Transforming Agrifood Systems in a Changing Climate

PROFESSOR JAYASHANKAR TELANGANA AGRICULTURAL UNIVERSITY (PJTAU)
Diamond Jubilee Celebrations

Reshaping Agricultural Research & Education Portfolio for better Future

21 December 2024

Key Takeaways

1. Food and nutrition security goals cannot be achieved without adequately addressing the agrifood system related causes and consequences of climate change. Likewise, climate goals cannot be achieved without transforming agrifood systems. Agrifood systems must be on the forefront of a just transition.
2. Less than 4% of climate finance goes to support agrifood systems, while agrifood systems remain the most vulnerable sector to impacts of climate change and contribute nearly 31% of total global greenhouse gas emissions.
3. Transforming agrifood systems requires a holistic approach tailored to specific local, sub-national, national, regional and global context focusing on transforming institutions, policies, technologies, markets, and stakeholder behaviors.
4. Institutions such as PJTAU can play a vital role in transforming agrifood systems in a changing climate through **reshaping agricultural research, education, and extension** in addressing food-nature-water-energy-climate nexus issues and overcoming tradeoffs.

Definition of Agrifood System

- From agricultural production to food consumption - **the entire industry chain and associated environmental & health impacts**
- Including policies and cultural norms surrounding food
- Abbreviated as '**Agrifood Systems**'

R&D Technology
- Biotechnology, information technology, farm mechanization technology, climate smart technology, intelligent technology……

Inputs
- Seeds, feed, fertilizers, pesticides, agricultural machinery, ……

Production
- Crops, livestock, forestry, fisheries, aquaculture……

Processing
- Food processing, food manufacturing, beverage manufacturing, textile processing, home furnishing manufacturing, ……

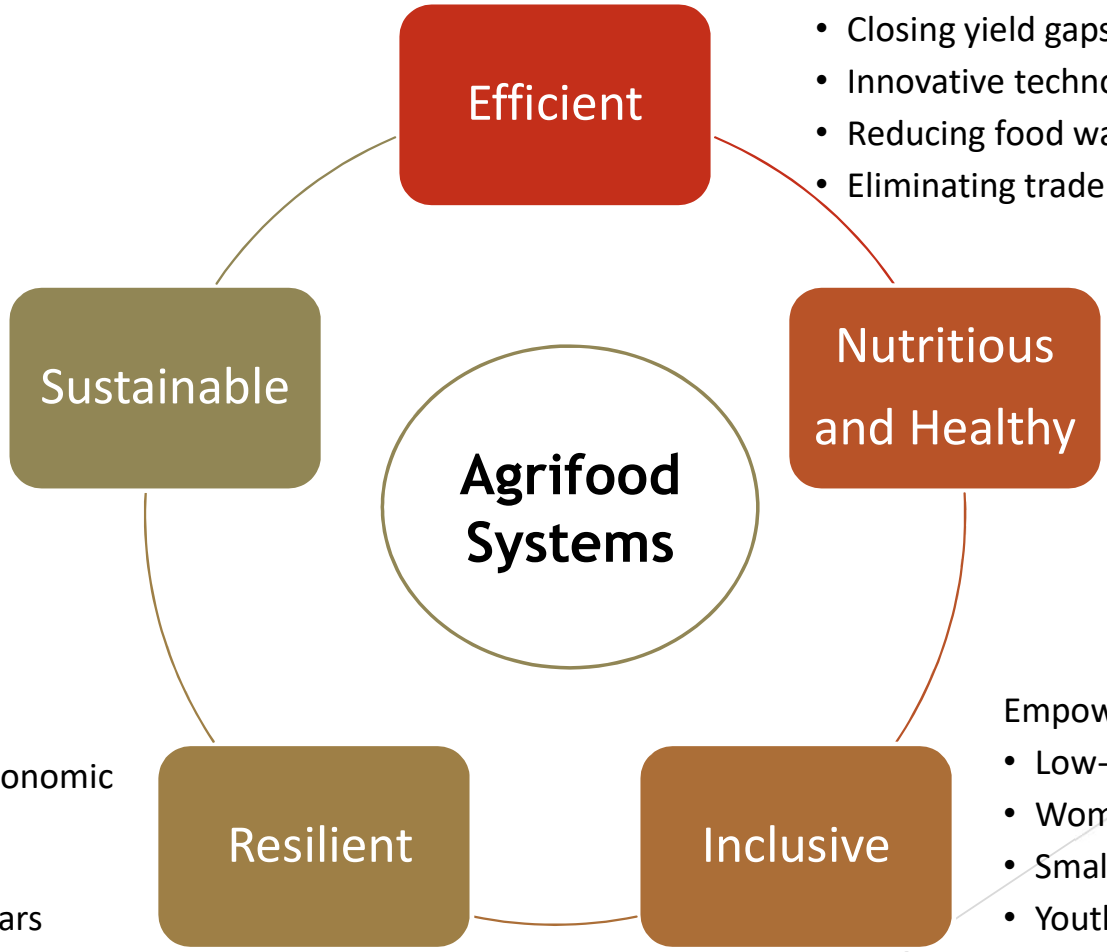
Distribution
- Agricultural product storage and logistics, wholesale, retail, ……

Consumption
- Marketing and promotion, catering services, ……

Transforming agrifood systems is crucial

- Agrifood systems contribute about **25% of GDP** and more than **30% of employment**.
- Compared to productivity improvements in industries and services of similar scale, increases in agricultural productivity are generally more effective in **alleviating poverty**.
- Agrifood systems have a significant **multiplier effect**; for every unit increase in the GDP of agrifood systems, it can drive a **3-unit** increase in the GDP of entire economy.

Why do we need to transform our Agrifood Systems?
To achieve a win-win for both human health and planetary health



- Closing yield gaps
- Innovative technologies
- Reducing food waste and loss
- Eliminating trade distortions

- Affordability
- Food safety
- Regulation and taxation
- Demand stimulation

Empowering and benefiting:
- Low-income populations
- Women (gender disparities)
- Smallholders
- Youth and the private sector

- Climate resilience
- Adaptation to macroeconomic and health shocks
- Managing shocks from pandemics/conflicts/wars

- Reducing greenhouse gas emissions

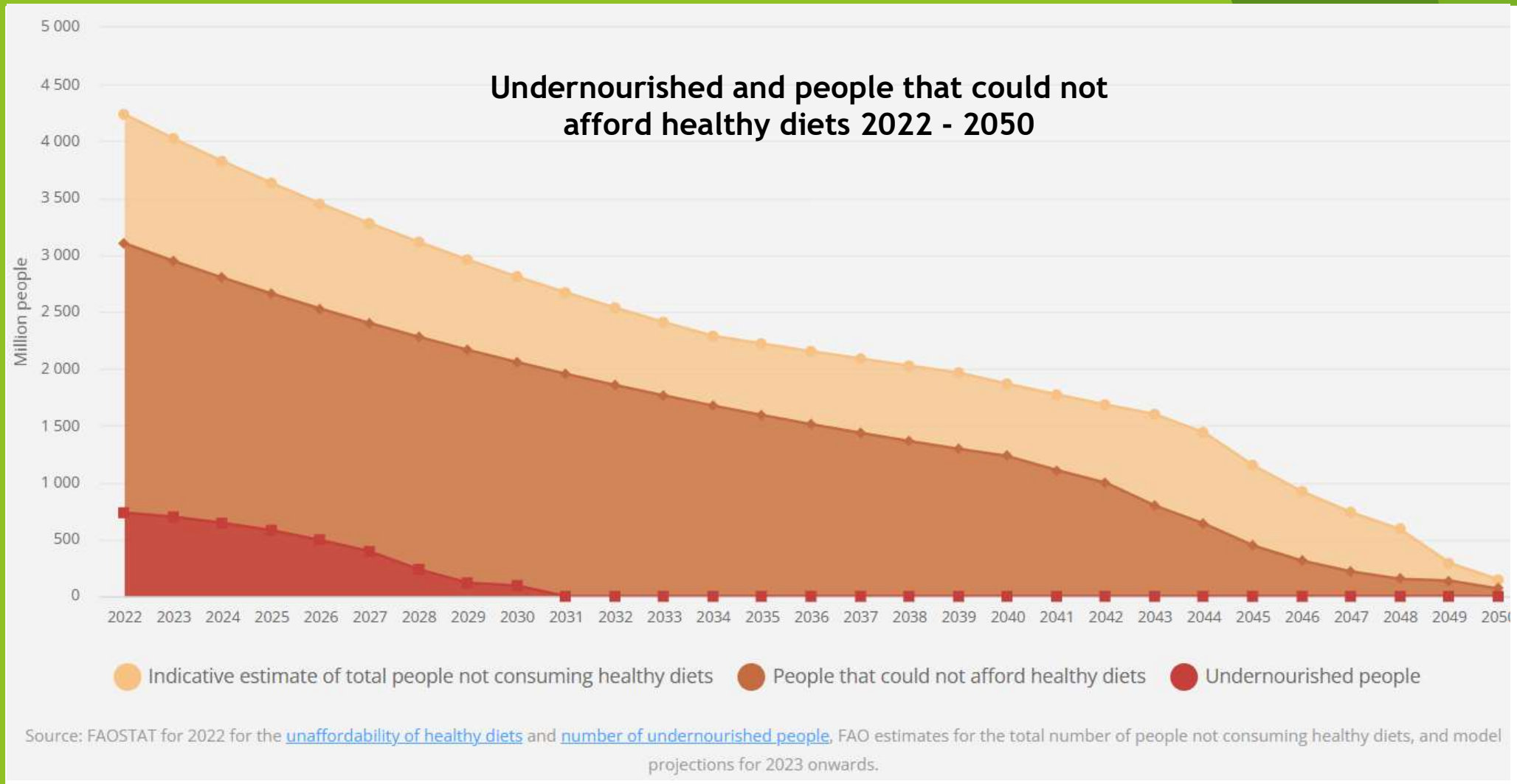
Protecting:
- Biodiversity
- Water health
- Soil health

