

Challenges for Analysing Environment and Food Security Tradeoffs

John Ingram
Executive Officer
ESSP-Global Environmental Change and Food Systems
(GECAPS)

NERC/University of Oxford

john.ingram@eci.ox.ac.uk

Global Food Overview

(von Braun, 2007)

World food situation is being re-defined by new driving forces affecting consumption, production and markets

- Population growth and urbanisation
- Globalisation plus influence of private sector
- Income growth affecting consumption
- Higher energy prices (closer link of food to energy prices)
- Climate variation and change

We need 50% more food by 2030

and

We need to mitigate GEC

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.

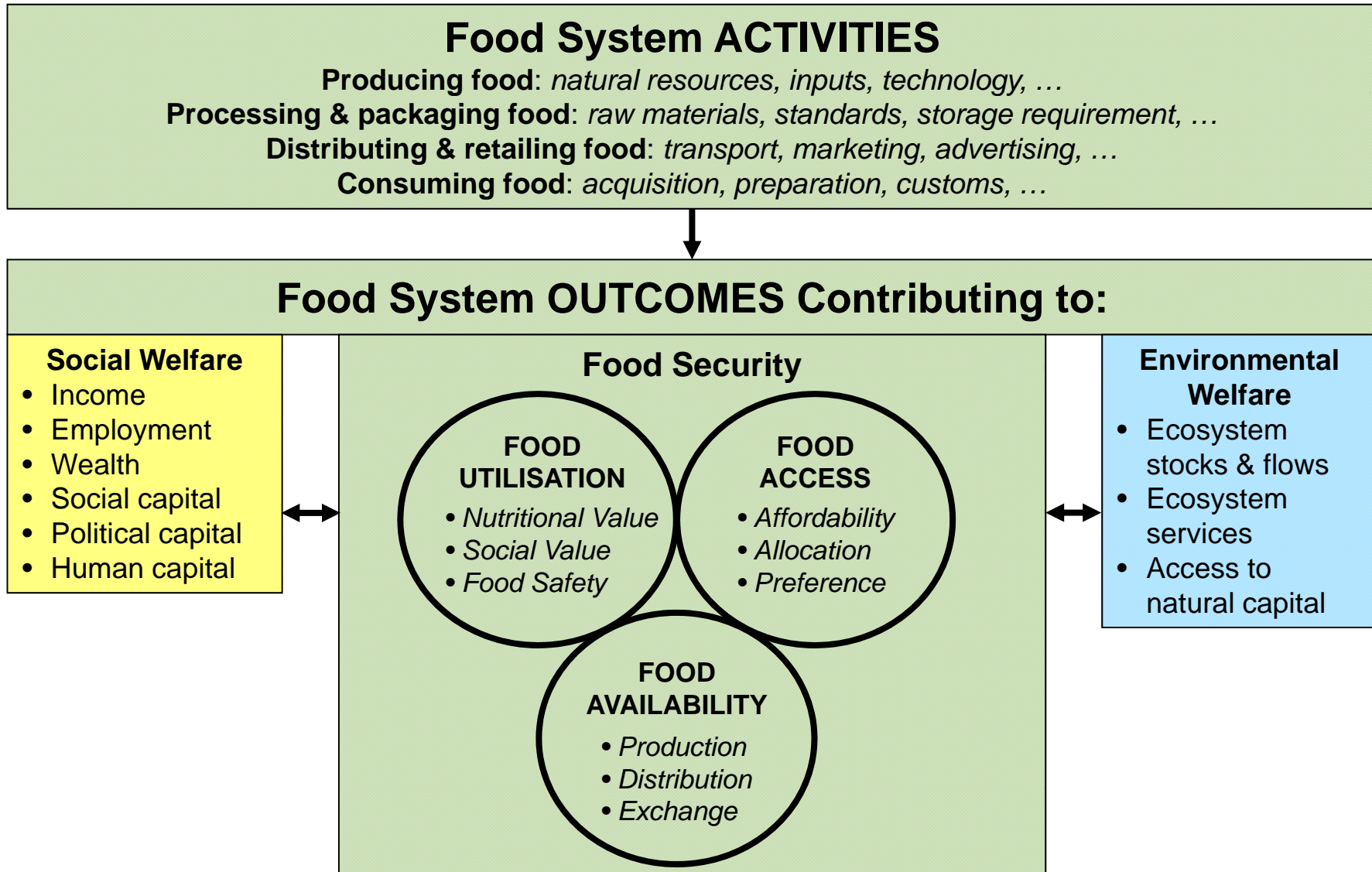
(UN-FAO World Food Summit 1996)



