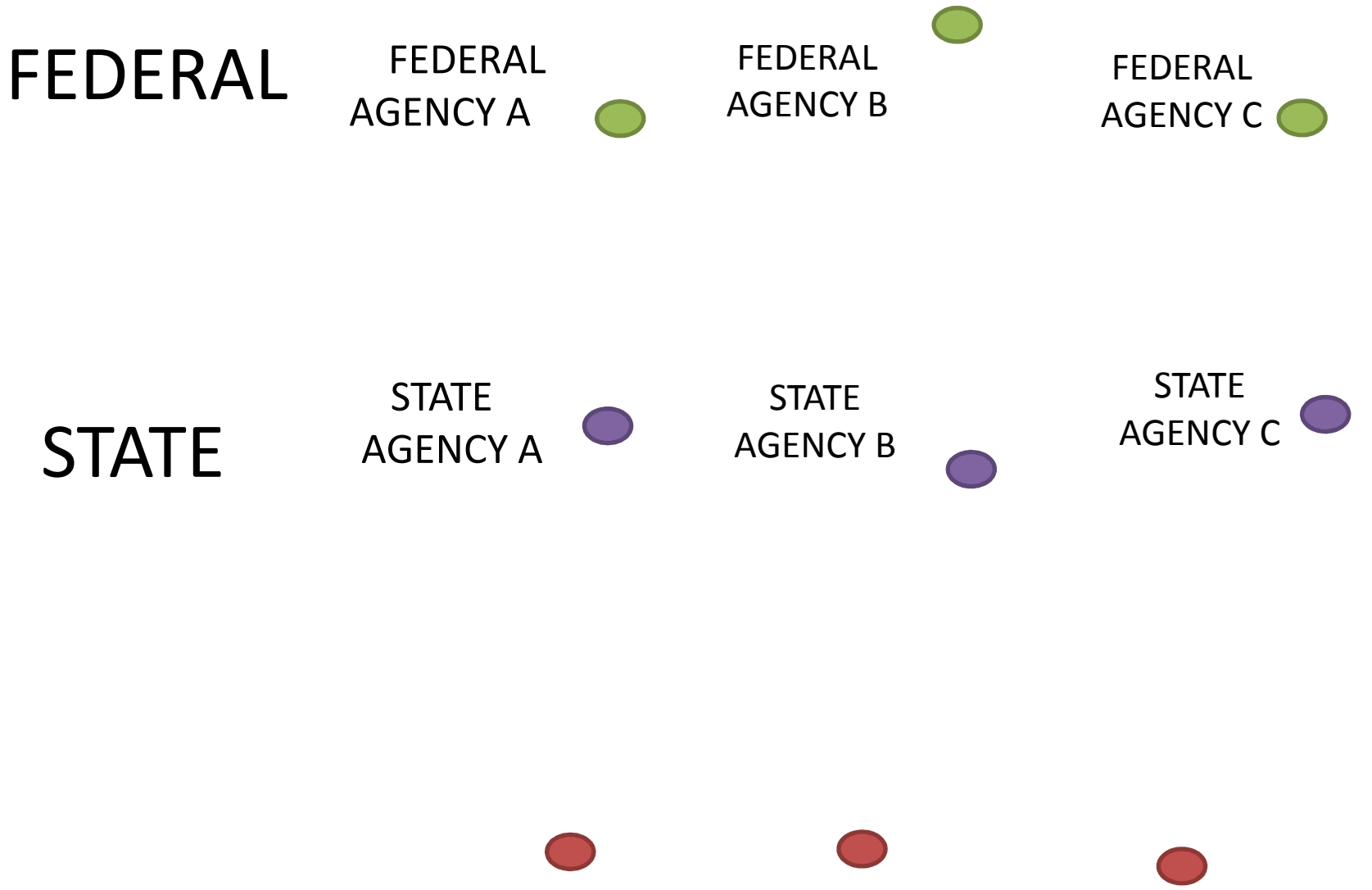
Consequences of parallel governance?

