

A satisficing and dynamic food-energy-water nexus approach to sustainability

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The Food-Energy-Water (FEW) nexus

The concept

The FEW nexus is a framework outlining interactions among these dimensions, identifying how changes in one may impact the others, **creating gains or trade-offs**

Science

- Nexus thinking
- Interdisciplinary research

Policy

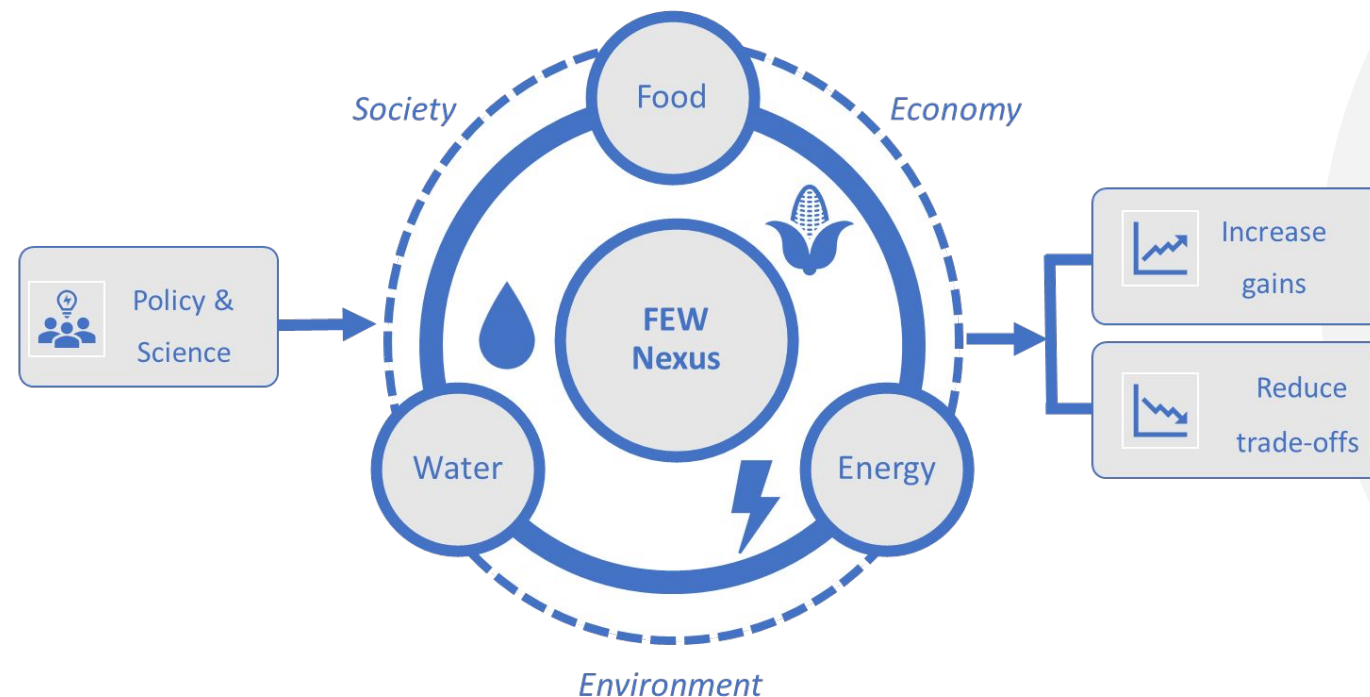
- Integrated Resources Management
- Resilience & Security

Technology innovation

- Systems Efficiency
- Smart Agriculture

Infrastructure

- Desalination
- Water treatment



(F. Brouwer et al., 2024; Carmona-Moreno et al., 2021; Zhang et al., 2019)

The Food-Energy-Water (FEW) nexus

The gap

Sustainability approaches aimed at **optimizing trade-offs between conflicting FEW goals** struggle to align due to vague and **inconsistent definitions of sustainability**

The sustainability wicked problems

No clear consensus definition

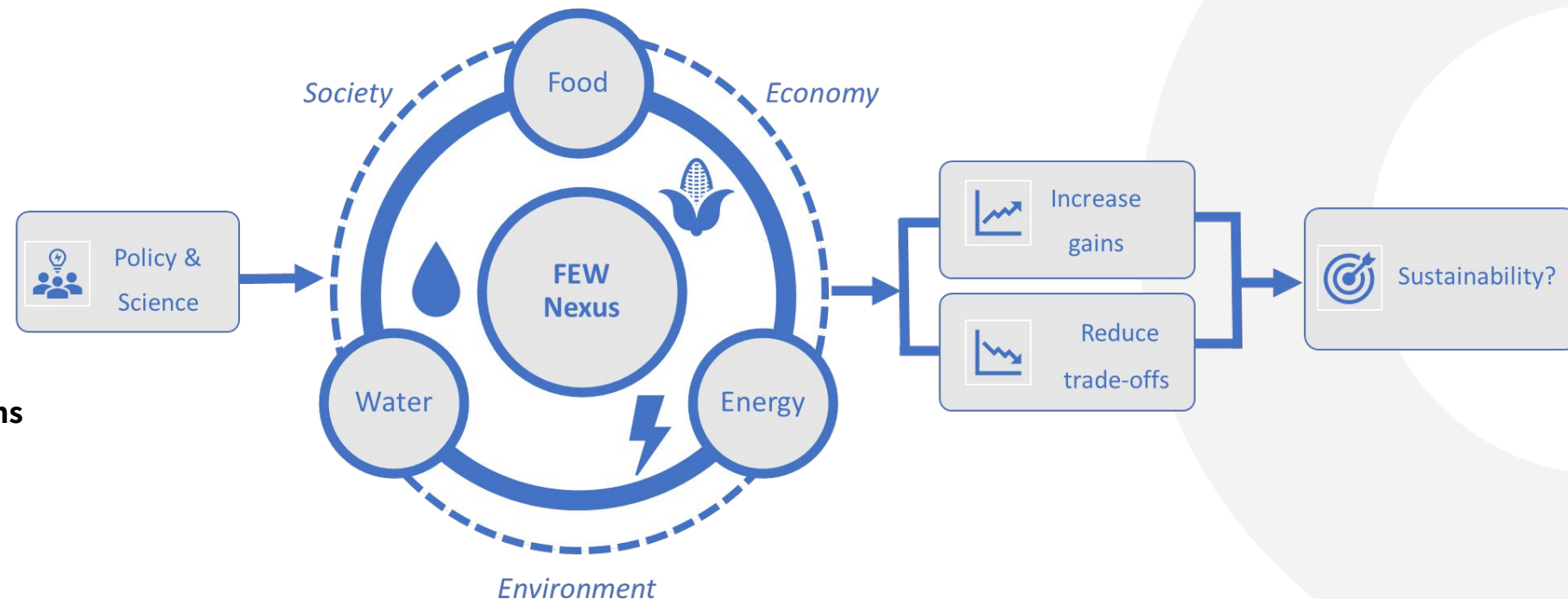
- Dozens of distinct, value-laden terms
- Diverse theoretical and disciplinary perspectives

Trade-offs between goals

- Different political aspects
- Different Goal prioritization

Variations in challenge perceptions

- Time, place, and scale

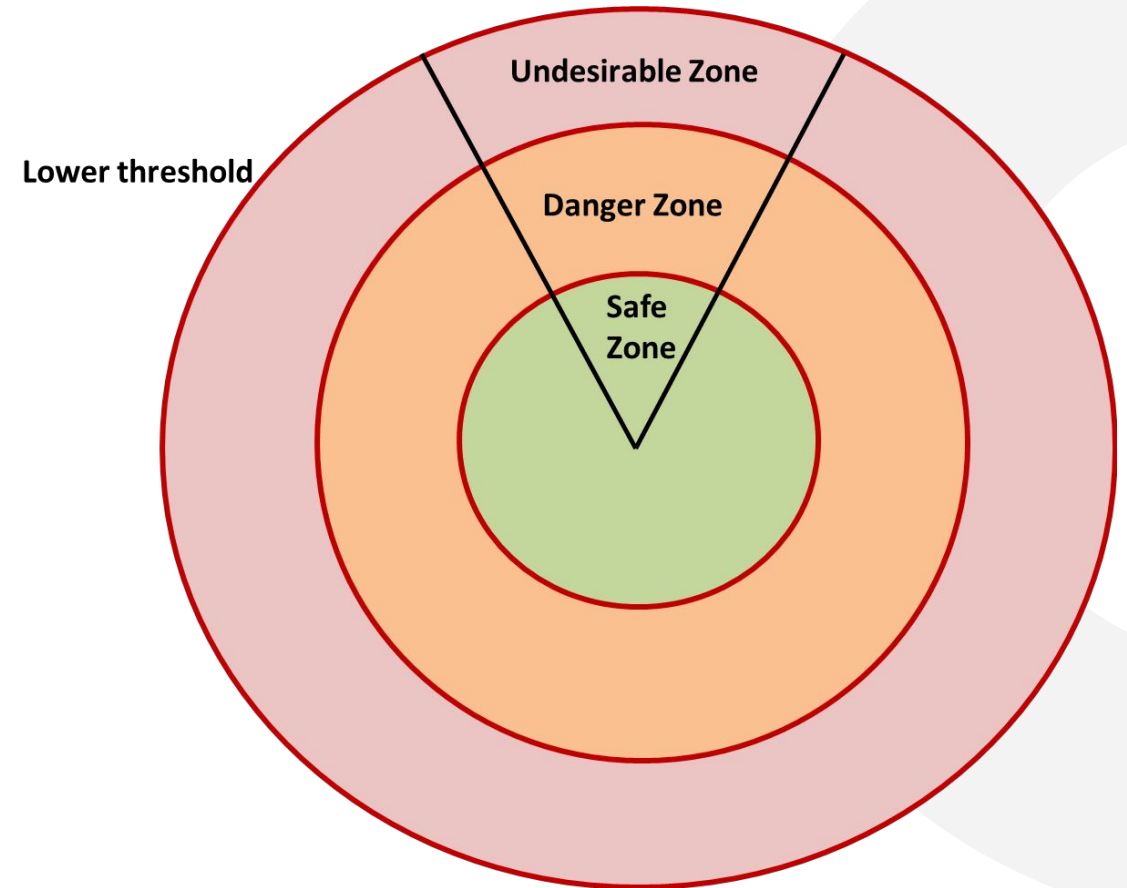


(F. Brouwer et al., 2024; Dragicevic, 2018; Purvis et al., 2019; White, 2013)

The double negative approach to sustainability

“Sustainability is a state that is **not** unsustainable, and sustainable development is development that **does not** lead to an unsustainable state.” (Raworth, 2017)

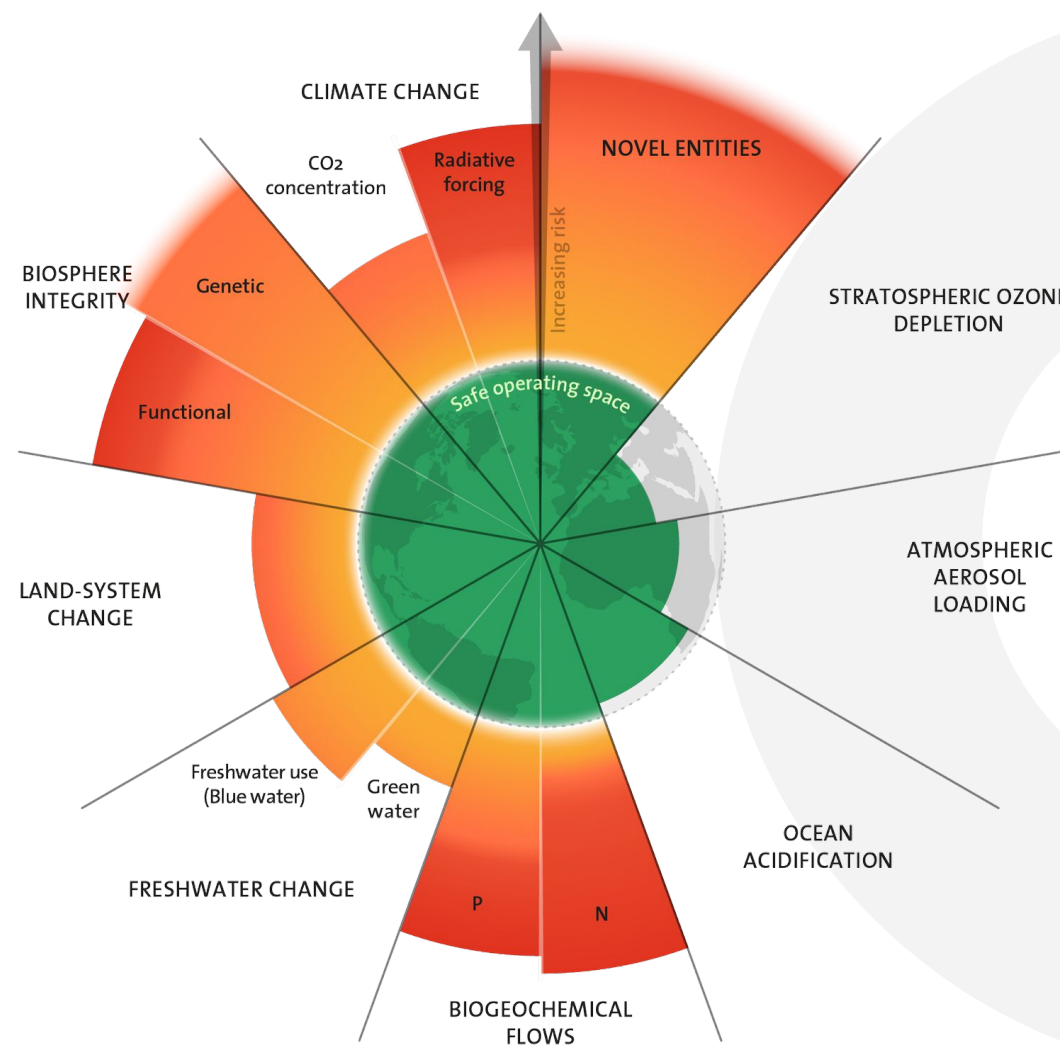
- Shifting the focus from what sustainability is to what it is not (Feitelson & Stern, 2023)
- It identifies what is unsustainable in settling on solutions that meet acceptable criteria (Raworth, 2017).
- This represents a "satisficing" state between them (Artinger et al., 2022).
- Reaching a “space” instead of an “optimum point” allows flexibility (Brullo et al., 2024).



