NEXUS Gains:
Realizing Multiple Benefits
Across Water, Energy, Food
and Ecosystems

Transforming the Global Food System needs a Nexus Lens

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IFPRI & NEXUS Gains

Per Invitation, Water-Energy-Food nexus symposium

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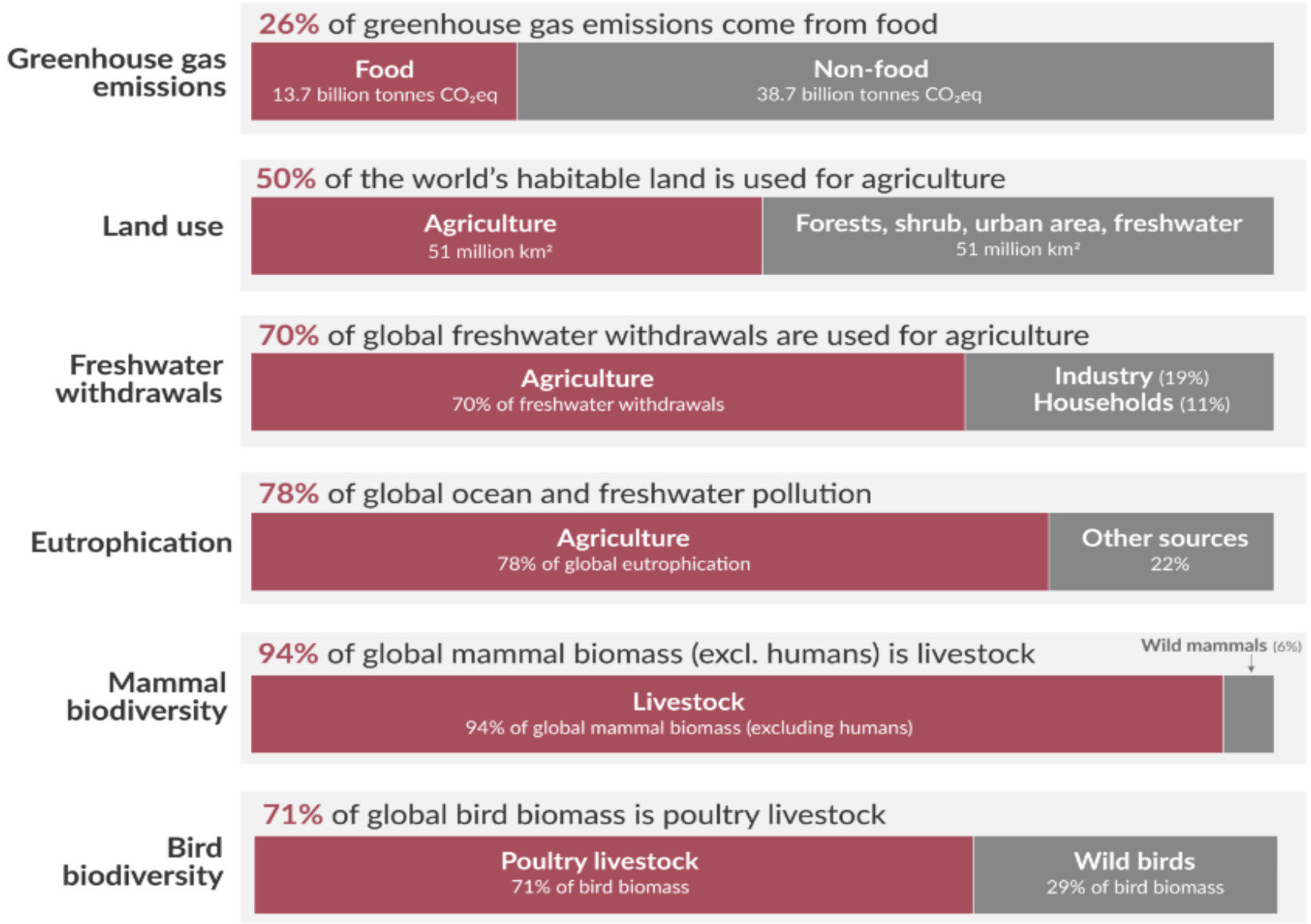
The Opportunity

