The Taos acequias

Michael Cox
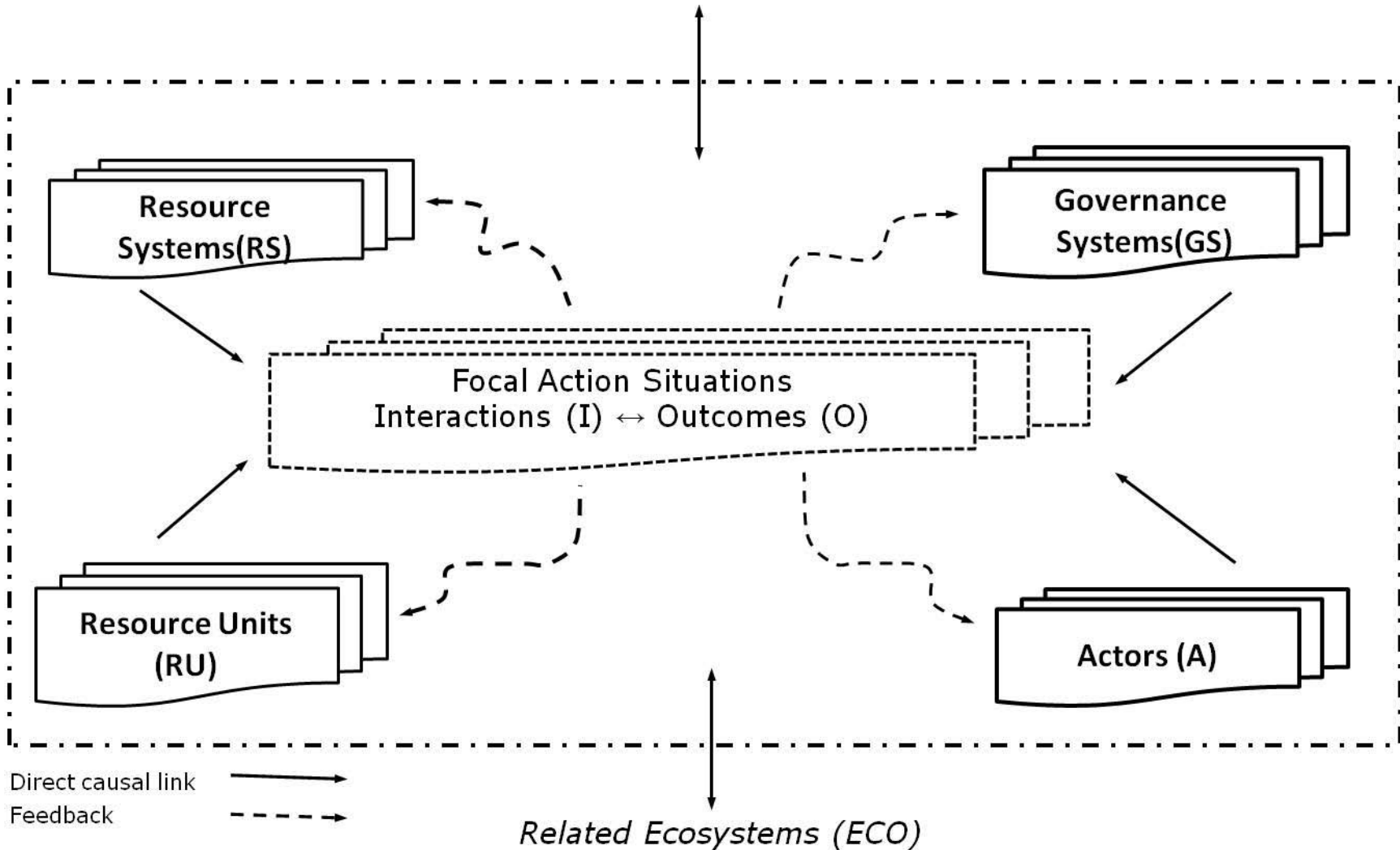
Environmental Studies Program

Dartmouth College

Colorado

Taos County

New Mexico

Texas

0 45 90   180 Kilometers

USGS Stream gages
Rivers
Irrigation canals
Irrigated land
Taos municipal boundary

