Water–Energy–Food (WEF) Nexus Tool 2.0

Guiding Integrative Resource Planning and Decision Making

(B.T. Daher & R.H. Mohtar, 2015)

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Gap?

Decision makers do not have access to comprehensive tools that:

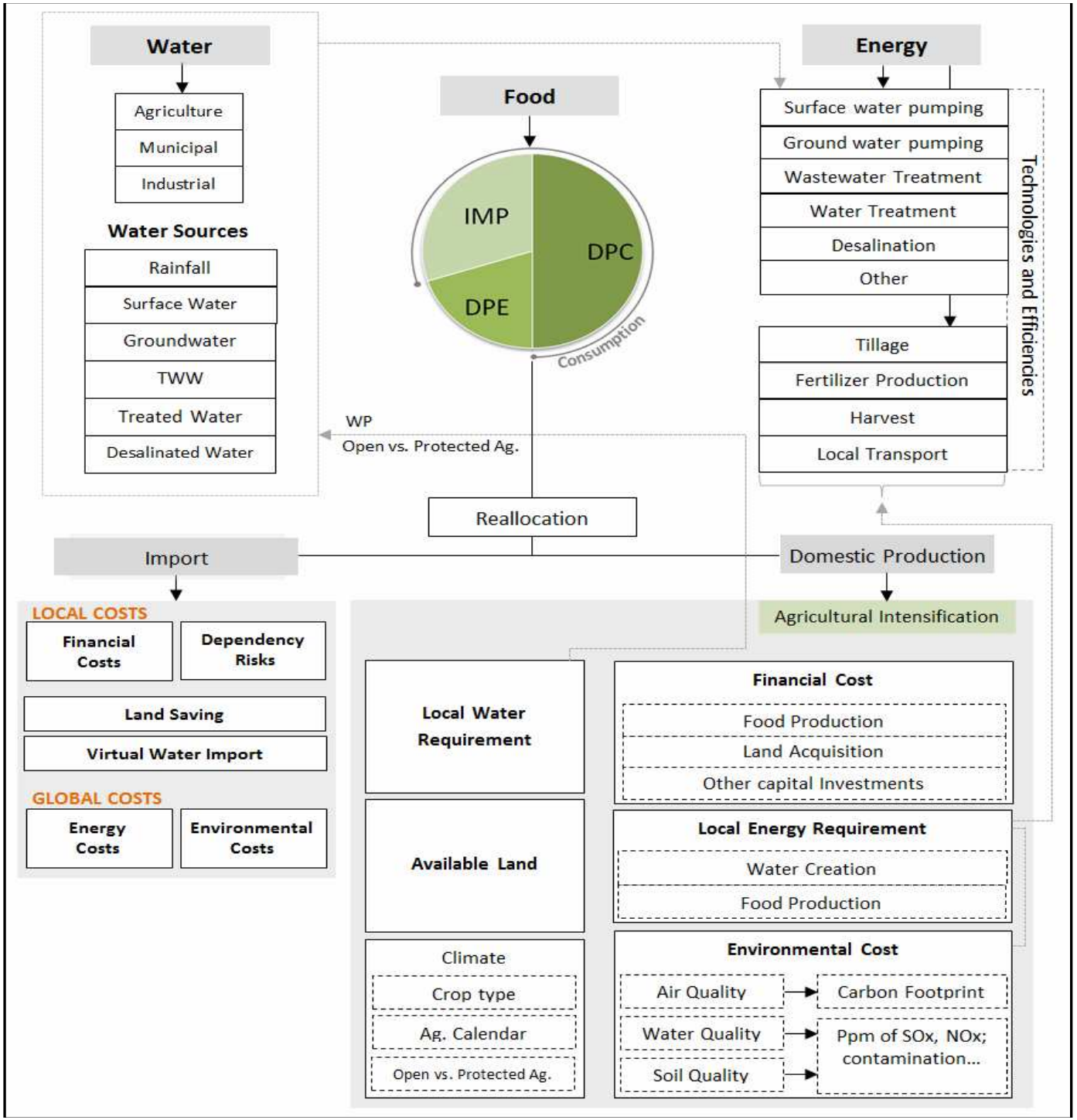
1. **Are inclusive and multi-scale**
2. **Define** and **quantify** interconnectivity between water, energy, and food
3. **Support** development of an **integrative strategy** for **holistic management** and planning for the future of these resources

