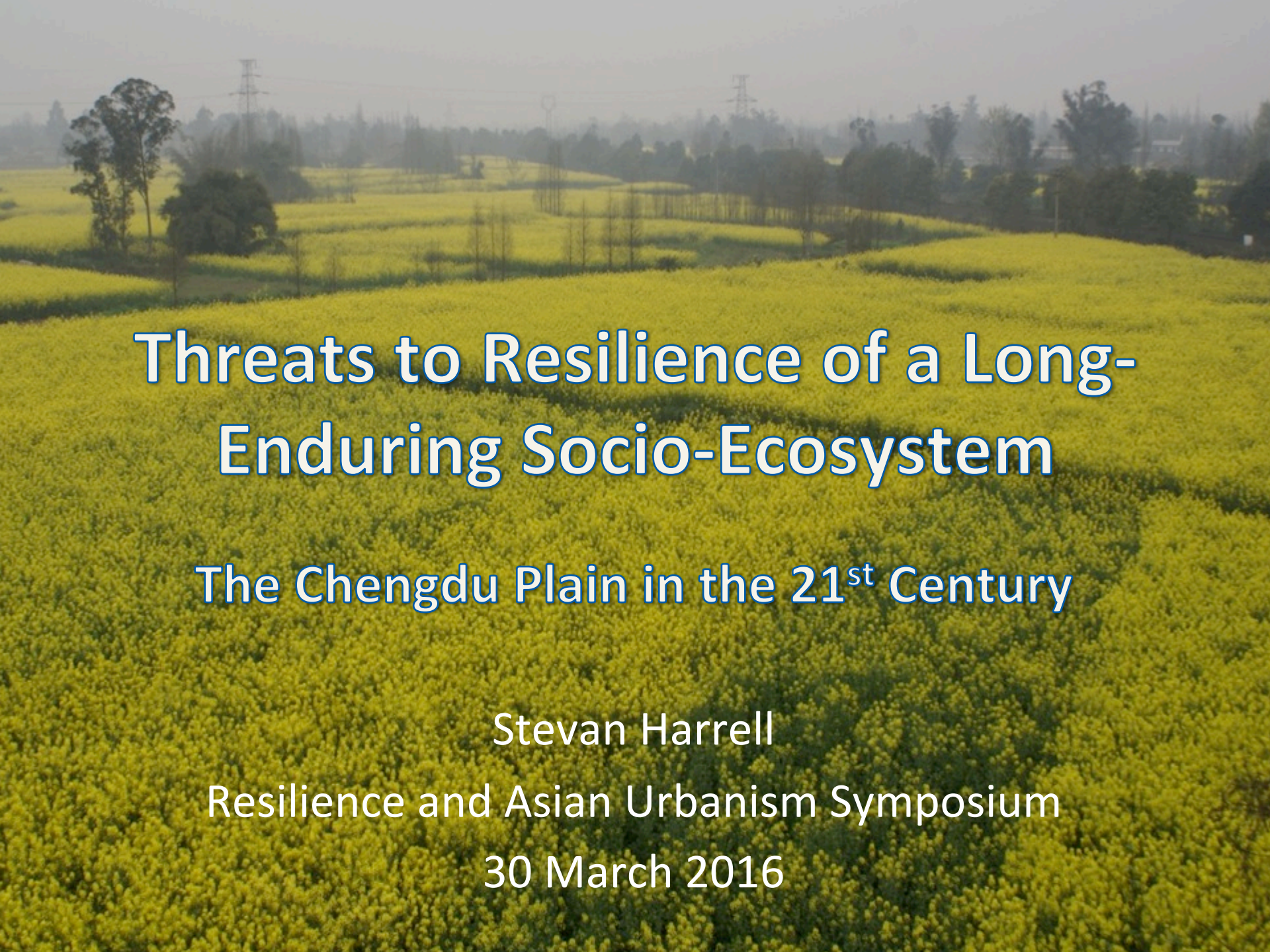

Threats to Resilience of a Long-Enduring Socio-Ecosystem

The Chengdu Plain in the 21st Century

Stevan Harrell

Resilience and Asian Urbanism Symposium

30 March 2016

OUTLINE

1. Resilience
2. A long-enduring socio-ecosystem
3. Threats

Waterworks as illustration of the curvilinear relationship between productivity/intensification and resilience

1. Resilience
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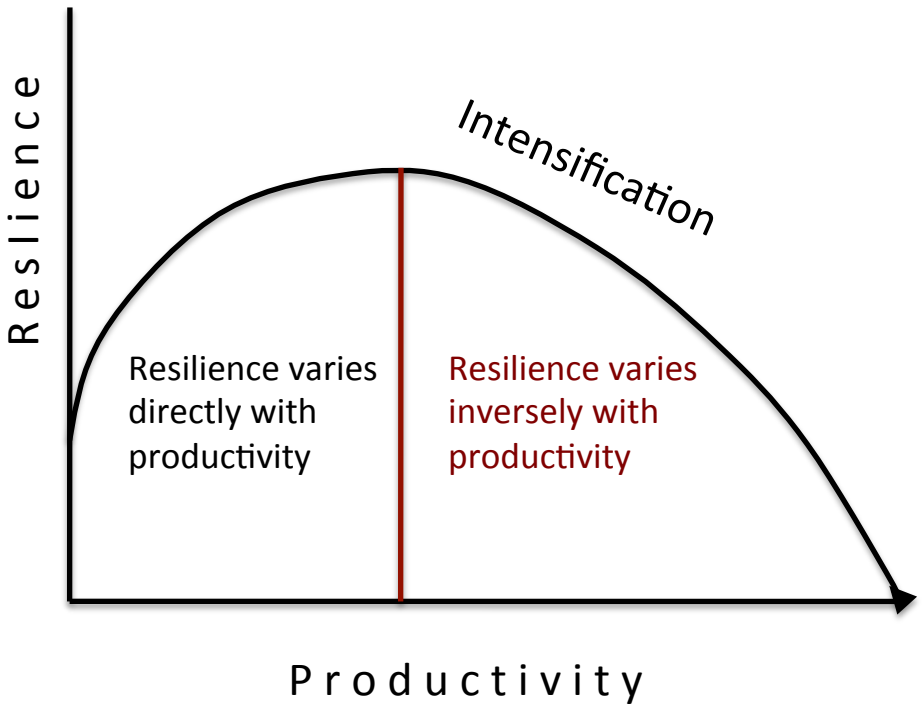

Start with irregular rainfall
Build a reservoir-infrastructural buffer
Reservoir contains excess in big storms
Reservoir retains water in droughts
Natural events don't become disasters
Harvests become more reliable
Resilience increases