0 2 4   8 Kilometers
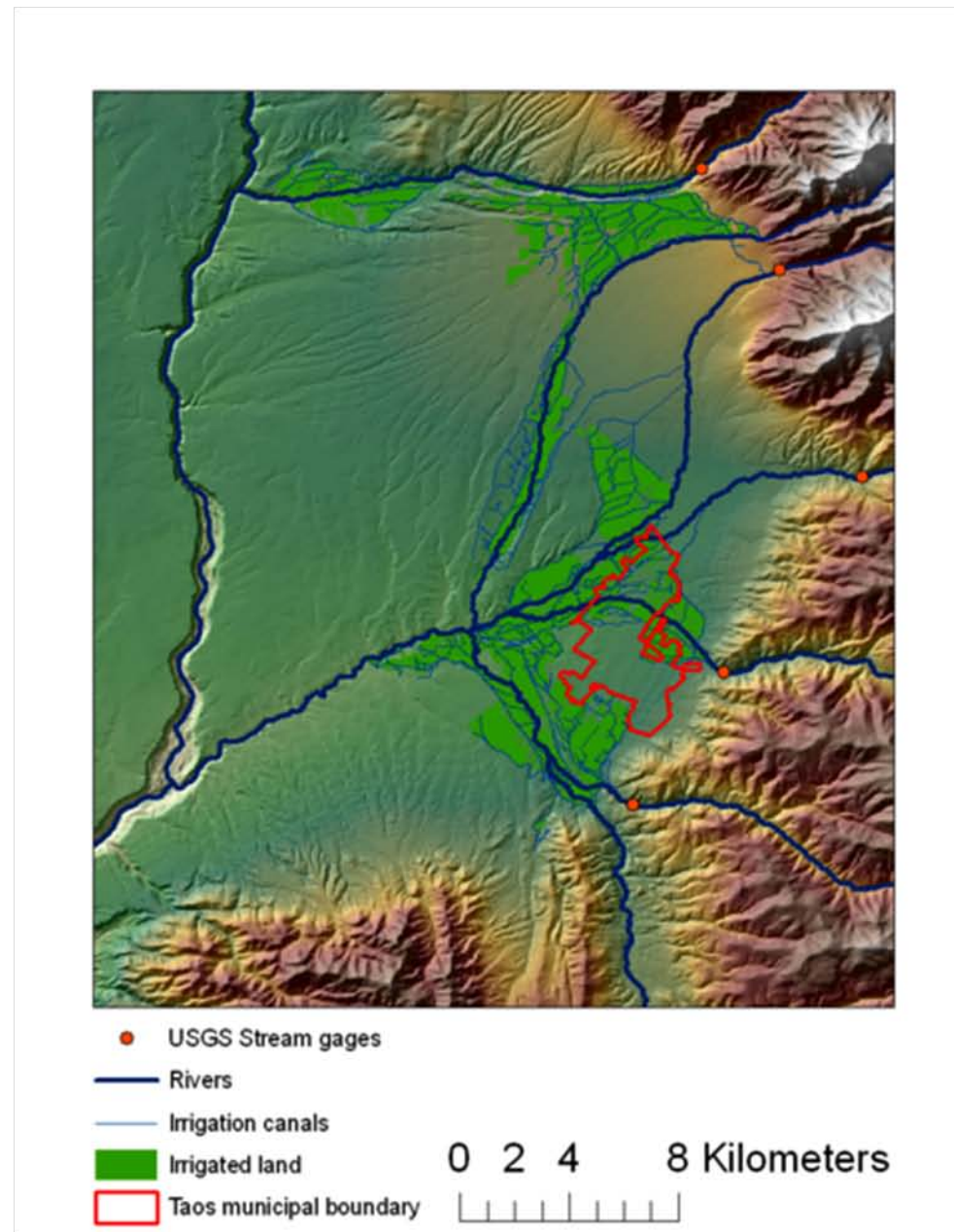
Social-ecological systems (Ostrom 2007)

Related Social, Economic, and Political Systems (S)

Resource Systems(RS)

Governance Systems(GS)

Focal Action Situations
Interactions (I) ↔ Outcomes (O)

Resource Units (RU)

Actors (A)

Direct causal link
Feedback

Related Ecosystems (ECO)

Social, Economic, and Political Settings (S)

S1- Economic development. S2- Demographic trends. S3- Political stability.
S4- Government settlement policies. S5- Market availability.