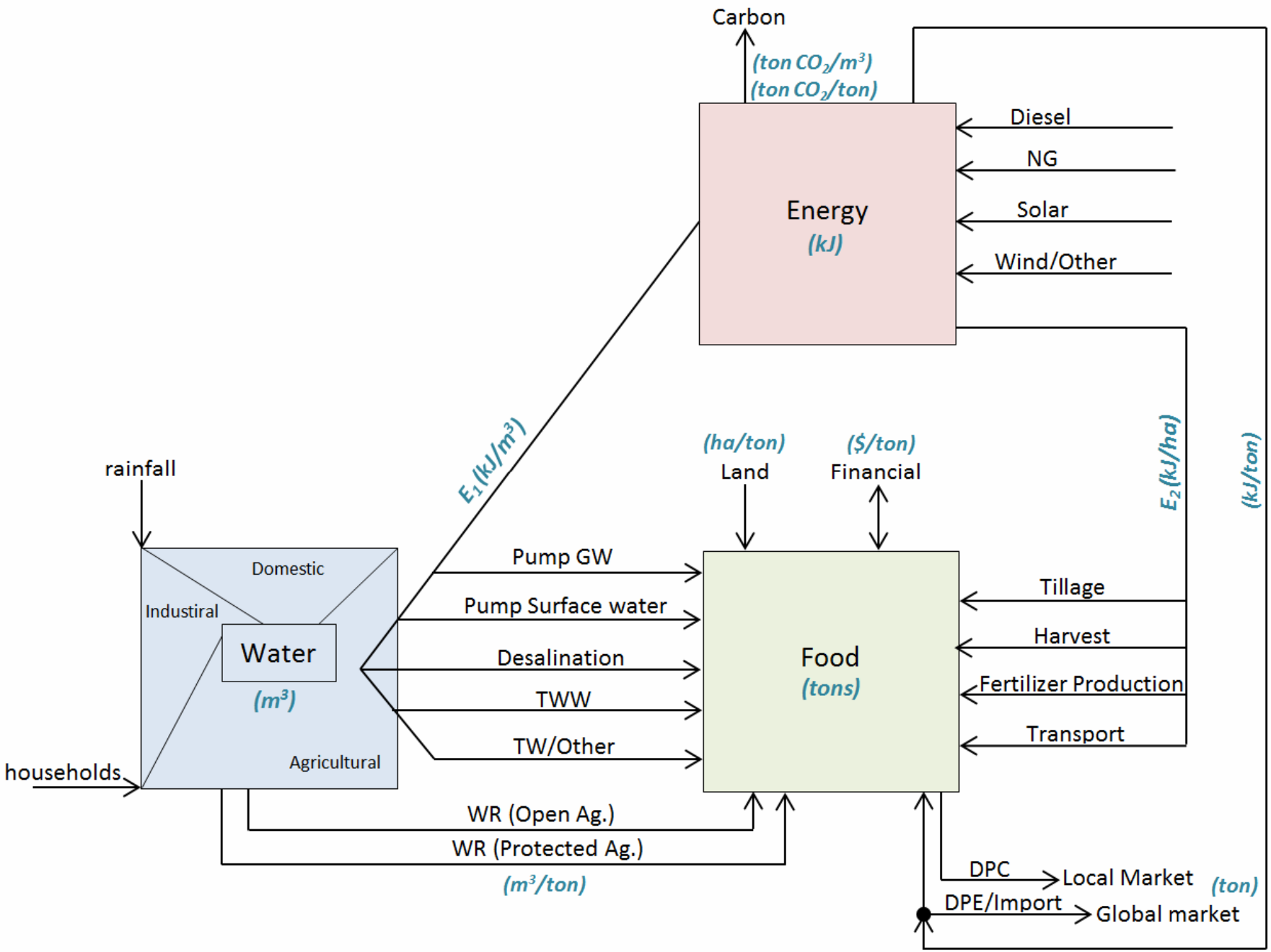
Objectives

- **Present** a **scenario-based framework** that offers an **explicit quantification** of the existent **interlinkages** between water, energy, and food systems.

- **Present** and **evaluate** assessment tool corresponding to developed framework.

- **Demonstrate the tool's utility** in supporting decision making in **food security** case study in **Qatar**.


