KTH Royal Institute of Technology

Division of dESA Energy Systems Analysis

FAO/ ESA/ GWSP Workshop on

Earth Observations and the Water-Energy-Food Nexus

26 March 2014
Rome, Italy

CLEWS MODELLING OF THE NEXUS
DIVISION OF ENERGY SYSTEMS ANALYSIS (KTH-DESA)

Mark Howells, Director mark.howells@desa.kth. se
Lucia de Strasser, Researcher lucia.destrasser@desa.kth. se
Dimitris Mentis, Researcher dimitris.mentis@desa.kth. se

SPI – **S**TRATEGIC **P**OLICIES AND **I**NVESTMENTS

Globally there are key policy and investment levers required for development

- Renewables
- Energy security
- Energy efficiency
- Market design
- Investment portfolios etc.

Quantification of sustainable development and capacity building of stakeholders is a key goal

EUROPEAN COMMISSION
UNDESA
JISEA
SEI
IRENA
iea International Energy Agency
The World Bank

OSEMOSYS AND ENERGY PLANNING

OPEN TRANSPARENT POLICY SUPPORT

Developing a toolkit that anyone can have access to that allows basic planning, but can be used for the most sophisticated analysis

- All countries need economic investment tools for infrastructure
- Most are closed, expensive or limited
- OSeMOSYS is open, free and adaptable
- Used from the US to China to Africa
- For academic studies to investment appraisal

SEAP
SUSTAINABLE ENERGY FOR ALL PROGRAM

Article

Print Email Share Cite

Understanding the Scale of Investment for Universal Energy Access

Authors: Morgan Bazilian, United Nations Industrial Development Organization, Patrick Nussbaumer, United Nations Industrial Development Organization, Erik Haites, Margaree Consultants Inc., Michael A. Levi, David M. Rubenstein Senior Fellow for Energy and the Environment and Director of the Program on Energy Security and Climate Change, Mark Howells, International Energy Agency; KTH Royal Swedish Institute of Technology, and Kandeh K. Yumkella, United Nations Industrial Development Organization

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Article

Global Insights Based on the Multidimensional Energy Poverty Index (MEPI)

Patrick Nussbaumer [1,*], Francesco Fuso Nerini [2], Ijeoma Onyeji [3] and Mark Howells [2]

Access to energy is universally agreed as important. We provide insights into what that means, how to 'get there' and what it will cost…

- Defining and measuring energy poverty
- Quantifying the investment needed to address it
- Identifying the best techno-economic options
- Incorporating access into national strategies
- Identifying enabling environments
- Developing transferable toolkits

CLEWS DEVELOPMENT NEXUS
INTEGRATED CLIMATE LAND ENERGY AND WATER STRATEGIES

More than 20% of the world are without safe water, clean energy or nutritious food. Demand is growing and climate changes makes the poor more vulnerable. We:

- Help identify hotspots and risks
- Evaluate integrated water, food and energy security
- Find and quantify solutions
- At global, regional, national and city level
- Develop case studies, frameworks and tools

United Nations
Department of Economic and Social Affairs

FAO
FIAT PANIS

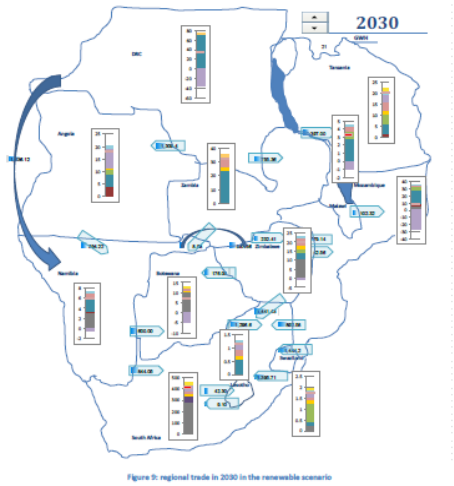
UNITED NATIONS
ECONOMIC COMMISSION FOR EUROPE

IIASA

SEI

IAEA

SPECIAL FOCUS: **AFRICA**



The continent has high resource potentials, high growth rates and low energy access levels. We focus on:

Mapping renewable energy potentials

Developing continent wide, regional and national electricity investment scenarios

