



GLOBAL  
I G B P  
CHANGE



WCRP



 CGIAR



# Global Environmental Change and Food Systems

**(GECAFS)**

*Aspects related to nutrition and food safety*

# Food security...

... exists when all people, at all times, have **physical and economic access** to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life.

*(World Food Summit 1996)*



# Food Security Components & Elements

## FOOD UTILISATION

- *Nutritional Value*
- *Social Value*
- *Food Safety*

## FOOD ACCESS

- *Affordability*
- *Allocation*
- *Preference*

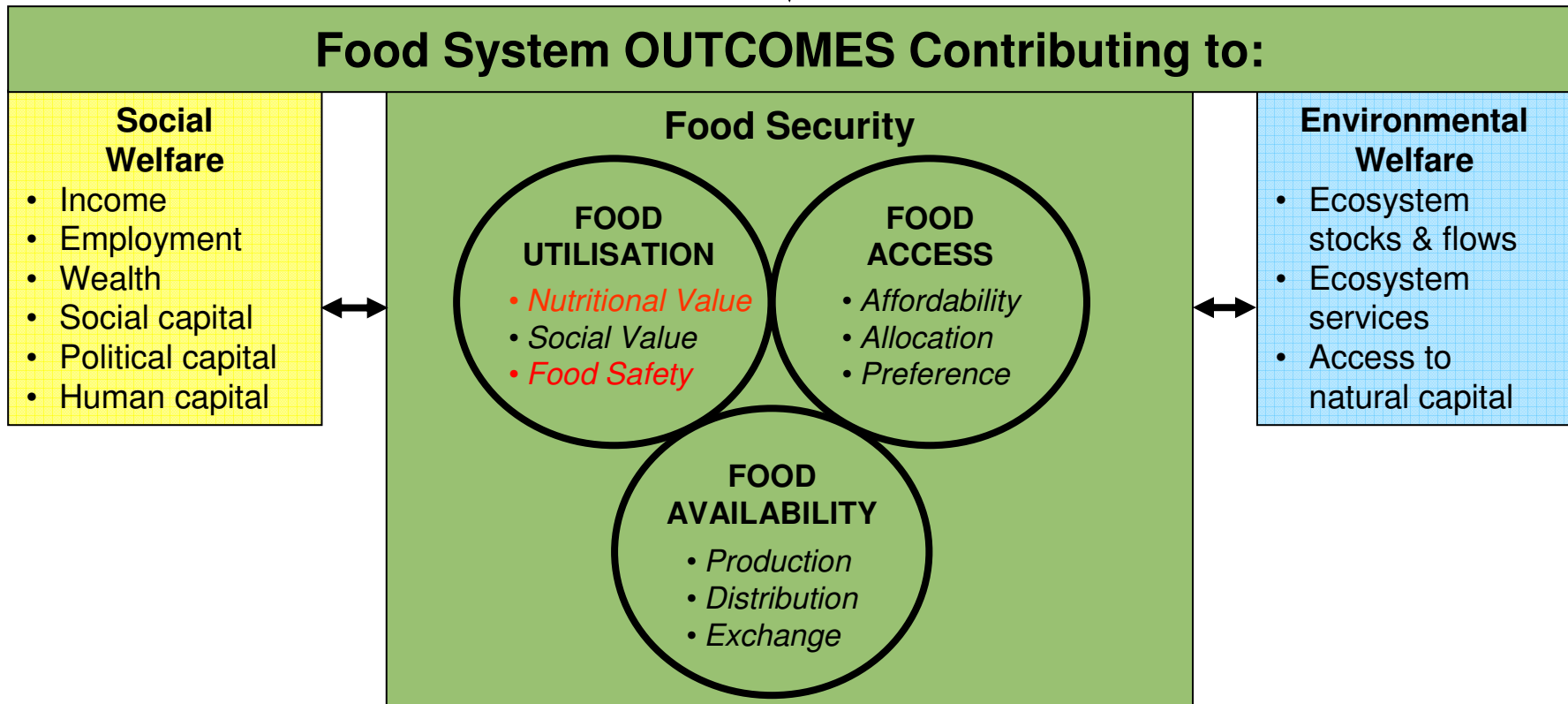
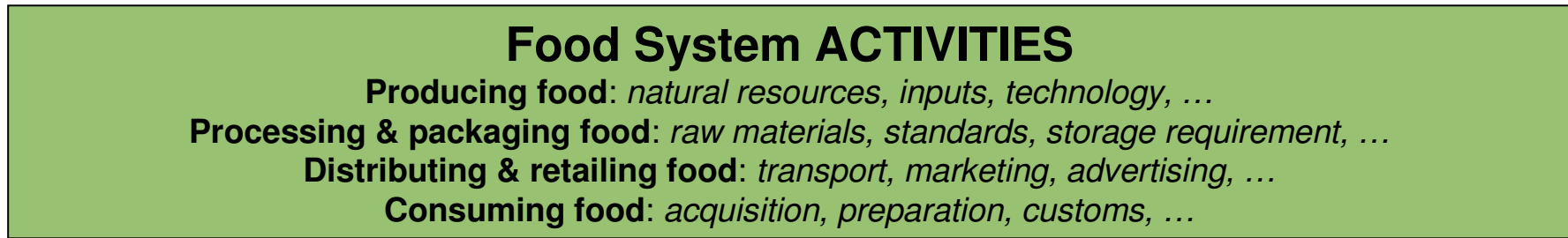
## FOOD AVAILABILITY

