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Science for a food-secure future

Innovating for climate-friendly food systems.

Climate Week for Latin America and the Caribbean, 2023.

Agriculture in the "Agenda for Accelerating Climate Action".
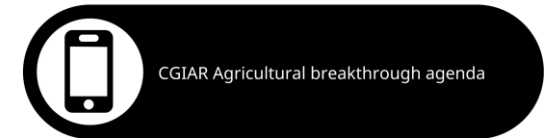
Deissy Martinez Barón.

Climate action, policy and scaling up researcher.
AgriLAC Resilient AgriLAC Leader, CGIAR Regional Integrating Initiative.
Regional Leader for Latin America and the Caribbean for Climate Action, Alliance Bioversity and CIAT.

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Achieving Agricultural Breakthrough:

A deep dive into seven technological areas

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CGIAR Agricultural breakthrough agenda

Agenda for Accelerating Climate Action: a master plan to accelerate the decarbonization of five major sectors.

What is it?

It is an international clean technology agenda initiated by 45 world leaders during COP26. These leaders represent countries that together account for more than 70% of the global Gross Domestic Product (GDP).

## How is the agenda composed?

The agenda integrates government strategies with business innovations to make clean technologies the most affordable and accessible option globally by 2030.

What is your objective?

Support the goal of limiting global temperature rise to 1.5°C above pre-industrial levels, as set out in the Paris Agreement.

Sectors:

Energy

Land Transportation

Steel

Nitrogen
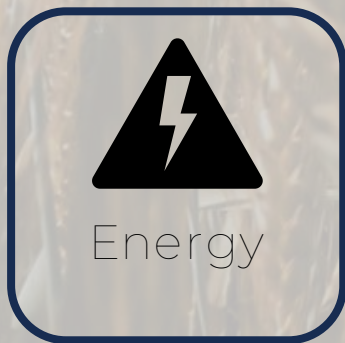
Agriculture

Why agriculture?

The agricultural sector contributes to GHG generation and is vulnerable to the impacts of climate change.

Most studies state that food and agriculture are responsible for between 25% and 35% of global greenhouse gas emissions.

WASTE	1.6 bn t CO²e	**Post-retail**
		2.1 bn tonnes of carbon-dioxide equivalents (CO²e)
COOKING	0.5 bn tonnes	
RETAIL	0.7 bn tonnes	
PACKAGING	1.0 bn tonnes	**Supply chain**
TRANSPORT	0.8 bn tonnes	3.1 bn tCO²e
FOOD PROCESSING	0.6 bn tonnes	
AGRICULTURAL PRODUCTION	7.1 bn tCO²e	This is emissions from agriculture, aquaculture and capture fisheris in both studies

Supply chain 2.4 bn tCO²e

RETAIL	0.4 bn tonnes
PACKAGING	0.6 bn tonnes
TRANSPORT	0.8 bn tonnes
FOOD PROCESSING	0.6 bn tonnes
AGRICULTURAL PRODUCTION	8 bn CO²e
LAND USE	3.2 bn CO²e

LAND USE 5.7 bn tCO²e

Crippa et al. (2021) estimate higher land use emissions since it allocates all deforestation to agriculture.

Poor and Nemecek (2018) assign only 60% of deforestation to agriculture for food

Poor and Nemecek (2018)
13.6 billion tonnes CO²e from food
That's 26% of global GHG emissions (Increases to 33% with non-food agricultural products)

Crippa et al. (2021)
17.9 billion tonnes CO²e from food*
That's 34% of global GHG emissions (*som non-food agricultural products included)

Global greenhouse gas emissions from food systems.

Four principles of the agenda for accelerating climate action in agriculture.

Sustainable increases in agricultural productivity and income, especially in low- and middle-income countries.

Reduction of greenhouse gas emissions from the agri-food sector.

Desired results.

Improvement of soil, water resources and natural ecosystems.

