

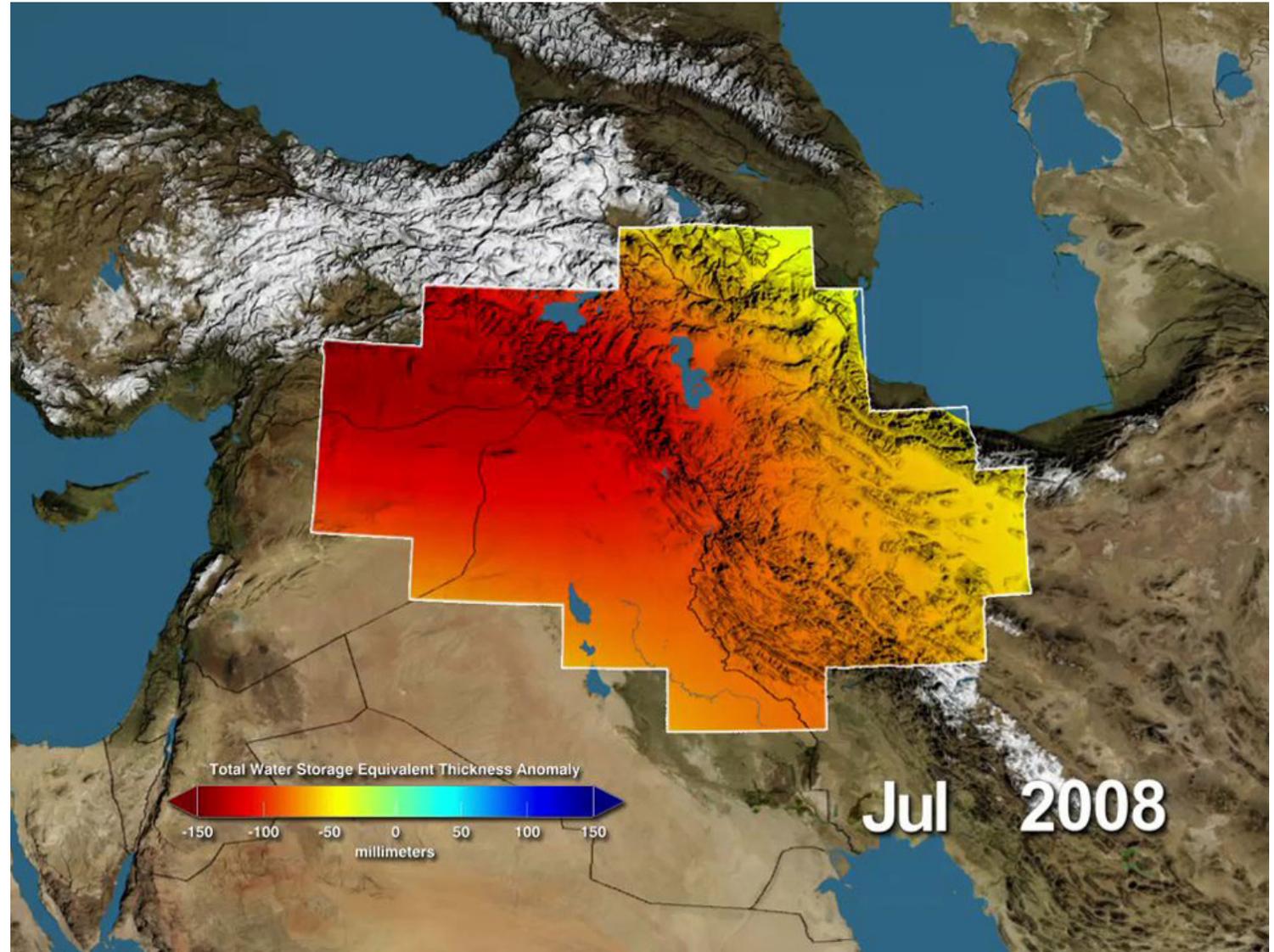
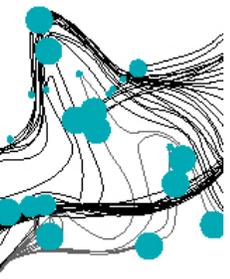
Socio-Ecological Resilience of Water Resource Management

Case study of Rafsanjan, Iran

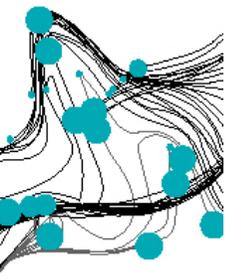


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- Middle East, including Iran, has lost fresh water almost the size of Dead Sea since 2003 till 2010
- It is predicted that demand for water in Middle East will increase 60% but water runoff is expected to decline 10%



- Ground water management in drought-prone areas is a serious socio-ecological issue

- It includes:

ecological elements (water resources and flows, climate change and drought),

normative elements (rules, rights and obligations related to access),

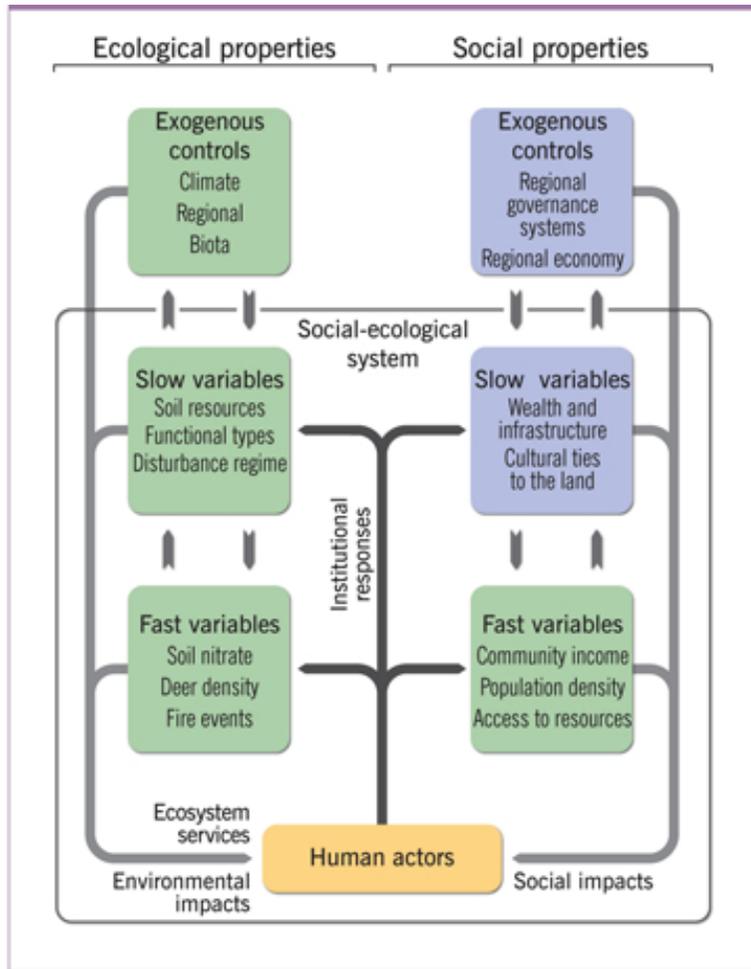
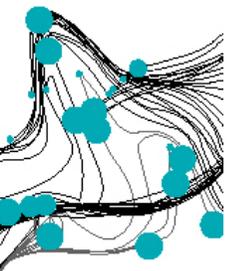
organizational elements (human organizations to govern, operate and sustain system)

socio-economic elements (demographic change, immigration, poverty, employment)

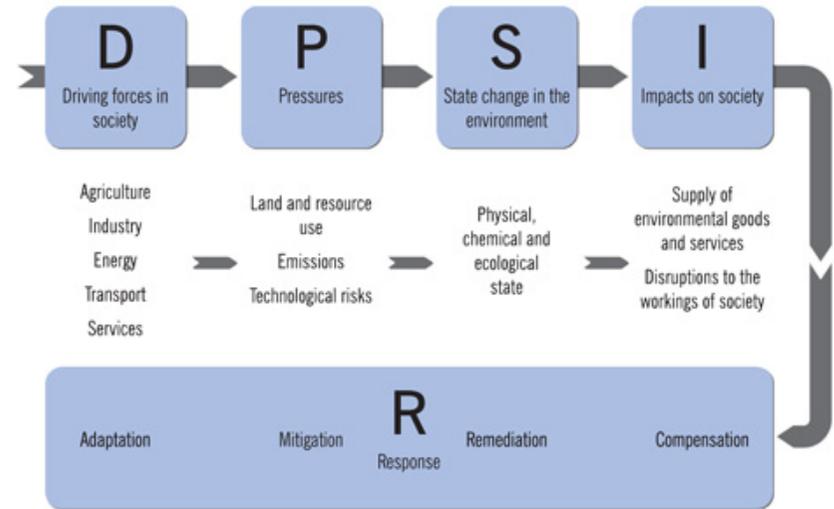
- Socio-ecological resilience: Persistence, Adaptation, Transformation

- Aim of research: to assess the Socio-ecological resilience of water resource management in relation with spatial planning of drought-prone areas (Case study)