- *Production*
- *Distribution*
- *Exchange*

**Food Security is  
underpinned by  
Food Systems**

# GECAFS “Food System” concept

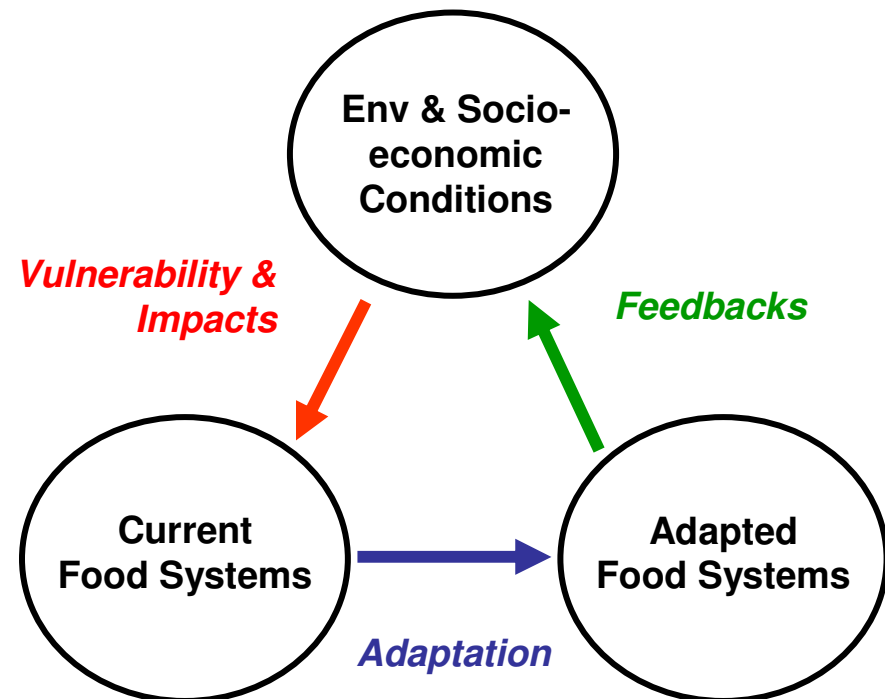
*integrates Food System **Activities** and **Outcomes***



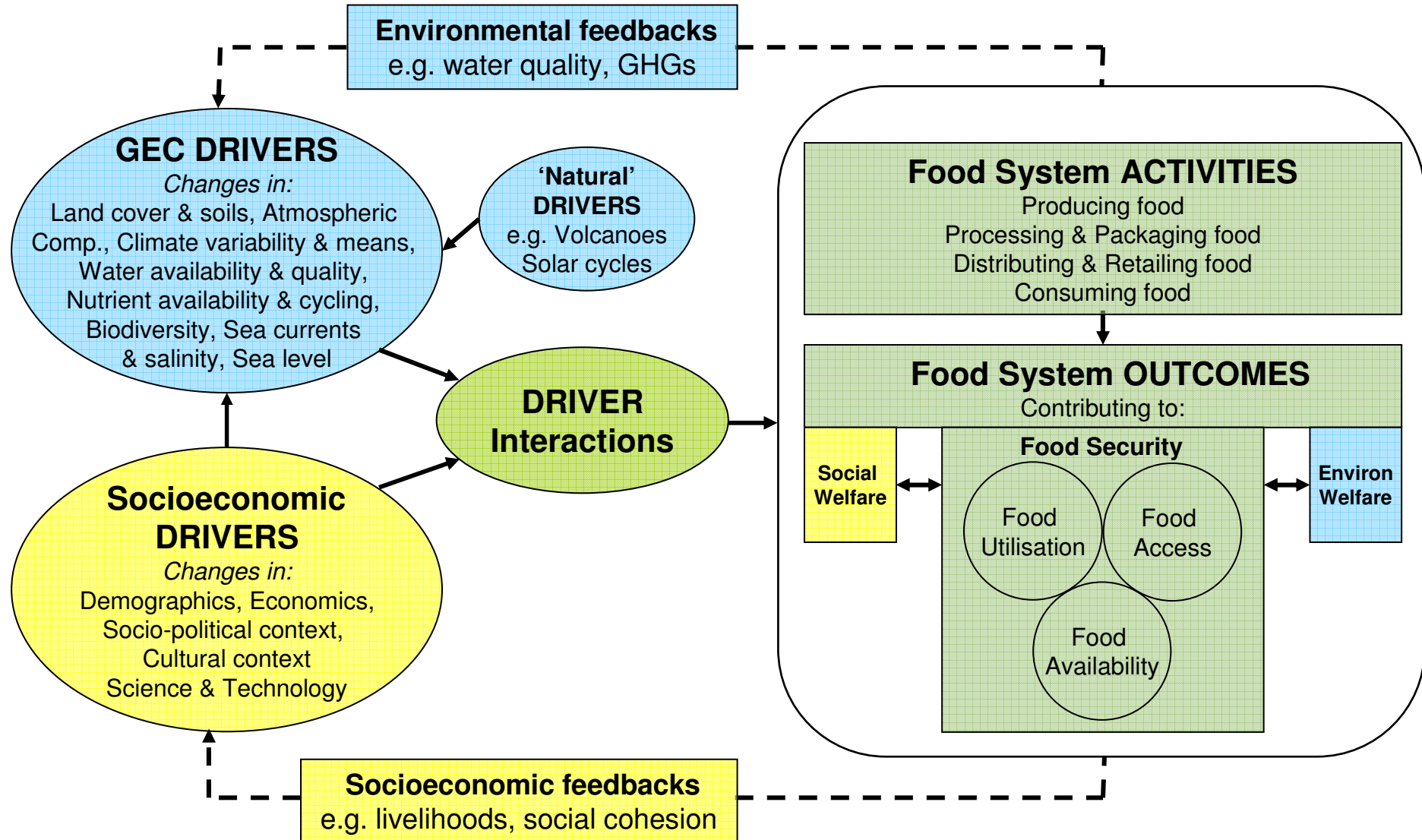
# GEC and Food Security

## “Fundamental Questions”

- How will GEC affect the vulnerability of food systems in different regions?
- How might food systems be adapted to cope with GEC so as to enhance food security?
- What would be the consequences of adaptation options for environmental and socioeconomic conditions?



