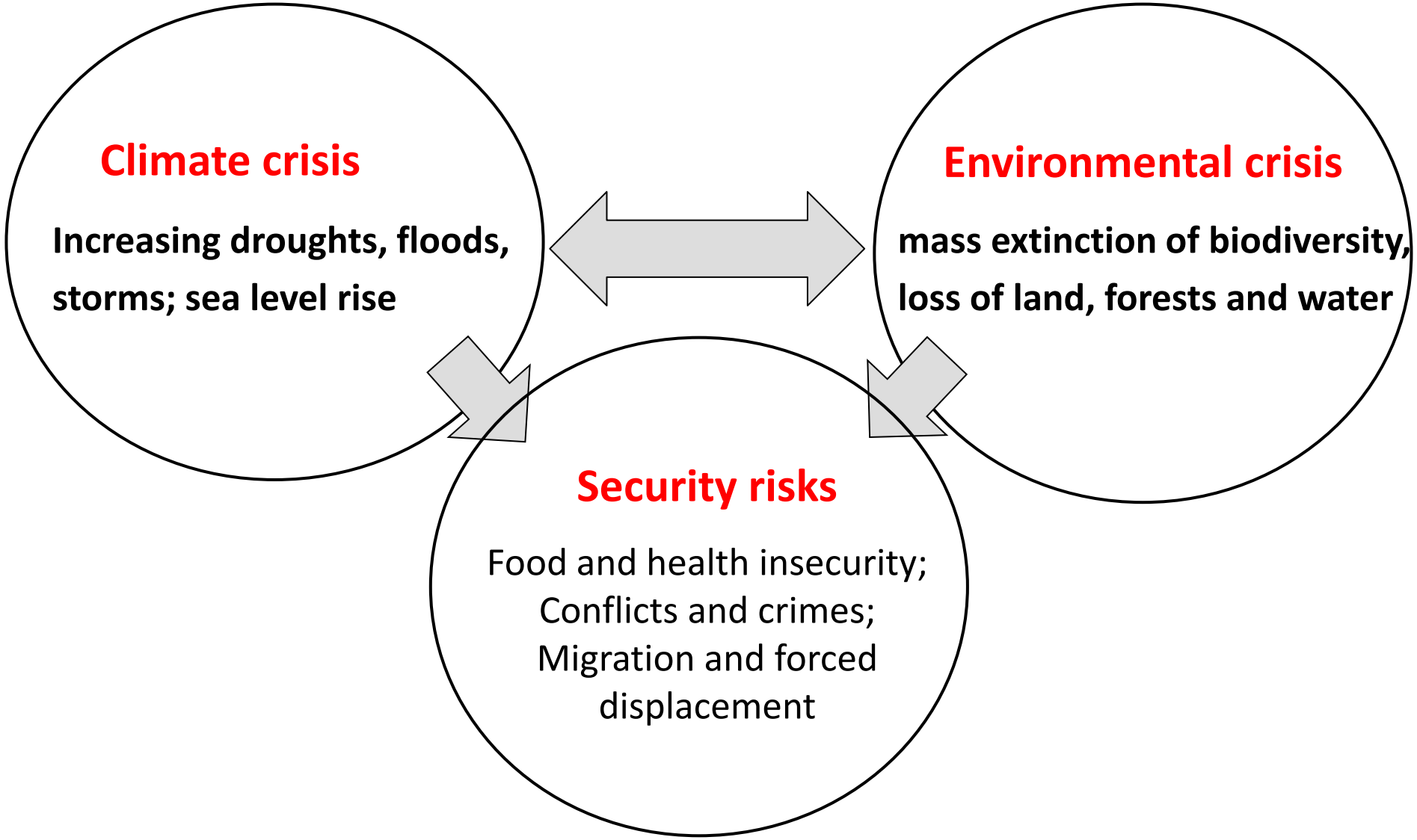
Security risks from climate change and environmental degradation: implications for sustainable transformation in the Global South

Prof. Dr. Ulrike Grote
Institute for Environmental Economics and World Trade
Leibniz University Hannover

