From Waste to Resource: Generating Value from Excess Fruit Production in Northern Uganda – an Application of the Water-Food-Energy Nexus

23rd – 24th February 2020, Kampala, Uganda
“So, four years into the SDGs, how are we doing?

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?
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
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
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?
WHY COMPLICATE AGRICULTURE?

4 Agricultural Interventions That Can Power Climate Adaptation

- Agroforestry
- Integrated systems agriculture
- Sustainable forestry
- Rehabilitation of degraded pastures

Source: WRI Brasil.

WFE-Nexus:
Searching for a balanced approach to achieve sustainable outcomes

FRUIT PRODUCTION & WFE-NEXUS

Source of Graphics: Wikimedia Commons & IUCN
Stakeholder Classes
FRUIT PRODUCING STAKEHOLDERS

- **Civil Society**
  - Consume
  - Demand

- **Private Sector**
  - Produce
  - Sell

- **Public Sector**
  - Support
  - Enable

- **Environment**
  - Ecosystem services

- **Financial Sector**
  - Finance

Source of Graphics: Wikimedia Commons & IUCN
ENERGY STAKEHOLDERS

- Civil Society
  - Consume
  - Demand

- Private Sector
  - Consume
  - Demand

- Public Sector
  - Generate
  - Enable

- Financial Sector
  - Finance
WATER STAKEHOLDERS

Civil Society
- Consume
- Demand

Private Sector
- Consume
- Demand

Public Sector
- Produce
- Enable

Financial Sector
- Finance
4 PRACTICAL EXAMPLES: WEF NEXUS & STAKEHOLDER ANALYSIS
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

**Financial Sector**
- Risk reduction
- Payback period reduces

**Environment**
- No excessive water loss

Source of Graphics: Wikimedia Commons & IUCN
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

- **Financial Sector**
  - Risk reduction
  - Payback period reduces

- **Environment**
  - No excessive water loss

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

**Financial Sector**
- Risk reduction
- New investment opportunities

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

Source of Graphics: Wikimedia Commons & IUCN
4. CROP DIVERSIFICATION - IMPACT ON WFE NEXUS

- **Water**: potentially positive, can reduce agricultural water demand and/or increase the economic efficiency of water used in agriculture
- **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.
Civil Society

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

Private Sector

- New value chain 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
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 and water availability
- Increase water filtration capability
- Increased catchment management

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

Socio-Economic & Environment

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

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

- Reduction of post-harvest loss
- Increased food security
- Diversified diet
- Residuals can be used for energy production (biogas) and as organic fertilizer
- 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
- 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 (ICLEI)
- Increase of export opportunities
- Increased climate change resilience

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