The double negative approach to sustainability

The planetary boundaries (Rockström et al., 2009)

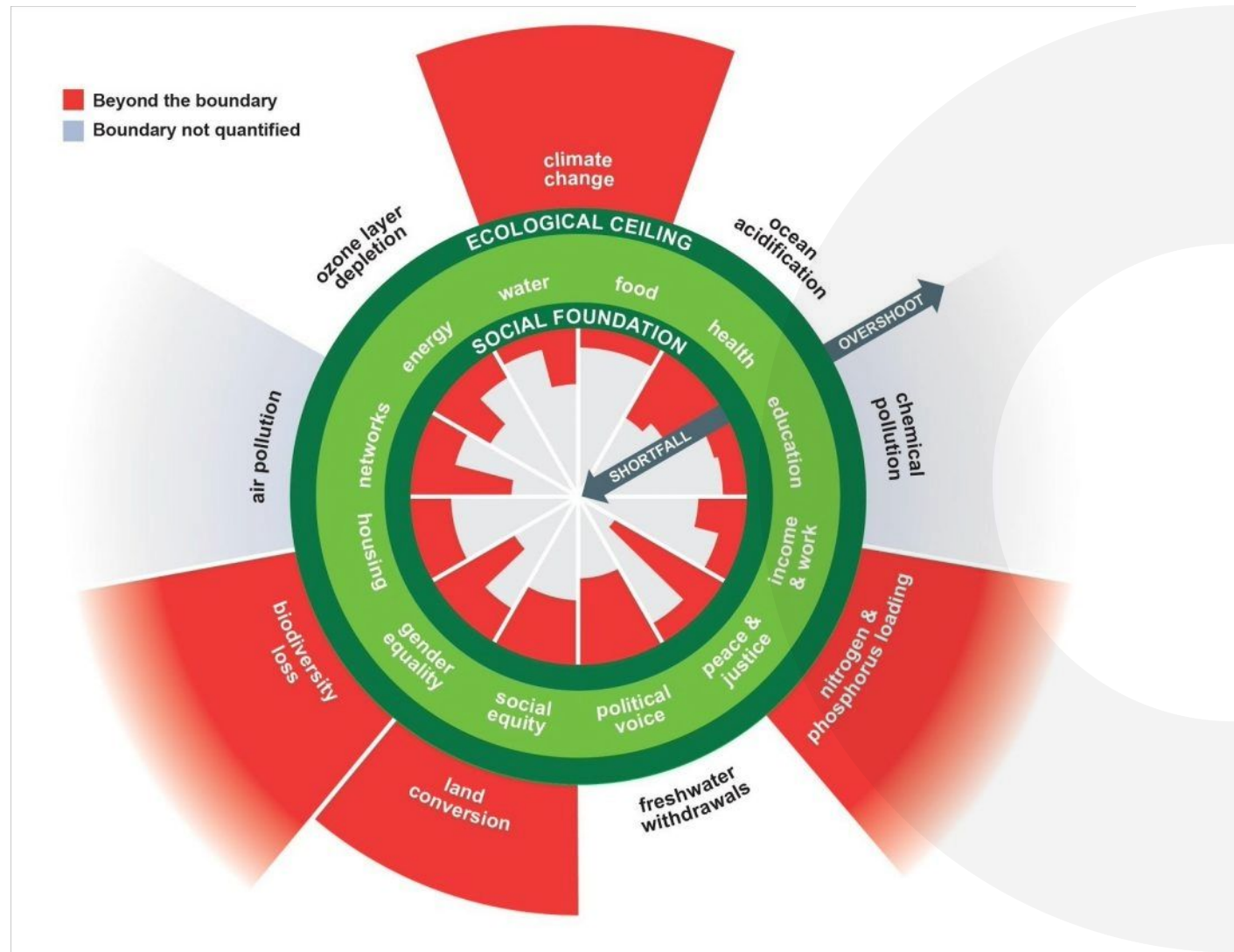
- Emphasize considerations at a **global level**
- Prioritize awareness of **ecological limits**



The double negative approach to sustainability

A safe and Just space (Raworth, 2017)

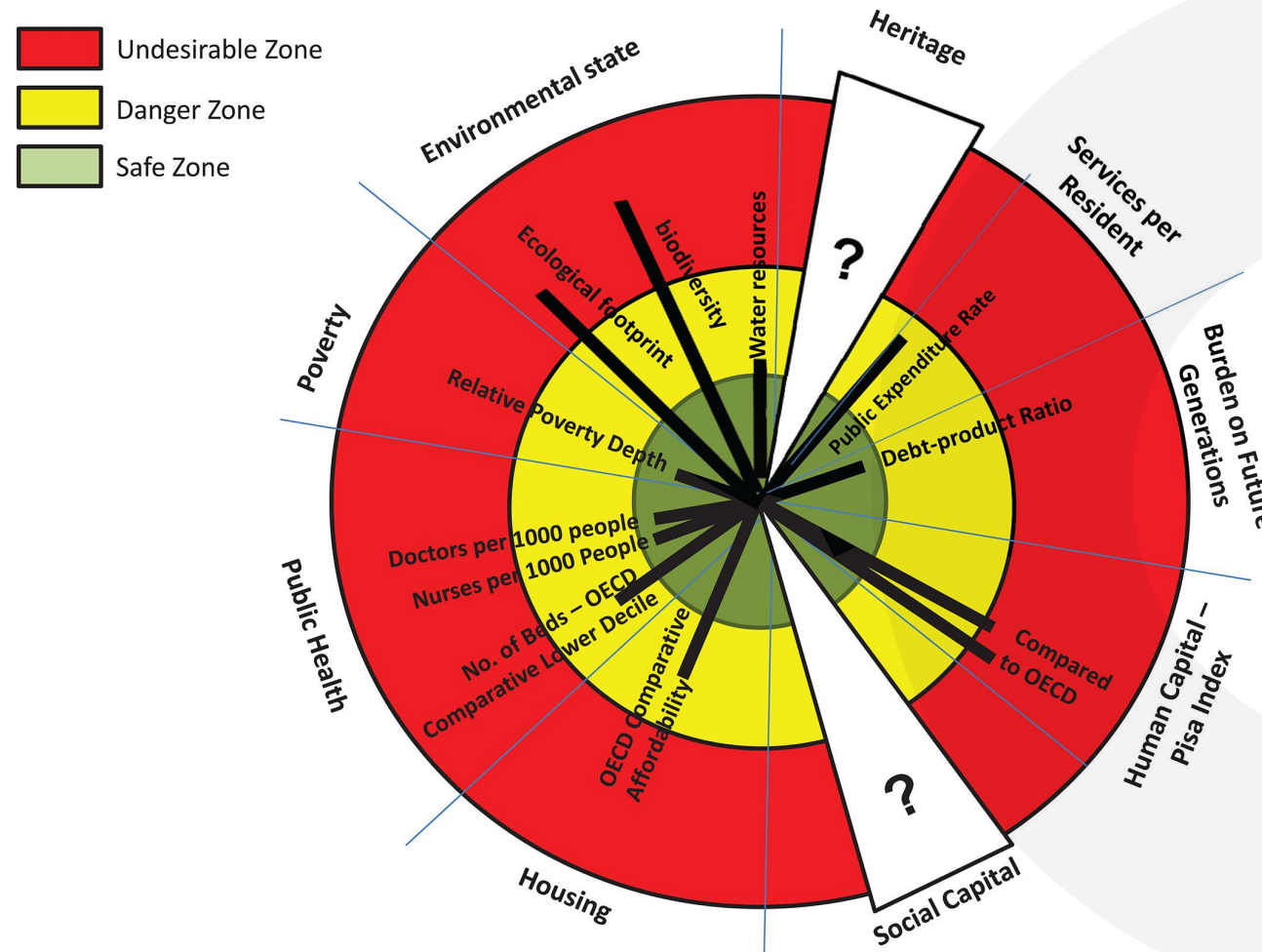
- **Safe:** respects ecological limits, ensuring that future states will be safe
- **Just:** safeguarding social and economic foundations, ensures that the state is just
- Emphasize considerations at **regional scales**
- Focusing on **economic** development



The double negative approach to sustainability

The “red line” method (Feitelson & Stern, 2023)

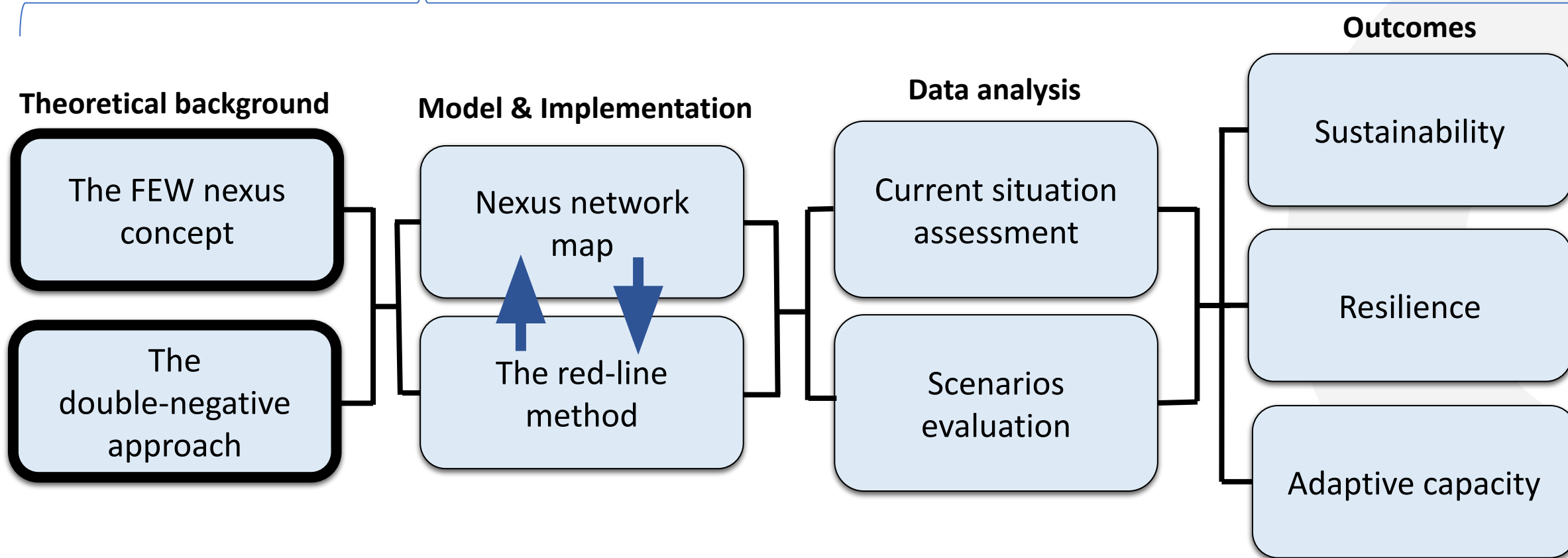
A scalable operational tool designed to apply the double-negative approach at various scales, particularly useful for addressing **local-scale concerns**



A satisficing & dynamic FEW nexus approach

Research aim

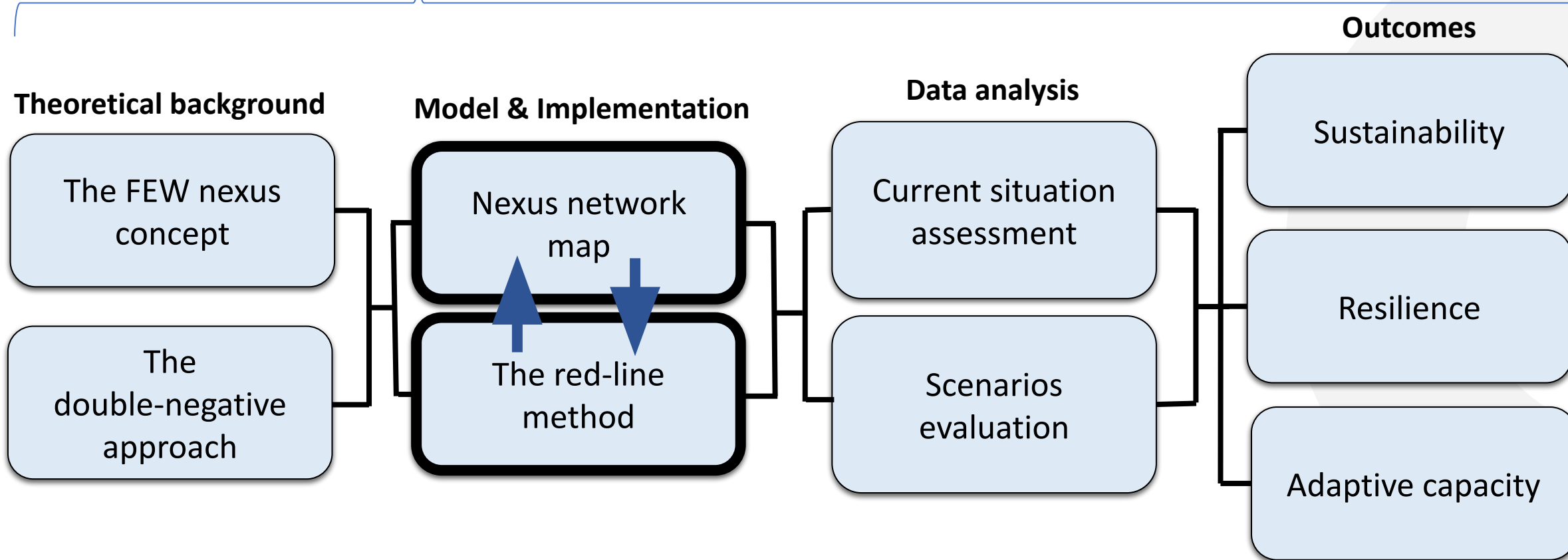
The dissertation aims to enhance the FEW Nexus concept's capacity to achieve sustainability, resilience, and adaptive capacity in **off-grid** communities



A satisficing & dynamic FEW nexus approach

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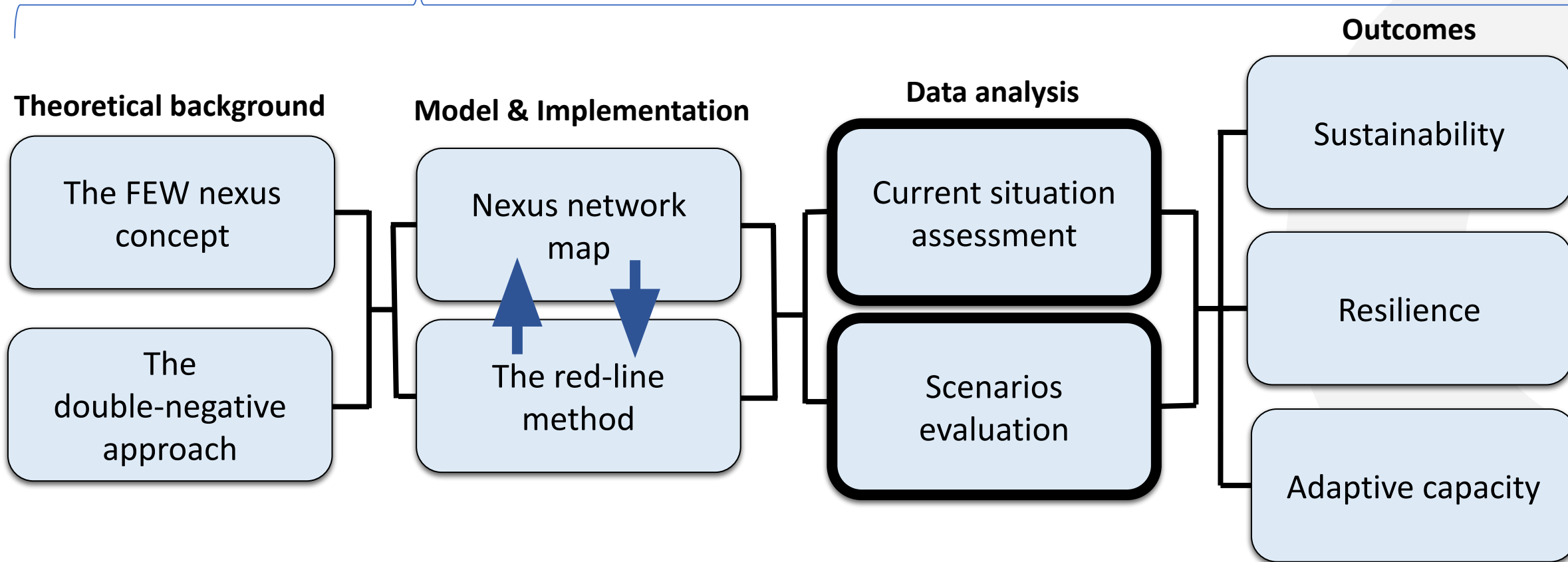
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A satisficing & dynamic FEW nexus approach

