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# INTRODUCTION TO THE WATER-ENERGY-FOOD SECURITY (WEF) NEXUS

# Outline

- Importance of the Nexus
- Concepts of water, energy and food security
- Interconnections: Trade-offs and competition, resources use efficiency, synergies
- The WEF Nexus approach
- WEF Nexus challenges: case study
- Questions

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# INTRODUCTION TO THE WATER-ENERGY-FOOD NEXUS

## Explaining the concept

# Why are Water Energy Food (WEF) securities important?

## Present

**Unmet demands!**

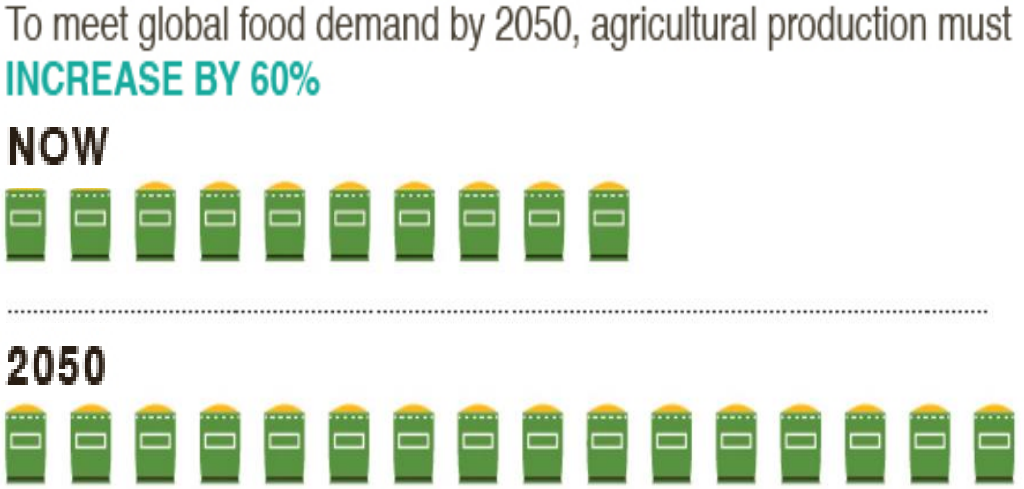
- 0.9 billion people have no access to clean water
- 1.1 billion people have no access to electricity
- 1 billion people have insufficient food supply

## Future

**Increasing demands!**

- Due to population growth, economic development and changing consumption patterns
- The uncertainties of global change exacerbate the difficulty in achieving these goals






UNDESA, 2014; CCAFS, n.d.

# Water, Energy and Food Security: pillars of development

- All communities strive to achieve water, energy, and food security
- Actions to achieve this may take place at local, national and global level
- Achieving each of these securities requires resources and may have negative impacts on other resources!

**The WEF Nexus means that the three sectors are inextricably linked, and that actions in one area have impacts in one or both of the others.**

**A Nexus approach aims to reduce trade-offs and enhance the efficiency of the entire system through synergies**

UNU, 2013

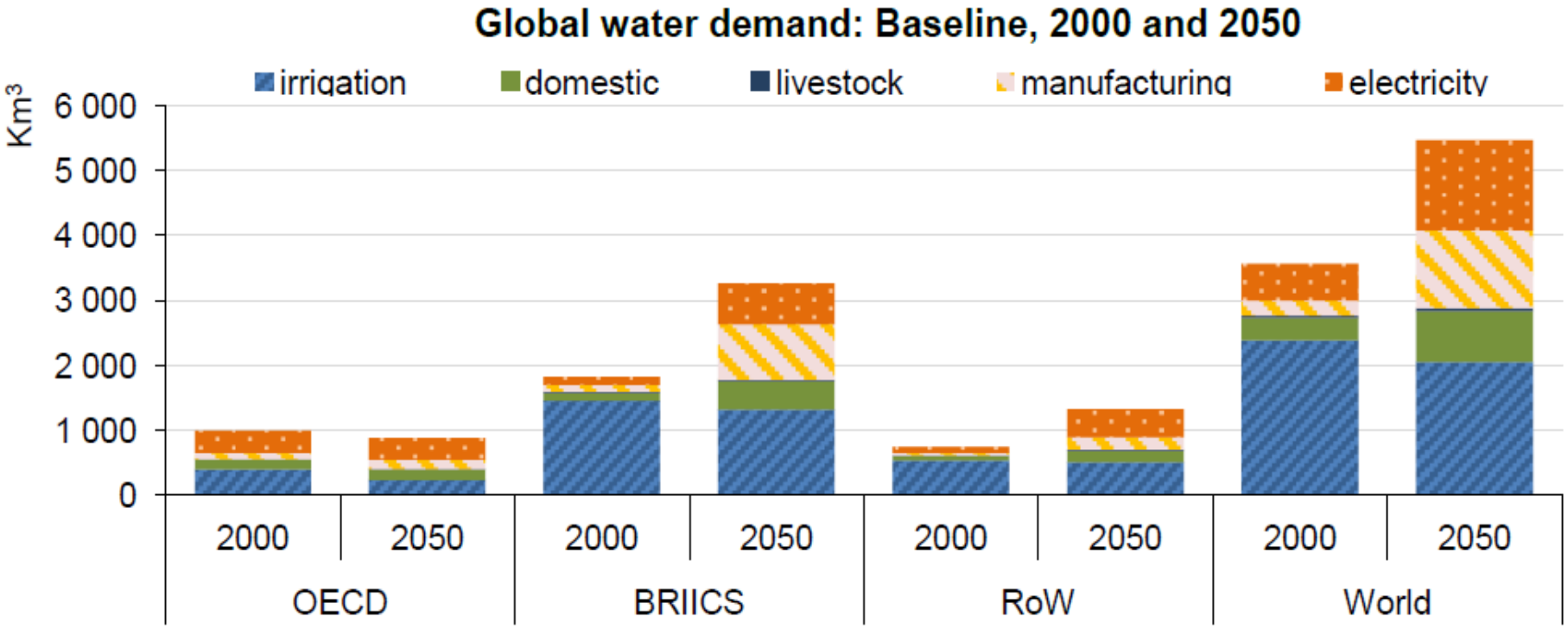
# Interconnections across Core Nexus Sectors

| | |
|---|---|
| **Water/Energy** | **Food (Land)/Energy** |
| **Water/Food (Land)** | **Energy/Water/Food (Land)** |