Water
Agriculture
Municipal
Industrial
Water Sources
Rainfall
Surface Water
Groundwater
TWW
Treated Water
Desalinated Water
Food
IMP
DPC
DPE
Consumption
Energy
Surface water pumping
Ground water pumping
Wastewater Treatment
Water Treatment
Desalination
Other
Tillage
Fertilizer Production
Harvest
Local Transport
Technologies and Efficiencies
WP
Open vs. Protected Ag.
Reallocation
Import
LOCAL COSTS
Financial Costs
Dependency Risks
Land Saving
Virtual Water Import
GLOBAL COSTS
Energy Costs
Environmental Costs
Domestic Production
Agricultural Intensification
Local Water Requirement
Available Land
Climate
Crop type
Ag. Calendar
Open vs. Protected Ag.
Financial Cost
Food Production
Land Acquisition
Other capital Investments
Local Energy Requirement
Water Creation
Food Production
Environmental Cost
Air Quality
Water Quality
Soil Quality
Carbon Footprint
Ppm of SOx, NOx; contamination...

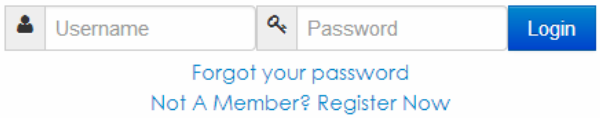

Carbon
(ton CO_2/m^3)
(ton CO_2/ton)
Energy
(kJ)
Diesel
NG
Solar
Wind/Other
E_1(kJ/m^3)
E_2(kJ/ha)
(kJ/ton)
(ha/ton)
Land
($/ton)
Financial
rainfall
Domestic
Industiral
Water
(m^3)
Agricultural
households
Pump GW
Pump Surface water
Desalination
TWW
TW/Other
Food
(tons)
Tillage
Harvest
Fertilizer Production
Transport
WR (Open Ag.)
WR (Protected Ag.)
(m^3/ton)
DPC
Local Market
(ton)
DPE/Import
Global market

WEF NEXUS TOOL 2.0

wefnexustool.org

WEF Nexus Tool 2.0

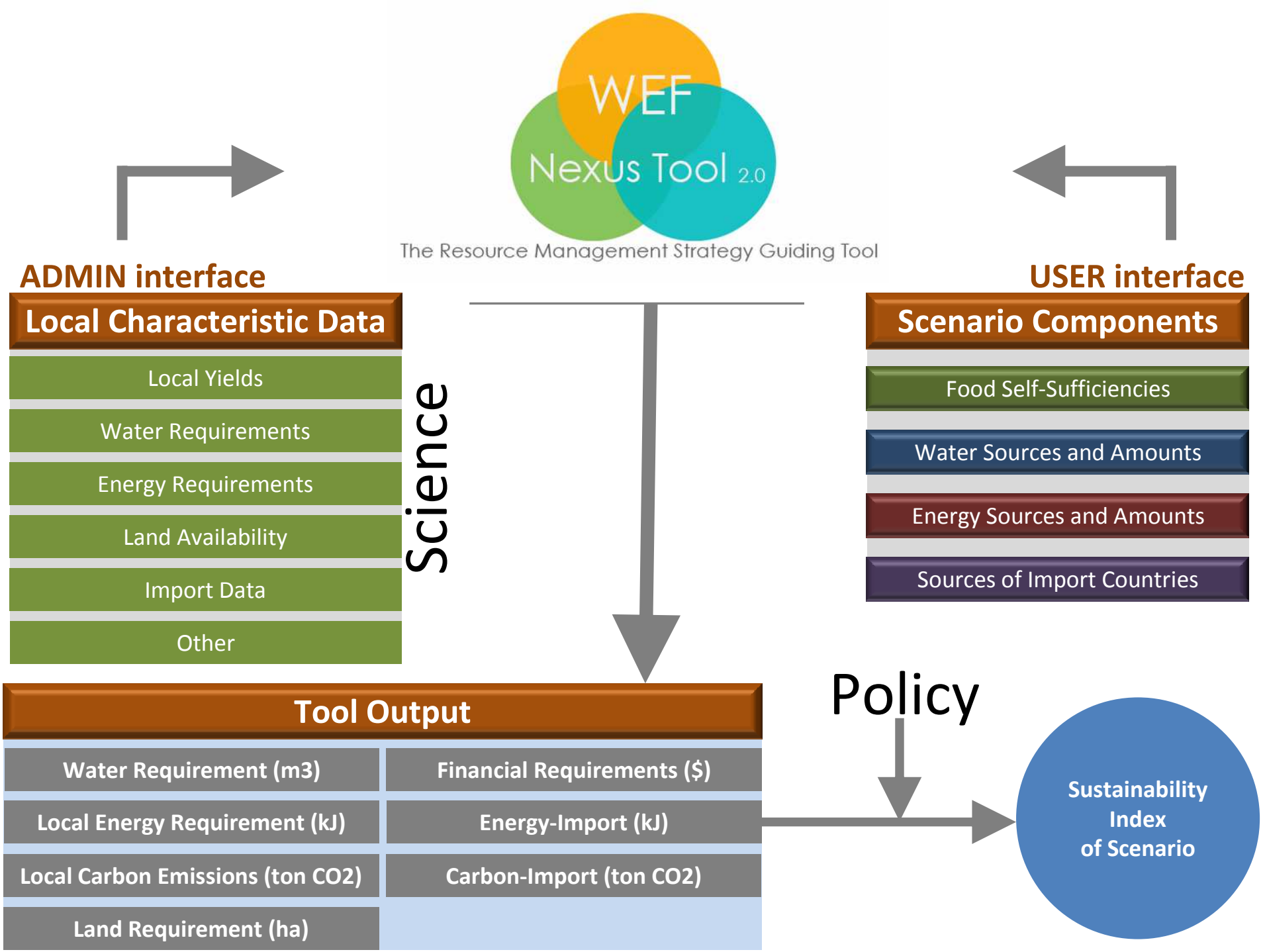
The Resource Management Strategy Guiding Tool



