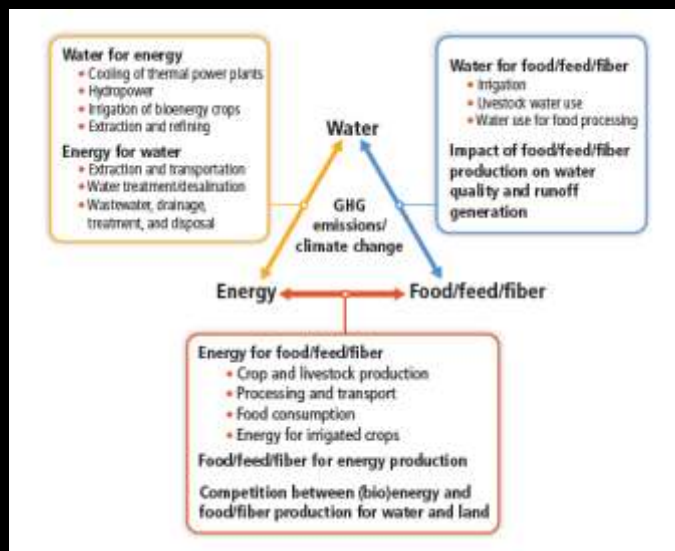


Water-Energy-Food Nexus and the Changing Climate

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The Water-Energy-Food Nexus

(Arent, *et al.*, The Water-Energy-Food/Feed/Fiber Nexus as linked to Climate Change. In IPCC 5th Report, 2014)



Climate Change & the Nexus

Energy – Water – Food/Feed/Fiber – Climate change



Nutritionally appropriate low-meat diet or low-water-consuming vegetarian diet generally reduces water and energy demand as well as GHG emissions per person.

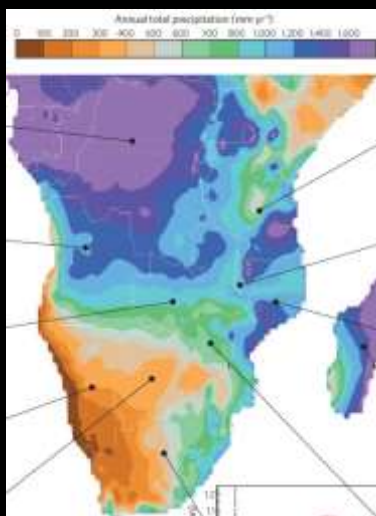
Use of agricultural, livestock, and food waste may reduce conventional energy use and GHG emissions.

Climate change tends to increase energy demand for cooling as well as water demand.

The interaction among each of these factors is influenced by the changing climate, which in turn impacts energy and water demand, bioproductivity and has implications for security of supplies of energy, food, and water.

Case: Southern Africa

(Declan Conway. Climate and southern Africa's water-energy-food nexus. Nature Climate Change, 2015)



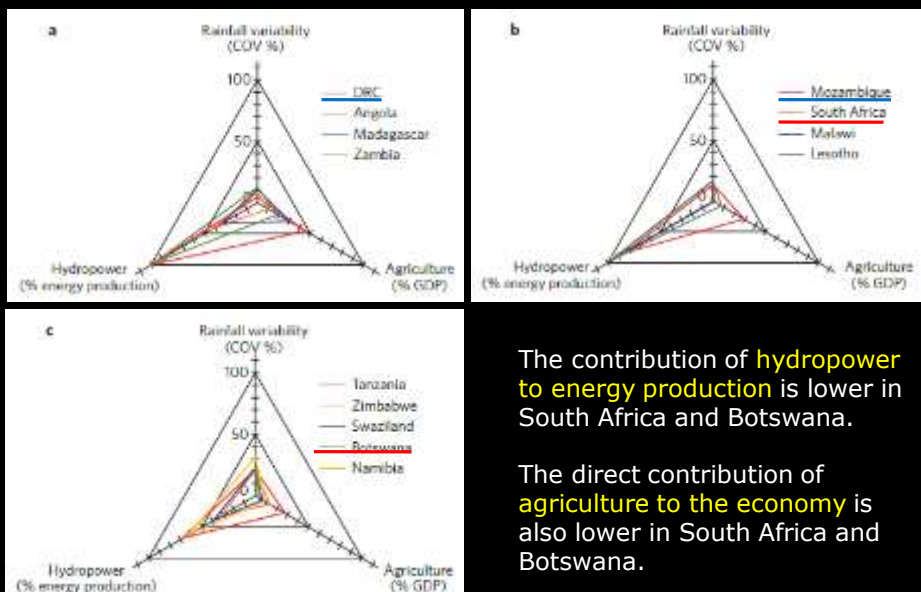
1. **Multiyear rainfall variability** is higher than, and the connections between **climate** and the **water-energy-food nexus** are strong.
2. Spatial interdependence is high driven by the regional extent of climate anomalies and **river basins and aquifers** that span national boundaries.
3. These changes of climate (decreasing rainfall) would propagate into reduced water availability and crop yields.

