Synergies and tradeoffs of global challenges through nexus approach at different scales

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Outline

- Introduction and context

- Global scale assessment

- Local scale assessment

- Conclusion

Introduction

- Key global challenges are closely interconnected, but are often separately studied and managed

- System integration is important for achieving SDGs (17 goals with 169 targets) by 2030

- the WEF Nexus approach can better transition societies towards a green economy and wider sustainability

Introduction

No. of publication
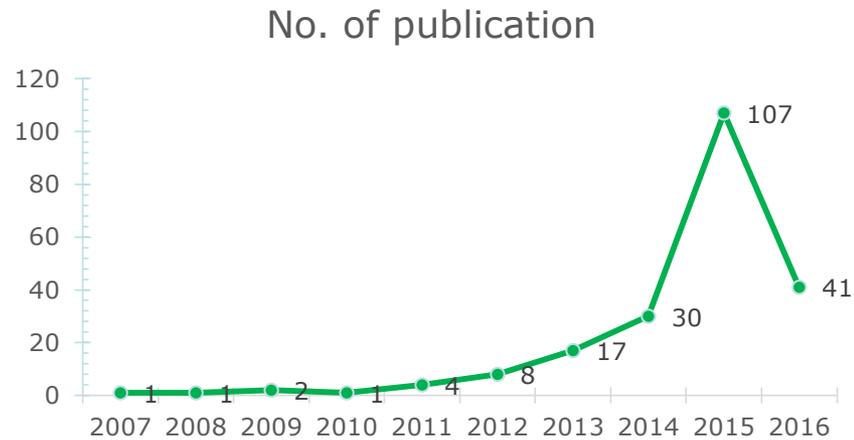
- The WEF Nexus approach is becoming increasingly popular

- The Bonn 2011 Conference

Introduction

- The nexus approach acknowledges the links between water, energy and food in management, analysis, planning and implementation

- Most studies consider theoretical framework; quantitative assessments are less

- Two quantitative assessments are presented: global and local scale

Global Scale assessment

CrossMark

Integrated spatial assessment of the water, energy and food dimensions of the Sustainable Development Goals

Carlo Giupponi[1] · Animesh Kumar Gain[1,2]

- This study presents a comprehensive indicator-based approach for the assessment of water, energy and food securities, refer to SDGs.

- Securities are defined based on available literature

- Indicators are relevant with SDGs and SDSNs

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Global Scale assessment

Reg Environ Change
DOI 10.1007/s10113-016-0998-z

CrossMark

ORIGINAL ARTICLE

Integrated spatial assessment of the water, energy and food dimensions of the Sustainable Development Goals

Carlo Giupponi[1] · Animesh Kumar Gain[1,2]

- A hierarchical multi-criteria evaluation model was developed

- All the indicators have been normalized between 0 (low security) and 1 (high security).

- Aggregation procedure: simple additive weighting (SAW, weights were defined by the authors); Ordered Weighted Average (OWA).

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Global Scale assessment (cont'd)

| Acronyms of Indicators	SDSN indicator code	Indicators	Definition, Notion and data Source
Water Security (SDG Goal 6. Ensure availability and sustainable management of water and sanitation for all)			
wtotinrepc	[49]	Total internal renewable water resources per capita	unit: m^3 per inhabitant per year. A higher value leads to increase water security [source: FAO AQUASTAT]
wsanit	46	Access to sanitation	Percentage of population with access to improved sanitation. The values with higher access lead to increase water security [source: EPI, 2014]
wdrink	45	Access to drinking water	Percentage of population with access to improved drinking water source. The values with higher access lead to increase water security [source: EPI, 2014]
wqualit	[47; 48]	Water quality index	The values with higher index value lead to increase water security. [source: Srebotnjak et al. 2012]
wgwdepl	[49]	Groundwater depletion rate	Groundwater depletion rate (million m^3/yr) is calculated using global hydrological model. The values with higher DI lead to decrease water security. [source: Wada et al. 2012].
wdrought	[85]	Drought index (DI)	DI is calculated using global hydrological model. The values with higher DI lead to decrease water security. [source: Wada et al. 2013].
wgovern	[48; 6.9]	World Governance Index	World Governance Index calculated through the aggregation of six governance dimensions (source: Kaufmann et al. 2010).
whydtransbd	6.8	Transboudary Management Index	A proxy of the challenges deriving from the management of transboundary river basins, calculated by means of GIS context analysis operators. The normalization procedure produced a map with null values attributed to basins entirely included within country boundaries and increasing values up to 1 to those that cross national boundaries and have increasing level of complexity (length of drainage paths) and number of riverine countries [maps from the FAO GAEZ]