# Analysing Food System adaptation in context of drivers and feedbacks



# Vulnerability of the Food System to GEC

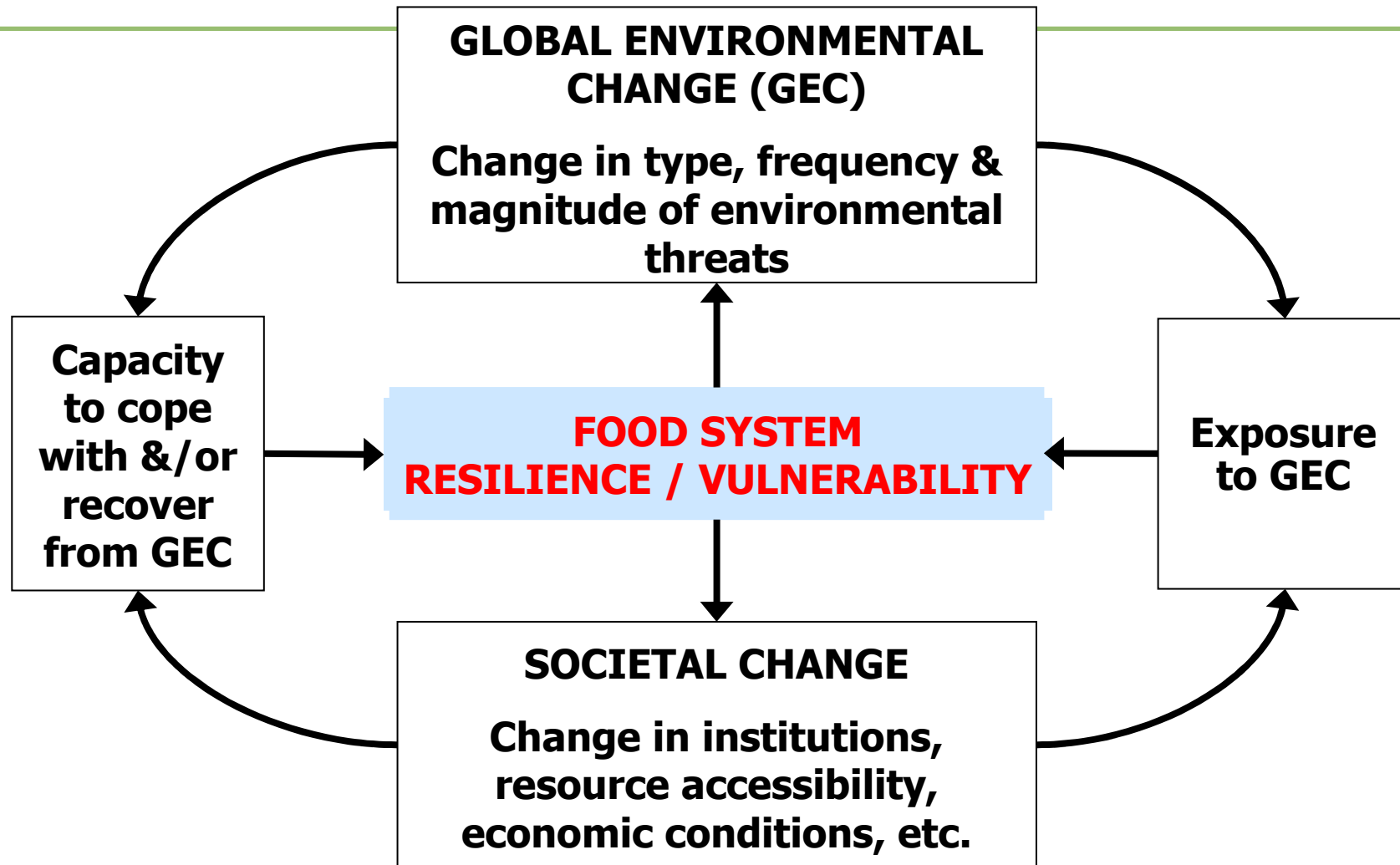
**GLOBAL ENVIRONMENTAL  
CHANGE (GEC)**

**Change in type, frequency &  
magnitude of environmental  
threats**



**FOOD PRODUCTION  
IMPACTS**

# Vulnerability of the Food System to GEC



*(Source: Ingram & Brklacich, 2002; Ericksen, 2008)*

# GECAFS Indo-Gangetic Plain Food System Research Context



## Gujarat, Punjab Pakistan

- effective institutions
- **high irrigation** & fertiliser inputs
- effective water institutions
- variable water availability
- **changes in glacier melt**
- rising GHG emissions

## Ruhani Basin, Terai Nepal

- out-migration of labour
- **weak infrastructure**
- weak governance
- **seasonal flooding**
- variable water availability
- land degradation

## Ludhiana, Punjab India

- **high irrigation** & fertiliser inputs
- effective markets for staples
- in-migration of labour
- **groundwater depletion**
- changes in monsoon
- changes in GHG emissions

## Vaishali, Bihar India

- weak infrastructure
- out-migration of labour
- **little policy support**
- seasonal flooding
- **variable water availability**
- siltation of dams

## Greater Faridpur Bangladesh

- low household incomes
- **institutions failing**
- out-migration of labour
- drought
- seasonal flooding
- **SLR & salt water intrusion**



# Key concerns on GEC-induced vulnerability of case study food systems



Gujarat, Punjab  
*Pakistan*

- reducing glacier melt
- reduces Indus flow
- **threatens crop productivity**

Ruhani Basin, Terai  
*Nepal*

- **more extreme flooding**
- damages tracks & bridges
- **disrupts food distribution**

Ludhiana, Punjab  
*India*

- **lowering ground water table**
- reduces irrigation supply
- **threatens crop productivity**