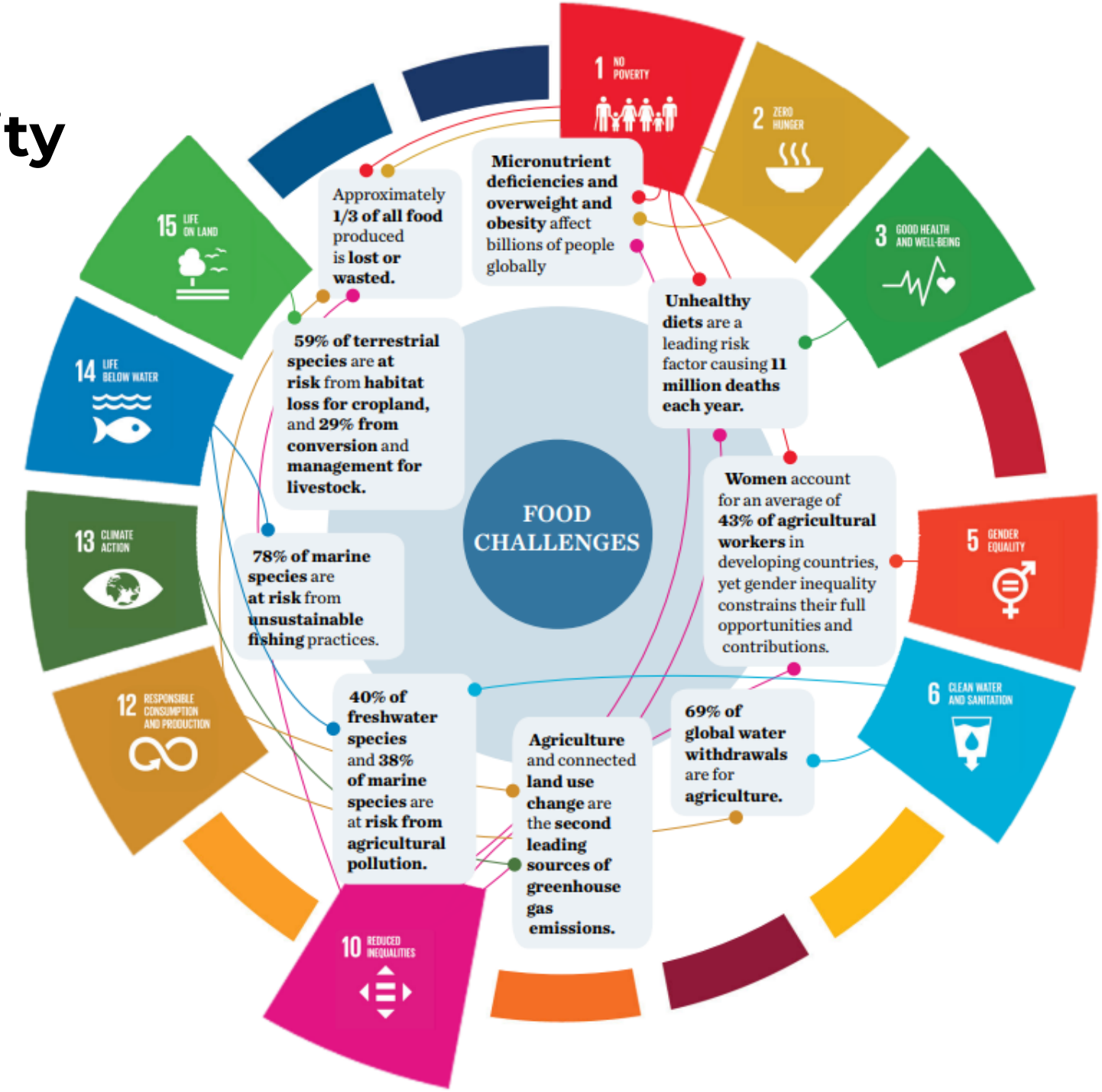
- Food is an essential human need
- Unsustainable food production and consumption
- Unbearable pressures on natural resources and ecosystems, ~1/3 of GHG emissions, leading driver of global biodiversity loss, largest freshwater user
- More than 3.1 billion people in the world (42%) – were unable to afford a healthy diet in 2021, 85% in West and East Africa, 72% in South Asia

Bridge Collaborative (2019);
FAO et al. (2023).