Reclaim more land
Reservoir can't release water, exceeds capacity;
Remaining ecological buffers gone
Community more dependent on lands that will flood
Maintenance costs continue to increase
Natural events become disasters

Resilience depends on buffers

- To be effective,
- Ecological buffers must be there
- Infrastructural buffers must be relatively inexpensive to maintain
- Institutional buffers must be flexible and adaptable, with reciprocity across scales
- Cultural buffers must be strongly engrained

Replacing buffers

- Most intensification reduces ecological buffers (wetlands, forests, etc) that provide ecosystem services
  - Exceptions: terracing (EAsia, Lake Patzcuaro)?
  - Exceptions: flash-flood irrigation (Pueblo)
- Infrastructural buffers can be constructed to make up for loss of ecological buffers, and institutional buffers created to manage the infrastructure thereby maintaining or enhancing overall resilience.
  - But there is a cost, in becoming dependent on the infrastructures and the institutions, leading to more energy being put into conservation (K-phase).
  - Eventually this energy going into conservation outweighs the ability of institutions and infrastructure to respond to disturbance
  - Eventually ecological buffers decline to almost zero, and no infrastructure or institutions can make up for them. The system reaches a threshold.

Resilience and Buffers in the Adaptive Cycle

1. Resilience
2. A long-enduring socio-ecosystem
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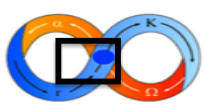
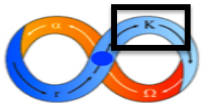
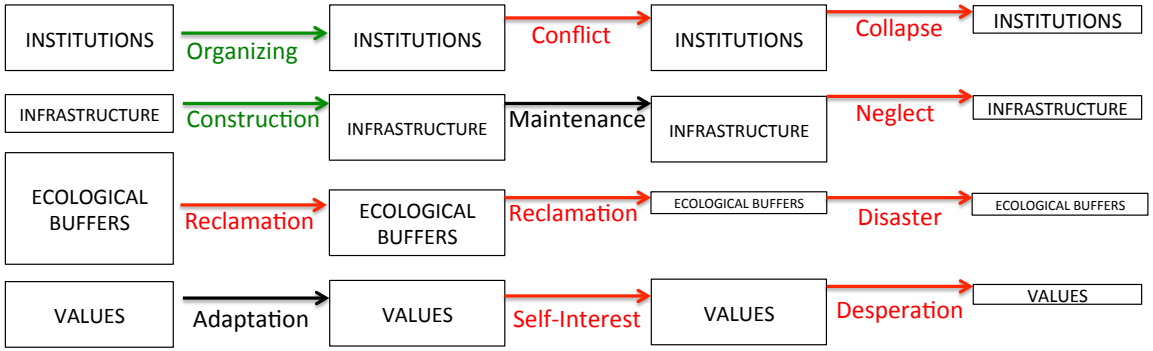


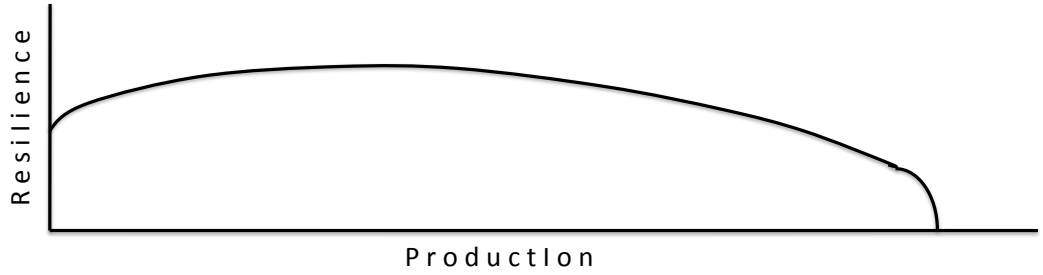
Exploitation: production and resilience both increase as stable agricultural system is built



Conservation: increased dependency on constructed buffers; further intensification diminishes buffers and resilience