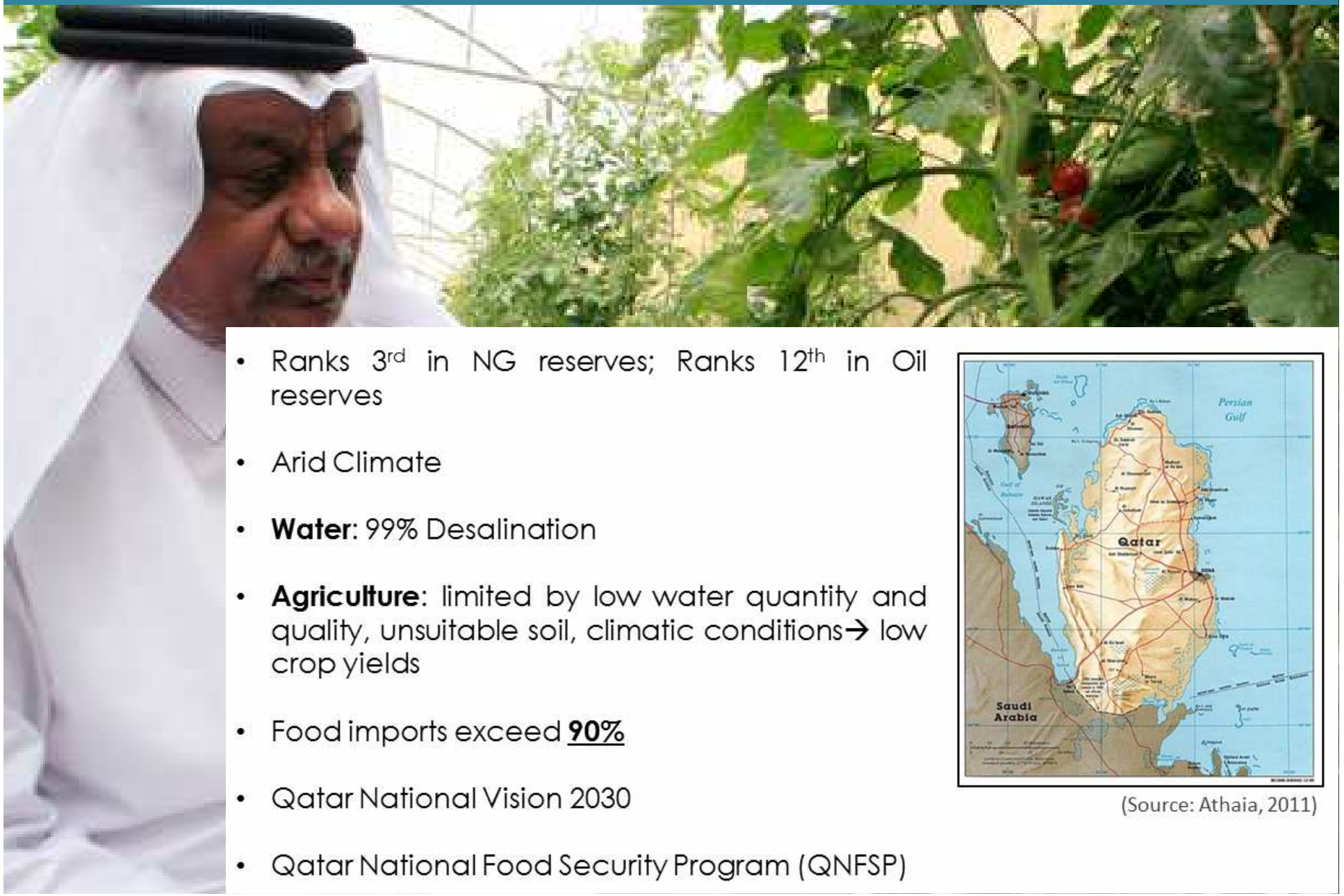
background | key concepts | about us | contact us | what's new