Improving adaptation and resilience to climate change of small producers.
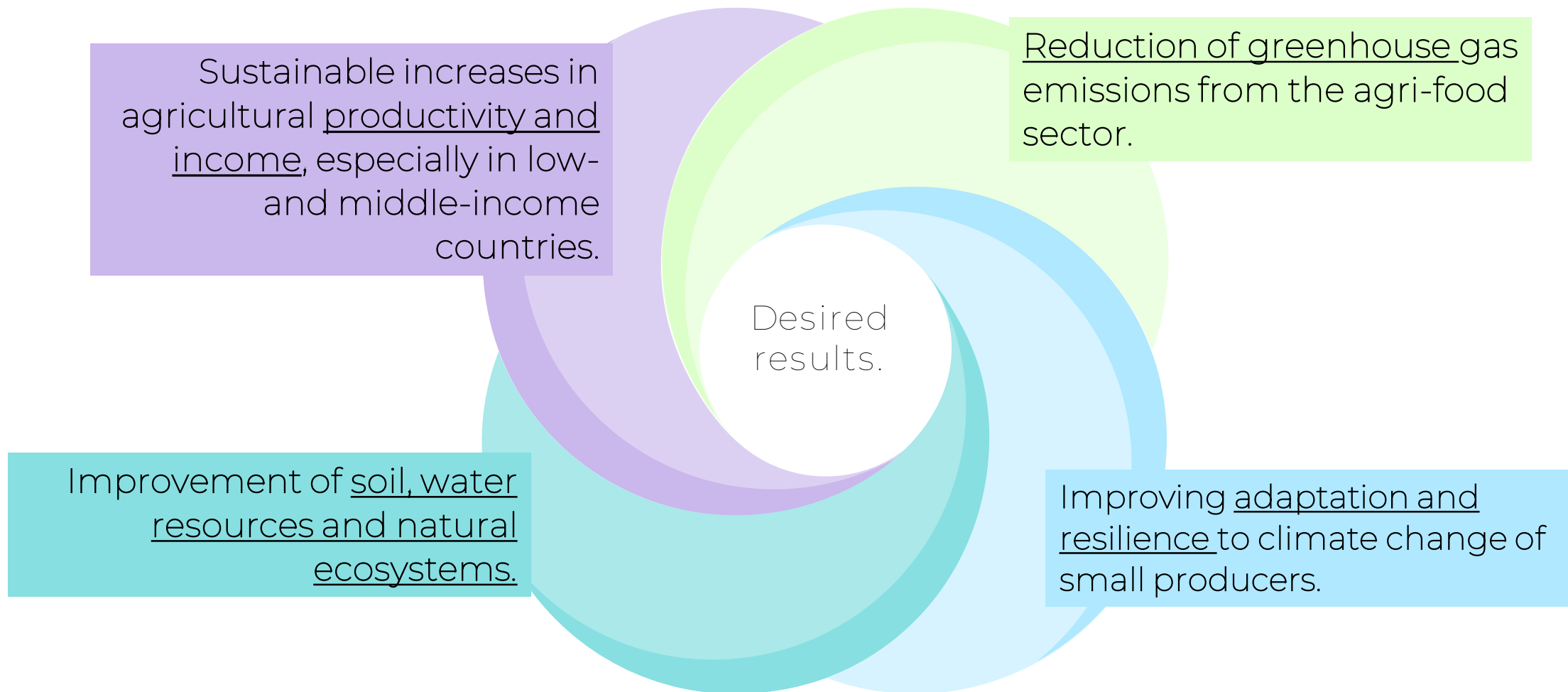
Five ways to move towards accelerating climate action in agriculture.

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TRACK 1:
Reduce unsustainable consumption where it has detrimental effects on health, climate and the environment.

TRACK 2:
Increase sustainable, healthy and nutritious food production, especially in low- and middle-income countries, without expanding agriculture to new lands.

TRACK 3:
Reduce damage to natural resources such as soil, water and biodiversity.

TRACK 4:
Reduce emissions, either absolute emissions or emissions intensity, with the ultimate goal of reducing absolute emissions.

TRACK 5:
Prioritize the needs and interests of small producers.

With the support of international collaboration actions in:

Climate finances.

Policies, regulations and innovations.

Metric indicators and standards.

Research, development and demonstration.

Private sector, markets and trade.

Ways to achieve the desired results.

Technological areas or approaches.

