



## **Understanding Modelling Tools for Sustainable Development**

**MODULE: CLEWS  
COUNTRY  
MODEL: HANDS-  
ON EXERCISES**

Climate, Land, Energy  
and Water Systems

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## INTRODUCTION

This training exercise has been developed to introduce the methodology followed during a CLEWS analysis. The training will be divided into two distinct sessions. The first session will illustrate how different climate scenarios or development choices within one sector affect the rest of the sectors, with the use of simple, practical exercises. The second session will focus on comparison of the existing scenario results for the Mauritius case study. Participants should try to formulate their own conclusions based on the exercises.

### LEARNING OBJECTIVE

- Use the online CLEWS interface as a tool to inform debates on sustainable development policies and the interlinkages among climate, land, energy and water issues.

## CASE STUDY BACKGROUND

### INTRODUCTION

This section provides a brief overview of challenges in Mauritius that led to a CLEWS study. The aim of the training is to demonstrate how CLEWS can be used to identify issues across sectors that would be missed if planning was done separately for each individual sector.

### MAURITIUS: CONTEXTUAL CHALLENGES

Mauritius is a small, lower-middle-income country with a population of approximately 1.3 million people and a gross domestic product (GDP) of \$10.6 billion in 2015. The country has few mineral resources, but a tropical climate and conditions suitable for agriculture, in particular, sugarcane cultivation.

There are no domestic reserves of fossil fuels; all coal and petroleum fuels therefore have to be imported. Energy-related imports, at \$463 million, equivalent to 4.4 per cent of GDP, were a significant contributor to a negative current account balance of \$1.1 billion. Reducing energy import bills and improving energy security is a priority for the Government. There is

currently no infrastructure for importing natural gas. The main domestic renewable energy resource being used is biomass.

A number of smaller hydropower plants operate, but with little potential for expansion. Wind and solar projects for electricity generation have started coming online with government support. Power purchase agreements have been signed between the national power company and private renewable energy developers at prices higher than the avoided cost for the utility. The treasury (taxpayer) compensates the utility for the difference.

The sugar sector has had a central role in the economy, but has been in decline in recent years. In the past, a sugar protocol gave sugar exporters preferential access to European markets through quotas and subsidized prices. As the protocol has ended, the sugar industry is in a period of transition. The response has been to downsize, such as by reducing planted area and employment; consolidate, including through fewer mills; and look for alternative sources of income, for example, ethanol and fertilizer. Without support from the Government, the sugar sector is expected to enter a permanent decline, yet it is still an important source of export revenues (10 per cent of total exports in 2015). It also occupies more land than any other economic sector and is responsible for over half of total water withdrawals.

Furthermore, the sugar industry and energy sectors are closely interlinked. Around 60 per cent of electricity is produced from co-generation facilities at sugar mills and sold to the national power company under power purchase agreements. This electricity is generated from renewable bagasse produced during the harvesting season and coal during the rest of the year (approximately 30 per cent of generation for the grid is from bagasse). Conversely, the electricity business is an important part of the sugar industry, responsible for more than 20 per cent of value added. Because of this interdependence, the future of the electricity sector is closely linked to the fate of the sugar sector.

While overall rainfall is relatively abundant, water availability is a concern in certain areas at the current level of demand. Supply is tight in dry years. It is possible to augment supply through additional groundwater pumping, but only moderate increases are possible without overexploitation of aquifers. Current water demand is therefore close to the upper limit of

what can be sustainably delivered in the long run. While the declining water demand in the sugar sector is alleviating the problem, there is strong growth in demand for municipal and industrial uses. Investment in additional storage reservoirs and inter-basin transfer canals to alleviate water shortages is foreseen.

The reference case represents a scenario without additional policy intervention in the energy or agricultural sectors. Consequently, there is no further subsidy of renewable electricity (i.e., no new power purchasing agreements at subsidized rates), and no new subsidy or support mechanism for sugar producers. The case is characterized by an increase in electricity generation from coal and the steady decline of the sugar industry. The decline of the sugar sector not only alleviates water supply concerns but also reduces land occupation for this purpose. A steady increase in energy demand brings about a corresponding growth in fossil fuel imports and carbon dioxide emissions.

#### ANALYSIS NEEDED

This analysis focuses on two policy interventions and vulnerability to climate change

1. A target (in percentage of generation) for renewable electricity production. The aim of this policy is to reduce reliance on fuel imports (imported fuel oil and coal are the main fuels used in power generation) to improve energy security, reduce import bills and cut carbon emissions.
2. A renewable fuel standard mandating the blending of ethanol into gasoline. The aim of the policy is to boost income for sugar growers (and support employment in the sector), and to displace imported liquid fuels in order to improve self-sufficiency in fuel supply and reduce import bills.

Two climate change scenarios are considered:

1. A “moderate” climate change scenario with a 7 per cent drop in annual average precipitation.
2. A “severe” climate change scenario with a 30 per cent drop in annual average precipitation.

## HANDS-ON SESSION

## TASK 1

The Government is considering the introduction of a renewable electricity target, where a given share of electricity supply is generated from renewable sources, such as wind, solar, hydro and biomass. Use the visualization tool to explore the potential benefits, costs and negative impacts this policy may have, and answer the questions below.

- a) Why do you think the Government might want to pursue this policy?
- b) What costs and detrimental impacts would you expect from the introduction of this policy?
- c) What are the food, energy and water implications?
- d) Could any of the detrimental impacts be addressed or mitigated through the design of the policy mechanisms?
- e) Your boss asks for a short summary of the findings of the quantitative analysis. What do you tell him/her? What insights would you highlight?

## TASK 2

The Government is considering the introduction of a renewable fuel target, which would mandate the blending of fuel ethanol into all gasoline sold in the country. The fuel ethanol could be produced from sugarcane at sugar mills. Use the visualization tool to explore the potential benefits, costs and negative impacts this policy may have, and answer the questions below.

- a) What benefits would you expect from the introduction of this policy?
- b) What costs and detrimental impacts would you expect from the introduction of this policy?

- c) What are the food, energy and water implications?
- d) Could any of the detrimental impacts be addressed or mitigated through the design of the policy mechanisms?
- e) Your boss asks for a short summary of the findings of the quantitative analysis. What do you tell him/her? What insights would you highlight?

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### TASK 3

The Government is concerned about the potential impacts of climate change. Climate models are predicting a reduction in precipitation if climate targets are not met. Use the visualization tool to explore the potential impacts of climate change, and answer the questions below.

- a) What are the potential risks of climate change for land, energy and water use?
- b) Does the potential impact of climate change alter your view of the two policies?
- c) How would you recommend addressing the risks associated with climate change?

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### TASK 4

Repeat Task 3 with the 20 per cent ethanol blending and 20 per cent renewable energy targets as a reference scenario.