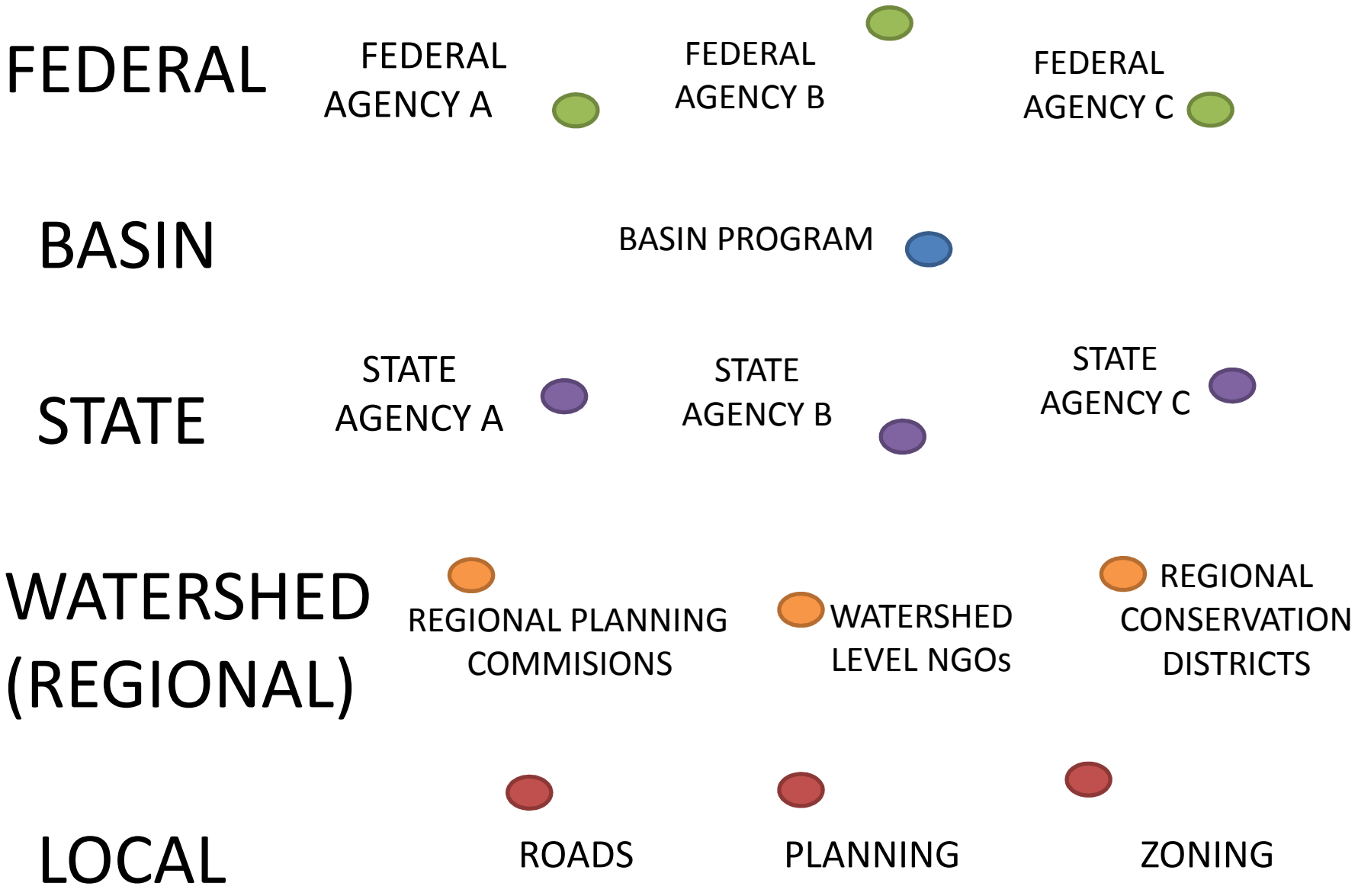
- Tendency toward compartmentalized Federal and State Agencies
  - environmental – agricultural trade-offs / technical assistance – regulation trade-offs
- Local government control over landuse and zoning decisions
  - Oftentimes, these local governments are fragmented themselves.