Crises, their interlinkages and effects



Source: Nguyen et al. 2023

Security risks: Food and health insecurity

- Extreme weather events (i.e. heat waves, floods)
  - ⇒ reduce productivity and availability of staple crops (Grote et al. 2021)
  - ⇒ disrupt food supply chains, reduce income and affect food prices => reduced access to food (Richards et al. 2021; Köberle 2022)
  - ⇒ lead to mental health problems, climate distress, climate anxiety (Wu et al. 2020)
  - ⇒ deaths and illnesses, especially of most vulnerable and disadvantaged (Vicedo-Cabrera et al. 2021)

- Climate change
  - ⇒ affects nutrient composition of food => reduced utilization (Köberle 2022)
  - ⇒ risk of food insecurity (Hasegawa et al. 2021) => triggers health problems (i.e. under- /overweight; cardiovascular diseases) (Militao et al. 2022)
  - ⇒ spread of infectious diseases (Hess et al. 2020)

- Environmental degradation (air pollution, water scarcity, exploitation of forests)
  - ⇒ triggers health problems and novel diseases (WHO 2021)

Source: Nguyen et al. 2023

Security risks: Conflicts and crime

- Climate change

  => resource scarcity => risk of conflicts and crime (Koubi 2019; Agnew 2012; Vesco et al. 2020; Hagan & Rymond-Richmond 2008)

- Higher temperatures

  => discomfort, irritability, agressiveness, violence (Koubi 2019)

  => facilitate outdoor activities => exposing more people to offenders and leaving homes unprotected (Koubi 2019; Agnew 2012)

- Weather shocks (i.e. floods, hurricanes)

  => more crime (Agnew 2012; Grote et al. 2025, 2024) => increased food insecurity (Ochieng & Grote 2025)

Source: Nguyen et al. 2023

Security risks: Migration and forced displacement

- Climate change

  => migration and forced displacement (Hoffmann et al. 2021)

  => likely to affect about 143 million people in the Global South by 2050 (Almulhim et al. 2024)

- At home destinations => labor shortages, reduction in quantity and diversity of food crops (Blackmore et al. 2021)

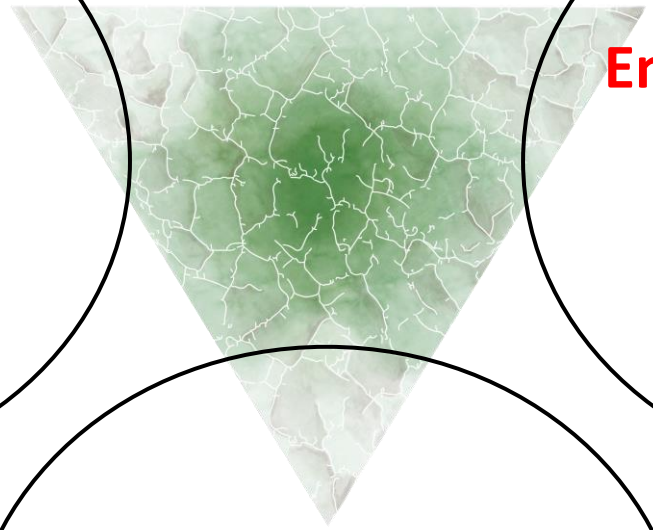
- Displaced migrants => crimes and conflicts in destination areas (Asaka 2021)