Global scale assessment (cont'd)

Acronyms of Indicators	SDSN indicator code	Indicators	Definition, Notion and data Source
Energy Security (SDG Goal 7. Ensure access to affordable, reliable, sustainable, and modern energy for all)			
eavailabi	[51]	Aggregated Energy Availability	Aggregated energy availability calculated through aggregation (equal weighting) of (i) ratio of energy production to consumption; (ii) diversity of electricity generation; (iii) distribution losses as percentage of generation; (iv) five-year compound annual growth rate of the ratio of total primary energy consumption to GDP; (v) days of oil and oil product stocks; (vi) aggregation of net fuel imports as a percentage of GDP. [Source: WEC, 2013]
eaffordab	[51]	Aggregated Energy Affordability	Aggregation (equal weighting) of (i) electricity relative to access; (ii) retail gasoline. [Source: WEC, 2013]
eenvsusqu	62; 78	Environmental Sustainability	Aggregation (equal weighting) of (i) total primary energy intensity; (ii) CO_2 intensity; (iii) Effect of air and water pollution; (iv) CO_2 grams/kWh from electricity generation [Source: WEC 2013]
epolitics	[91]	Political Strength	Aggregation (equal weighting) of (i) political stability; (ii) regulatory quality; (iii) effectiveness of government. [Source: WEC 2013]
esocialst	[94; 31; 37; 17-30]	Social Strength	Aggregation (equal weighting) of (i) control of corruption; (ii) rule of law; (iii) quality of education; (iv) quality of health. [Source: WEC 2013]
Food Security (SDG Goal 2. End hunger, achieve food security and improved nutrition, and promote sustainable agriculture)			
favgsupp	[8]	Average food supply	unit: kcal/capita/day. The higher food supply value lead to increase food security. [Source: GFSI, 2014]
fvolagrpr	[13; 2.14]]	Volatility on agricultural production	The higher volatility value represent lower food security
foodloss	73	Food loss	Calculated as total waste/total supply quantity (in tonnes). The higher food loss value lead to decrease food security. [Source: GFSI, 2014]
foodcons	[8]	Food consumption	Food consumption (percent) as a share of total household expenditure.
fpoverty	1	Poverty	Percentage of population living under $2/day purchasing power parity (PPP).
fagrimpt	17.7	Agricultural Import Tariffs	Percentage of tariffs on agricultural import. The higher tariffs lead to decrease food security. [Source: GFSI, 2014]
fundernour	[8]	Prevalence of undernourishment (% of people)	The higher index value lead to decrease food security. [Source: GFSI, 2014]
fdietdiv	[2.2]	Diet Diversification	Percentage of diversification. The higher index value lead to increase food security. [Source: GFSI, 2014]
fprotqu	2.8	Protein Quality	Amount of protein (in gram) in daily consumed food. The higher protein value lead to increase food security. [Source: GFSI, 2014]
fpreobes	24	Prevalence of Obesity (% of people)	The higher index value lead to decrease food security. [Source: GFSI, 2014]