... is underpinned by **Food Systems.**

GECAFS “Food System” concept

integrates Food System Activities and Outcomes



Food Systems ⇌ Environment

Food system activities:

- Producing food
- Processing & packaging food
- Distributing & retailing food
- Consuming food



Changes in:

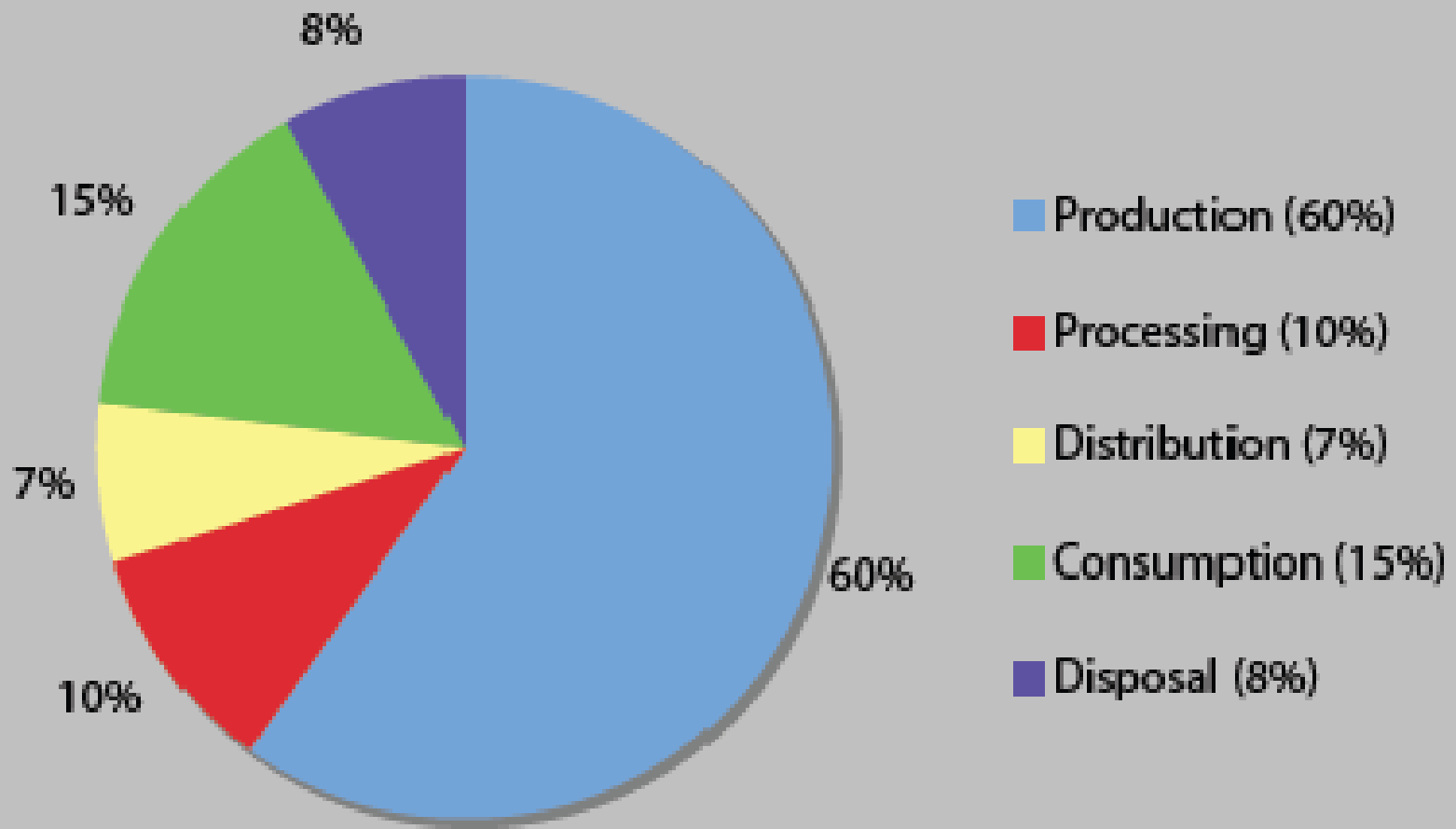
- Biodiversity
- Biogeochemical cycling, esp. nitrogen
- GHG emissions
- Pollution
- Soils (physical, biological & chemical conditions)
- Water availability & quality
- ...

