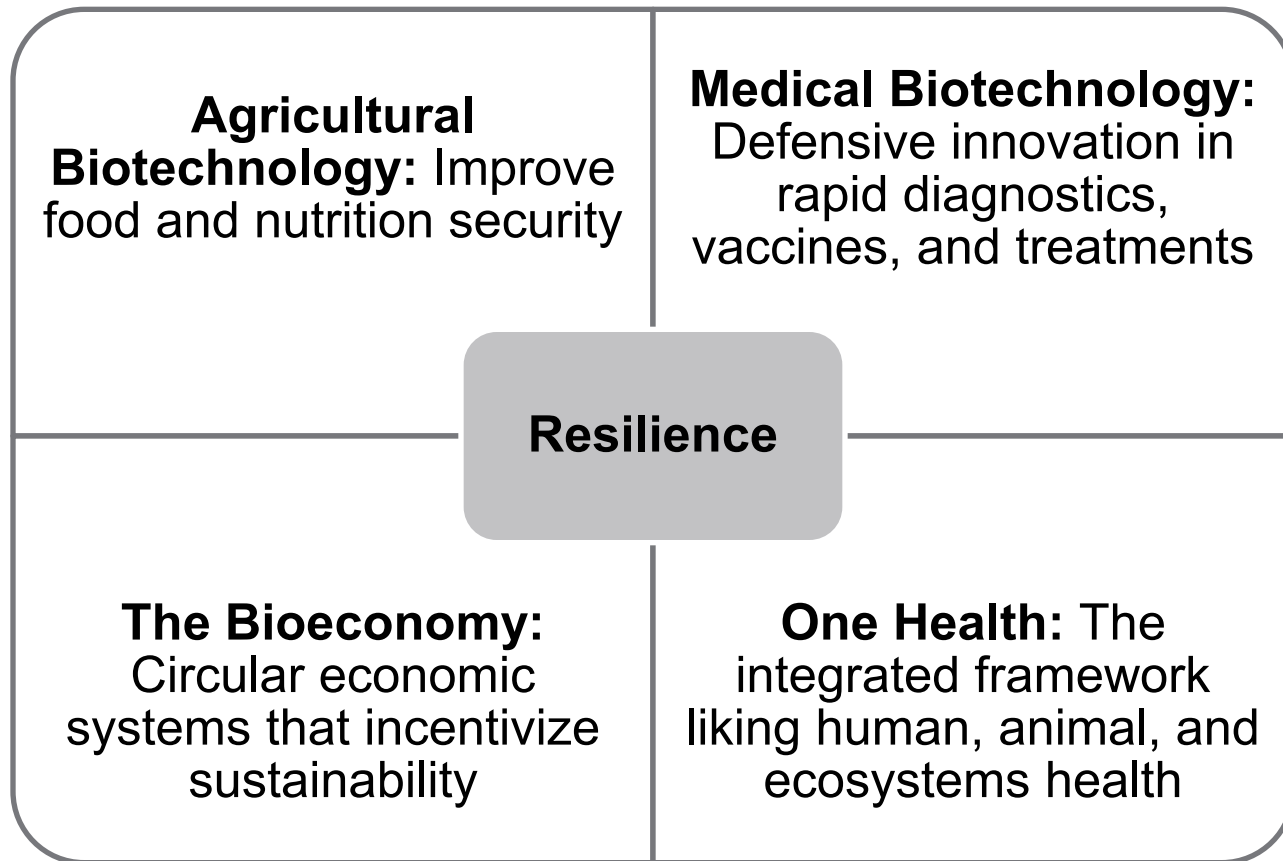




Agricultural and Medical Biotechnology, Bioeconomy Innovation and One Health

Carl Pray and Yanhong Jin

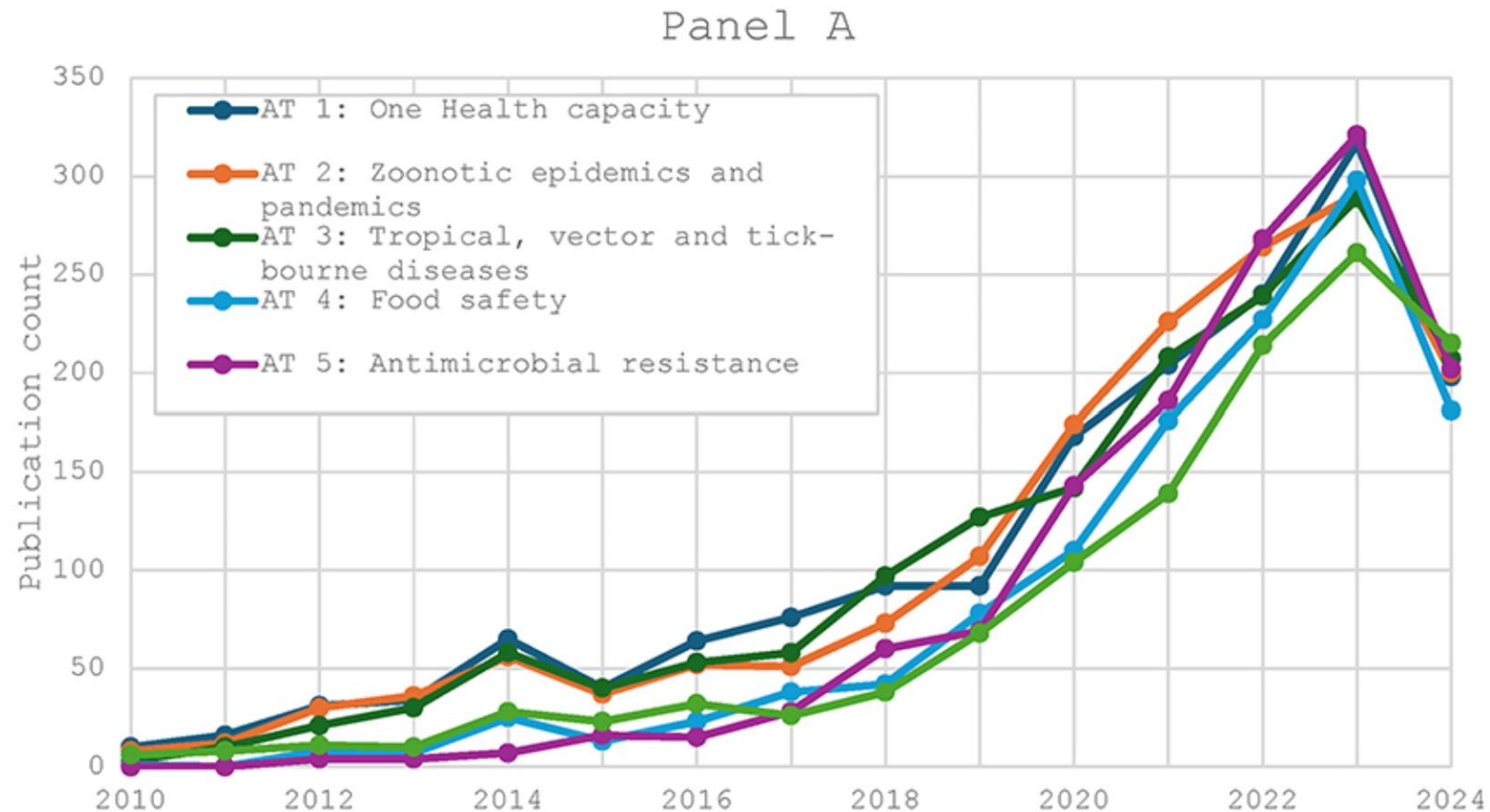
The Four Pillars of Resilience



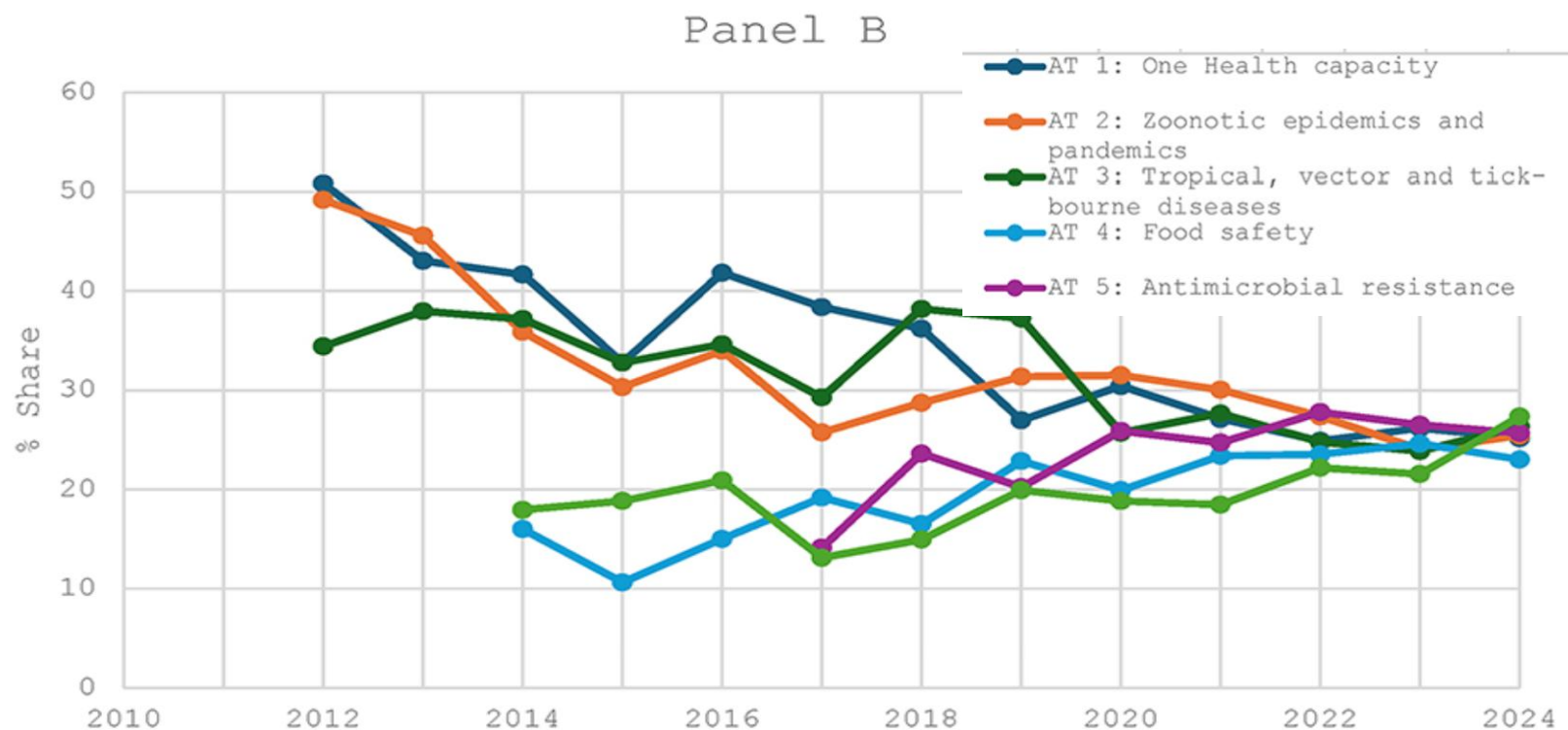
CABI's Take on One Health Research

- ❑ The Beginning: Originated within veterinary medicine and looked at the connection between animal diseases and how they can be transmitted to humans and how this impacts human health” (CABI 2025)
- ❑ Research accelerated with Ebola and COVID-19
- ❑ Definitions “One Health addresses..... zoonotic diseases, food security and safety, climate change, and any health threats shared by people, plants, animals, and the environment”
- ❑ CABI One Health journal since 2022
- ❑ Plant & One Health: “Worlds apart: Plant health and One Health and a path to convergence”

