20th AfWA International Congress and Exhibition 2020
Breaking new grounds to accelerate access to water and sanitation for all in Africa

An Application of the Water-Food-Energy Nexus: Generating Value from Diversified Agriculture in Northern Uganda

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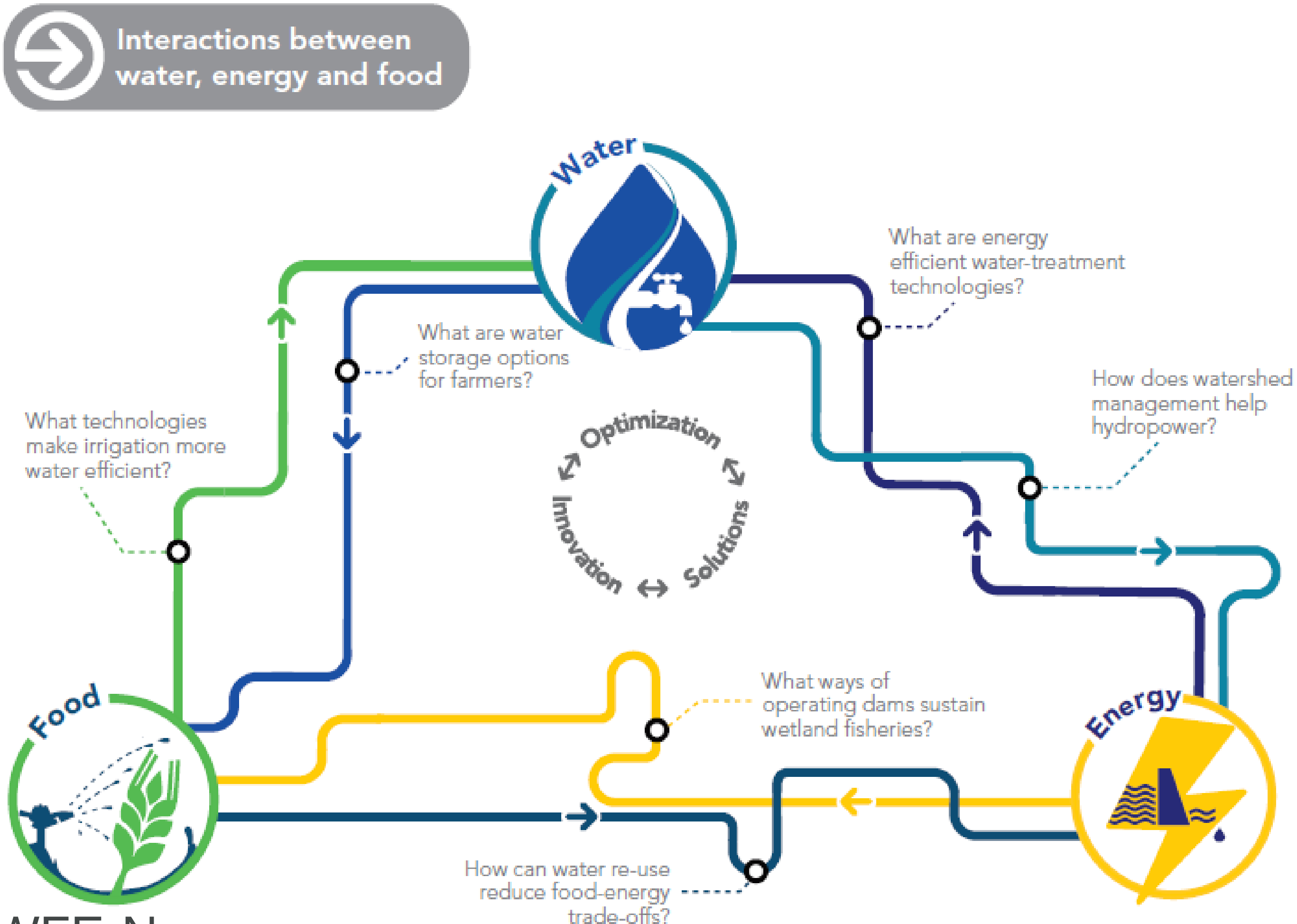
SYSTEMS THINKING: THE WATER-FOOD-ENERGY (WFE) NEXUS



WFE-Nexus:

Searching for a balanced approach to achieve sustainable outcomes

HOW ARE WE DOING?