=> Food & security crisis

Source: Nguyen et al. 2023

Crises and land use

Trilemma of land use



Climate crisis

=> land needed as carbon sink, to mitigate climate change

Environmental crisis

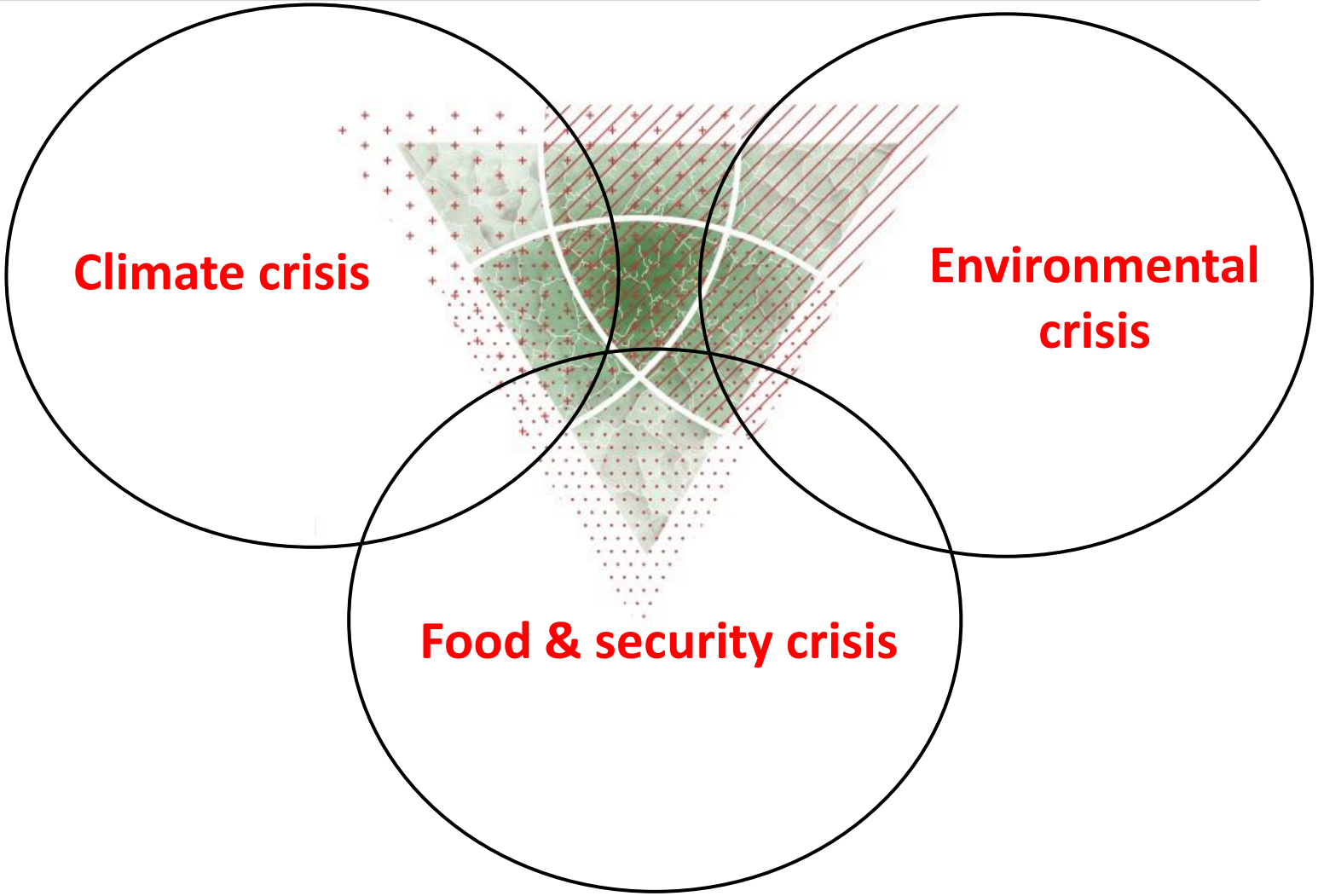
=> more land needed to protect biodiversity

Food & security crisis

=> land needed to ensure food security and avoid conflicts over scarce resources

Source: Nguyen et al. 2023; WBGU, 2020

Integrated land use



To overcome land use competition, we need an integrated way to manage land.

Source: Nguyen et al. 2023; WBGU, 2020

Towards more resilient land use

Expanding protected areas

Restoring degraded ecosystems

Diversifying agriculture

Source: Nguyen et al. 2023; WBGU

Expanding protected areas

Effective & well-connected systems of protected areas are needed

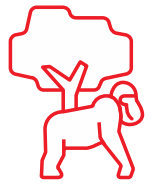
→ Benefits climate change mitigation

→ Counters the global biodiversity crisis

→ Maintains basic ecosystem services

→ Multiple benefits for food security

(e.g. by allowing sustainable forms of use in certain zones)



Recommended to expand terrestrial systems of protected areas to 30% of the Earth's land area