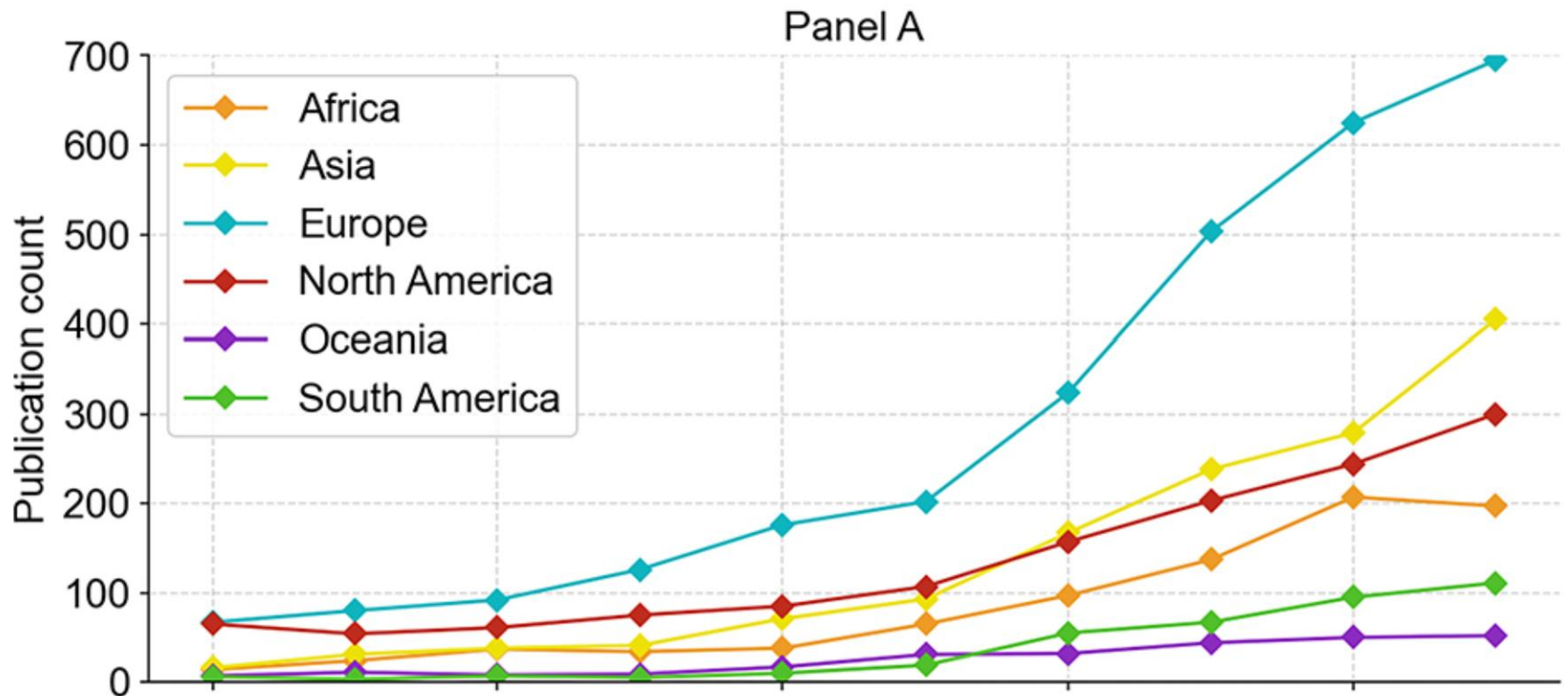
Trends in research publications on one health



Share of One Health Publications



Research led by Europe followed by Asia and N. America...