Adapted from: Fan S, Headey D, Rue C, et al. Food Systems for Human and Planetary Health: Economic Perspectives and Challenges. Annual Review of Resource Economics, 2021, 13.

Some Sobering Statistics and Facts

- Over 700 million people are undernourished and don't have enough to eat.
- 2.8 billion people are unable to afford healthy diet.
- 3.8 billion people, perhaps including most of us attending the event, are not consuming healthy diets.
- Food and nutrition insecurity skyrocketed during the COVID-19 pandemic and has never quite bounced back.
- Record-high temperatures and an El Niño pattern took a toll on global agricultural production.
- 2024 is on track to be hottest year on record (Jan-Sept 2024 global average temperature 1.54 (±0.13)°C above pre-industrial level) – Global climate goal: 1.5°C
- Past 10 years are warmest on record and ocean heat rises - From 2014-2023, global mean sea level rose at a rate of 4.77 mm per year, more than double the rate between 1993 and 2002.
- Antarctic sea ice second lowest on record and glacier loss accelerates - In 2023, glaciers lost a record 1.2-meter water equivalent of ice.
- Atmospheric concentration of carbon dioxide (CO_2) has increased from around 278 ppm in 1750 to **420 ppm in 2023.**
- Heavy precipitation, floods and tropical cyclones led to massive loss of life and damage. Persistent drought in some regions was worsened by El Niño.

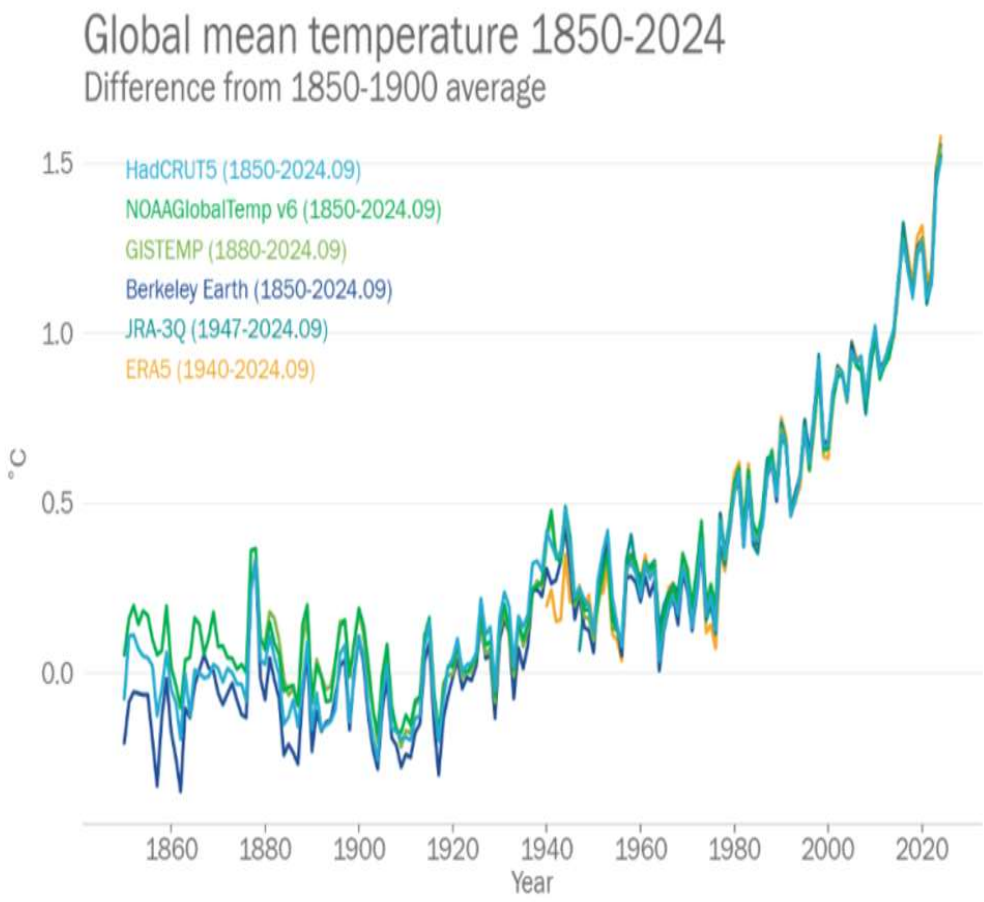
Sources: FAOSTAT and WMO State of the Climate 2024 Update


Undernourished and people that could not afford healthy diets 2022 - 2050
Million people
5 000
4 500
4 000
3 500
3 000
2 500
2 000
1 500
1 000
500
0
2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044 2045 2046 2047 2048 2049
Indicative estimate of total people not consuming healthy diets
People that could not afford healthy diets
Undernourished people
Source: FAOSTAT for 2022 for the unaffordability of healthy diets and number of undernourished people, FAO estimates for the total number of people not consuming healthy diets, and model projections for 2023 onwards.

Climate Hazards in Asia/India to 2050

- **G20 Climate risk Atlas:** Average temperatures are projected to increase in many parts of Asia. On a high carbon pathway, temperatures in India could increase by as much as 1.8°C by 2050. On a low carbon pathway this drops to 1.2°C.
- Surface sea temperatures in India could increase by 1.5°C by 2050 in a high carbon scenario, triggering a sharp rise in ocean acidification and reducing fish catch potential by 17.1%.
- Likelihood to experience lethal heat waves in parts of Asia (especially India) is increasing. Parts of India could see as many as 100 dangerous hot days (heat index above 39.4°C) per year in 2050. Dangerous hot days could exceed 150 days in Gujarat, Uttar Pradesh and Rajasthan.
- In the next 30 years, the length of heatwaves will increase by 2,515%, driving heat-related deaths 25 times higher than 1990. Those longer heatwaves will destroy rice and grain crops, too – burning up ₹7 trillion and costing farmers 15% in lost income by 2050.
- In some areas, the likelihood of extreme precipitation could potentially rise 3- to 4-fold.
- Likelihood of severe typhoons in Asia would increase.
- Water stresses – floods and droughts, and saline water intrusion – are projected to increase. Droughts are expected to increase water demand in India by up to 29.1% by 2050.