Source: Nguyen et al. 2023; WBGU 2020

Restoring degraded terrestrial ecosystems

- Reforestation of deforested areas
- Rewetting of peatlands

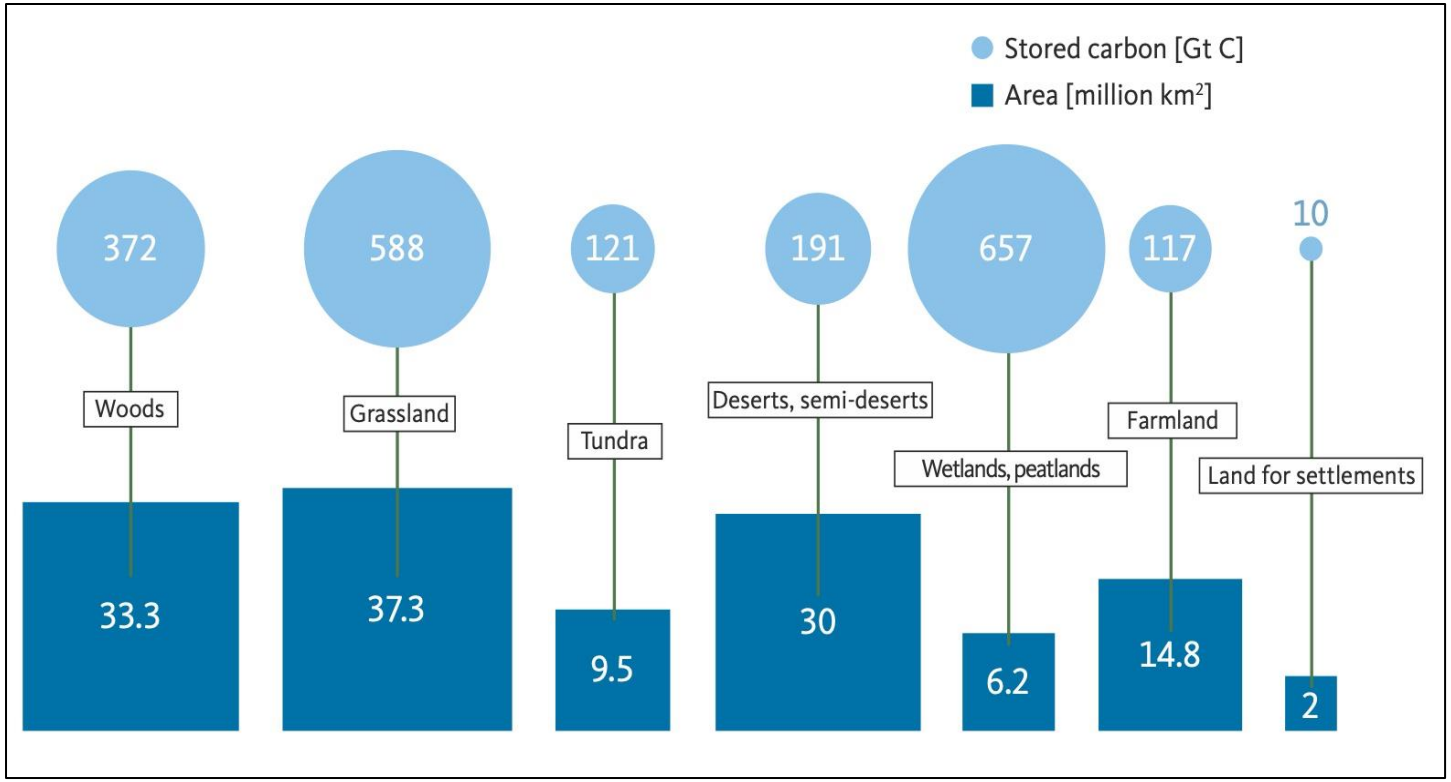
⇒ CO_2 storage

⇒ biodiversity protection

⇒ nutrition

Peatlands are most important

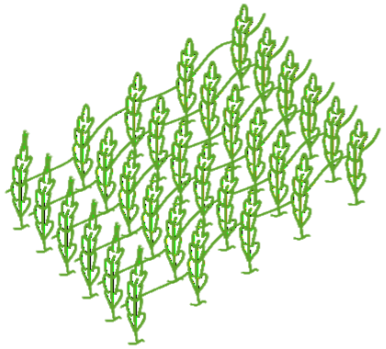
Carbon storage in terrestrial ecosystems



Source: WBGU

Diversifying agriculture

=> **Transformation needed!**



- largely monofunctional
- production orientated

- ecologically intensive
- multifunctional systems

Source: Nguyen et al. 2023; WBGU 2020

Diversifying agriculture

- Increasingly negative **impacts of climate change** on agricultural systems
  => Droughts or extreme weather events
  => Decreasing incomes in agriculture under current land use system

- Move away from maximization of **revenues, biomass yield**

- Reducing heavy **dependence** of conventional agriculture on energy-intensive, external inputs such as nitrogen fertilizers and pesticides => Environmental problems: heavy nitrate pollution of soil and water, emission of greenhouse gases