- “So, four years into the SDGs, how are we doing?

  From a water perspective not so well.
  According to UN-Water’s ‘SDG 6 Synthesis Report 2018,’ water pollution is worsening, water resource governance is weak and fragmented, and agriculture places enormous and increasing stress on freshwater supplies.”

- Agriculture – the problem and the cure?

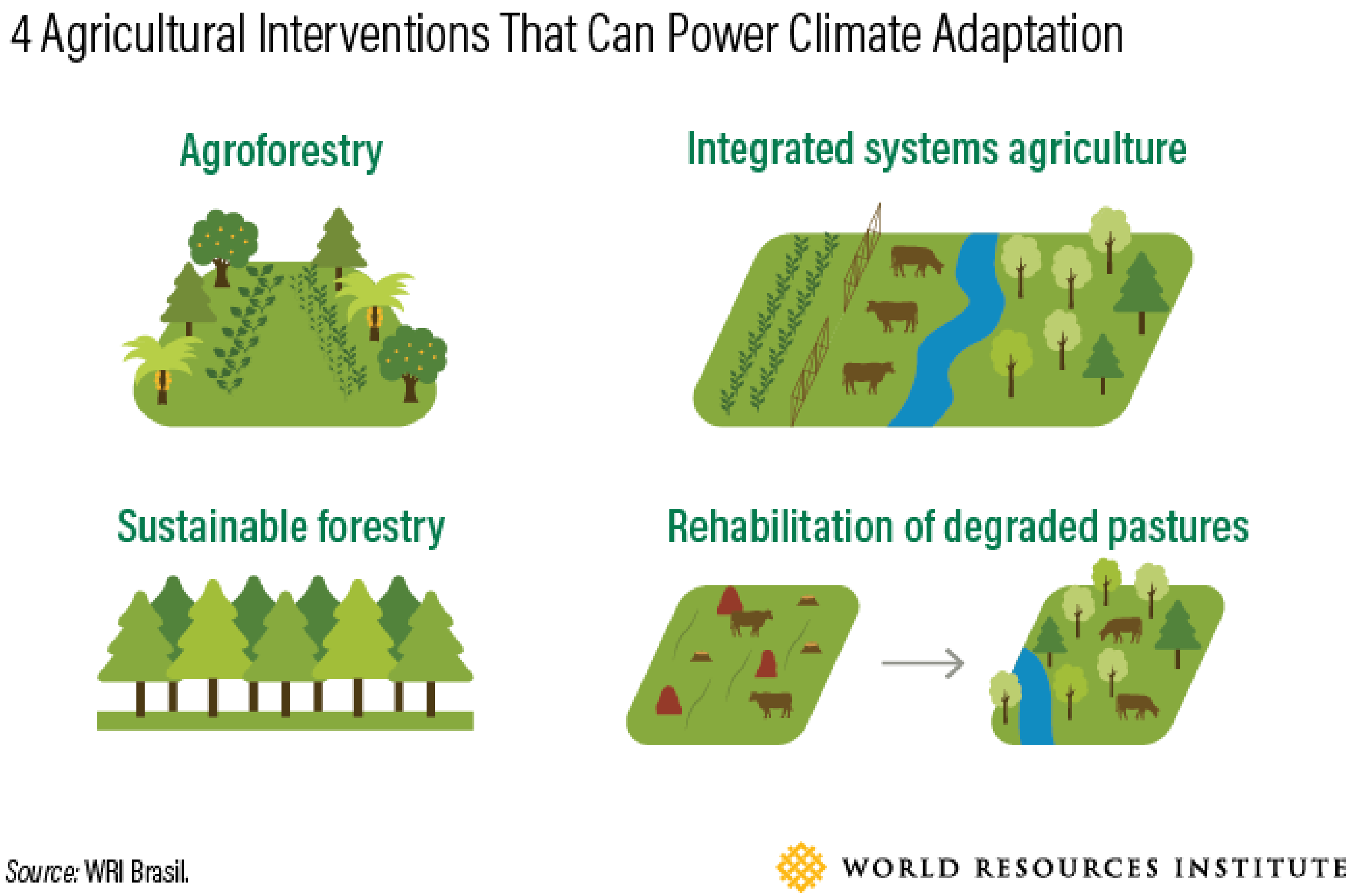
WHERE ARE WE?