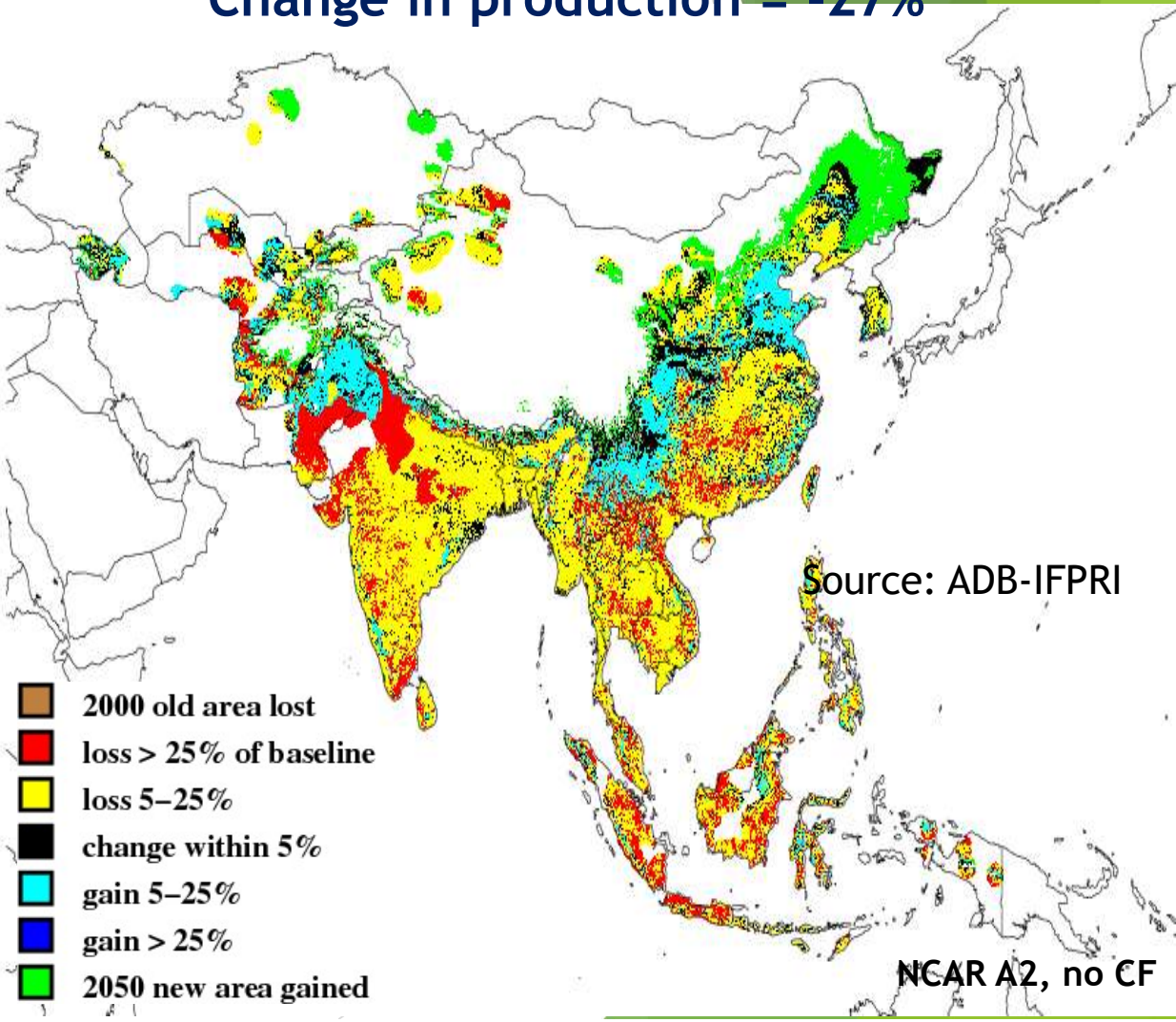
Temperature Record in 2024



Annual global mean temperature anomalies from January – September 2024 (relative to the 1850-1900 average) from six international datasets.

Climate induced change in production in 2050: Irrigated Rice in Asia

Change in production = -27%



Source: ADB-IFPRI

NCAR A2, no CF

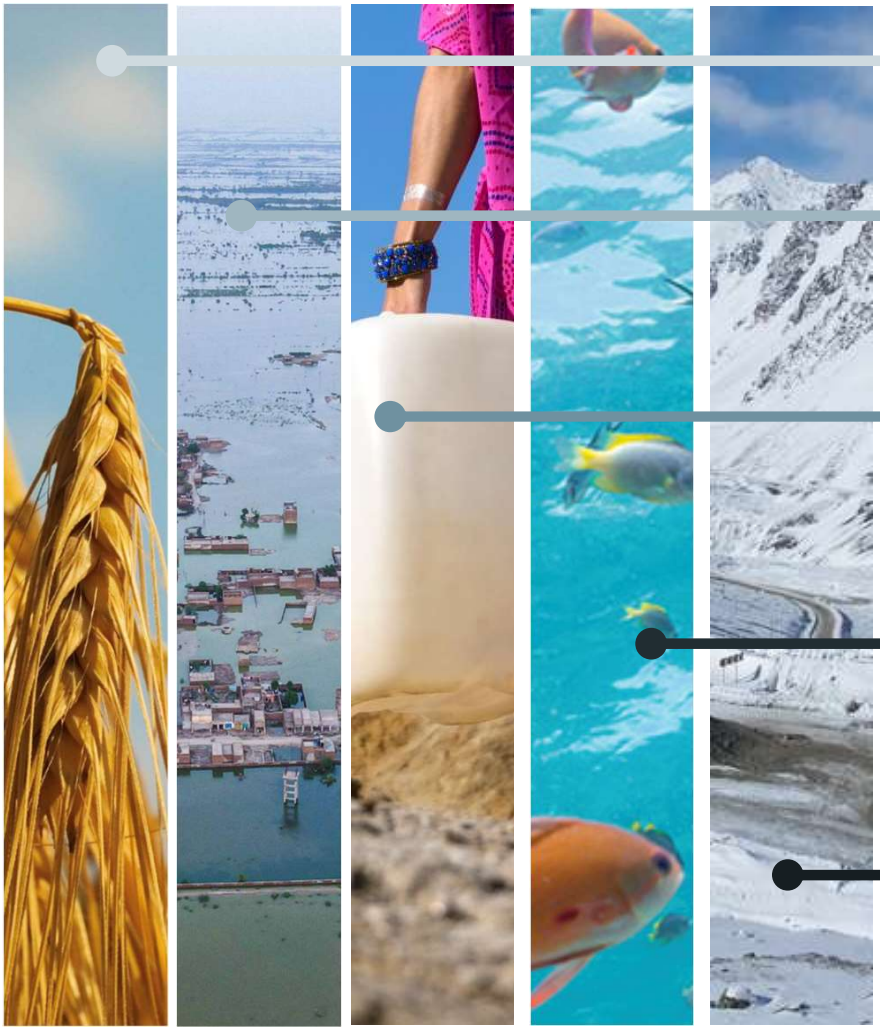
Drivers of Transformation of Agrifood Systems

1. Demographic Shifts and Food Diversification
   - Rapid urbanization in the GMS is shifting dietary preferences toward higher-value foods and alternative protein sources as consumers seek healthier, sustainable options requiring farmers to diversify production. However, challenges around food safety standards and sustainable practices persist.
2. Climate Change, Biodiversity Loss, and Degradation of Natural Capital
   - Agriculture a major consumer of natural resources and a contributor to environmental degradation.
   - Solutions such as CSA and agroforestry & better management of the water-food-energy-climate nexus presents opportunities to address resource trade-offs.
3. Poverty, Inequality and Food Insecurity
   - Disparities in access to land, credit, and technology remain significant.
   - Empowering smallholder farmers, particularly women, youth, and marginalized groups, is critical to reducing poverty and enhancing food security.
4. Inflation and Food Prices
   - Inflation and rising food prices, exacerbated by global tensions and climate impacts, are straining agrifood systems.
   - Higher input costs and supply chain disruptions reduce farmers' profitability and heighten food insecurity.
5. Technological Advancements and Digitalization
   - Digital traceability, precision agriculture, and ecommerce platforms offer transformative opportunities for enhancing market access, traceability, and resource management by improving productivity and reducing transaction costs. However, poor infrastructure in rural areas and limited digital literacy restrict the adoption of digital tools.

