Collaboration in Research, Development and Scaling Out of Climate-Smart Technologies and Practices

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CGIAR

RESEARCH PROGRAM ON
Climate Change, Agriculture and Food Security
CCAFS

GLOBAL RESEARCH ALLIANCE
ON AGRICULTURAL GREENHOUSE GASES

GLOBAL RESEARCH ALLIANCE

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AT A GLANCE

56 member countries

4 Research Groups

- Paddy Rice Research Group
- Livestock Research Group
- Croplands Research Group
- Integrative Research Group

18 Science Networks

17 partner organisations

Over **3000** scientists involved in activities of the GRA

66 international collaborative projects supporting the GRA

87 fellowships awarded to recipients from **33** countries

32 technical training workshops held

21 technical guidelines, resource materials and databases produced

globalresearchalliance.org

@GRA_GHG

February 2019

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A GLOBAL RESEARCH PARTNERSHIP

CCAFS works closely with the CGIAR System research centers to generate high-quality scientific products to support decision-making in rural communities to address the impacts of changing climate.

15 CGIAR CENTRES

5 REGIONS

4 FLAGSHIP PROGRAMS

Partnerships and capacity for scaling CSA

Climate-smart agriculture, gender and social inclusion

Priorities and **Policies** for Climate-Smart Agriculture

Climate-Smart Technologies and Practices

Low **Emissions** Development

Climate **Services** and safety nets

Climate-smart agriculture (CSA)