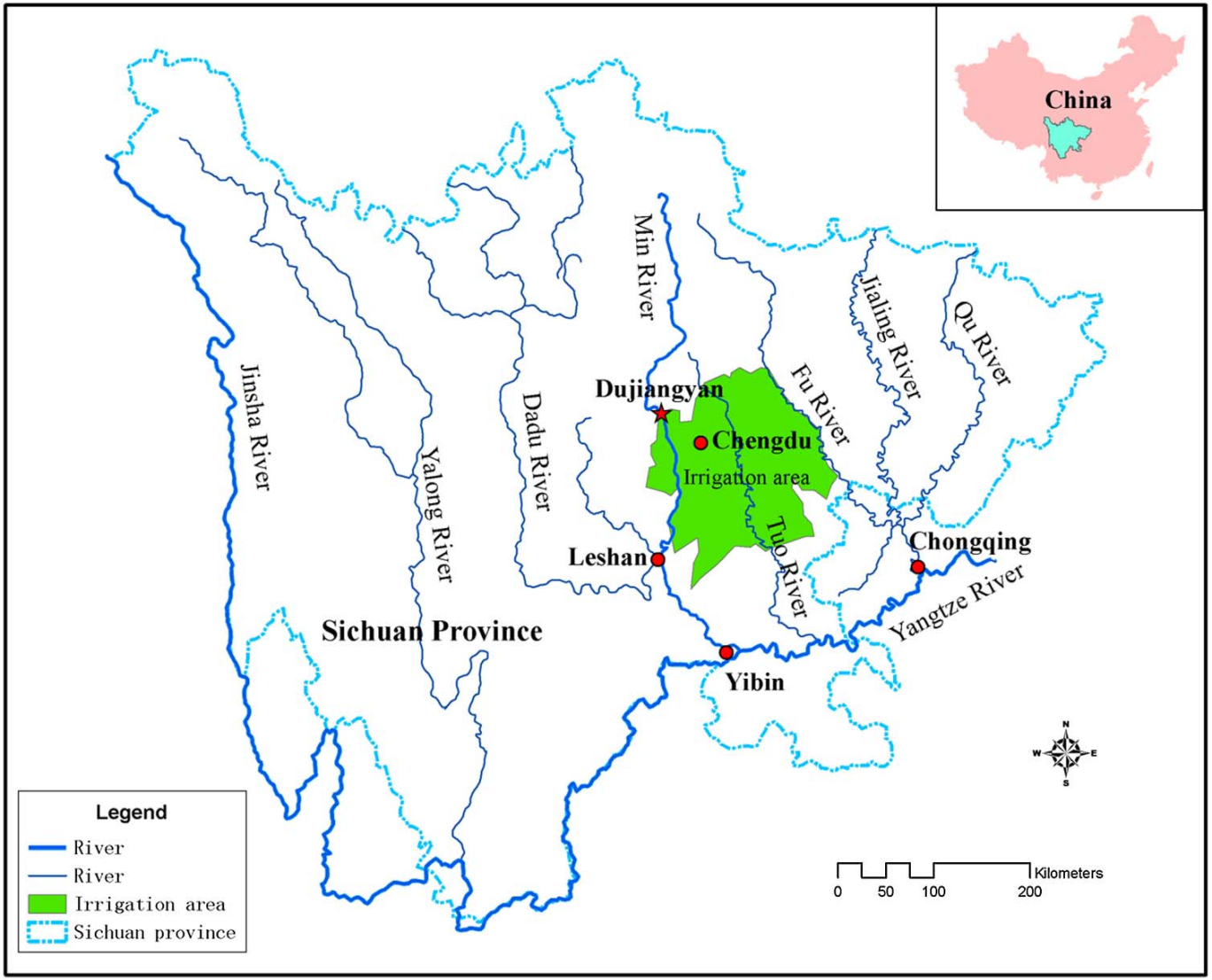
Collapse: resource needs have overshot carrying capacity; buffers chronically inadequate





Chengdu Plain and Dujiangyan in China

1. Resilience
2. A long-enduring socio-ecosystem
3. Threats



Relevant Scales for the Chengdu Plain

1. Resilience
2. A long-enduring socio-ecosystem
3. Threats

Globe

Nation

Province

Region

Landscape

Household

Min River Delta Agricultural Settlement Form

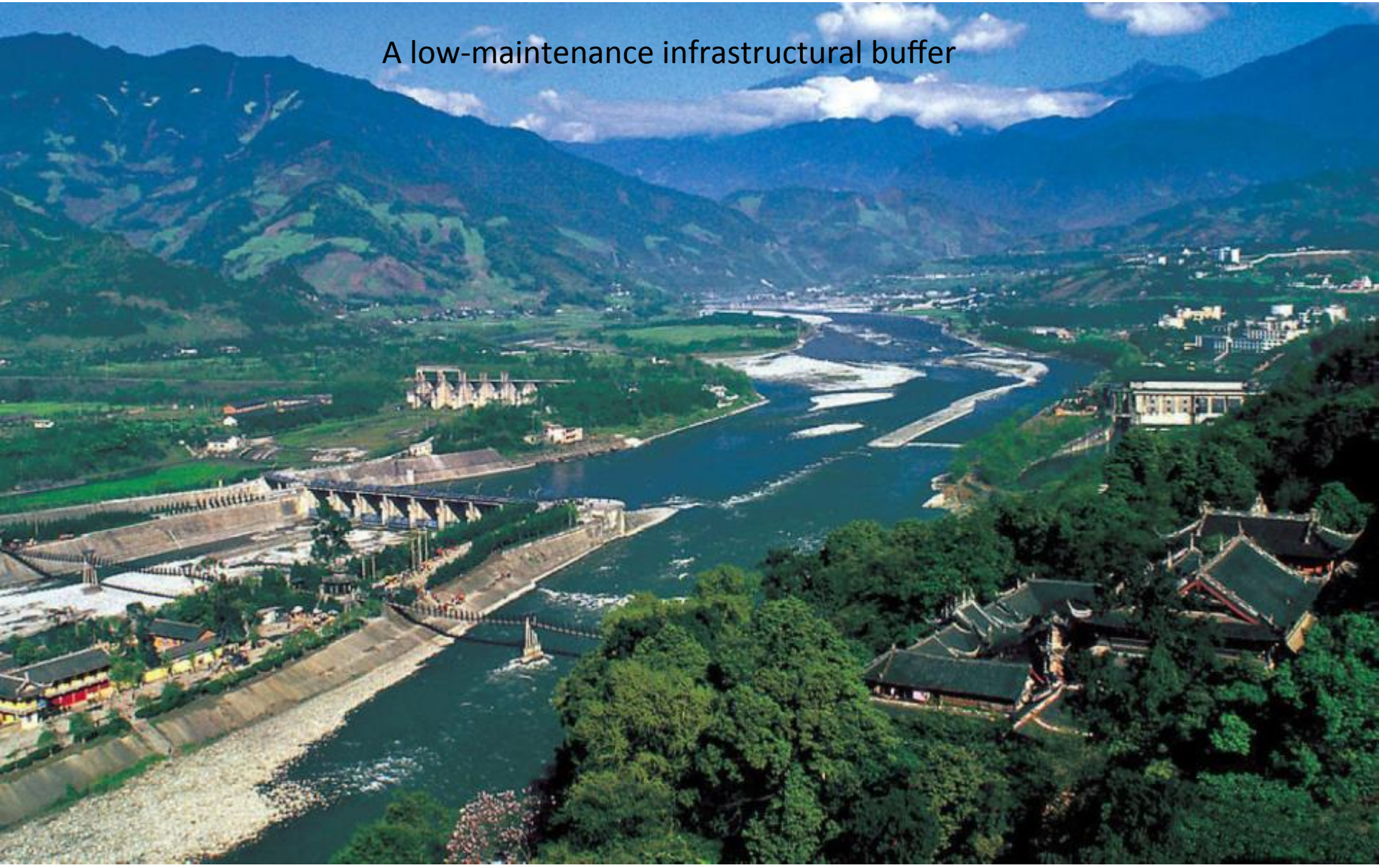
***Linpan* of the Chengdu Plain or *chuanxi bazi* (川西坝子) -- an especially forested and dispersed settlement form for a densely populated, highly productive agricultural region**