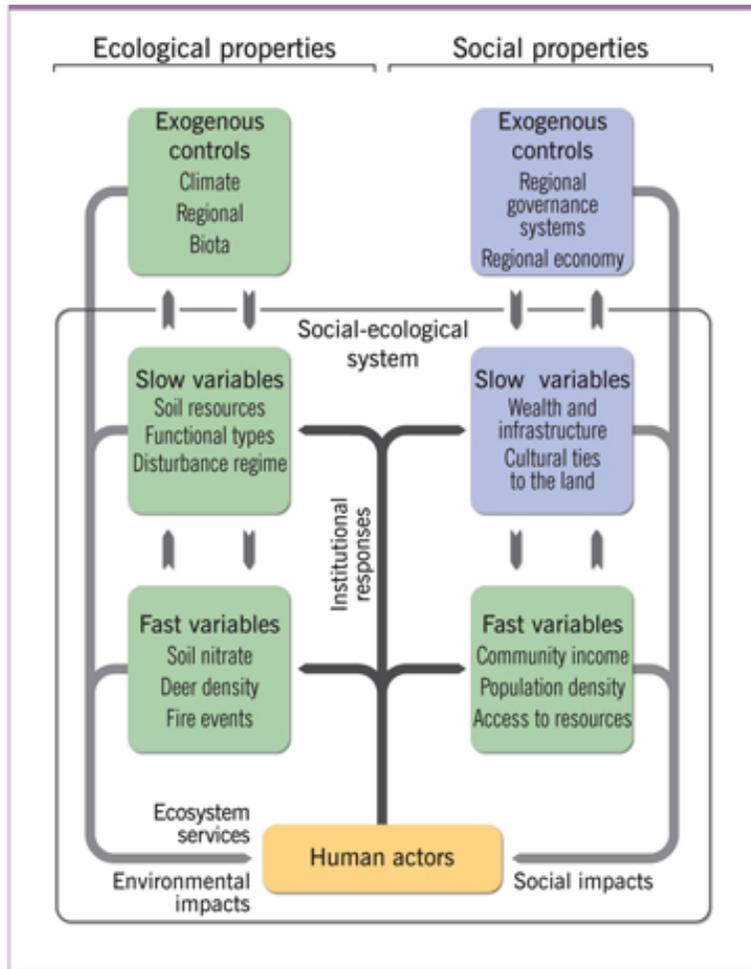
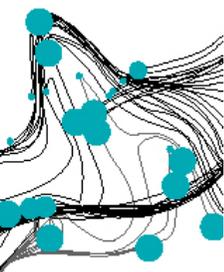




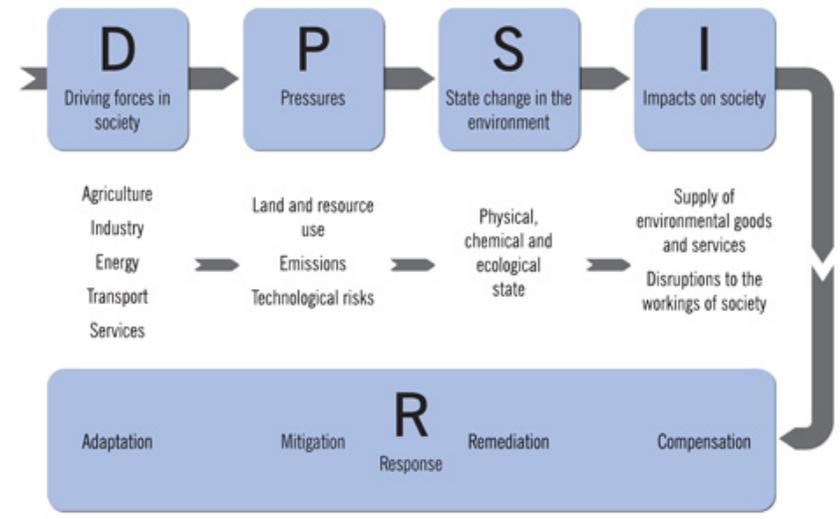
Conceptual model of interactions in a socio-ecological system, source: Chapin et al (2009)



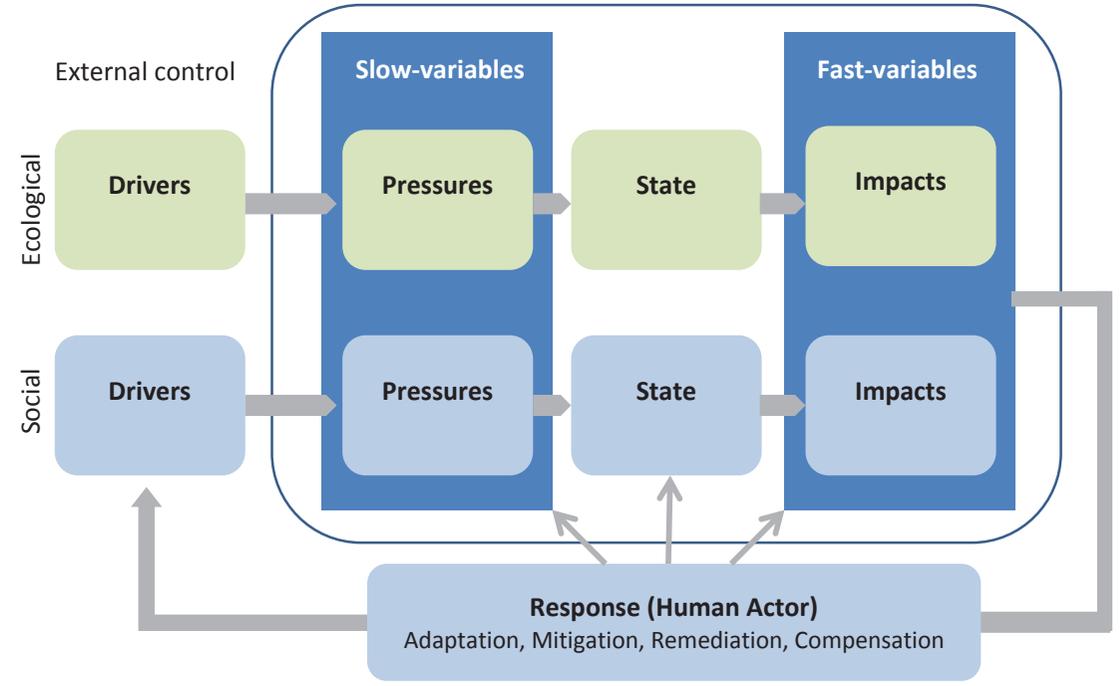
The Driver-pressure-state-impact-response framework



Conceptual model of interactions in a socio-ecological system, source: Chapin et al (2009)