Vaishali, Bihar  
*India*

- **increasing weather extremes**
- Increases food costs
- **reduces food affordability**

Greater Faridpur  
*Bangladesh*

- **sea-level rise** and salt water intrusion at coast
- decreases arable land
- **reduces food production**



## Changes in:

Content

e.g. Wheat,  $[\text{CO}_2]_{2050}$

Protein ↓

Fe 8% ↓

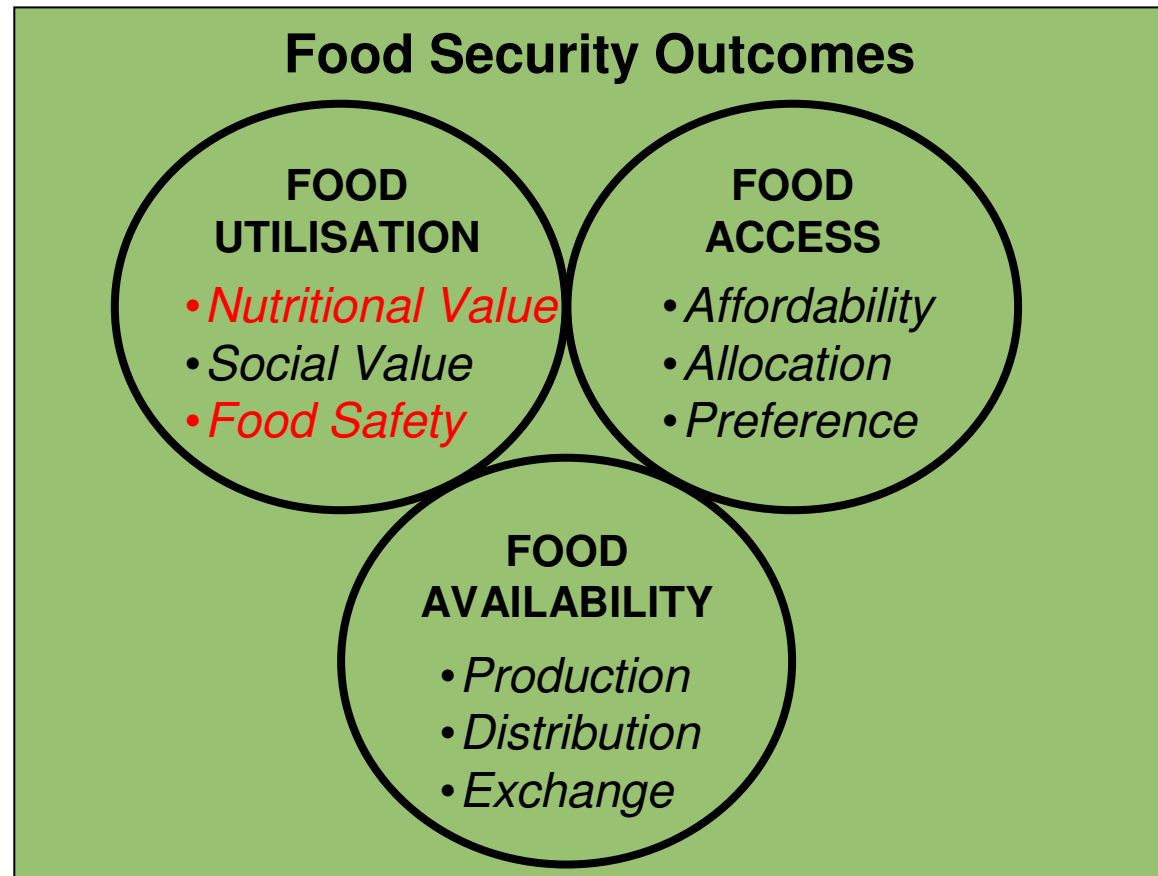
Pb 14% ↑

Cd 14% ↓

(Högy, 2009)

Pesticides ↑↓

Different crops ?