Global scale assessment (cont'd)
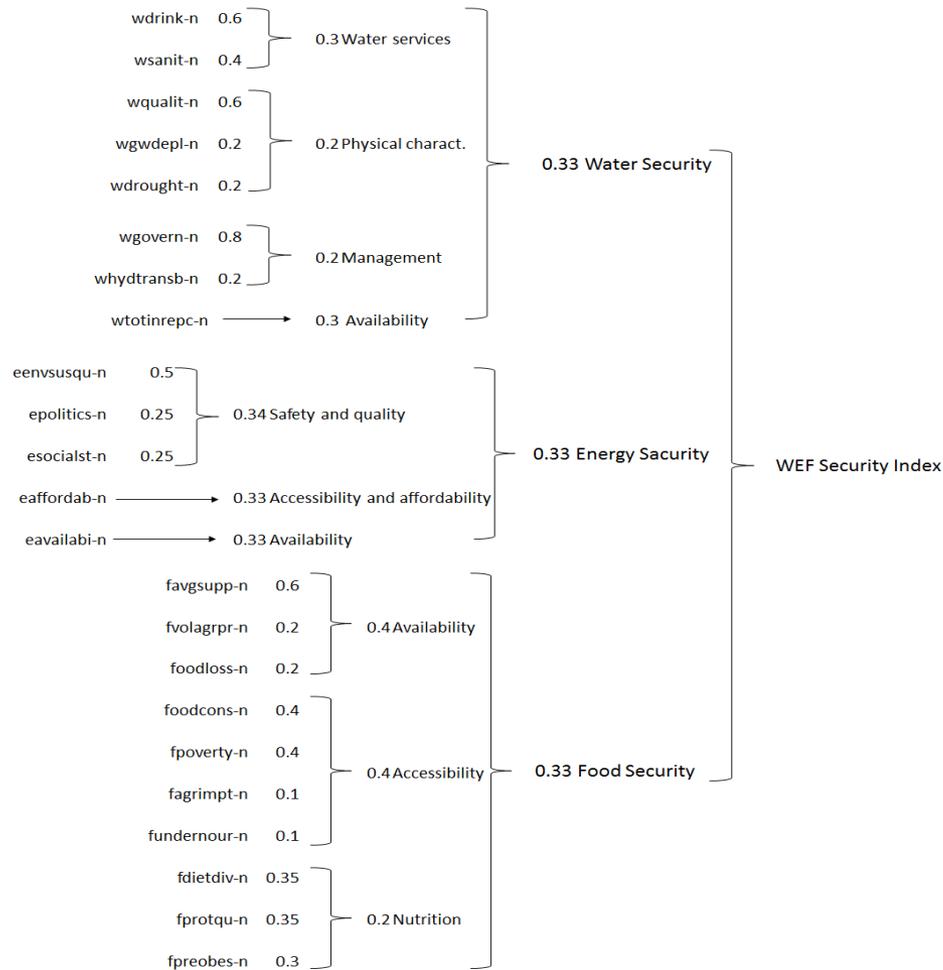
Global scale assessment (cont'd)
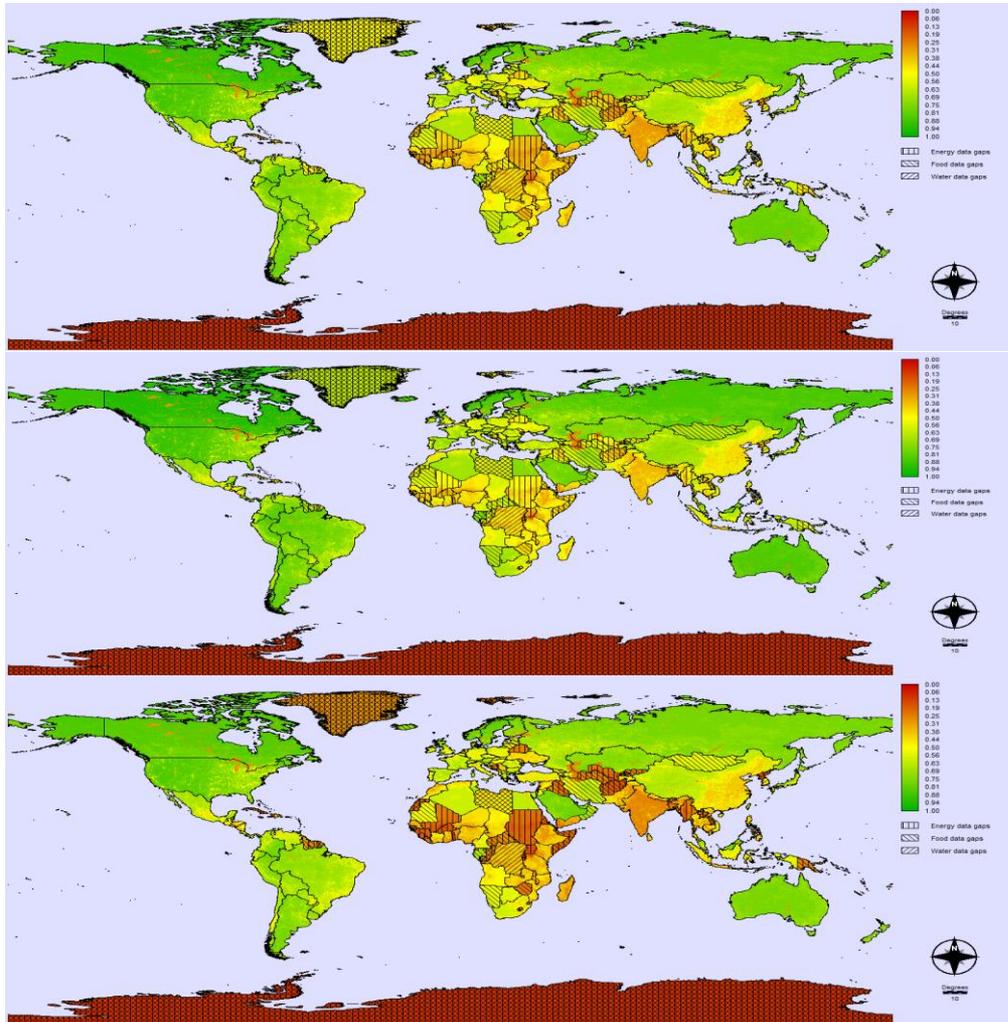
SAW