Capacity building government, utility and universities

The World Bank

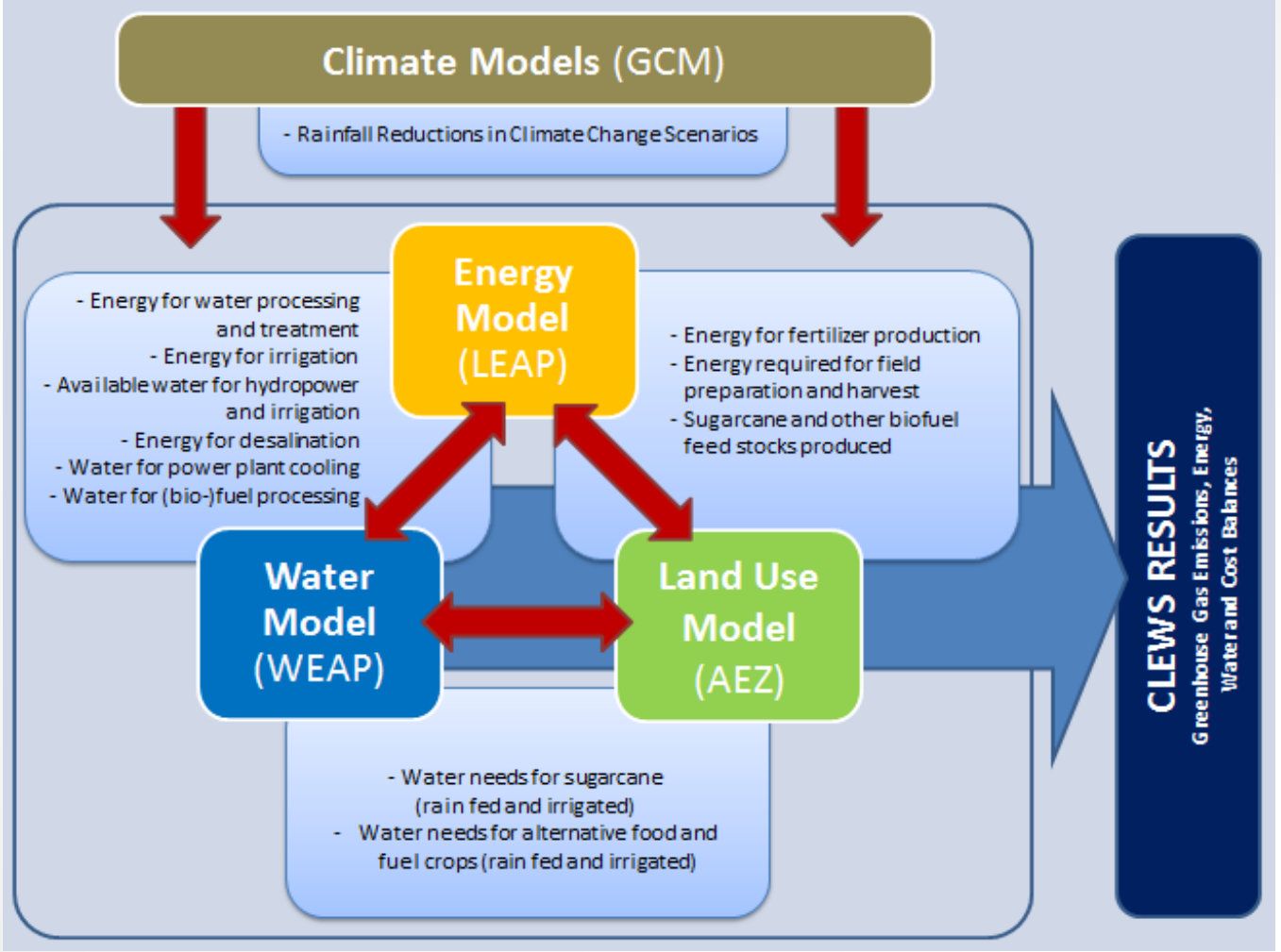
SEI STOCKHOLM ENVIRONMENT INSTITUTE US CENTER

CLIMATE, LAND-USE, ENERGY AND WATER SYSTEMS(CLEWS)

- Resources are constrained
- Climate, Land-use, Energy and Water Systems (CLEWS) can be highly interlinked
- Policy development may not recognise these linkages

Factors which indicate that a CLEWS approach might be valuable:

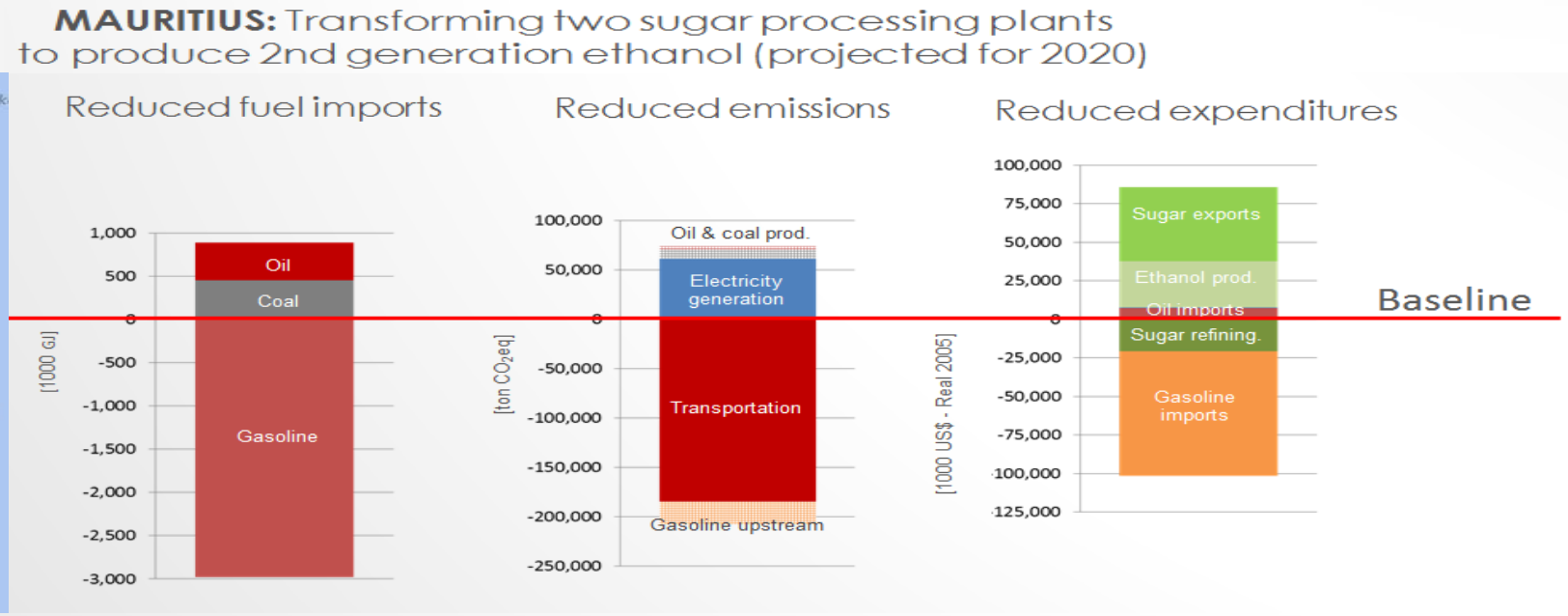
- Integrated policies with implications for multiple resource systems
- High shares of hydropower
- Climate change induced rainfall changes
- Conflicting water management priorities
- Holistic assessment of greenhouse gas emissions