The Opportunity



The Opportunity



Bridge Collaborative (2019)

Intentional WE(F)E Policies for Nutrition

- Food loss and waste reduction
- Investments in electrification for in-situ food processing
- Investments in (energy-intensive) cold storage chains
- More efficient, women-led, solar irrigation
- Groundwater governance and stewardship
- Micronutrient Fertilization (zinc, iodine, selenium)
- Intentional improvements in food processing to use less water and energy
- Intentional improvements in water pollution to improve food safety
- Intentional changes in food production systems to reduce products that use most water & energy and pollute a lot, and are bad for nutrition (beef in HICs/ sugarcane / biofuels)

Intentional Nutrition Policies for WEF

- Taxes on red meat in HICs [water/ pollution, agrochemicals, energy for irrigation, health in HICs, ASF access in LMICs]
- Taxes on sugary drinks everywhere [sugarcane, water/pollution, agrochemicals]
- Alternative proteins for milk, eggs / cultured meat / clean fish [land, water, energy]
- Food Based Dietary Guidelines with environmental considerations
- School meals/ food procurement with environmental considerations

Linkages between irrigation & nutrition

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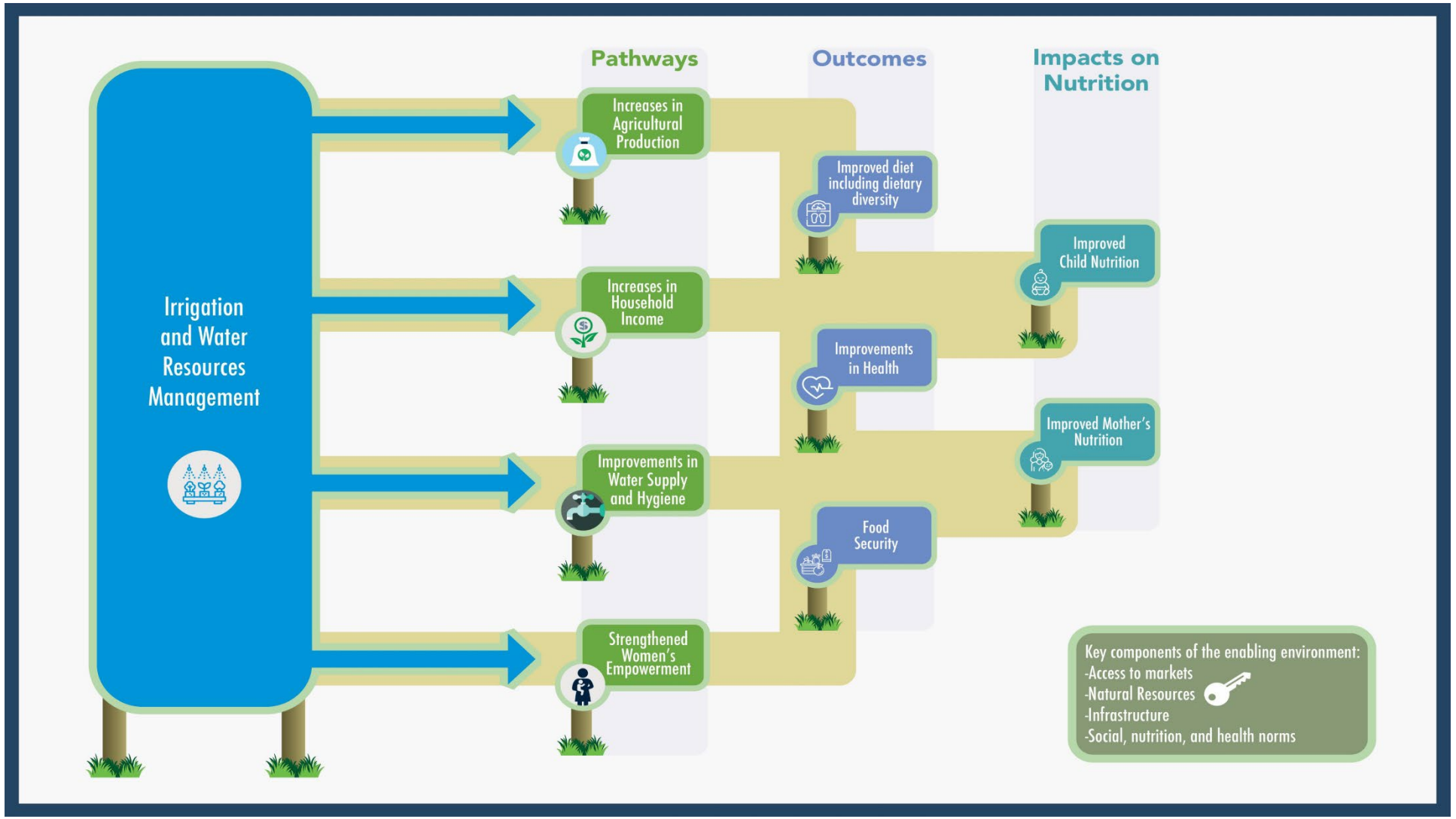