Climate change is now a major concern

GHGs from food production *excluding land conversion*

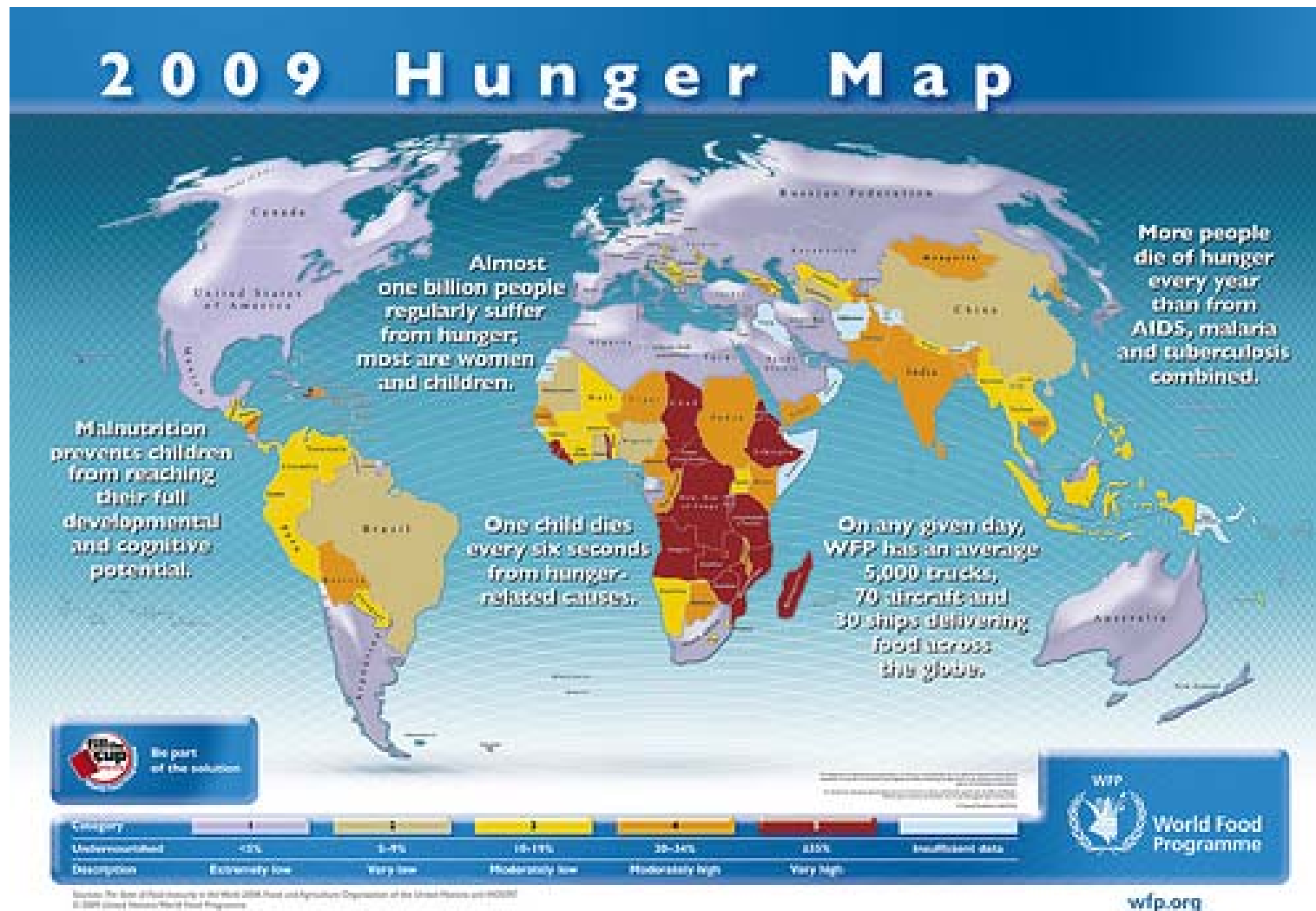
- **N₂O** from use of synthetic fertilizers
- **CO₂** from the energy used for the manufacture and transport of fertilizers
- **CH₄** from rice paddy and ruminant animals, and eroded soil washed to waterlogged conditions
- **CO₂** from the manufacture and fuelling of on-farm machinery, including irrigation pumps

Estimated Percentage of Greenhouse Gas Contributions from U.S. Food System by Sector



from Edwards et al., Institute for Agriculture and Trade Policy, 2009

Food systems are already failing many. Climate change will bring additional stress.