Treatment Plant

# Interdependency between Water, Energy and Food

Global water demand is expected to increase significantly in the coming decades, especially for domestic, industrial and energy production purposes




- OECD: Countries of the Organisation for Economic Co-operation and Development
- BRIICS: Brazil, Russia, India, Indonesia, China and South Africa
- RoW: Rest of world

OECD, 2012

# Relationships between Water and Energy

## Water and energy are interconnected.

Water and energy are interlinked in two ways:

1. **WATER** is used in the production of nearly all types of **ENERGY**

   (coal, geothermal, hydro, oil and gas, nuclear)

1. **ENERGY** is the **dominant** cost factor in the provision of **WATER** and wastewater services (extracting and conveying water, treating water, distributing water, using water and collecting and treating wastewater).

Energy can account for up to 30% of total operating costs of water and waste water utilities.

On average 15% of the world's total water withdrawals are used for energy production

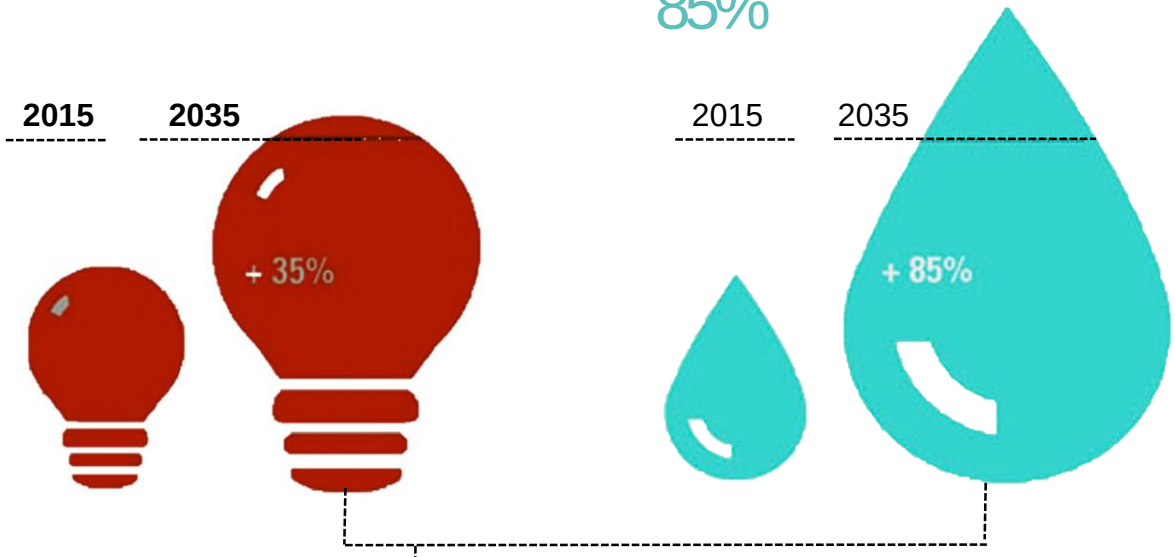
# Relationships between Water and Energy

By 2035,
energy consumption
will increase by

35%

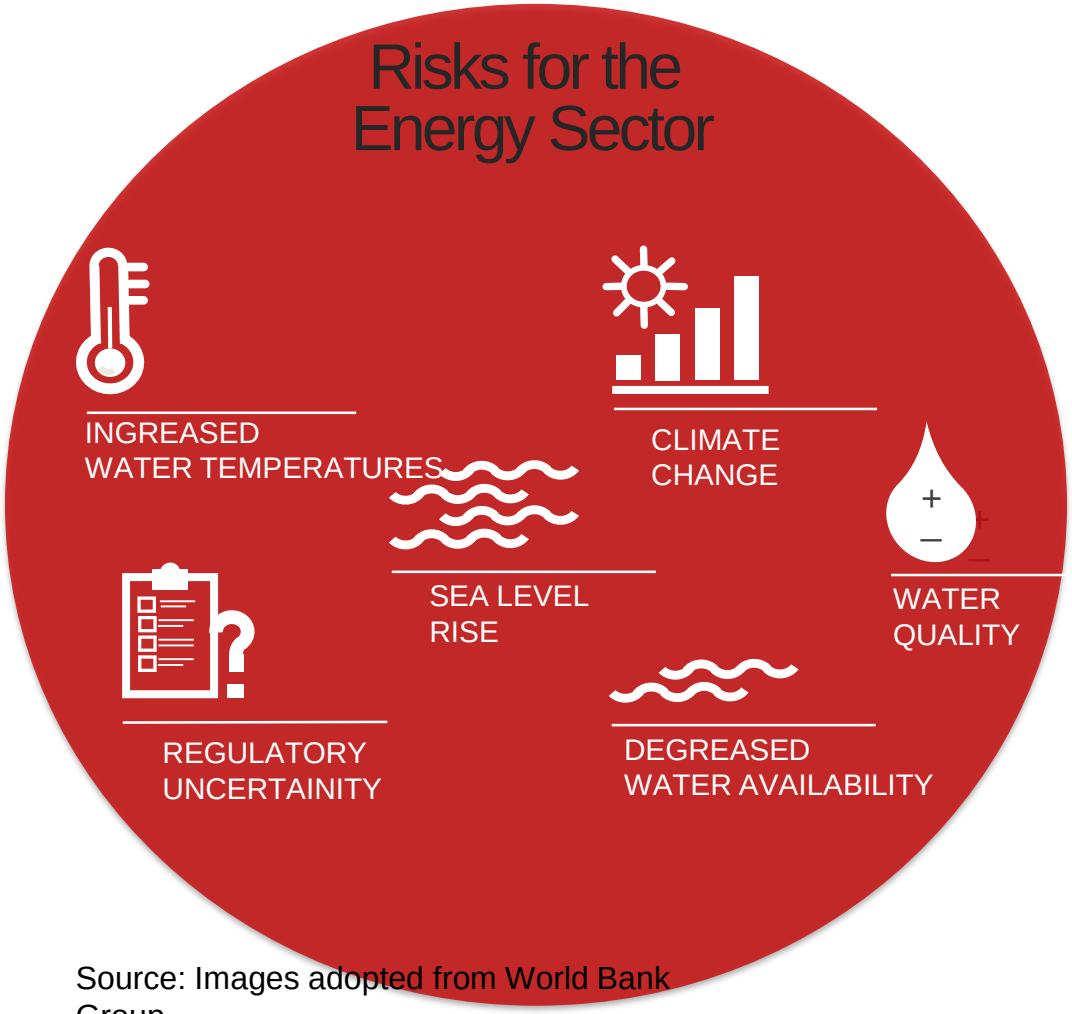
which
will increase
water consumption by