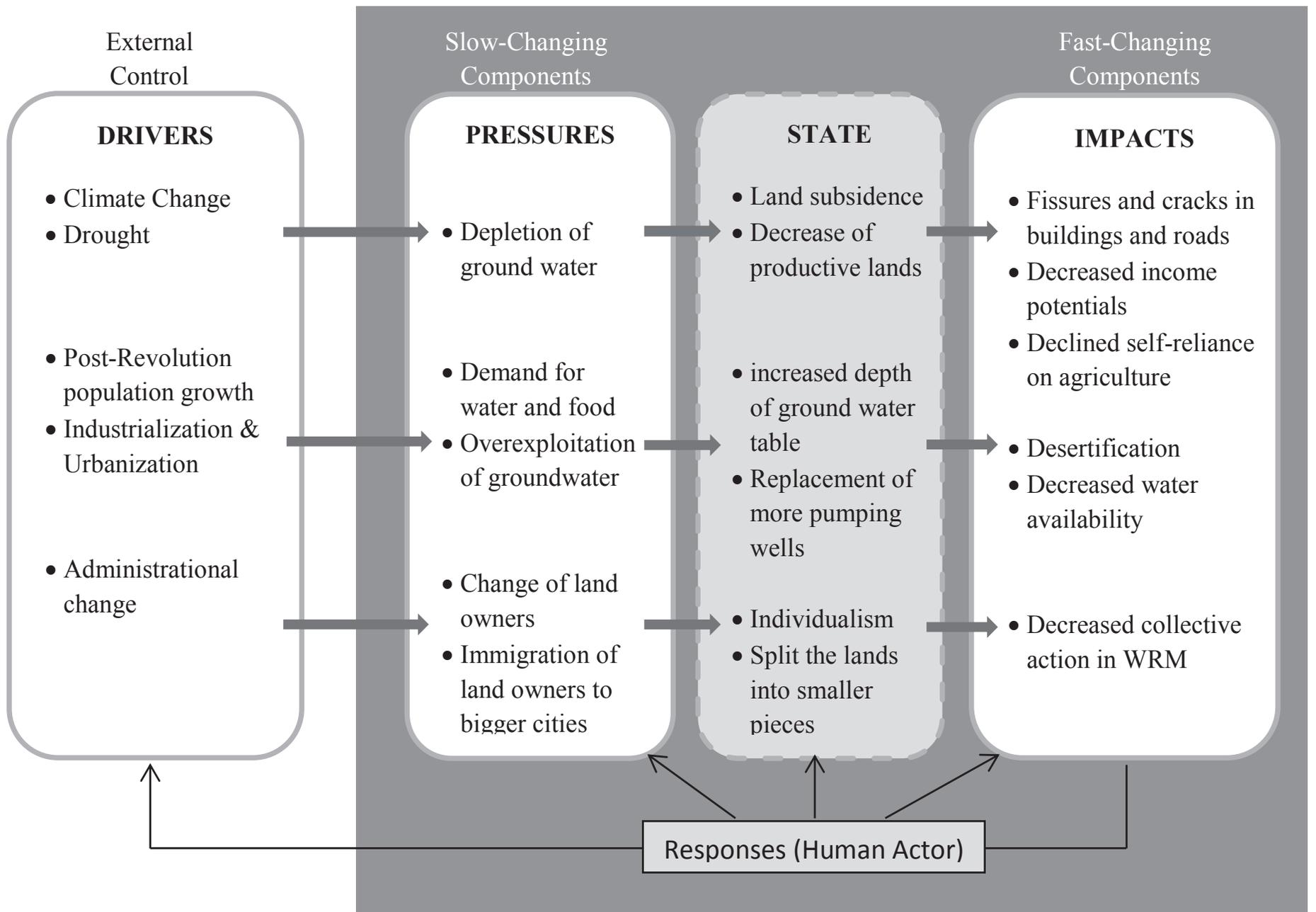


The Driver-pressure-state-impact-response framework

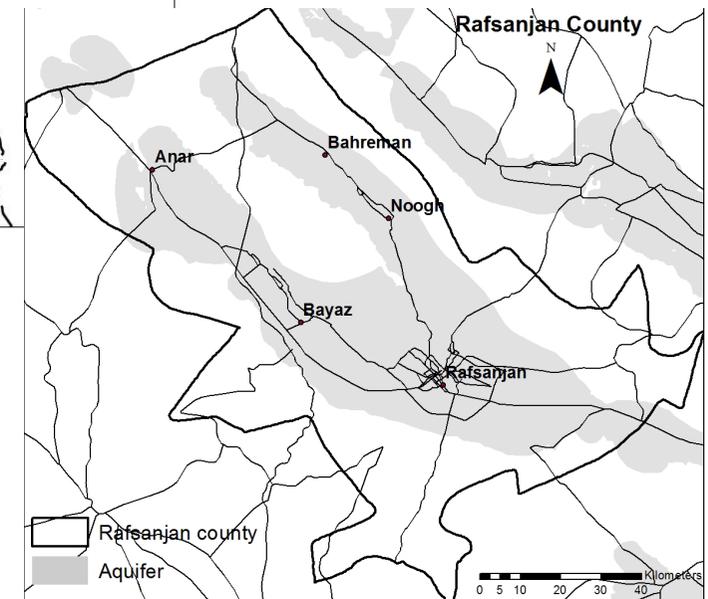
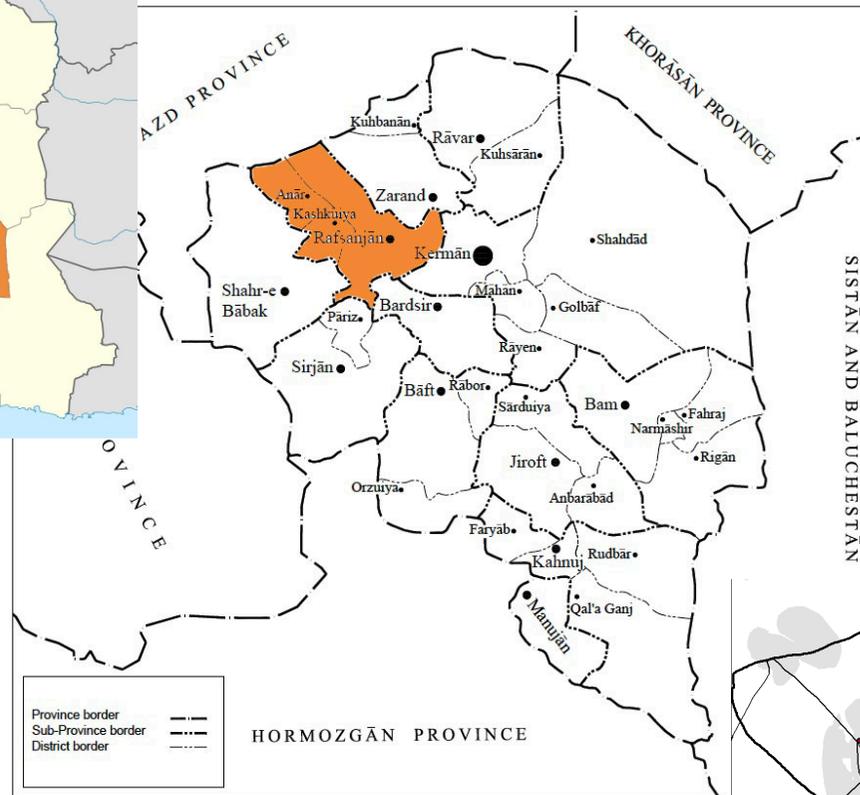




Ecological
Social



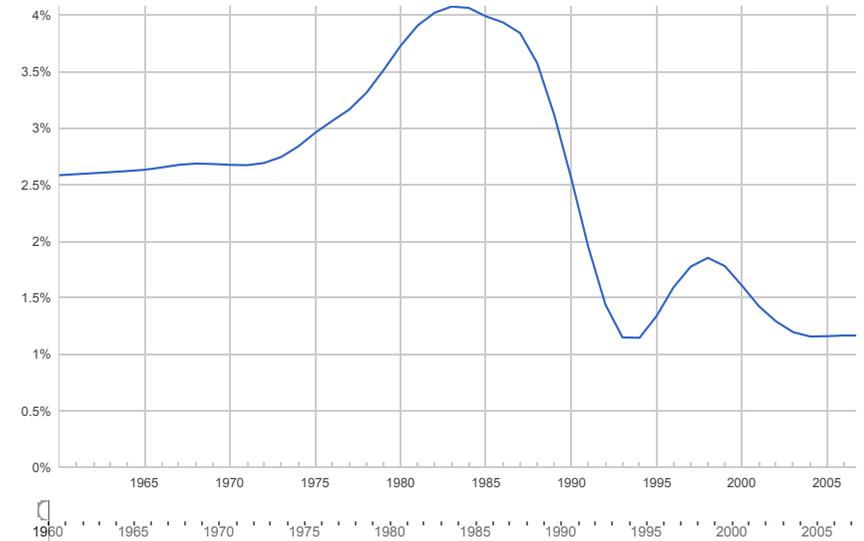
Modified Conceptual model of Water Resource Management as an integrated socio-ecological system



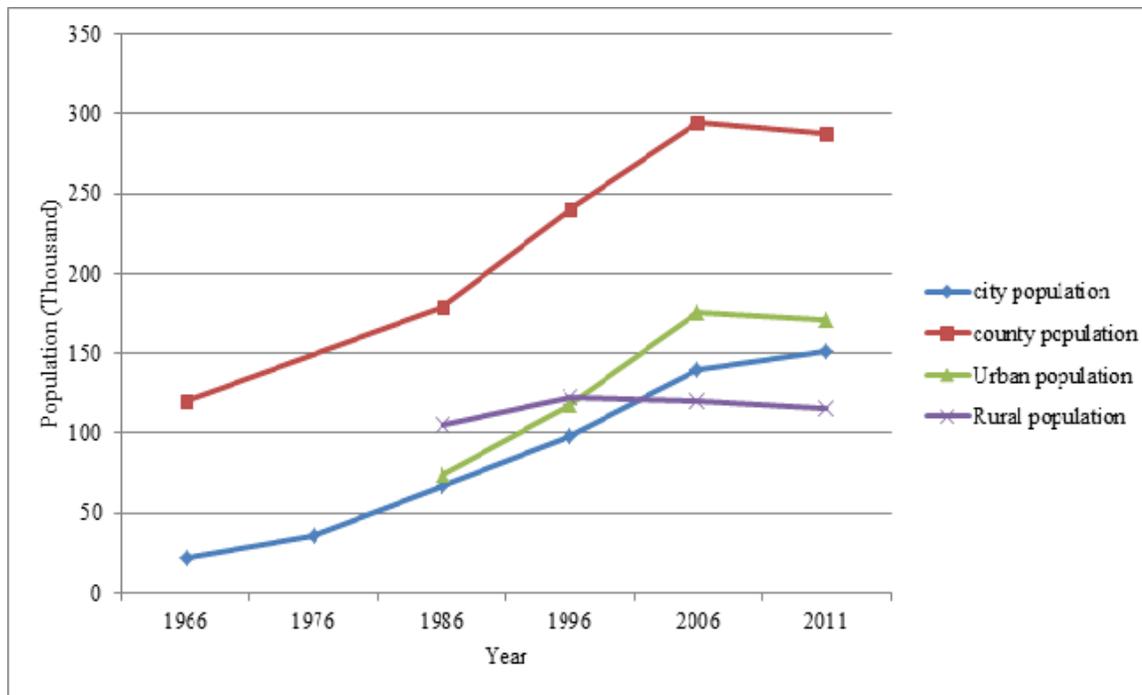
The county of Rafsanjan consists of five urban areas, four districts and 305 villages occupying 8288 km² or 4.5% of the province area. Rafsanjan is the main and largest city in the south of the county

Drivers: Demographic change

- Islamic Republic revolution: 1978
- Iran-Iraq war: 1980-1988
- population doubled in almost 20 years