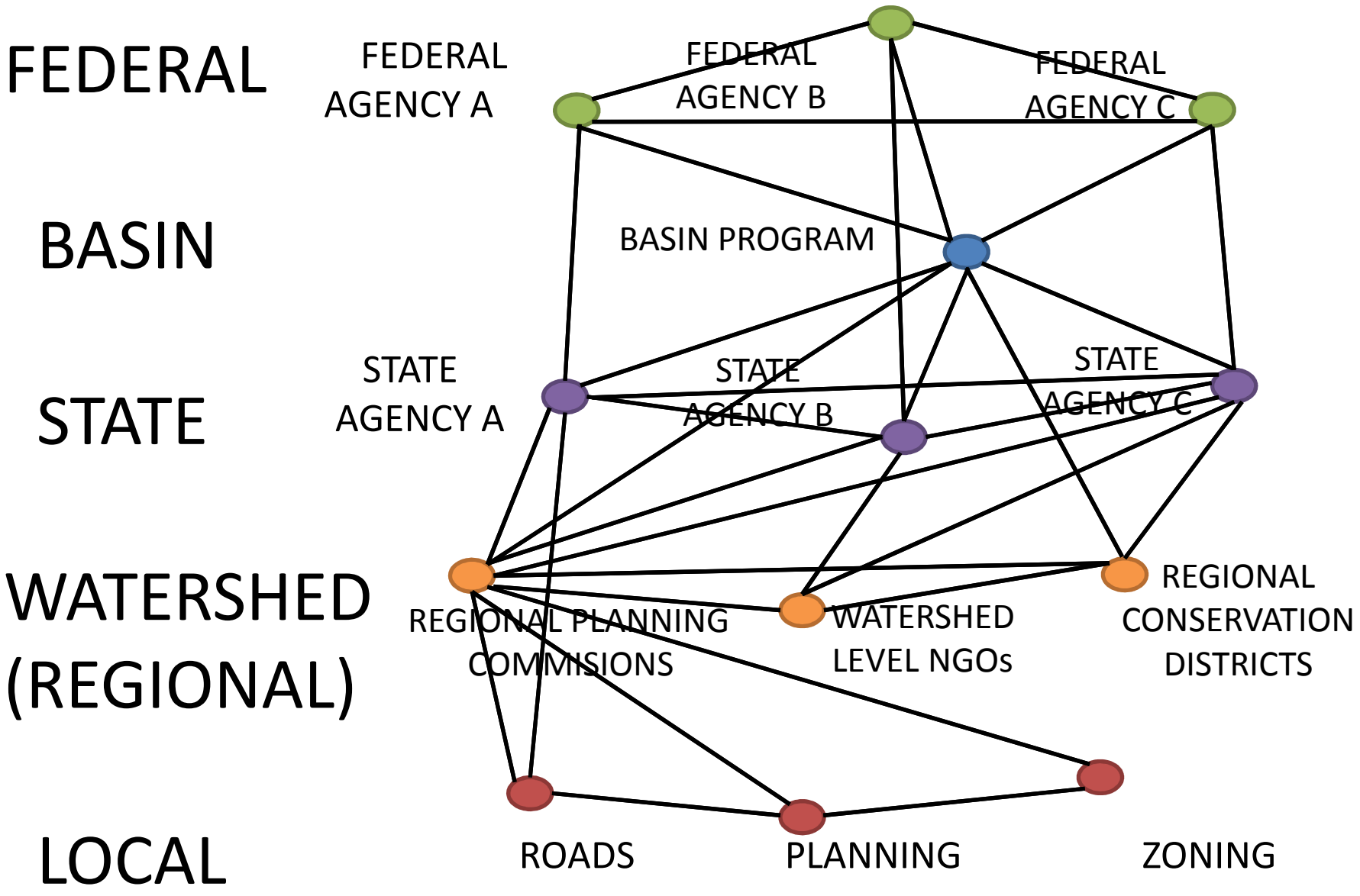
Alternative governance design:
(Bio)Regionalism at the Watershed Level for Planning and Coordination

- Empowered civil society groups operating at regional scales vested with real resources and/or authority.
- Regional planning and implementation practices that take into account local variation.
- Watershed-level approaches to interventions that rely on the best science and technologies available.


Missisquoi
Winooski
Northwest RPC
Northeastern Vermont Development Association
Lamoille County PC
Chittenden County RPC
Central Vermont RPC
Addison County RPC
Two Rivers-Ottauquechee RC
Rutland RPC
Southern Windsor County RPC
Bennington County RC
Windham RC
Winooski R., Essex
Allen Brook
Mad R., Moretown
Missisquoi R., East Berkshire
Missisquoi R., North Troy
Hungerford Brk
Quebec
Vermont
Vermont's Regional Planning Commissions
Friends of the River
Since 1973


FEDERAL
FEDERAL AGENCY A
FEDERAL AGENCY B
FEDERAL AGENCY C
STATE
STATE AGENCY A
STATE AGENCY B
STATE AGENCY C
LOCAL
ROADS
PLANNING
ZONING