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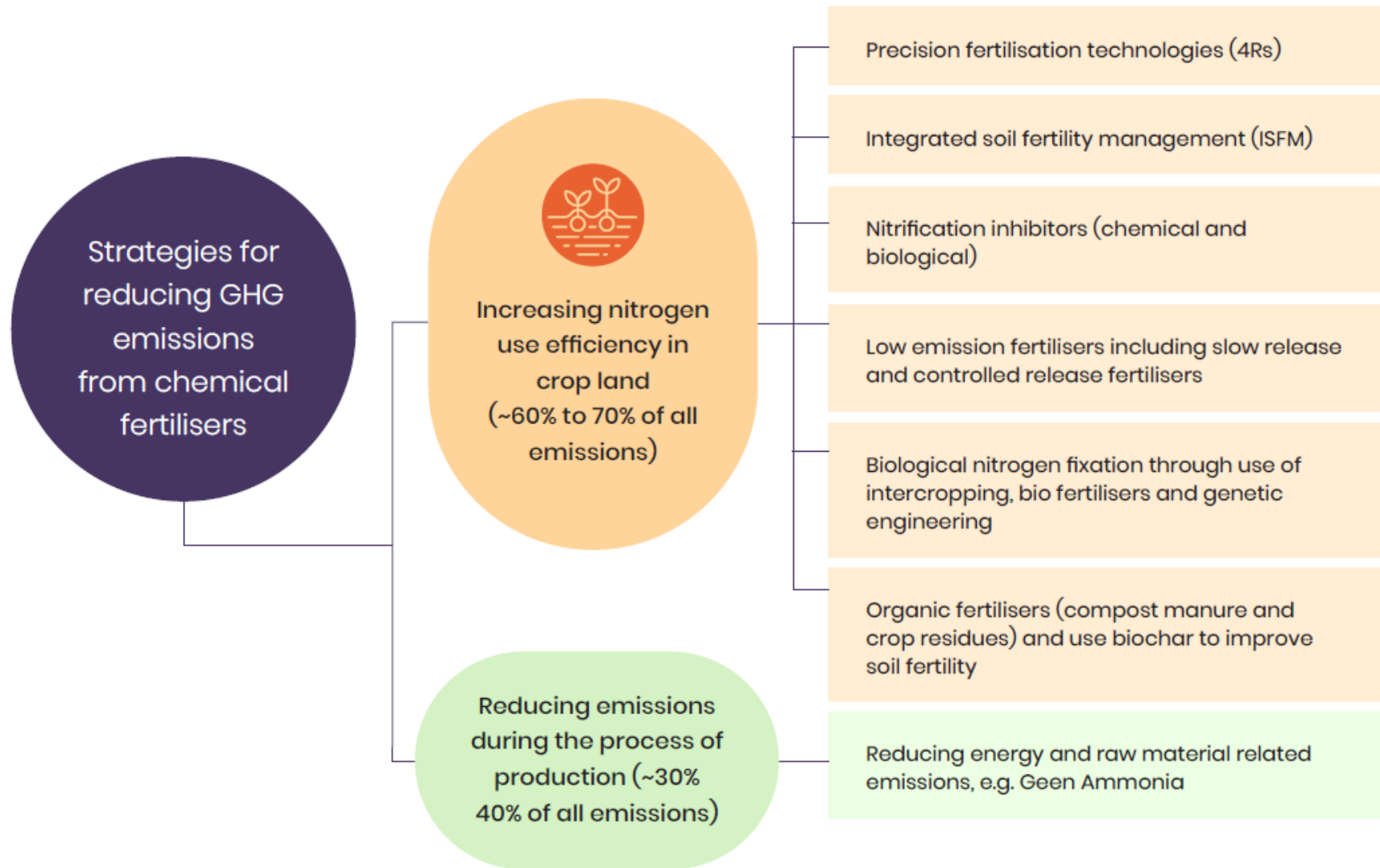| 1. Reduction of fertilizer emissions. | 2. Alternative proteins. | 3. Reduction of food loss and food waste. | 4. Crop and livestock improvement. |

Concrete actions to be taken to achieve the desired results.

| 5. Reduction of methane emissions from livestock. | 6. Agroecology and other sustainable approaches. | 7. Digital Agricultural and Climate Services (DACS). |

1. Reduction of fertilizer emissions.

Strategies for reducing GHG emissions from chemical fertilisers

Increasing nitrogen use efficiency in crop land (~60% to 70% of all emissions)

- Precision fertilisation technologies (4Rs)
- Integrated soil fertility management (ISFM)
- Nitrification inhibitors (chemical and biological)
- Low emission fertilisers including slow release and controlled release fertilisers
- Biological nitrogen fixation through use of intercropping, bio fertilisers and genetic engineering
- Organic fertilisers (compost manure and crop residues) and use biochar to improve soil fertility

Reducing emissions during the process of production (~30% 40% of all emissions)

- Reducing energy and raw material related emissions, e.g. Geen Ammonia

- Chemical fertilizers play a **critical role** in ensuring agricultural production and food security.

- Both over-fertilization and under-fertilization of crops worldwide have led to numerous environmental problems, including climate change and soil degradation.