- It is hot (almost always)
- It is dry (not always)
- A lot of surface water (the Nile!)
- Little water management

- Most people are farmers (subsistence)
- Processed agricultural products largely imported

- Low energy access rate (10-29%)
- Deforestation for cooking fuel

WHY COMPLICATE AGRICULTURE?



Source of Graphic: WRI, https://www.wri.org/blog/2019/12/4-ways-farmers-can-adapt-climate-change

AGRICULTURE – THE PROBLEM & CURE?

- Sustainable Fruit Production and Processing Opportunities (1,2,3,4,5)
  - Job creation
  - Higher yields per acre
  - Utilizing available arable land
  - Increased food security
  - Generating new income
  - Organic high-quality produce
  - Displacing imports
  - Export of higher value agricultural products
  - Increased climate change resilience
  - Increased biodiversity
  - Increased water storage and filter capability of soil

- Sustainable Fruit Production & Processing Challenges(4,5,6,7)
  - High post-harvest losses
  - Lack of finance
  - Environmental impacts on soil and water
  - Lack of irrigation infrastructure
  - Lack of fertilizer use
  - lack of storage facilities
  - Lack of freight infrastructure
  - limited know-how regarding production practices
  - an inefficient land management system

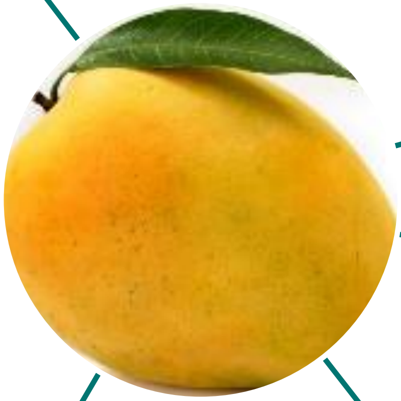
- HOW TO DO IT RIGHT?

4 THEORETICAL EXAMPLES: WEF NEXUS & STAKEHOLDER ANALYSIS

4. CROP DIVERSIFICATION - IMPACT ON WFE NEXUS

- **Water**: POSITIVE,
  - improve local micro-climate,
  - reduce agricultural water demand and/or increase the economic efficiency of water used
- **Food**: POSITIVE, increased productivity
- **Energy**: potentially NEGATIVE,
  - because high added value crops may need more energy along the value chain (trade off),
  - but potentially POSITIVE, if diversified crops include bio-energy crops.

4. CROP DIVERSIFICATION – IMPACT ON STAKEHOLDER CLASSES



Civil Society
- Increased employment opportunities for smallholders, estate workers and workers in any resulting value chains

Private Sector
- New value chain opportunities
- New retail opportunities

Public Sector
- New export possibilities and investment in value added

Financial Sector
- Risk reduction through diversification
- New investment opportunities