FEDERAL
FEDERAL AGENCY A
FEDERAL AGENCY B
FEDERAL AGENCY C
BASIN
BASIN PROGRAM
STATE
STATE AGENCY A
STATE AGENCY B
STATE AGENCY C
WATERSHED (REGIONAL)
REGIONAL PLANNING COMMISIONS
WATERSHED LEVEL NGOs
REGIONAL CONSERVATION DISTRICTS
LOCAL
ROADS
PLANNING
ZONING


FEDERAL
BASIN
STATE
WATERSHED
(REGIONAL)
LOCAL
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AGENCY A
FEDERAL
AGENCY B
FEDERAL
AGENCY C
BASIN PROGRAM
STATE
AGENCY A
STATE
AGENCY B
STATE
AGENCY C
REGIONAL PLANNING
COMMISIONS
WATERSHED
LEVEL NGOs
REGIONAL
CONSERVATION
DISTRICTS
ROADS
PLANNING
ZONING

Resource Availability

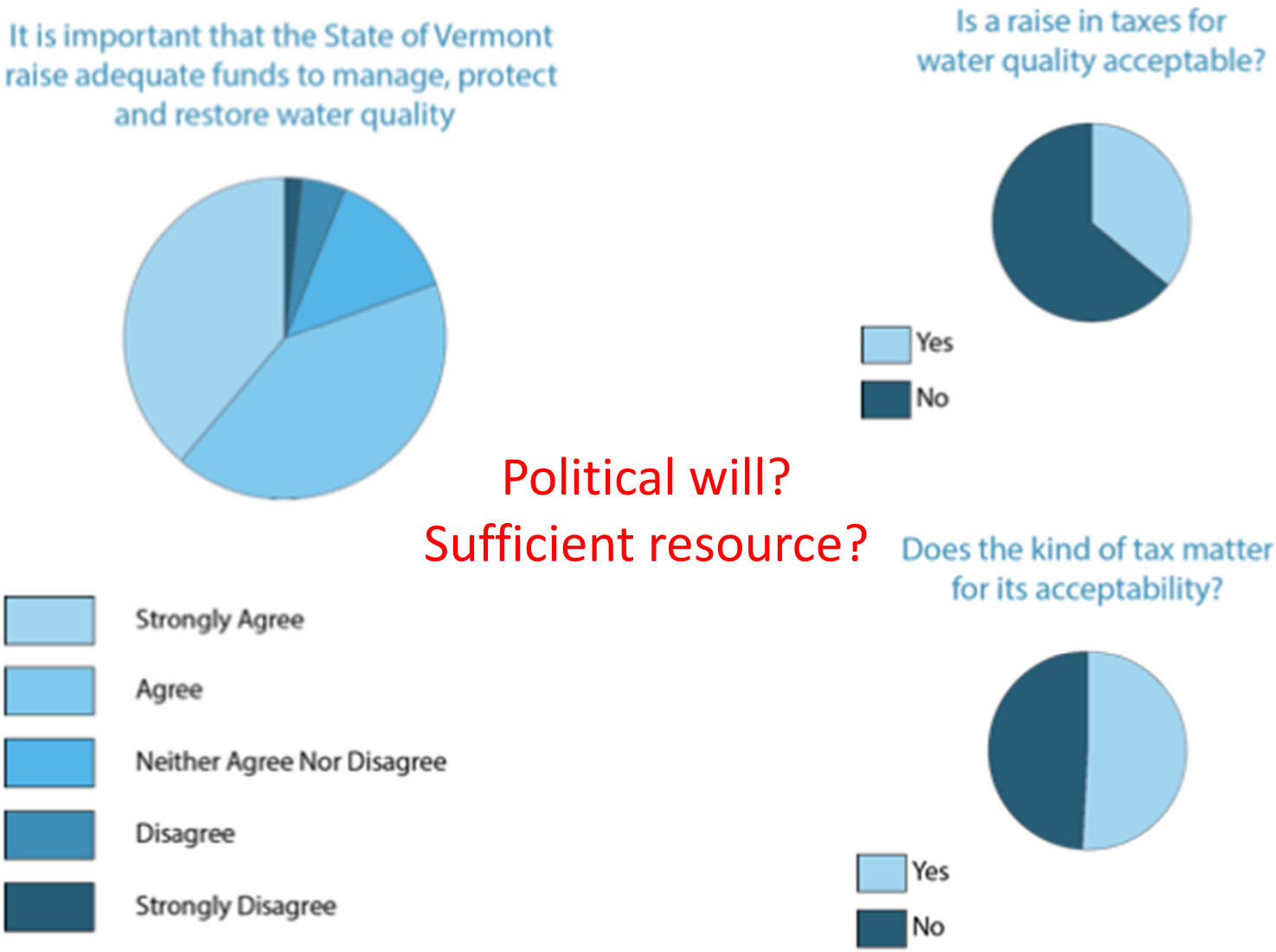
V.