Drivers of Transformation

6. Economic and Market Dynamics
   - The agrifood sector is integrated into global markets, but market volatility, global competition, and disparities in logistics and supply chain infrastructure pose challenges.
   - Smallholder farmers struggle to compete with larger agribusinesses due to limited access to technology, finance, and markets.
7. Investment in Agrifood Systems
   - There is a need for investment projects focusing on agro-industrial zones and parks, agribusiness incubators, livestock health and value chains, fisheries and aquaculture value chains, education and training, improved logistics, and incentives for innovation. 'One Health' approach will ensure interconnected health benefits across human, animal and environmental systems
8. National, Regional and International Interdependencies
   - With increased Globalization, transboundary issues like diseases, resource challenges and climate change require countries to tailor their programs with a sub-regional approach that respects country-specific needs within a cohesive framework.
9. Transition in Workforce, Gender and Inclusivity
   - Aging farmers and urban migration has led to labor shortages in several countries. Empowering youth and ensuring gender inclusivity through access to finance, technology and leadership opportunities will foster a more equitable and sustainable agrifood system.
10. Financial Access
    - Limited access to affordable financing, high interest rates and complex lending requirements, pose challenges for smallholders and MSMEs. Innovative financing instruments and microfinance are necessary to support the transition to more resilient agrifood systems.

Climate change remains a dominant driver of food insecurity



Heatwaves in South Asia in the last few years has led to severe disruption to food production

Untimely floods, cyclones, and storms

Continued drought in Central Asia, high costs of agricultural inputs and limited access to irrigation water, resulting in a below-average harvests.

Ocean warming and acidification. Ocean absorbs around 25% of the annual emissions of anthropogenic CO_2 to the atmosphere

Glaciers in high mountains of Asia (the 'third pole') causing glacial lake outbursts and eventual loss of river systems

Climate and Environmental Challenges

Increasing Threats from Climate Change

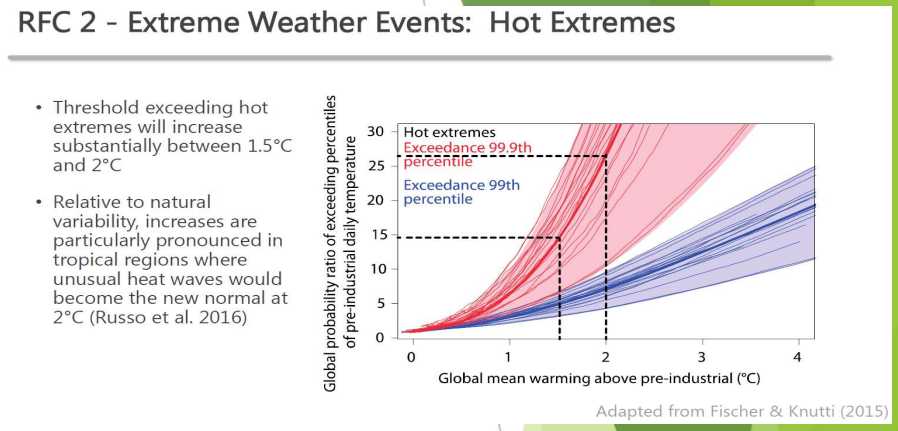
- Temperature Changes
  - -Past Decades: ↑ 0.5-1.5°C
  - -Projected: ↑ 2-4°C by Century's End
- Increased frequency of extreme weather events (e.g. **droughts, storms, floods**)
- One of the most vulnerable regions to **sea-level rise** globally

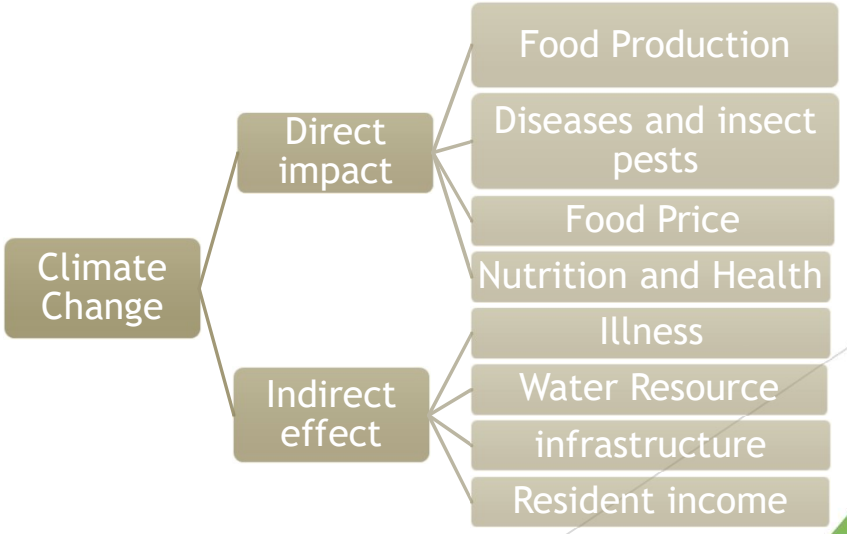
GHG emissions are rising

- Agrifood systems: **31%** of global GHS emission(FAO,2021)
- Agriculture sector: significant contributor to GHG emissions due to rice cultivation, livestock production and heavy reliance on synthetic fertilizers

Natural Resources Under Pressure

- **Deforestation**
- **Water scarcity**
- **Wetland Loss**
- **Soil Salinization**
- **Biodiversity Loss**





Natural capital in the region demands increased attention

Poor Water Management

Inefficient water use, especially for irrigation, results in withdrawals exceeding sustainable levels,

Land degradation and desertification

Unsustainable farming, land, and livestock management practices and loss of forest and vegetation cover

Saltwater intrusion and increased Salinization

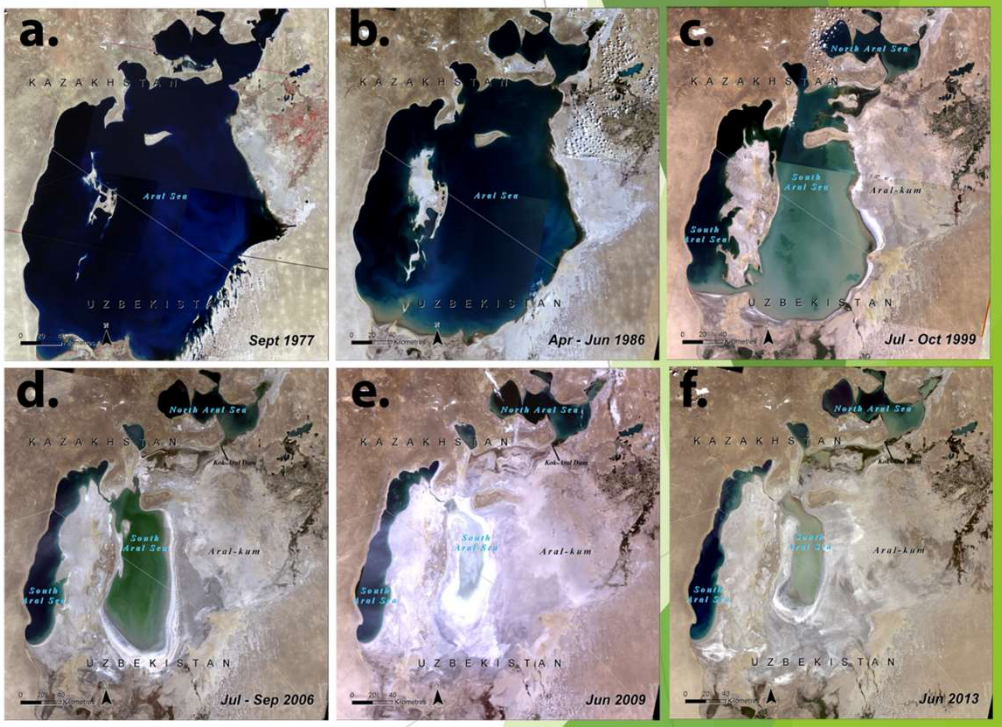
Sea level rise and storm surges, land subsidence in coastal zones; saline soils that reduce crop yields.

Pollution and resources depletion

Excessive use of fertilizers and other chemicals, contribute to resource depletion and environmental degradation, pollution and GHG emissions.

Biodiversity Loss

Biodiversity degradation due to expanding cropland and over-utilization of resources, which in turn affects both agriculture productivity and the environment.