1. Resilience
2. A long-enduring socio-ecosystem
3. Threats

1. Resilience
2. A long-enduring socio-ecosystem
3. Threats

Dujiangyan Irrigation Project

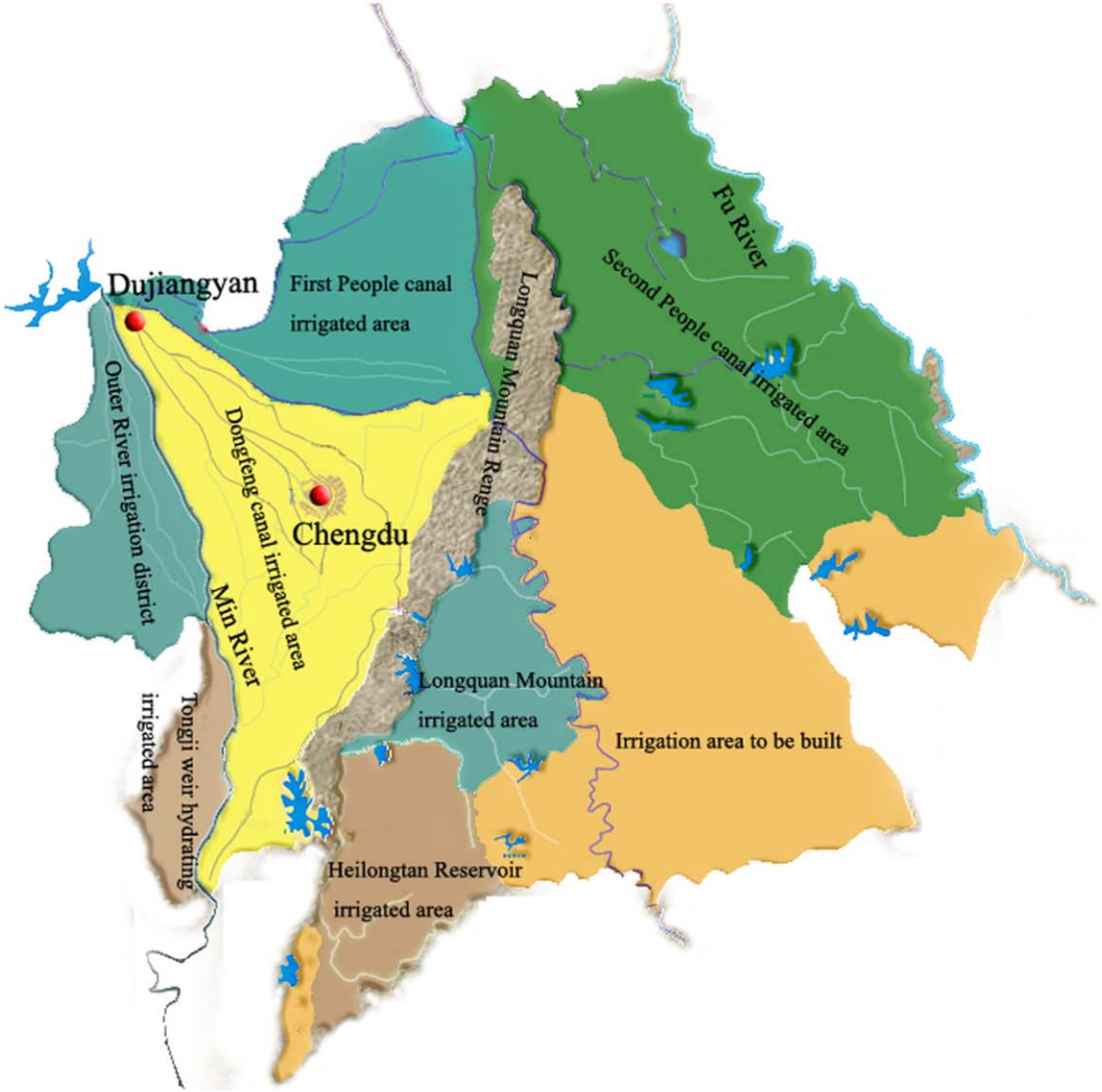
A low-maintenance infrastructural buffer



Source: http://shifu.people.com.cn/wp-content/uploads/2011/09/都江堰.jpg

1. Resilience
2. A long-enduring socio-ecosystem
3. Threats

Dujiangyan in Space



1. Resilience
2. A long-enduring socio-ecosystem
3. Threats

Buffers or Guarantors of Socioecological Resilience:

- Ecological buffers
  - Patchy Landscape
  - Crop diversity
  - Wetlands
  - Forests
  - Fallow land
  - Ungrazed pasture
- Infrastructure: mostly waterworks
- Institutions
  - Kin groups
  - Irrigation Associations
  - Temples
  - Fraternal Societies
  - Formal Government
  - Market exchange
- Beliefs and values:
  - Frugality
  - Recycling
  - Generational Continuity
  - Within-community Reciprocity

