Agrivoltaics AA

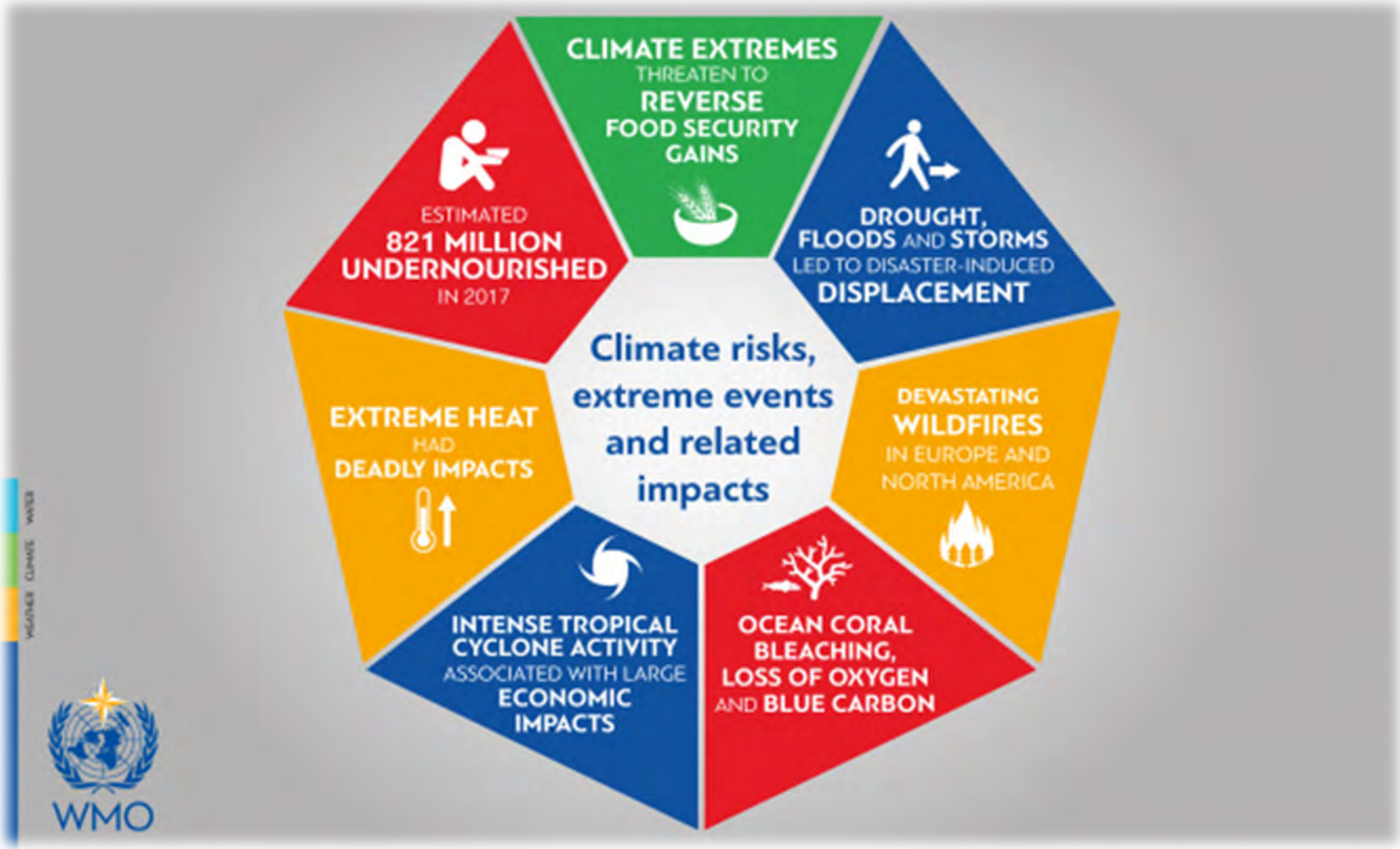
The Water-Energy-Food Nexus

Tali Zohar, Dead Sea and Arava Science Center

Global projections towards 2050

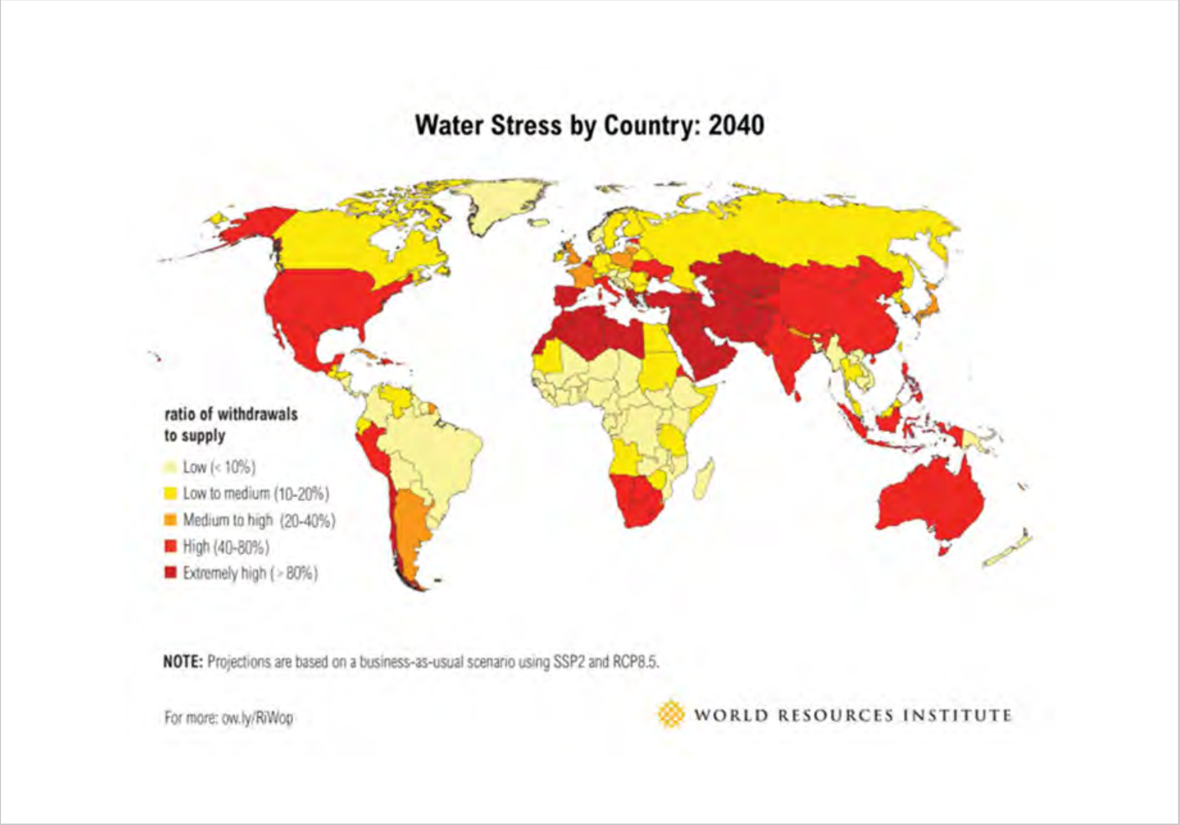
- 60% more food will need to be produced in order to feed the world population in 2050
- Global agriculture will withdrawals 80% of all freshwater for irrigation
- Global energy consumption is projected to grow by 50% by 2035