Source: NASA earth observatory, accessed 2023

Agrifood systems contribute a quarter of global GHG emissions leading to climate change

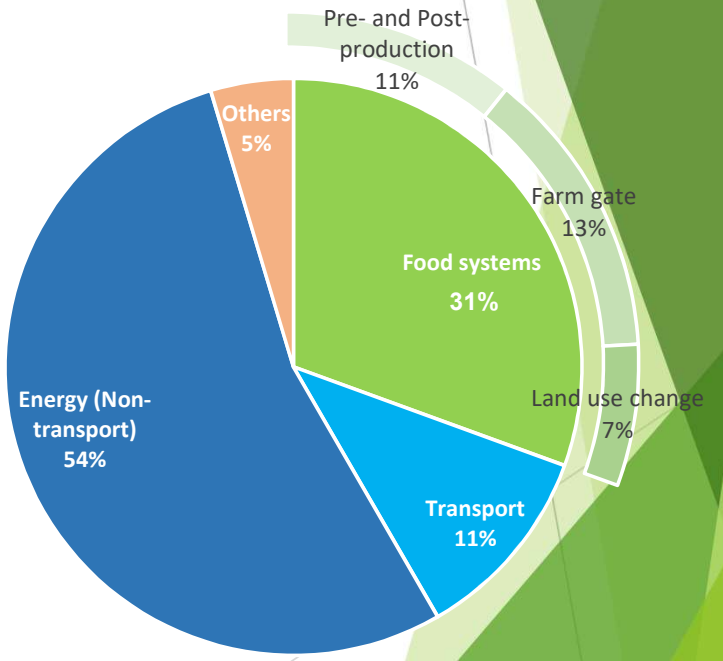
Emissions from food systems as a percentage of global GHG emissions[1]

31%

Individual GHG gas emission global share of food systems (%)

21%	Carbon Dioxide (Mostly through energy inputs)
53%	Methane (Rice production and livestock)
78%	Nitrous Oxide (Fertilizer overuse)

Emissions from food systems compared to other sectors

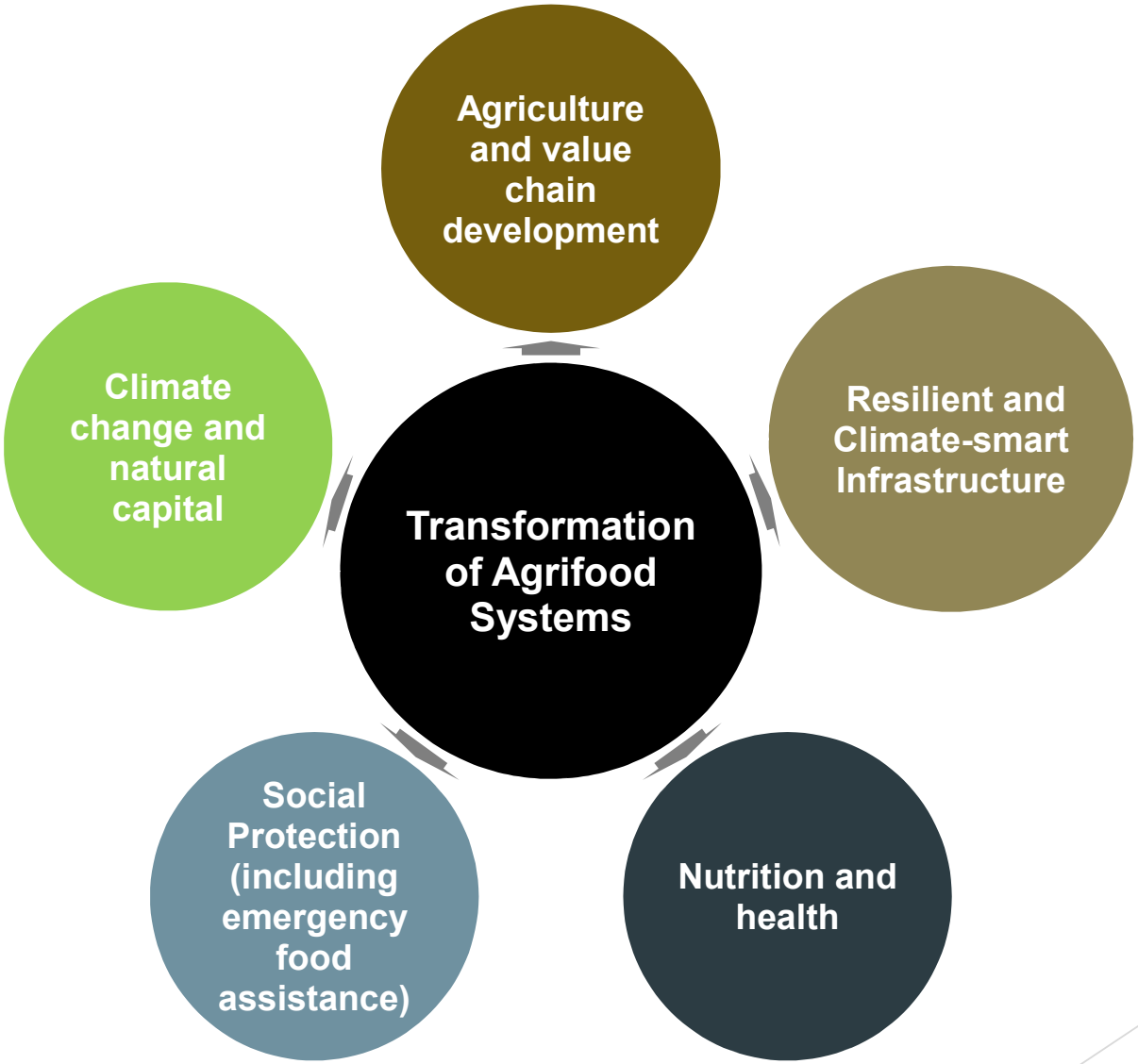


[1]FAO. 2021. The share of agri-food systems in total greenhouse gas emissions Global, regional and country trends, 1990–2019

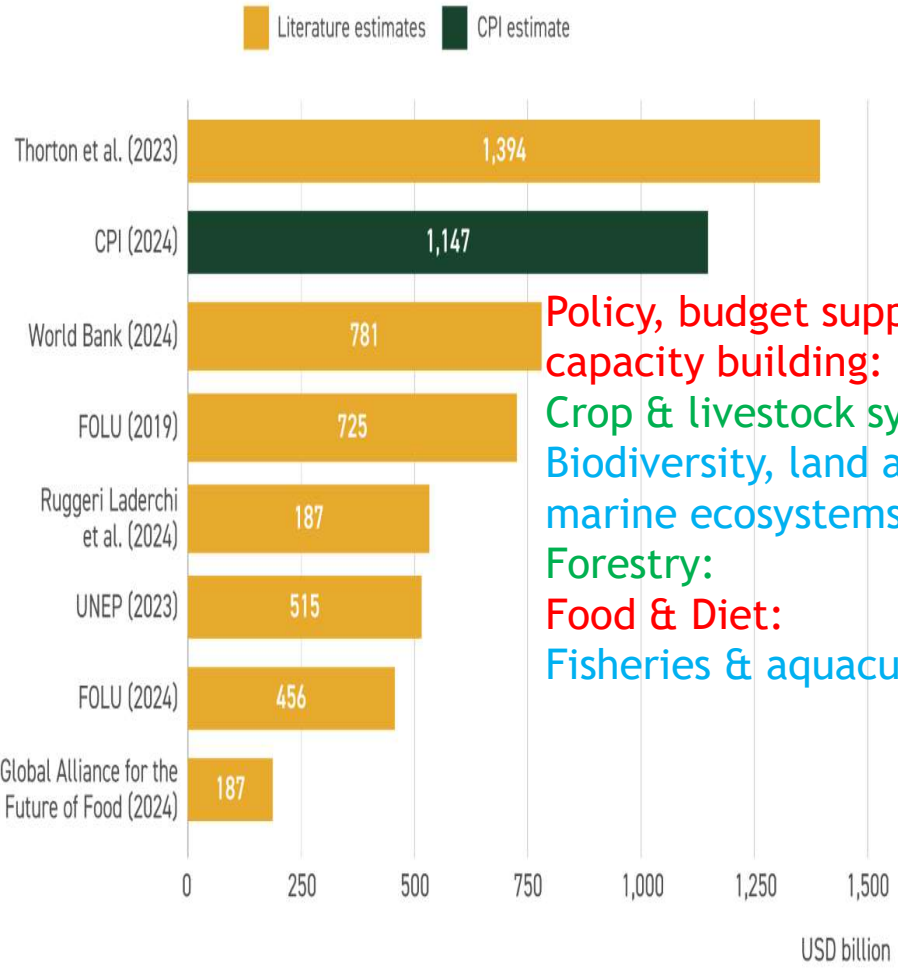
FAO's 120 Actions in 10 Domains for Transforming Agrifood Systems