2. Alternative proteins.
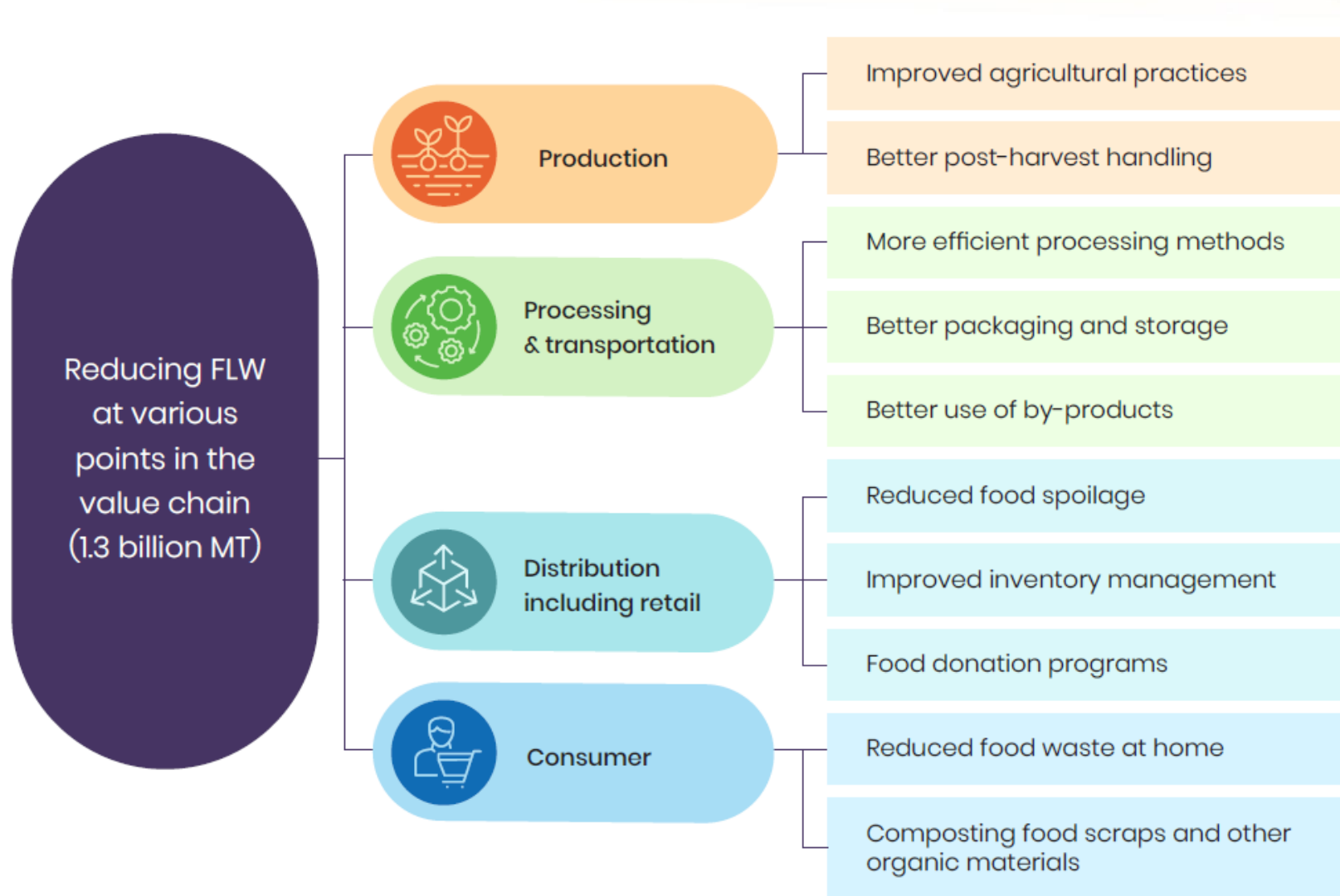

Protein source

- Plant-based
- Microbial fermentation - based
- Cultivated meat
- Insect-based

Alternative proteins

Emissions reductions from:

- Reduce land use (change)
- Removal of animal feed
- Removal of animal manure
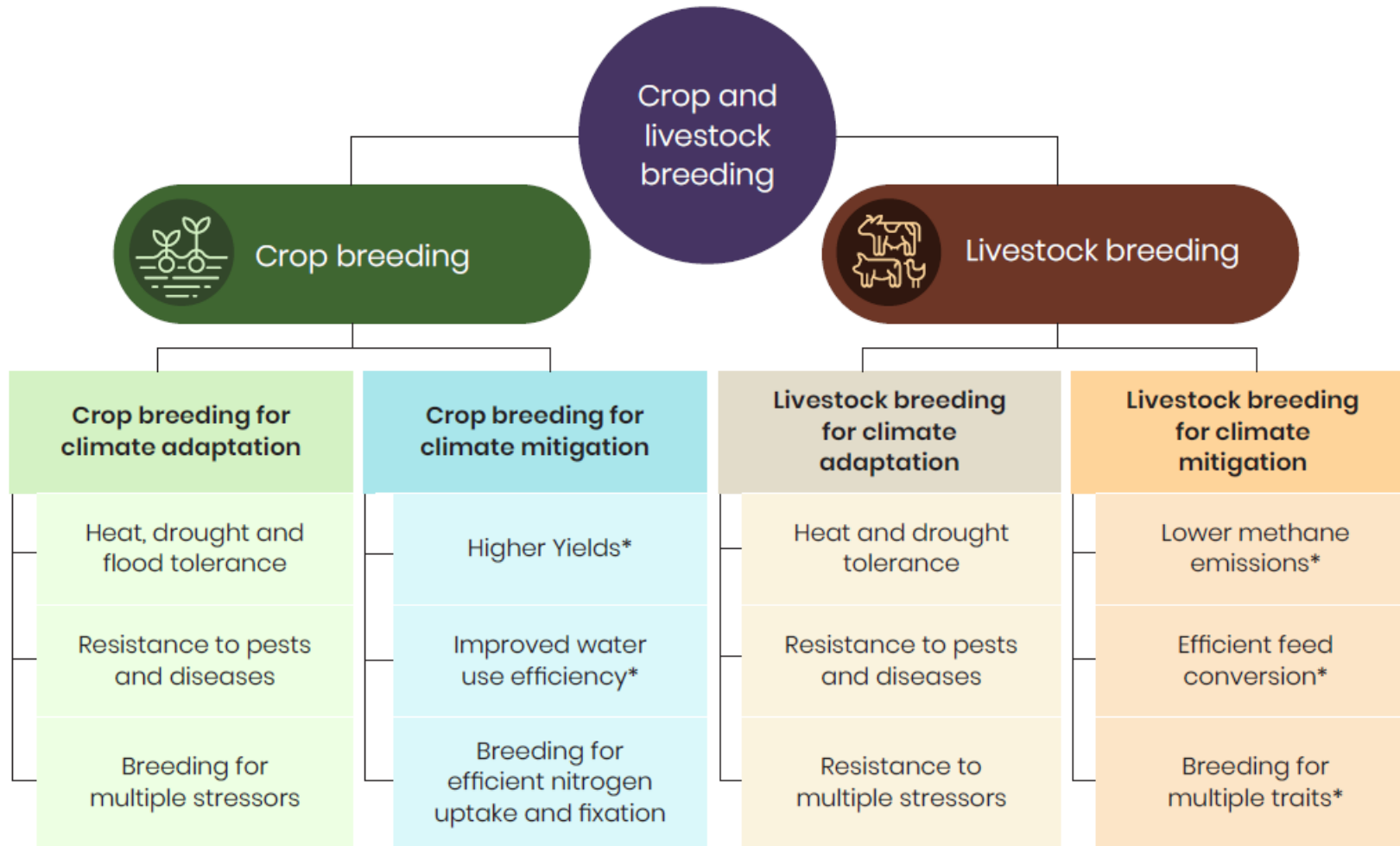- Reduced agrochemical use
- Reduced energy use
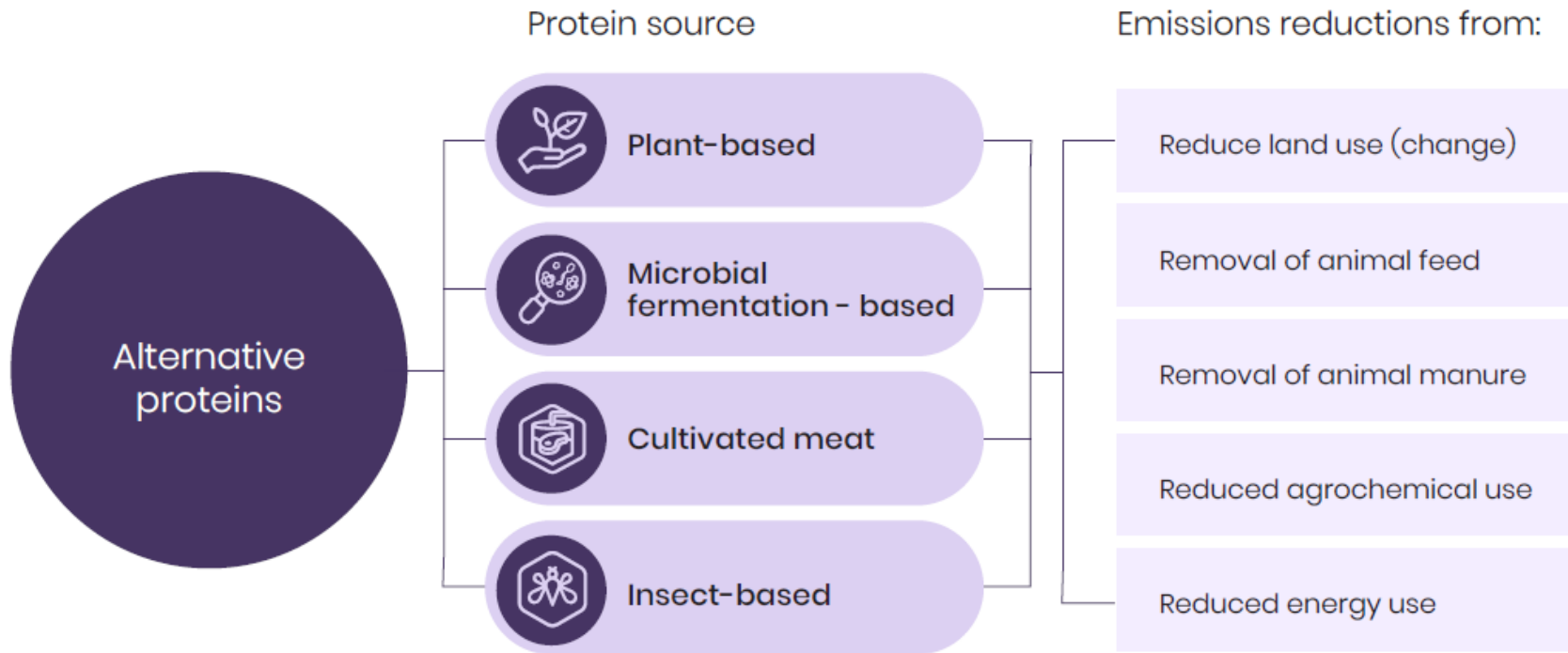
- Alternative proteins have great potential to reduce the environmental footprint of traditional animal source foods (ASF).