Bryan et al. (2019)

Irrigation Buffers Seasonal Dietary Gaps for Women in Ethiopia

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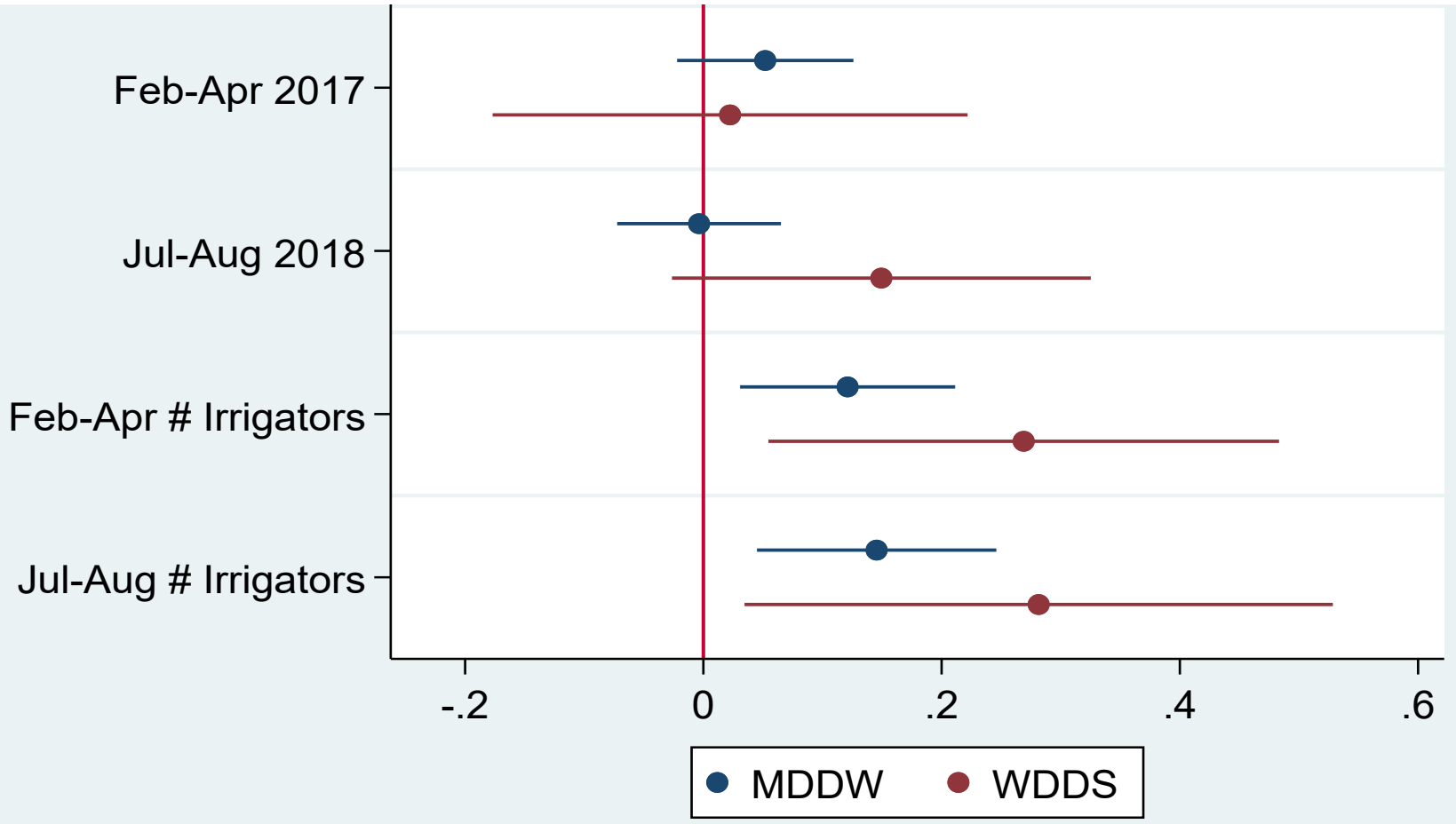
Seasons covered:

Feb-Apr: Irrigation and fasting season

Jul-Aug: Lean season

Oct-Nov: Harvest season

MDDW and WDDS estimation with interaction



Baye et al (2022)

Irrigation Buffers Climate Extreme Events in Ethiopia

- During the 2016 ENSO drought, irrigators in Ethiopia maintained their net crop income, area cultivated, HDDS, and share of harvest sold; and increased spending on food (by 72%)

- Expenditures increased because food was more expensive during the climate-extreme event

Mekonnen et al. under development

Irrigation Improves Nutrition Outcomes for Children

- Children in irrigating households in Ethiopia have higher weight for height scores than children in non-irrigating households (WHZ +0.87 SD)
- Children in irrigating HHs that experienced a drought had higher WHZ scores in Tanzania (+0.62 SD)
- Irrigation as an entry point to improve nutrition

Mekonnen et al. (2022)

Irrigation Improves Domestic Water Access

- The irrigation-WASH pathway also has potential to improve nutrition (less evidence)
- Emerging results show that households with irrigation are also more likely to have sufficient domestic water and improved sanitation facilities, reduces time and energy to collect water
- MUS more likely when groundwater is the irrigation source
- Hygiene practices are not influenced by water source or access to irrigation

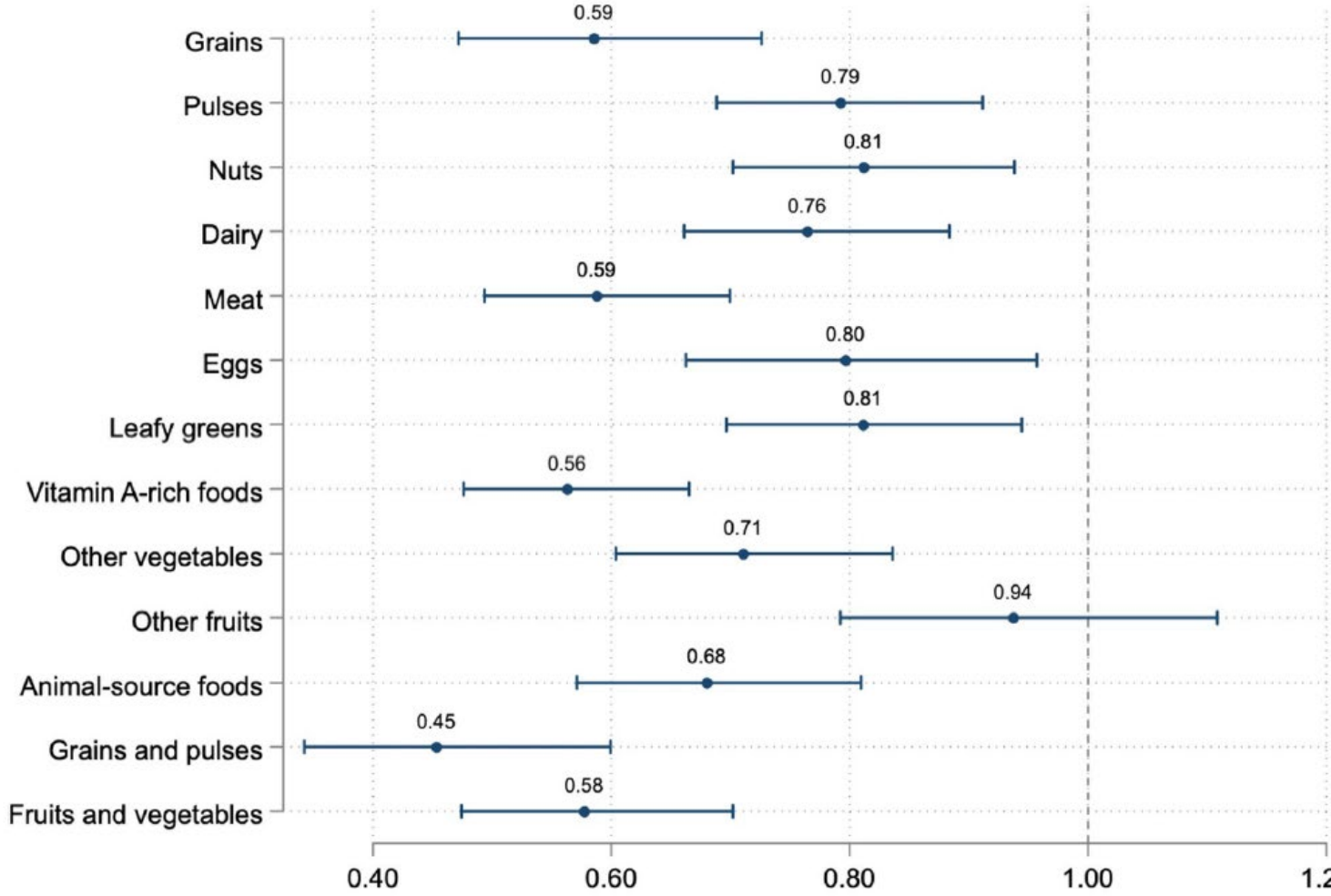
Credit: IWMI.

Van Biljon et al. Under Review

Minimum Dietary Diversity-Women and Household Water Insecurity

- Individuals from water-insecure households had lower odds of consuming each type of food included in the MDD-W, except for other fruits
- Individuals in water-insecure households had lower odds of consuming ASF (0.68), grains or pulses (0.45) and fruits or vegetables (0.58)
- Household water security as an entry point to improve nutrition

Associations between household water insecurity (HWISE-4 score ≥ 4) and 10 food groups included in the MDD-W



Miller et al. (accepted).