Resource System (RS)

RS1- Sector (e.g., water, forests, pasture, fish)
RS2- Clarity of system boundaries
RS3- Size of resource system
RS4- Human-constructed facilities
RS5- Productivity of system
RS6- Equilibrium properties
RS7- Predictability of system dynamics
RS8- Storage characteristics
RS9- Location

Governance System (GS)

GS1- Government organizations
GS2- Non-government organizations
GS3- Network structure
GS4- Property-rights systems
GS5- Operational rules
GS6- Collective-choice rules
GS7- Constitutional rules
GS8- Monitoring and sanctioning processes

Resource Units (RU)

RU1- Resource unit mobility
RU2- Growth or replacement rate
RU3- Interaction among resource units
RU4- Economic value
RU5- Size
RU6- Distinctive markings
RU7- Spatial and temporal distribution

Users (U)

U1- Number of users
U2- Socioeconomic attributes of users
U3- History of use
U4- Location
U5- Leadership/entrepreneurship
U6- Norms/social capital
U7- Knowledge of SES/mental models
U8- Dependence on resource
U9- Technology used

Action Situation

Interactions (I) → Outcomes (O)

I1- Harvesting levels of diverse users
I2- Information sharing among users
I3- Deliberation processes
I4- Conflicts among users
I5- Investment activities
I6- Lobbying activities

O1- Social performance measures
   (e.g., efficiency, equity, accountability)
O2- Ecological performance measures
   (e.g., overharvested, resilience, diversity)
O3- Externalities to other SESs
O4 – Social-ecological equilibrium

Related Ecosystems (ECO)

ECO1- Climate patterns. ECO2- Pollution patterns.
ECO3- Flows into and out of focal SES.

Irrigation System (RS)

RSI1 Sector: Irrigation
RSI2 Strong physical boundaries
RS4Ia Unlined canals
RS4Ib Drainage canals (desagues)
RS4Ic Canal branching
RSI7 Low predictability
RSI8 Low storage
RSI9 High costs of exclusion

Aquifer System (RS)

RSG1 Sector: Groundwater
RSG2 Weak physical boundaries
RSG7 Moderate predictability
RSG8 High storage
RSG9 High costs of exclusion

Land system (RS)

RSL1 Sector: Pasture and agriculture
RSL2 Moderate physical boundaries
RSL9 High costs of exclusion
RSL10 Strong surface/aquifer connection

Water (RU)

RU1 High mobility
RU2 Moderate renewability
RU7a High spatial heterogeneity
RU7b High temporal heterogeneity
RU8 Moderate subtractability

Taos acequia governance system (GS)

GS1a Local courts
GS3a Moderate network Centrality
GS3b High network Modularity
GS3c Moderate network Hierarchy
GS4a Heterogeneous property rights distribution
GS4b Private/common property mix
GS4c (Inter)Communal management regime
GS5a High proportionality
GS5b Rotational water distribution system
GS8a Monitoring present
GS8b Graduated sanctioning present
GS9 Conflict resolution present

Acequias members (A)

A1 Small group size
A2a Low economic status
A4a High spatial clustering
A5 Strong leadership
A6a Strong social capital
A6b Norms of equity and reciprocity
A8 High resource dependence
A9 Low technology
A10 High exit cost

Action situations

Interactions (I) → Outcomes (O)

I1 Water harvesting levels

O1 – Sustained Collective action
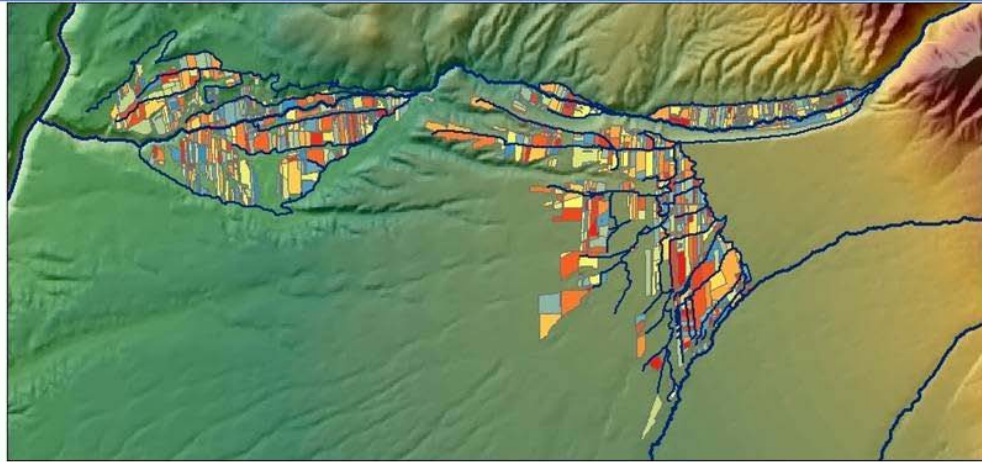
I5 Infrastructure investment activities