## Changes in:

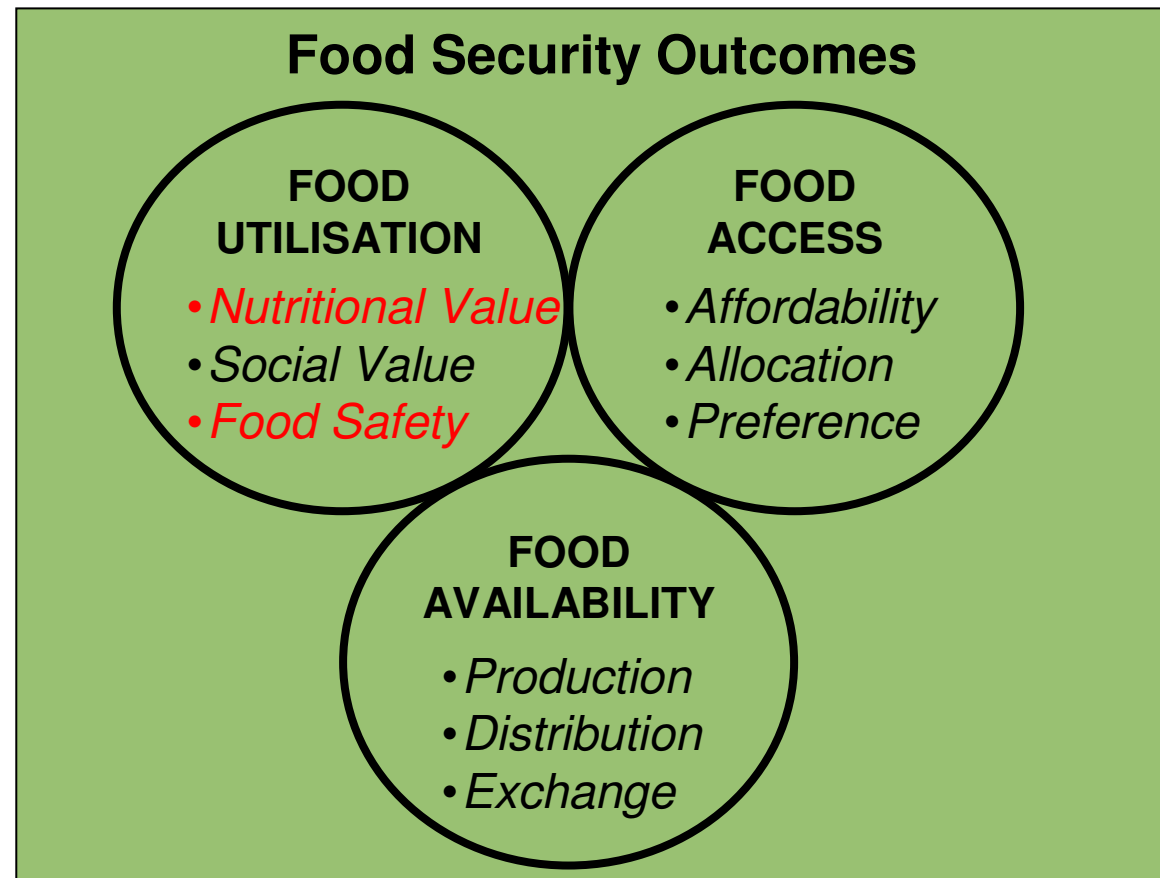
Shelf life ↑

Vitamins ↑↓?

Beneficial  
additives ↑

“e”-numbers ↑

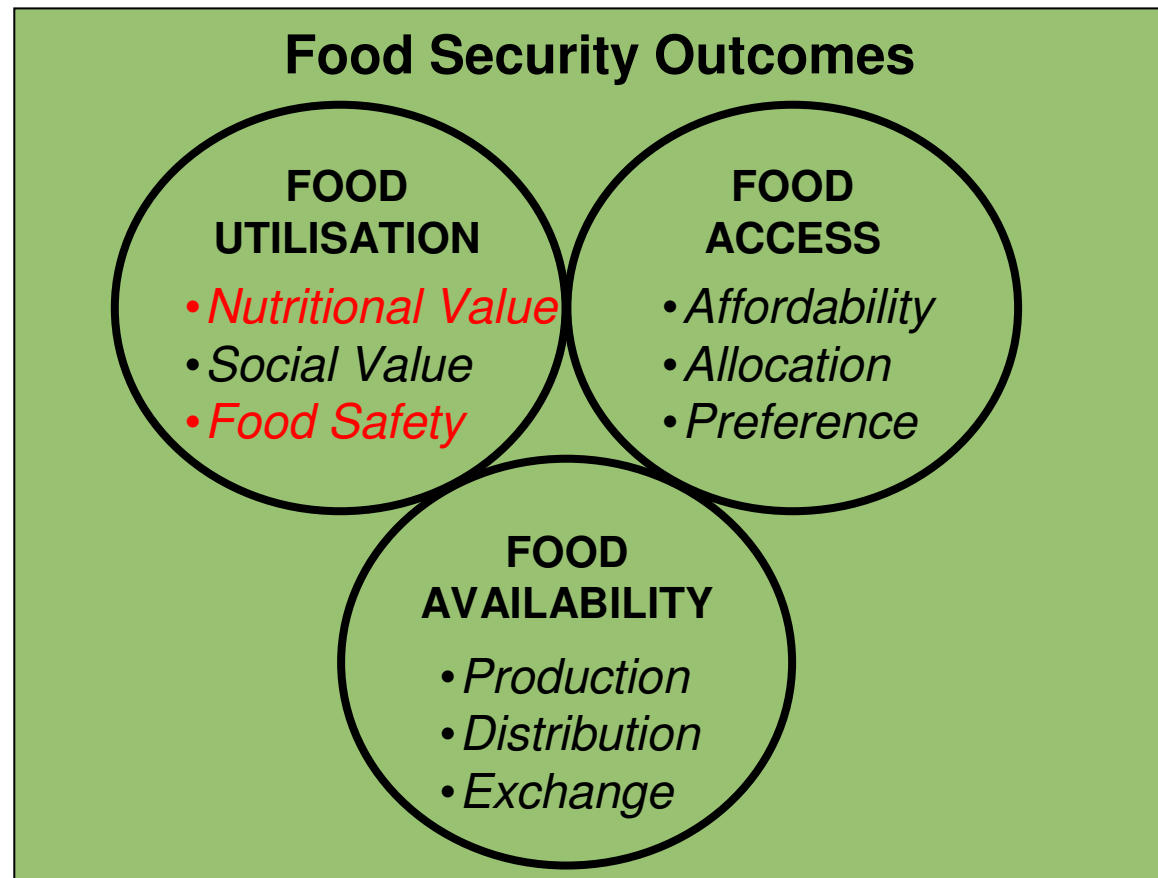
Natural toxins &  
pathogens ↑↓?:



## Changes in:

Aflatoxin build up in food storage

Food Access and Food Availability aspects increasingly important, esp. affordability