Climate-smart food systems

Climate-smart landscapes

Reduce Poverty

Improve food & nutrition security for health

Improve natural resource systems and ecosystem services

@CGIARclimate https://ccafs.cgiar.org/

Coverage of CCAFS/GRA

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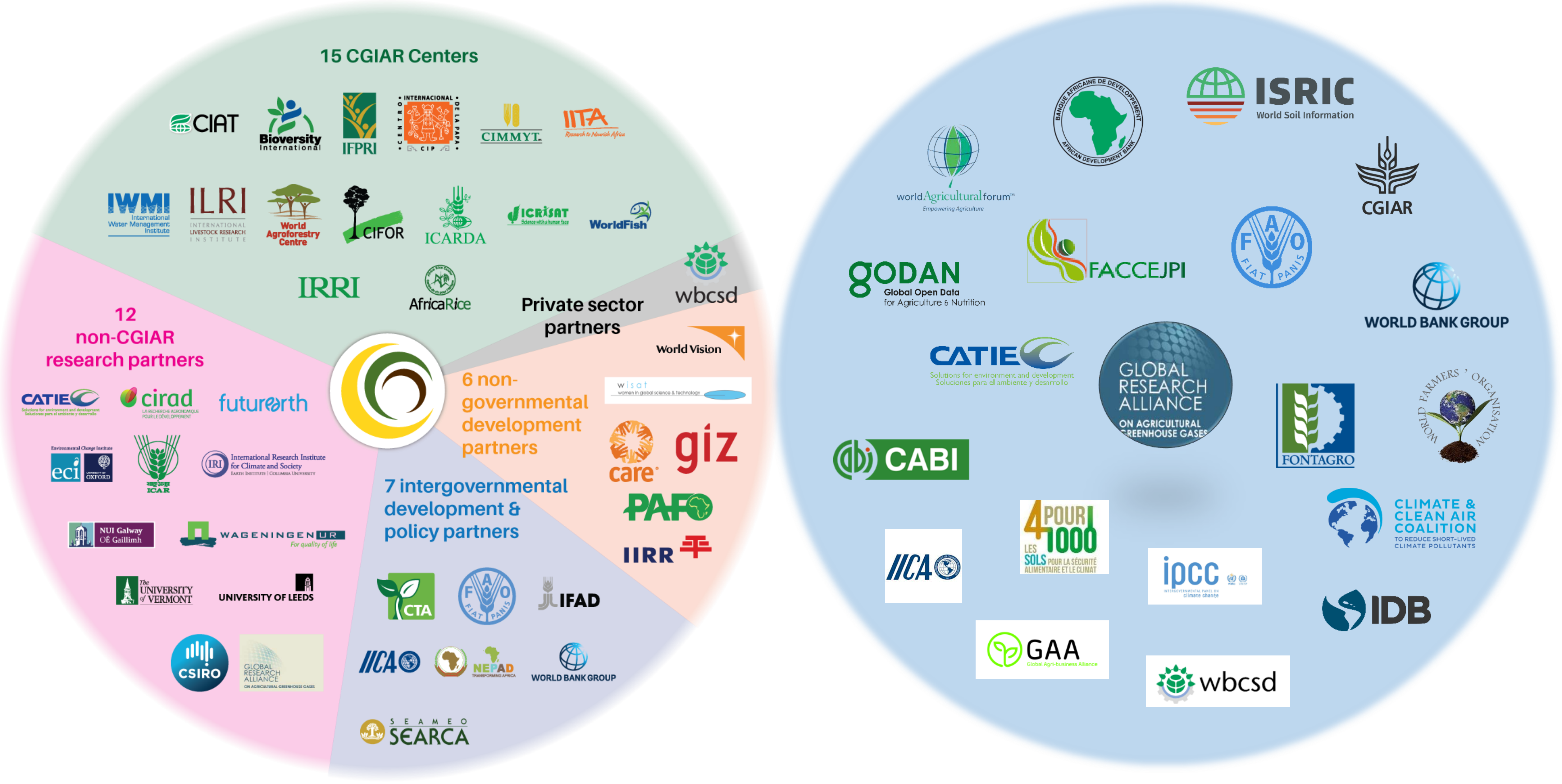
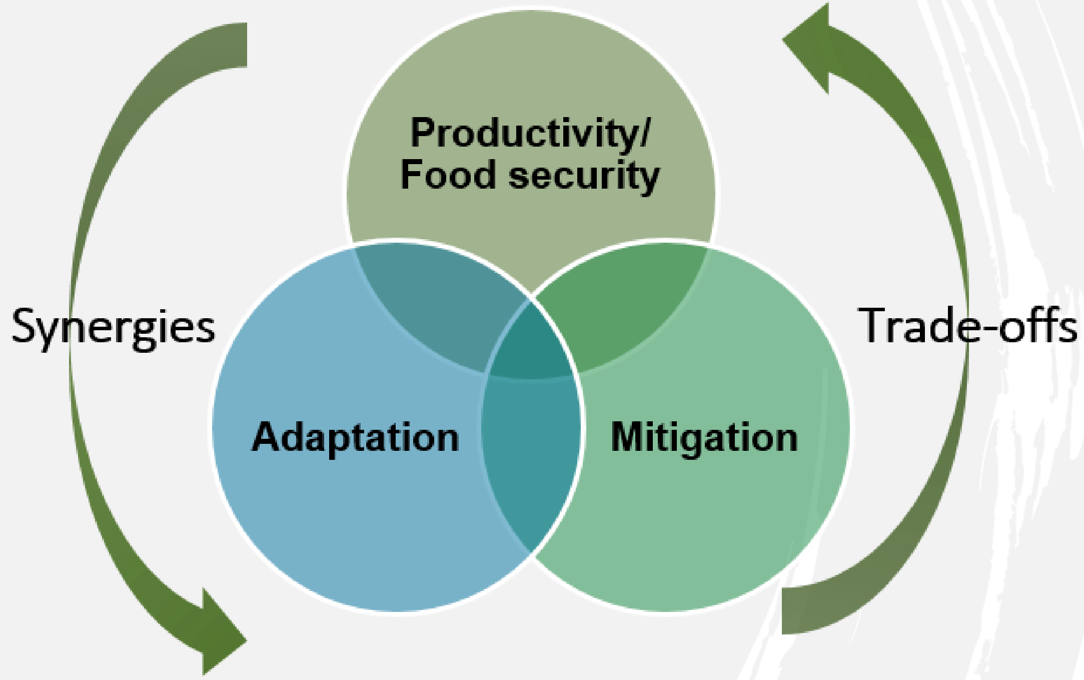
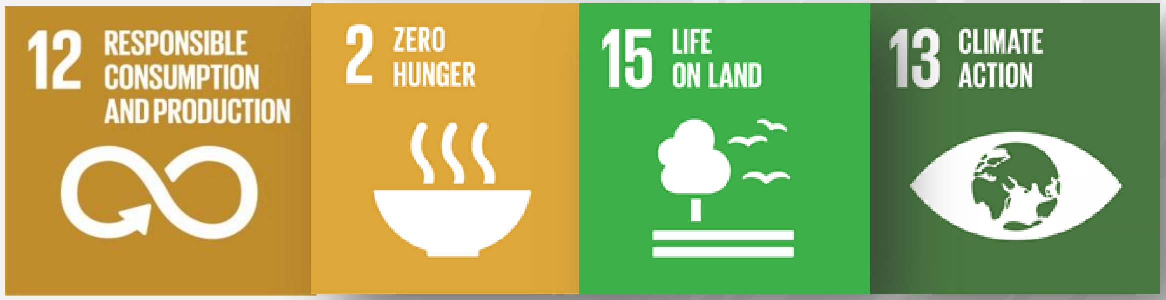
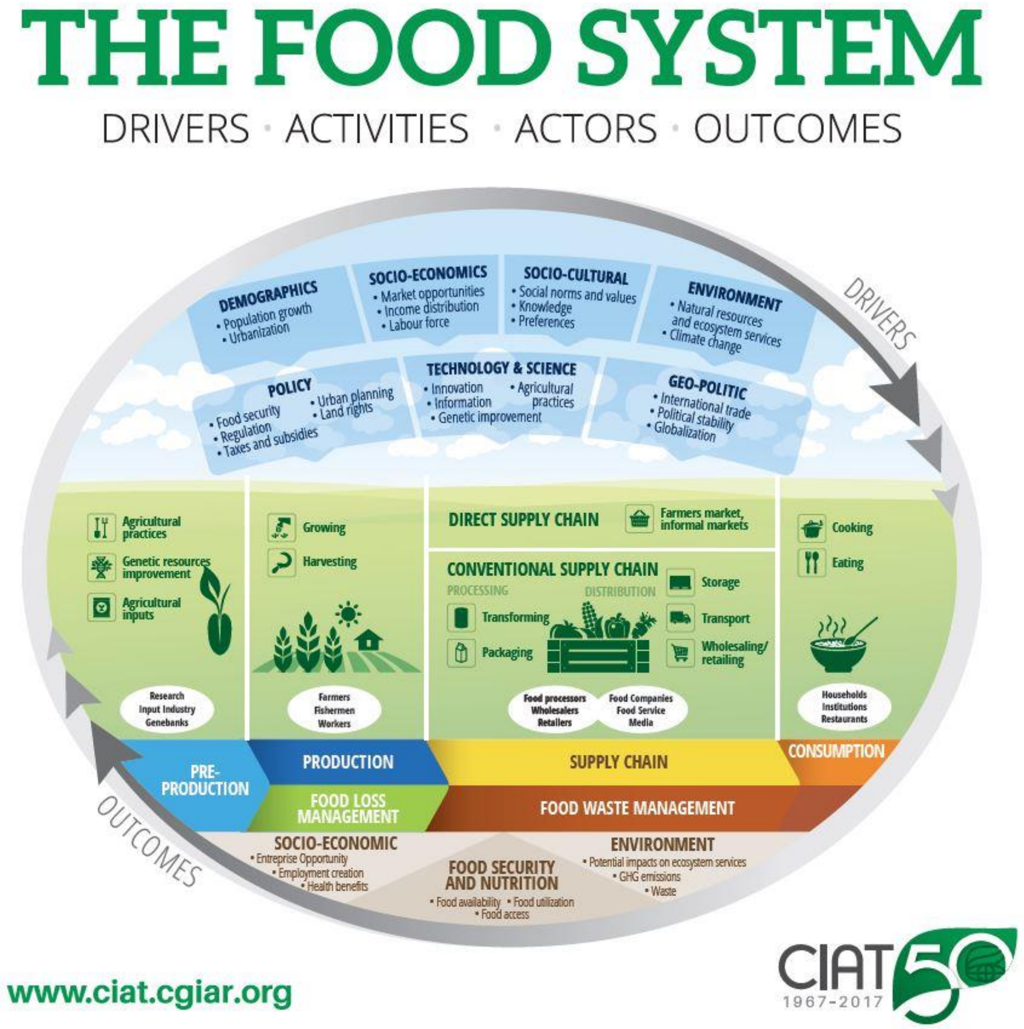
STRATEGIC PARTNERS