Salient Scales of Cross-Scale Feedback



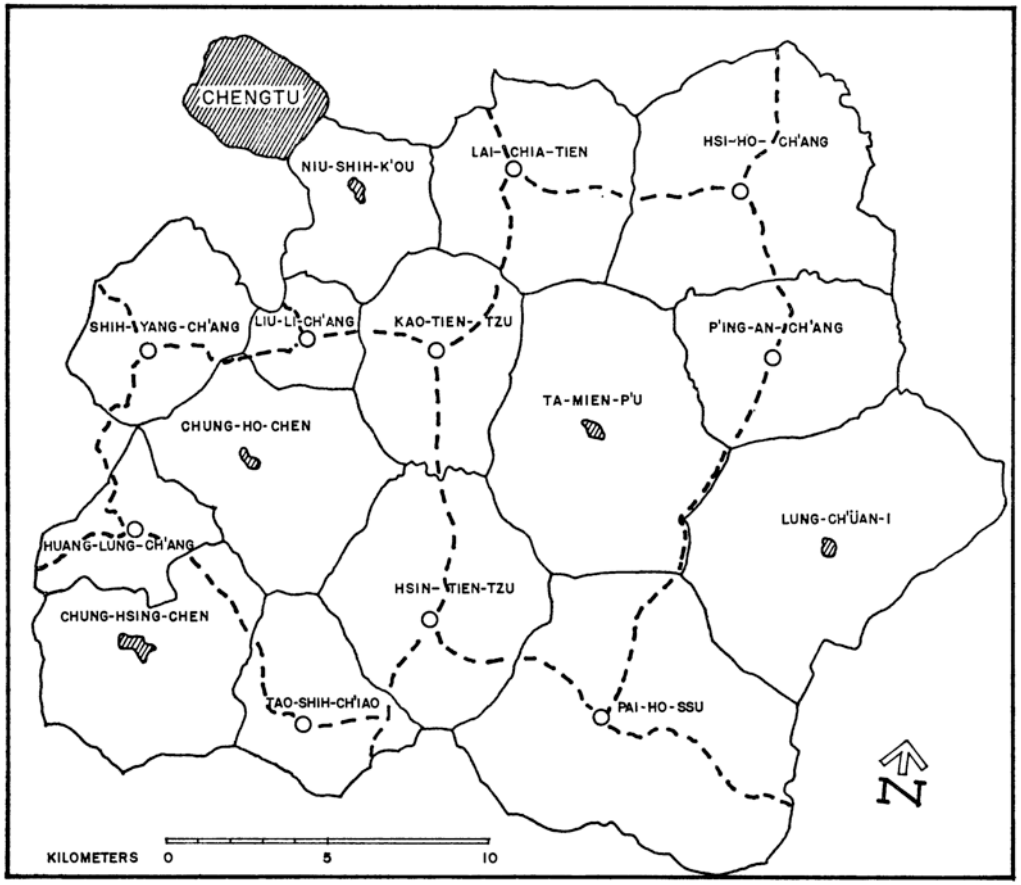






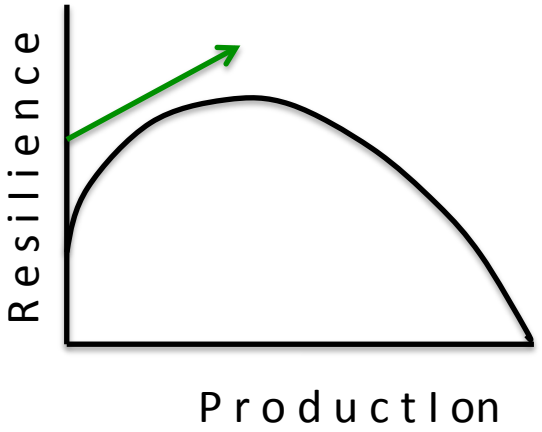

1. Resilience
2. A long-enduring socio-ecosystem
3. Threats

Market System



G.W. Skinner, "Marketing and Social Structure in Rural China

Building Dujiangyan: Historical Process



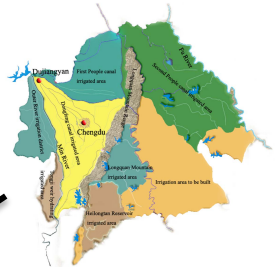
- 2000-800 BCE: Shu Civilization
- 800-400 BCE: "Sinification" of Shu
- 316 Qin conquers Shu
- 256-242 Dujiangyan Construction
- 221 Qin unifies East Asian Continent

Notable features:
No moving parts
Everything below grade
Low maintenance

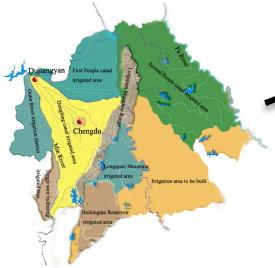
Li Bing

Cross-scale interactions in Building Dujiangyan

- Building a nested system of governance: an institutional buffer



- Guaranteeing a food surplus



1. Resilience
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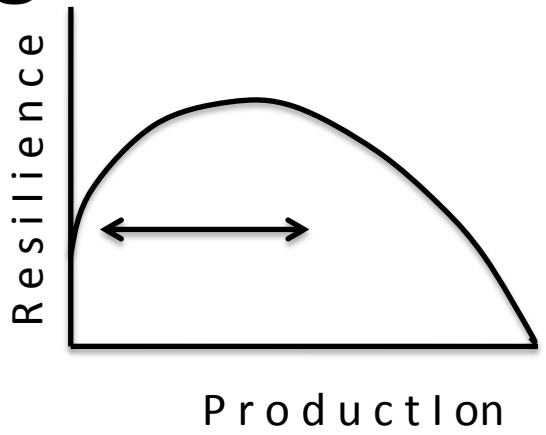
The Depredations of Zhang Xianzhong



- Conquered Sichuan in 1644
- Set up capital at Chendgu
- Instituted terror policy 1645-46
- Estimates from 1/3 to 3/4 of population killed
- Population recovered by 1720
- Sichuan population multilingual
- Sichuan flourished in Qing

On what temporal scale do we assess resilience?

Is the Linpan System particularly resilient? Historical evidence

Ferdinand von Richthofen 1871: If the rate at which a people has contrived to develop to its fullest capacity the productive power of the soil on which it lives is taken as a measure by which to estimate its position in the scale of industrial accomplishment, the palm among all provinces of China is probably due to Sz'-chwan; nothing speaks more forcibly in favour of the practical intellect of its inhabitants, than the fact that they have succeeded in adapting the products to soil and climate with admirable ingenuity

Is the Linpan System particularly resilient? An Early-20th Century Description

"The most important part of the Red Basin is the Chengtu plain, which has been described as the most densely populated area of the earth's surface. The vegetation is in most parts of the basin of almost tropical luxuriance owing to the extreme dampness of the climate, which permits, in the Chengtu plain, an admirable system of irrigation. Seen from a height, the plain looks like a forest, for every farm has its grove of bamboo, cypress, palms, and fruit orchards while tung and varnish trees abound."