85%




Source: IEA 2012, adopted from World Bank Group

# Relationships between Water and Energy




## Impacts

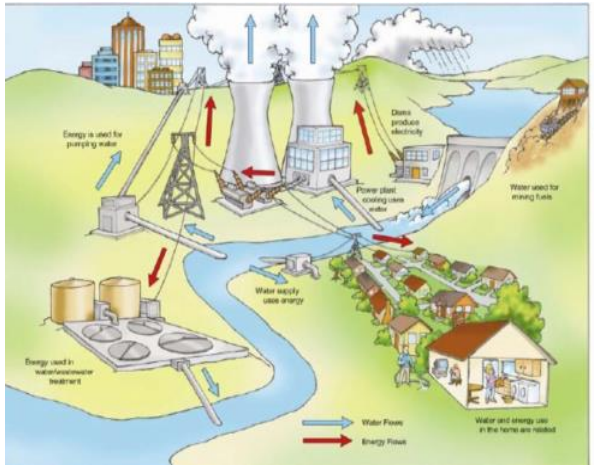
- Power plants shut down or degreased Power generation
- Hydropower capacity decreased
- Permits to locate power plants or extraction facilities denied
- Financial losses
- **Social and political instability**

Source: Images adopted from World Bank Group

# Single-mindedly pursuing individual goals may interfere with other goals

**Example: Increasing electricity production**

- Higher energy security
- More abstraction of water for cooling
- Less water for other sectors and the environment
- Less water security