OWA: Optimistic

OWA: Pessimistic

Global scale assessment (cont'd)

- Current assessment of global scale WEF nexus: data gaps need to be addressed

Five priorities for the UN Sustainable Development Goals

Restructure data–gathering and evaluation networks to address climate change, energy, food, health and water provision, say **Yonglong Lu** and colleagues.

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- Five priorities: devise metrics, establish monitoring systems, evaluate progress, enhance infrastructure, standardize and verify data

- In order to monitoring progress, dynamic assessment is required

Local Scale assessment

Environmental Science & Technology

The Conservation Nexus: Valuing Interdependent Water and Energy Savings in Arizona

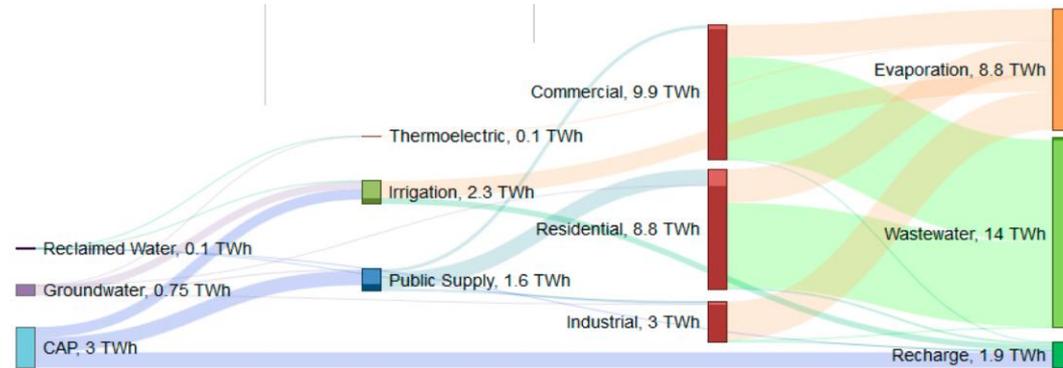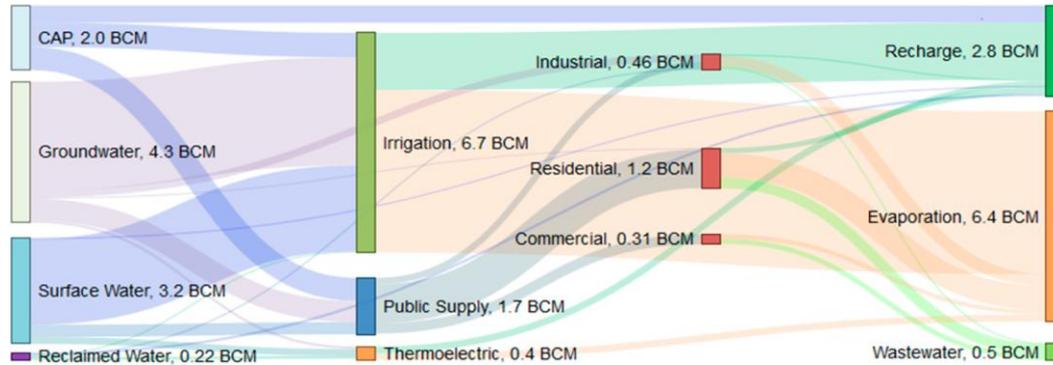Matthew D. Bartos* and Mikhail V. Chester

WATER-ENERGY NEXUS

Assessing integrated systems

The various supply chains that deliver the services society needs are often managed in silos. Research now shows the advantages of integrated management.

Mark Howells and H-Holger Rogner

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Local Scale assessment (cont'd)

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NATURE CLIMATE CHANGE | VOL 4 | APRIL 2014 | www.nature.com/natureclimatechange

- It is required to go beyond water-energy integration

- To model feedback mechanism of using water, energy and food saving technologies

Conclusion

- Global scale assessment: WEF index is developed; data gaps need to be addressed; time series analysis is required for achieving SDG targets by 2030

- Local scale assessment: comprehensive assessment for water and energy securities is provided; need to include food securities as well

- Issues need to addressed: climate change projection, transboundary cooperation, equity and social issues