Alternative Proteins: A NEXUS-Nutrition construct

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Alternative proteins

AP Source

Plant-based

Microbial fermentation - based

Cultivated meat

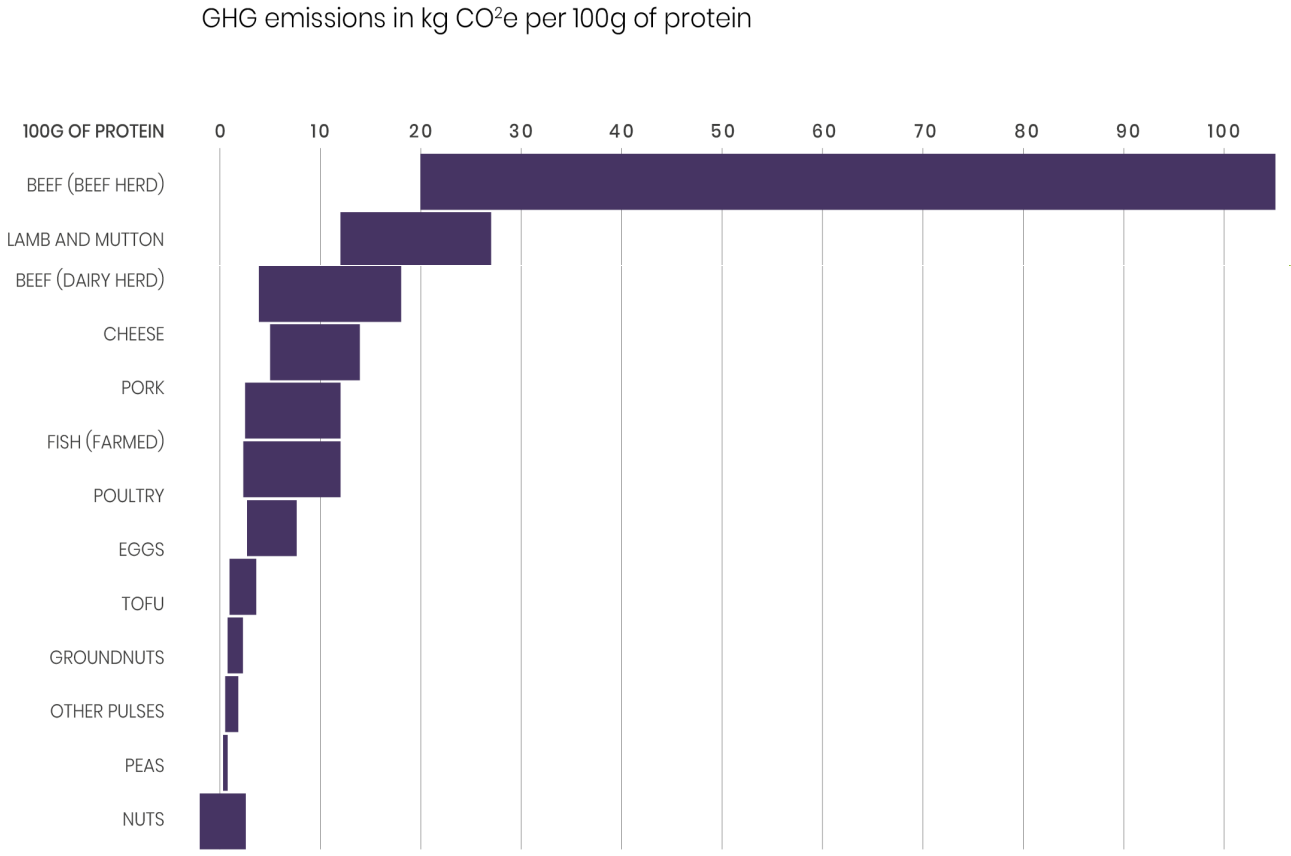
Insect-based

Nexus Relevance

- Reduce land use (change)
- Removal of animal feed
- Removal of animal manure
- Reduced agrochemical use
- Reduced energy use
- Reduced water use/pollution

Defining Characteristics

- Emissions, energy and water use differ by source of alternative protein
- Potential role in HMICs: reduce intake of traditional ASF, potential health benefits, animal welfare benefits, GHG reduction
- Potential roles in LMICs: increase access to traditional ASF through lower livestock prices from AP adoption in HICs, direct access to high-quality proteins, f. ex. precision-fermented milk powder, in humanitarian settings



Poore & Nemecek (2018).

Do Alternative Proteins Reduce Water and Energy Footprint of Food Production?

- Plant-based meat substitutes require 47–99% less land and 72–99% less water, emit 30–90% fewer GHG emissions and cause 51–91% less aquatic nutrient pollution compared with factory-farmed animal meat and fish (Thornton et al. 2023)
- Precision fermentation example: Substituting 20% of per capita ruminant meat consumption with microbial protein can eliminate pasture area increase, reduce deforestation in half and lower methane emissions (Humpenöder et al. 2022) .
- Cultivated meats: least certain due to high energy requirements and lack of large-scale implementation (e.g., Alexander et al., 2017; Godfray, 2019; Rubio et al., 2020; Sinke et al., 2023)

Summary

- Many options to transform food systems through nexus approaches that explicitly consider water, energy and food linkages and ecosystem health
- Recognition of the impact of nutrition policy on water, energy and food security is nascent
- Options to improve nutrition outcomes through interventions in the water and energy sectors are large and have yet to be materialized
- Need more awareness raising and tools to analyse the WEF Nexus and nutrition jointly (nutrition-water productivity tools, or analyzing linkages of nutrition and water productivity tools)