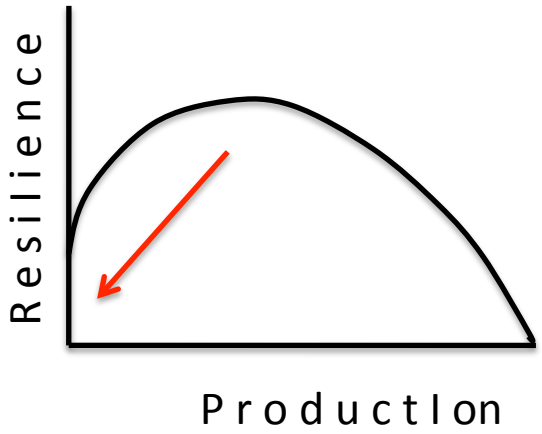
-Norman Shaw, *China's Forest, Trees and Timber Supply, 1914*

1. Resilience
2. A long-enduring socio-ecosystem
3. Threats

CCP Principles

- Increase production
- Stabilize production
- Govern top-down

Great Leap Famine: A Few General Facts



- Grain harvests declined
  - 198 Mt 1958
  - 137 Mt 1961
- Much grain extracted from farmers
- Excess deaths 25-45 M people
- Spatially unequal distribution of mortality
- Sichuan had highest death toll; 2nd highest mortality

Great Leap Famine: Sichuan Mortality

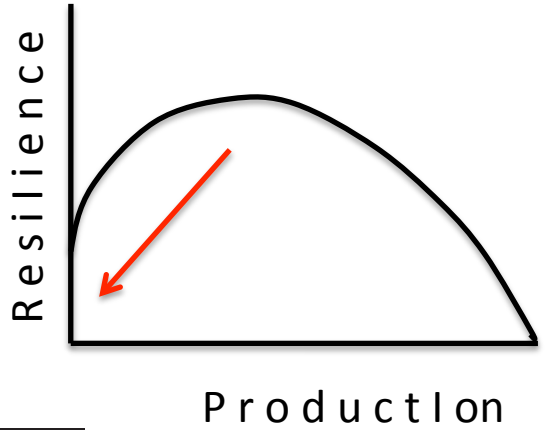


Table 1: **Grain Output, Procurements and Mortality in Sichuan**

	Net grain procurement rate (%)	Grain output (m tonnes)	Grain availability per head (kgs)		Crude death rate(per 1,000)	
			Rural	Urban	Rural	Urban
1955	23	15.70	194	371	9	10
1956	23	17.23	209	296	11	9
1957	26	17.07	197	238	12	11
1958	26	17.89	209	406	26	15
1959	36	12.66	133	350	49	21
1960	27	10.70	135	197	54	24
1961	20	9.55	134	217	30	23
1962	19	11.49	160	358	15	14

Notes:

"Availability" means grain which could be used directly and indirectly (feed, food processing etc.). It is net of husking, resales, and exports to the USSR and other provinces but excludes stock changes.

Sources:

Zhonggong Sichuan sheng wei yanjiushi (Research Unit of the Sichuan Committee of the CCP), *Sichuan sheng qing(Conditions in Sichuan*) (Chengdu: Sichuan renmin chubanshe, 1984) pp. 559, 571; Sichuan tongjiju (Sichuan Statistical Bureau), *Sichuan tongji nian-jian 1990 (Sichuan Statistical Yearbook 1990*) *(*Beijing: Zhongguo tongji chubanshe, 1990*)* (*SCTJNJ 1990*), pp. 57–58.

Chris Bramall, *China Quarterly 208*, 2012

Great Leap Famine: Sichuan Mortality

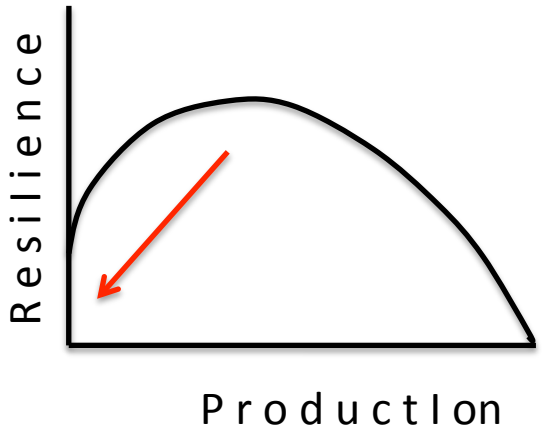
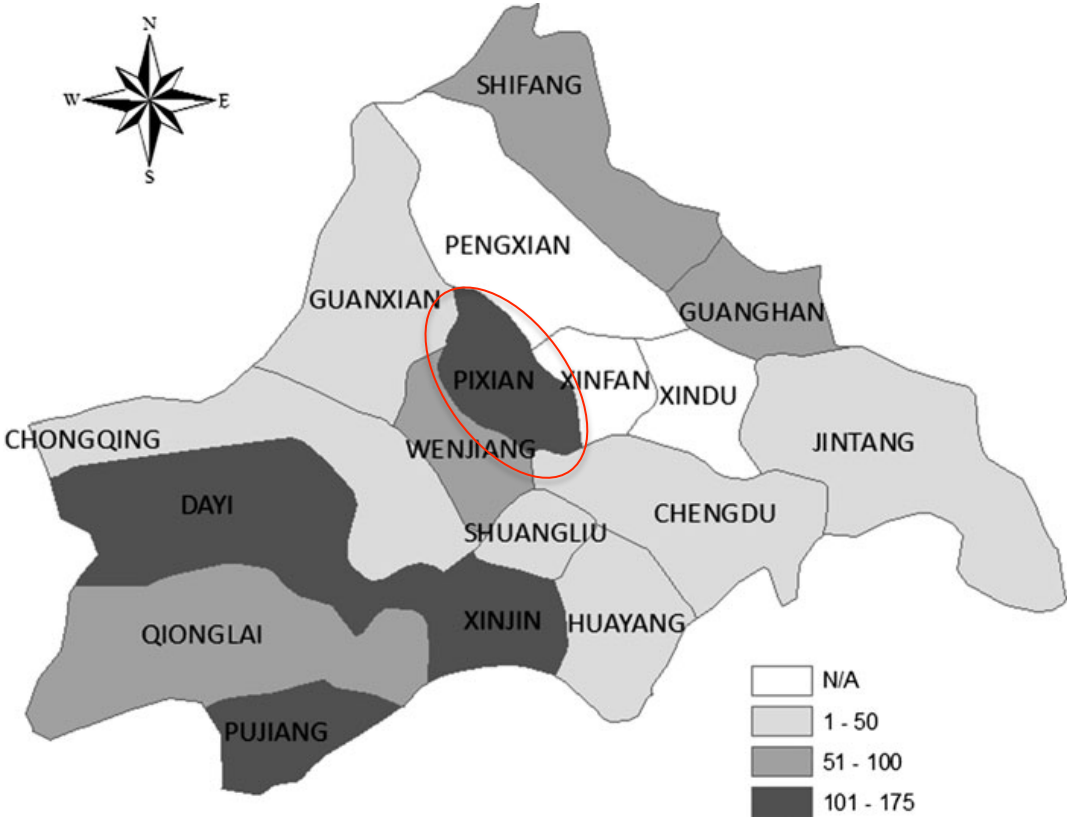