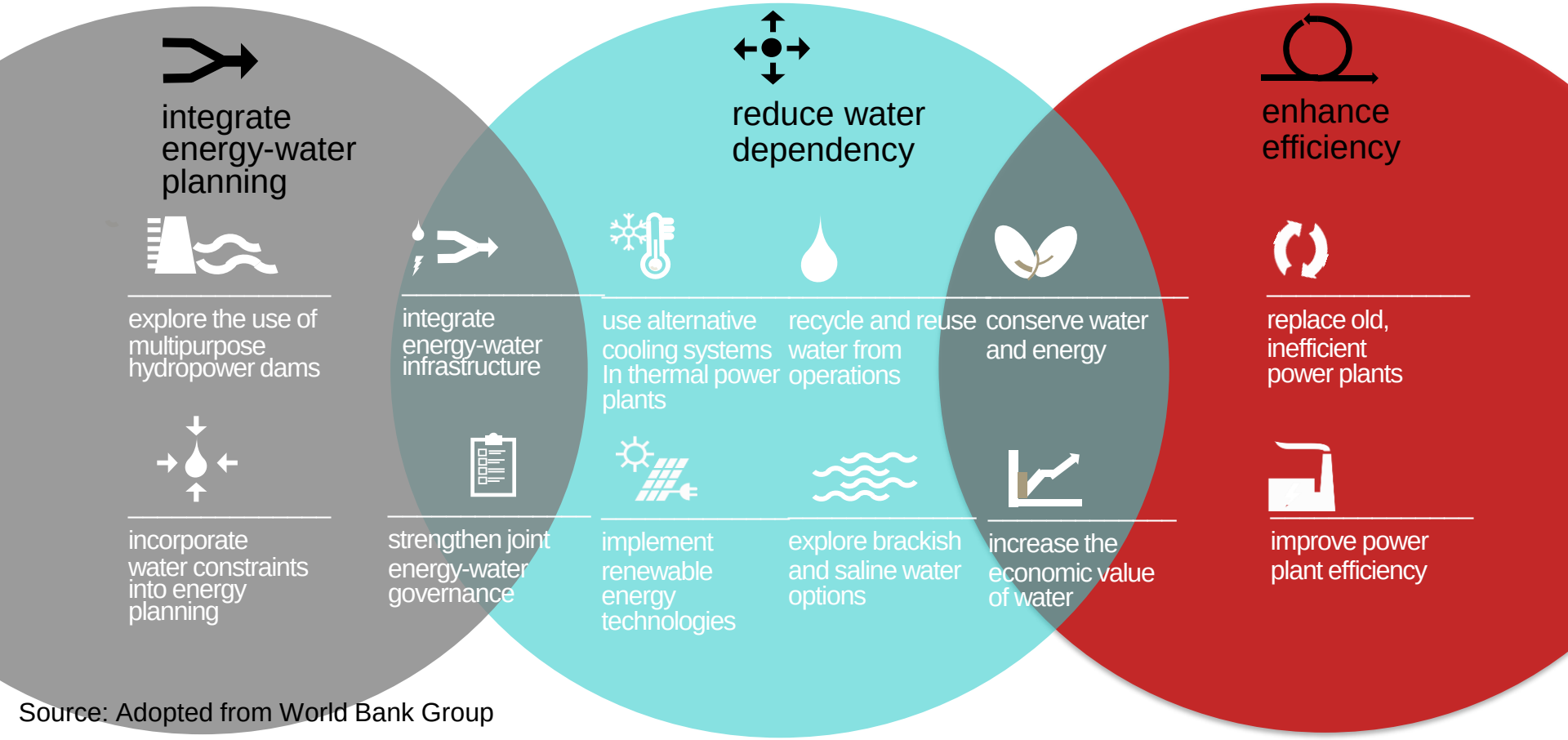


U.S. Department of Energy, 2006

**→ Need for a systematic WEF Nexus approach**

# Relationships between Water and Energy

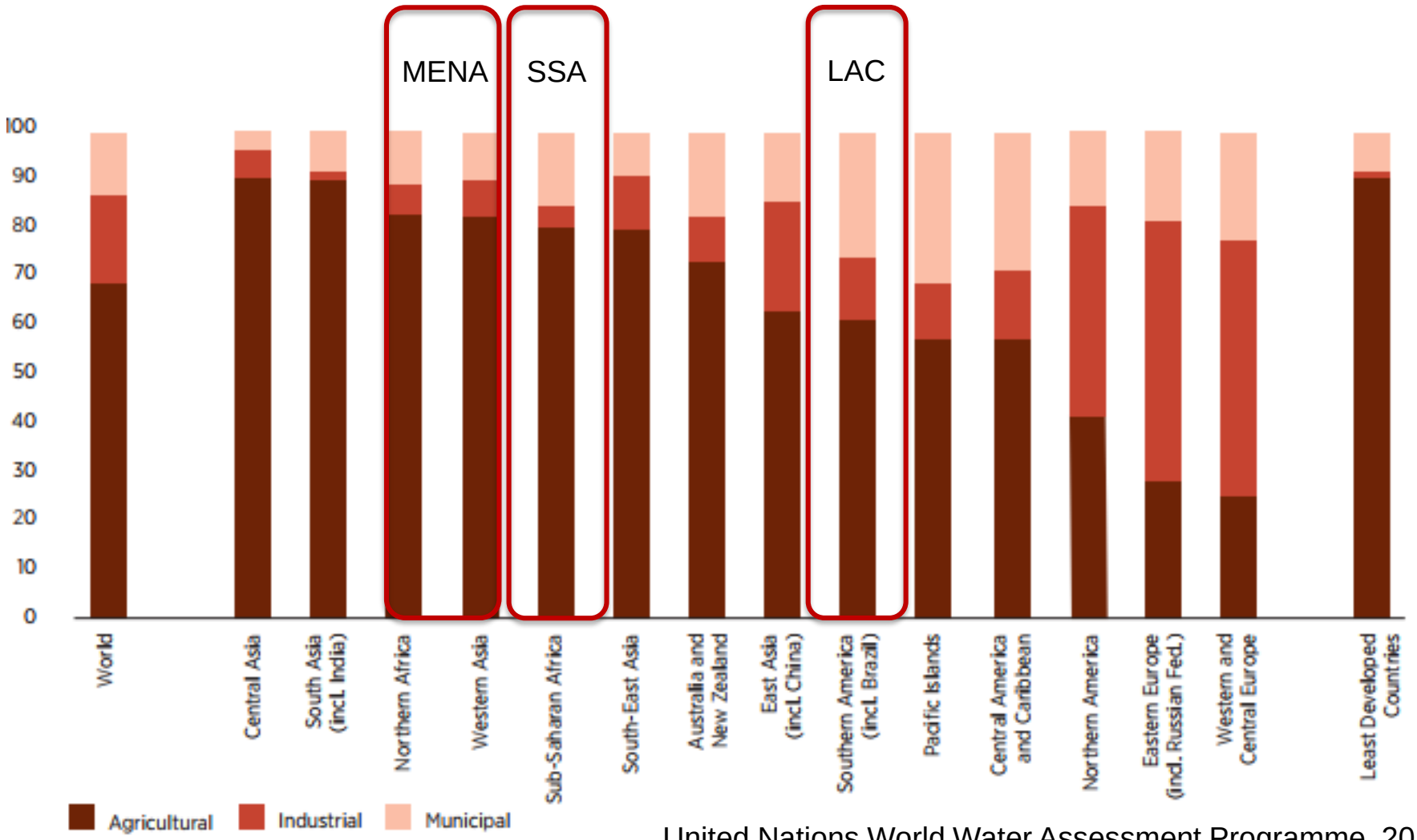
## Solutions




Source: Adopted from World Bank Group

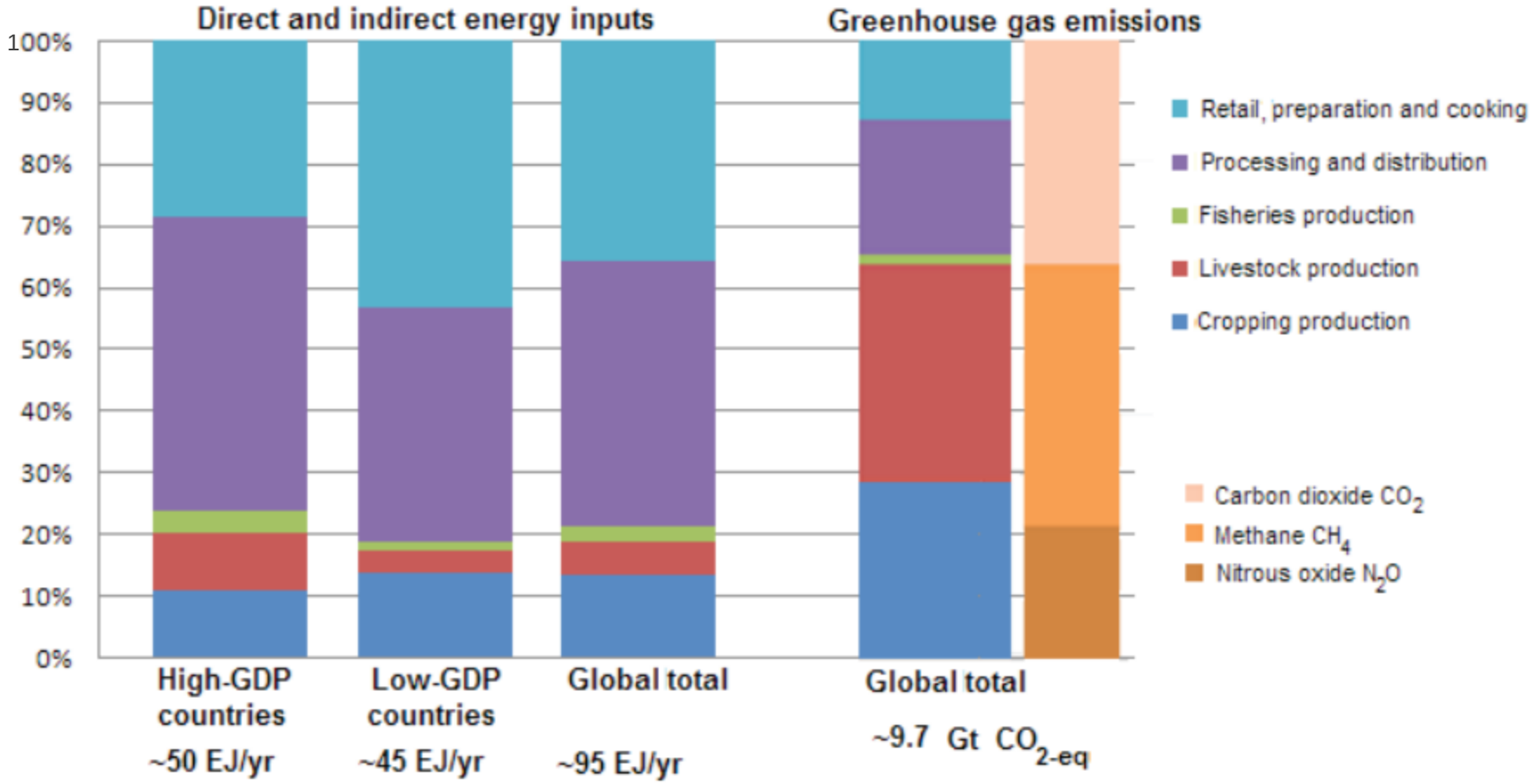
# Relationships between Water and Agriculture

Water withdrawal by sector in different regions of the world (2005)




United Nations World Water Assessment Programme, 2012

# Energy for Food Production

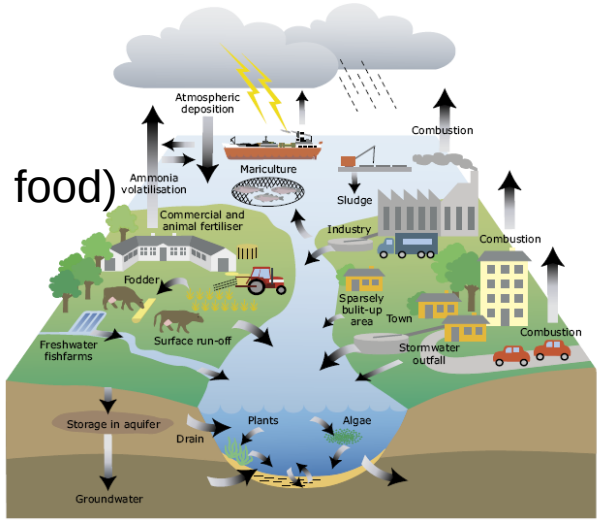



FAO, 2011

# Single-mindedly pursuing individual goals may interfere with other goals

**Example: Intensifying agricultural production**

- Higher food security
- Competition for land resources (eg. biofuels vs. crops as food)
- More use of fertilisers
- Contamination of water resources
- Less water security downstream




LaB, 2010

**→ Need for a systematic WEF Nexus approach**

# The Sustainable Development Goals

- Adopted in September 2015 by UN General Assembly, Agenda for developed and developing countries alike
- **17 Sustainable Development Goals and 169 targets,** which are cross-cutting and indivisible
- Call to move beyond sector-specific policies and planning and apply **integrated approaches → NEXUS**