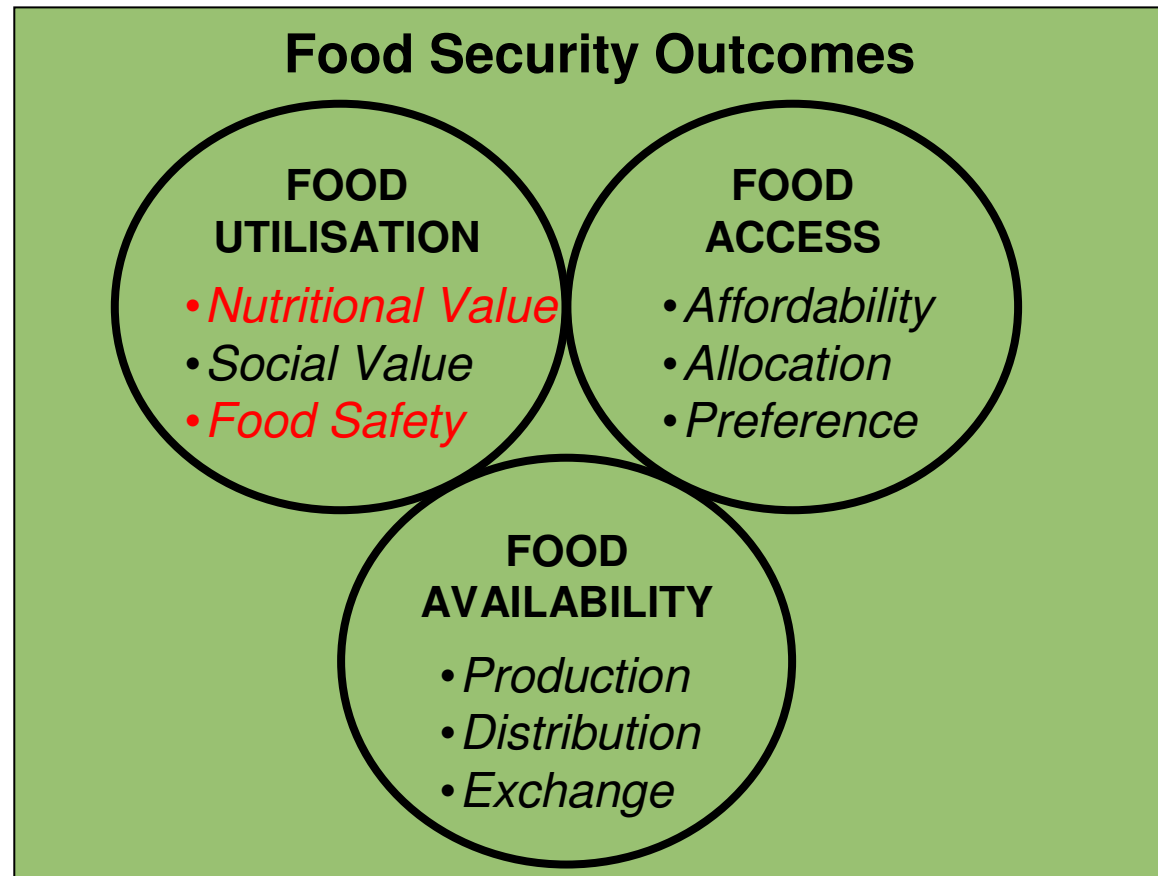


## Changes in:

Natural toxins?  
e.g. cassava  
HCN

Pathogen  
build-up?

Contamination  
during food  
preparation,  
esp. related to  
water quality  
(e.g. arsenic in  
ground water)





# ICT will have significant impacts in nutritional and safety aspects of the Food System

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- ✓ Sensors for freshness measure for nutrient content
- ✓ Smart packaging for spoilage identification
- ✓ Enhanced communications for “just in time” delivery to help freshness
- ✓ Low cost detection kits for scanning for food contaminants

# Some benefits of the GECAFS “food systems” approach

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- Identifies GEC interactions with food system
  - ✓ helps systematically “map” interactions between Food System Activities and nutrition and food safety Outcomes
  - ✓ highlights underemphasised aspects of the food system (e.g. nutritional content, distribution infrastructure, food storage) and their sensitivity to GEC
  - ✓ analyses feedbacks to the earth system from the food system (GHG, biodiversity, water quality)
  
- Allows analysis of a multiple food system outcomes
  - ✓ food security
  - ✓ ecosystem services
  - ✓ social welfare



*CGIAR Challenge Program on*

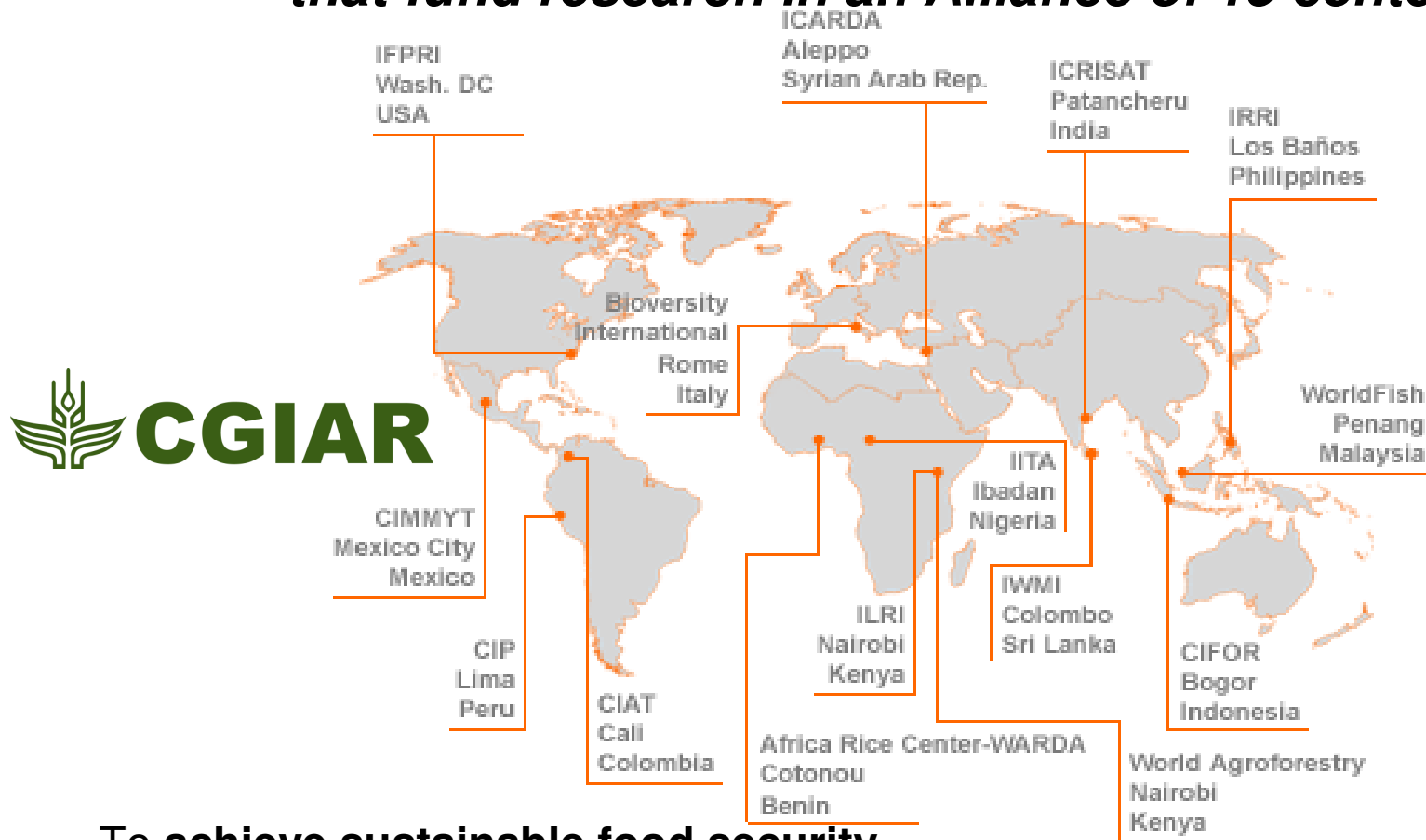
# **Climate Change, Agriculture and Food Security (CCAFS)**