	Food security and nutrition goals	and contributing to the 1.5 °C agenda
2025	150 million people out of hunger compared to 2020.	Emissions from drained carbon soils are cut by 5% compared to 2020.
2030	Chronic hunger eliminated.	Gross GHG emissions of agrifood systems cut by 25%.
2035	Number of people that could not access to healthy diets cut by half compared to 2020.	Agrifood systems are CO_2 neutral, only other GHG are net emitters.
2040	Number of people that do not consume a healthy diet has been cut by half compared to 2020.	N_2O emissions of the agrifood systems are halved compared to 2020.
2045	Number of people that could not access to healthy diets has been reduced by 85% compared to 2020.	CH_4 emissions of the agrifood systems are halved compared to 2020.
2050	Everyone consumes healthy diets.	Agrifood systems are a net carbon-sink (-1.5 Gt CO_2eq per year).

ADB's approach for Transforming Agrifood Systems

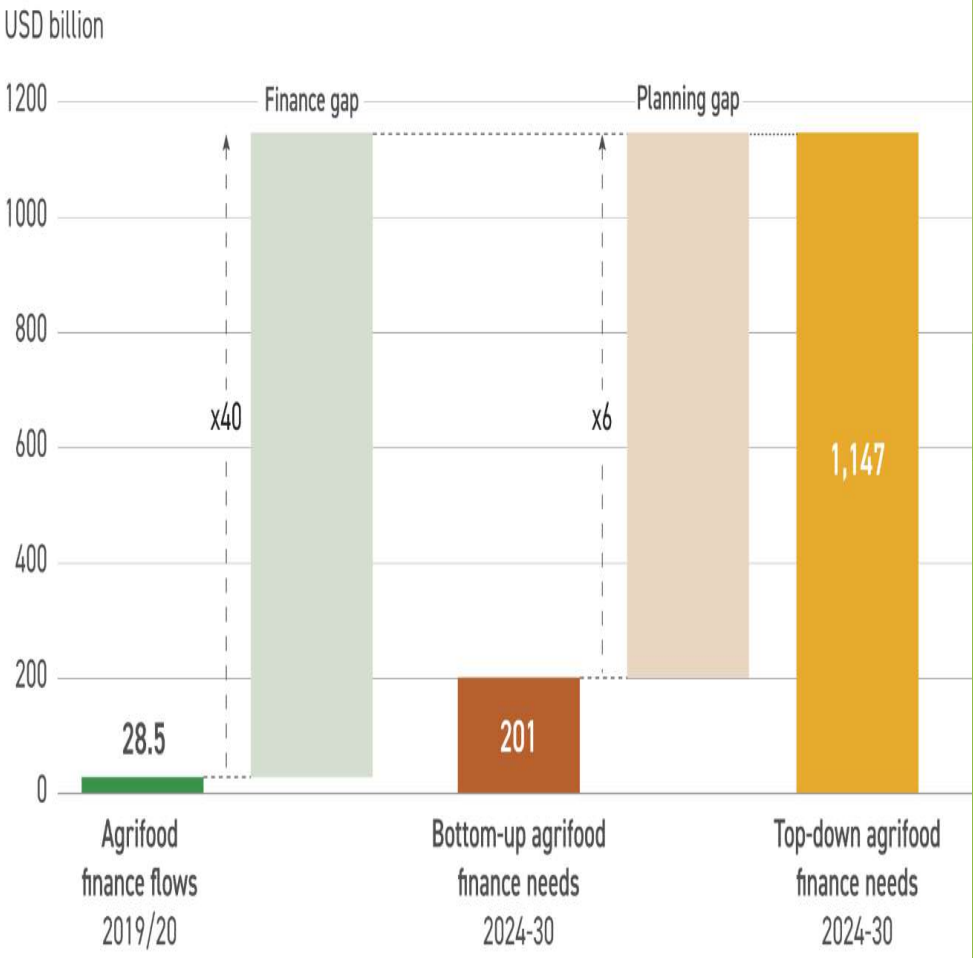


Climate Finance Flows and Needs for Transforming Agrifood Systems



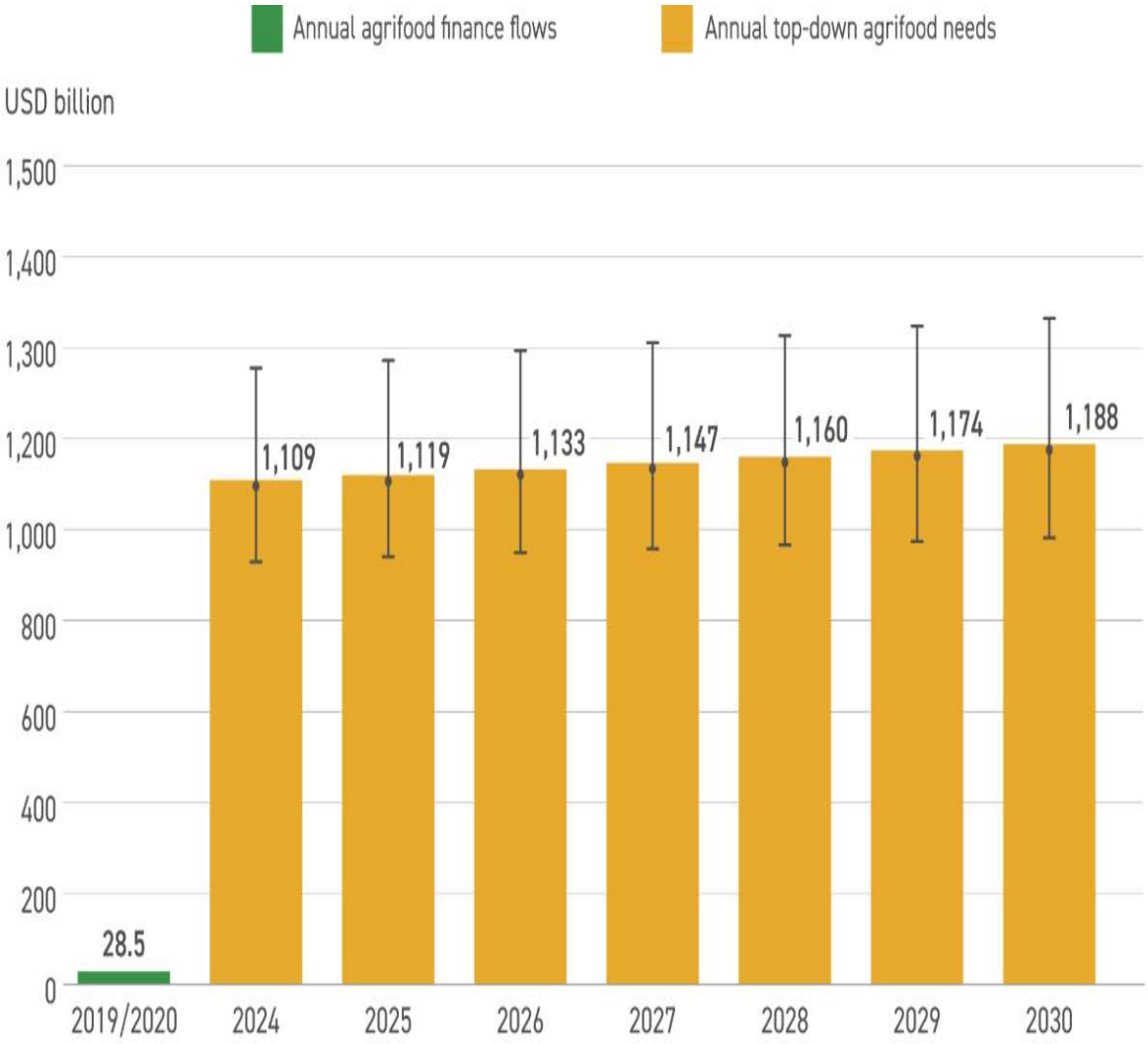
Source: Climate Policy Initiative

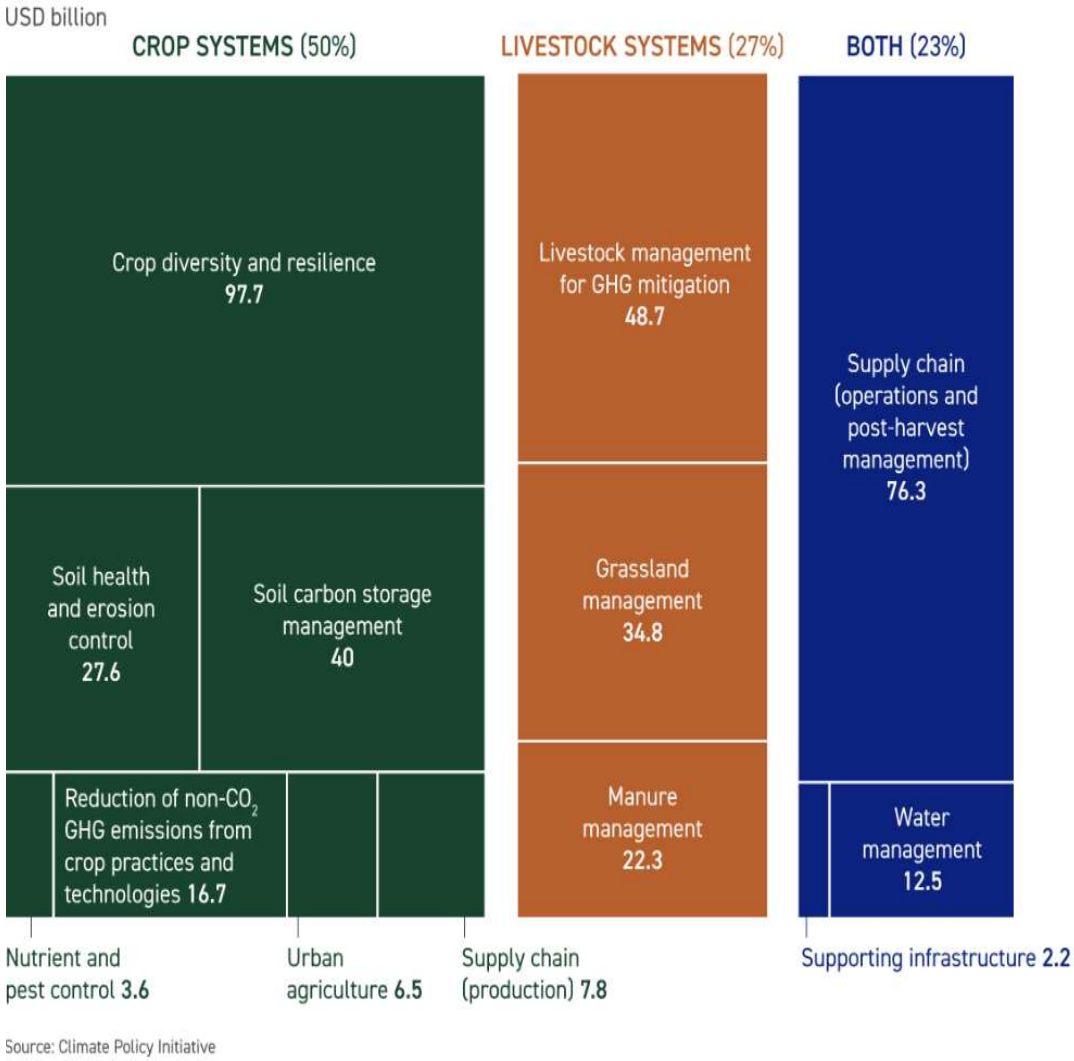
Policy, budget support and capacity building: $467 billion
Crop & livestock systems: $317 billion
Biodiversity, land and marine ecosystems: $188 billion
Forestry: $117 billion
Food & Diet: $53 billion
Fisheries & aquaculture: $5.3 billion



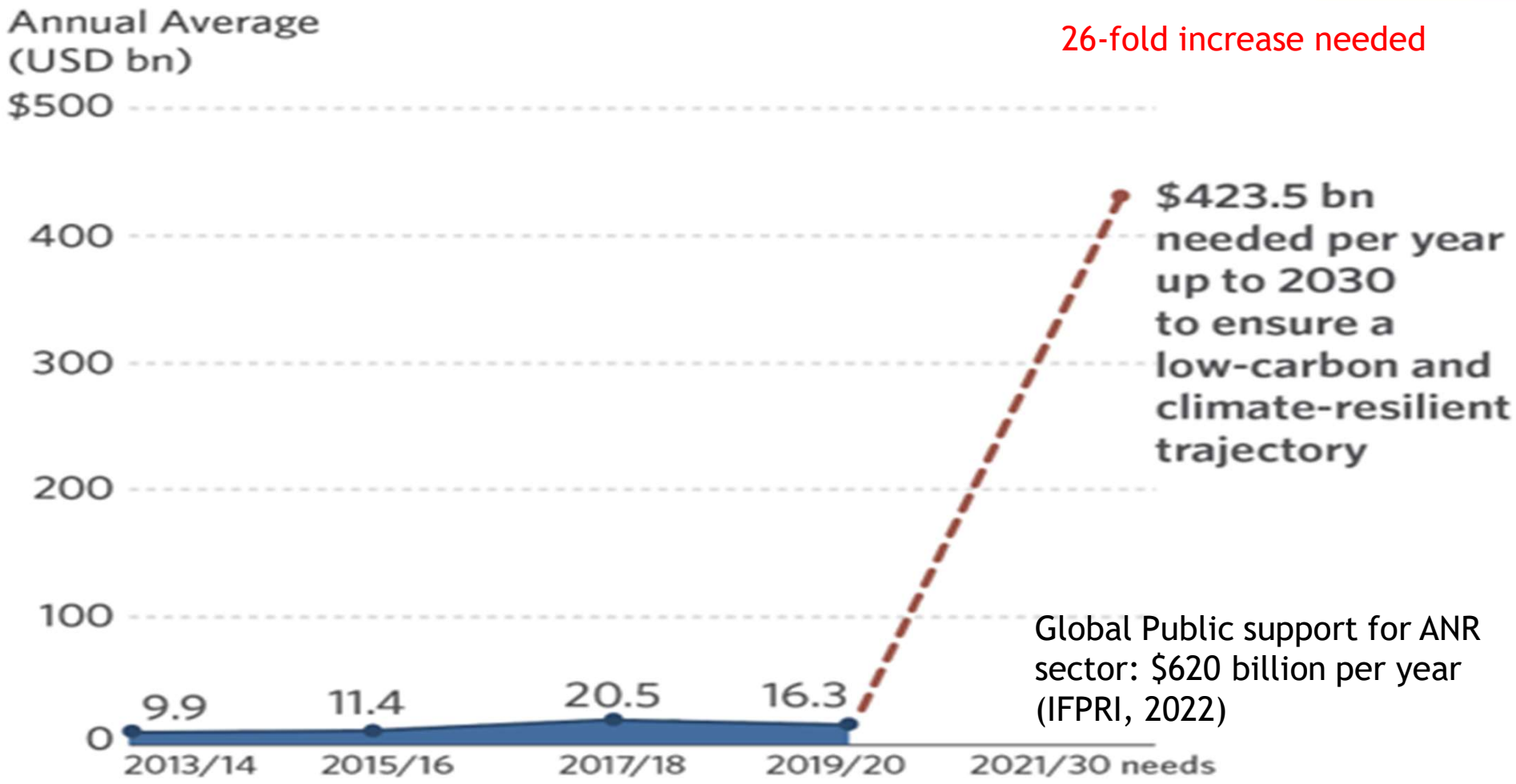
Source: Climate Policy Initiative

Climate Finance Flows and Needs for Transforming Agrifood Systems





Climate Finance in the Agriculture sector
Need vs. Reality



Global Public support for ANR sector: $620 billion per year (IFPRI, 2022)