Source: WBGU 2020; Bioeconomy Council 2024

Example: Agroforestry systems

Christian Dupraz (INRA)

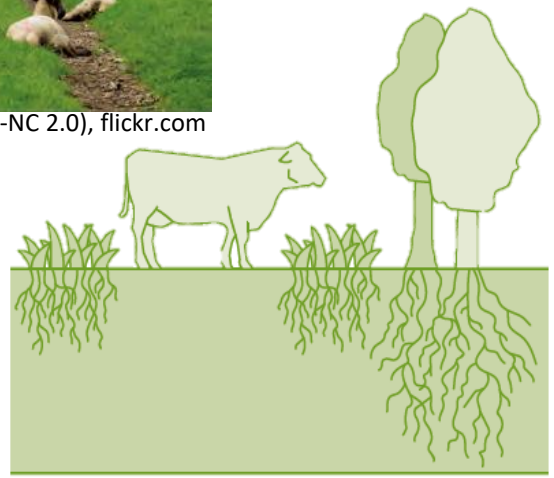
Agrisilvicultural systems

- trees
- crops

Phil McIver „The watcher“ (CC BY-NC 2.0), flickr.com

Silvopastoral systems

- trees
- livestock



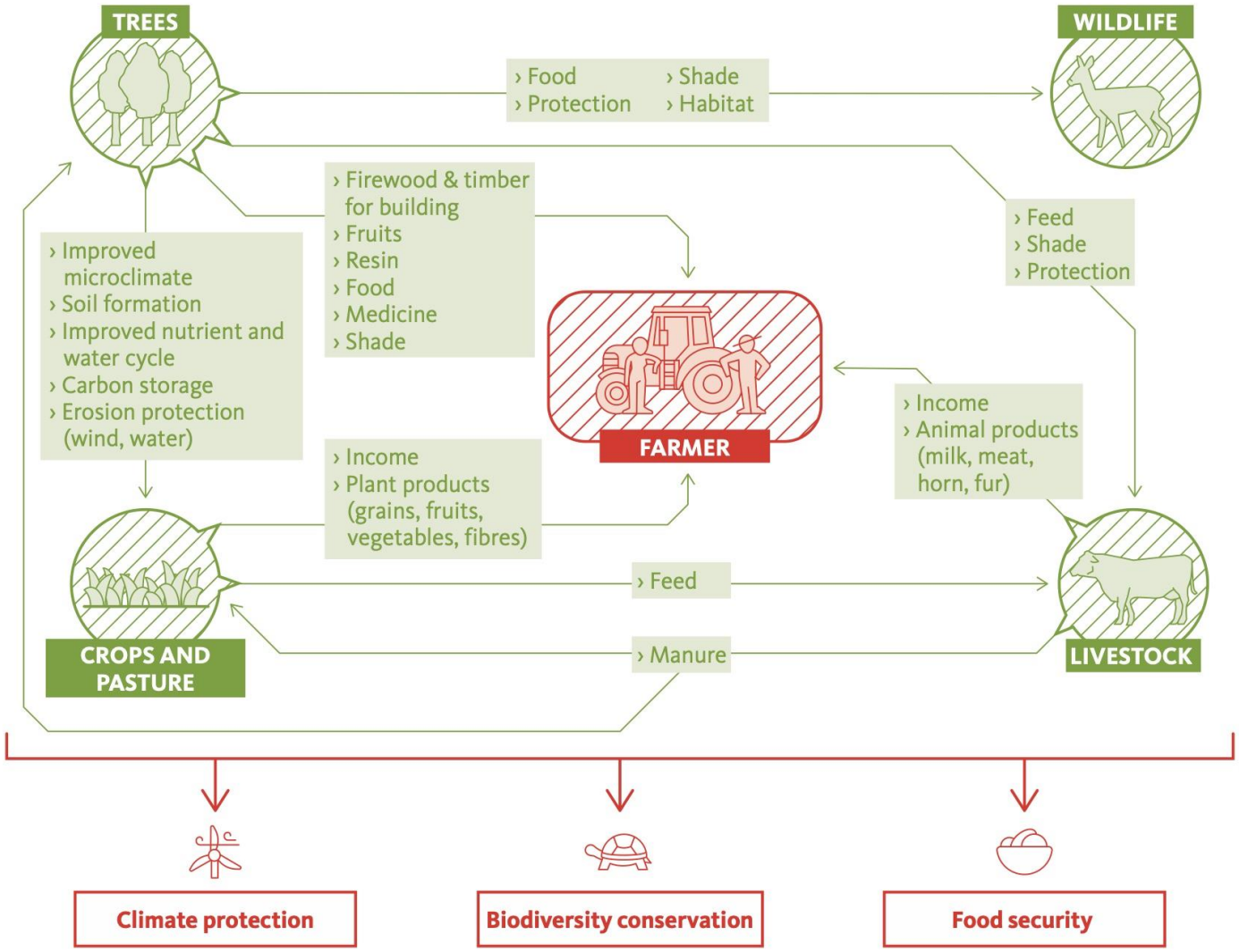
Agrisilvopastoral systems

- trees
- crop
- livestock

Contributions to diversification

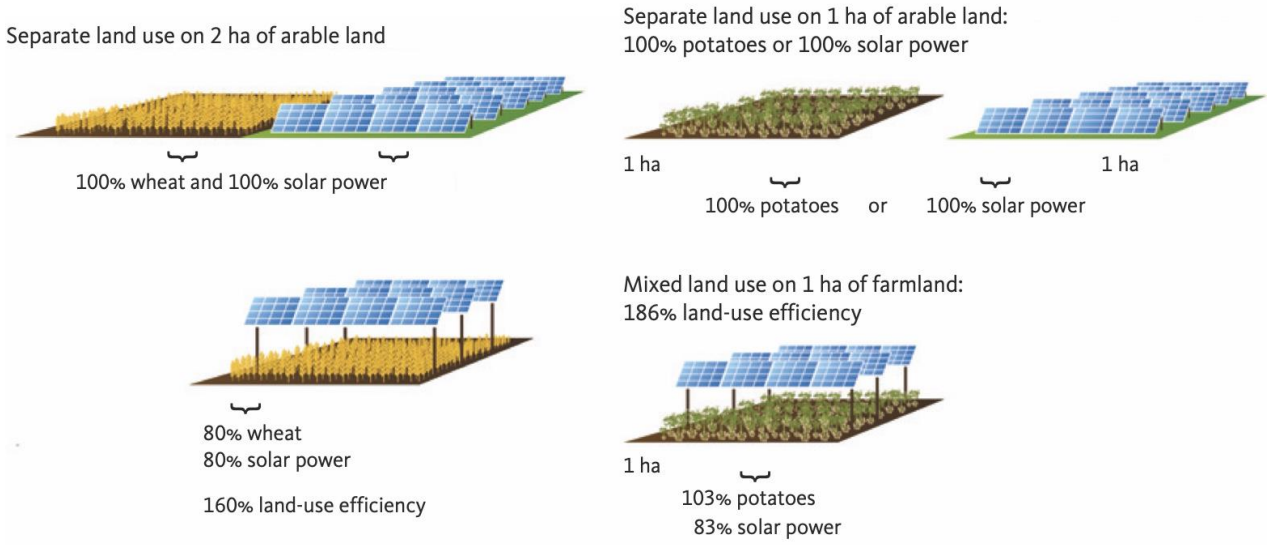
- Reducing input dependence of agricultural systems
- Pos. effects on soil, water, air, biodiversity
- Carbon fixation in soils
- Higher land use rate in the long run
- Increasing resilience of agricultural systems
- More income opportunities in agriculture

Synergies of agroforestry systems



Source: WBGU

Example: Agri-photovoltaic systems (Agri-PV)



Fotos: Bauerle/Universität Hohenheim; Franhofer ISE

Contributions to diversification

- Reduction of input dependency
- Production of own electricity (CO_2-neutral)
- Increasing land use rate
- Possible synergies with agricultural production (e.g. shading, ↓ water require-ments; hail protection)
- Additional income opportunities (electricity sales; energy for further processing)

