Prototype Global Sustainable Development Report

Brief 6
Climate-land-energy-water-development nexus

Integrated approaches

Sustainable development needs integrated approaches in order to identify solutions to achieve economic, social and environmental goals that are often interlinked. However, at the national level, planning and assessment continue to follow sectoral and/or thematic lines in most countries.

An increasing number of scientists and practitioners have started to promote integrated assessments in recent years. They suggest focusing initially on clusters of interlinked issues that are considered most important for policy action. The strength of inter-linkages among issues and the policy priorities of governments might define the most suitable cluster of issues to be analysed in each country or geographic area. Hence, the "right" cluster of issues is case-specific.

An example of a cluster that has relevance in a wide range of contexts worldwide is the climate, land, water, energy and development (CLEWD) cluster or "nexus". This cluster is central to many integrated scenarios at the global level. Many of the national submissions in preparation for the Rio+20 Conference in 2012 also highlighted these issues among the highest priority areas.

The climate-land-energy-water-development nexus is but one of a number of clusters of strongly interlinked issues of great relevance for sustainable development. Future editions of a global sustainable development report could address these clusters in turn.

CLEWD nexus

Water, energy and land are needed to grow food. Some food crops can also be used as biofuel. Power plants require water. Energy-intensive seawater desalination increasingly provides water for drinking and agriculture. Water and energy infrastructure is needed to spur development and vice versa. In many parts of the world, a changing climate exacerbates some of these already strained links. Increasing droughts call for increased energy inputs for irrigation and limit the use of hydro-power plants. In some Smalls Island Developing States, as well as in drought-sensitive areas, these impacts of a changing climate are already a reality. In many cases, these links are so significant that they cannot be neglected by policy and call for integrated approaches.

CLEWD nexus applications

Integrated modelling and planning approaches for assessment of the climate-land-energy-water-development (CLEWD) cluster have multiplied in recent years.

In preparation for the present report, a global CLEWD model was developed as an open-source, open-data tool for research cooperation on global sustainable development: the Global Least-cost User-friendly CLEWs Open-Source Exploratory (GLUCOSE) model. The original model was developed by researchers from the Royal Institute of Technology (KTH) in Sweden and the UN Division for Sustainable Development.

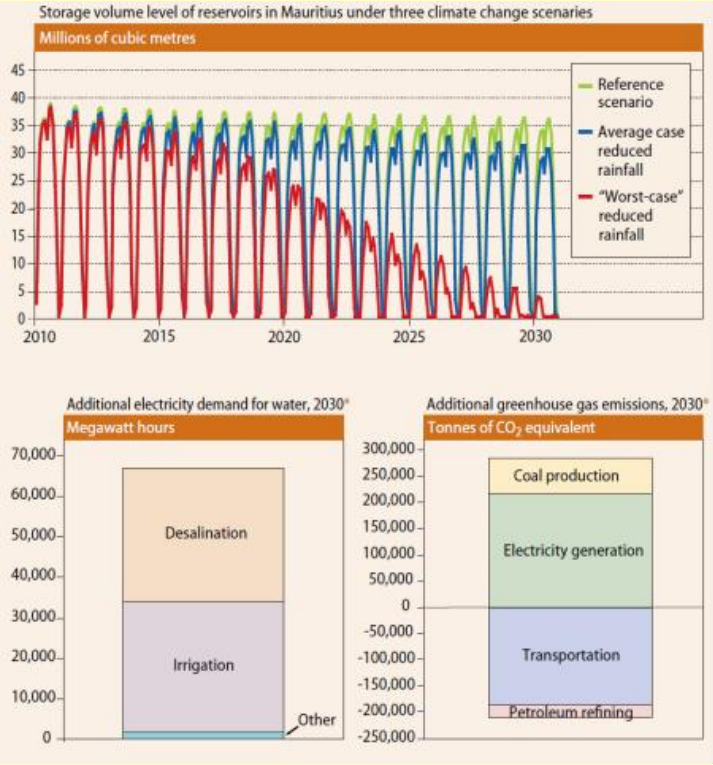
At the national level, a pioneering pilot assessment of the climate-land-energy-water-development nexus in Mauritius has shown the practical benefits of integrated analysis for policy making. In a very short time, the Mauritius case study has inspired many similar nexus applications. The expert group in support of this report identified CLEWD case studies in Australia, Brazil, Burkina Faso, Canada, Cuba, Chile, China, Germany, India, Jamaica, Lithuania, Mauritius, Qatar, Cape Town/South Africa, Syria, Thailand, USA, UK, Tarawa/Kiribati, Comoros, Madagascar, Seychelles, Zanzibar, and California/USA; in the river basins of the Danube, Nile and Mekong, and regional applications in the Pacific islands, Indian Ocean, Africa and Central Asia. These applications use different entry points – energy security, water security or food security – but they share the same overall integrated approach.