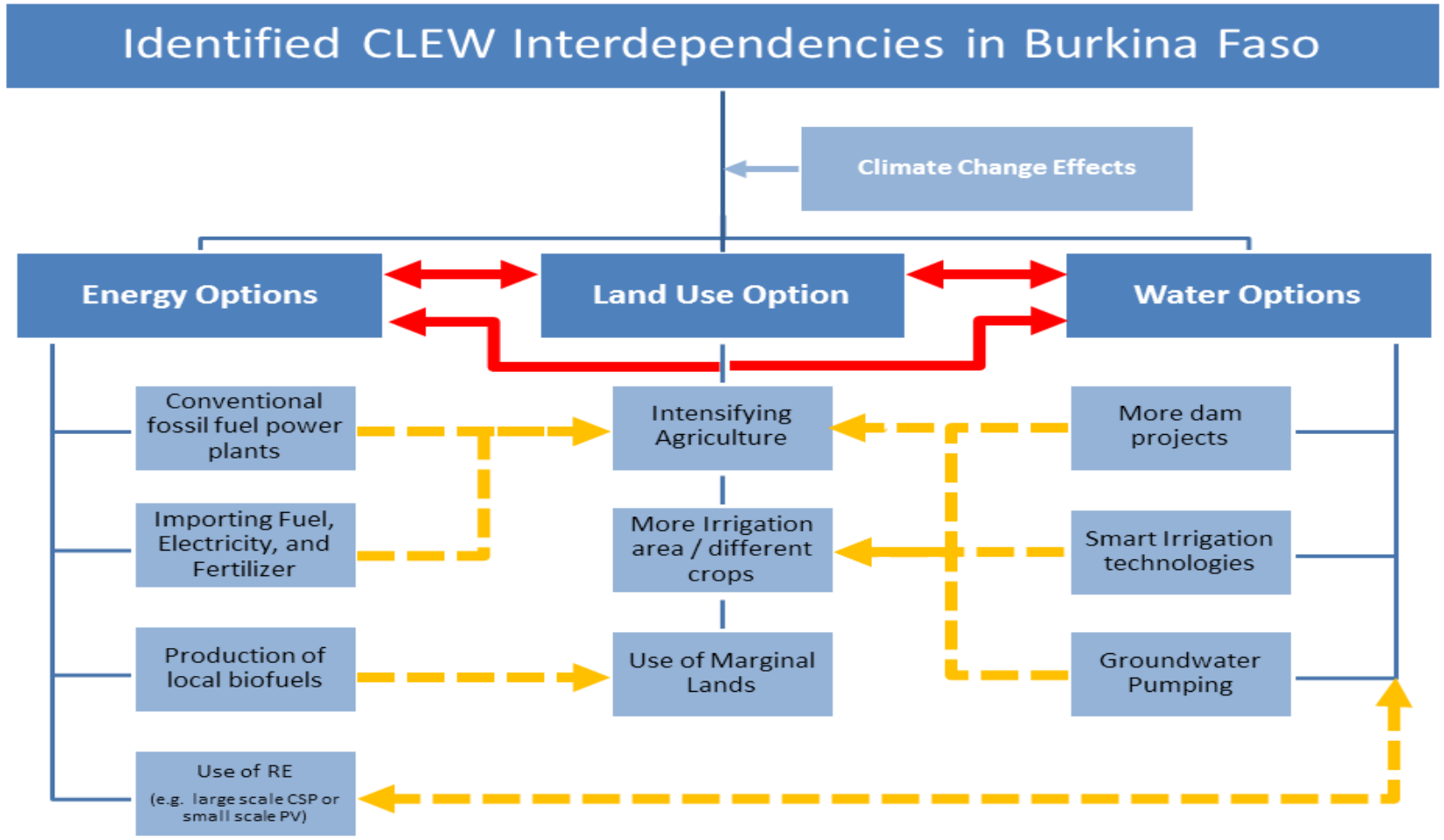
CLEWS CASE STUDIES (I) - MAURITIUS

Why:

- Producer and exporter of sugar (occupying 80% cultivated land area)
- EU decision in 2009 to cut guaranteed sugar import price by 36%
- Dependent on fuel imports (83%)
- Diverse climate, prone to climate change
- Integrated agricultural and energy policy