“Pathways for implementation of adaptation actions must be developed.”



Agriculture and Rural Development Discussion Paper 42

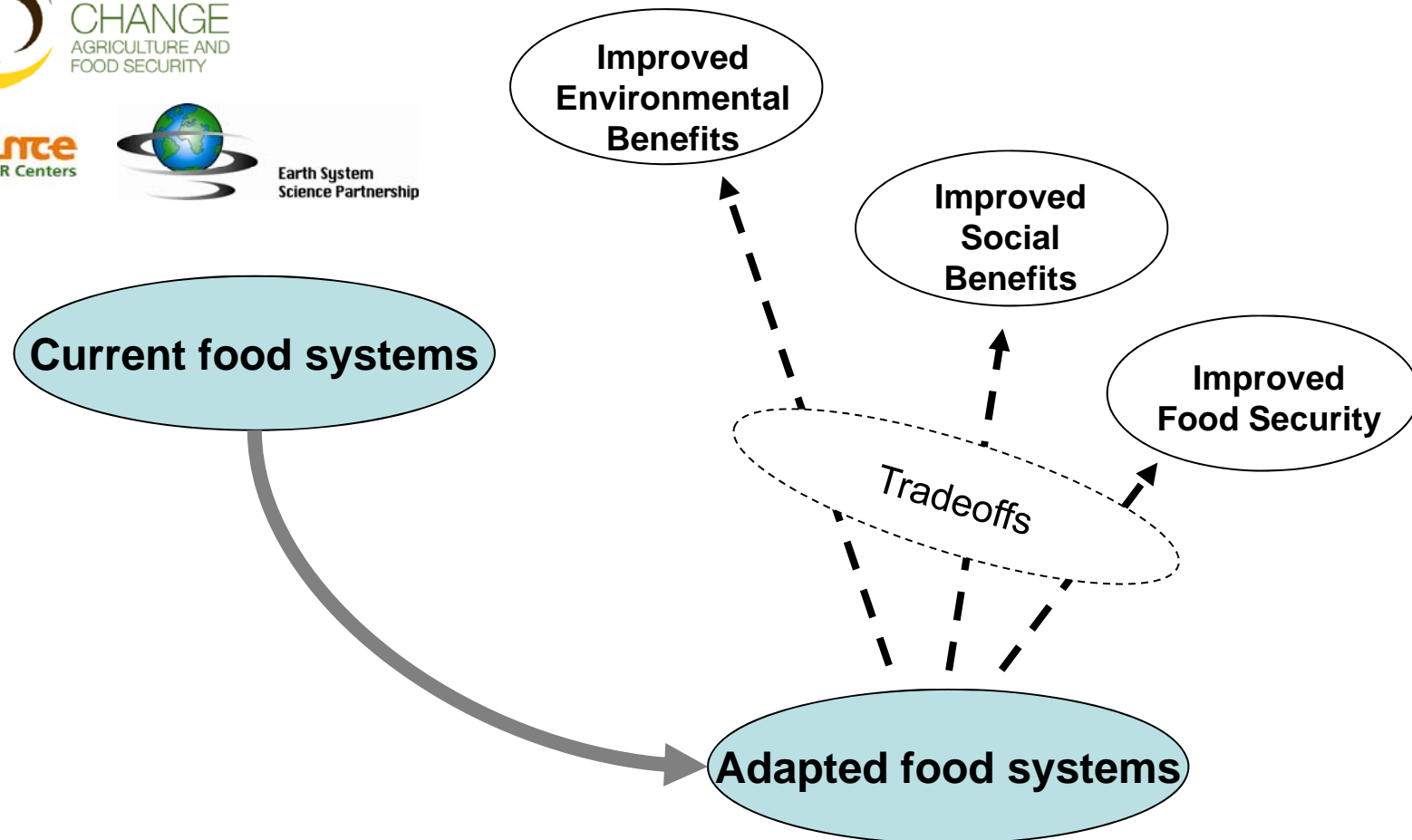
Climate Change Response
Strategies for Agriculture:
Challenges and Opportunities
for the 21st Century