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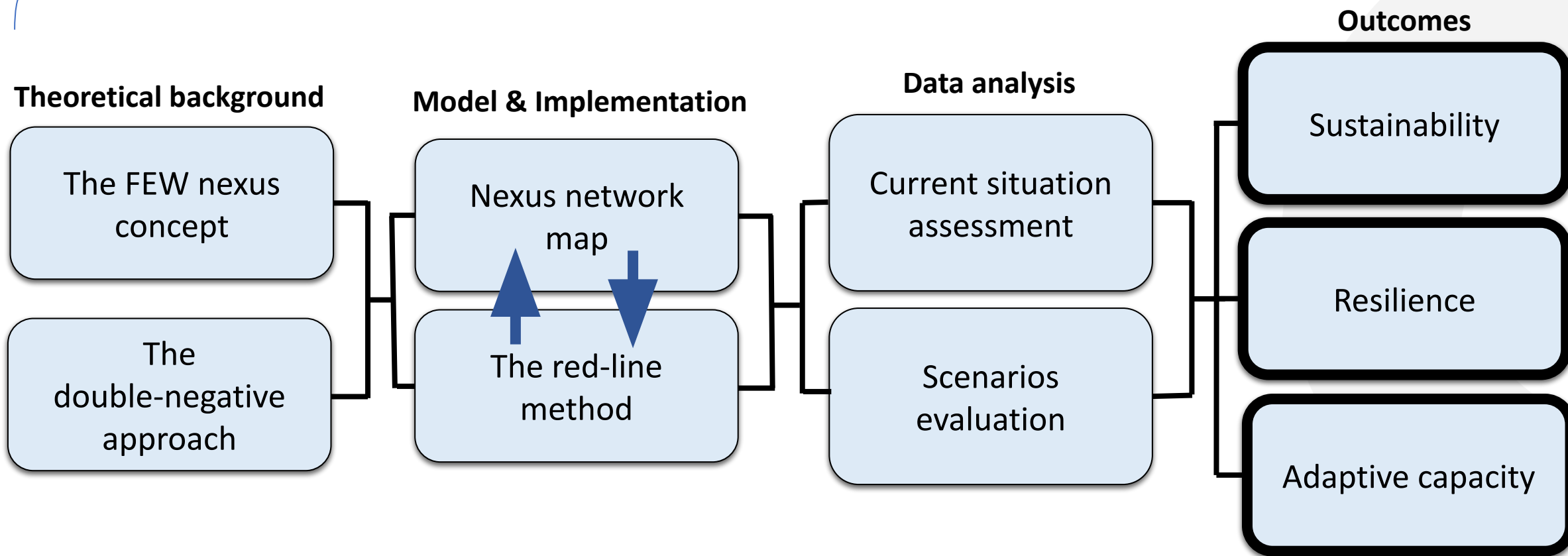
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A satisficing & dynamic FEW nexus approach

Research aim

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A satisficing & dynamic FEW nexus model

The FEW redlines diagram

An example of a potential FEW redlines diagram in an off-grid village

Undesirable Zone



Danger Zone



A Safe & Just Space



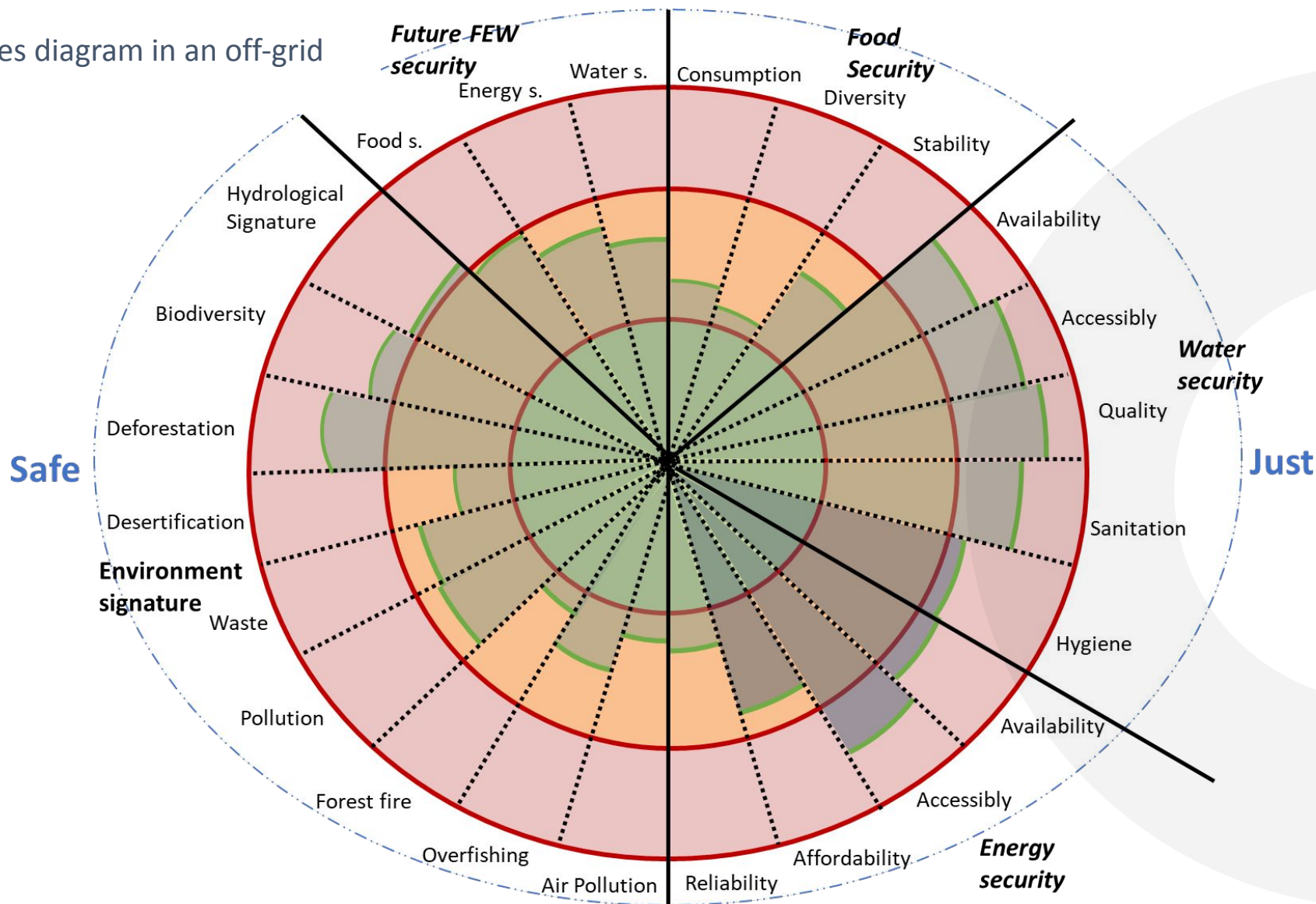
Current state



Lower threshold



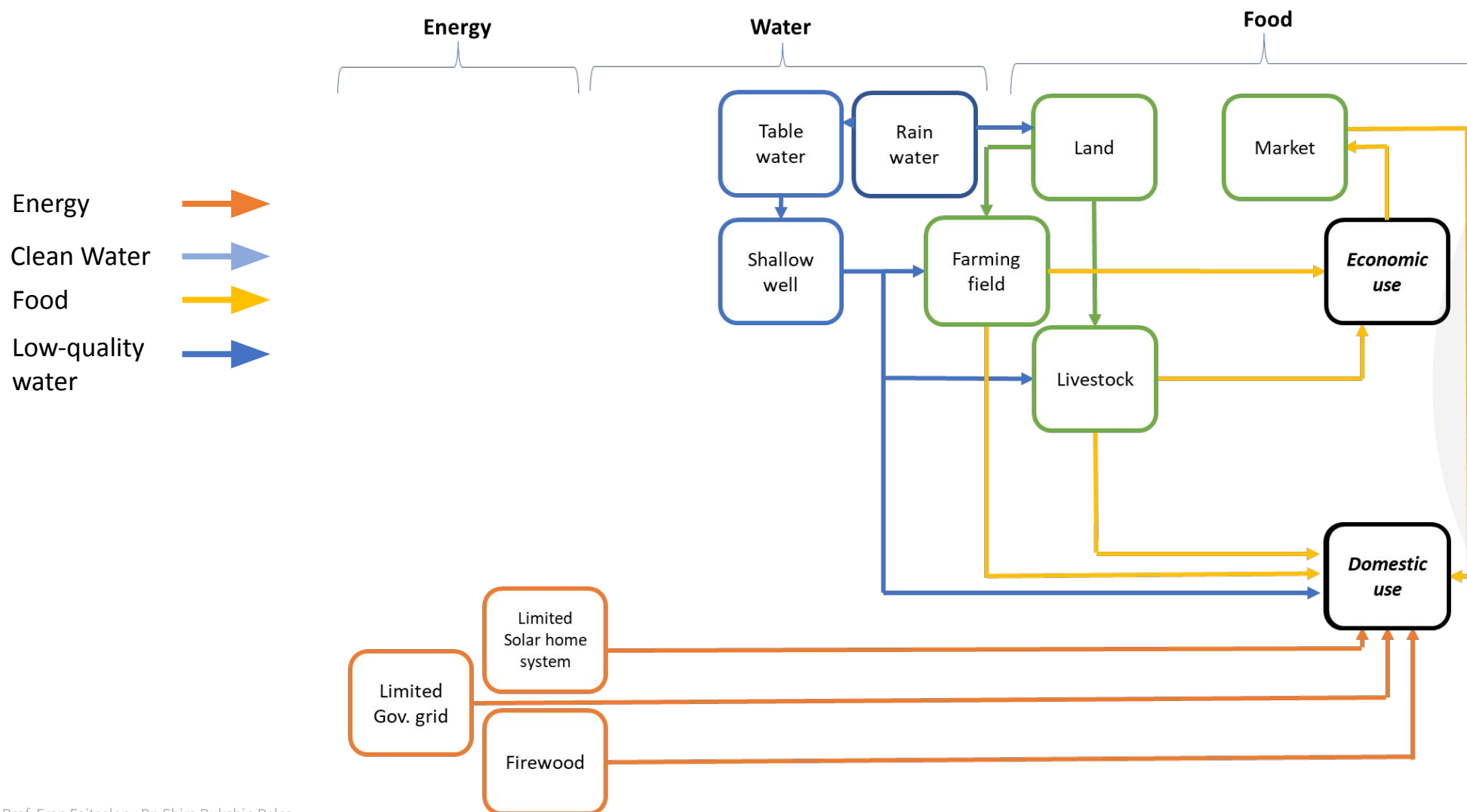
The ratio between the
current state to red lines



A satisficing & dynamic FEW nexus model

The FEW nexus network

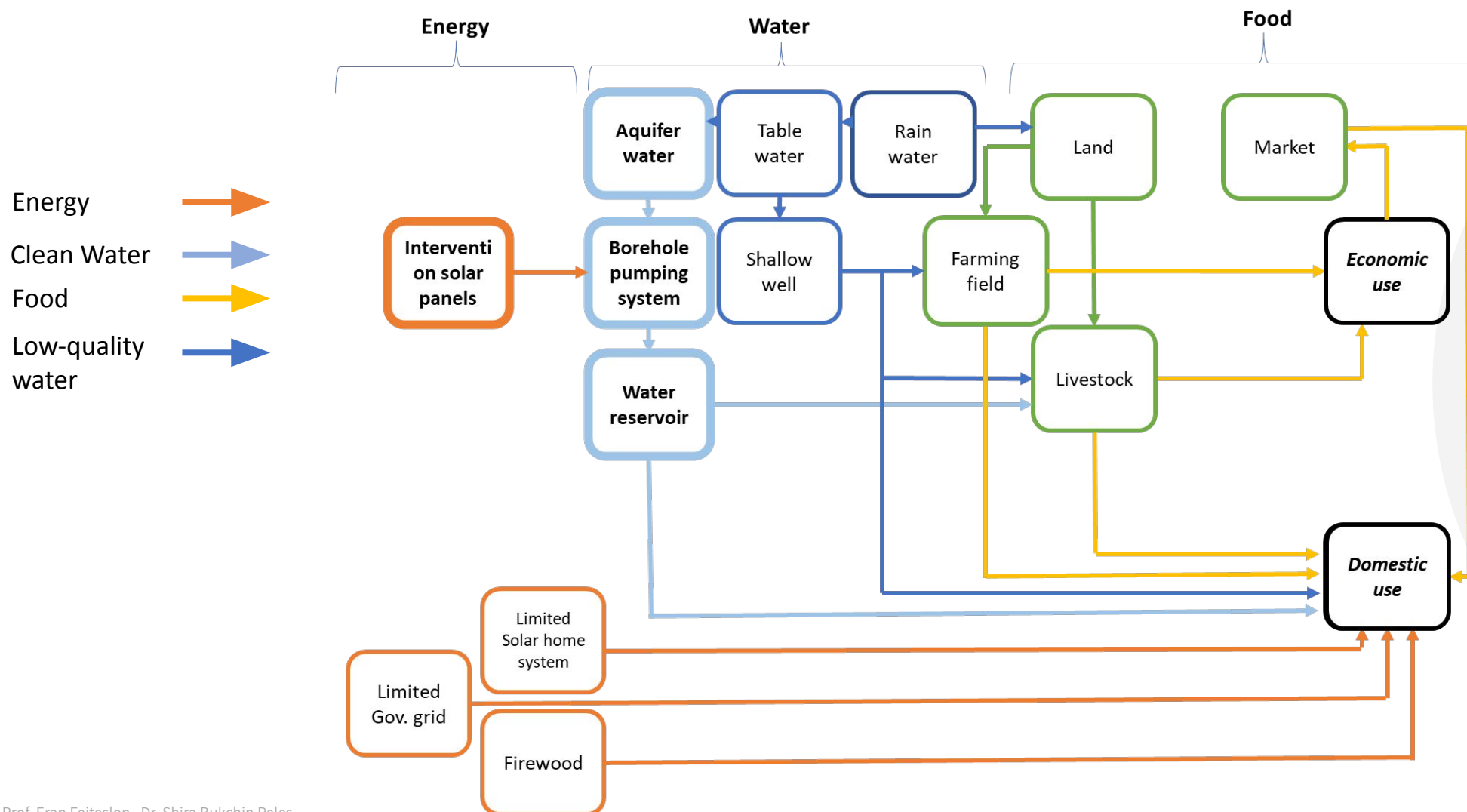
An example of a potential FEW nexus network in an off-grid village - **No intervention**