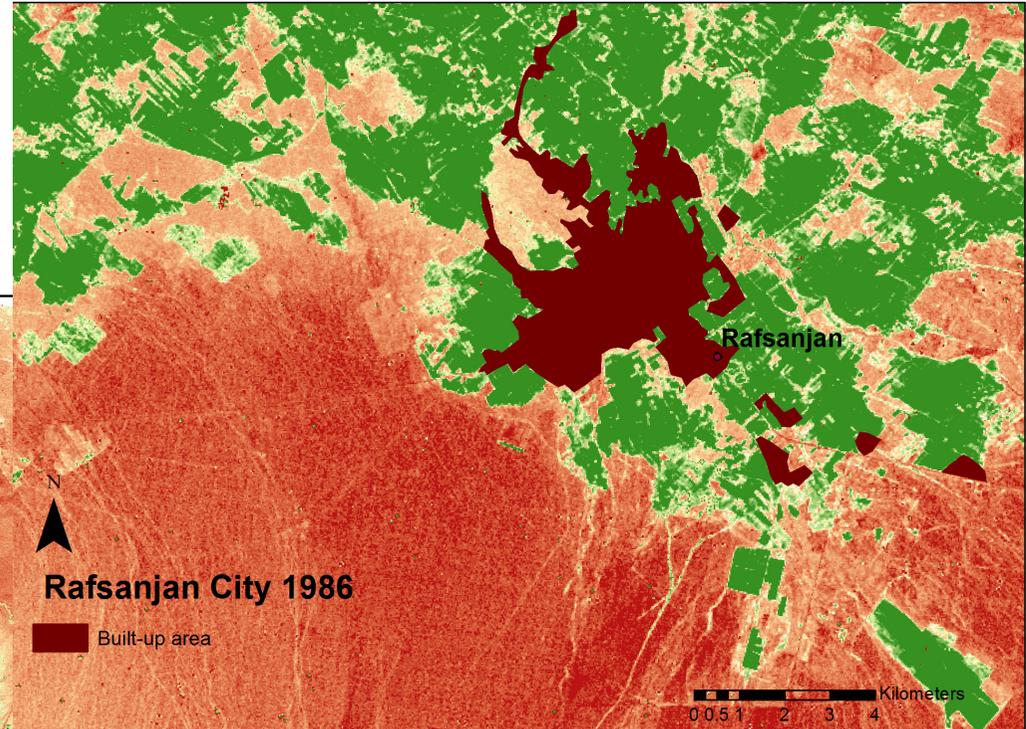
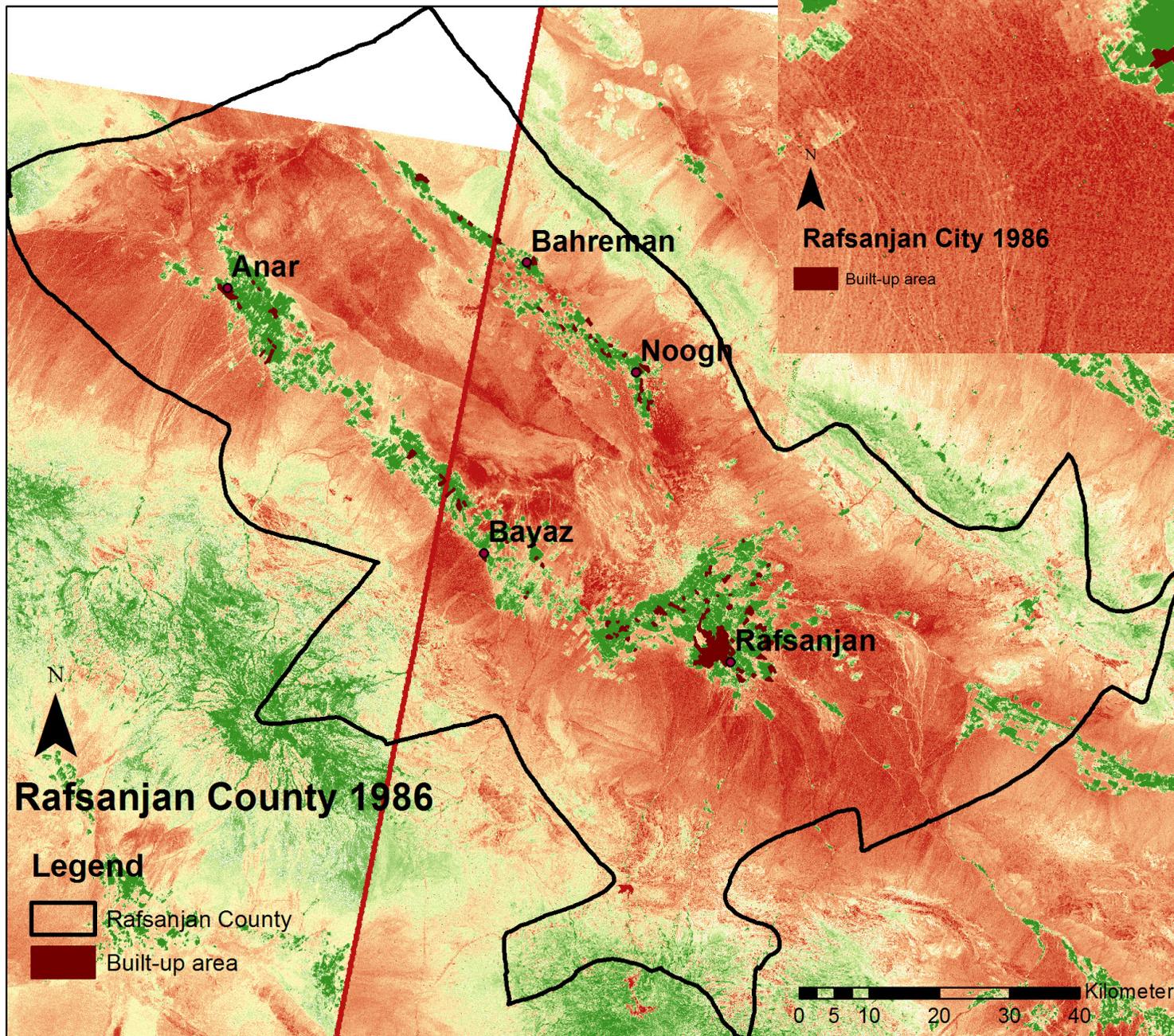
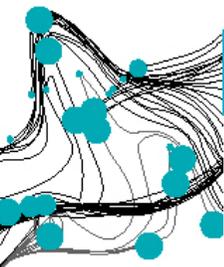
Data from [World Bank](#) Last updated: Sep 19, 2014



Population growth rate:

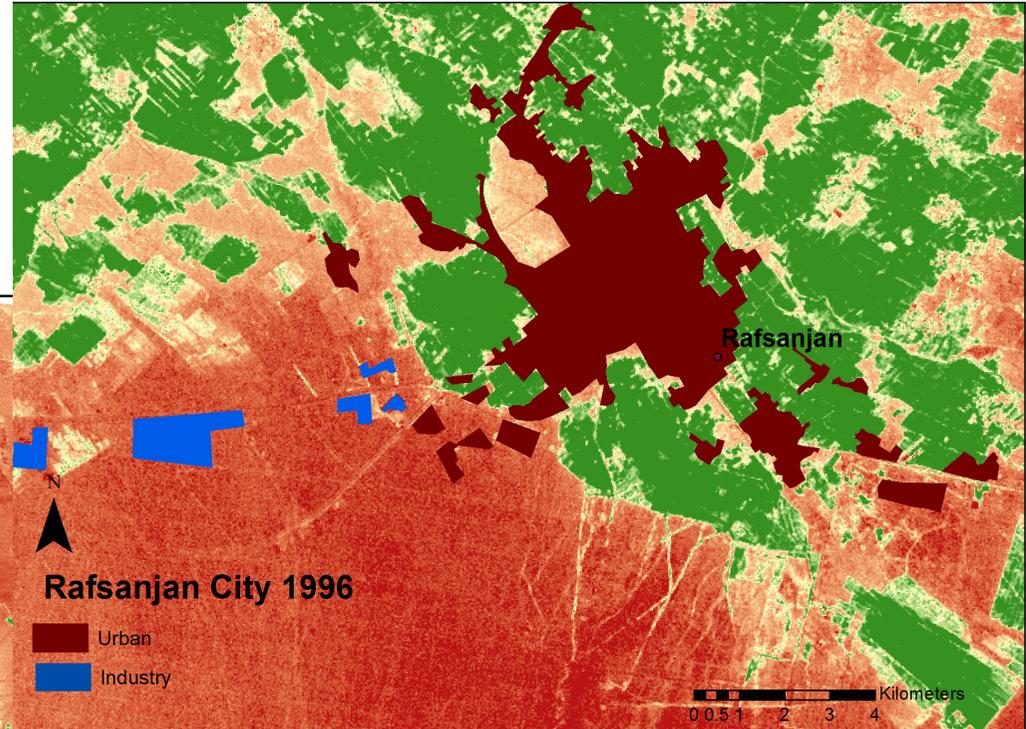
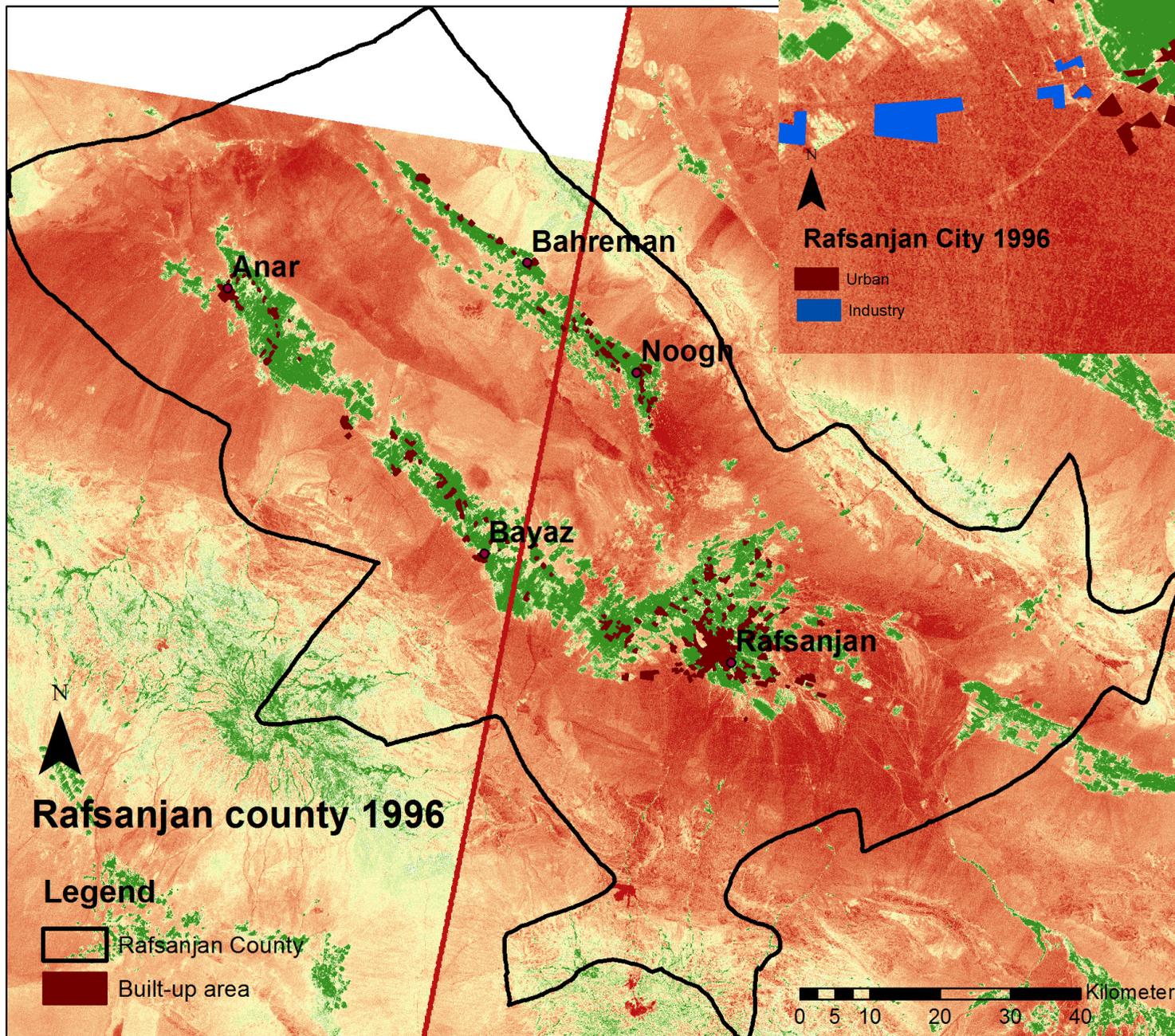
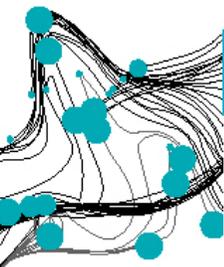
- Rafsanjan county: 2.5% between 1986 and 2006
- Urban population: 5.2% between 1986 and 2006
- Rural population: -1% between 1996 and 2011