3 CHALLENGES: FOOD SECURITY, ADAPTATION AND MITIGATION







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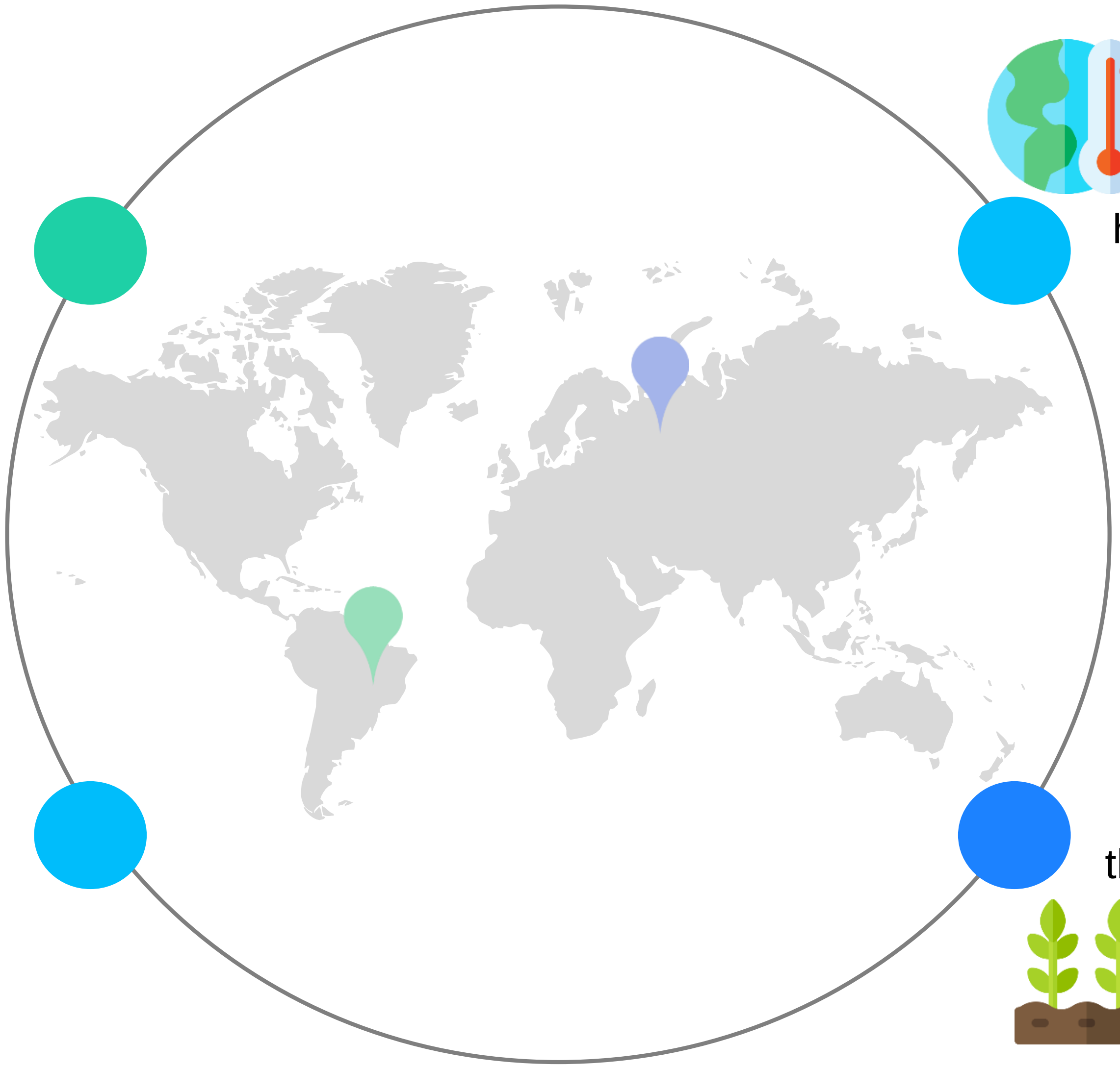
PRODUCTIVITY AND FOOD SECURITY

Food prices are projected to increase across a wider range of scenarios, but there are considerable differences between the results of different macro-economic models (Nelson et al., 2014b).

Climate change is likely to reduce food safety due to higher rates of microbial growth at increased temperatures (Hammond et al., 2015).



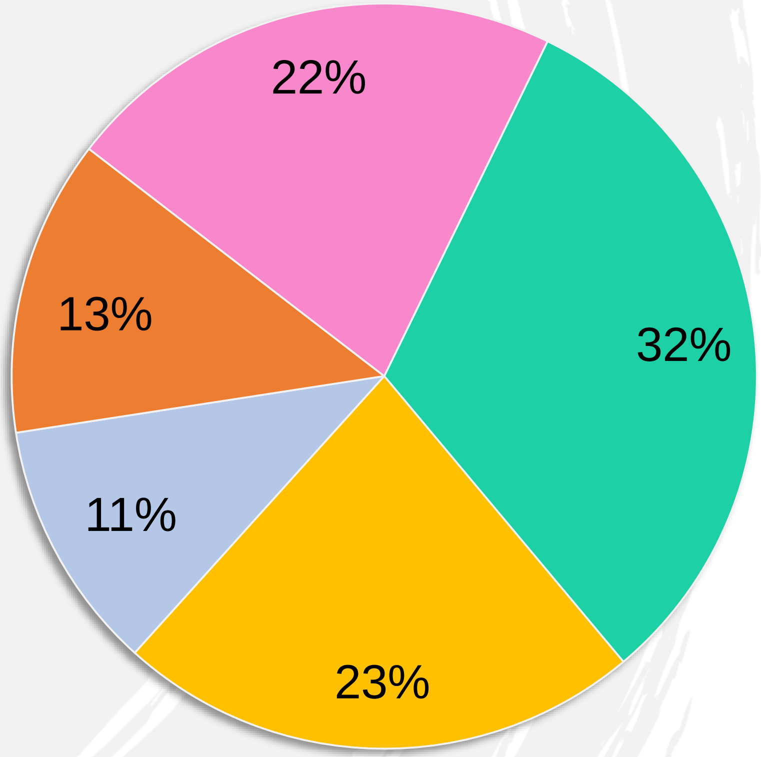
Affordability also depends on purchasing power of households (White et al., 2010), which may be affected by climate, especially among agricultural households.

Food security is linked directly and indirectly to ecosystems through provisioning, regulating and supporting services (Millennium Ecosystem Assessment, 2005).

PRODUCTIVITY AND FOOD SECURITY

STAGE OF FOOD SUPPLY CHAIN

- Agricultural production
- Post-harvest handling and storage
- Processing
- Distribution
- Consumption



% Total food loss and waste

FAO (2016) estimates that each year global food loss and waste generate 4.4 $GtCO_2$ eq, or about 8% of total anthropogenic GHG emissions.

Even if just 1/4 of global food waste could be saved, it would be enough to feed 870 million hungry people every year.