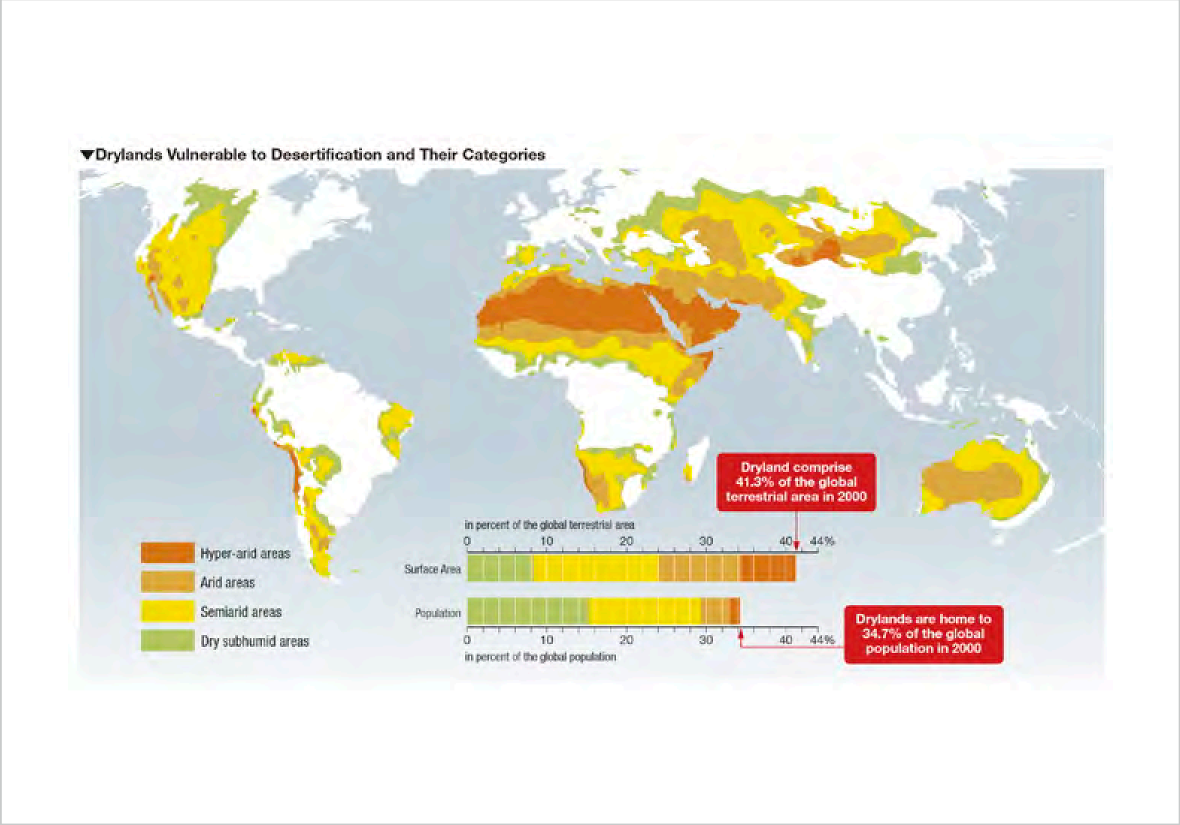
Climate change impact

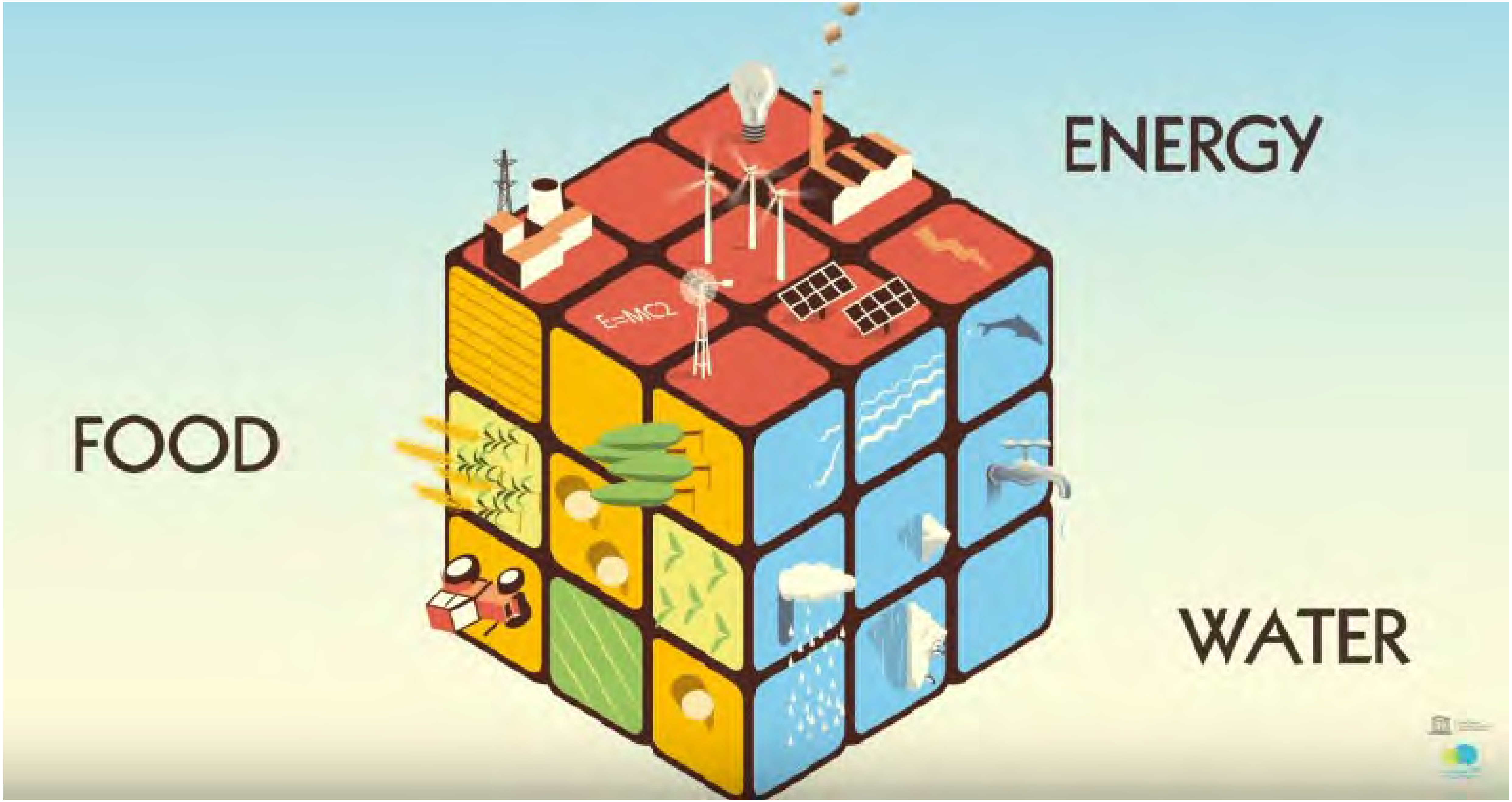


Global desertification

Source: Millennium Ecosystem Assessment



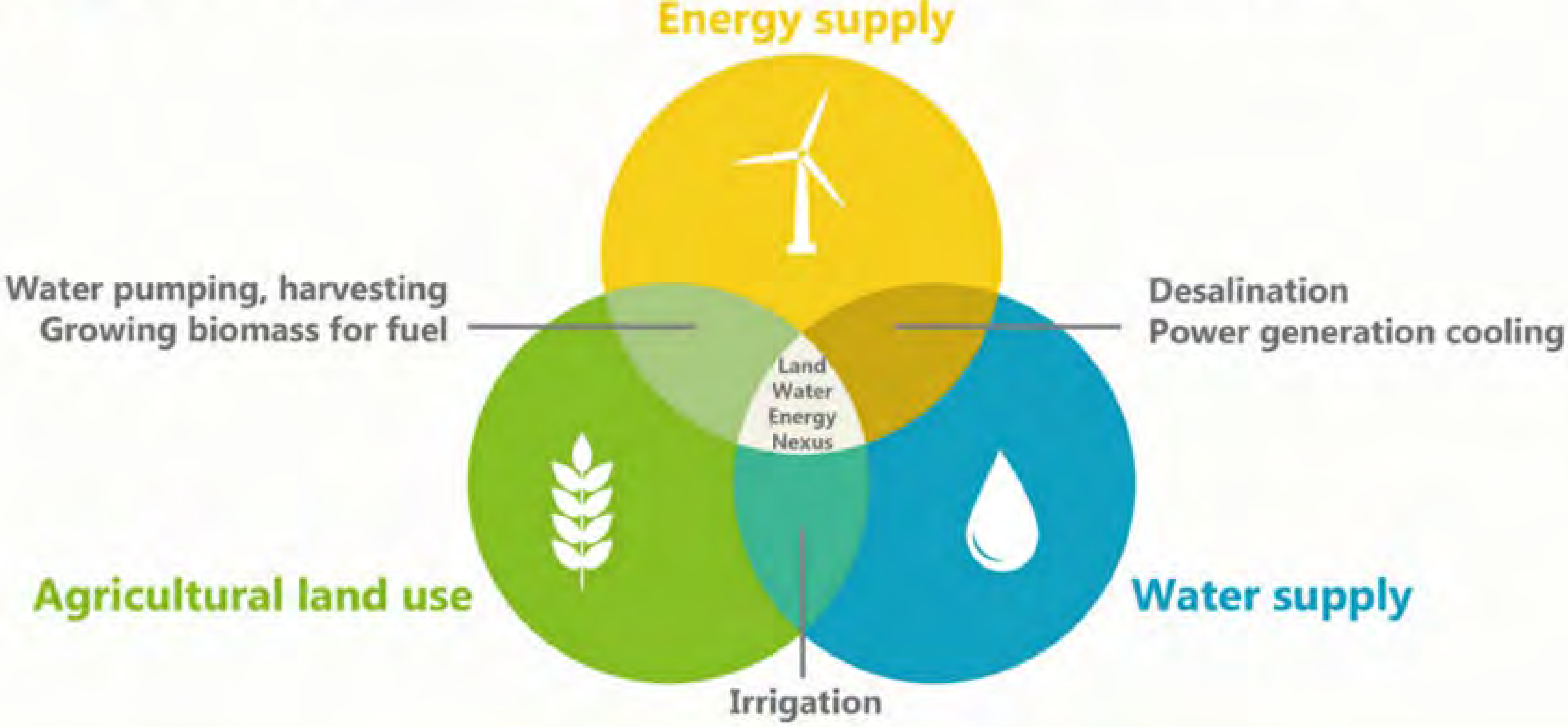