This research considers national-level exposure of water, energy and food production to climate variability and analyse the relationship between climate variability and economic activity.

Table 1 | Economic indicators and climate-sensitive economic activities across water, energy and food.

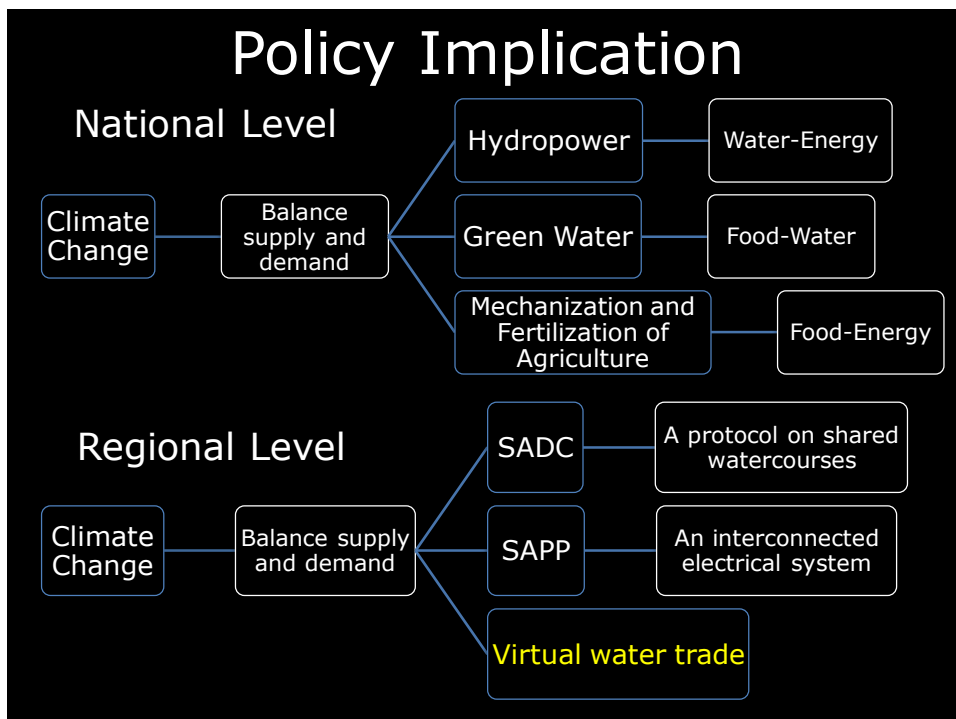
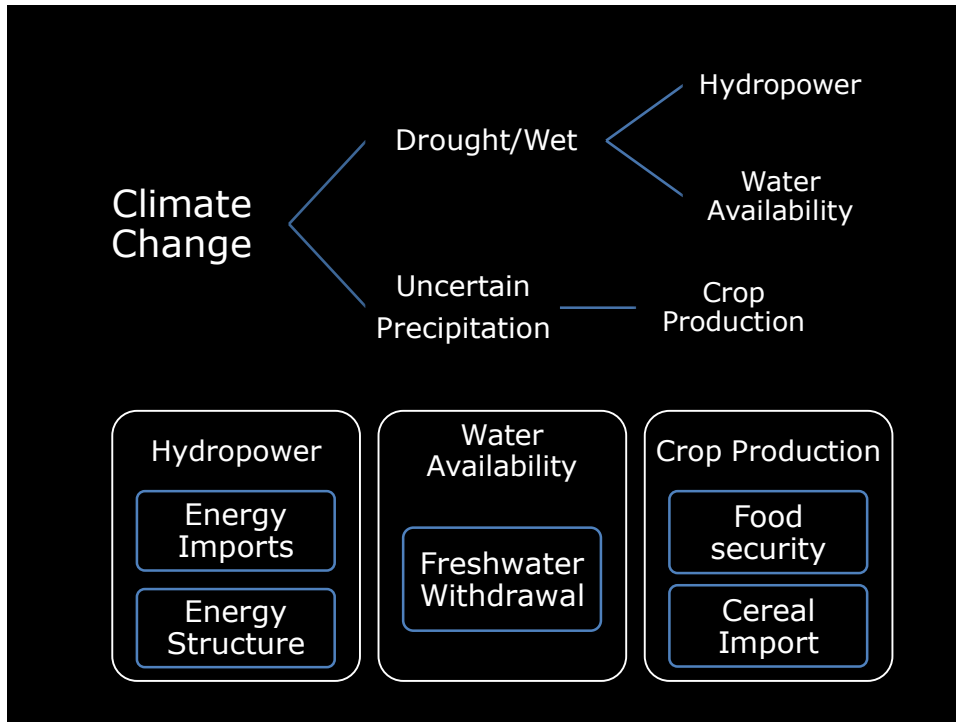
Country	GDP (current US\$ billion)	GDP per capita (current US\$)	Energy imports (% consumption)	Freshwater withdrawal (% TARWR)	Cereal import dependency ratio (%)	Area equipped for irrigation (% cultivated land)
Angola	115	5,540	32	0.48	55	2
Botswana	14.5	7,250	63	1.6	90	1
DRC	18	420	5	0.05	37	0.1
Lesotho	2.3	1,130	-	1.4	85	1
Madagascar	30	440	-	4.9	10	31
Malawi	4.2	270	-	2.9	6	2
Mozambique	14.4	570	21	0.4	31	3
Namibia	13.4	5,930	84	1.6	65	1
South Africa	382	7,310	46	24	19	13
Swaziland	4.1	3,290	-	23	79	26
Tanzania	28	610	13	5.4	13	2
Zambia	20.6	1,460	14	1.5	5	6
Zimbabwe	12.5	910	10	21	52	5