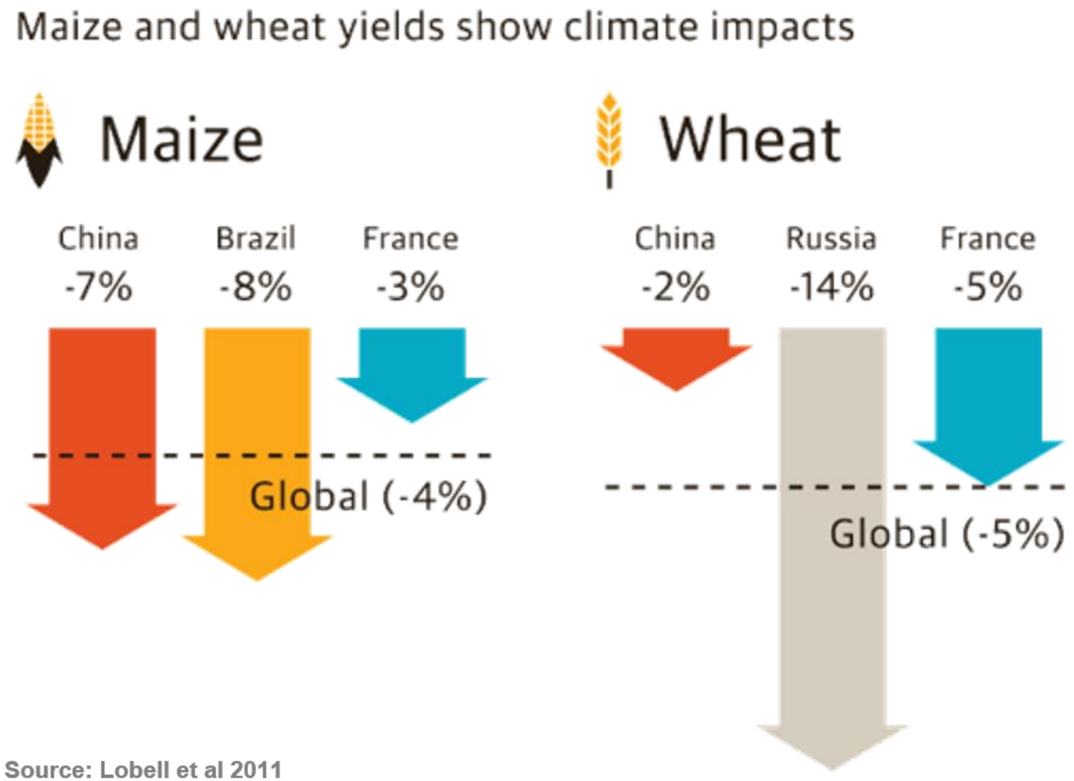
CLIMATE CHANGE IMPACTS AND ADAPTATION

Despite uncertainties, on average, global mean crop yields of rice, maize and wheat are projected to decrease (Challinor et al., 2014b).

Evidence suggests reduced quality due to decreases in leaf and grain N, protein and macro- and micronutrient concentrations associated with increased CO_2 concentrations and more variable and warmer climates (DaMatta et al., 2010).

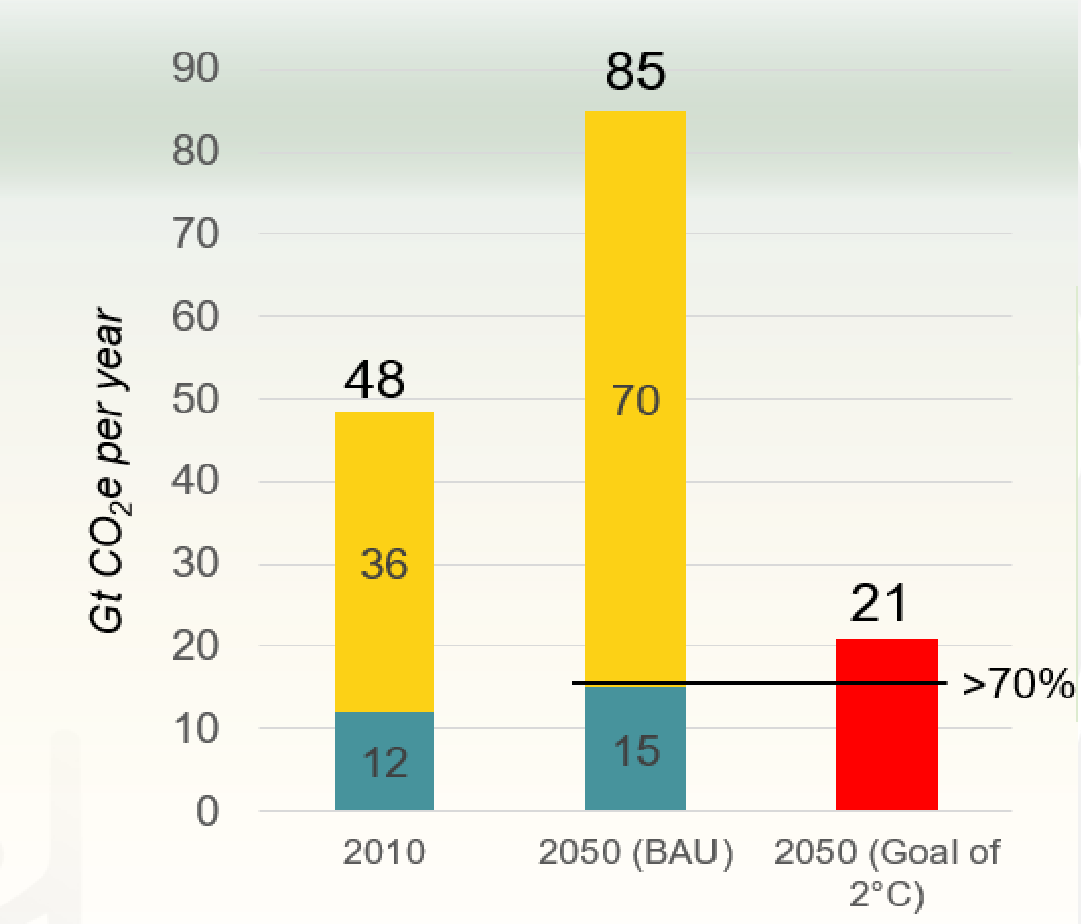
Impacts on livestock systems will be mediated through reduced feed quantity and quality, changes in pest and disease prevalence, and direct impairment of production.