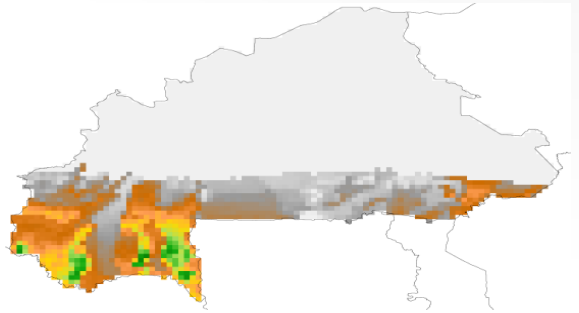


CLEWS CASE STUDIES (II) – BURKINA FASO

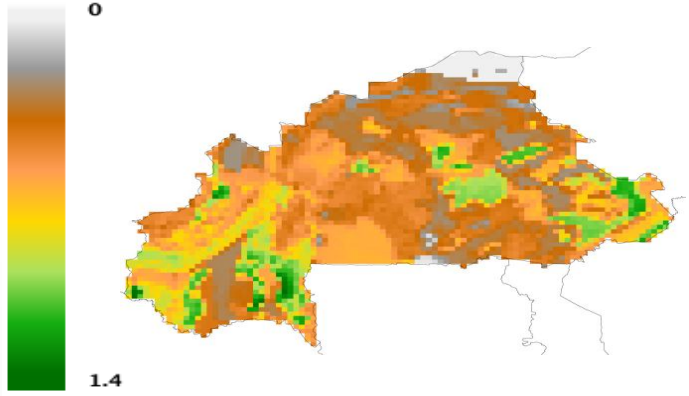


Introducing Jatropha

Rain-fed



Irrigation

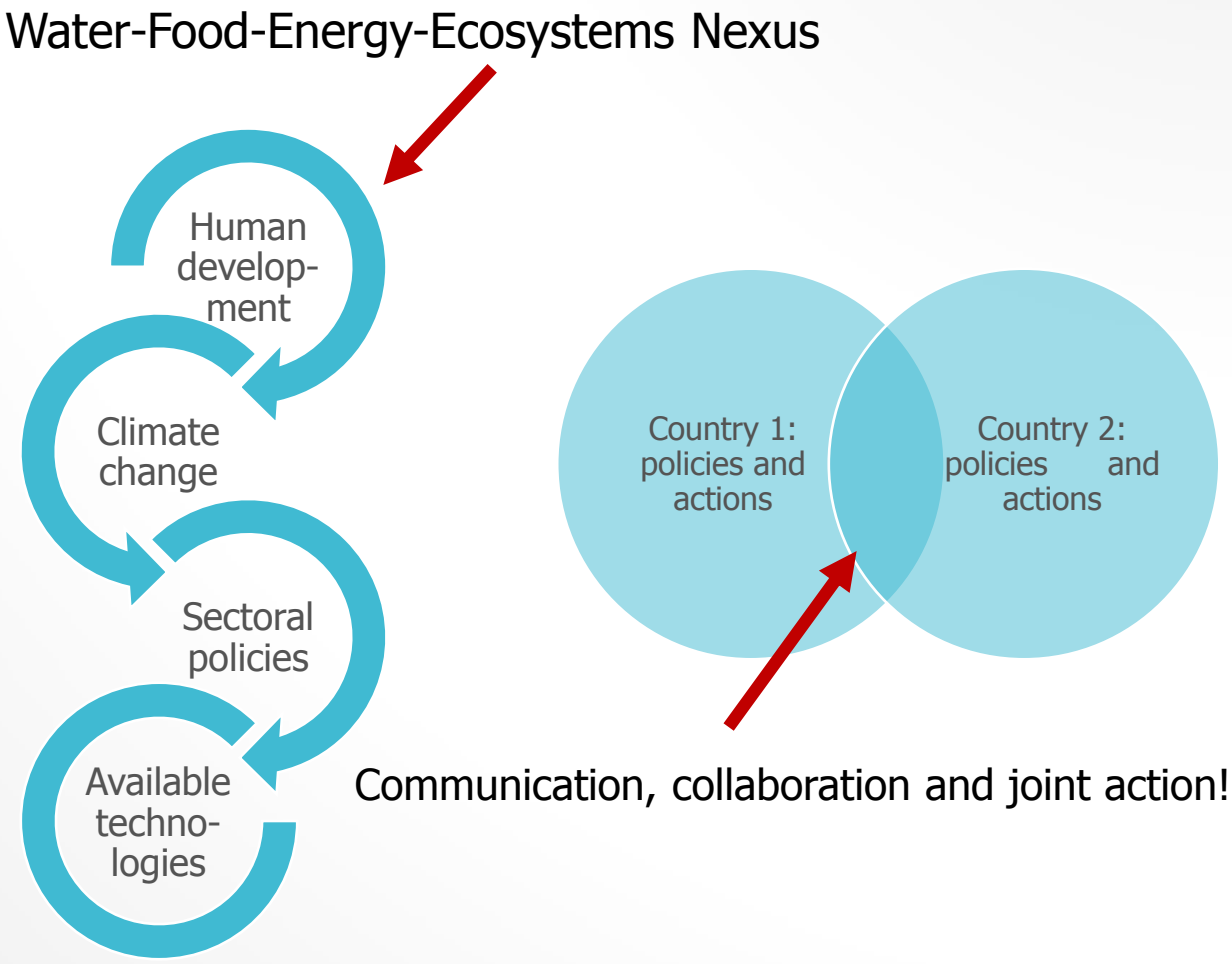


THE CLEW CHALLENGE FOR COMING DECADES

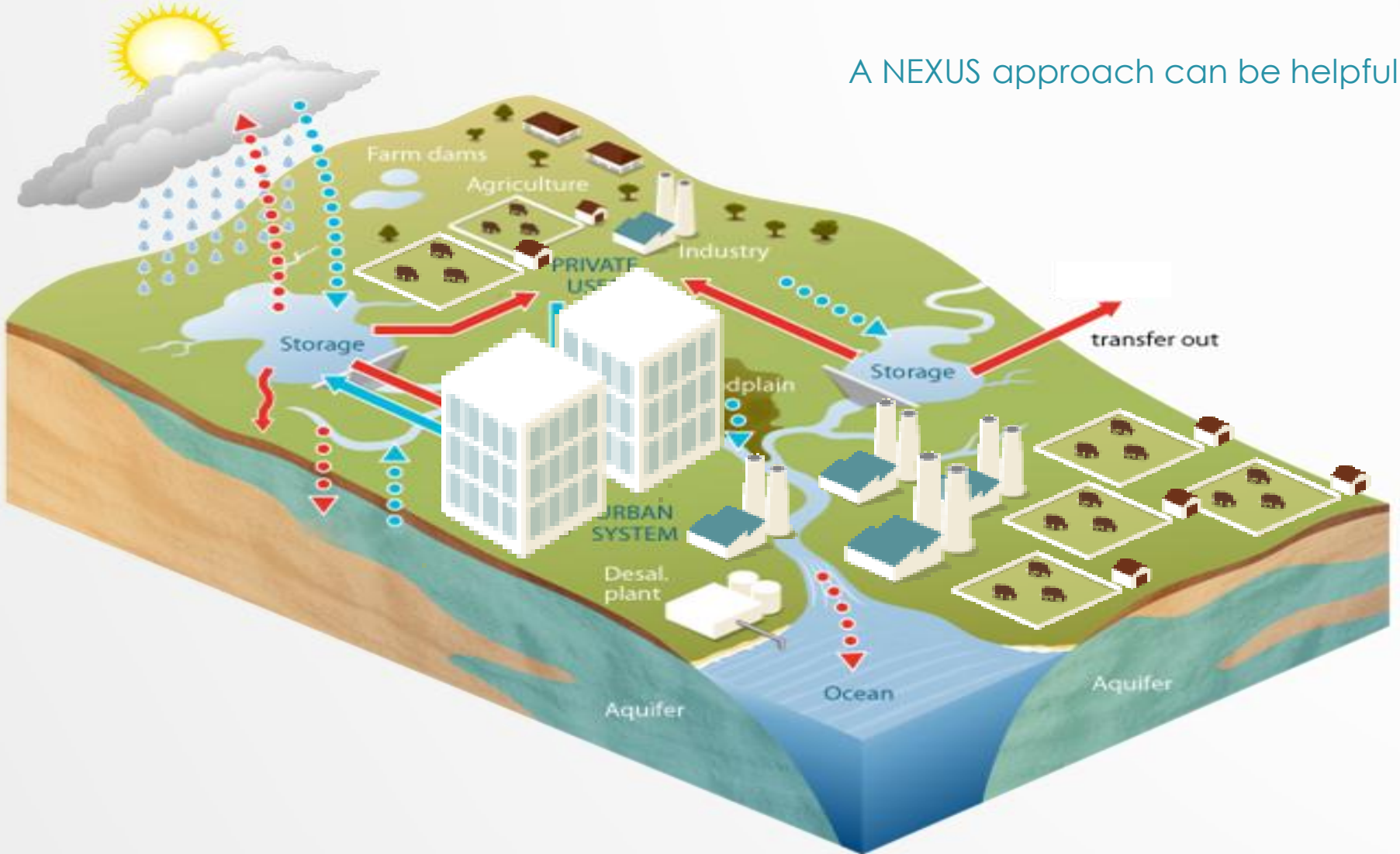
- Need for more "**crop per drop**" and more crop per hectare
- Produce **more energy** for a larger and more affluent population in a more sustainable manner.
- Adopt sustainable practices for supply of **more freshwater** and disposal of wastewater.
- Integrate the possible Effects of **Climate Change** into our planning.

THE UNECE PROJECT - NEXUS IN TRANSBOUNDARY BASINS

- UNECE Water Convention on the Protection and Use of Transboundary Watercourses and International Lakes
- Task Force on Water-Energy-Food-Ecosystems Nexus