V.

Where does money for water quality mitigation come from?

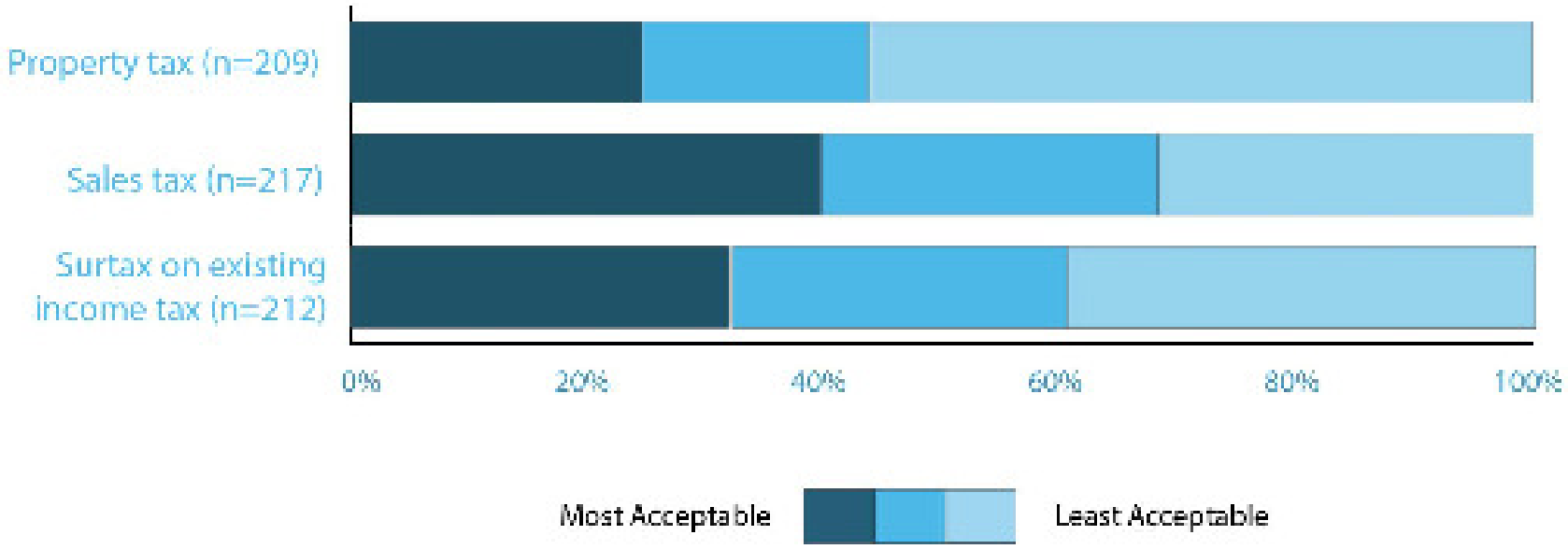
Jurisdiction	Agency	Department	Program
Vermont	AAFM	ARM	Agrichemical Management
Vermont	AAFM	ARM	ARM Enforcement
Vermont	AAFM	ARM	Engineering
Vermont	AAFM	ARM	Laboratory
Vermont	AAFM	ARM	Plant Industry
Vermont	AAFM	ARM	Water Quality
Vermont	ANR	DEC	Compliance & Enforcement
Vermont	ANR	DEC	Enforcement Services
Vermont	ANR	DEC	Connecticut Valley Flood Control Compact
Vermont	ANR	DEC	Public Drinking Water Engineering and Financial Services
Vermont	ANR	DEC	Public Drinking Water Operations/Compliance/ Planning
Vermont	ANR	DEC	Indirect Discharge
Vermont	ANR	DEC	Underground Injection Control
Vermont	ANR	DEC	Regional Permits
Vermont	ANR	DEC	Permit and Compliance Assistance
Vermont	ANR	DEC	Pollution Prevention
Vermont	ANR	DEC	Laboratory Services
Vermont	ANR	DEC	ANR Engineering Services
Vermont	ANR	DEC	Pollution Control Projects Implementation
Vermont	ANR	DEC	Water System Project Implementation
Vermont	ANR	DEC	Dam Safety
Vermont	ANR	DEC	Vermont Geological Survey
Vermont	ANR	DEC	Hazardous Waste
Vermont	ANR	DEC	Sites Management
Vermont	ANR	DEC	Hazardous Sites Settlement Accounts
Vermont	ANR	DEC	Solid Waste
Vermont	ANR	DEC	Hazardous Material Spills Response
Vermont	ANR	DEC	Underground Storage Tanks
Vermont	ANR	DEC	VT Agricultural Environmental Management (AEM) Program
Vermont	ANR	DEC	Public Water System Resource Management
Vermont	ANR	DEC	Lakes and Ponds
Vermont	ANR	DEC	Surface Water Monitoring, Assessment & Watershed Planning
Vermont	ANR	DEC	Riparian Corridor
Vermont	ANR	DEC	Stormwater
Vermont	ANR	DEC	Direct Discharge
Vermont	ANR	DEC	Residuals
Vermont	ANR	DEC	Wetlands
Vermont	ANR	Fish & Wildlife	Fisheries
Vermont	ANR	Fish & Wildlife	Law Enforcement
Vermont	ANR	Fish & Wildlife	Outreach
Vermont	ANR	Fish & Wildlife	Wildlife
Vermont	ANR	FPR	Administration
Vermont	ANR	FPR	Forest Product Utilization and Marketing
Vermont	ANR	FPR	Private Forest Land Management
Vermont	ANR	FPR	State Forest Land Management
Vermont	ANR	FPR	Forest Resource Protection
Vermont	ANR	FPR	Urban and Community Forestry
Vermont	ANR	FPR	Lands Administration
Vermont	ANR	FPR	State Park Operations
Vermont	ANR	FPR	Forest Highway Maintenance
Vermont	VTrans	Program Development	Better Backroads
Vermont	VTrans	Environmental	Municipal Mitigation Grants
Vermont	NRB	N/A	Land Use Panel
Vermont	NRB	N/A	Water Resources Panel
Federal	USDA	Farm Service Agency	Conservation Reserve Enhancement Program (CREP)
Federal	USDA	Farm Service Agency	Conservation Reserve Program (CRP)
Federal	USDA	NRCS	Farm and Ranch Lands Protection Program (FRPP)
Federal	USDA	NRCS	Agricultural Management Assistance (AMA)
Federal	USDA	NRCS	Environmental Quality Incentive Program (EQIP)
Federal	USDA	NRCS	Wildlife Habitat Incentives Program (WHIP)
Federal	USDA	NRCS	Conservation Technical Assistance (CTA)
Federal	EPA	Office of Wastewater Management	National Pollutant Discharge Elimination System (NPDES)
Federal	FEMA	N/A	National Flood Insurance Program (NFIP)

