Development of the Water-Energy-Food (WEF) Nexus Index

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Introduction

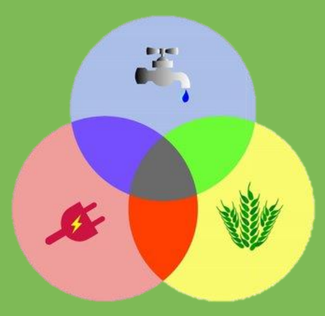

Figure 1. Water-energy-food nexus

The water-energy-food (WEF) nexus is a multi-centric approach/lens for assessing sustainable development and integrated resource management. Since water, energy and food indicators have different units of measurement at different scales, the development of an index was proposed to quantify the WEF nexus system. An index is a single value that captures information from several variables into one composite indicator.

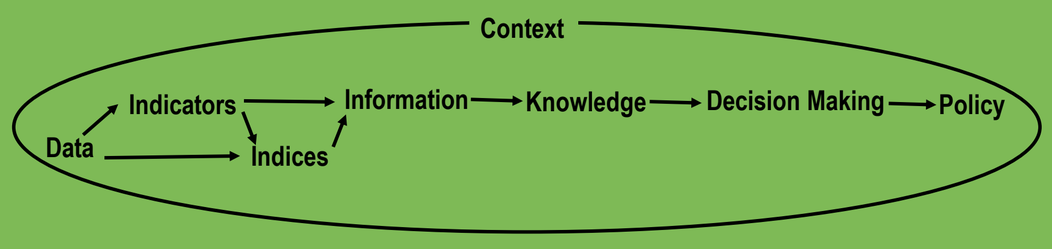

Figure 2. Data is used to develop indices & policies (from Segnestam, 2002 and Waas et al. 2014)

Methods

The WEF Nexus Index was developed using the *JRC-Competence Centre on Composite Indicators and Scoreboards* guideline. After assessing 87 WEF nexus-related indicators, 21 indicators were included in the index, with 170 countries having sufficient data.

Data sources: Various organisations including the World Bank, WHO, FAO, IEA and IRENA

Normalisation: min-max method

Weighting: Equal weights for pillars since WEF nexus is a multi-centric framework