Earth System  
Science Partnership

# Consultative Group on International Agricultural Research (CGIAR)

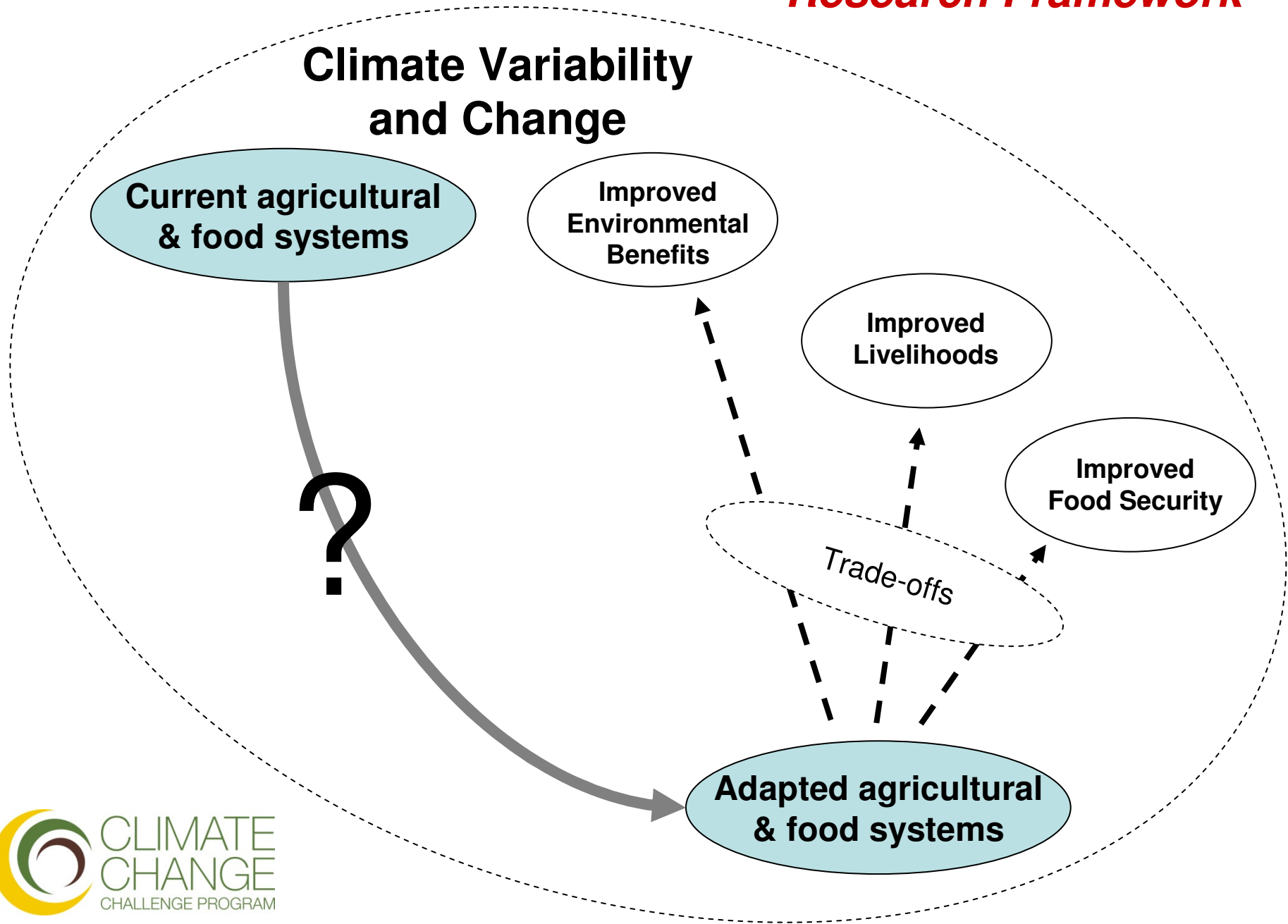
*~ 65 countries, foundations & int. organisations  
that fund research in an Alliance of 15 centers*



To achieve sustainable food security and **reduce poverty** in developing countries through scientific research and research-related activities in the fields of agriculture, forestry, fisheries, policy, and environment.