- Selected basins (Alazani, Sava, NWSAS + Niger, Isonzo, Syr Darya)to be assessed until 2015



NEXUS CONNECTIONS ILLUSTRATED – DEVELOPING A STORY LINE



A NEXUS approach can be helpful and illustrative to develop future developments.

What happens with:

MORE AGRICULTURE

MORE INDUSTRY

BIGGER CITIES

???

NEXUS AND EARTH OBSERVATION DATA (1/6)

Earth Observation data are essential in the Nexus assessment in order to visualize potential nexus hotspots and carry out geospatial calculations (i.e. estimate deforestation figures and connect with fuel wood consumption)

Such data can be general

- Administrative country data (UNSALB)
- Roads (Natural Earth)
- Elevation (CGIAR-CSI GeoPortal)

Or more specific (related to **Nexus** components)

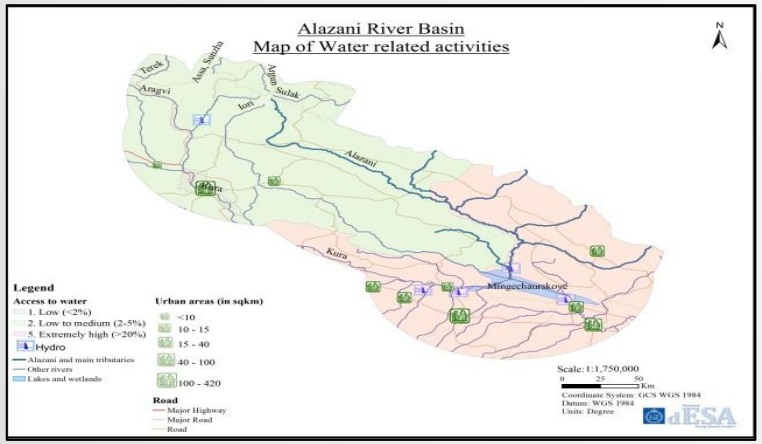
- Water
- Energy
- Land Use
- Ecosystems