**Goal 2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture**

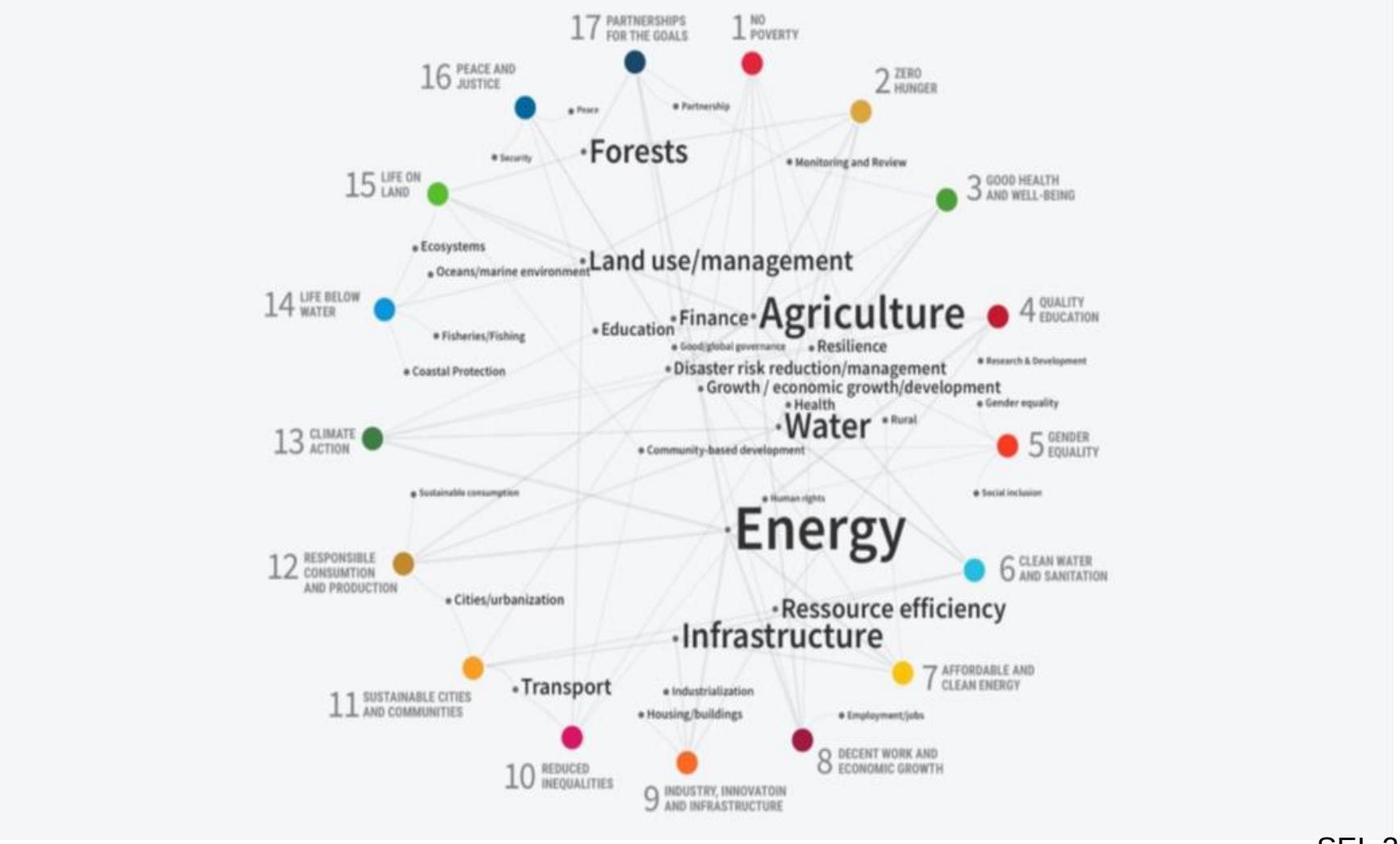
**Goal 6: Ensure availability and sustainable management of water and sanitation for all**

**Goal 7: Ensure access to affordable, reliable, sustainable and modern energy for all**


**Other goals supported indirectly**

UN, 2015

# Understanding the links between SDGs




SEI, 2017

# Interactions between SDGs

- To overcome potential constraints and negative interactions between the SDGs, **coordinated policy interventions are crucial to manage competing demands over natural resources**

**Example:**

"If the Ministry of **Agriculture** puts food security through agricultural intensification as its key **SDG2** target,

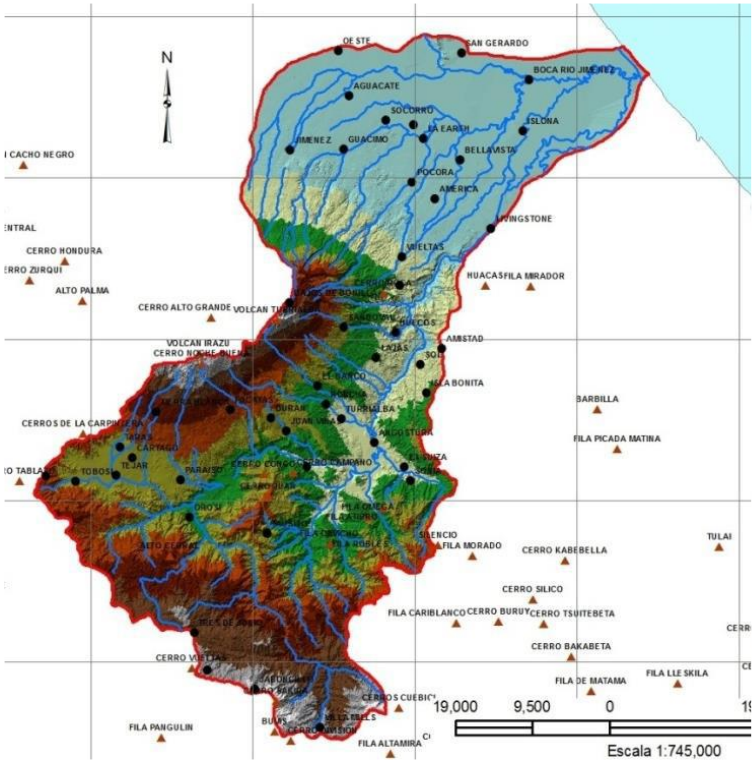
while the Ministry of **Water**'s target is to dramatically reduce agricultural water pollution under **SDG6** and **SDG14**,

and the Ministry of **Environment**'s target is to reduce biodiversity loss and expand conservation zones under **SDG15**, then mechanisms must be put in place to **negotiate how** the sets of targets should be moved forward." (ISCU 2017: 222)