- Further study is needed on their impacts on farm income and productivity.

3. Reduction of food losses and waste.

Reducing FLW at various points in the value chain (1.3 billion MT)

Production
- Improved agricultural practices
- Better post-harvest handling

Processing & transportation
- More efficient processing methods
- Better packaging and storage
- Better use of by-products

Distribution including retail
- Reduced food spoilage
- Improved inventory management
- Food donation programs

Consumer
- Reduced food waste at home
- Composting food scraps and other organic materials

- If food loss and waste were a country, it would be the third highest greenhouse gas emitting nation in the world.

- To develop appropriate loss and waste reduction policies, better data on volumes, impacts, benefits and costs are needed at national and international levels.
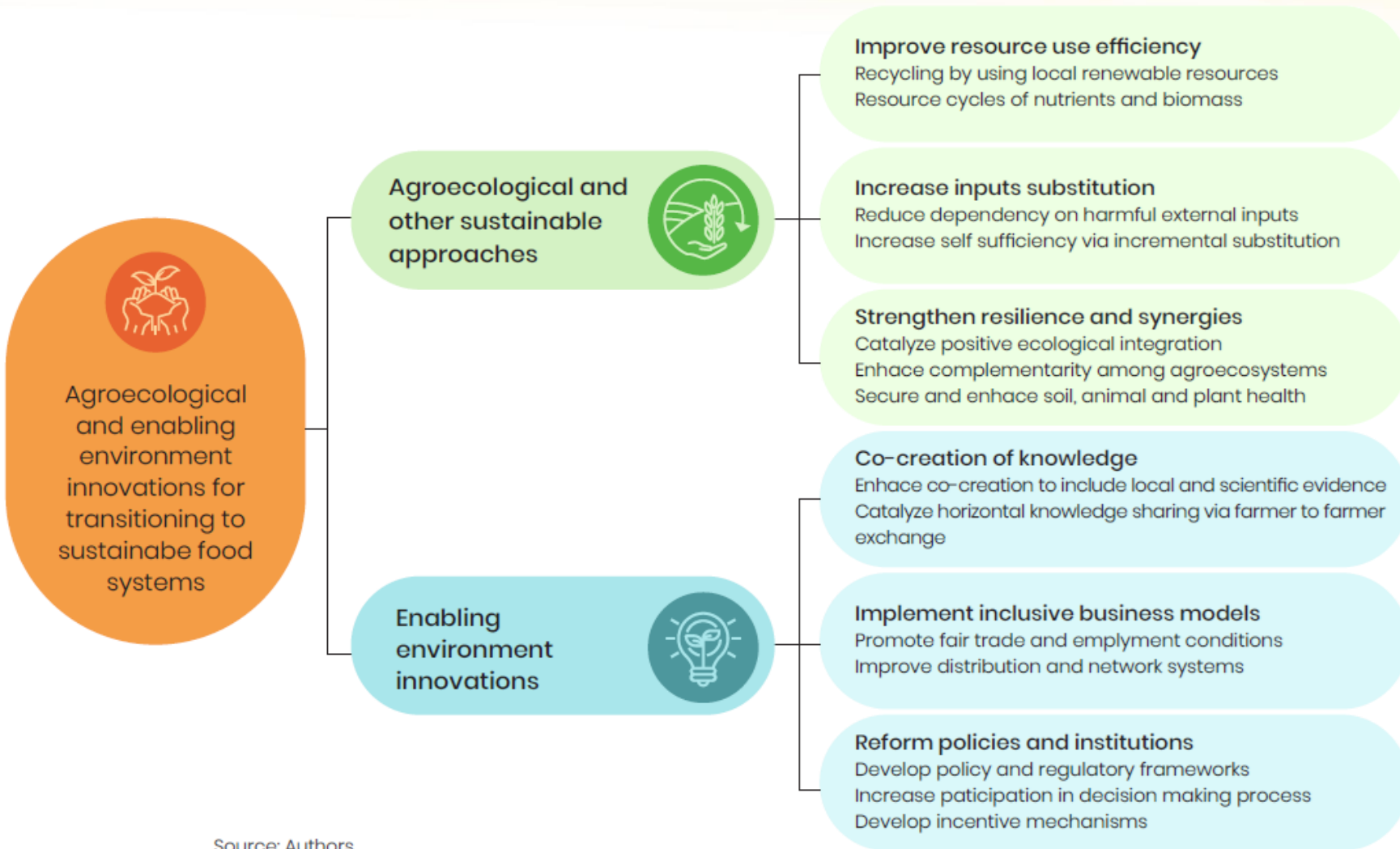
4. Crop and livestock improvement.