Which countries doing one health research 2010 to 2024

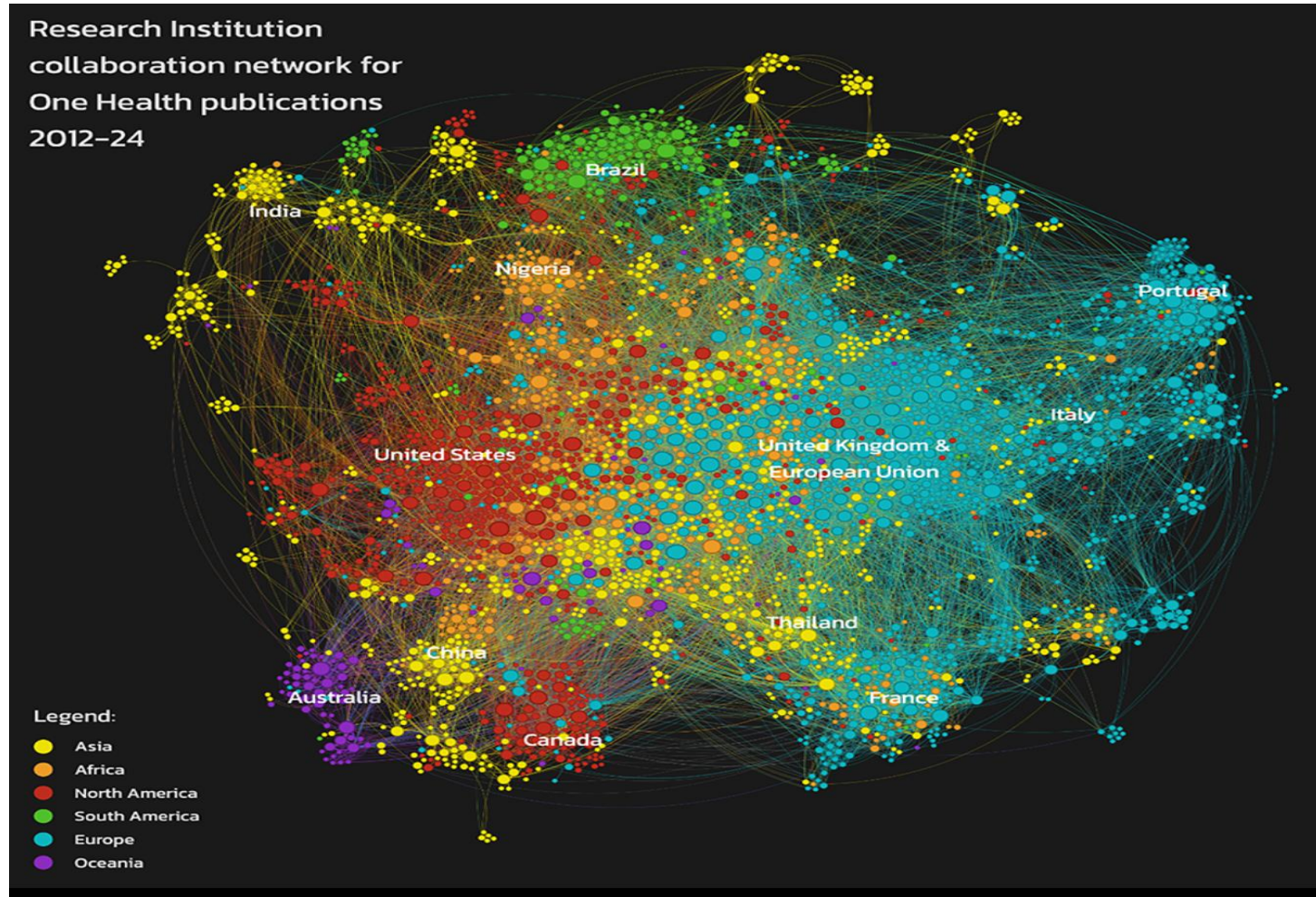
Table 4 The leading countries
are organized publications with
citation counts

TP (Total Publications), TC
(Total Citations)
Authors

Ranking	Countries	TP	Countries	TC
1	Germany	217	Germany	5428
2	Italy	104	Italy	3661
3	Spain	100	Netherlands	3435
4	Finland	93	Sweden	3199
5	United State	89	Finland	3121
6	Netherland	85	United Kingdom	2946
7	Brazil	75	Spain	2424
8	Sweden	73	France	1616
9	United Kingdom	59	United States	1554
10	France	52	Canada	1391

[Exploring the Global Trend of the Sustainable Bioeconomy: An Analysis of Scientific Literature | Circular Economy and Sustainability | Springer Nature Link](#)

Collaborations led by Europe & N.America encompassed most of the globe.



Biotechnology has a major impact on One-Health research

- Agricultural biotech
- Medical biotech
- Bioindustry biotech

Agricultural Biotechnology for Global Nutrition and Food Security

Biotech drives food security in a changing climate and institutional contexts

- ❑ Climate Resilience: Developing drought and heat-tolerant, pest-resistant crops (e.g., GMO, gene-editing technology, AI for breeding)
- ❑ Biofortification: Enhancing nutritional content to combat malnutrition (e.g., vitamin A-enriched rice)
- ❑ Resource Efficiency & Sustainability: Reducing the use of pesticides and chemical fertilizers, which indirectly benefits human health by producing water resources and soil microbiome

Past agricultural innovations have significantly influenced food production, pesticide application, and land use.

❑ **Genetic engineering of crops (since the 1980s)**

- Enhancements in agricultural productivity
 - Development of insect resistance and herbicide tolerance
 - Improvement in grain quality, including vitamin A in rice and reduced mycotoxins in grain
- **Biopesticides and biofertilizers:** Integration of biological alternatives to manage pests and diseases and reduce reliance on synthetic chemical fertilizers.
 - **Advancements in Conventional Breeding:** Integration of genomic knowledge and sophisticated tools (e.g., AI) to refine traditional practices
 - Increased efficiency in plant and animal breeding through the use of genomics, genetic markers, and phenomics,

Impacts of GMO research

❑ **Insect-resistant GMO Crops**

- China insect-resistant cotton: Improved productivity, environmental outcomes, and health by reducing pesticide applications
- Technological advancements led to crop yields, benefiting Monsanto in North America, thousands of small seed companies, and millions of farmers over the period of years.
- The use of GMO soybeans and corn for cattle feed in Europe because European and South American has contributed to lower meat prices

❑ **Herbicide-Tolerant GMO Crops**

- Reduced costs in the US and allowed for the replacement of more harmful herbicides
- Facilitated the adoption of low-till and no-till agricultural practices in South America.