Drivers: land use change



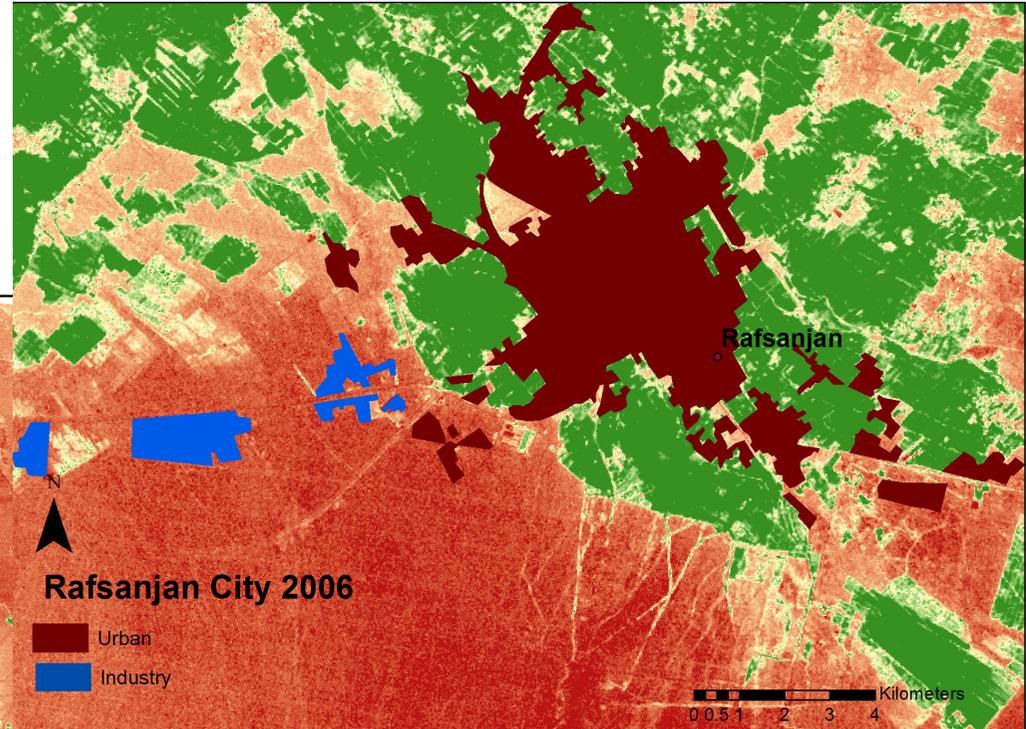
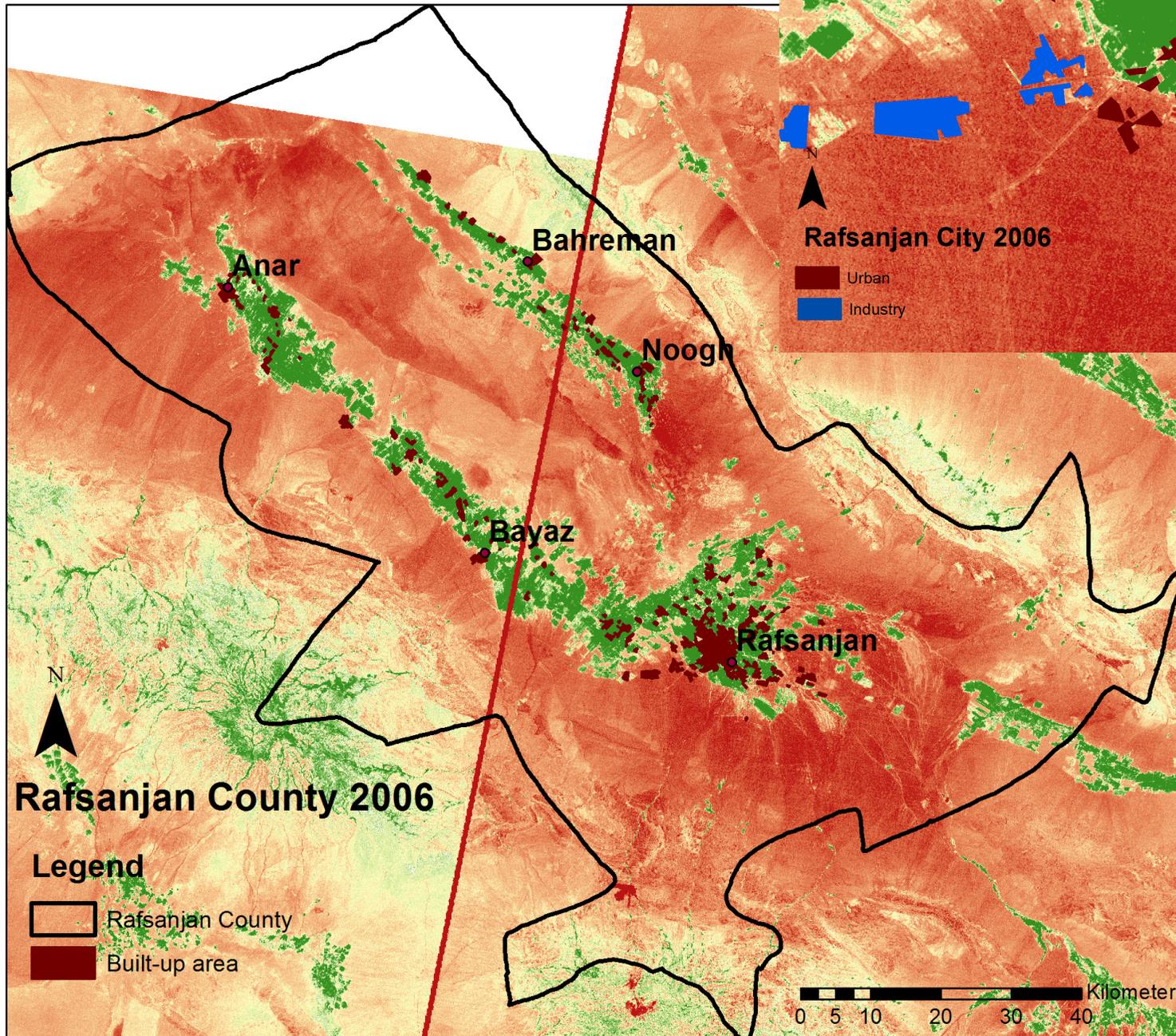
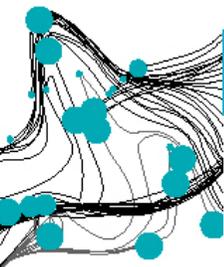
City area: 75 km²
County area: 42 km²