Case Studies on Transforming Agrifood Systems in a Changing Climate

National Level and Project Level

Viet Nam's National Action Plan (NAP) for Transforming Agrifood Systems by 2030

- Approved by Prime Minister in March 2023 (Decision N° 300/QD-TTg) with a commitment to
  - transparency, responsibility, and sustainability based on local advantages; firmly ensure national food and nutrition security; improve people's income and quality of life; prevent and fight natural disasters, epidemics, protect the environment, respond to climate change; and contribute to the implementation of sustainable development goals until 2030
- **Specific objectives by 2030:**
  - **Rural residents' income will be 2.5 to 3 times higher than in 2020;**
  - **Rate of multidimensional poor households in rural areas will decrease by an average of 1 to 1.5%/year;**
  - **Rate of households with severe and moderate food insecurity will be below 5%;**
  - **Maintain food export turnover of over 30 billion USD/year;**
  - **Rate of malnutrition and stunting in children under 5 years old to be below 15%.**
  - **Rate of overweight and obesity in**
    - **children under 5 years old: below 10%;**
    - **children 5 - 18 years old: below 19%;**
    - **adults 19 - 64 years old: below 20%.**

Viet Nam's National Action Plan (NAP) for Transforming Agrifood Systems

- Proportion of areas granted planting and farming area codes account for over 10% of agricultural and aquaculture production land;
- Number of animal disease-free areas and facilities registered for certification to increase by 5%/year
- Ratio of product value produced as per good or equivalent production processes above 30%;
- Area under organic agriculture reach at least 2.5% of the total agricultural area;
- Amount of organic fertilizer accounts for over 30% of the fertilizer supply on the market;
- Over 30% of the total irrigated dry crop area use advanced, water-saving irrigation methods;
- Post-harvest losses of key agricultural, forestry and fishery products decrease by 0.5% to 1.0%/year;
- Ratio of the value of processed agricultural products in the total value of agricultural, forestry and fishery production and processing over 50%;
- **GHG emissions from the agrifood system decrease by 10% compared to 2020.**
- Food export value **over 30 billion USD/year**;

Climate-friendly Agribusiness Value Chains Sector Project

- **Impact:** Agricultural competiveness in the project areas improved (reflected through enhanced ***productivity***, climate ***resilience***, ***quality*** and ***safety***, ***value addition*** and rural ***household incomes***).
- **Outcome:** Productive and resource-efficient agribusiness value chains developed in project areas.
- **Outputs:**
  1. Critical agribusiness value chain ***infrastructure*** improved and made climate-resilient
  2. ***Climate-smart agriculture*** and agribusiness promoted
  3. ***Enabling environment*** for climate-friendly agribusiness enhanced

GMS Cross-border Livestock Health and Value Chains (CLHVC) Improvement Project

- **Impact:** GMS vision as a leading supplier of safe and environment-friendly agriculture products realized
- **Outcome:** Health, value chains and formal trade of livestock and livestock products improved.
- **Outputs:**
  1. **Livestock health and value chain infrastructure** expanded and upgraded in a climate-friendly manner
  2. **Capacity** for improved **production and health** of livestock and livestock products strengthened
  3. **Enabling policies** for better supply, health, safety and trade in livestock and livestock products enhanced

A few other case studies in Asia

- One-Million Hectare Low-Emission High-Quality Rice Program in Viet Nam
- Crop seeding and weeding robots in Thailand to overcome labor shortage
- Climate resilient rice commercialization program in Cambodia (e.g., alternate wetting and drying, laser land levelling, system of rice intensification)
- Incentives for AgTech and FinTech companies serving small farmers in GMS (e.g., exemption of Import duties on machinery)
- Community-based climate resilient fisheries and aquaculture development
- Sloping agricultural land technology for coconut farms in the Philippines
- Climate smart Aeroponic vegetable farming in Urban areas of Japan
- Climate friendly feed, breed, and waste management in livestock production

The Way Forward –I

- Investing in Agricultural Education, R&D (e.g., integrating agri-environmental issues in primary, secondary and tertiary curricula; enhancing exchange and training programs; expanding resource sharing and upgrading education; focusing more on availability of digital educational materials and promoting remote learning; Expanding Joint Research - Supporting multidisciplinary collaborative projects that address key regional challenges such as water management, crop resilience, and sustainable farming practices.)
- Establishing Policy Networks for Agrifood Systems Transformation (e.g., Viet Nam; China-Africa Food Systems Transformation Knowledge Sharing Platform)
- Enhancing Rural Infrastructure to connect the “Last Mile ”
- Leveraging e-commerce focusing on smallholders (Increasing bargaining power; Boosting income, expanding market channels, and creating employment opportunities; Reducing poverty and stimulating agricultural production and sales)
- Holistic resilience
  - Infrastructure, Social/Community, Institutional, and Financial

Taobao Villages in China: Boosting Rural E-commerce

Initiative: Launched by Alibaba to promote platform growth and rural economic development.

Definition: Villages where at least 10% of residents run online stores or host 100+ active shops with a total annual turnover of ≥ RMB 10 million.

Impacts: Smallholders expanding their **reach to customers nationwide** through e-commerce, enhancing **local economies** and **increasing income**

Coverage: Expanded from 20 villages in one province in 2013 to **28 provinces** and **7,780 villages** in 2022.

The Way Forward -II

- Integrated and Inclusive Climate-smart Agri-food Value Chains
  - Agri-food diversification, intensification, safety and quality, and value addition
  - Agri-food ecosystem integrity (provisioning, regulating, supporting, and cultural services)
  - Mobilize more private sector investments with focus on human welfare
- One Health Approach
  - Human health, crop health, animal health, and environmental health
- Strengthening Climate Data Sharing for Holistic Resilience
  - Enhance transparency, timeliness, and effective use
  - Facilitate information exchange for disaster management
  - Expand the scope of climate data sharing
  - Establish early warning systems and public notifications to inform communities about potential climate risks and forecasts
  - Utilizing cellphones to disseminate weather information to farmers (e.g., through text messages)
- Enhancing Agricultural Trade Cooperation (e.g., **Promoting cooperation with other countries in the prevention and control of cross-border animal and plant diseases; Improving trade facilitation and market access)**
- Expanding Agricultural Technology Cooperation (e.g., 7 priorities: **weather and seasonal forecasts; rainwater harvesting; microbial fertilizers; innovations to reduce livestock methane emissions; digital agriculture; climate-resilient social protection; alternative proteins)**

Innovation Commission on Climate Change, Food Security, and Agriculture

1. Improved Weather and Seasonal Forecasts
2. Rainwater Harvesting
3. Microbial Fertilizers
4. Innovations to Reduce Livestock Methane Emissions
5. Digital Agriculture
6. Climate-Resilient Social Protection
7. Alternative Proteins

PJTAU's Role in Transforming Agrifood Systems in a Changing Climate

- Envision a climate-smart and sustainable agrifood system for Telangana by 2050.

  (e.g., Vision of Telangana becoming a major region worldwide to produce safe and climate-friendly agrifood products meeting regional and international standards)

- Clarify the role of stakeholders (students, teachers, scientists, policymakers, and the private sector) in achieving the vision.
- Mobilize collective action for continued innovation, collaboration, and commitment.
- Enhance National and International Collaborations and Partnerships
  - Leverage national and international research and development collaborations.
  - Learn from global best practices and adapt them to Telangana context
  - Mobilize national and international funding and technologies for agrifood system transformation projects.
- Advocate robust research, education and extension policies and provide Institutional Support.
- Educate and empower farmers and agribusiness value chain stakeholders about climate actions.

Key Takeaways

1. Food and nutrition security goals cannot be achieved without adequately addressing the agrifood system related causes and consequences of climate change. Likewise, climate goals cannot be achieved without transforming agrifood systems.
2. Less than 4% of climate finance goes to support agrifood systems, while agrifood systems remain the most vulnerable sector to impacts of climate change and contribute nearly 31% of total global greenhouse gas emissions.
3. Transforming agrifood systems requires a holistic approach tailored to specific local, sub-national, national, regional and global context focusing on transforming institutions, policies, technologies, markets, and behaviors.
4. Institutions such as PJTAU play a vital role in transforming agrifood systems in a changing climate through reshaping agricultural research, education, and extension in addressing food-nature-water-energy-climate nexus issues and tradeoffs.

Thank you.