Source: UNESCO WWAP https://www.youtube.com/watch?v=83x8wvfqboo

WATER, ENERGY, FOOD - Nexus Thinking

Linking land, water and energy



Source: OECD (2017), *The Land-Water-Energy Nexus: Biophysical and Economic Consequences*, available at bit.ly/LW

Impacts of nexus approach on SDGs

Liu, J., Hull, V., Godfray, H.C.J. *et al.* Nexus approaches to global sustainable development. *Nat Sustain* **1,** 466–476 (2018)

Dual-use of land

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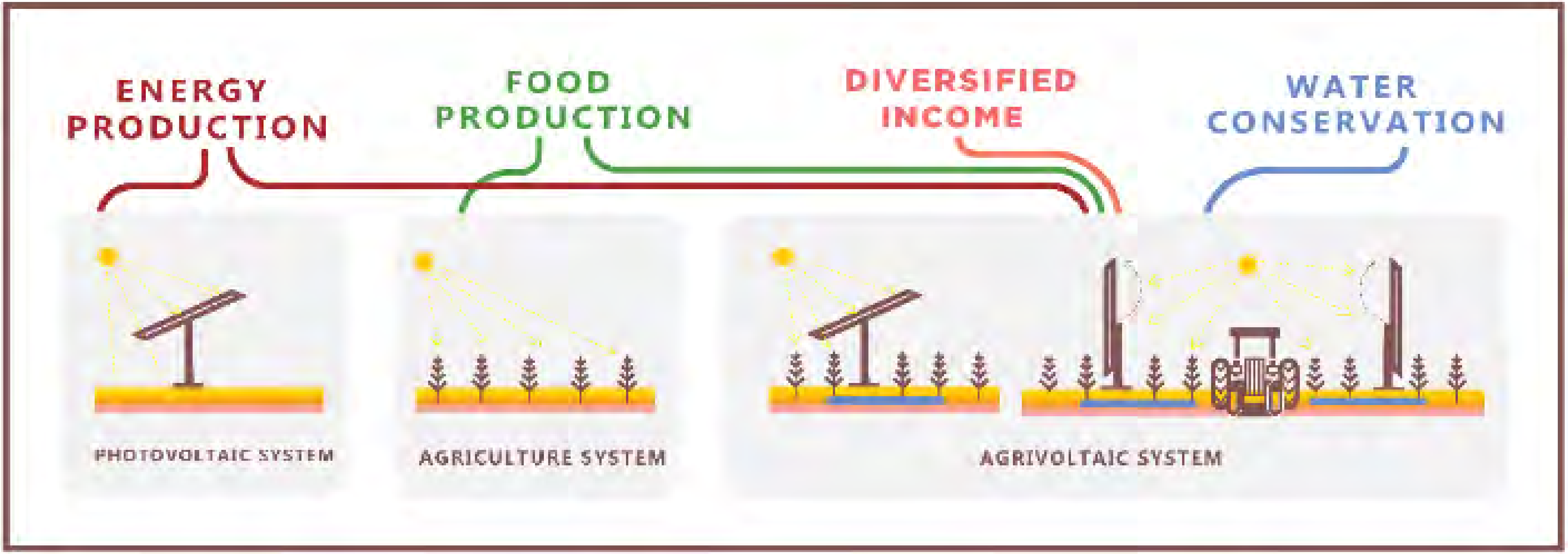