Drivers: land use change



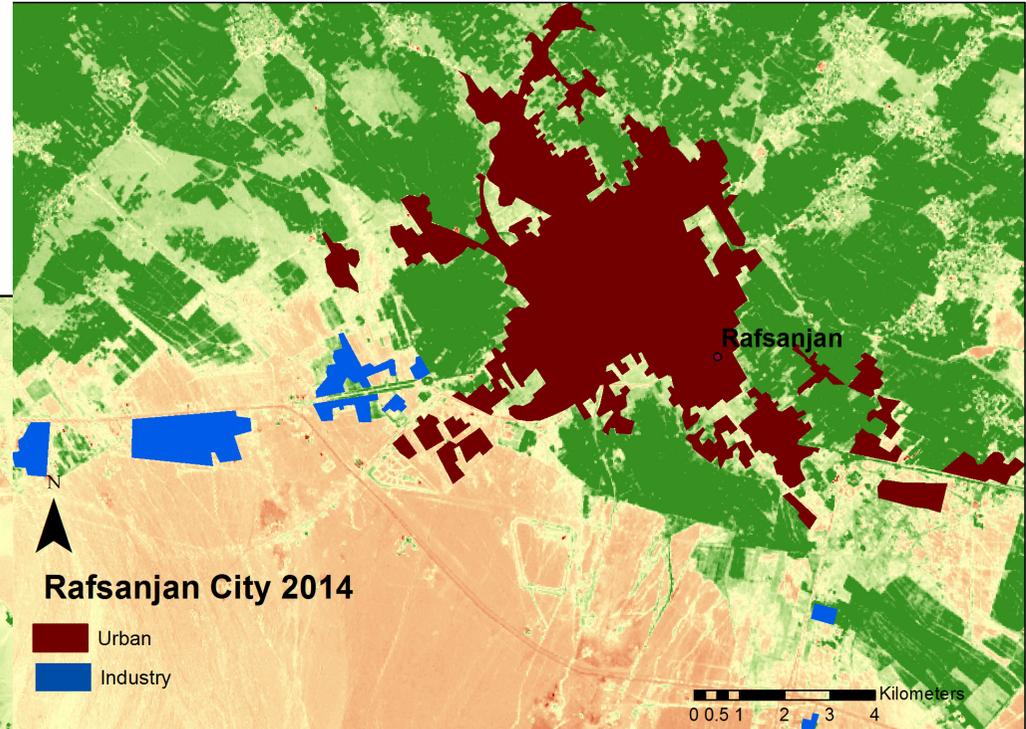
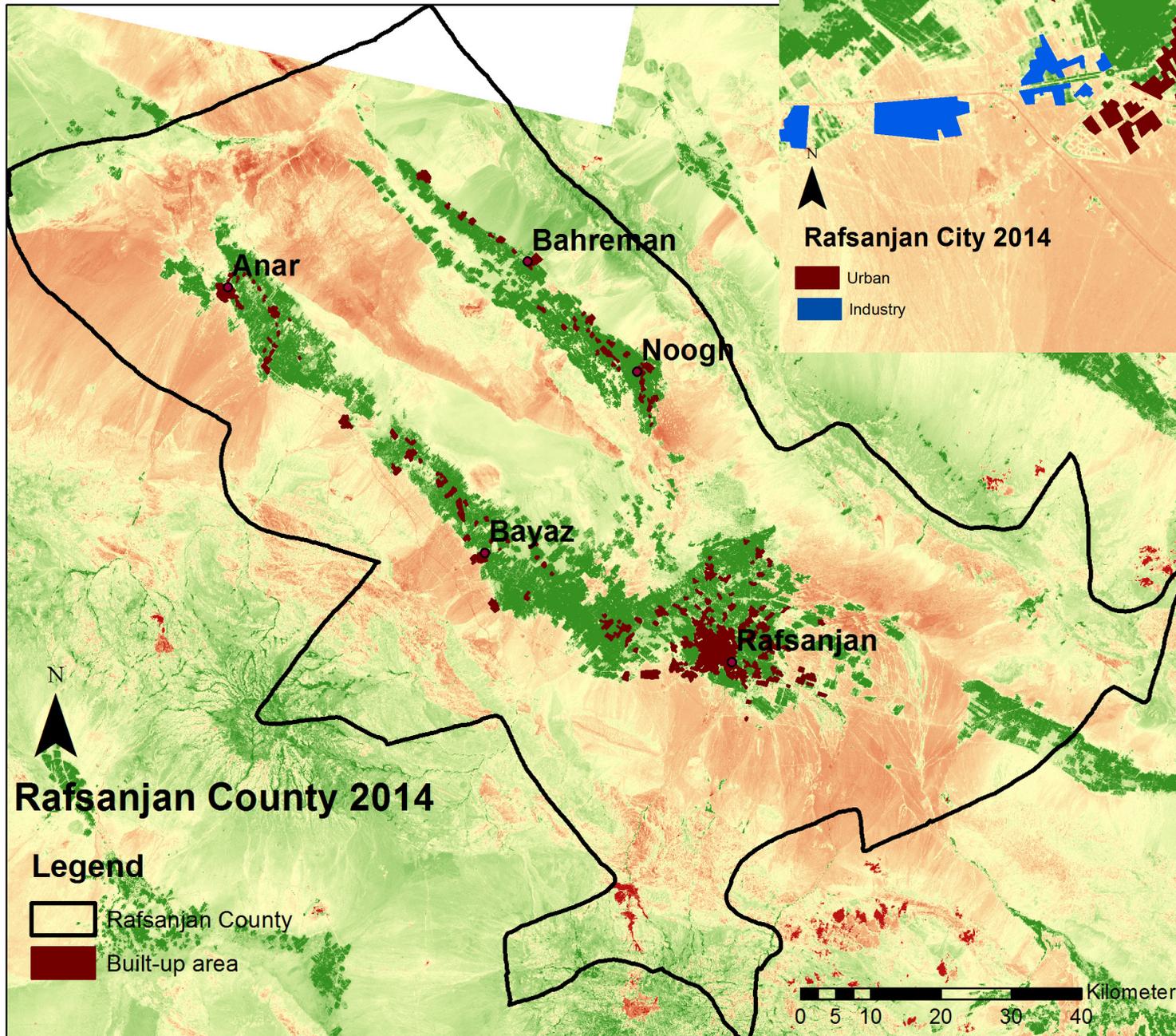
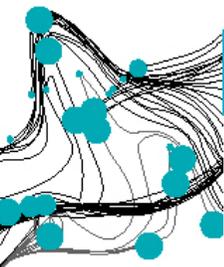
County area: 90 km²
Growth rate: 11.4%

Drivers: land use change



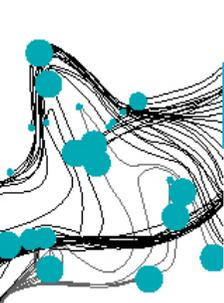
County area: 104 km²
Growth rate: 1.5%

Drivers: land use change



City area: 176 km²
Growth rate: 1.3%

County area: 110 km²
Growth rate: 0.7%

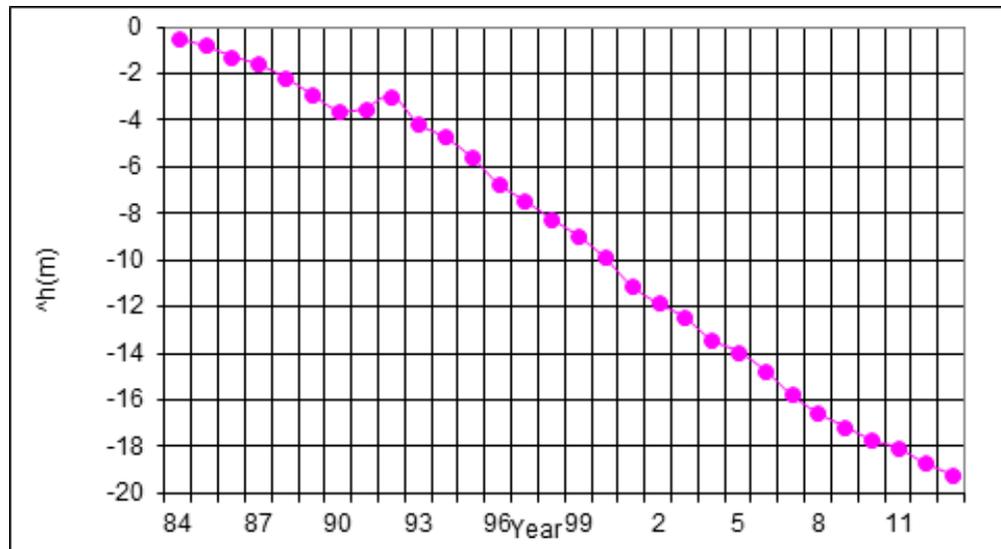


Drivers: Modernization and industrialization

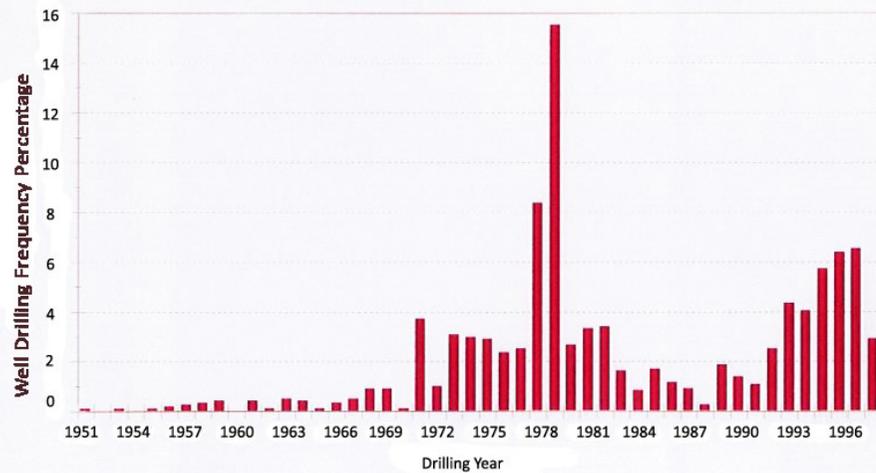
- Modernization and industrialization
 - White revolution in 1963:
 1. Industrialization: Environmental impact
 2. Land reform: Fragmentation, lack of collective action
 - Technology change: Transformation of Qanat system to pumped deep wells:

Qanat, more sustainable less productive, Wells, more productive less sustainable
- 
- 

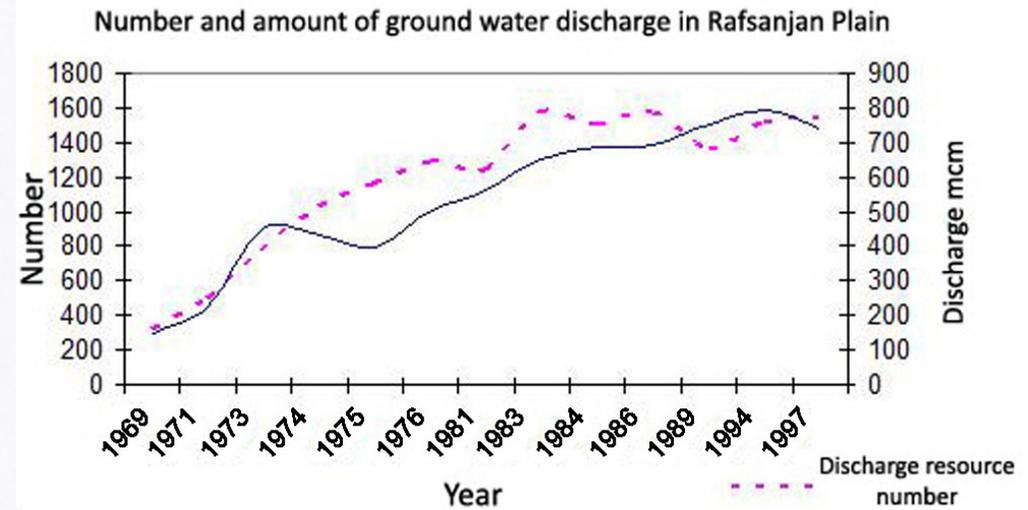
Pressures (slow variables) and State



Ground water Hydrograph of Rafsanjan Plain from 1983 to 2013. Source: wrs.arm.