Adaptation: Evidence that yields losses occur already



Source: Lobell et al 2011

AGRICULTURE AND EMISSIONS REDUCTION

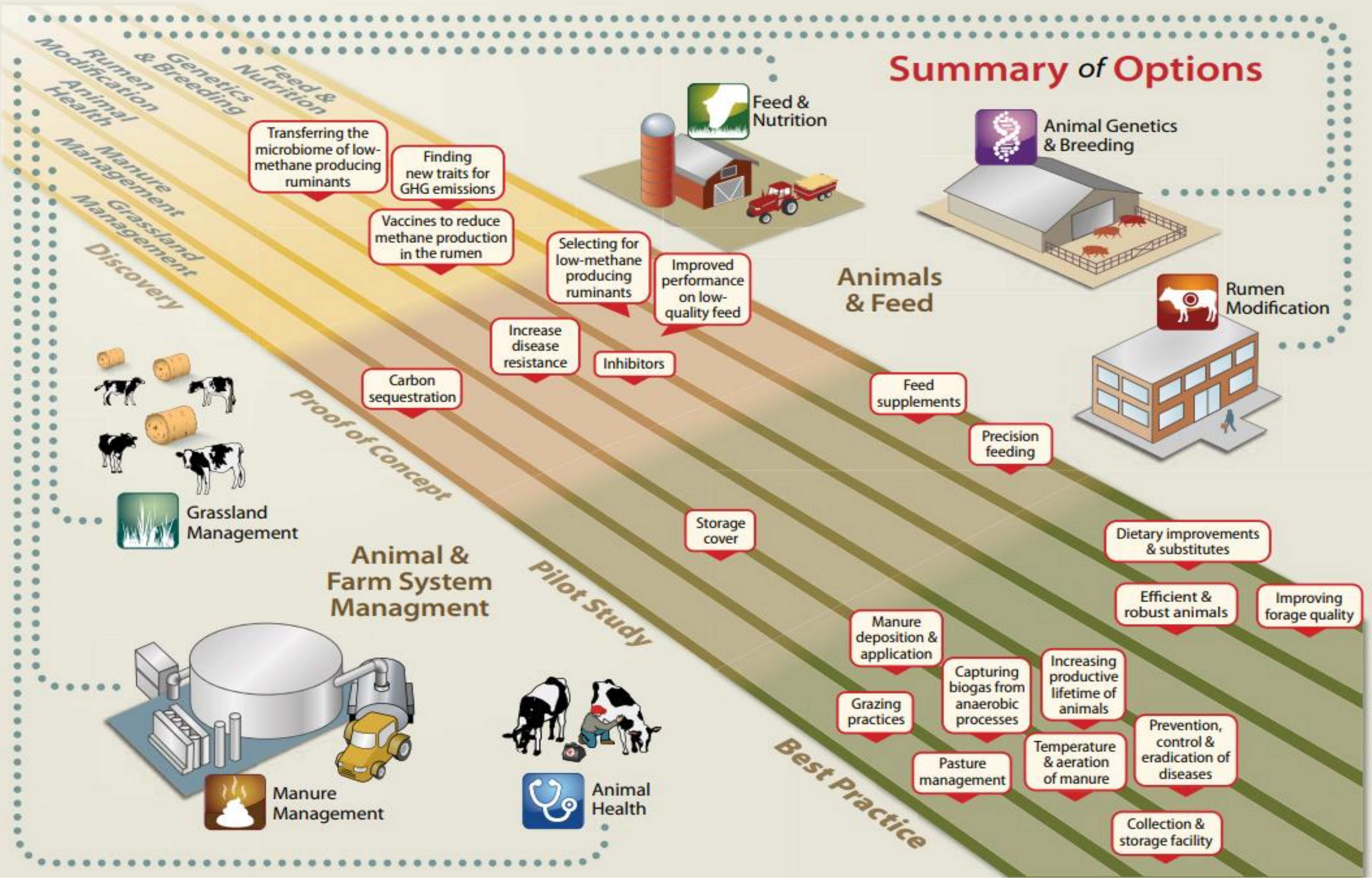


Source: WRI (2014)

Agriculture must reduce emissions of methane and nitrous oxide by 1Gt CO_2eq/yr by 2030 to remain below the 2C limit

Source: Wollenberg E. et al. 2016. Reducing emissions from agriculture to meet the 2°C target. Global Change Biology.

USEFUL TECHNOLOGIES



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USEFUL TECHNOLOGIES FOR MITIGATION AND ADAPTATION

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Improving forage quality

Best Practice Available Now

Forages are feeds with a high variation in composition. In ruminant farming systems using poor quality feed (such as straw, crop residues, or dry fodder), forage processing can effectively improve digestibility of the diet and improve animal productivity at the same time. Systems using coarse straws from millet, sorghum and corn/maize have better feeding quality than slender straws (rice, wheat, barley). Grazing management and improving forage quality by changing forage species can equally contribute to a proper diet formulation in extensive systems, which can substantially increase feed efficiency and production; reductions in emissions intensity of 30% are considered possible in systems that currently use very low-quality feed. See also mitigation options related to *Grassland Management*. However, indirect emissions from off-farm feed production need to be considered before net GHG benefits can be determined.

Mitigation potential: **++ - +++** *(estimated up to 30% in systems with poor quality feed)*

Economics: **$ - $$$** *(constraints: knowledge, supply chains, labour)*

Sustainability: ↑ *(resource efficiency, food security, livelihoods)*

SAI PLATFORM

Temperature & aeration of manure

Best Practice Available Now

The temperature of manure influences the amount of methane (CH_4) and ammonia (NH_3) produced through anaerobic digestion, with emissions reduced at lower temperatures (but anaerobic digestion stops at very low temperatures). Management options to regulate temperature will depend strongly on climate system, with options ranging from the location of manure storage systems to the use of natural cooling mechanisms. Aeration of solid and liquid manure can substantially decrease CH_4 and nitrous oxide (N_2O) emissions, with a variety of approaches available for different systems.

Mitigation potential: **+ - ++** *(depending on climate)*

Economics: O *(investment cost; limited production benefits)*

Sustainability: ↕ *(aeration can increase NH_3 emissions)*

Prevention, control & eradication of diseases

Best Practice Available Now

Prevention as well as early detection of animal diseases and early treatment is key in improving animal health and productivity, reducing mortality and morbidity, and preventing further outbreaks. Education, use of veterinary services, proactive herd health planning, and availability of efficient animal health diagnostic tools and therapeutics are key parts of this, but access to such tools and services remains highly uneven across the world. Improving farm biosecurity measures are important to protect the farm from incoming diseases as well as to help prevent outbreaks of diseases to other farms. An overview of global animal health status is provided by the OIE World Livestock Disease Atlas. The online database *Discontools* currently describes over 50 animal diseases, and the diagnostics and vaccines available. It also indicates the diseases that require development of new diagnostics and therapeutics.

Mitigation potential: **++** *(but lack of detailed estimates)*

Economics: **$ - $$** *(depending on cost of treatment and productivity impact)*

Sustainability: ↑ *(animal welfare, resource efficiency, food security, livelihoods)*

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USEFUL TECHNOLOGIES FOR MITIGATION AND ADAPTATION

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AWD

Alternate Wetting and Drying

CO- BENEFITS:

- ✓ Reduced lodging
- ✓ Reduced damage due to fungal diseases
- ✓ Higher resistance to certain pests
- ✓ Better soil conditions for machine operation
- ✓ Reduction in mosquito-borne diseases
- ✓ Better root development
- ✓ Irrigation water savings
- ✓ Reduced arsenic uptake
- ✓ Higher or similar yields
- ✓ Better nutrient availability

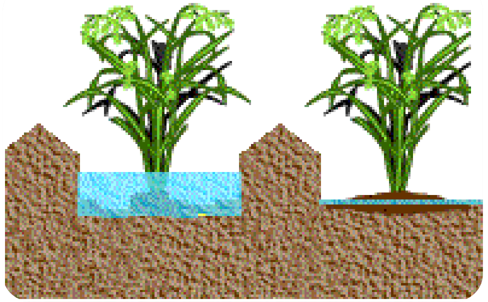
BENEFITS:

- Reduce water use
- Greenhouse gas mitigation potential. → 48% compared to continuous flooding.

It is defined by the periodic drying and re-flooding of the rice field.

AWD is a management practice in irrigated lowland rice that saves water and reduces GHG emissions while maintaining yields.

Flooded Non-Flooded



Agroforestry
Aquaculture
Stress-tolerant varieties
Climate-informed advisories
Digital agriculture
Innovative finance systems
Alternate wetting and drying in rice
Weather-index insurance
Improved smallholder dairy
Micro-irrigation powered by solar

10 best bet innovations for adaptation in agriculture:

A supplement to the UNFCCC NAP Technical Guidelines

Working Paper No. 215
CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS)

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Research Program on Climate Change, Agriculture and Food Security

Working Paper

WHAT CSA INNOVATIONS CAN BE BROUGHT TO SCALE?

