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The WRC operates in terms of the Water Research Act (Act 34 of 1971) and its mandate is to support water research and development as well as the building of a sustainable water research capacity in South Africa.

The development of a WEF nexus index and testing its application in Southern Africa

A recently completed Water Research Commission (WRC) project investigated the development of a Water – Energy – Food index and its application to South Africa and the Southern African Development Community.

Background

The interdependency of water, energy and food security has long been highlighted, and since 2011 significant attention has been given to the water-energy-food (WEF) nexus in academic, policy, regulatory and development fraternities.

The WEF nexus is a multi-centric lens through which to assess sustainable development and integrated resource management. This approach has direct links to the Sustainable Development Goals (SDG), principally SDGs 2, 6 and 7.

Because the WEF nexus has constituents that are measured in different units, and at different spatial and temporal scales, there is a need to normalise indicators from each of these sectors before integrating them. One such method is the development of a composite indicator (or index), as was developed in this WRC study.

Aims and objectives

The study's main aim was to develop a WEF nexus-based indicator framework, dashboard and composite index, and apply it to South Africa and the Southern African Development Community (SADC) region:

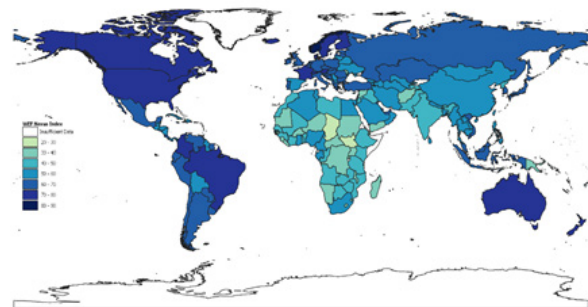
- For assessing national progress towards the constituent Sustainable Development Goals (SDGs), i.e. SDGs 2, 6 and 7, and
- To facilitate integrated sustainability planning and policy development at both national and regional levels.

Key findings

In the development of the proposed WEF Nexus Index, a total of 87 indicators relevant to an anthropocentric WEF nexus framework (that was developed as part of this

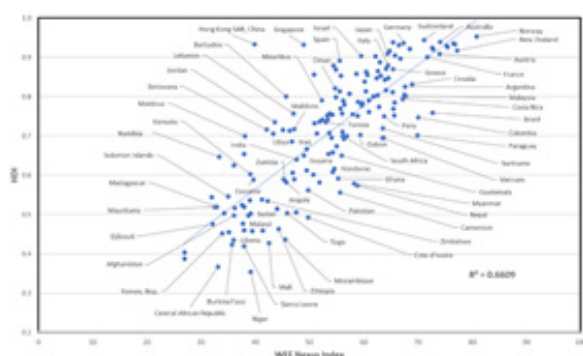
project) were reviewed to ascertain their relevance and data availability.

Following an iterative process, a total of 21 indicators were selected for inclusion in the proposed composite indicator, with adequate data being available for 170 countries. The WEF Nexus Index values per country are plotted on the following world map:



Once the results of the WEF Nexus Index were determined, these results were plotted on two separate graphs against the SDG Index and the Human Development Index (HDI).

The top twenty ranking nations based on the WEF Nexus Index calculation are dominated by first-world countries, with Norway, New Zealand and Sweden ranking highest. Five South American countries feature in the top twenty, with Brazil being the highest placed of these. One Asian nation (Malaysia) features in the top twenty, while no African nations run on. Three-quarters of the bottom twenty ranking nations are from Africa.



South Africa ranks 72nd of the 170 nations assessed. While South Africa ranked relatively well in terms of its “Water-access” and “Food-access” sub-pillars, it performs comparatively poorly in the two associated “Availability” sub-pillars.

Similarly, although the proportion of South Africans with access to electricity is relatively high, much of this energy is generated by burning fossil fuels. Because of this, the country has a high level of CO₂ emissions. Because the “Energy-Access” sub-pillar is linked to SDG 7 (access to clean, modern, affordable energy), the relatively high level of access to electricity in this country is to a large degree nullified in this sub-pillar by the high emissions and low level of renewable energy adoption.

The ranking of SADC countries according to their respective WEF Nexus Index values has South Africa ranking highest, while Madagascar is lowest at 165th, as presented in the following table. Also shown in this table 1 are the SDG Index and HDI values for the fifteen SADC countries listed.