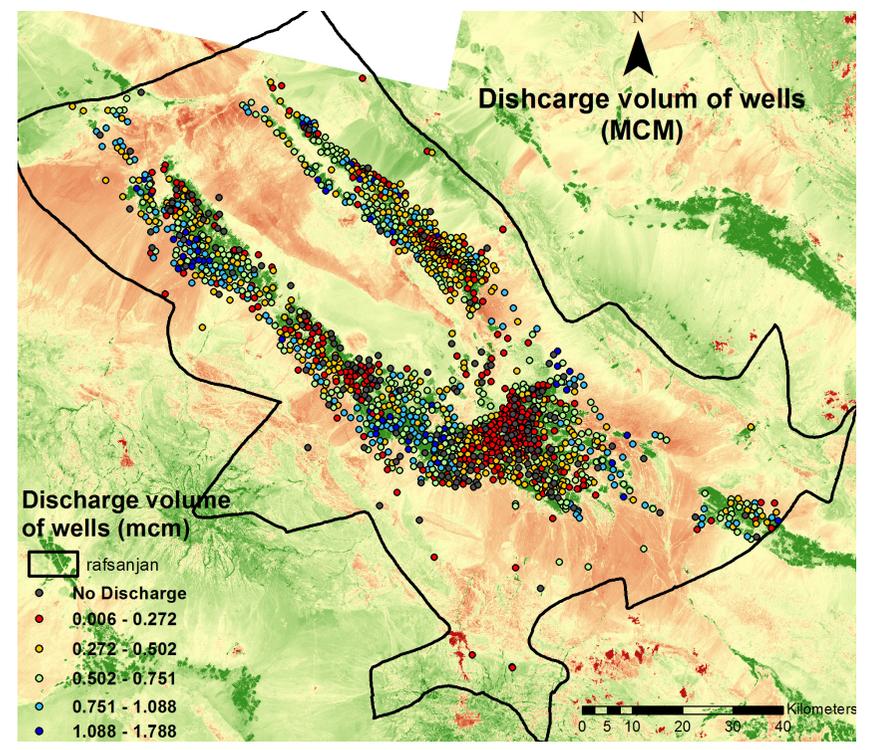
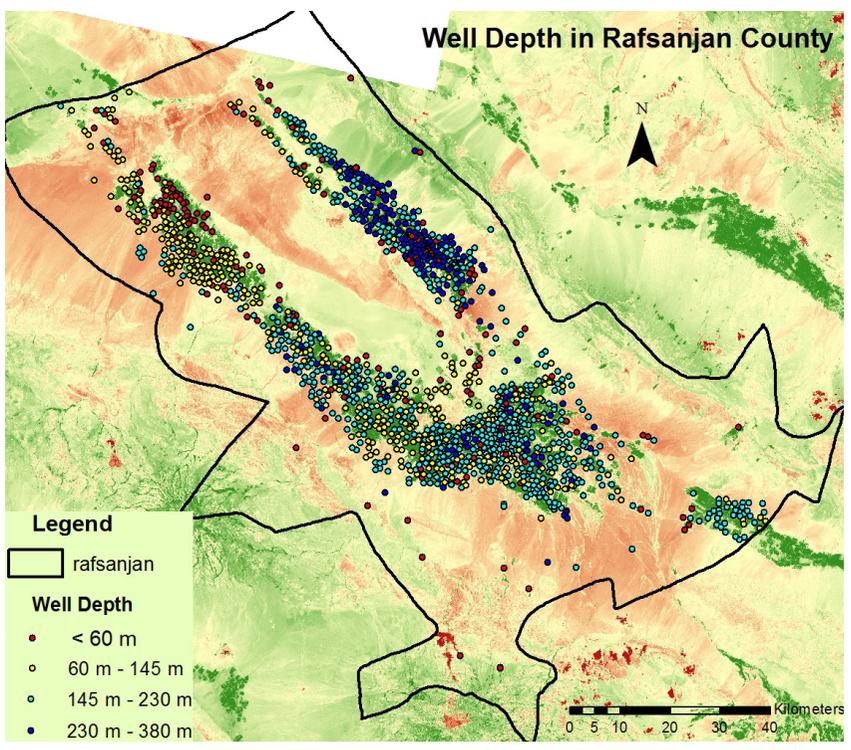
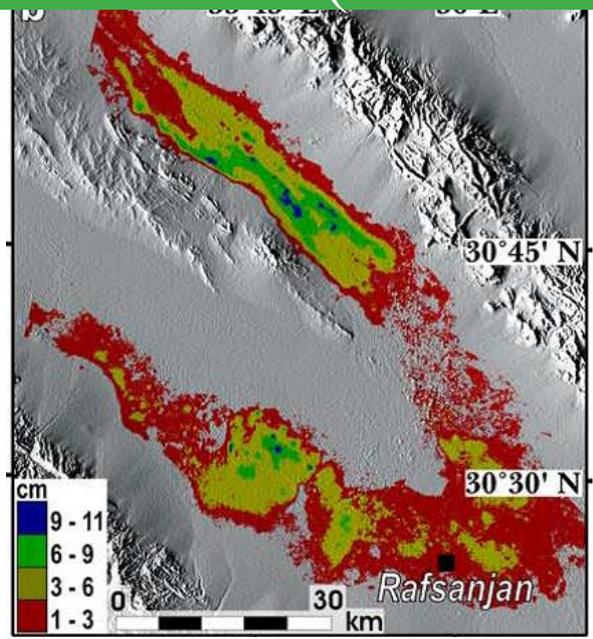
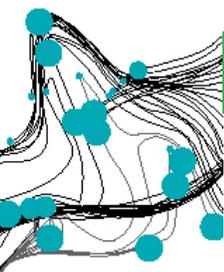


Graph of annual drilling Frequency in Rafsanjan Plain wells between 1951 and 1996, Source: (Jamab, 2004)

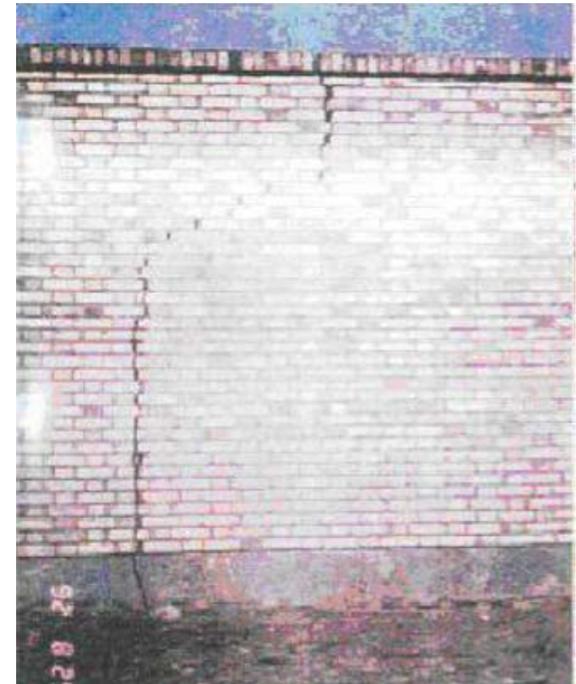
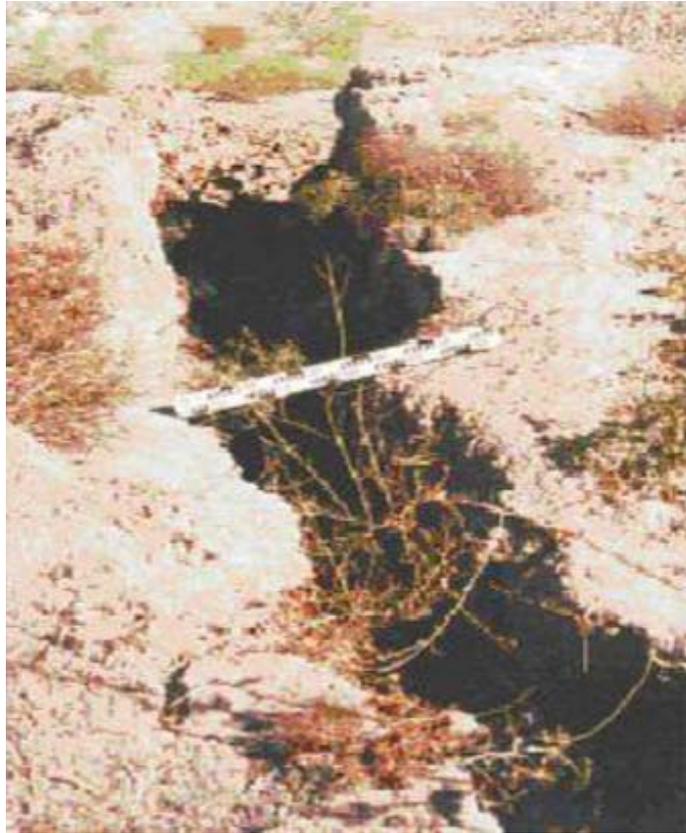
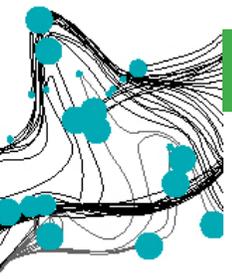


Number of wells and amount of ground water discharge in Rafsanjan Plain. Source: (Jamab, 2004)

Pressures (slow variables) and State

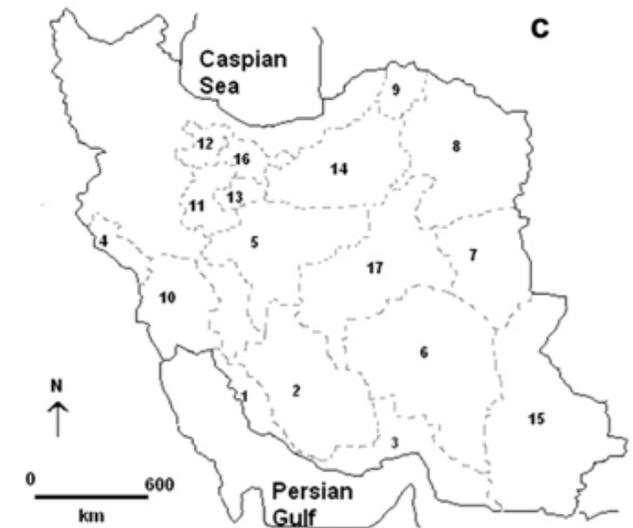
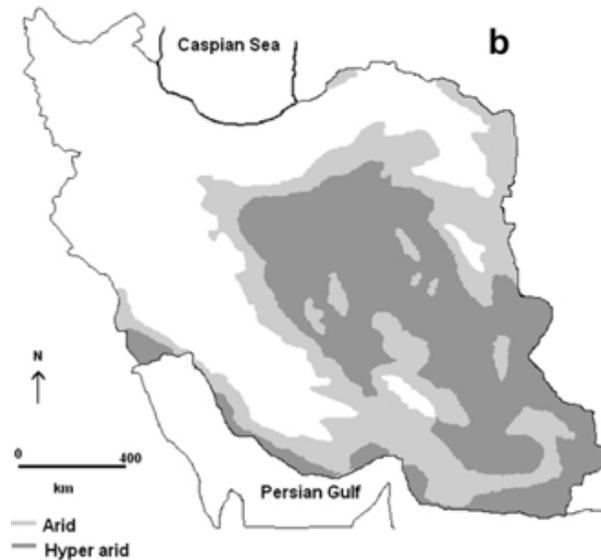