* Miao R, Khanna M. 2020. Harnessing Advances in Agricultural Technologies to Optimize Resource Utilization in the Food-Energy-Water Nexus. Annual Review of Resource Economics, 12

Harvesting the sun twice

Image: Rainer Brohm, Vietnam

Image: *Antoine BOLCATO (RPC), France*

Image: Fraunhofer Chile

Image: BayWa and Wageningen University, Babberich, Netherlands


Image: GroenLeven, Arnhem, Netherlands


Image: Tokushima, Japan


Image: Wikimed, Kamisu City, Japan

(**a**) Agrinergie system, Pierrefonds, Reunion Island (France)

(**b**) Next2Sun vertical system, Guntramsdorf (Austria)

(**c**) Next2Sun vertical system, Baden-Wurttemberg (Germany)

Toledo, C., & Scognamiglio, A. (2021). Agrivoltaic Systems Design and Assessment: A Critical Review, and a Descriptive Model towards a Sustainable Landscape Vision (Three-Dimensional Agrivoltaic Patterns). Sustainability, 13(12), 6871.

System parameters

- System size - MW installed capacity
- PV configuration - fixed tilt panels, tracking systems, vertically mounted
- Height, width, and turning clearances for farm equipment
- Shading, weed and pest management
- Optimization point - a balance between electrical generation and agricultural production

Avaluation parameters

- Productivity of crop or herd: Including pounds harvested or grazed, herd size growth and/or success of the crop, as applicable, and actual productivity relative to expectations.
- Crop management: Detailing any observable differences in necessary crop treatment relative to solely agricultural systems, including irrigation, soil amendments, disease and weed management, etc.
- Potential changes for future years: Including revised crop or grazing plans.

The Joint Institute for Global Food, Water and Energy Security

מו"פ מדבר וים המלח
Dead Sea & Arava Science Center
בחסות אוניברסיטת בן גוריון בנגב
Under the auspices of Ben-Gurion University of the Negev