- **The Nexus approach** helps to visualize **interdependencies and synergies** between the water, energy and agricultural sectors, which are necessary in order to facilitate **coordinated policy** approaches and interventions

# Costa Rica - Reventazón River Basin

- Total area: 2.8 x $10^6$ $km^2$
- Third biggest basin in the country
- Population of 500,000
- Provides 25% of the drinking water of the Costa Rican Greater Metropolitan Area, which is located **outside** the basin
- In terms of the national production:
  - Produces 38% of the hydropower
  - Produces 50% of the cement
  - Produces 85% of the vegetables
  - Produces 30% of the milk
- The only basin with a legally regulated administrator




Jouravlev, Rodriguez & Peñailillo, 2017

# Major Problems in the Reventazón River Basin

**Solid waste: 94 tonnes/yr**

**Overuse of fertilisers and pesticides**

**Inadequate use of natural resources**

**Sediments: 772 x$10^3$ tonnes/yr**

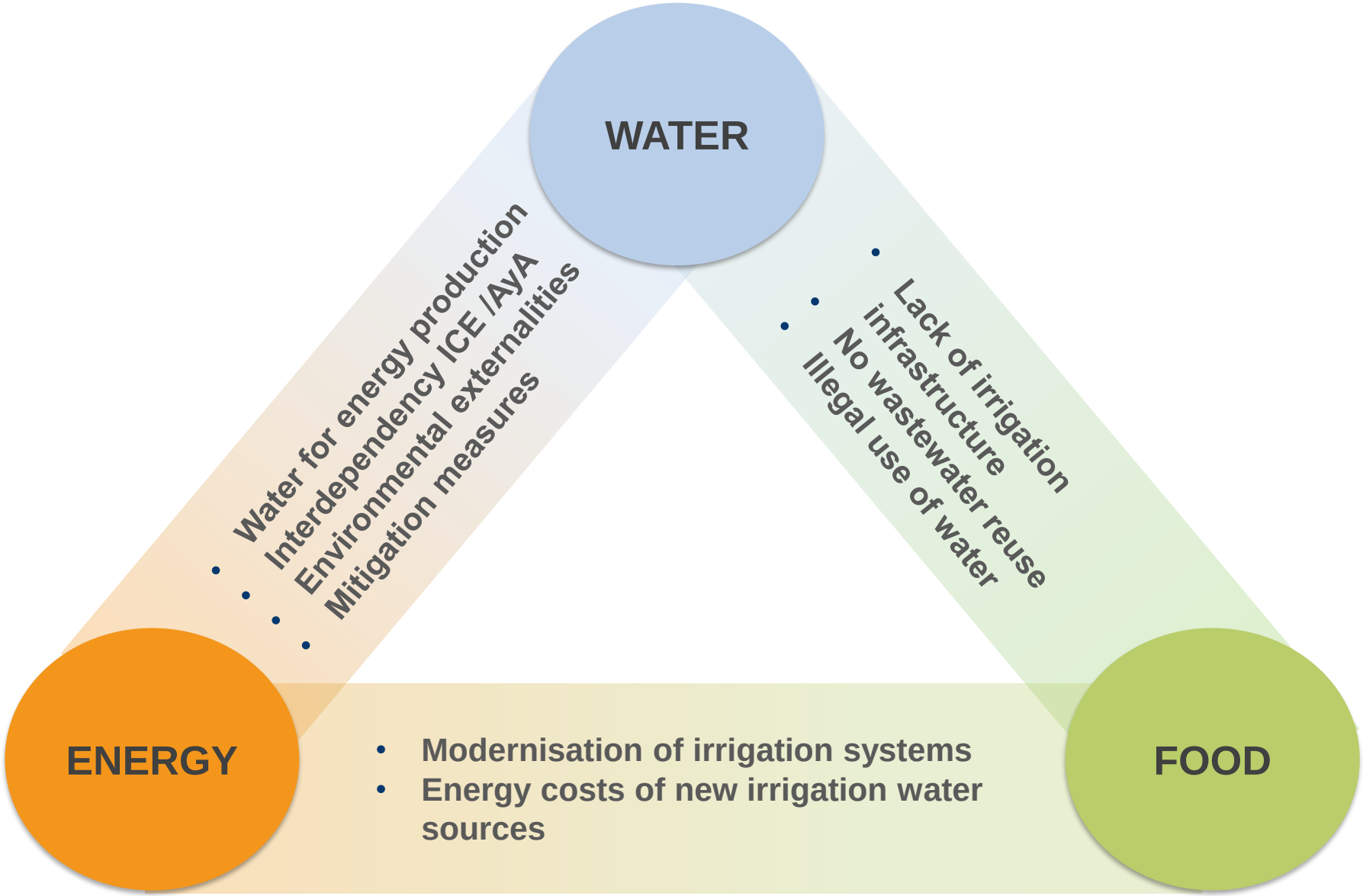
**Soil erosion**

**No water treatment plants**

**2nd most contaminated river in the country**

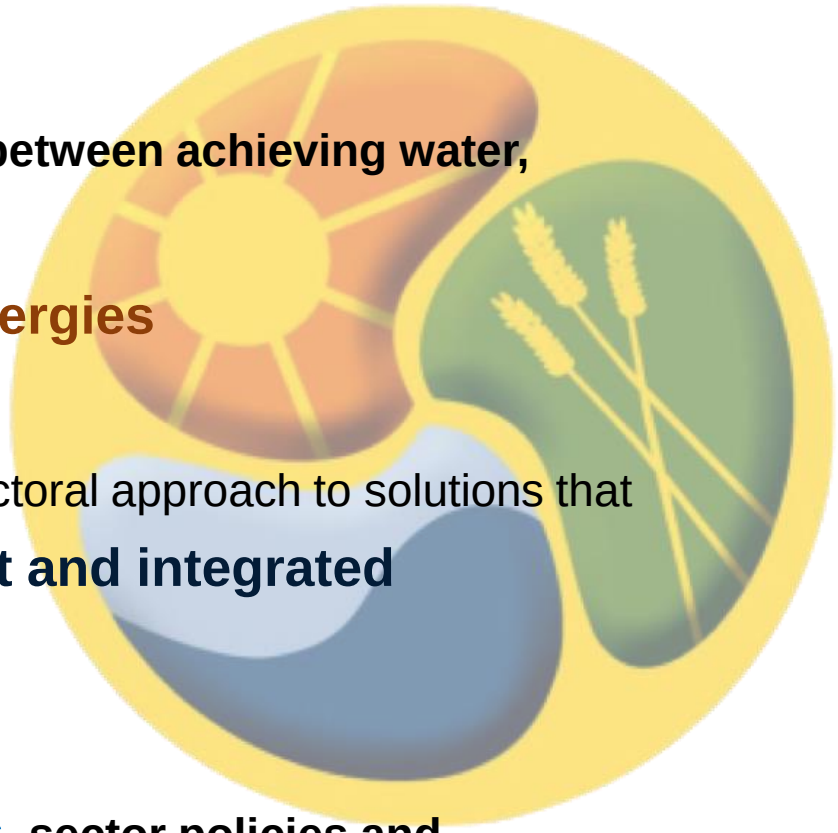
Jouravlev, Rodriguez & Peñailillo, 2017; Vargas & Lee, 2017

# WEF Nexus of the Reventazón River Basin



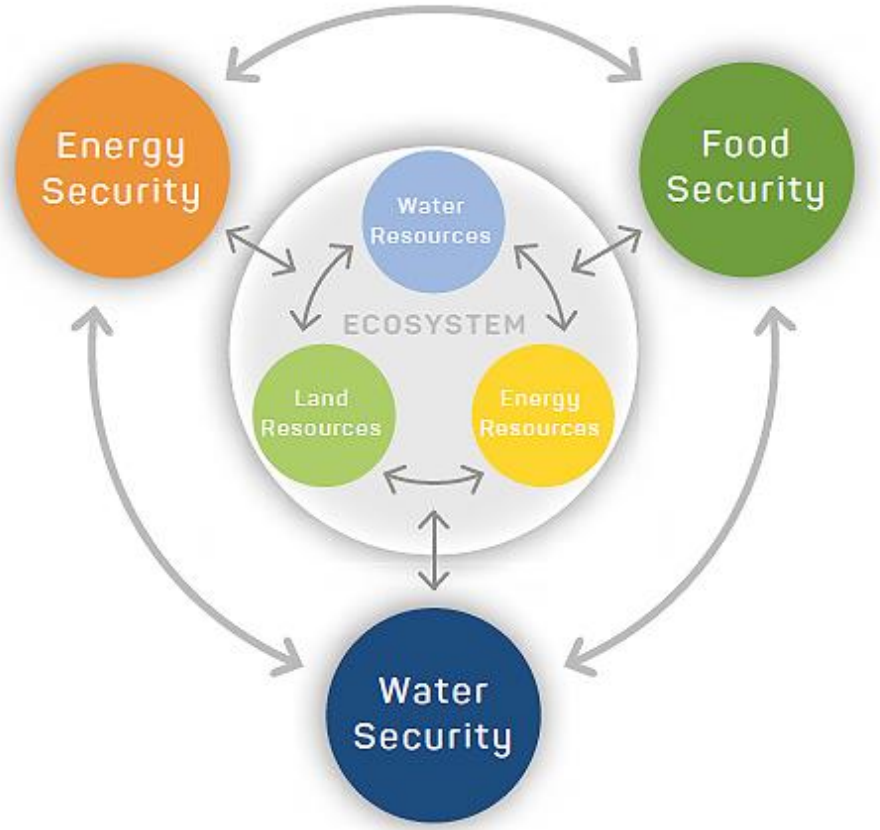
# Aim of the Nexus approach

- …seeks to **design sustainable development solutions**.
- …highlights **the interdependencies between achieving water, energy and food security**
- …is based on an **understanding of synergies**
- …**is a fundamental shift** from a pure sectoral approach to solutions that embrace a **cross-sectoral, coherent and integrated perspective**.
- …..**challenges existing structures, sector policies and procedures** at global, regional, national, provincial and local level



# Key resources of the Nexus

- The "**supply securities**" water, energy and food depend on ecosystems and on each other.
- The **resources land, water and energy** (atmosphere) are part of this ecosystem and must be used and protected in a **balanced manner.**



- The Water-Energy-Food security Nexus is a concept and approach which looks at **interconnections** which are usually overlooked, yet are very important

- The WEF Nexus concept is about **harnessing synergies** and **addressing trade-offs**

# Questions

## Please answer with regard to your country or region

- What are the major WEF Nexus challenges in your country?
- Are there any Nexus related projects implemented in your country? → Examples?
- How could integration between the water, energy and food sectors be achieved under the existing institutional structures in your country?

# Thank you for your attention!

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