Pressures (slow variables) and State



Impacts (Fast Variables)

Desertification: land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors, including climate variations and human activities



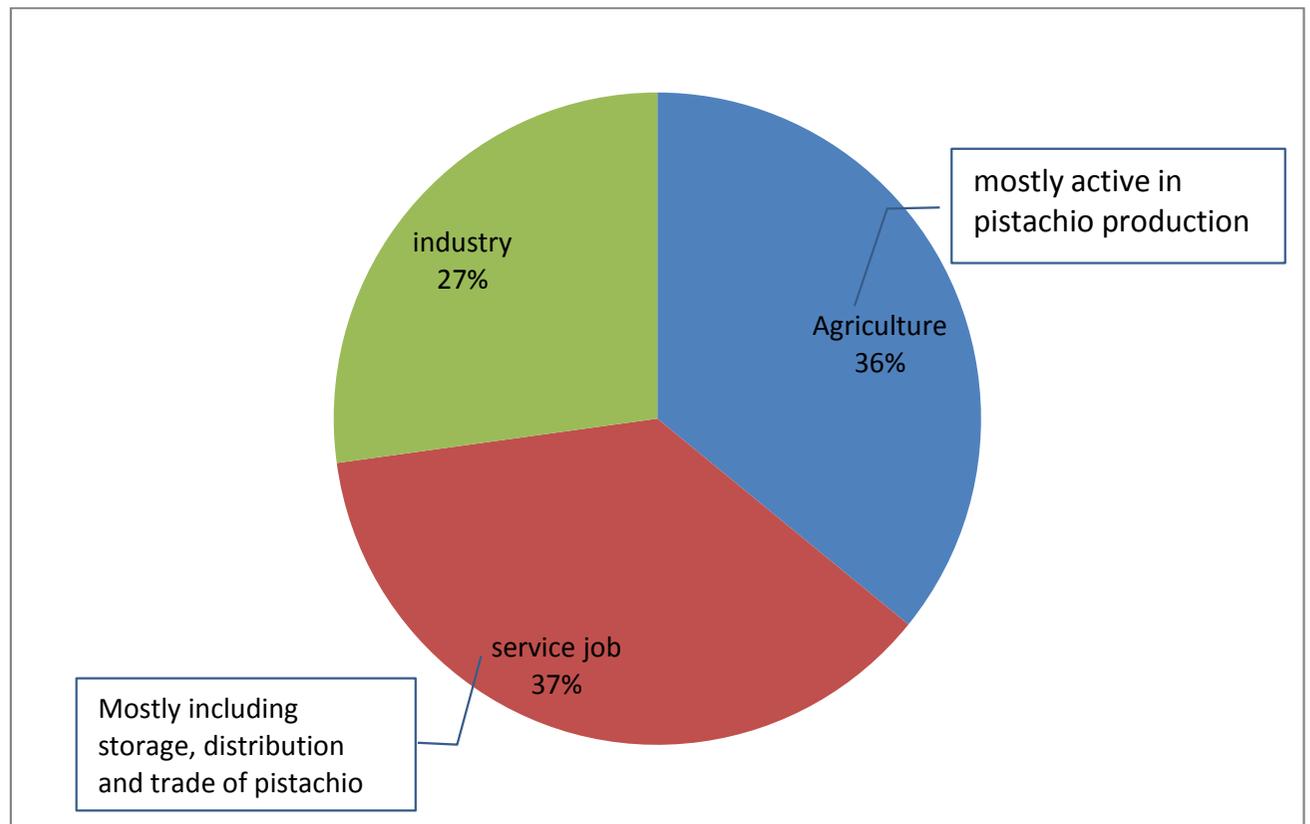
Decreased collective action:

From Qanat as a sample of participatory management to the top-down government control of water resources

Impacts (Fast Variables)

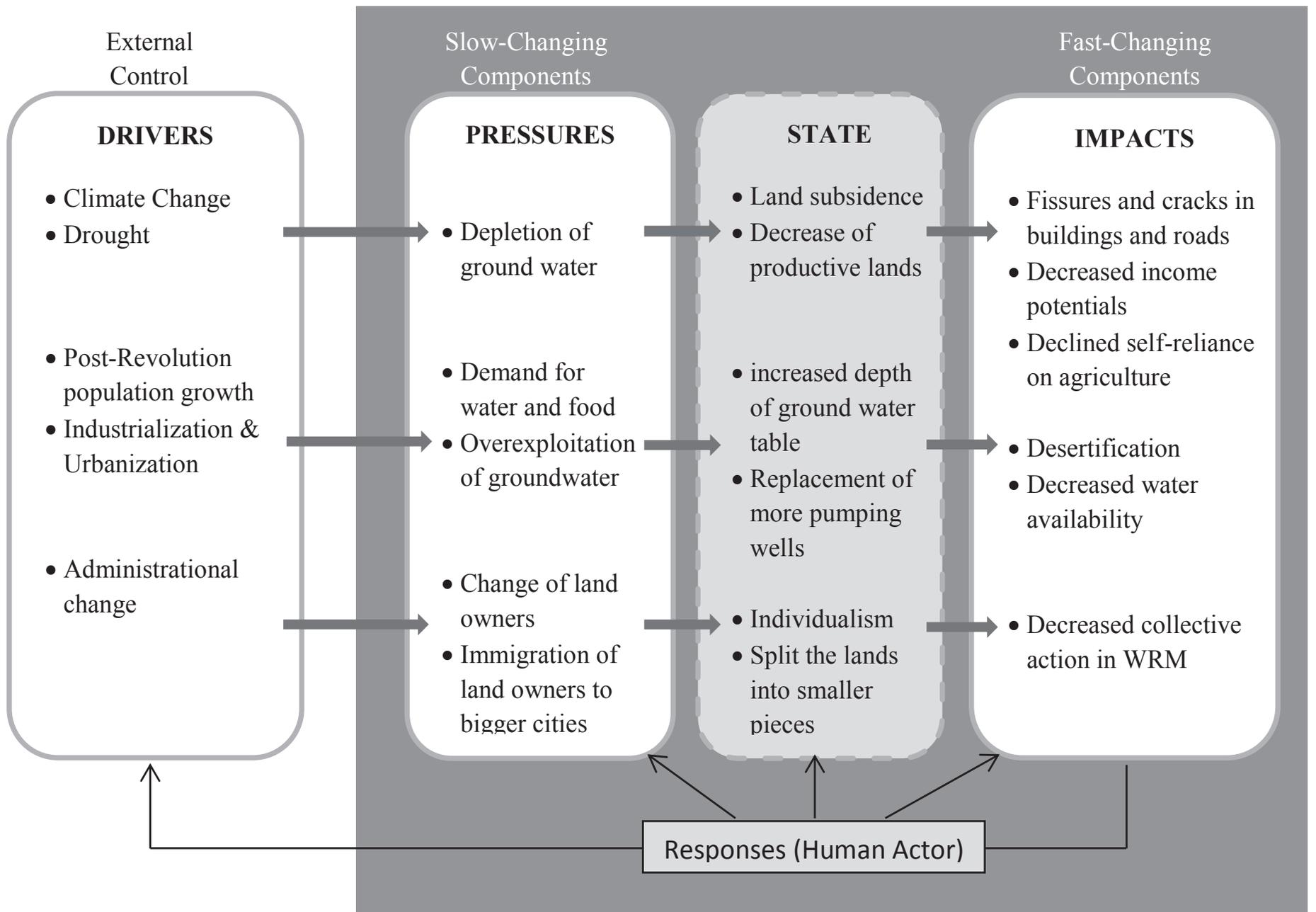
Decreased income potential and self-reliance on agriculture:

- 96% of agricultural lands allocated to pistachio
- In 2004, 44% of world pistachio production and 60% of global exports were from Iran and 16.6% of this world production belongs to Rafsanjan
- In the year 2012 the pistachio production of Iran decreased from annual average of 280 thousand to 150 thousand ton

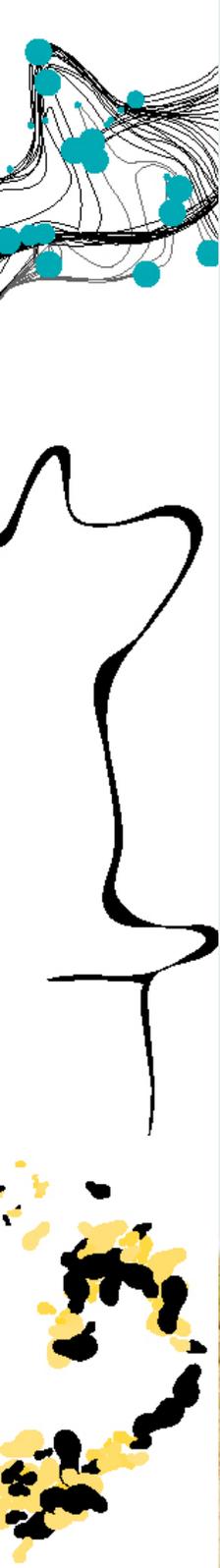




Ecological
Social



Modified Conceptual model of Water Resource Management as an integrated socio-ecological system



Thank you!