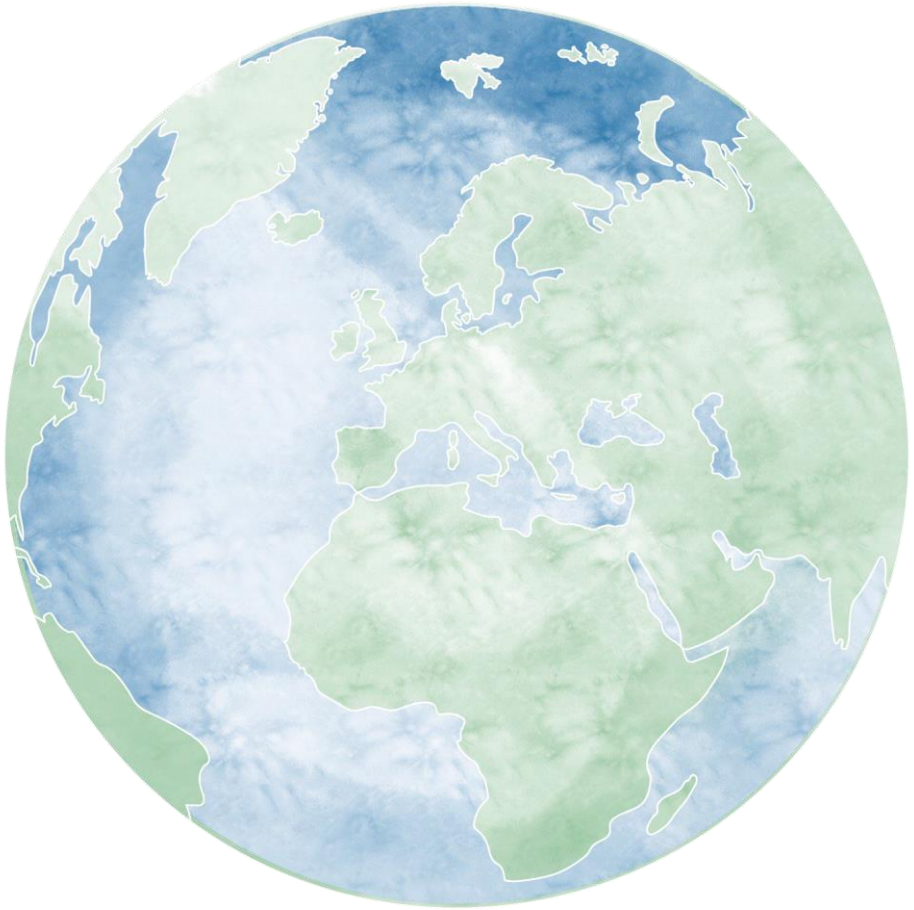
Source: WBGU; BÖR

Example: Synergies through small-scale digitized systems

Contributions to diversification

- Reduction of input dependence (fertilizers, pesticides, labor)
- Positive effects on soil, water, air, biodiversity
- Carbon fixation in soils
- Higher land use rate in the long run
- Increasing resilience of agricultural systems

Governance strategies for a solidarity-based land stewardship



- **Change agents**
- **Proactive state**
- **Regional and international cooperation**

Source: WBGU

Change agents

Pioneers of change

Sebastião Salgado: Bulcão Farm

Before and After: 20 years of renaturation through afforestation

Source: WBGU; Instituto Terra

Proactive state

Developing a consistent system of different instruments to support a land-use transformation. We need…

- a system of coordinated instruments (e.g. price incentives, spatial planning)
- to ensure that environmental costs are internalized
- voluntary and mandatory sustainability standards & monitoring
- promoting circular and cascading uses
- to enforce domestic requirements on land stewardship

Source: WBGU

Regional and international cooperation

→Regional organizations (i.e. ASEAN) are particularly well suited for testing a land-use transformation over a large area

→Regional organizations bear international responsibility because of high demand for land outside them → trade policy

- → essential that they use their foreign-trade policy to promote a global land use transformation
- → Call for sustainability and resilience in trade

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Source: WBGU

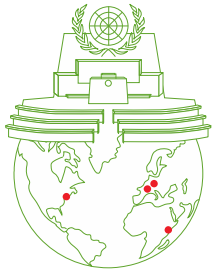
Regional and international cooperation

Numerous international organizations, institutions & conventions are working on the global land use transformation

→ convening a '**Global Land Summit**'
  → Generate attention for the global land use transformation
  → Generate resources to develop a common vision for sustainable land stewardship

→ **indigenous and local communities** should be given a higher profile in international forums

→ Establishment of **new cooperation alliances** by like-minded states and subnational regions (i.e. cross-border implementation of integrated landscape approaches)



Source: WBGU

Thank you