USEFUL TECHNOLOGIES FOR MITIGATION AND ADAPTATION

Table ES1. Business cases that reduce food loss and waste

Measure	Food losses reduced	Breakeven period	IRR	GHGs associated with reduced losses (tCO_2e)
Dairy Kenya: Cooler	52,560 liters per cooler or 6% reduction	2 years	303% after five years	1,367
Dairy Kenya: Extension service	65,610 liters per extension team or 4.5% reduction	1 year	72% after two years	341
Cereals in Tanzania: Hermetic storage bag	42kg per bag or 14% reduction	3-6 months	23% after three years	0.01
Tomatoes in Nigeria: Crate	756 kg per crate or 36% reduction	4 months	34% after three years	0.1

Note: GHG reduction potential is proportionate to FLW reduction potential and does not reflect the embedded emissions of the intervention, i.e. the emissions of producing the cooler, crates, bags or providing services. A full life cycle analysis has not been done. Source: https://ccafs.cgiar.org/publications/climate-change-mitigation-and-food-loss-and-waste-reduction-exploring-business-case#.XJO4OdVKi01

CHALLENGES AND WHAT HAS BEEN DONE SO FAR

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Challenges for disseminating technologies to farmers

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Globally 570 million farms,
c. 500 million < 2 ha,
(Lowder et al., 2016).

CO_2

AFOLU total contribution to global GHGs is large (24%) – but many small scale emitters of diffuse sources of multiple GHGs

Agriculture still lags behind the progress being made in other sectors in responding to the climate change challenge.

Small and medium farms (≤50 ha) produce **51–77%** of nearly all nutrients (Herrero et al., 2017).

Collective contribution:

Smallholders: **32%** of emissions from the agriculture sector and **29%** of emissions from agriculture-driven land-use change.

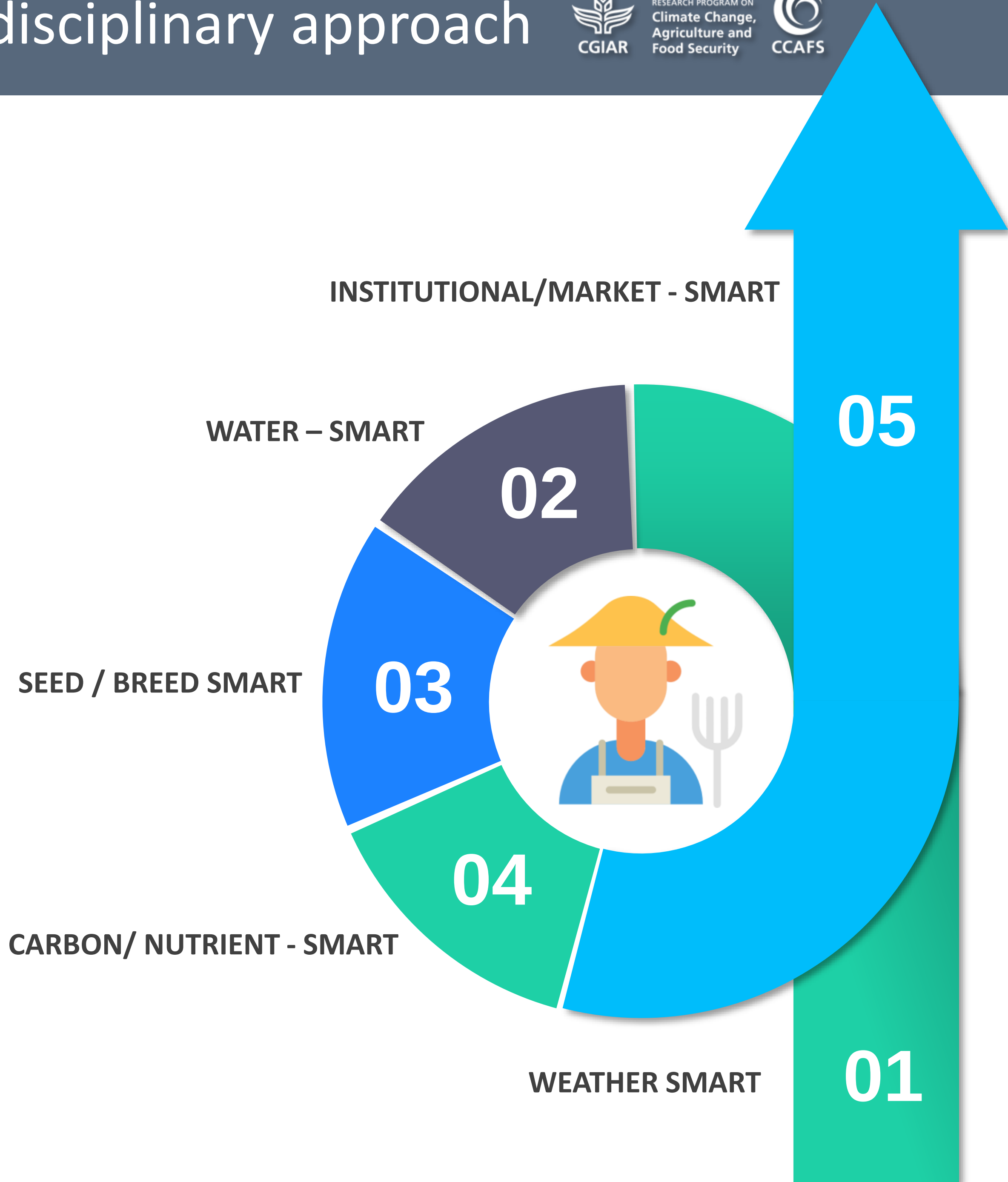
71% of the cars we drive come from **10** major carmakers, the food we eat comes from hundreds of millions of smallscale producers, and hundreds of thousands of larger ones. It means large-scale transformation is more elusive - less appealing to investors