Figure 2: **Crude Death Rates on the Chengdu Plain by County, 1960 (deaths per 1,000)**



Notes:

I use the Sichuan urban average (see *SCTJNJ 1990*, p. 58) for Chengdu city. There are no data for Pengxian, Xinfan and Xindu.

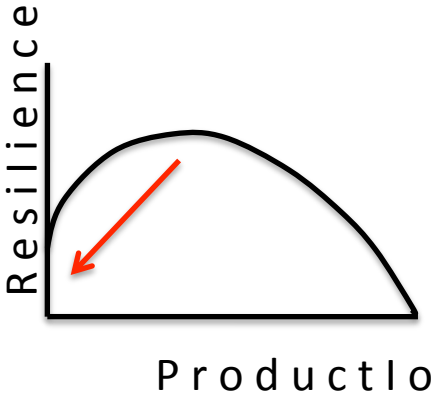
Sources:

As for Figure 1.

Still, at a medium time-scale, the system was resilient to a huge disturbance, caused by top-down governance.

Chris Bramall, *China Quarterly 208*, 2012

Great Leap Famine:
Cross-scale interactions in Sichuan Mortality



Still, at a medium time-scale, the system was resilient to a huge disturbance, caused by top-down governance.

Debt Obligations

Radicalism

Pressure To Procure

Forced Procurement

All top down,
No feedbacks

New Socialist Village Construction

- National program, 2009-
- Part of overall urbanization plan
- Village consolidation in Sichuan Linpan landscape

What spatial pattern is appropriate?

Dispersed → Concentrated

TRADITIONAL DISPERSED MODEL
Jiang'an Village

Strengths:
Preserves dispersed settlement pattern of traditional linpan landscape that allows for small-scale family farming practices and preserves elements and interactions of local ecology

Settlement pattern still retains key components and family farming practices

Many farms also grow ornamental landscape trees which are more profitable

Typical small shop/tea house along main road serves as a social space

SEMI-CONCENTRATION MODEL
Anlong Village

Strengths:
Residences concentrated into 10-12 districts could provide options for more efficient economies of scale while still providing options for selective preservation of linpan units

Caution signs hung on trees protect them during the reconstruction process

Construction of new housing district August 2012

Rice harvesting continues during reconstruction, September 2012

EXTREME CONCENTRATION MODEL
Zhanqi Village

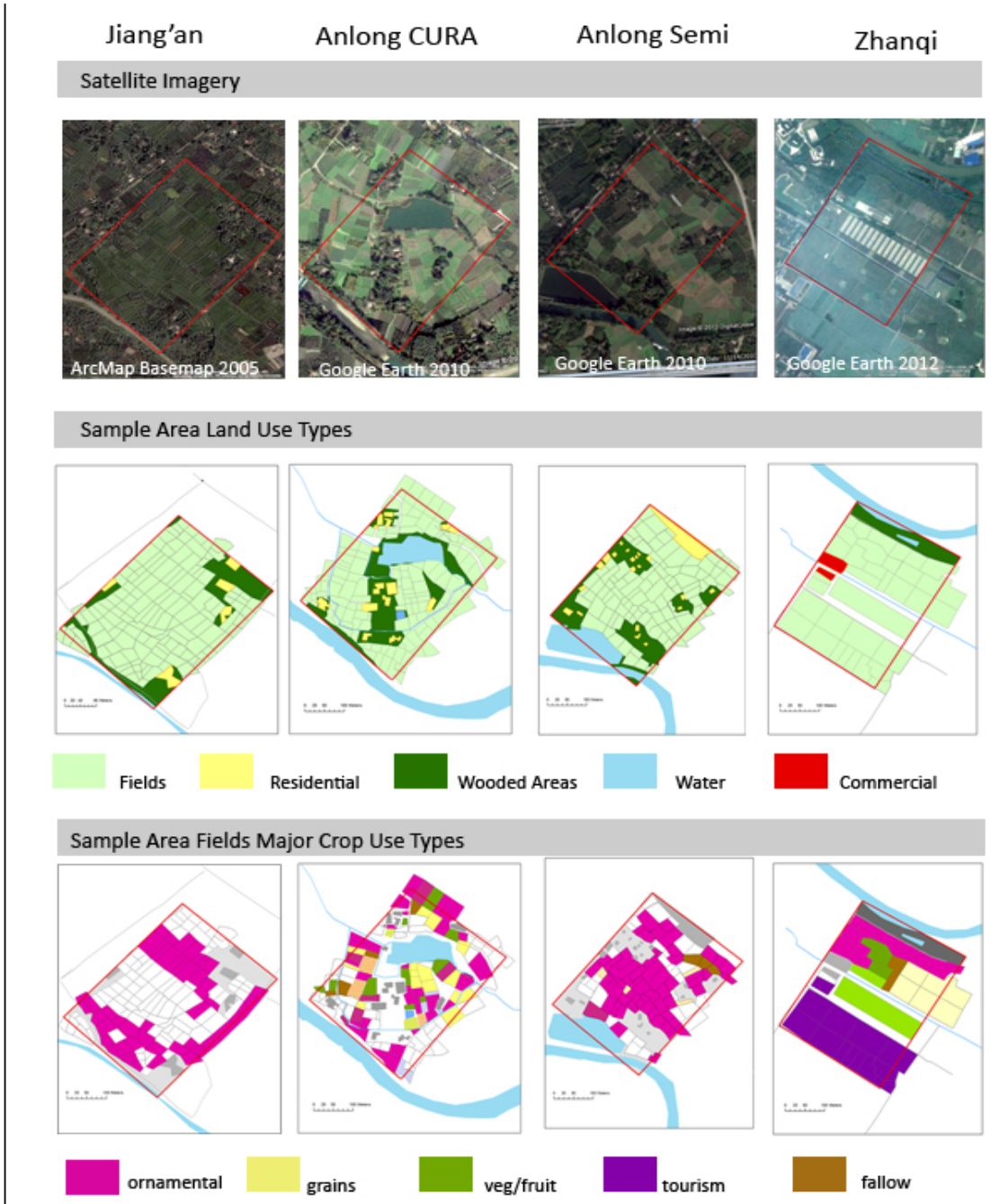
Strengths:
Singular concentrated residential area allows for diversity of economic activity including large-scale agriculture, value-added production, and additional economic ventures