A satisficing & dynamic FEW nexus model

The FEW nexus network

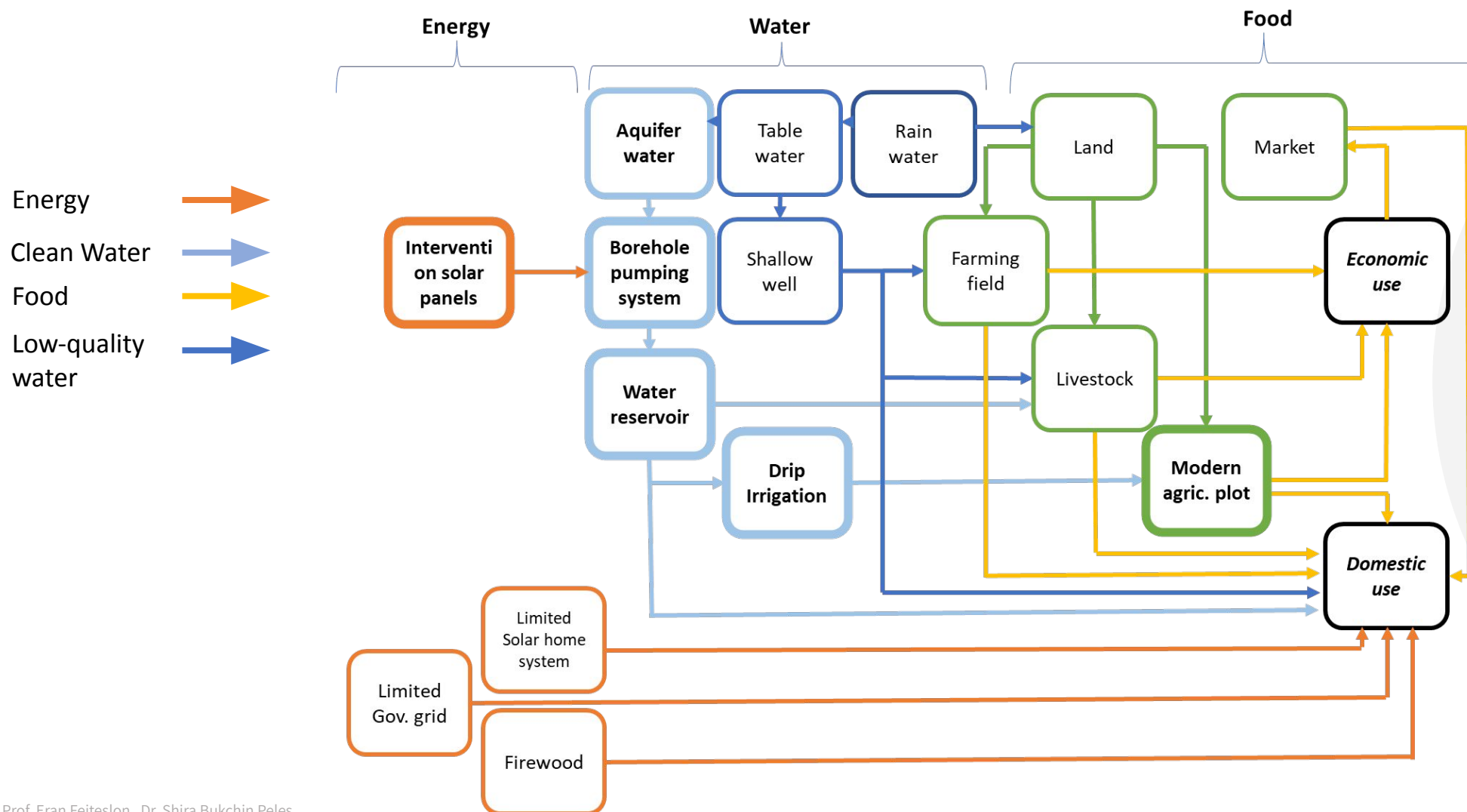
An example of a potential FEW nexus network in an off-grid village - **Partial intervention**



A satisficing & dynamic FEW nexus model

The FEW nexus network

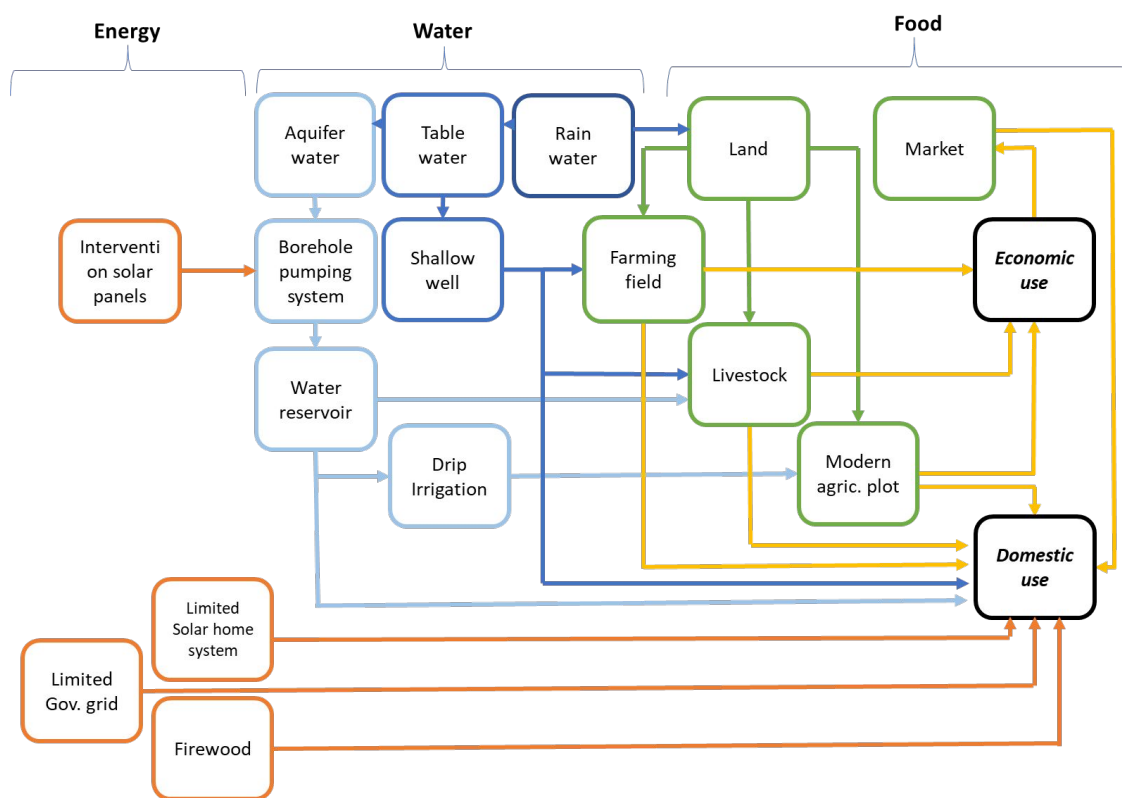
An example of a potential FEW nexus network in an off-grid village - **Full intervention**



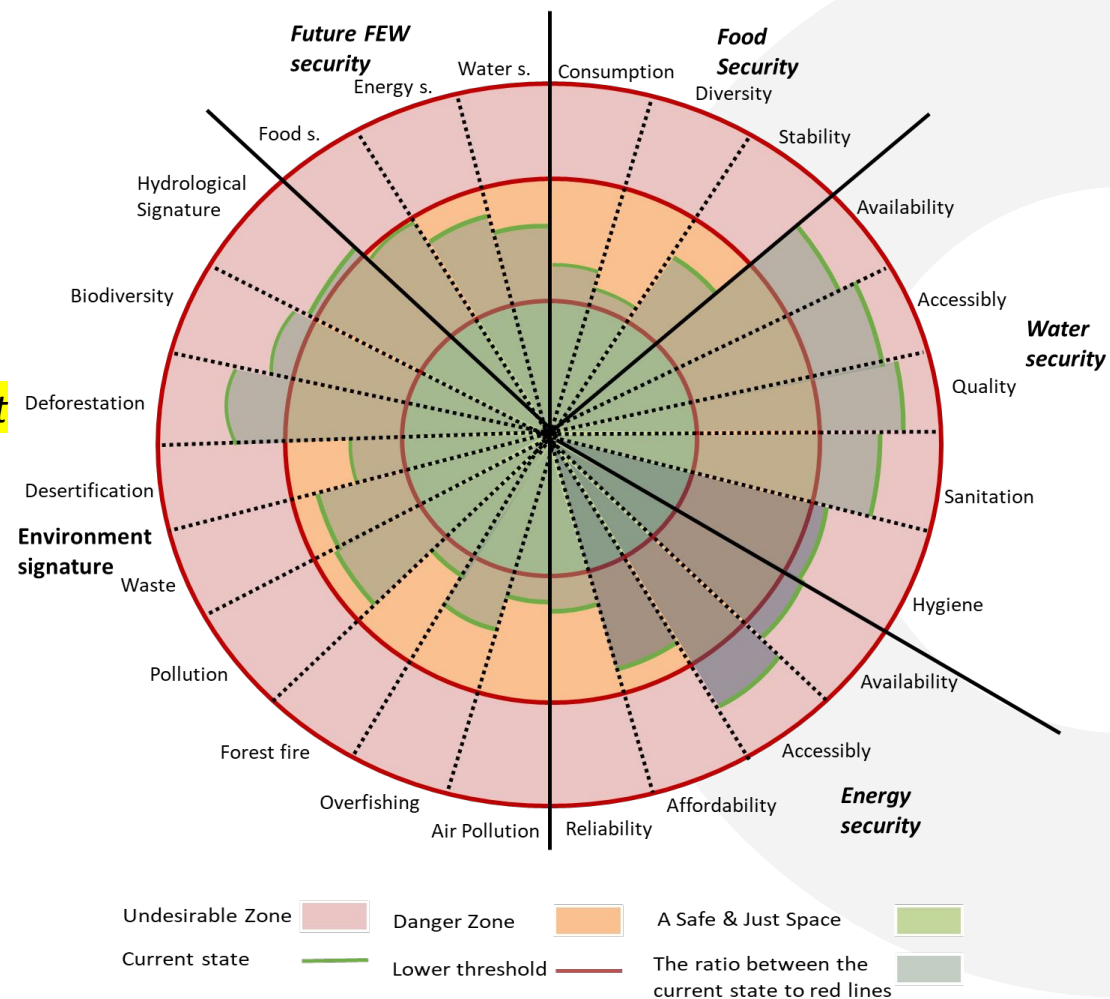
A satisficing & dynamic FEW nexus model

1. Current situation

The **nexus** determines options for movement, while the **red lines** determine the constraints on what outcomes are desirable



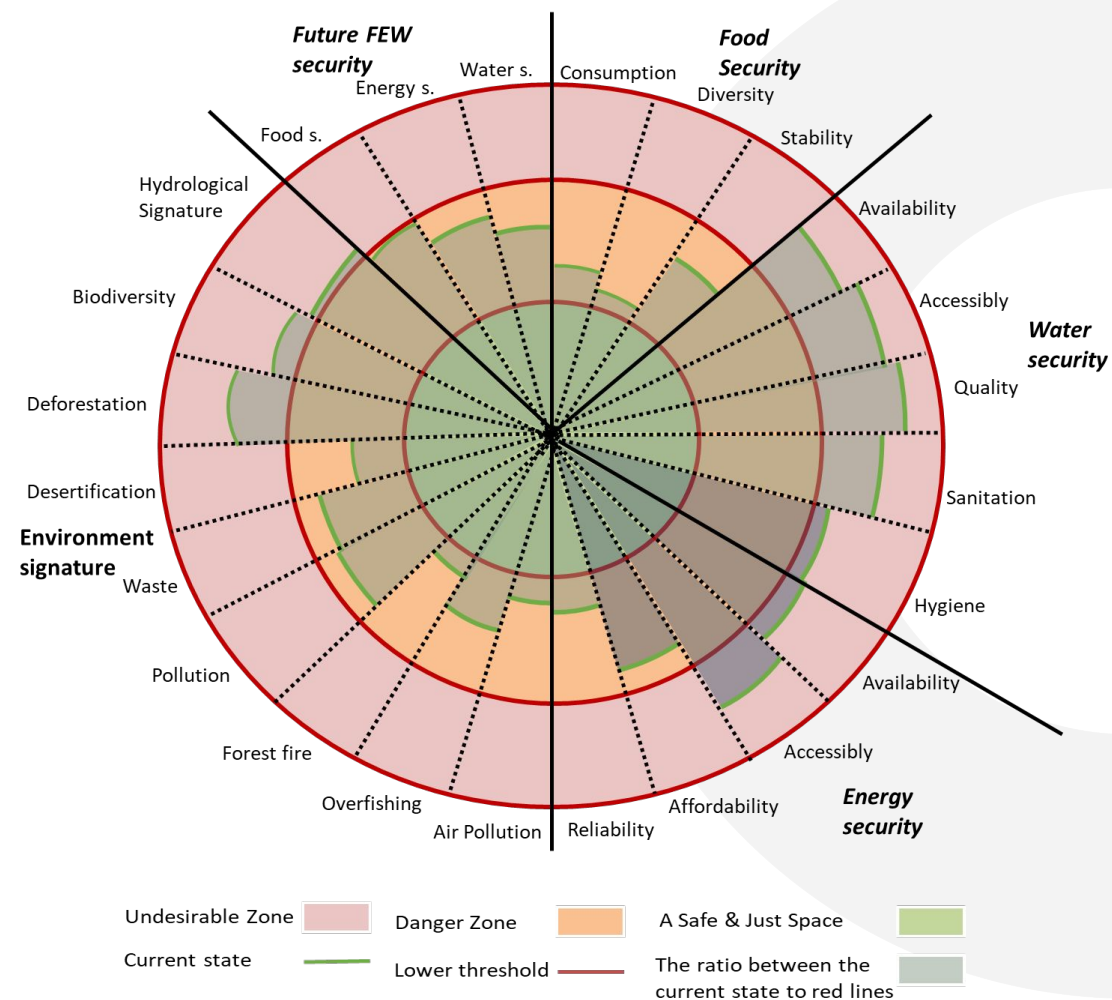
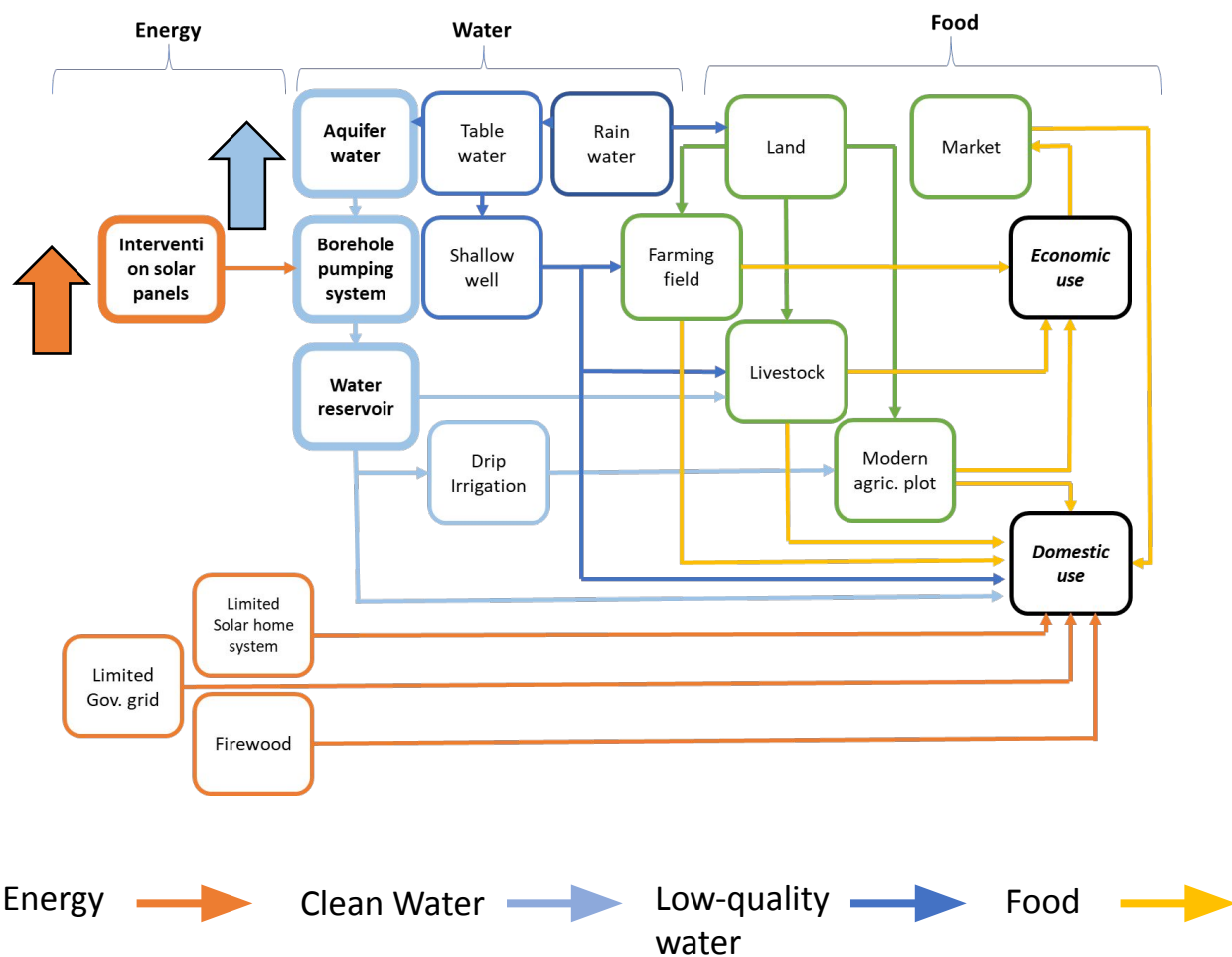
Synchronized interdependent