Mauritius example

CLEWD modelling in Mauritius has exposed how a national biofuel policy that made sense from a best practice energy, land and water planning point of view could be jeopardized by adverse climate change outcomes – specifically, reductions in precipitation. The change in rainfall patterns would lead to an increase in water withdrawals, which in turn would lead to higher demand for energy to drive pumps to bring the water from its source to the fields and to power water desalination plants. This leads to increased demand for cooling of thermal power plants and thus to additional withdrawals of water. If the increase in electricity demand is met with coal-fired power generation, the GHG benefits of the ethanol policy are eroded by increased emissions from the power sector. Higher coal imports also have a negative impact on energy security. The

benefits of the ethanol policy – aimed to reduce energy import costs and emissions – are thus clearly vulnerable to the impacts of climate change and the long term viability of this strategy is at risk if rainfall were to decrease further and droughts continue. In this event, producers would either have to scale back production or resort to expensive water desalination. This type of insight can only be gained when interlinked systems are modelled in an integrated manner. In response, the Government of Mauritius appointed a high level CLEWs panel to ensure consistency between its climate, land, energy and water strategies.

Predicted impact of climate change on water availability in Mauritius, water related energy consumption and GHG emissions, predictions for year 2030.



Notes: ***Upper graph:*** Storage volume levels in reservoirs in Mauritius under 3 climate change scenarios (in Million m3).
Left graph: Additional electricity demand (compared to scenario without climate change impacts) under worst-case climate change scenario (in MWh). The additional water requirements in the "worst case" climate change scenario leads to an increase in energy demand. This is mainly due to additional desalination requirements and the need for irrigation in sugar cane plantations.
Right graph: Additional greenhouse gas emissions (compared to scenario without climate change impacts) under worst-case climate change scenario (in ton CO2-equivalent). The additional energy demand leads to an overall increase in greenhouse gas emissions. The additional demand is largely met by coal-based electricity generation. The resulting emissions outweigh the emission benefits of the 2nd generation ethanol production.
Source: UN (2013) and Howells (2013).

Qatar example

Qatar is a nation currently enjoying a period of unprecedented growth and advancement governed by set national visions and goals. Qatar is well recognized for its oil and gas abundance. Qatar has an arid desert type climate with hot and humid summers. Agricultural development is limited by water scarcity, low water quality, unsuitable climatic conditions, unfertile soils and poor water management which contribute to low crop yields. Most agricultural food products are being imported. Population and GDP have grown rapidly (9.6 and 8.6 per cent, respectively, in 2010). Qatar has one of the highest energy consumption and carbon emissions per capita. Qatar's General Vision 2030 aims to choose "*the development path that carefully balances the interests of the current generation with the interests of future generations".* The Qatar National Food Security Program highlighted the necessity of reducing the nation's food imports which currently represent about 90 per cent of the total national consumption.

The starting objective of the case study was to identify water, energy, agricultural and economic strategies to achieve food self-sufficiency. Present agricultural practices use exclusively fresh ground water, with extraction rates more than one hundred times the natural replenishment rate. Therefore, agricultural intensification to increase food self-sufficiency would require energy-intensive desalination as an alternative source of water.

The case study initially looked at eight locally produced food products typical of a Middle Eastern diet: tomato, eggplant, lettuce, carrots, watermelon, cucumber, potato, and green onion. Multiple scenarios showed that increasing the self-sufficiency of the studied food products by only 10 per cent would increase land requirement by 153 per cent and water requirement by 82 per cent. Throughout the case study the scientific discussion and the policy narrative changed from trying to achieve national full self-sufficiency to searching for the right mix of local production and international trade.

Financing the nexus

Innovative CLEWD nexus solutions tend to be "cheaper" in terms of GHG mitigation costs, but may mean shifts of investments across sectors. Because of this, there would typically be both "winners" and "losers" from integrated solutions, potentially leading to political economy issues. Since components of CLEWD nexus solutions depend on what happens in other parts of the system, investors may face additional uncertainty and risks, which might make nexus solutions less attractive to investors. In addition, CLEWD nexus projects are expected to face important challenges in tapping into financial resources provided by local and international financing institutions and funds due to the existing fragmentation in narrowly defined sectors and activities.

More information

For further information, see the website of the Prototype Global Sustainable Development Report at:
http://sustainabledevelopment.un.org/globalsdreport