Semi-detached new housing units after reconstruction

New tourism venture: lavender fields, vacation bungalows, and a luxury hotel

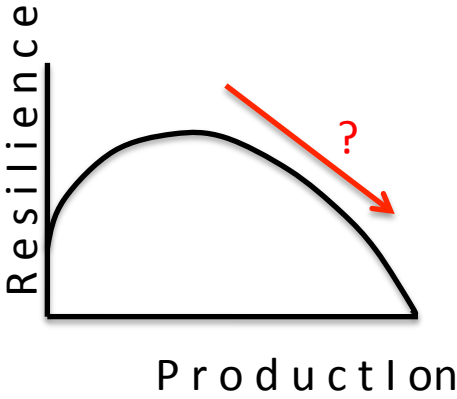
Large greenhouses constructed on consolidated agricultural land

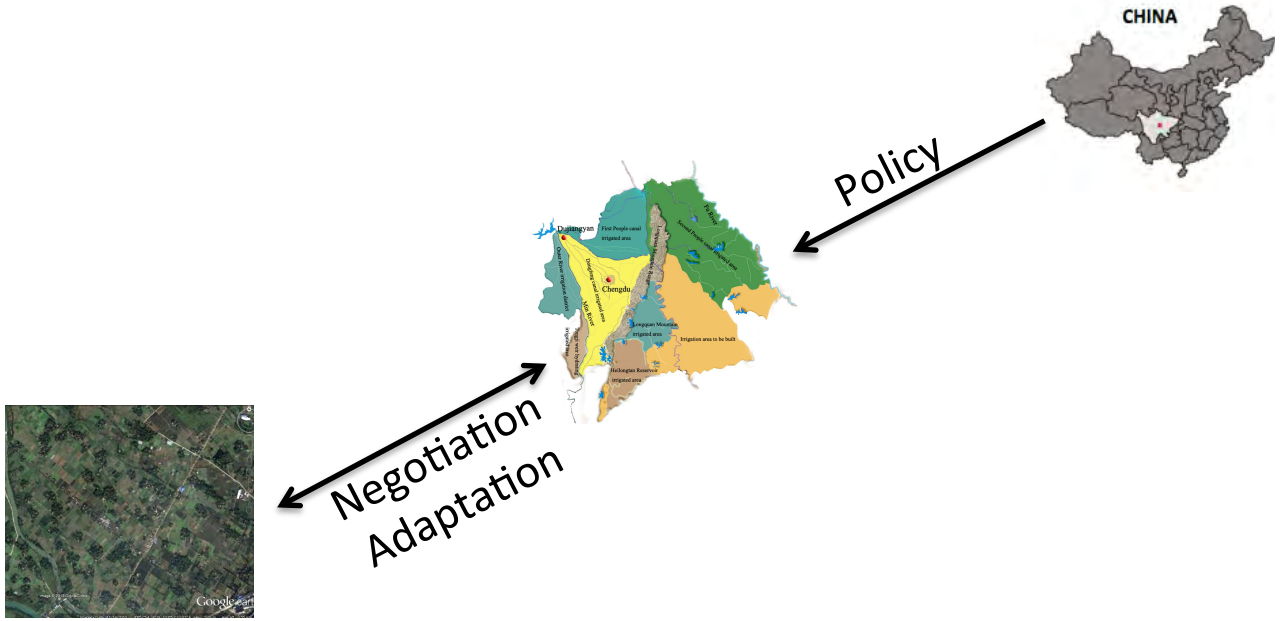
Created by Jennifer Tippins, Master of Urban Planning, University of Washington



Tippins 2013, Fig. 5.25. Summary Comparison of Spatial Patterns in Sample Areas

New Socialist Village Construction: Cross-Scale interactions





Buffers or Guarantors of Resilience: Red ones in Decline

Cross-Scale Interactions Responsible for the Decline

- Ecological buffers
  - Patchy landscape
  - Crop diversity
  - Wetlands
  - Forests
  - Fallow land
  - Ungrazed pasture
- Infrastructure: mostly waterworks
- Institutions
  - Kin groups
  - Irrigation Associations
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  - Fraternal Societies
  - Formal Government
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- Beliefs and values:
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