Levels of governance
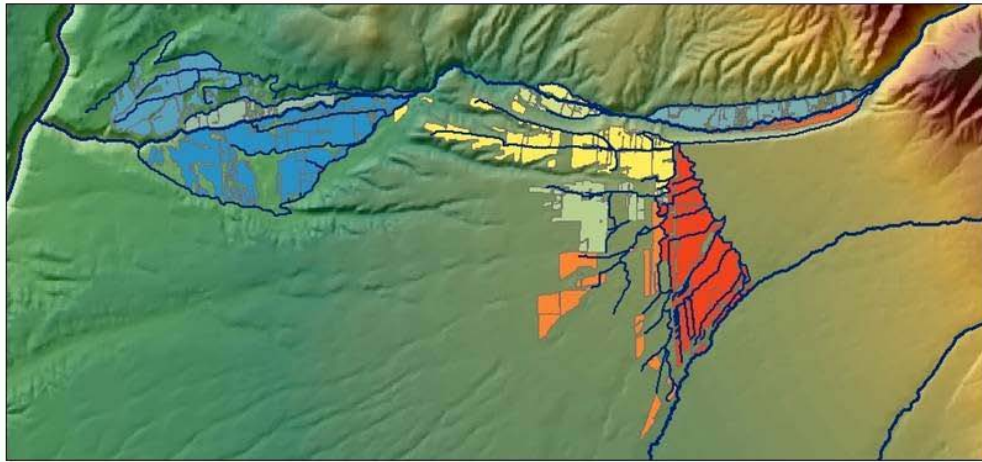
Governance Level 2:
Repartimientos
between acequias

Governance Level 1:
Within acequias

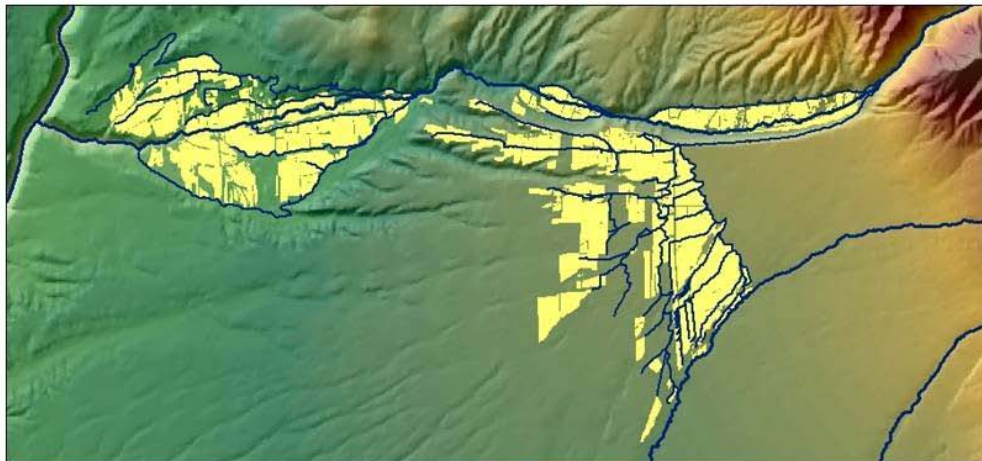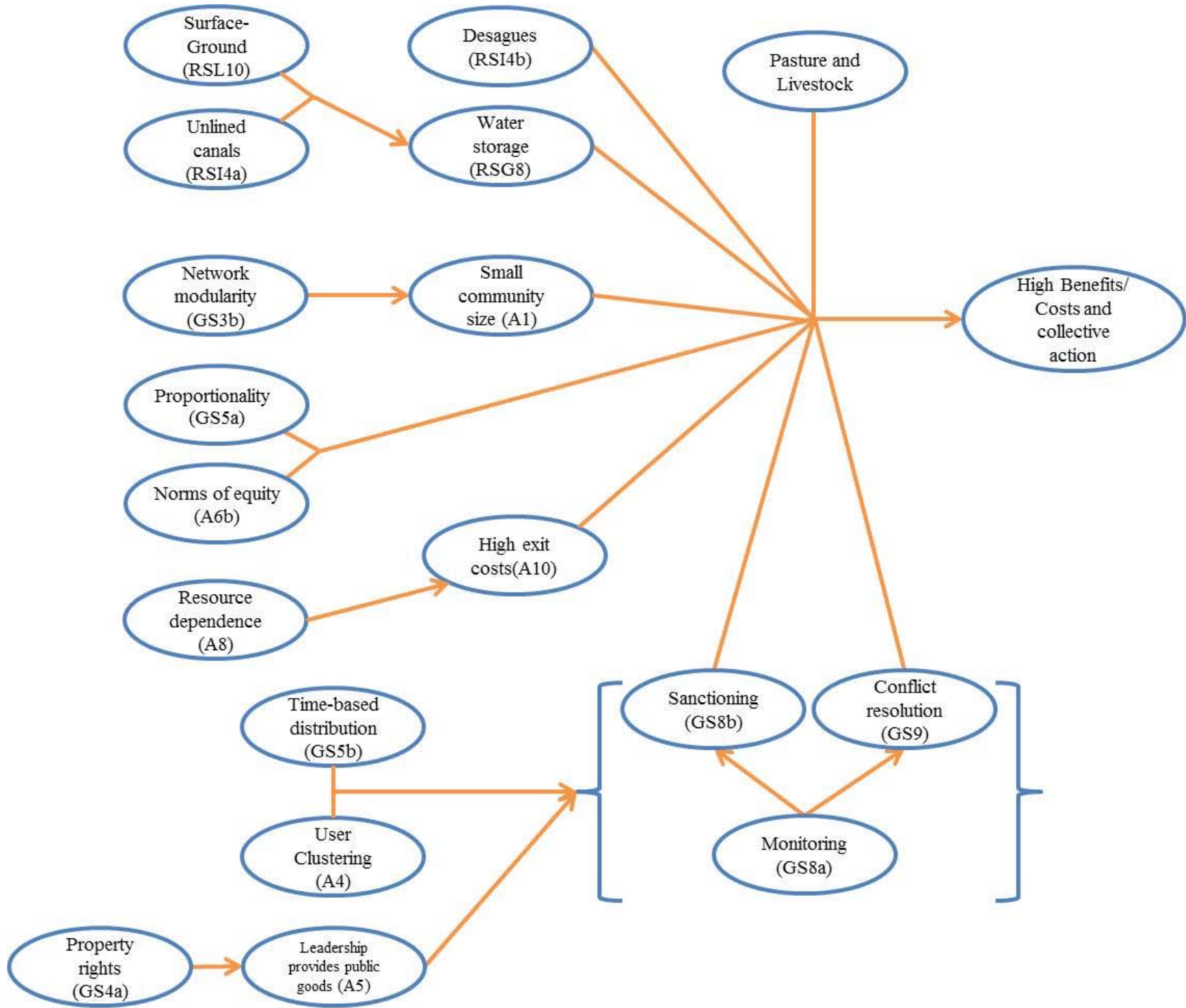| Appropriation	
Appropriation	Provision