A satisficing & dynamic FEW nexus model

2. Scenarios Evaluation

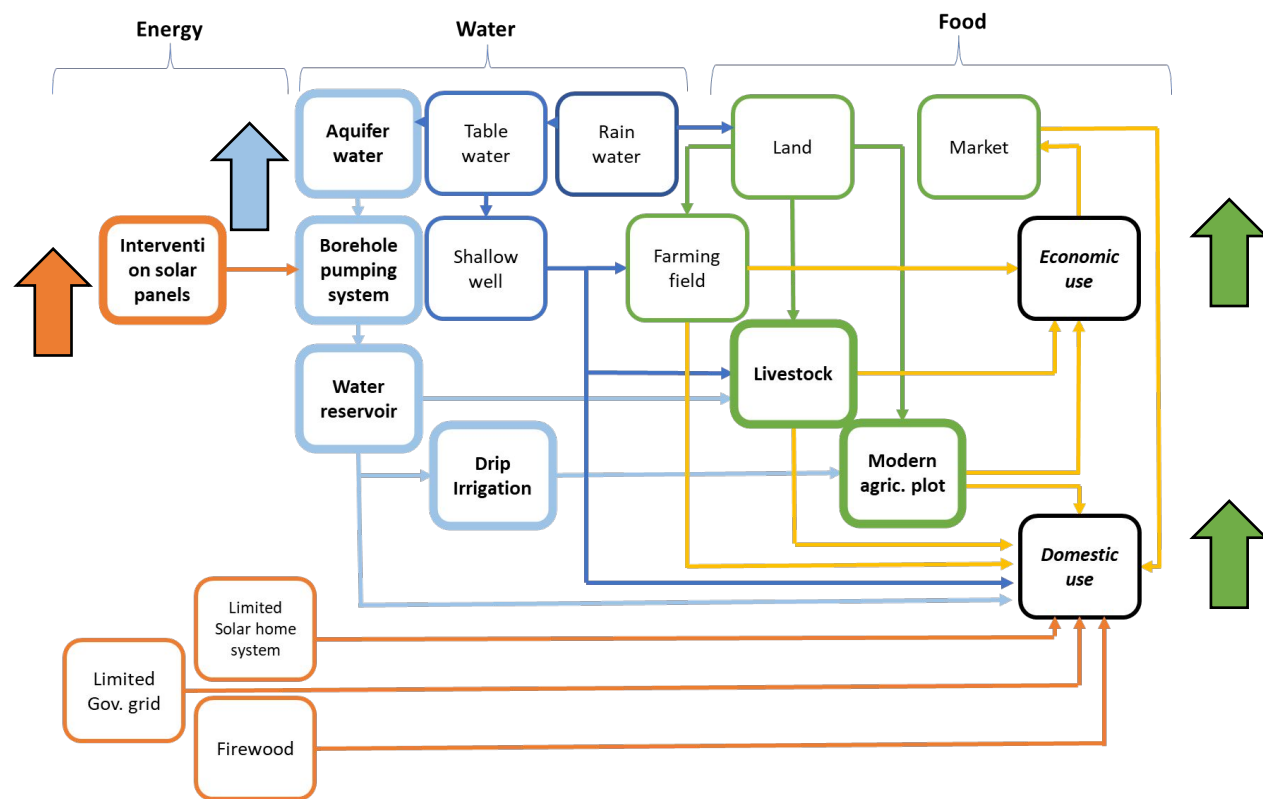
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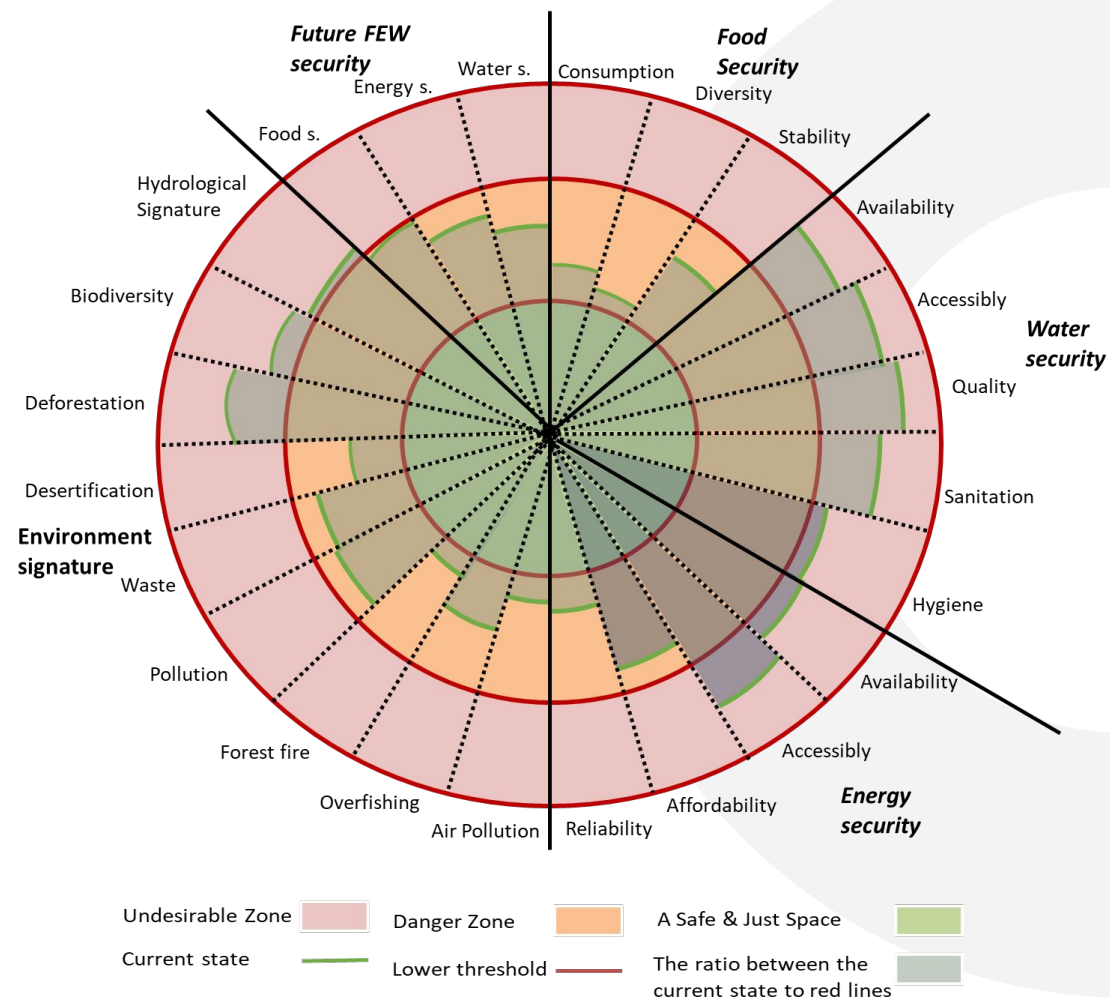
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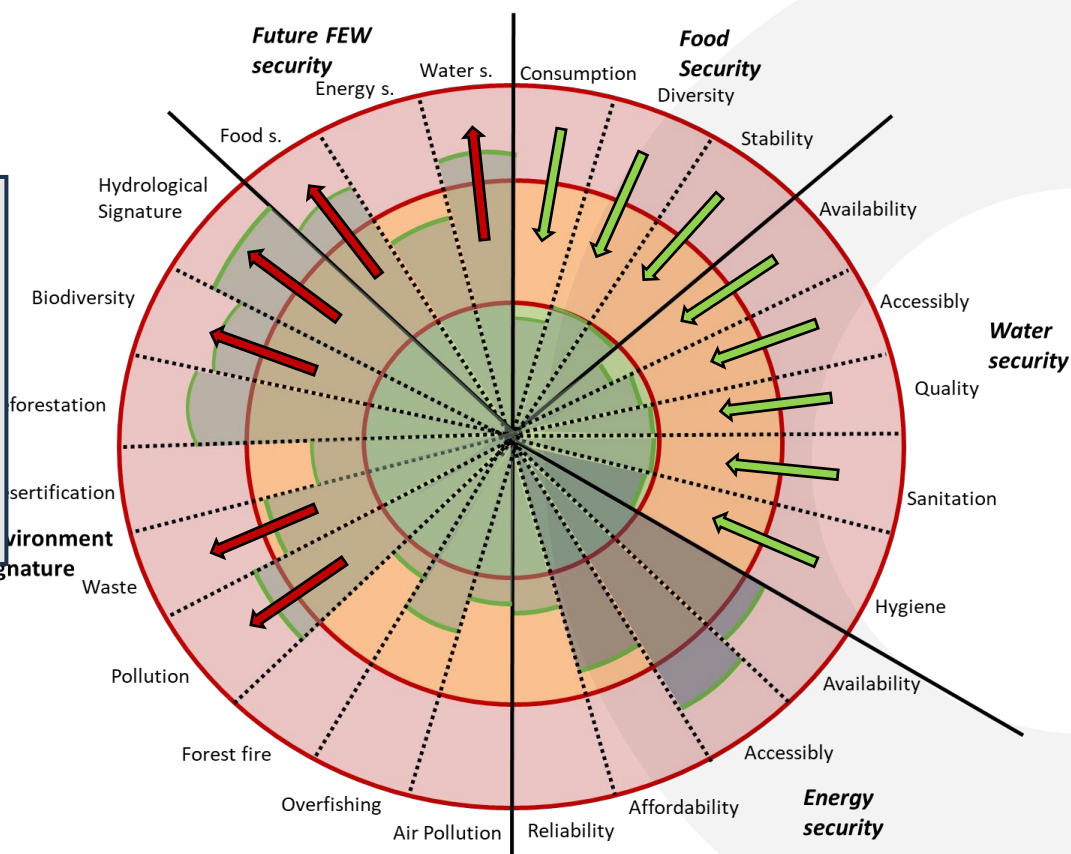
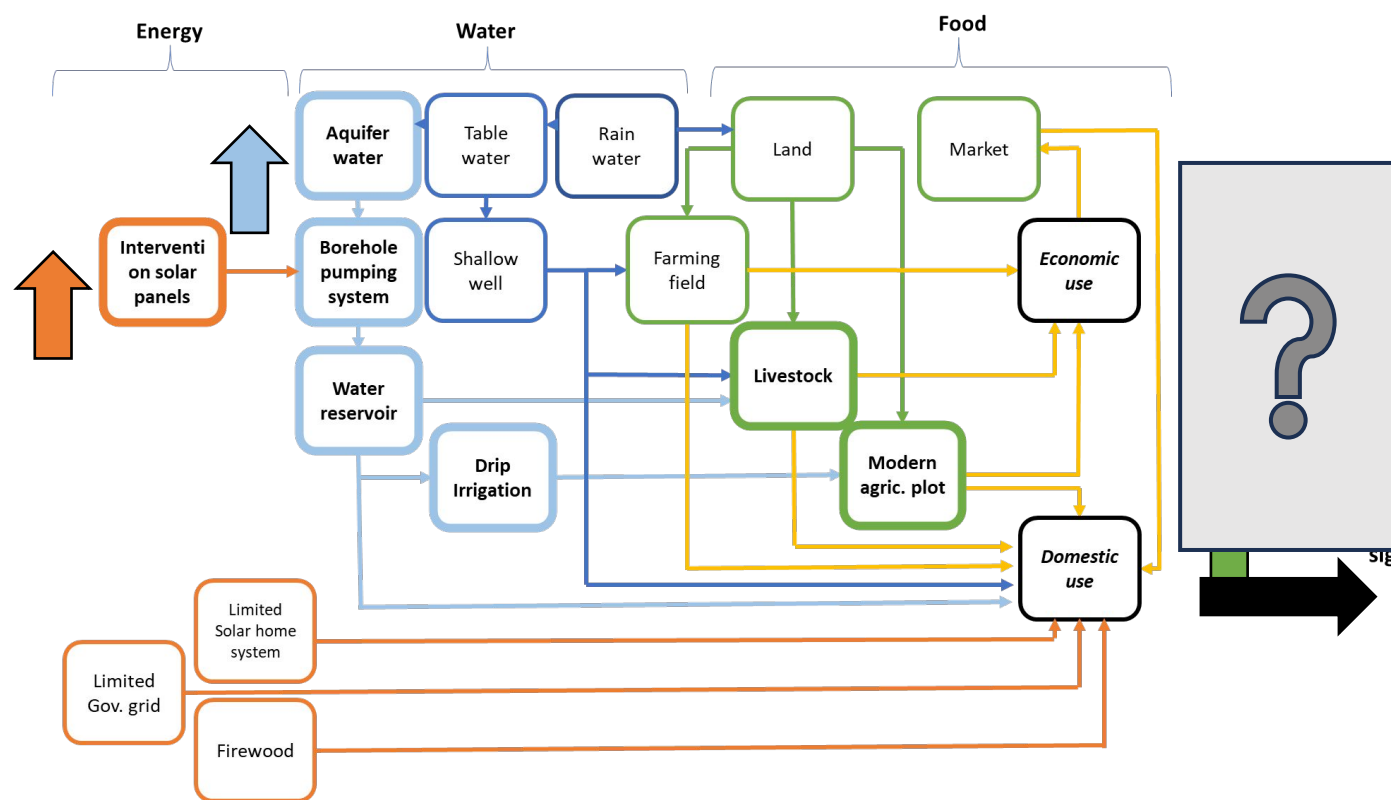
Energy → Clean Water → Low-quality water → Food



A satisficing & dynamic FEW nexus model

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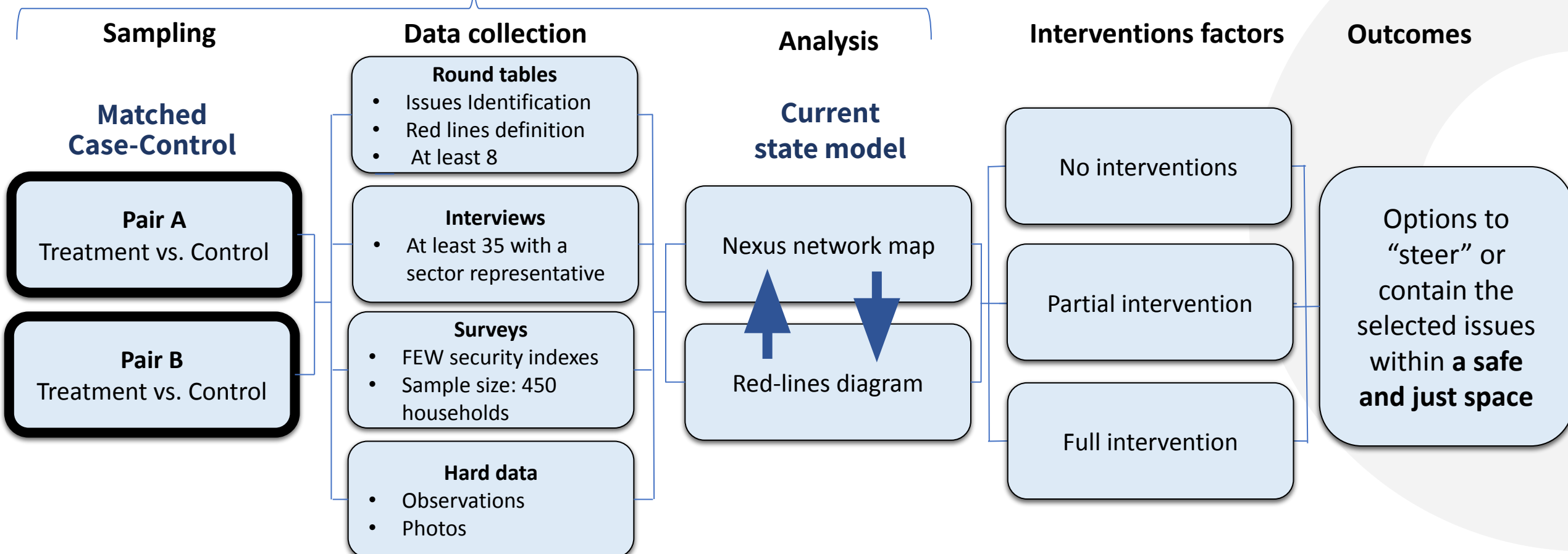