60 + FEDERAL AND STATE PROGRAMS



Source: Koliba et al. 2013 Vermont Water Quality Survey. University of Vermont

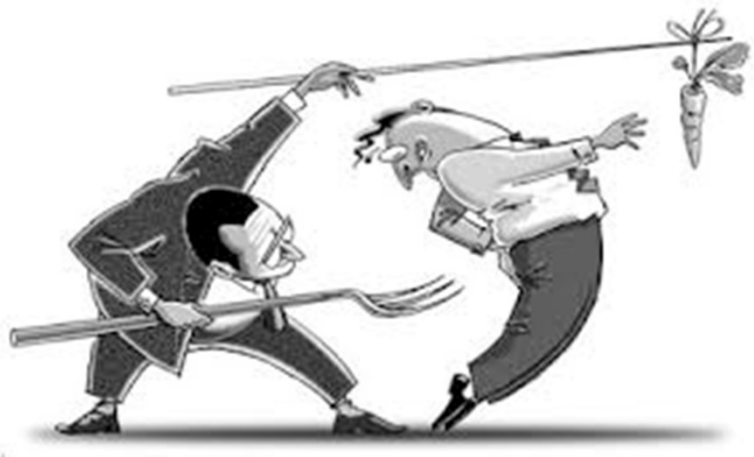
Figure 11: Acceptability of different kinds of taxes



Source: Koliba et al. 2013 Vermont Water Quality Survey. University of Vermont

Policy Preferences

- Policy tools are commonly grouped into two categories: incentives and regulations (e.g. carrots & sticks)