South Africa and Botswana have higher **energy imports** dependency ratio, higher **freshwater withdrawal** ratio (TARWR).

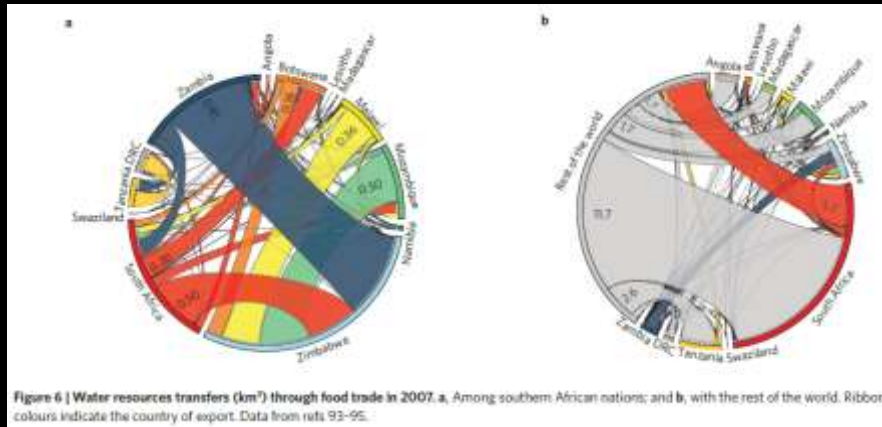


The contribution of **hydropower to energy production** is lower in South Africa and Botswana.

The direct contribution of **agriculture to the economy** is also lower in South Africa and Botswana.



VWT: Virtual Water Trade



Strong open trade is an important tool to alleviate climate-induced food deficits and VWT openness tends to reduce undernourishment.

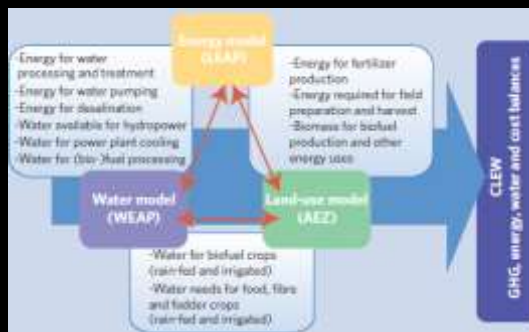
Informal traders are less encumbered by trade regulations than larger formal grain traders, and hence can respond to arbitrage opportunities more quickly.

Case: Mauritius

(Mark Howells. Integrated analysis of climate change, land-use, energy and water strategies. Nature Climate Change, 2013)

Sugarcane plantations cover 80-90% of cultivated land in Mauritius. The sugar business contributes significantly to the country's export earnings. It is facing decreasing water availability and **vulnerable to climate change**.