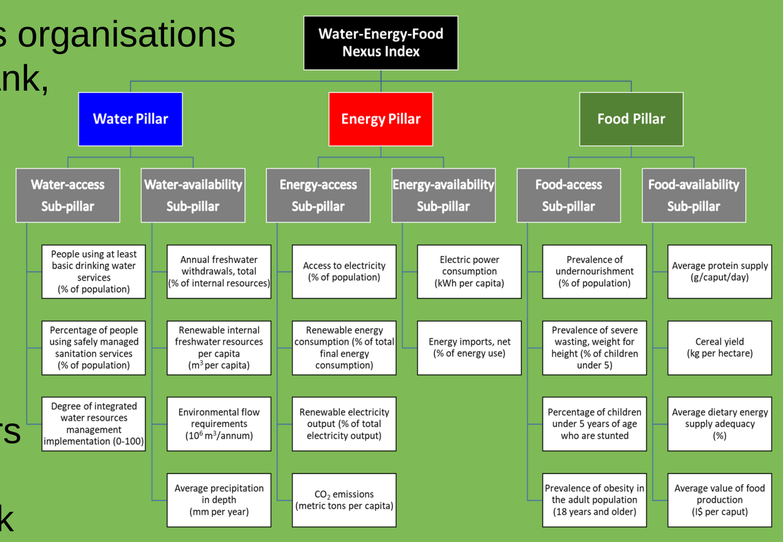

Figure 3. The 21 indicators used in the WEF Nexus Index

Results

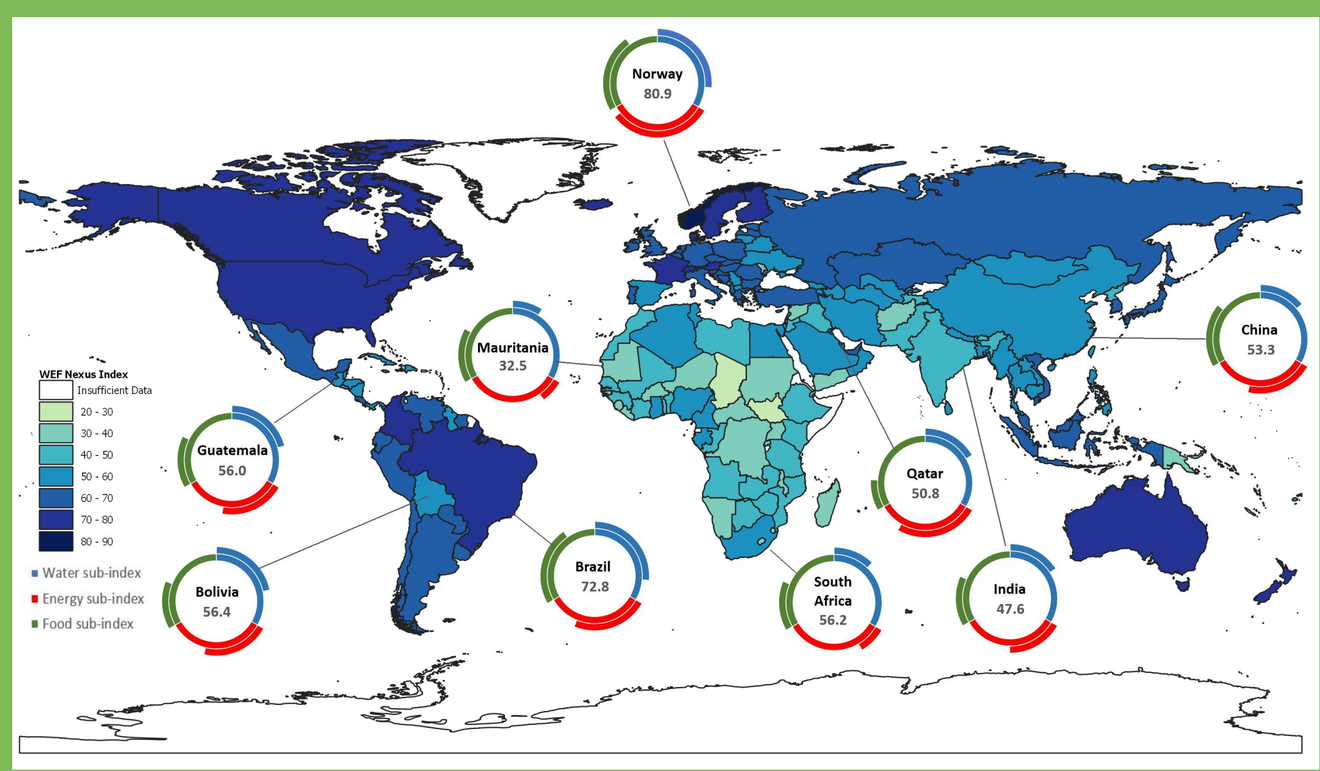

Figure 4. World map indicating WEF Nexus Index values. The inner ring of the doughnut graphs represent the total weighting of the water, energy and food indicators; The outer rings of doughnut graphs represent the sub-index scores per resource for selected countries.

WEF Nexus Index: Higher ranking countries:
Generally first world countries with:
▼ carbon emissions
▲ water availability
▲ service delivery (high levels of clean drinking water and safe sanitation service provision, and access to energy)
▲ renewable energy output and consumption

Highest ranking country – Norway (WEF Nexus Index = 80.9)

WEF Nexus Index: Lower ranking countries:
Mostly developing nations:
▼service delivery (lower levels of provision of clean drinking water and safe sanitation services, and energy access)
▼ carbon emissions
▲undernourishment, and wasting & stunting in children less than five years of age

Lowest ranking country – Chad (WEF Nexus Index = 27)

Discussion

Higher ranking countries for the WEF Nexus Index exhibit integrated resource management where trade-offs between water, energy and food security are relatively well balanced.

Many lower ranking countries are landlocked with limited resources and low levels of access to energy (which is an economic enabler). Some lower-ranking countries have insufficient data which also contributes to a lower score.

Countries that have invested in large-scale renewable energy production and consumption generally have higher WEF Nexus Index scores, emphasising the necessity for a just transition to a low carbon economy, whilst also pursuing the other Sustainable Development Goals (SDGs).

Conclusions

- The WEF Nexus Index quantifies progress towards integrated resource management and sustainable development on a national scale and provides an entry point for a more detailed analysis of the underlying sub-indices and indicators.
- Large scale access to affordable, clean energy is essential for economic development, which is a key high-level finding of this study.
- Improved data access and monitoring will enhance the accuracy and reach of the WEF Nexus Index and assist in policy development related to integrated resource management.
- No country has achieved a state of nirvana in terms of the water-energy-food nexus. All nations must implement focussed policies in order to achieve all of the SDGs by 2030. The WEF nexus provides a lens for evaluating integrated progress towards SDGs 2, 6 and 7.

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SOURCES

- Poster adapted from the Water Research Commission report no. 2959/1/19: http://wrcwebsite.azurewebsites.net/wp-content/uploads/mdocs/2959_final.pdf
- Segnestam, L. 2002. *Indicators of Environment and Sustainable Development: Theories and Practical Experience*. The World Bank Environment Department.
- Waas, T., J. Hugé, T. Block, T. Wright, F. Benitez-Capistros and A. Verbruggen. 2014. *Sustainability Assessment and Indicators: Tools in a Decision-Making Strategy for Sustainable Development*. Sustainability 6:5512-5534.