NEXUS AND EARTH OBSERVATION DATA (2/6)

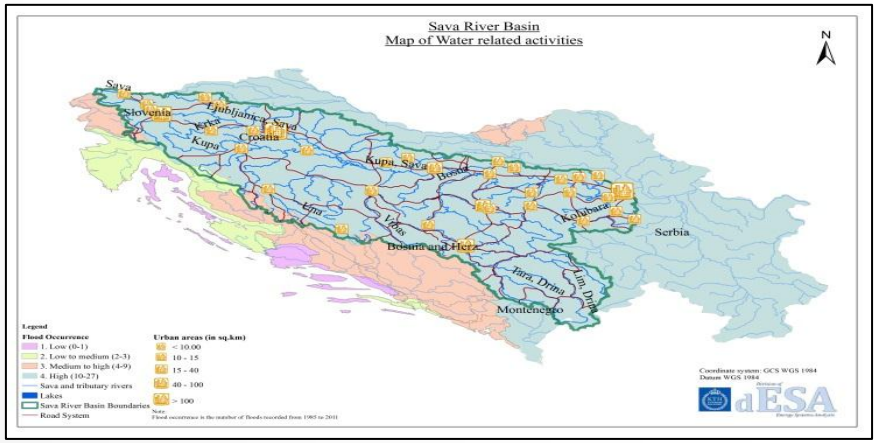
Data showing **Water** related activities

- Lakes and wetlands (Global Lakes and Wetlands Database)
- River catchments (European Environment Agency)
- Industrial Activities (Regional data)
- Urban areas (Global Rural-Urban Mapping Project, GRUMP)

Water related activities (Alazani)



Water related activities (Sava)

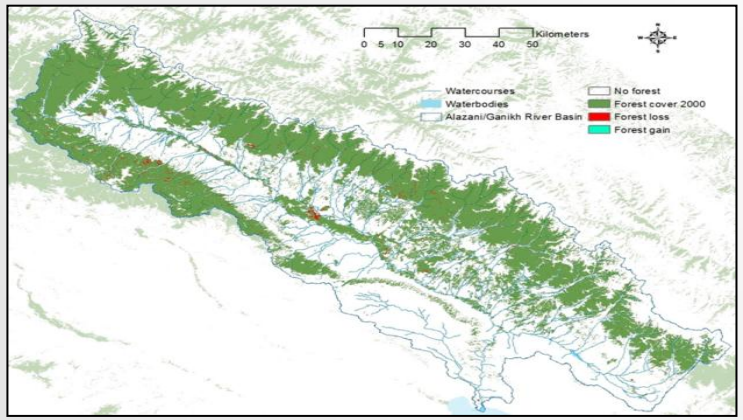


NEXUS AND EARTH OBSERVATION DATA (3/6)

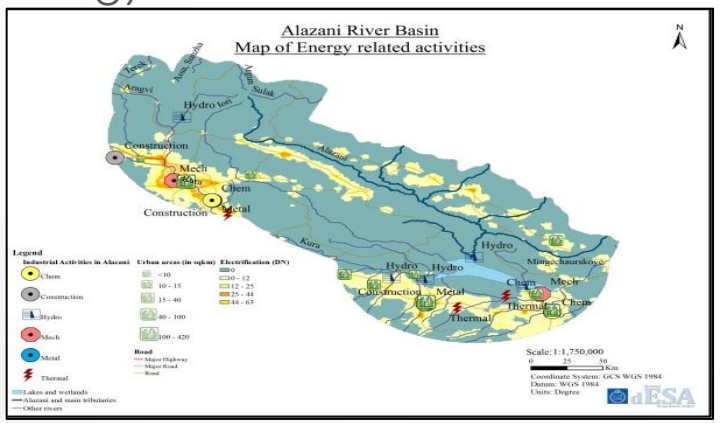
Data showing **Energy** related activities

- Industrial Activities
- Urban areas
- Deforestation/Reforestation(Global Forest change, Hansen et al.)
- Nighttime light (National Geophysical Datacenter)

Deforestation



Energy related activities



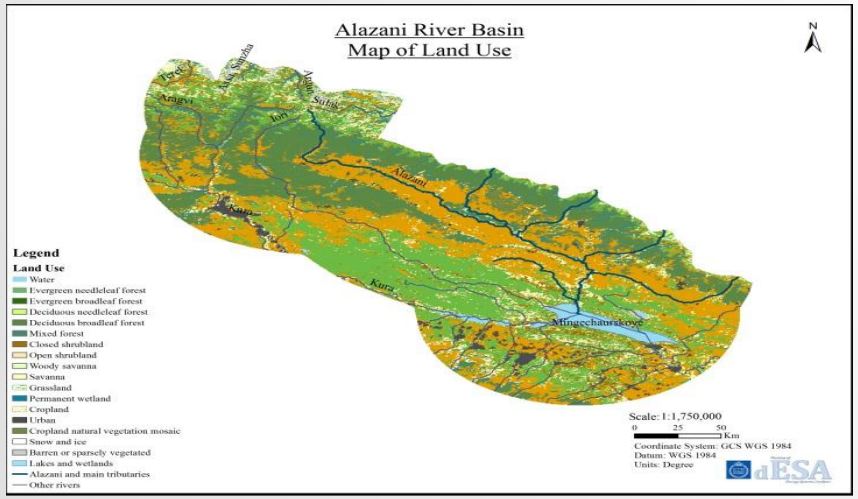
NEXUS AND EARTH OBSERVATION DATA (4/6)