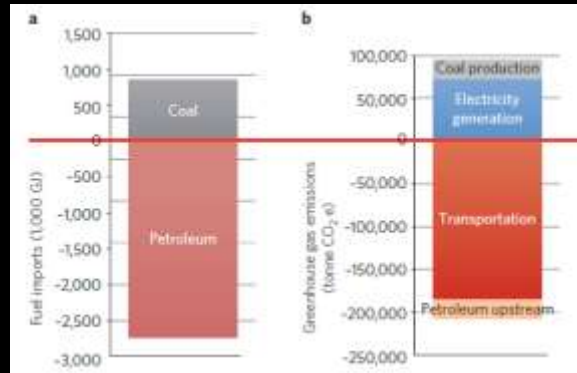
CLEWs (climate, land-use, energy and water strategies) is a new paradigm for resource assessment which can help to remedy some of shortcomings.



Mauritian sugar exporters have recently **lost the preferential access** to the EU market they used to enjoy under the ACP sugar protocol. The question has therefore been raised of whether it would be in the national interest to promote a local **biofuel industry**.

'**Baseline**' scenario: sugar cane remains the dominant crop and sugar is the mainstay of export agriculture

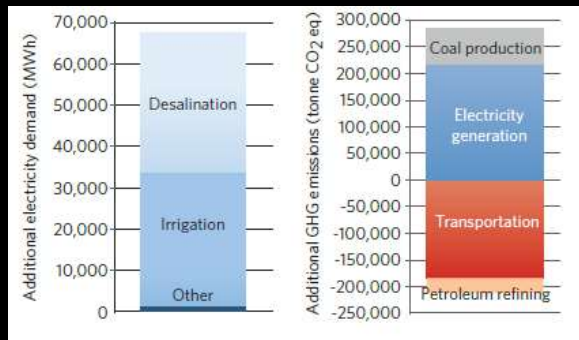
First set of scenarios: transform two major sugar mills to ethanol plants



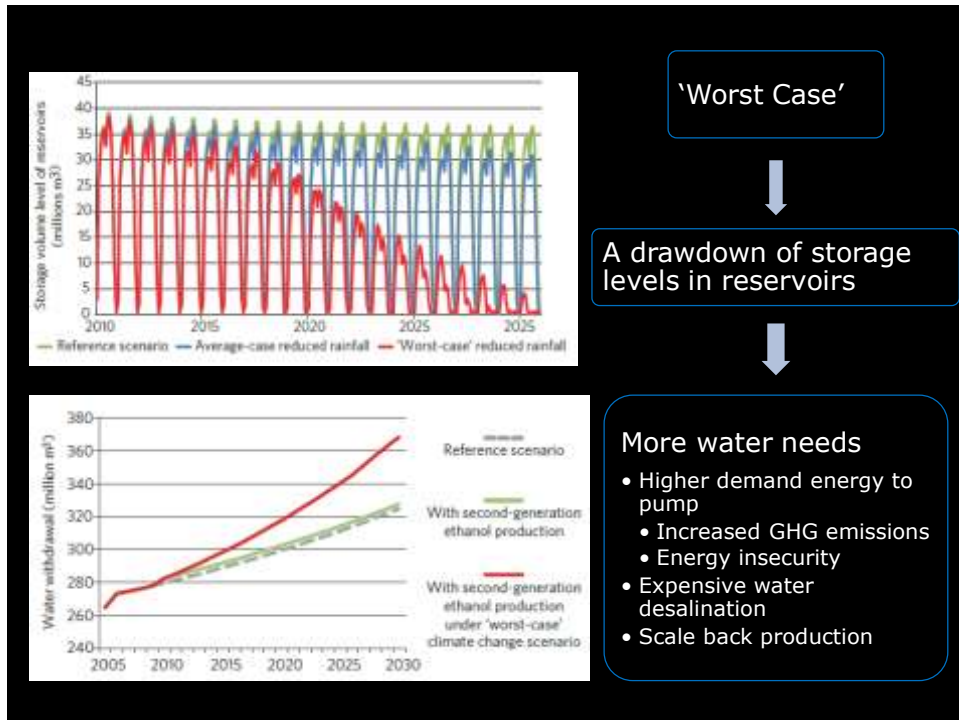
Comparison between two scenarios

Water supply in Mauritius relies mainly on withdrawals of **surface water** and **ground water**. If demand exceeds, the shortfall will have to be met by **desalination of sea water**. Investment in renewable electricity generation has so far been limited.

Second set of scenarios: the first set under a 'worst case' scenario developed based on the largest average monthly drop in rainfall



There is an **extra electricity demand for water** compared with the first set. This is because greater desalination requirements and the need for irrigation in sugar-cane plantation.



Policy Implication

Promote local biofuel industry

- Reduce reliance on petroleum fuel imports
- Reduce GHG emissions
- Flexible to change

Renewable electricity generation

- Wind electricity generation
- Photovoltaic electricity generation

Thank You!