Promoting adoption through multidisciplinary approach

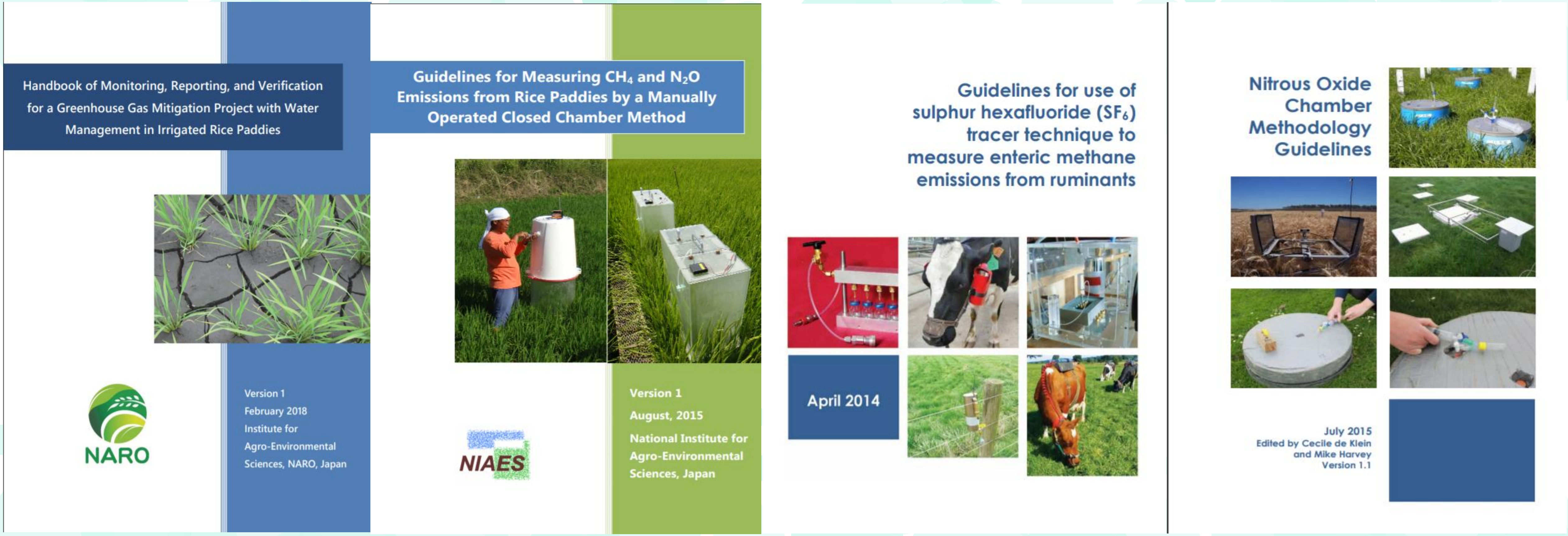
CLIMATE SMART VILLAGE

Addressing the need for proven and effective CSA options, CCAFS has developed the Climate-Smart Village (CSV) approach as a means to agricultural research for development (AR4D) in the context of climate change. It seeks to fill knowledge gaps and stimulate scaling of CSA.

- HOLISTIC VISION FOR CLIMATE CHANGE ACTION
- ENHANCING ADAPTATION; AVOIDING MALADAPTATION
- LINKING GLOBAL AND LOCAL KNOWLEDGE



Supporting good practice in science



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Supporting science-policy interface

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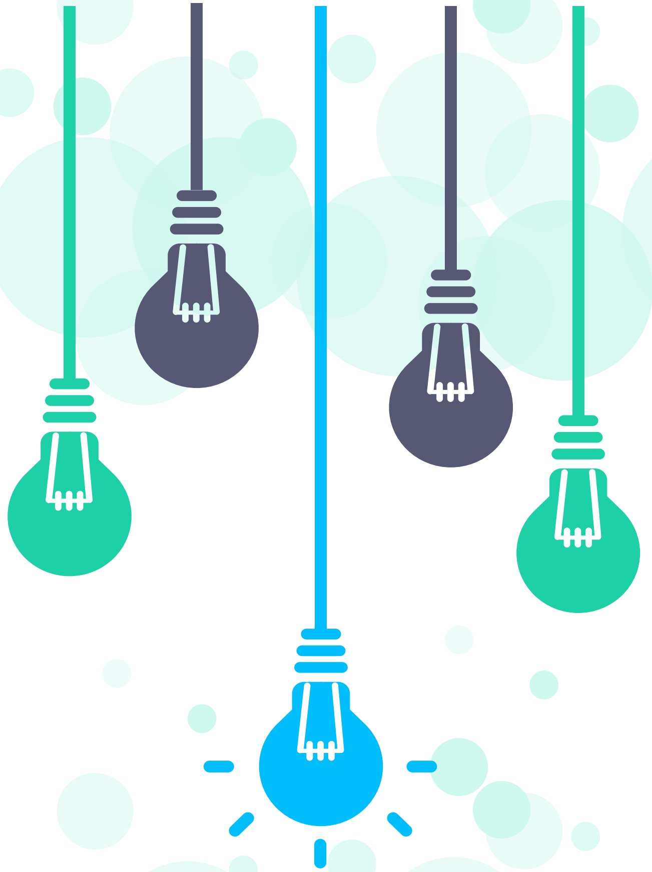