- The integration of new methodologies and technologies in classical breeding can accelerate climate resilience in crop and livestock systems.

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Strategies to reduce enteric CH4 emissions according to their effectiveness and applicability in different production systems.

Zero-grazing production systems

Chemical inhibitors*
Tanniferous forages*
Electron sinks*
Lipids*
Concentrate
Feed, forage & forage management
Herd management*
Low-CH$_4$ emitting animals*

Grazing with feed supplementation

Chemical inhibitors*
Tanniferous forages*
Electron sinks*
Lipids*
Concentrate
Feed, forage & forage management
Pasture and pasture management
Herd management*
Low-CH$_4$ emitting animals*

Grazing without feed supplementation

Tanniferous forages*
Pasture and pasture management
Herd management*
Low-CH$_4$ emitting animals*

Manure management strategies and technologies for CH4 emission reduction.

Manure in wet form/slurry

Anaerobic digestion*
Impermeable covers
Daily cleaning, collection and land spread*
Decreasing storage time*
Acidification*
Biofilter
Solid-liquid separation and/or composting
Complete removal of manure residues between storage periods

Manure in solid form

Anaerobic digestion*[1]
Daily cleaning, collection and land spread*
Decreasing storage time*
Composting (aeration) with biochar

Grazing system[2]

Short-rotation pasture management
Short-rotation corrals/bomas

6. Agroecological approaches.

Agroecological and enabling environment innovations for transitioning to sustainabe food systems

Agroecological and other sustainable approaches

Improve resource use efficiency
Recycling by using local renewable resources
Resource cycles of nutrients and biomass

Increase inputs substitution
Reduce dependency on harmful external inputs
Increase self sufficiency via incremental substitution

Strengthen resilience and synergies
Catalyze positive ecological integration
Enhace complementarity among agroecosystems
Secure and enhace soil, animal and plant health

Enabling environment innovations

Co-creation of knowledge
Enhace co-creation to include local and scientific evidence
Catalyze horizontal knowledge sharing via farmer to farmer exchange

Implement inclusive business models
Promote fair trade and emplyment conditions
Improve distribution and network systems