Data showing **Land Use** related activities

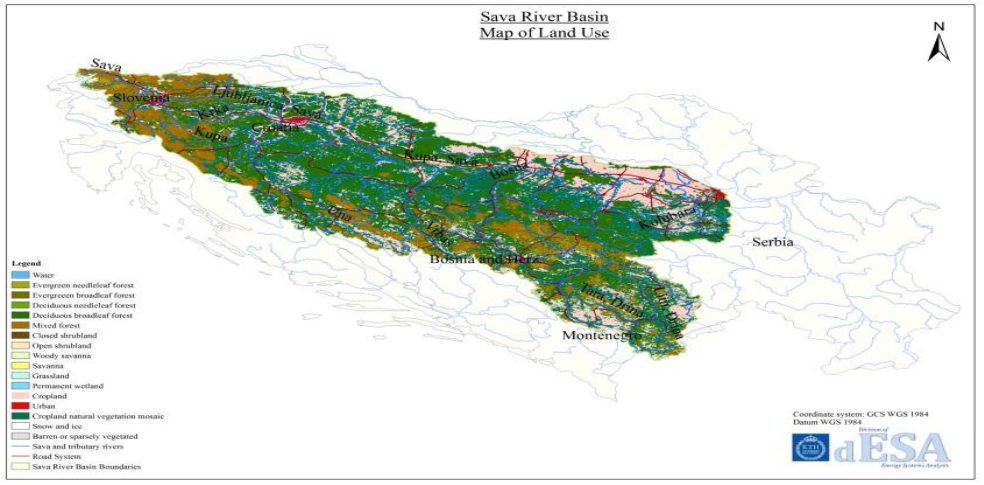
Land Use and Land cover data

Land cover data can be extracted from FAO's and JRC's databases

Land Use (Alazani)



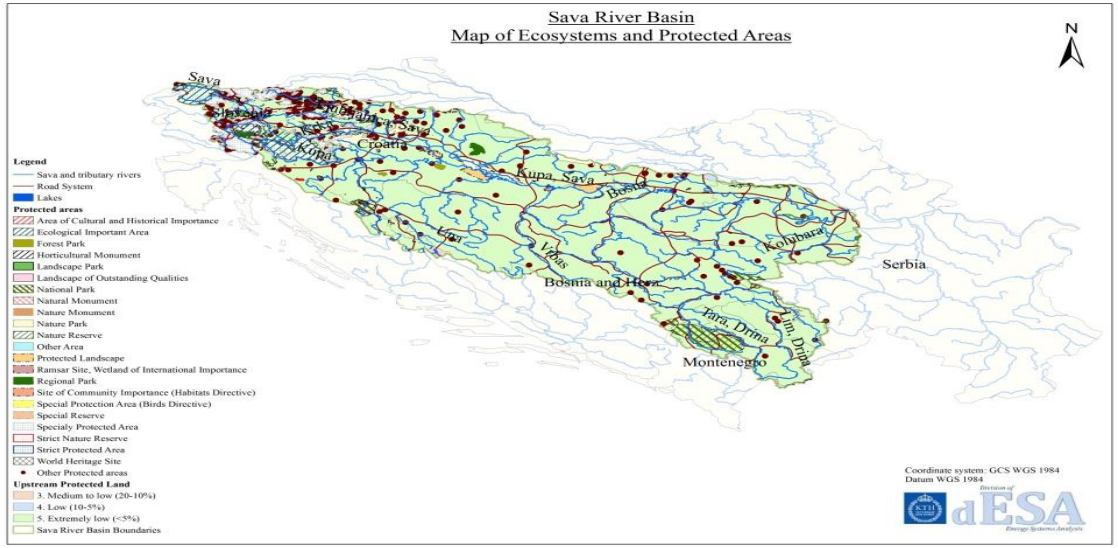
Land Use (Sava)



NEXUS AND EARTH OBSERVATION DATA (5/6)

Data showing **Ecosystem** related activities

- Protected areas and Ecosystems (World Database on Protected Areas)
- Access to water and upstream protected land (FAO, AQUEDUCT Global Maps)



NEXUS AND EARTH OBSERVATION DATA (6/6)

Main interest from the UNECE Water Convention's mandate point of view: joint or coordinated monitoring and assessment of transboundary waters (rivers, lakes, groundwaters) and effectiveness of measures taken to prevent, control and reduce transboundary impact

Challenges in assessing the status of transboundary waters

- application of harmonized approaches across the basin/by the different countries

- continuous data series over long periods of time

- use of consistent classifications

The value-added of RS (Water Convention)

- commonly a lack of **basin level** information

- for transboundary settings, **consistency** of RS data is an advantage

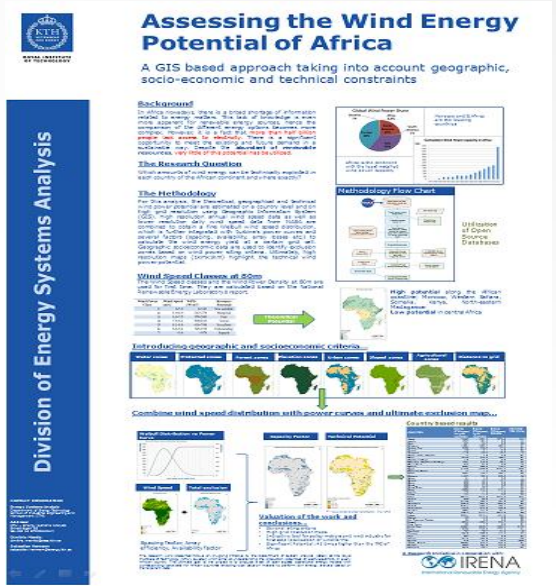
- RS also helps to **fill gaps** left by degradation of in situ monitoring networks experienced in the EECCA (especially for specific applications like monitoring glaciers and snow cover in Central Asia)