Energy → Clean Water → Low-quality water → Food →

Research design

First stage: current situation assessment

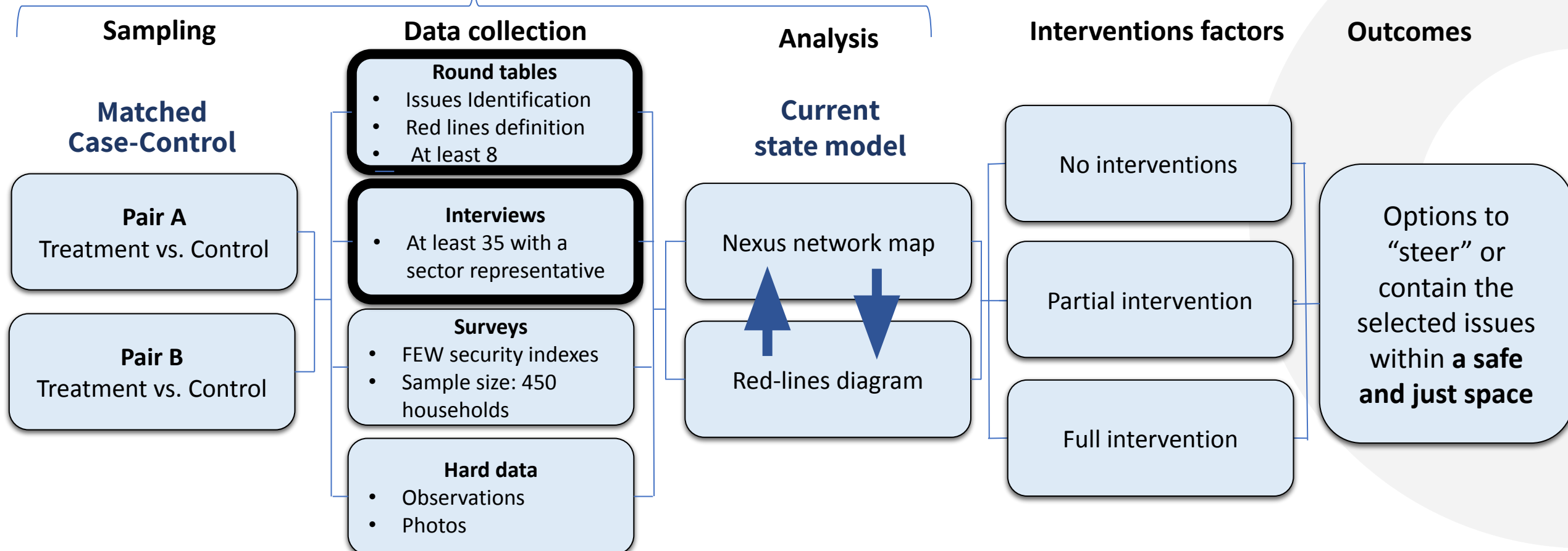
Question 1: How can safe and just spaces be identified across various dimensions of the off-grid FEW nexus?



Research design

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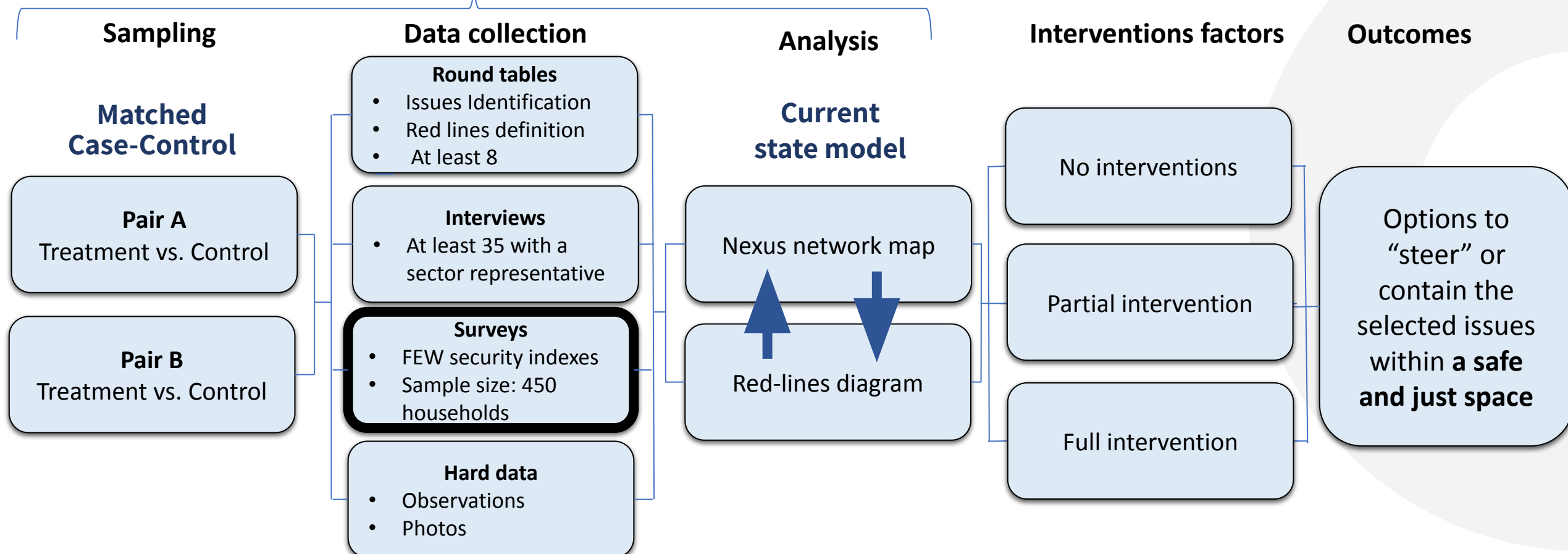
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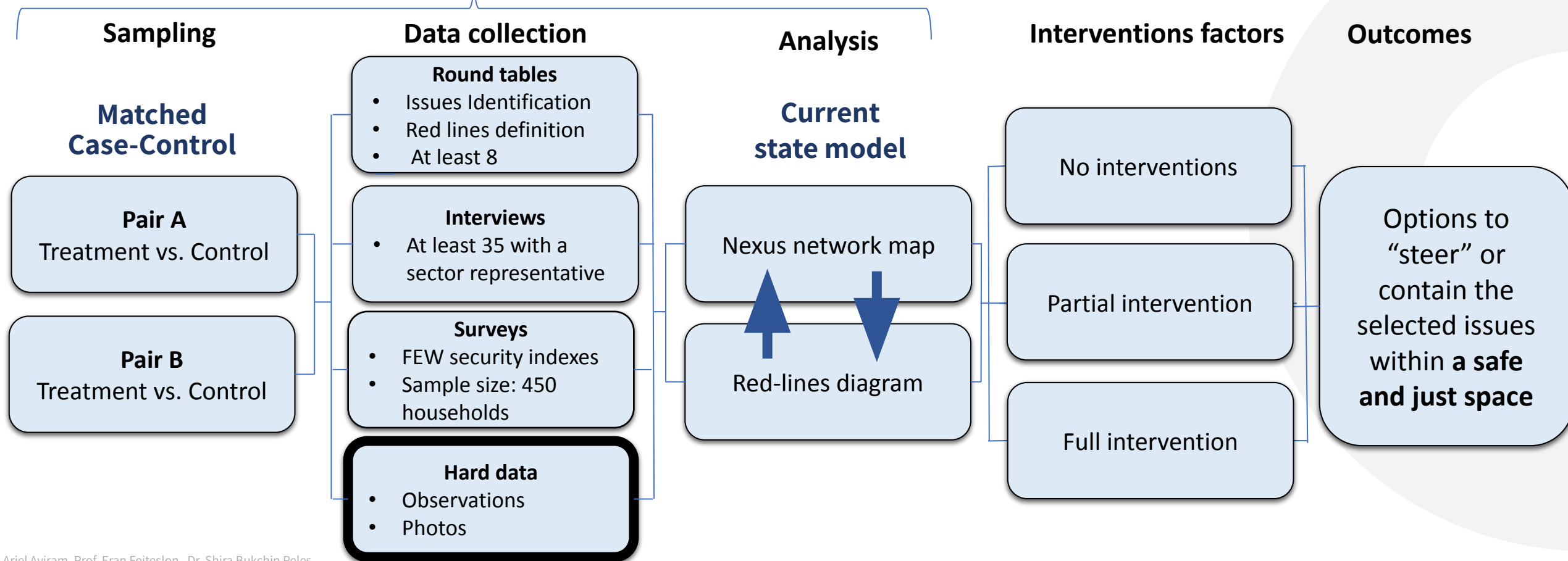
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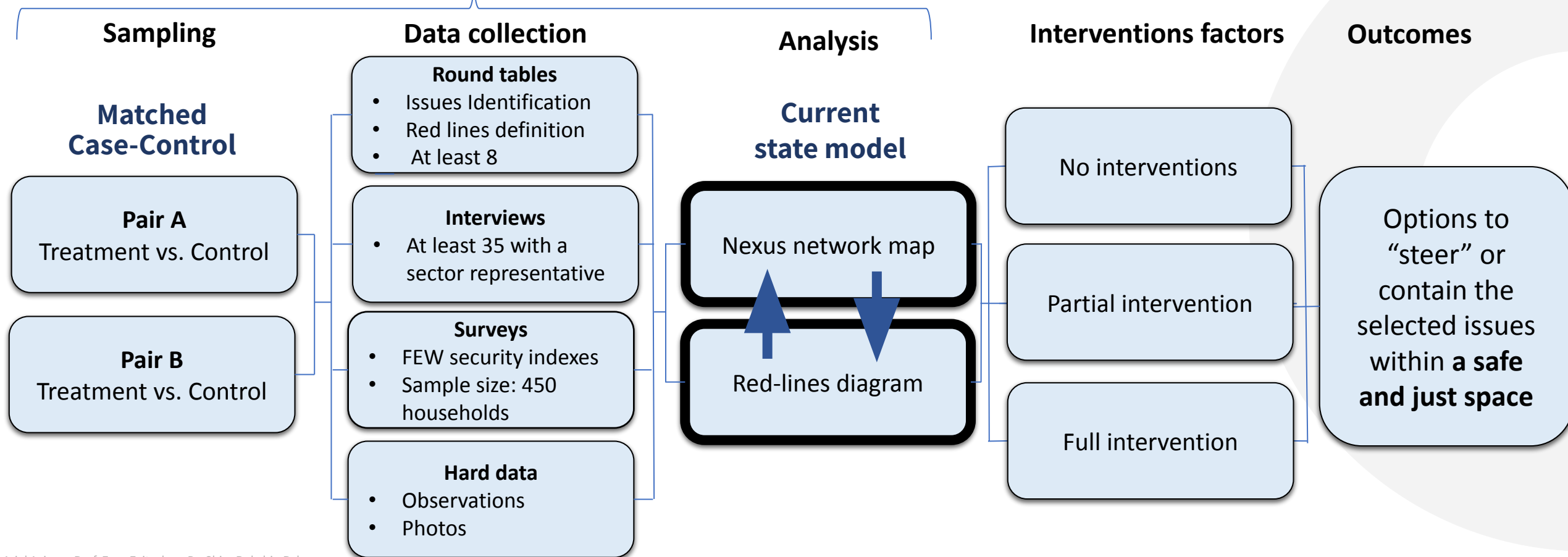
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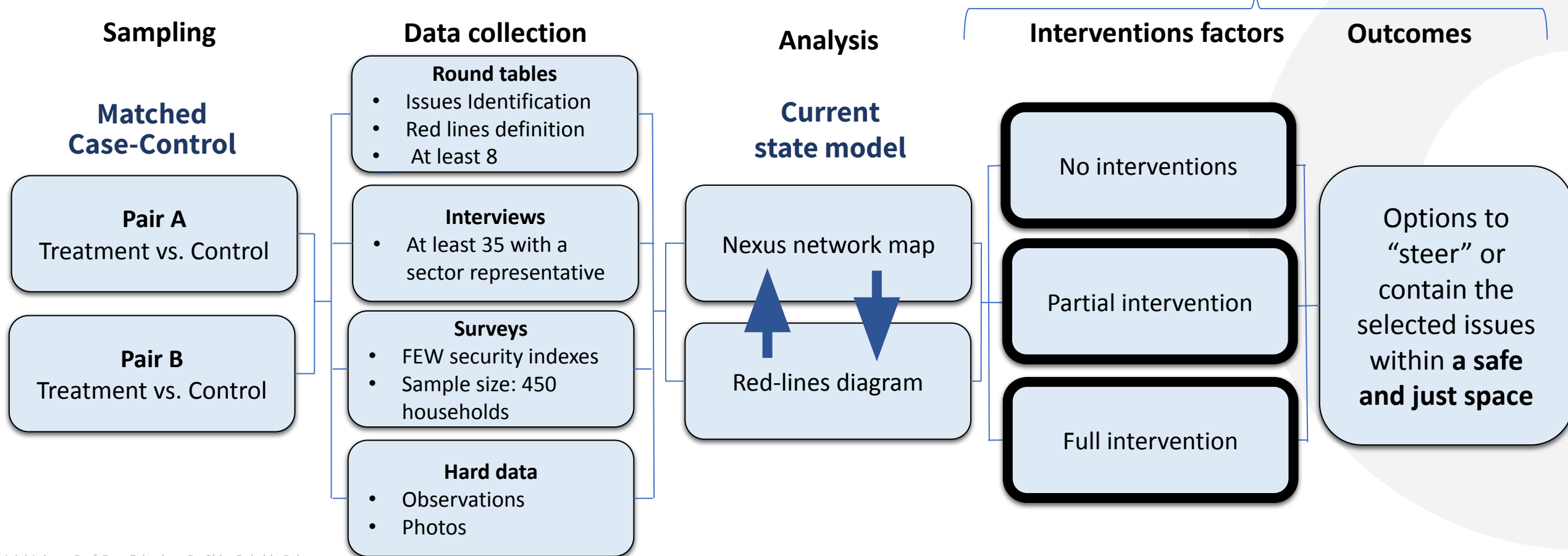
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Research design