For more information

wefnexus.tamu.edu


WEF
Nexus Tool 2.0
The Resource Management Strategy Guiding Tool
ADMIN interface
USER interface
Local Characteristic Data
Local Yields
Water Requirements
Energy Requirements
Land Availability
Import Data
Other
Science
Scenario Components
Food Self-Sufficiencies
Water Sources and Amounts
Energy Sources and Amounts
Sources of Import Countries
Tool Output
Water Requirement (m3)
Financial Requirements ($)
Local Energy Requirement (kJ)
Energy-Import (kJ)
Local Carbon Emissions (ton CO2)
Carbon-Import (ton CO2)
Land Requirement (ha)
Policy
Sustainability Index of Scenario

Case Study: Qatar Food Security

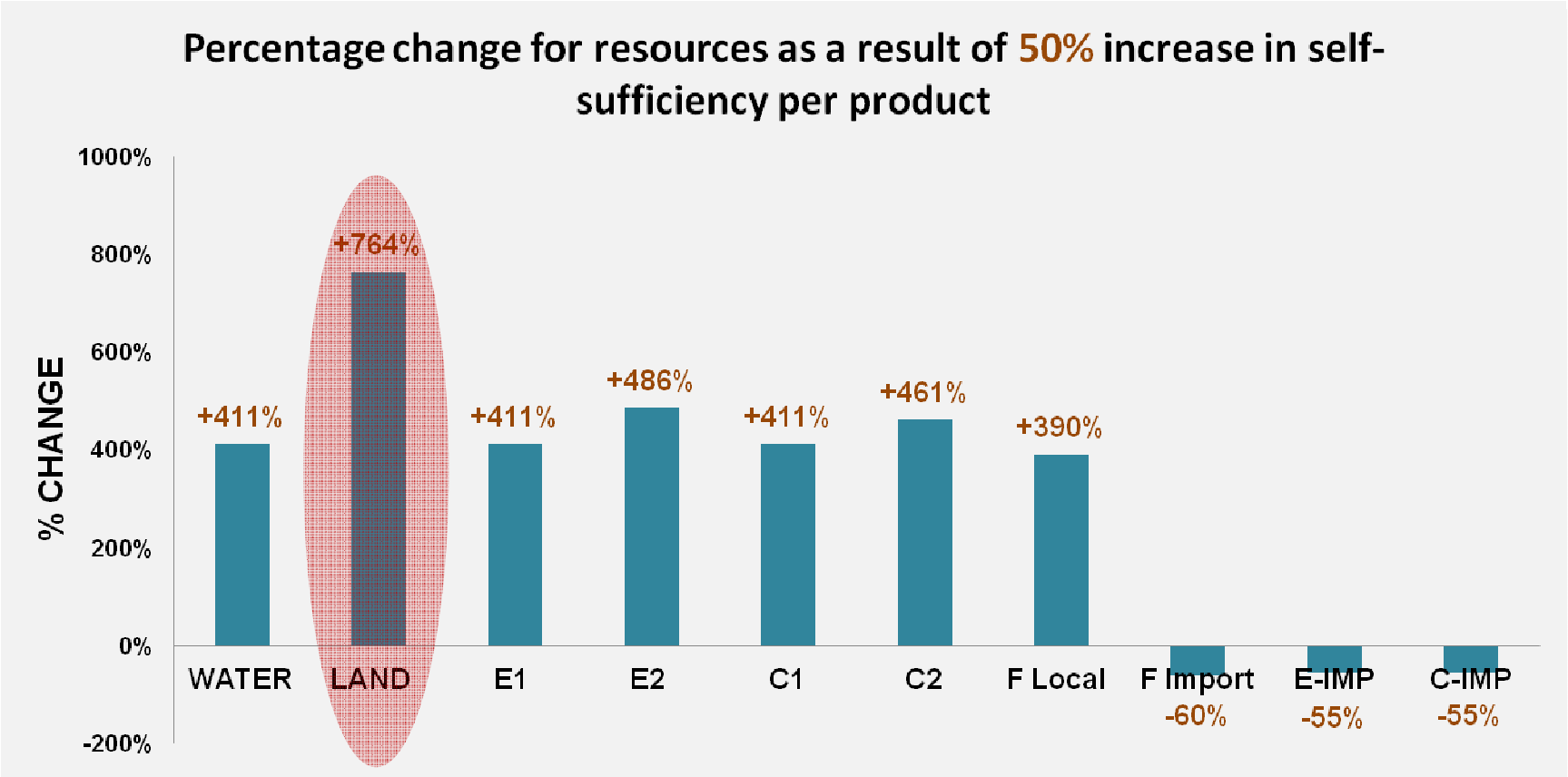


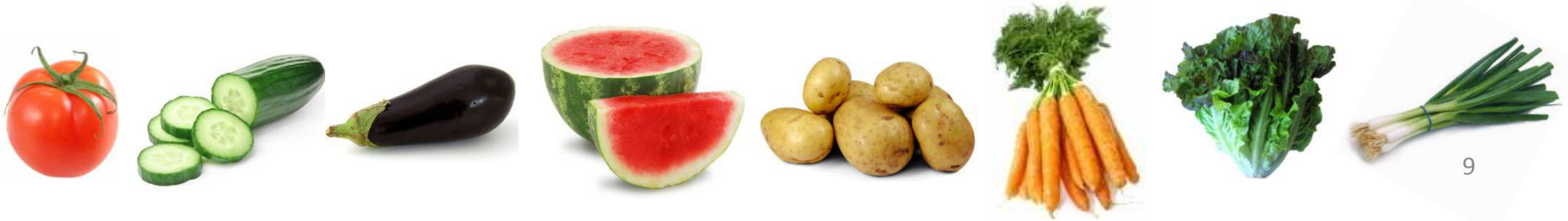
- Ranks 3rd in NG reserves; Ranks 12th in Oil reserves
- Arid Climate
- **Water**: 99% Desalination
- **Agriculture**: limited by low water quantity and quality, unsuitable soil, climatic conditions→ low crop yields
- Food imports exceed **<u>90%</u>**
- Qatar National Vision 2030
- Qatar National Food Security Program (QNFSP)

(Source: Athaia, 2011)

Discussions

Hypothetical Scenario





Discussions

Based on preliminary projections of the study sample in Qatar:

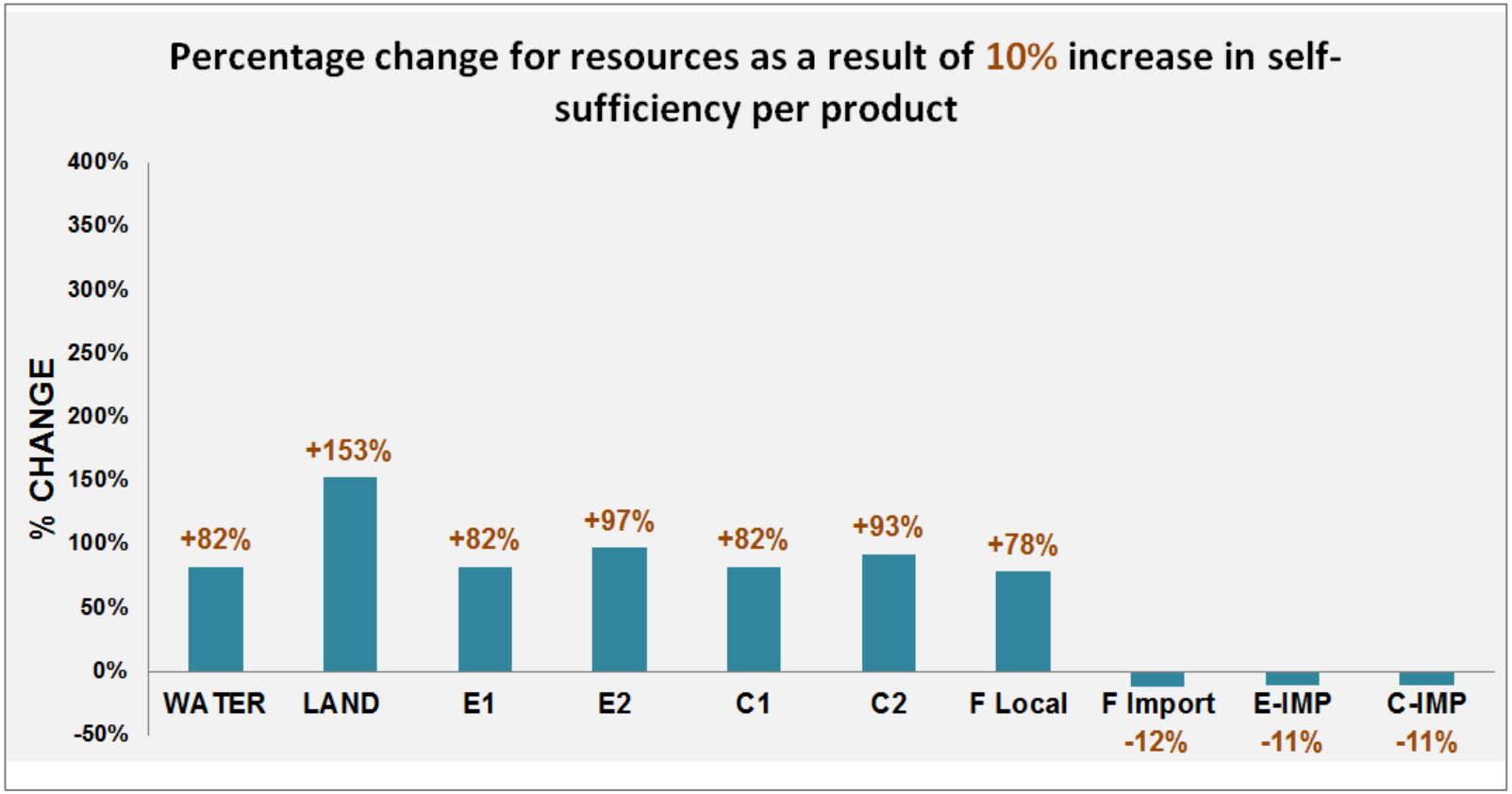
•**Land** is the most sensitive resource requirement
- invest in research and consolidate efforts towards improving local yields
- detailed soil suitability mapping for potential food products
- investigate different food growing technologies

•**Food production energy and carbon footprint (E_2, C_2)**
- invest in less carbon emitting machinery
- control over energy consumption during the food growing phases

• **Water, Energy for water, and respective carbon footprint (W, E_1, C_1)**
- Relying on groundwater for irrigation is catastrophic/use other sources
- less water demanding technologies/ new irrigation techniques
- invest in less energy demanding technologies
- explore potential of renewables to fuel these water sufficing technologies

Discussions

- Most **sensitive** does not mean most **critical**!



Remarks

- **Research Limitations**:
  - data unavailability
  - absence of locally measured data
  - confidentiality of present data

- **Potential improvements** to tool:
  - water quality & water degradation
  - soil quality & soil degradation
  - improve financial assessment
  - quantify risk for scenarios
  - projection models

Conclusions

- **NO** one-size-fits-all tool
- **Need to identify the critical question** and prescribe proper tool
- Different tools answer **different questions** at **different scales**, requiring **different data resolution**, involving **different stakeholders**
- Choice of tool will depends on the **output** needed and **resources** and **time** available


Thank You