Assessing water supply and demand vulnerabilities within the water-food-energy nexus: a quantitative perspective from Western Australia

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A Nexus Approach

Assessing water supply and demand vulnerabilities within the water-food-energy nexus

- Accelerating development
- Urbanisation
- Climate change
- Globalisation
- Resources degradation
- Land and water scarcity
- Water-energy-food security

→ How can we measure?

Highly applicable to Western Australia

Hoff (2011)
**Spatial Multidimensional Indices**

Integrated index
- Representative of environmental and socioeconomic conditions
- Address water-energy-food scarcity
- Promote equal development
- More informative for decision-making
- Greater potential to effectively improve livelihoods

* e.g. Sullivan et al. (2008); Cohen and Sullivan (2010); Sullivan (2011); Sullivan and Meigh (2005)

Spatial application
- Appropriate scale for adaptation and coping mechanisms
- Effective targeting for management of resources
THE WHEATBELT, WESTERN AUSTRALIA

- Diverse population
- Rich in environmental resources
  - Minerals & Petroleum
  - Agriculture
- Drive for economic development
- Limited consideration for environmental sustainability
- Push for intensive energy generation and food production
- Freshwater resource scarcity

Wheatbelt Development Commission (2012)
“Water supply is fundamental for supporting and sustaining community and industry development in the Wheatbelt.” (WDC, 2013)

→ Assessment of water vulnerability required to build future preparedness

Boruff et al. (in prep)
CALCULATING VULNERABILITY

Assessing water supply and demand vulnerabilities within the water-food-energy nexus

Water System Vulnerability (WSV) = WSSV + WSDV

Supply Vulnerability (WSSV)
- Precipitation characteristics
- Sustainability of aquifer(s)
- Density and capacity of scheme

Demand Vulnerability (WSDV)
- Evapotranspiration
- Temperature
- Livestock density
- Land under cropping
- Population density
- Employment in water-dependent sectors
- Distance to scheme

Stepwise regression used to identify dominant variables on system vulnerability
Assessing water supply and demand vulnerabilities within the water-food-energy nexus | WWC Edinburgh 2015

Preliminary results

WSSV
WSDV
WSV

2001
2006
2011

Supply Vulnerability

0.0 - 0.2
0.3 - 0.4
0.5 - 0.6
0.7 - 0.8
0.9 - 1.0

0 125 250 500 Km

Boruff et al. (in prep)
## Preliminary results

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<td>Supply and delivery capacity</td>
<td>Supply and delivery capacity</td>
<td>Population demand</td>
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Boruff et al. (in prep)
WSV INDEX IMPLICATIONS

• Informative planning for Wheatbelt Development Commission
  • Wheatbelt water strategy (action required)
  • Targeting development of technology to reduce demand vulnerability (e.g. scheme expansion) and supply vulnerability (e.g. desalination capacity)

• Can incorporate future pressures and growth rates to reflect projected water vulnerability for region

• Transferable index-building process to apply quantitative system vulnerability concept to other regions

• Potential expansion to consider energy and food systems
  • Better manage trade-offs and synergies between nexus linkages
Assessing water supply and demand vulnerabilities within the water-food-energy nexus

• Determine vulnerabilities within the energy and food systems in Wheatbelt
• Deliver a nexus-based approach for assessing system vulnerability to promote sustainable resource practice

Biggs et al. (in review)
REFERENCES


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