Second stage: scenario evaluation

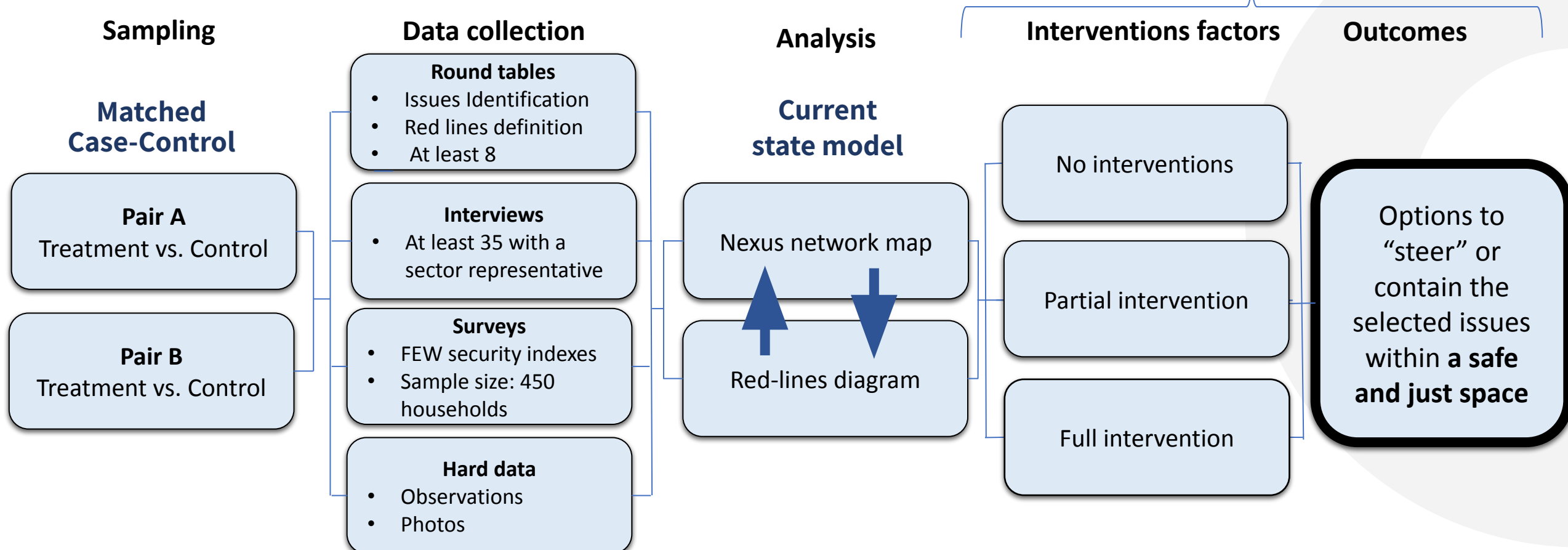
Question 2: Under which circumstances can off-grid communities manage their local FEW resources sustainably?



Research design

Second stage: scenario evaluation

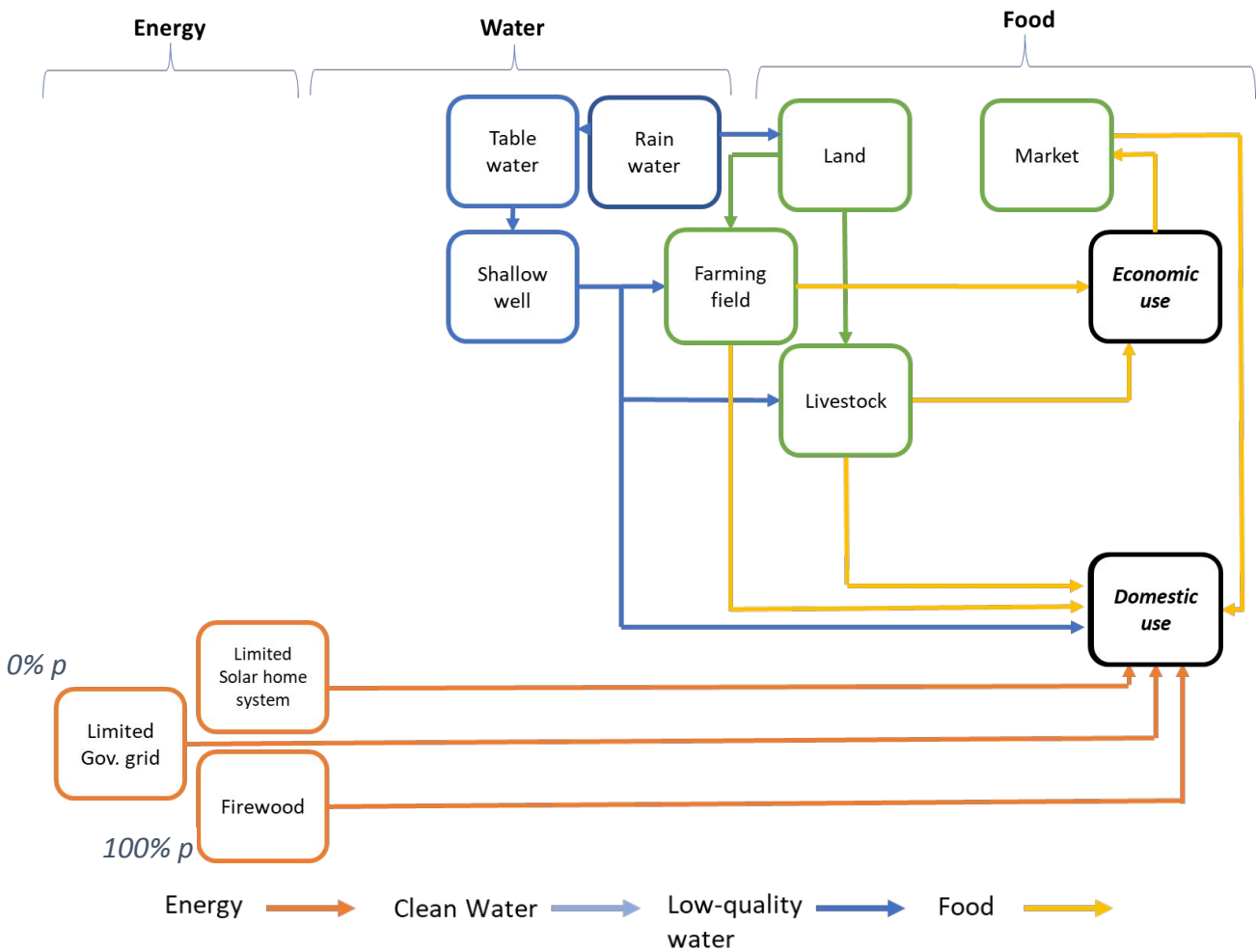
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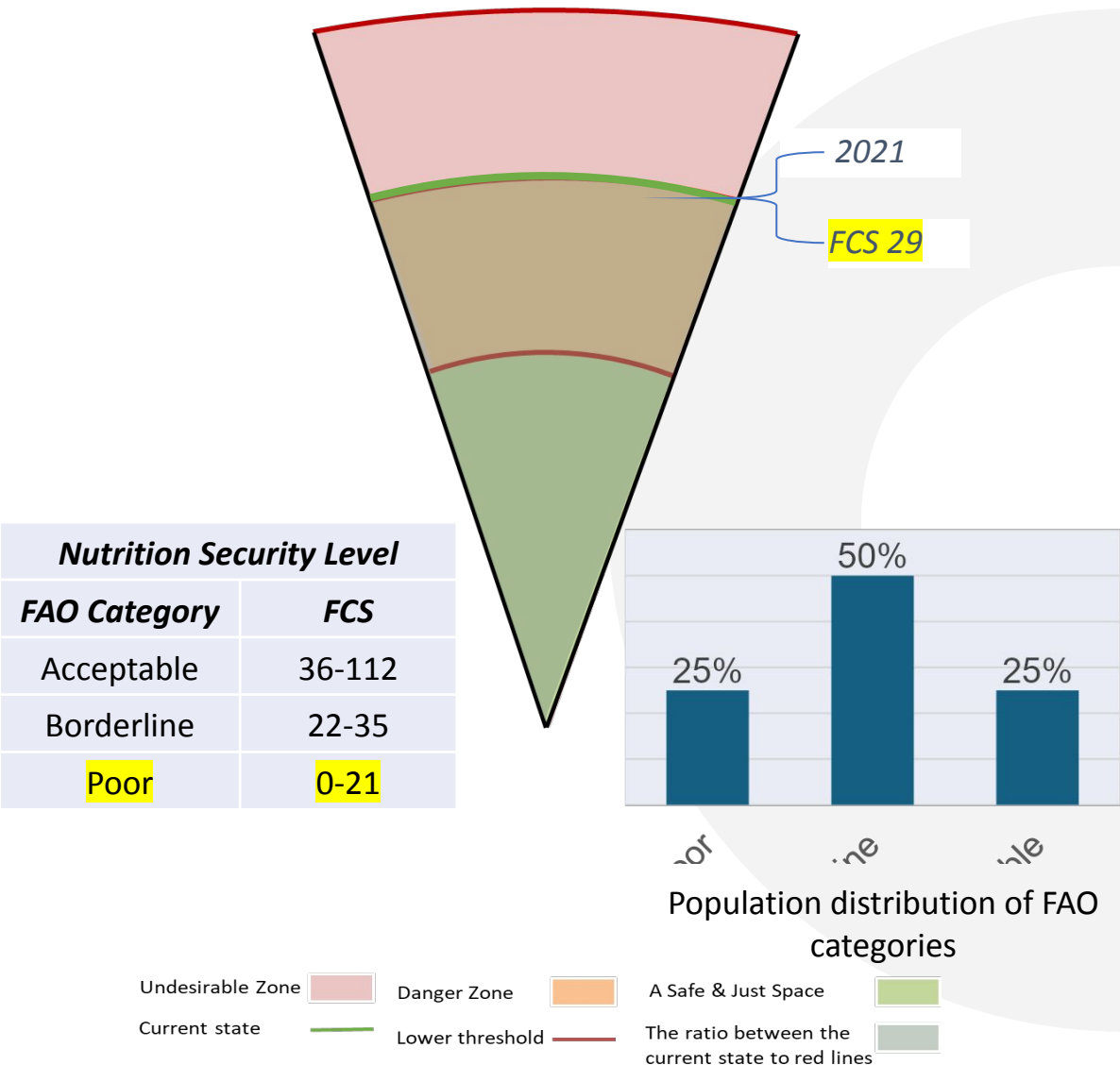
Food Security

Consumption & Diversity

Chinoje Village - *No intervention*



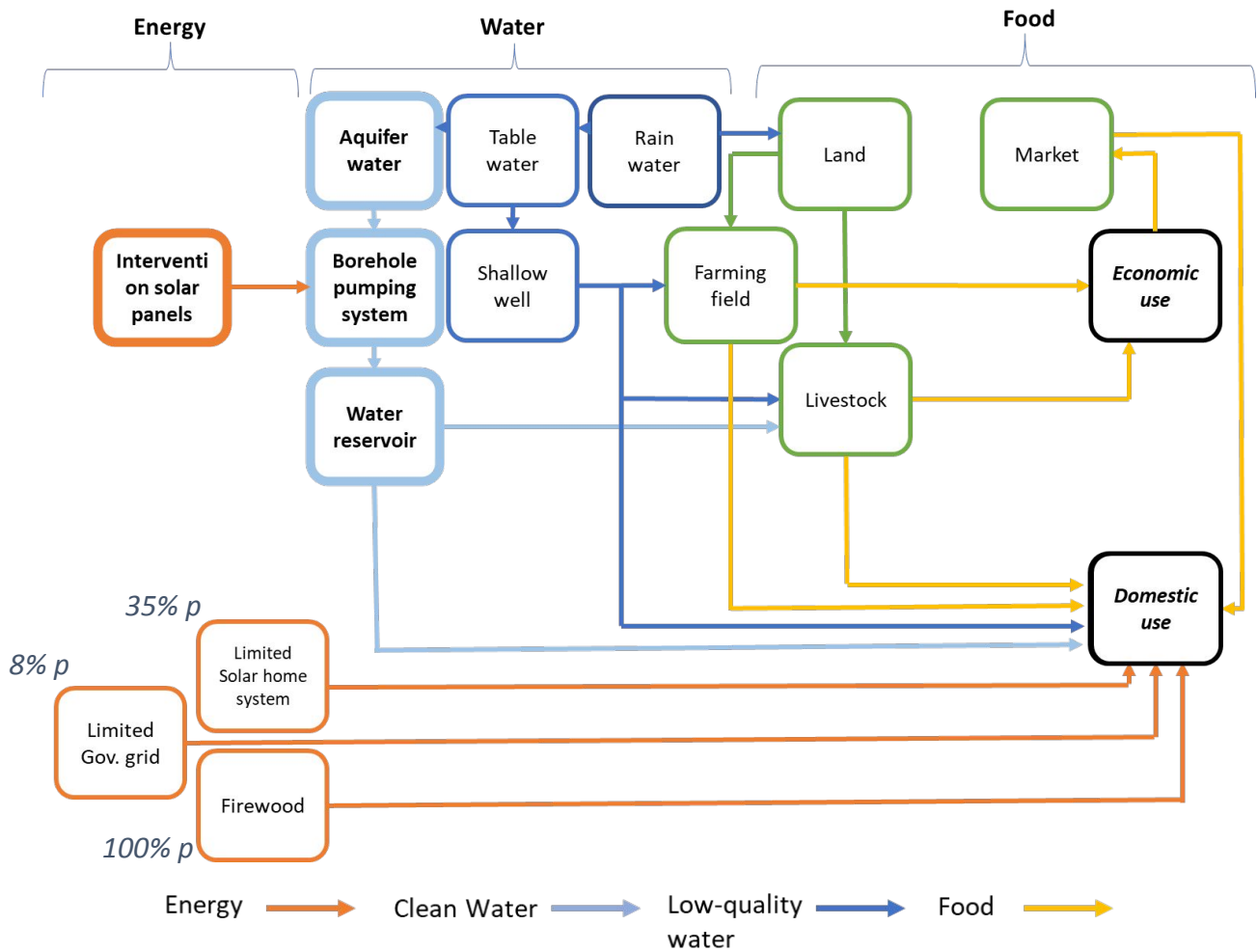
Food Consumption Score (Before)