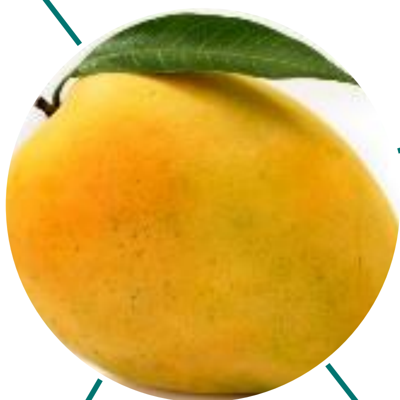
Environment
- comparative productive advantage and hence the best use of natural resources
- increased diversity of flora and fauna

Source of Graphics: Wikimedia Commons & IUCN

3. INTENSIFICATION
- IMPACT ON WFE NEXUS

- **Water**: NEGATIVE, because of withdrawals for irrigation
- **Food**: POSITIVE, increased productivity
- **Energy**: potentially NEGATIVE, because there is less water for energy production, however a net gain in biomass may offset this to a certain degree.

3. INTENSIFICATION – IMPACT ON STAKEHOLDER CLASSES



Civil Society
- increased incomes
- higher labor productivity for rural households
- possibility of employment in new value chains

Private Sector
- Possible cost reduction in producing and transporting raw materials
- Introduction of new markets for equipment and inputs

Public Sector
- New export possibilities and investment in value added

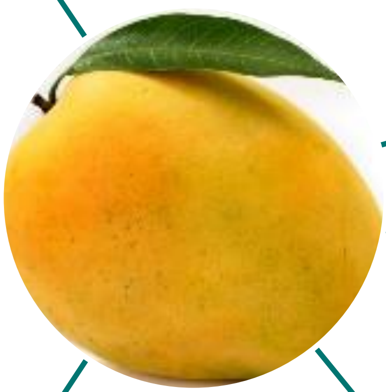
Environment
- If well managed: higher production with less impact on ecosystem

Financial Sector
- Risk reduction
- New investment opportunities

1. INCREASED IRRIGATION EFFICIENCY - IMPACT ON WFE NEXUS

- **Water**: POSITIVE, but only if saved water is reallocated wisely (i.e. longitudinally not transversely)
- **Food**: potentially POSITIVE, if the saved water is used for irrigation, and if the more efficient use of water leads to yield increases and improved uniformity of distribution
- **Energy**: NEGATIVE, because increased precision needs more energy (trade off), but potentially POSITIVE if the saved water is reallocated via hydropower installations (synergy). Alternative: solar pumps provide power without negative impact on food or water

1. INCREASED IRRIGATION EFFICIENCY – IMPACT ON STAKEHOLDER CLASSES



Civil Society
- Increase water for domestic use and production

Private Sector
- Increase water for production
- Increase in income

Public Sector
- Increase water for production
- possible increase in transboundary flows

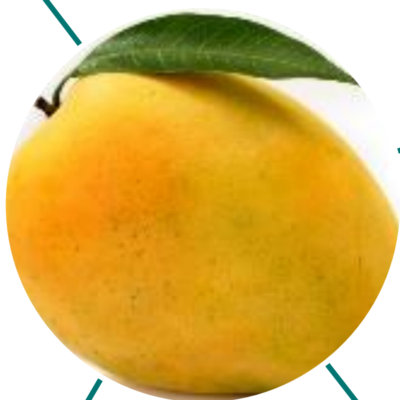
Environment
- No excessive water loss

Financial Sector
- Risk reduction
- Payback period reduces

2. IRRIGATION ON DEMAND - IMPACT ON WFE NEXUS

- **Water**: POSITIVE, because withdrawals for irrigation will be minimized
- **Food**: potentially POSITIVE, because more water is available for irrigation expansion and every farmer gets the water he or she needs and has independent choice of farming system
- **Energy**: NEGATIVE, because irrigation on demand needs more energy. Alternative: solar pumps provide power without negative impact on food or water (synergy)

2. IRRIGATION ON DEMAND – IMPACT ON STAKEHOLDER CLASSES



Civil Society
- Increase water for domestic use and production
- more control over farming system choices

Private Sector
- Increase water for production

Public Sector
- Increase water for production
- possible increase in transboundary flows

Environment
- No excessive water loss

Financial Sector
- Risk reduction
- Payback period reduces

SUMMARY OF EFFECTS

A CASE FOR FRUIT PRODUCTION [1,2,3]

- Contribute to soil fertility
- Contribute to biodiversity
- Prevent soil erosion
- Increased food security
- Diversified diet (vitamins & minerals!)