Level 0:
Property: Private
Management: Mostly private
Unit: private farms

Level 1:
Property: Communal
Management: Communal
Unit: acequias

Level 2:
Property: Communal
Management: Inter-communal
Unit: Repartimiento

Changes...

Variable	Native	Non-native	Overall
Number of respondents	73	34	107
Chlidren Expectation	80%	48%	71%
Dependence on farming	1.9	1.44	1.76
Parents' dependence on farming	2.53	1.42	2.3
Farming dependence difference	-0.63	0.02	-0.54
Change in acres farmed	1.81	2.3	2.05
Own livestock	42%	33%	39%
Parents owned livestock	80%	26%	64%
Dependence on pasture/livestock	1.56	1.27	1.47
Parents' dependence on livestock	2.39	1.42	2.09
Livestock dependence difference	-0.83	-0.15	-0.62
Change in livestock owned	1.3	1.96	1.53

Disturbances

Disturbance	Native	Non	Difference	Overall
Droughts	3.81	3.12	0.69	3.58
Less participation	3.26	3.09	0.17	3.20
Newcomers	3.35	2.88	0.47	3.19
Infrastructure	3.13	3.09	0.04	3.12
Physical	3.01	2.68	0.34	2.90
Officers	2.72	2.64	0.08	2.69
Water markets	2.64	2.33	0.31	2.54
Abeyta	2.81	1.70	1.11	2.44
Leadership	2.33	1.91	0.42	2.20
Floods	2.10	1.66	0.44	1.95
USFS	2.08	1.20	0.88	1.79
M&D pressure	0.33	0.21	0.12	0.30
Average	2.63	2.21	0.42	2.49

Challenges and future directions

- Challenges:
  - For communities: adaptation
  - For researchers: collaboration, comparison and synthesis
- Future research:
  - Additional research on irrigation systems in Taos and the San Luis valley
  - Meta-analysis of diverse social-ecological systems

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