Bt Cotton in India



Spraying cotton for bollworm



Bt Corn and Mycotoxin Reduction in South Africa

- ❑ **Insects as Vectors for fungal disease in corn**
 - Primarily pre-harvest damage
 - Kernel damage
 - European corn borers directly linked to mycotoxins on US experiment stations (Dowd 1998)
- ❑ **Benefits of Bt corn can reduce mycotoxins**
 - Reduce mycotoxin levels
 - Less insect pest damage
 - Less opportunity for fungus growths
- ❑ **Consumer Reception and Research Findings**
 - Our studies in South Africa showed a significantly lower level of fumonisin in Bt maize



Medical Biotechnology for Health Innovation

Revolutionizing defense against health threats

- ❑ Vaccine platforms: Rapid mRNA and viral vector technology
- ❑ Personal Medicines: Moving from “one-size-fits-all” treatments to targeted therapies, using big data and AI (e.g., Genomic-based tailored therapies)
- ❑ Diagnostic Tools: Molecular diagnostics for early detection
- ❑ Antimicrobial Resistance (AMR): Using biotech to create novel diagnostics and alternatives to antibiotics

Medical biotechnology

Research achievements related to One Health

- ❑ **Pioneering Medical Biotech:** The transition from animal-derived insulin (porcine/bovine) to recombinant human insulin produced by genetically modified microorganisms.
- ❑ **Vaccine Innovation & Therapeutics:** Advancements in addressing infectious diseases including COVID-19, Ebola, and Malaria. Key developments include genetically engineered viral vectors (e.g., AstraZeneca, J&J), mRNA technology (e.g., Moderna, Pfizer), and traditional vaccine platforms utilized in China.
- ❑ **Metabolic Therapeutics:** The development of GLP-1 receptor agonists, pioneered by the same firms that revolutionized insulin production.

Bioindustry Research and Impact

❑ Biofuels (sugarcane, corn, and soybeans)

- **Benefits:** Economic growth and potential environmental advantages by replacing fossil fuels and reducing GHG emissions,
- **Technology:** Biofuel production costs lowered through improved engineering and the use of specialized microbes. Sugarcane yields and supply systems are improving, including the use of bagasse waste for electricity and on-site enzyme engineering at factories.
- **Challenges:** Increased demand for sugar and corn for fuel has led to higher prices and reduced food production.

❑ Alternative protein

- **Scope:** Replace meat with vegetables or cell-based meat
- **Potential Advantages:** Reduction in zoonotic disease and lower GHG emissions.
- **Challenges:** Consumer demand in the US is currently lower than anticipated.

Bioindustry Research and Impact (continued)

Converting used cooking oils into sustainable aviation fuels

- ❑ **Benefits:** Mitigate food safety risk by reducing the illegal use of USO back to the food system; reduce aviation GHG emissions
- ❑ **Technology:** Hydro-processed Esters and Fatty Acids (HEFA) method, a technology already well-established for renewable diesel and jet fuel production
- ❑ **Challenges:**
 - Feedstock governance (feedstock origin, life cycle emissions, and sustainability attributes)
 - Formation of domestic demand: Without a stronger domestic demand signal, China's SAF sector may remain a supply platform for foreign decarbonization policies rather than a fully domestic aviation decarbonization system.
 - Price and Trade volatility
 - Technology diversification

Can One Health help with Research Efficiency?

- ❑ Collaboration between scientists in different disciplines working on One Health, Agricultural Biotechnology, and Bioeconomy is a challenge
- ❑ Global collaboration in faces nationalism and declining government funding in wealthy and poor countries.
- ❑ Collaboration between public and private research around One Health
- ❑ CGIAR One-Health led by the International Livestock Research Institute (ILRI)

Can One Health generate more money for Research?

- ❑ One Health might help generate funding for government research funding in many countries where R&D is stagnant or declining.

Most dramatic in the US – medical research budgets down, environmental research declined more and government eliminates US Agency for International Development which helped transfer medical tech.

Influence lobbying groups like MAHA movement in US

- ❑ Philanthropic foundations research like Novo Nordisk Foundation might fund environmental, agriculture and veterinary research more attractive in One Health format

The End – Thanks