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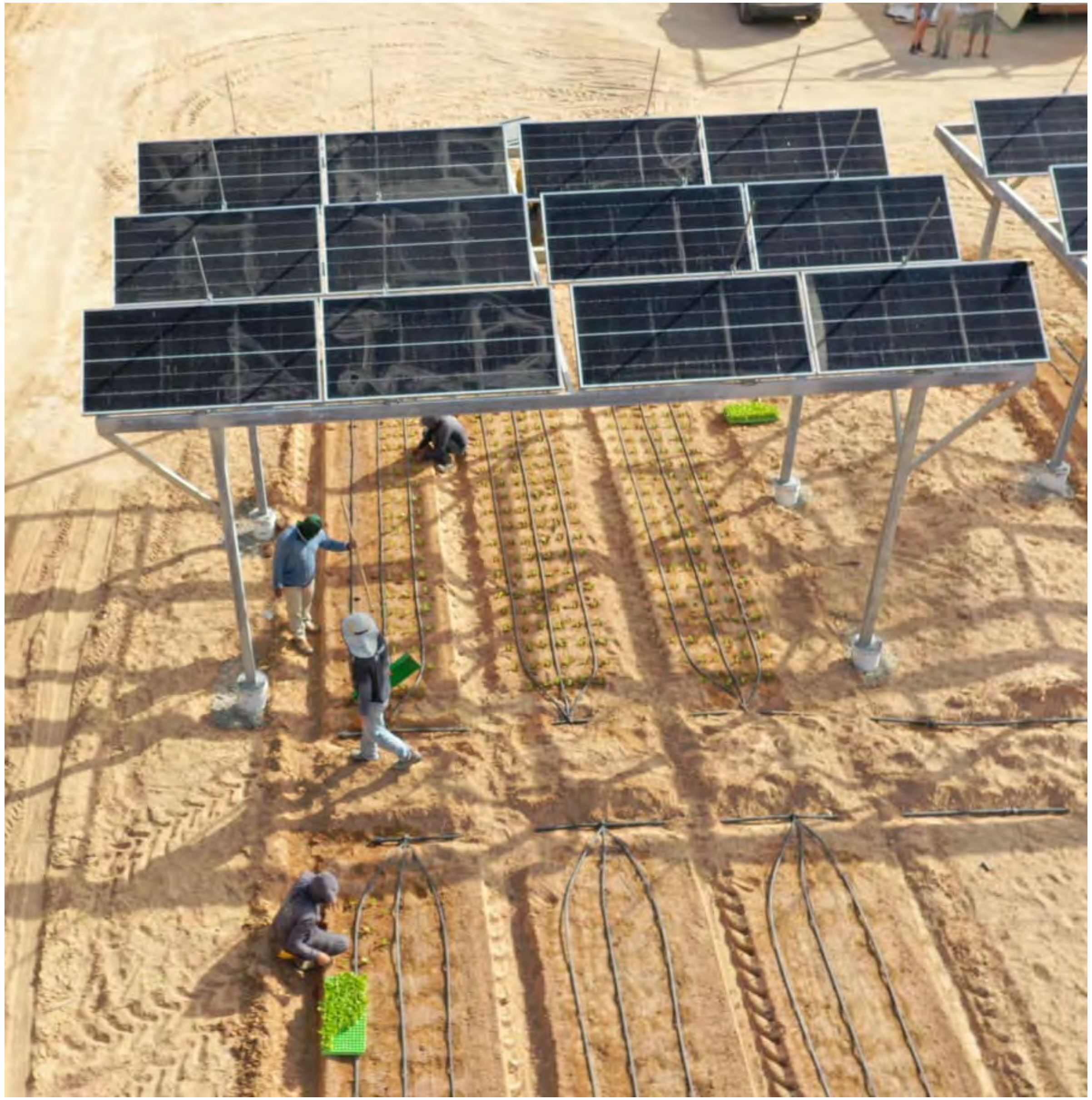

Insights from AgriVoltaic research

Water demand reduction

Increased biomass production

Increase solar panels efficiency

Shade-intolerant crops growth feasibility






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ערדום


Initial results

- We found no differences in size between shade and sun radish
- Shade lettuce had a better start than sun lettuce. However, the growth rate was slower in the shade than in the sun, which affected the total biomass weight at harvest time
- This round of planting was short but enable the chance to establish some measurements protocol, to install equipment, and to have some preliminary insights

AGRIVOLTAICS – 2ND YEAR

changes implemented in the research model:

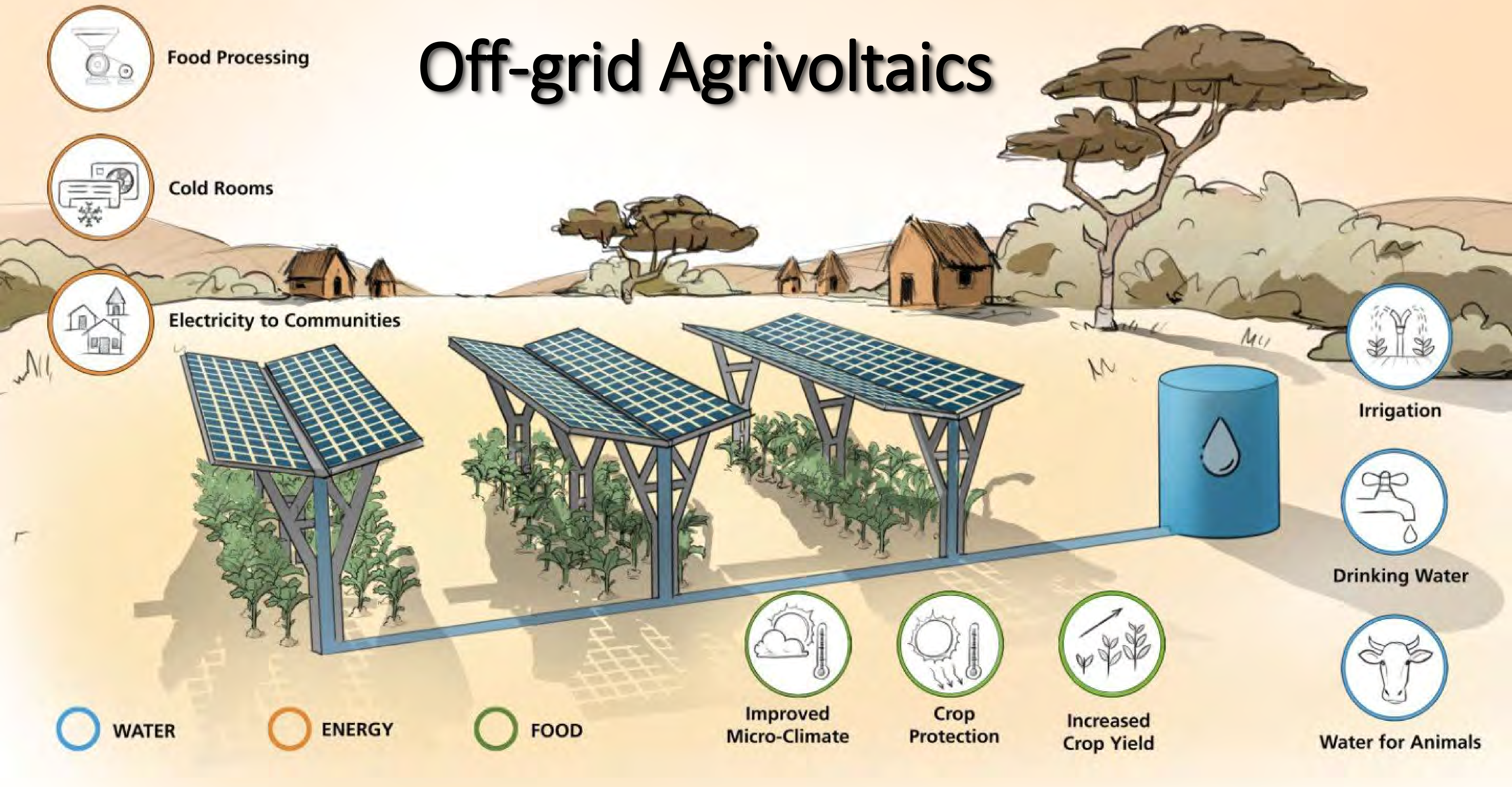
1) One pergola was adapted to simulate 100% PV shade. Existing panels were laid at 15° and wood layers added between the rows. So, 3 plots were created for comparison - 100% PV shade, 50% PV shade and control in full sun.

2) We decided to plant a variety of crops simultaneously to make better use of land and time and to simulate the living conditions of a community, with the intention to support a diverse diet while increasing food security

2^{ND} year crops



Off-grid Agrivoltaics



 Schematic diagram of a triple land use through Agrivoltaics.

Policy recommendations

- Estimating the potential of Agrivoltaics in the country
- Definition of deployment targets includes planning aspects and environmental impacts
- Pilot projects including R&D
- Electricity tariff for the pilot phase supporting a variety of projects, in different areas, different crops and different technologies, enabling optimal research practices and precise agriculture


Thanks for listening! Questions?
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