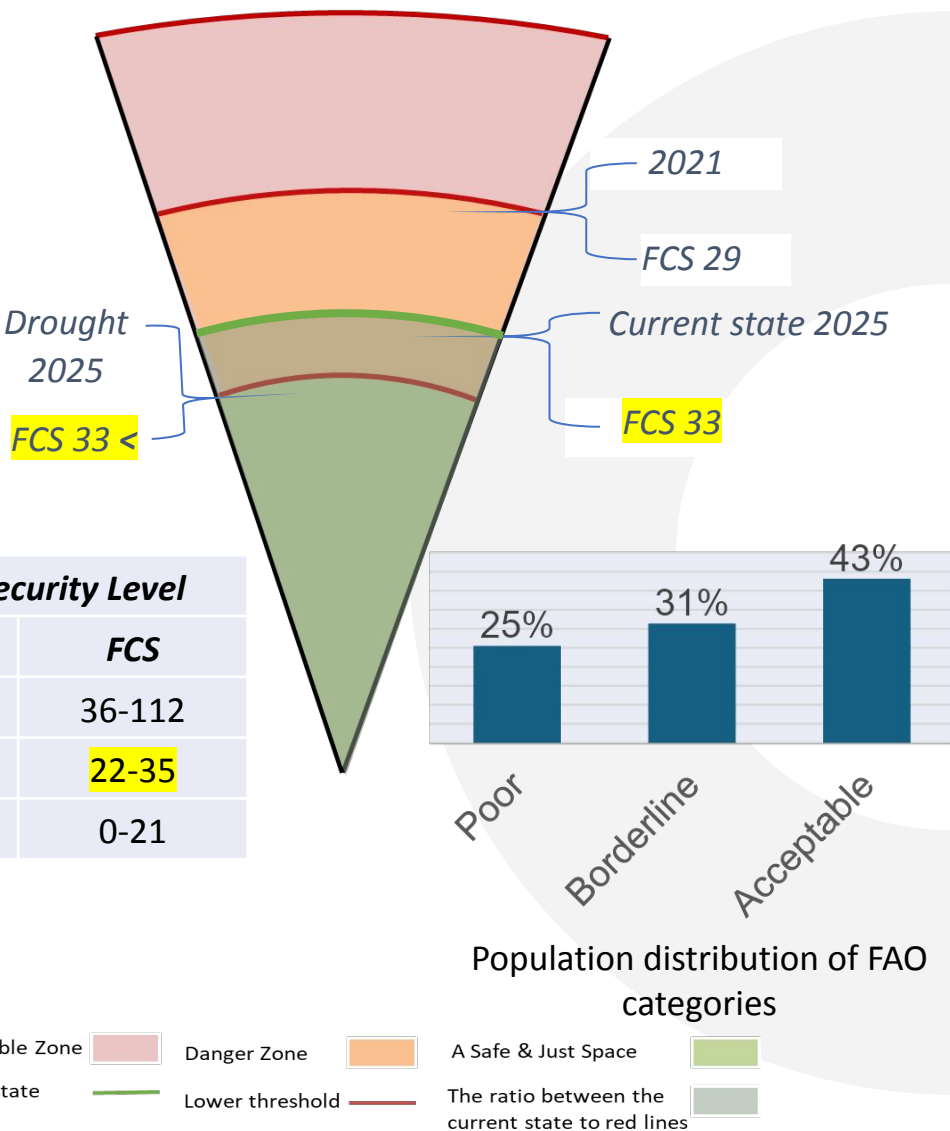
Food Security

Consumption & Diversity

Chinoje Village - *Partial intervention*



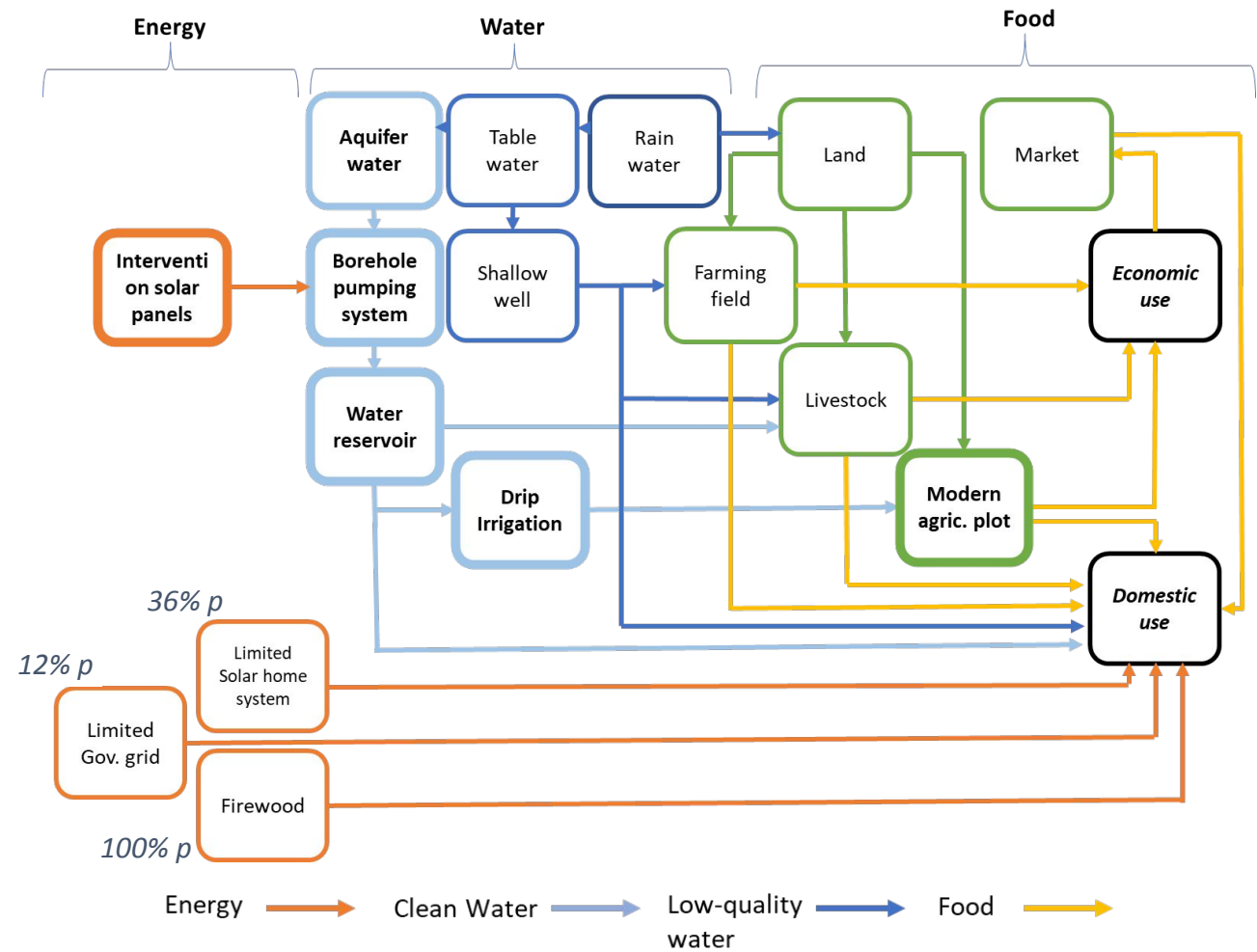
Food Consumption Score (Current state)



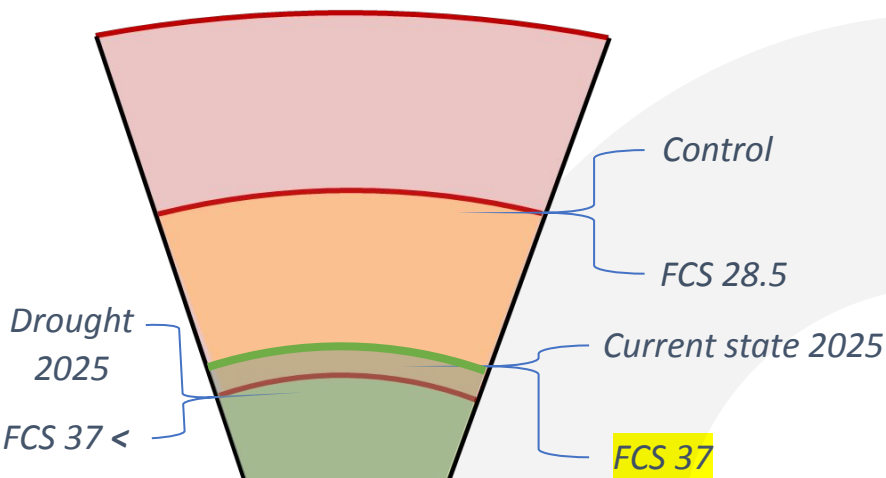
Food Security

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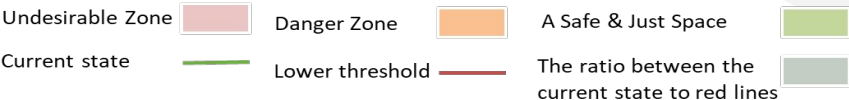
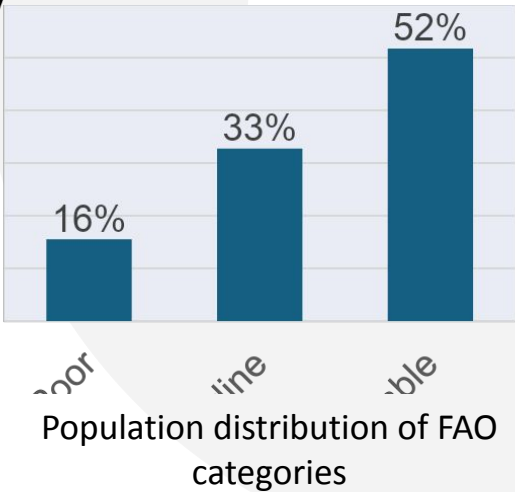
Mabalangu Village - *Full intervention*



Food Consumption Score (Current state)



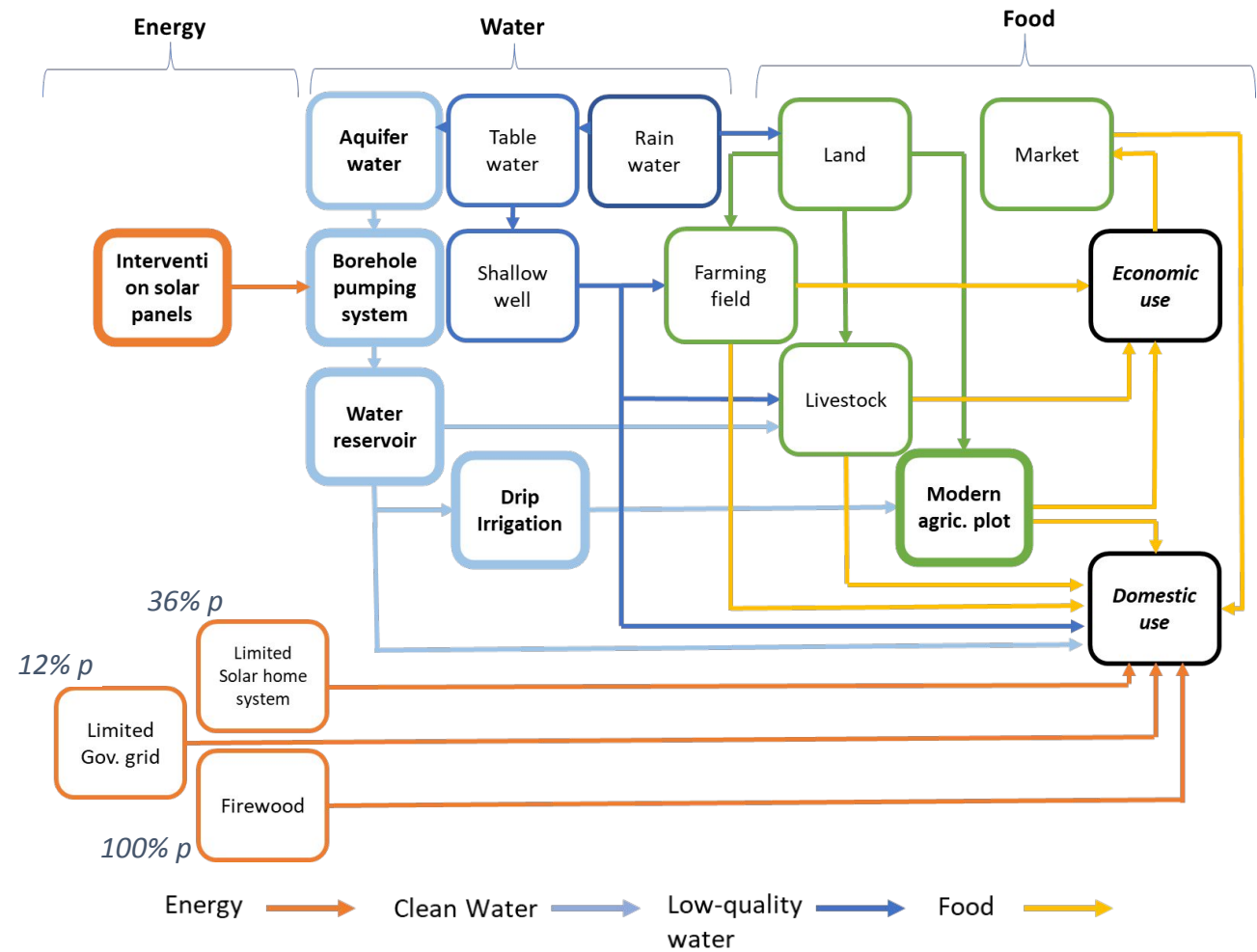
Nutrition Security Level	
FAO Category	FCS
Acceptable	36-112
Borderline	22-35
Poor	0-21



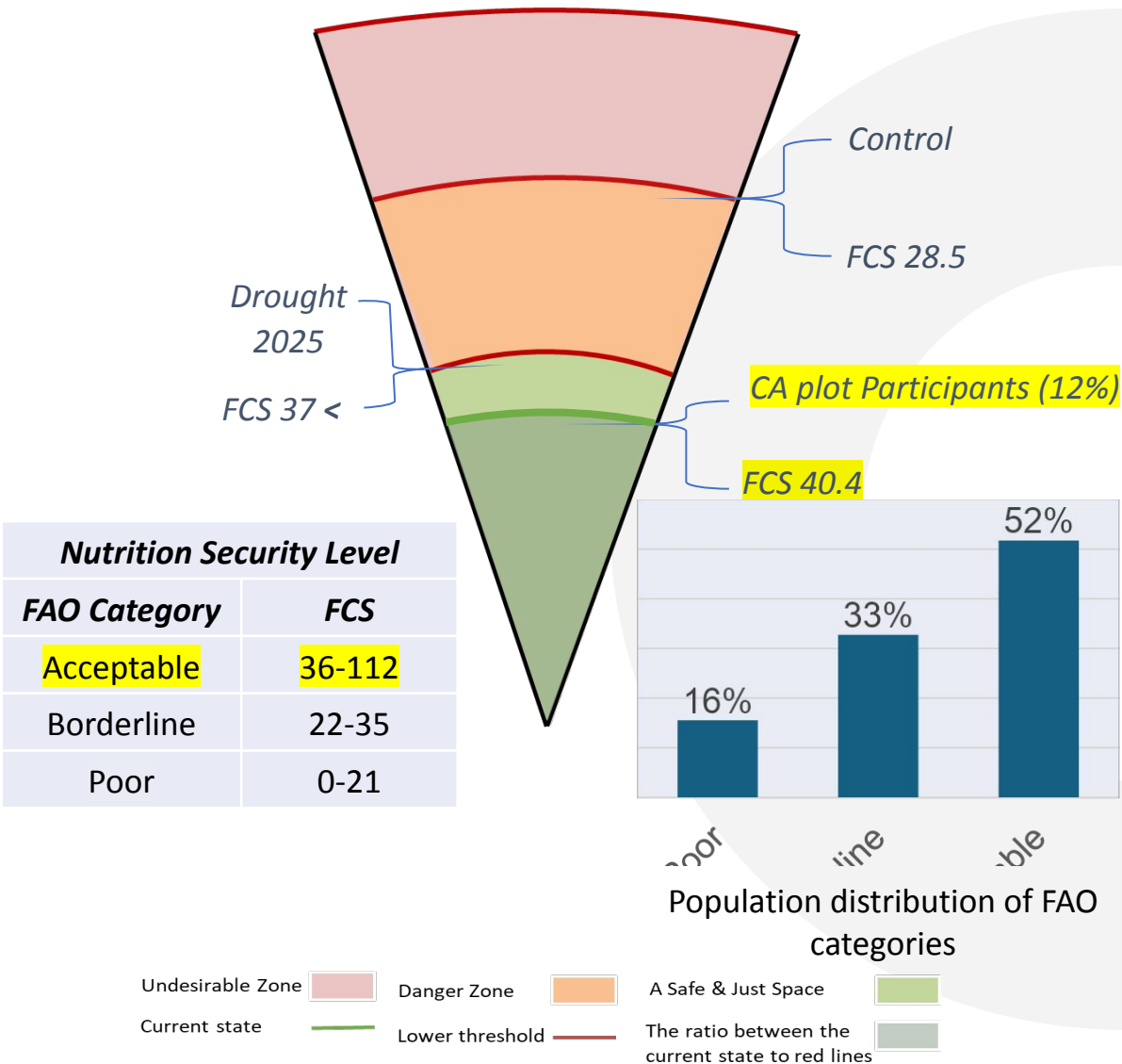
Food Security

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Food Consumption Score (Current state)



Thank You

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