- in some geographical application areas of the nexus assessment, RS might be the **best available** source

CLEWS IN AFRICA

Renewable Energy Assessment in Africa

- Broad shortage of information on energy matters
- More than half billion people lack access to electricity
- Apparent lack of knowledge about RES
- Most endowed continent in RES
- Estimate the actual potential of the domestic energy sources (Solar, Biomass, Hydro power, Wind)
- Optimize the energy mixture considering RES
- Optimize the land use for RES
- Comply with strategies and legislation framework for RE planning
- Preserve protected and sensitive areas
- Consider infrastructure investments



A Research Initiative in cooperation with IRENA International Renewable Energy Agency

Detailed RES resource mapping → Geographical and Socio-economic constraints → Technical possibilities and constraints → Technically and economically feasible RE potential

High resolution maps and relatively small scale RE potentials throughout Africa

MEET THE KTH ENERGY SYSTEMS ANALYSIS TEAM

Professors:

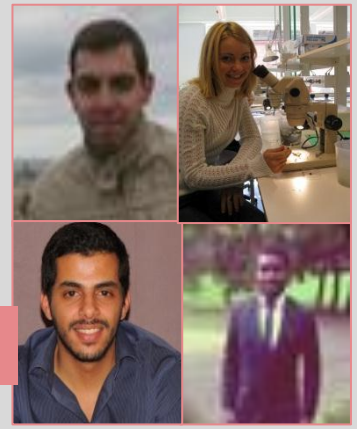

M Howells


M Bazilian


H Rogner

The **S**ustainable **E**nergy **F**or **A**ll **P**rogram **SEAP**

The **O**pen **S**ource **E**nergy **M**odeling **S**ystem **OSeMOSYS**

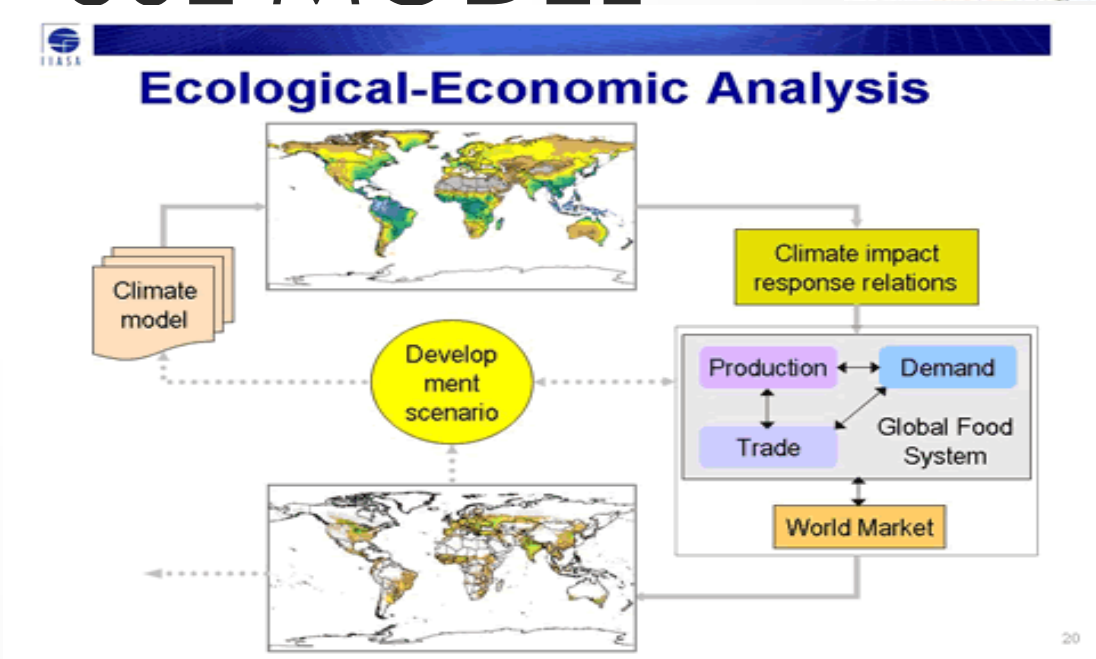


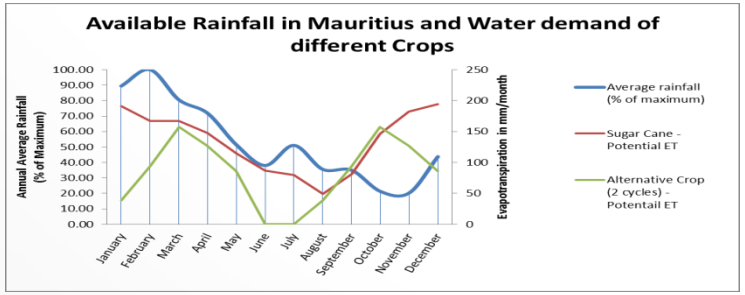
SPI **S**trategic **P**olicies and **I**nvestments

CLEWs **C**limate **L**and **E**nergy **W**ater **s**trategies

AEZ - THE LAND-USE MODEL

- Input:
  - Climatic Data
  - Detailed soil map and data from soil profils
  - Slopes and marginal land
  - GIS data for landcover
  - Irrigated areas
- Output:
  - Grid map of Mauritius show optimal crops, potential water use, and potential yield, plus crop calendar





NEXUS CONNECTIONS ILLUSTRATED – DEVELOPING A STORY LINE

Geographical Data **+ Land Use** **+ Protected Land** **+ Industries**