- improve the local micro-climate by reducing local temperature and increasing precipitation & water availability
- Increase water filtration capability
- Increased catchment management

- Increased firewood and charcoal source
- Renewable energy can be utilized for production and home use

Source of Graphics: IUCN, https://www.iucn.org/downloads/nexus_graphic.pdf

A CASE FOR FRUIT PRODUCTION [1,2,3]

Socio-Economic & Environment

- Increased production & income
- Increased investment capability (i.e. renewable energy)
- Diversified production (NURDS)
- Increase of jobs
- Strengthening of local food systems
- Increase of export opportunities
- Increased climate change resilience
- Secure biodiversity
- Sustainable ecosystem services

Source of Graphics: IUCN, https://www.iucn.org/downloads/nexus_graphic.pdf

THE WAY FORWARD

THE WAY FORWARD

- Data collection in the field
- More comprehensive mapping / stakeholder mapping
- Verification of results via on the field research at smallholder farms and data collection
- Research on policy coherence
- How to handle lack of enforcement of policies/laws

QUESTIONS?


20th AfWA
CONGRESS
YOU ARE WELCOME

SITUATION IN UGANDA

- **Location & Climate**:
  - on the East African Plateau (at 1,000-1,500m over sea level), favorable climate (allows agricultural production all year around), dry and wet seasons, average temperatures range between 20 °C and 25 °C [1]
- **Water:**
  - annual rainfall ranges between 500 and 2,800 millimeters, direct rainfall most important water source[1]
  - 5% of surface area is covered by open water and 13% by wetlands [2]
- **Energy:**
  - Energy access rate of 29%, in rural areas 10%
  - 95% of the population use wood or charcoal for cooking
- **Food:** [3,4,5]
  - In 2017/2018 agriculture accounted for roughly 20 percent of Ugandan GDP and more than 40% of export earnings.
  - about 70% of the population is employed in agriculture
  - 35% of available 80% of arable land is cultivated
  - Processed fruit products largely imported (i.e. juice) to meet local demand

SITUATION IN NORTHERN UGANDA[1,2,3,4]

- **Development:**
  - Least developed region in Uganda
  - High unemployment of especially young population
  - High climate change vulnerability of population
- **Water:**
  - Little to no wastewater management in rural areas
  - Water supply through surface and ground water abstraction (boreholes)
  - Wetland degradation through unformal settlements, waste and sewerage disposal
- **Energy:**
  - Deforestation due to charcoal and firewood production
  - Energy access rate 10%, intermittent energy supply
- **Food:**
  - Small holder farming and subsistence agriculture prevalent (80% of population)
  - Little to no irrigation schemes

A CASE FOR FRUIT PROCESSING (1,2,3,4)

Food

- Reduction of post-harvest loss
- Increased food security
- Diversified diet
- Residuals can be used for energy production (biogas) and as organic fertilizer

Water

- Excess water content after production can be reintroduced into the local watershed
- Employees are sensitized towards sustainable water management
- Wastewater facilities can be expanded to accommodate surrounding dwellings

Energy

- Biogas generation reduces reliability towards energy supply (reducing costs)
- Renewable energy can be utilized for processing and home use

Socio-Economic & Environment

- Increased production & income
- Increased investment capability
- Diversified production (NURDS)
- Increase of jobs
- Strengthening of local food systems
- Increase of export opportunities
- Increased climate change resilience

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FRUIT & THE WFE-NEXUS