STICKS:

REGULATIONS

SANCTIONS

PERMITS

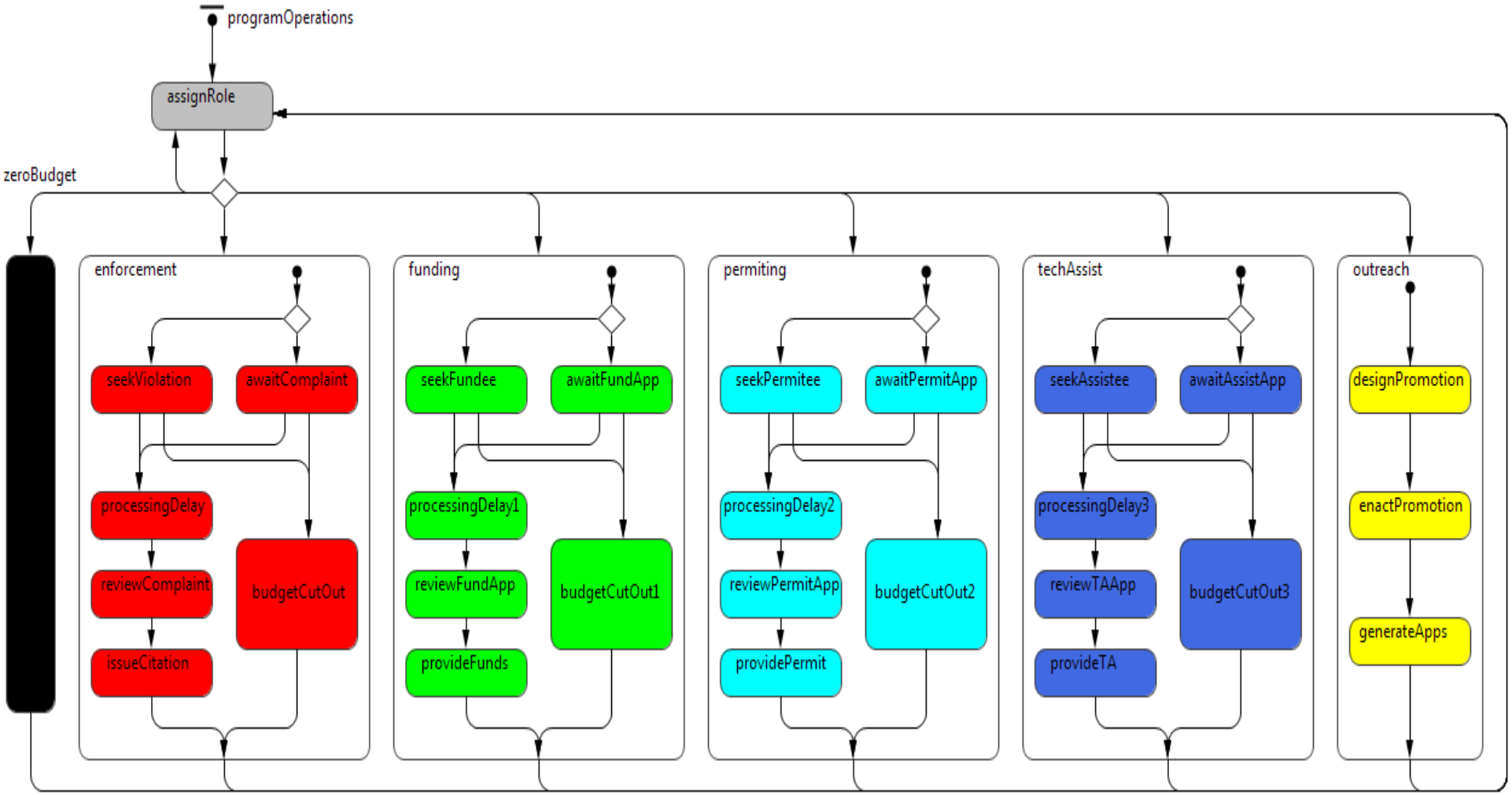
CARROTS:

INCENTIVES

TECHNICAL ASSISTANCE

PUBLIC INFORMATION/ EDUCATION

How are policy tools used to address water quality?