- Sustainable production
- Enhancing national capacities
- **Germplasm improvement**
- Natural resources management
- Policy

# Research Framework



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## Goal

*To overcome the additional threats posed by a changing climate to attaining food security, enhancing livelihoods and improving environmental management.*

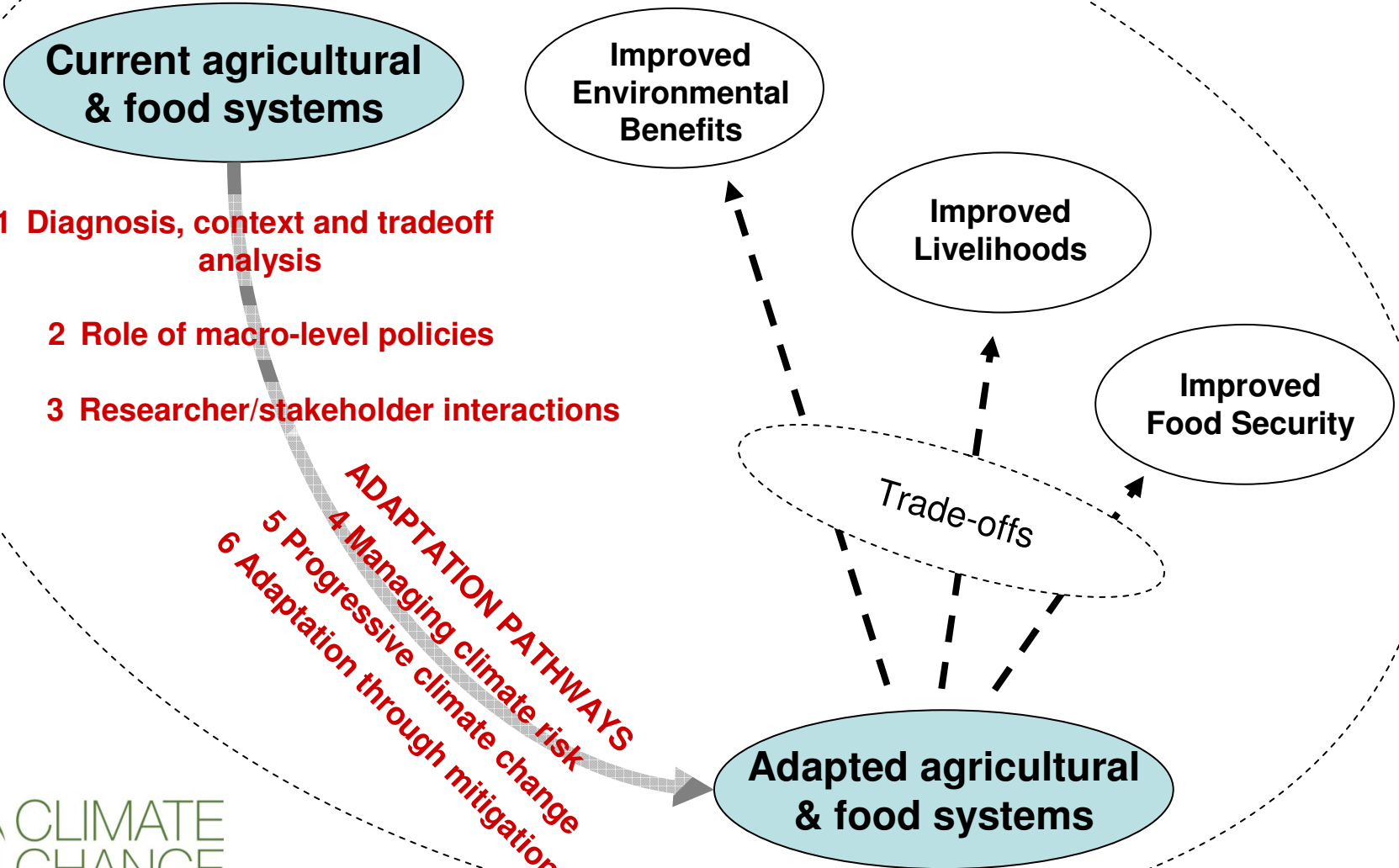
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## Objectives

1. Overcome critical gaps in knowledge of how to enhance – and manage the tradeoffs between – food security, livelihood and environmental goals in the face of a changing climate. [*=> outputs*]
2. Develop and evaluate options for adapting to a changing climate to inform agricultural development, food security policy and donor investment strategies. [*=> outcomes*]
3. Assist farmers, policymakers, researchers and donors to continually monitor, assess and adjust their actions in response to a changing climate. [*=> impacts*]

**Science Themes**

**Climate Variability and Change**



**ANALYTICAL & DIAGNOSTIC FRAMEWORK**

- 1 Diagnosis, context and tradeoff analysis
- 2 Role of macro-level policies
- 3 Researcher/stakeholder interactions

**ADAPTATION PATHWAYS**

- 4 Managing climate change
- 5 Progressive climate risk
- 6 Adaptation through mitigation



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## Opportunities

1. Science:
  - i. Enhanced food security research based on best climate/GEC science
  - ii. Enhanced climate/GEC research based on best agricultural & land management science
  - iii. Enhanced science support for, and data from, the developing world
2. Science, policy and development agendas more effectively linked
3. New and substantial funding based on enhanced collaboration between science and development agencies

# Potential GECHH - CCAFS collaborations

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- ? Enhancing consumption aspects in food security concept
- ? Enhancing food safety aspects in food security concept
- ? Food systems adaptation research
- ? Joint bids for research funding