With much of the developed world having built their nations on the foundation of fossil-fuel-based energy generation, it is evident that the dearth of coal in Africa outside of South Africa has crippled its development and contributed to a poverty trap. Ironically, much of the world is moving away from coal-fired power generation, but they can do so because they have reached the point where they can afford to do so.

Access to energy is indeed a pivotal enabler of economic development. In reviewing the constituent indicators of the WEF Nexus Index it is evident that most SADC nations are not utilising their available freshwater. If they could gain significantly broader access to affordable, modern, renewable energy, then a great benefit could result in terms of food production and economic development. The “Food-availability” sub-pillar is generally the poorest performing sub-pillar within the WEF Nexus Index for SADC countries.

Country	WEF Nexus Index Rank	WEF Nexus Index	SDG Index	HDI
Angola	124	45.8	49.3	0.581
Botswana	136	42.1	61.6	0.717
Comoros	161	34.3	47.6	0.503
Congo, Dem. Rep.	141	39.5	41.6	0.457
Eswatini	140	39.7	52.4	0.588
Lesotho	151	37.9	50.9	0.520
Madagascar	165	32.9	45.6	0.519
Malawi	152	37.7	52.3	0.477
Mauritius	100	52.3	66.2	0.790
Mozambique	126	45.6	51.4	0.437
Namibia	163	33.4	57.1	0.647
South Africa	72	56.1	60.4	0.699
Tanzania	138	41.3	55.9	0.538
Zambia	127	45.3	53.0	0.588
Zimbabwe	135	42.4	54.8	0.535

¹Excluding Seychelles, since there was insufficient data to ascertain the WEF Nexus Index for this country

By following the JRC-COIN process, the proposed composite indicator has been developed sensibly and transparently. If the WEF Nexus Index results are utilised responsibly they can contribute to the sustainable development and integrated resource management discourse.

Recommendations

The following are recommendations emerged from this project:

- The WEF Nexus Index and the associated dashboard be utilised as a contribution towards the development of the WEF nexus framework that SADC is working towards.
- Based on the WEF Nexus Index project, it is proposed that for nexus investments to be identified, the development of broader access to, and an increased generation of, renewable energy must be prioritised since access to electricity is an enabler of development. In order to attain SDG 7, SADC countries must work both corporately and individually to secure non-burdensome development funding to build utility-scale solar and (where applicable) wind, geothermal, hydropower, pumped storage, and bioenergy installations. This funding must include grid integration and the maintenance, and the upgrading and extension of

the transmission and distribution network within the Southern African Power Pool (SAPP). It is essential that transparent tender-based procurement is implemented for these projects.

- In terms of research projects that will support and guide the development of the framework for SADC, as well as the identification of priority nexus investments, it is proposed that SADC:
 - Undertake catchment-based assessments of selected catchments using the WEF nexus approach to identify resilient upstream policy recommendations. This is especially important when the transboundary nature of so many river basins within the SADC region is considered,
 - To develop an integrated roadmap to achieve SDGs 2, 6 and 7 by 2030 in SADC utilising the WEF nexus approach.
- In order to facilitate nexus investments within the region, it will be necessary to undertake sector-specific SADC protocol harmonisations to promote integrated resource planning and sustainable development within this region.
- In terms of facilitating nexus developments, national governments of SADC countries should be very cautious when allowing large-scale land acquisitions (LSLAs).

While these transactions introduce foreign capital, the acquisitions are undertaken to secure the energy and food security of developed countries, i.e. not the host nations. Many of these SADC countries have high levels of undernourishment, stunting and wasting. By entering into these agreements SADC nations relinquish land and export 'virtual water' which could both be utilised to secure domestic food security. To plant bioenergy crops in Africa to secure energy security for developed nations, while many in these African nations are undernourished is ethically indefensible. SADC nations must instead provide incentives and facilitate trade for nexus investments such that African entrepreneurs can obtain funding and other support mechanisms to develop these vast tracts of land to produce food for their own nations' nutritional needs. Clear rules regarding land tenure must be established to facilitate this process.

Related report:

Development of water-energy-food nexus index and its application to South Africa and the Southern African Development Community (WRC Report no. 2959/1/19). For more information, contact WRC Executive Manager, Dr Sylvester Mpandeli, at Email: sylvesterm@wrc.org.za