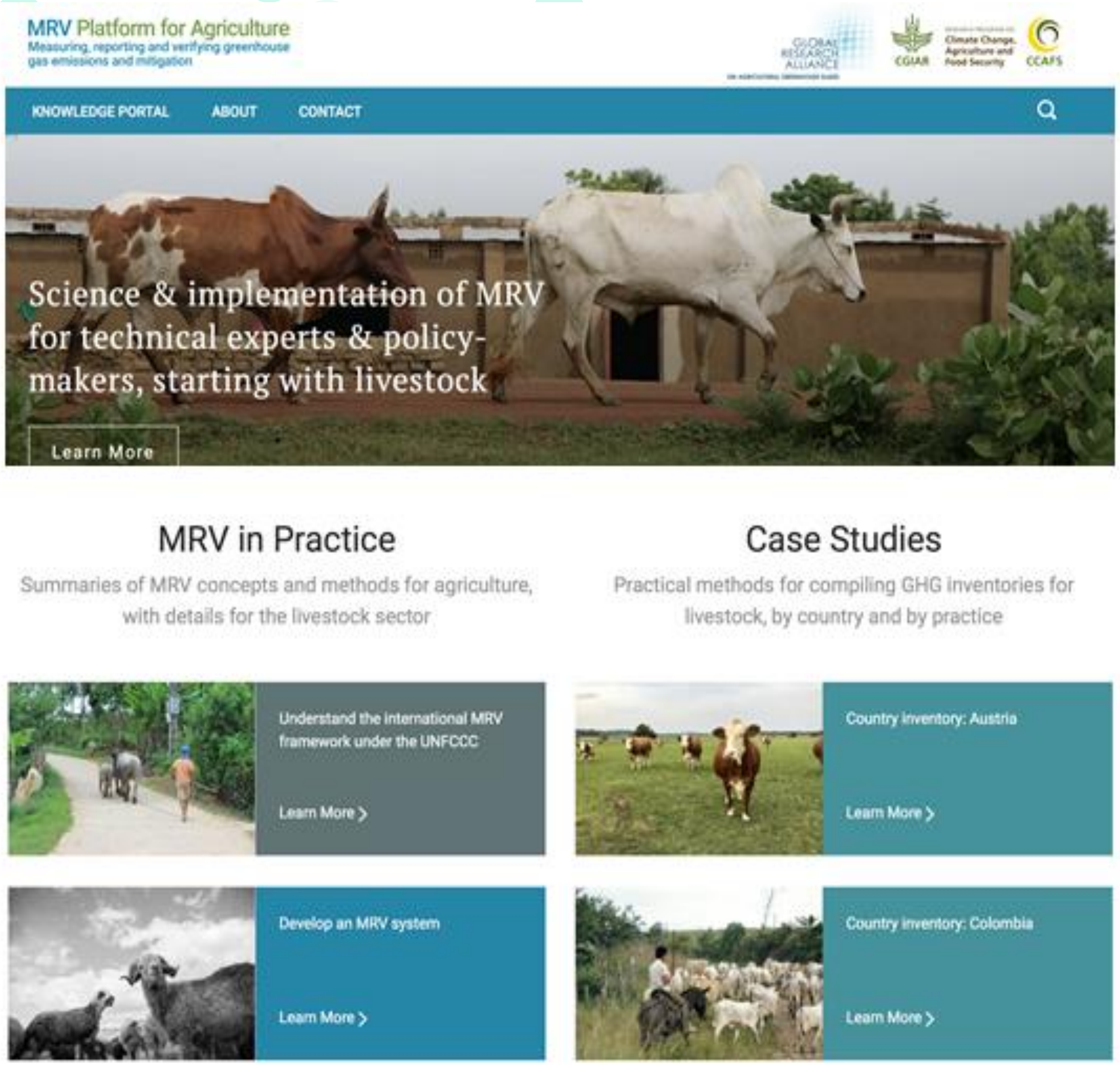

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Building capability of future science leaders

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CLIFF-GRADS

Builds the capability of early-career scientists and graduate students from developing countries to conduct applied research on climate change mitigation in agriculture with the goal of expanding knowledge and experience in quantification of agricultural GHG and food loss and waste.

Generates novel climate change research on smallholder farming systems and facilitates South-South knowledge exchange

AARHUS UNIVERSITET | USAID | New Zealand Government Te Kāwanatanga o Aotearoa

1ST call – December 2017

18 opportunities advertised.

9 scholarships awarded to recipients from Nigeria, Tunisia, Ethiopia, Colombia, and Argentina.

Hosted at CGIAR centres (CIAT, CYMMIT) and GRA member country research institutes (Netherlands, Chile, UK).

2nd call – September 2018

50 opportunities advertised (including 10x FLW).

243 applications from students from > 50 developing countries.

33 scholarships awarded to recipients from 18 countries.

Hosted at following institutions

Planned 3rd call – August 2019

Hosts and sponsors wanted!

Awards announced at COP25

2019 #CLIFF-GRADS fellows go to @inra_france @USDA_ARS @ISRICorg @Thuenen_aktuell @unimelb @intaargentina @irri @ilri @iniachile @queensu @BangorUni @CIAT_ @CATIEOficial @CIFOR @_SLU @SyddanskUniv @ICRISAT @mustmw @HokkaidoUni @GRA_GHG

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Building farmer-farmer and science-farmer networks

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2014 *Farm Management and Research for Environmental Outcomes*

2015 *Agricultural activity: sustainable practices and emission of greenhouse gases*

2016 *Skills and Tools to Address Climate Change Challenges*

2017 *Extending climate change science to farmers*

2019 *On-farm innovation to improve productivity and build climate resilience*

WORLD FARMERS' ORGANISATION

INTERNATIONAL RESEARCH COLLABORATION

Ways to strengthen international research collaboration

Through students (PhD and Post-Doc) to provide bridging between projects, countries and institutions

Through increased mobility of science leaders to align national programmes

Through alignment of national programmes and priorities, including bilateral, plurilateral

Ways to strengthen international research collaboration

Through joint calls, 'virtual common pot' aligned to shared priority research areas

Through international research consortia, shared research agenda supported by pooled resources

Through multi- and trans-disciplinary approaches, e.g ALL, CSV, co-innovation

Examples of possible global research priorities

Harnessing nature's diversity – rumen microbiome metagenomics, soil microbiome metagenomics

BNI and other plant effects on nitrogen cycle and N20 emissions

Selecting for low emissions, e.g. low CH4 rice cultivars, low CH4 livestock

Capacity and capability building

Examples of possible global research priorities

Impact of pests and diseases on emissions, e.g. through crop and animal losses

Well adapted species of crop and animal to respond to, e.g. heat stress, drought, salinity

Digital agriculture and ICT at all stages of chain, including two-way extension

Capacity and capability building

What opportunities for CCAFS and GRA working together with G20 MACS?

CCAFS-GRA supporting the priorities of G20 MACS

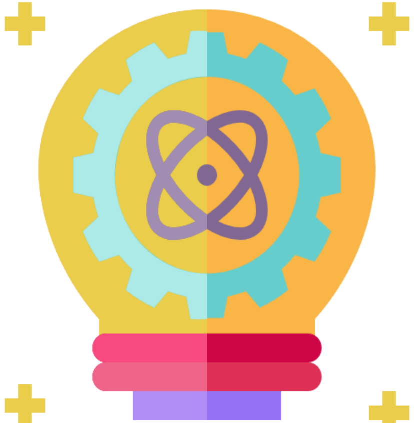
Near global geographic coverage through Members, Partners, Centers, Flagships, Programmes

Established platforms for capability building, e.g. CLIFF GRADS, can be utilized by G20

Provide platform for integrating science into policy and decision making

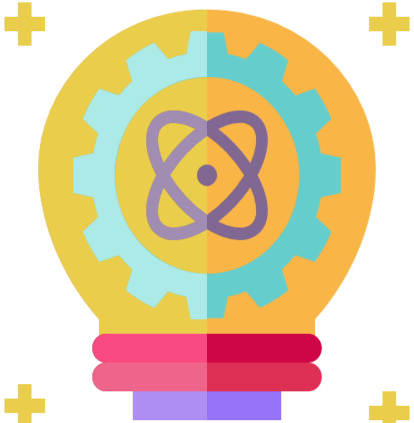
Already have public and private sector participation through partnerships and specific activities

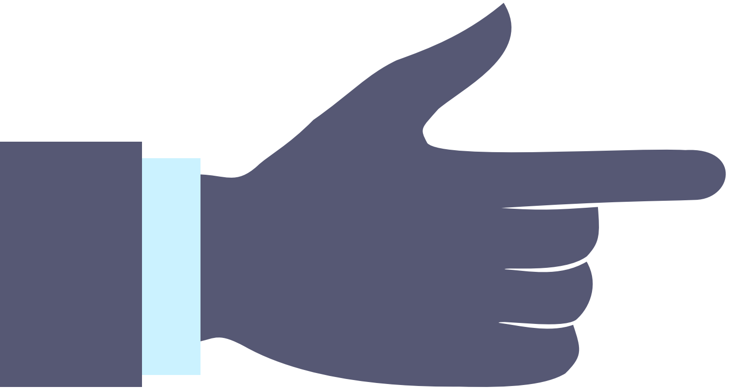
Comprehensive research agenda covering impacts, adaptation, mitigation, policy



G20 MACS supporting the activities of CCAFS-GRA

- Help to make agricultural innovation systems more agile, responsive and focused on solutions for climate change adaptation and mitigation
- Help to break down siloes between research, agriculture, environment, and development agencies
- Promote member participation in collaborative research activities
- Support capacity and capability building
- Share successful cases of massive implementation of technologies





QUESTIONS & ANSWERS