Evidence of policy preferences in the 2010 Opportunities for Action (OFA) Plan and the 2010 TMDL Implementation Plan

	OFA (192 tasks)		TMDL (249 tasks)	
	Count	*Percent*	*Count*	*Percent*
Economic Regulation	0	0.0	1	0.4
Environmental Regulation	42	21.9	48	19.3
Permits	9	4.7	14	5.6
Public Information	100	52.1	135	54.2
Contracts	6	3.1	6	2.4
Grants	35	18.2	36	14.5
Loan Guarantees	0	0.0	7	2.8
Tax Incentives	0	0.0	2	0.8
Policy Tools Utilized	192	100.0	249	100.0

Source: Koliba, C., Reynolds, A., Zia, A., and Scheinert, S. (accepted for publication). **Isomorphic Properties of Network Governance: Comparing Two Watershed Governance Initiatives in the Lake Champlain Basin Using Institutional Network Analysis.** *Complexity, Governance and Networks. 1(2).*

What interventions can be put in place to address the problem?

What kind of resources are needed?

Design using “crowdsourcing”

THE PURPOSE OF CSS2CC.ORG

- To **deepen our capacity** as a region to adapt to human-induced climate change, and in particular to secure our region's water quality for the long term.
- To **envision a wide array of intervention strategies** for ensuring water quality for the Lake Champlain Basin
- To develop **adaptation scenarios for stakeholder groups** using a variety of simulation tools.

Popular Discussions

Created by member: #69
2014-03-04 08:57:26 **Domain**

Increasing soil health
Comments (6)


Agriculture

Created by member: #69
2014-03-04 08:59:39 **Domain**

Proper, targeted channel stabilization
Comments (5)


River Mgt.

Created by member: #179
2014-03-09 22:47:49 **Domain**

Fence Livestock Out of Streams
Comments (5)


Agriculture

Newest Discussions

Created by member: #229
2014-03-24 14:56:13 **Domain**

Public Bioremediation Project for the Pi ...
Comments (0)


Development and Land Use

Created by member: #231
2014-03-24 12:55:33 **Domain**

Encourage composting
Comments (0)


Agriculture

Created by member: #228
2014-03-24 00:30:34 **Domain**

Ski Mountain Water Management
Comments (1)


River Mgt.

RACC
Research on Adaptation to Climate Change

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Introduction & Directions | Personal Information | Background Materials | My Interventions | All Interventions | General Discussions

BACKGROUND MATERIALS

REGIONAL RESOURCES TO CLIMATE CHANGE

FUTURE PROJECTIONS

HISTORICAL TRENDS

STAKEHOLDER GENERATED CLIMATE IMPACTS

RACC
Research on Adaptation to Climate Change

Logout

Introduction & Directions | Personal Information | Background Materials | My Interventions | All Interventions | General Discussions

My Interventions: Envisioning climate change adaptation interventions

Save

Considering the problems of climate change and water quality, please suggest one or more adaptive interventions to address these issues using the form below. Material is available under tabs "BACKGROUND MATERIALS" to provide context and inspiration. Please click on the help icons for instructions on completing each field, or refer to the introduction for more information.

Chris Koliba's Interventions

Primary Domain	Scope	Title	Rationale	Comments

Created by member: #208 2014-03-17 14:54:17 — Primary Domain

Let municipalities trade with other sectors to implement most beneficial mitigation measures
Comments (1)

Created by member: #81 2014-03-14 16:45:35 — Primary Domain

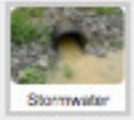
Green Infrastructure Retrofit of Existing Commercial & Industrial Sites
Comments (2)

Created by member: #179 2014-03-09 22:27:43 — Primary Domain

Controlling Polluted Runoff from Existing Developed Areas Through Regulation
Comments (0)

Created by member: #134 2014-03-06 10:49:31 — Primary Domain

Promote low impact development and green infrastructure
Comments (2)

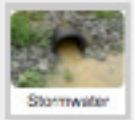


Created by member: #126 2014-03-05 20:58:19 — Primary Domain

culvert sizing
Comments (2)

Created by member: #48 2014-03-03 14:00:17 — Primary Domain

Give Property Tax Incentives for Enhanced Stormwater/Runoff Management
Comments (4)



Tying these together through Integrated Assessment Models (IAM)

- Critical “Q3” concern: engaging stakeholders in IAM construction and use…

Thank you

Chris Koliba
ckoliba@uvm.edu
802-656-3772

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Research on Adaptation to Climate Change

http://www.uvm.edu/~epscor/new02