Reform policies and institutions
Develop policy and regulatory frameworks
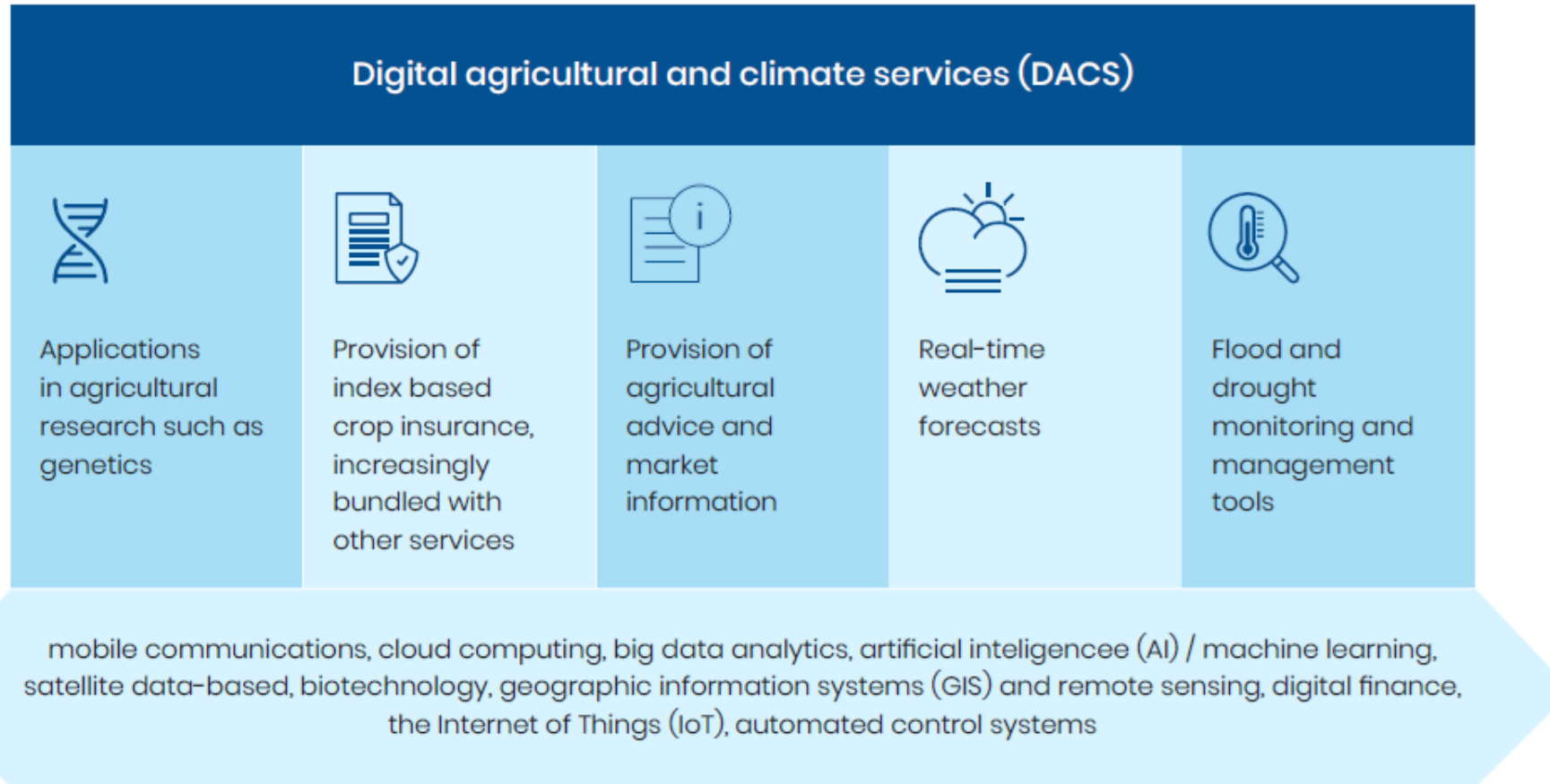Increase paticipation in decision making process
Develop incentive mechanisms

Source: Authors

- Agroecology and other sustainable approaches provide a transitional pathway to sustainable food systems.

- Several barriers and knowledge gaps are limiting the potential for scaling up agroecology and other sustainable approaches.

7. Digital services.

Digital agricultural and climate services (DACS)

| Applications in agricultural research such as genetics | Provision of index based crop insurance, increasingly bundled with other services | Provision of agricultural advice and market information | Real-time weather forecasts | Flood and drought monitoring and management tools |

mobile communications, cloud computing, big data analytics, artificial inteligencee (AI) / machine learning, satellite data-based, biotechnology, geographic information systems (GIS) and remote sensing, digital finance, the Internet of Things (IoT), automated control systems

- Digital agricultural and climate services (DACS) have become critical tools for transforming systems at all levels.

- Where farmers have affordable access to DACS, they benefit from climate information, agronomic and marketing advice, and access to low-cost crop insurance and other services.

Final key messages.

1. Mitigation strategies need contextualization, scientific evidence and climate finance to be adopted at scale to also achieve adaptation co-benefits.

2. Long-term commitment to testing, evidence development and knowledge sharing on policy and implementation.

3. Development of common metrics to monitor sustainable agricultural solutions and natural resources essential to agriculture.

4. Investment in the development and scaling up of agricultural innovations to reduce methane emissions, promote alternative proteins and improve crop resilience.

5. Action-oriented strategic dialogues to ensure that international trade facilitates the transition to sustainable agriculture, setting standards for organic products and promoting private investment and consumer participation.

Achieving Agricultural Breakthrough:

A deep dive into seven technological areas

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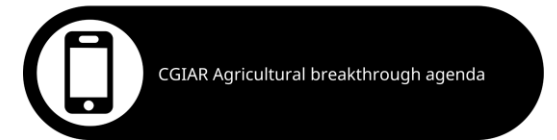
¡Thank you!

Deissy Martinez Barón
d.m.baron@cgiar.org