Francesco Tubiello
Josef Schmidhuber
Mark Howden
Peter G. Neofotis
Sarah Park
Erick Fernandes
Dipti Thapa

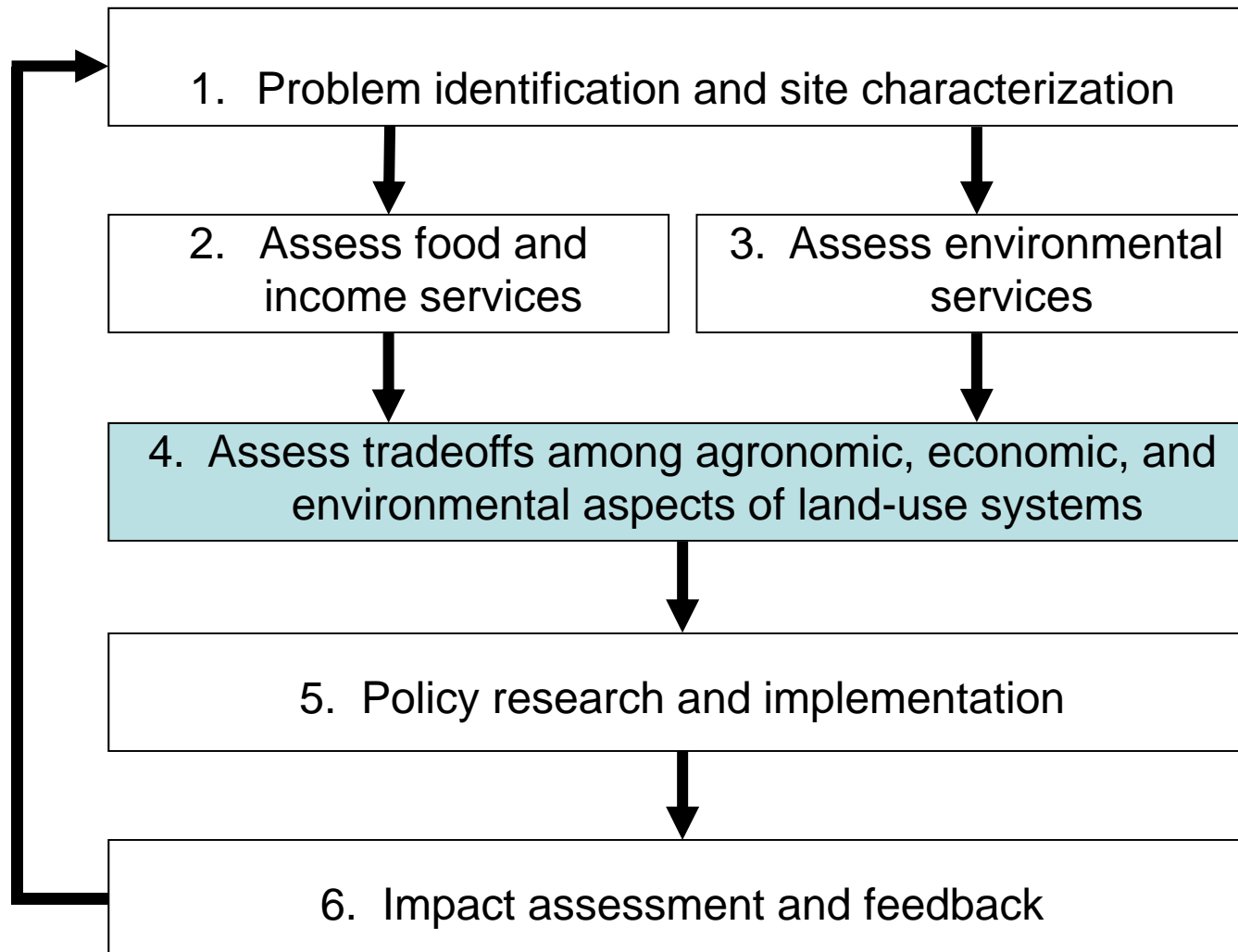
“The tradeoffs between land use for food, bio-energy and carbon sequestration, as well as the social, environmental, and economic implications of adaptation responses, increasingly need to be considered within such analyses.” (WB, 2008)

We need better methods to evaluate and analyse tradeoffs

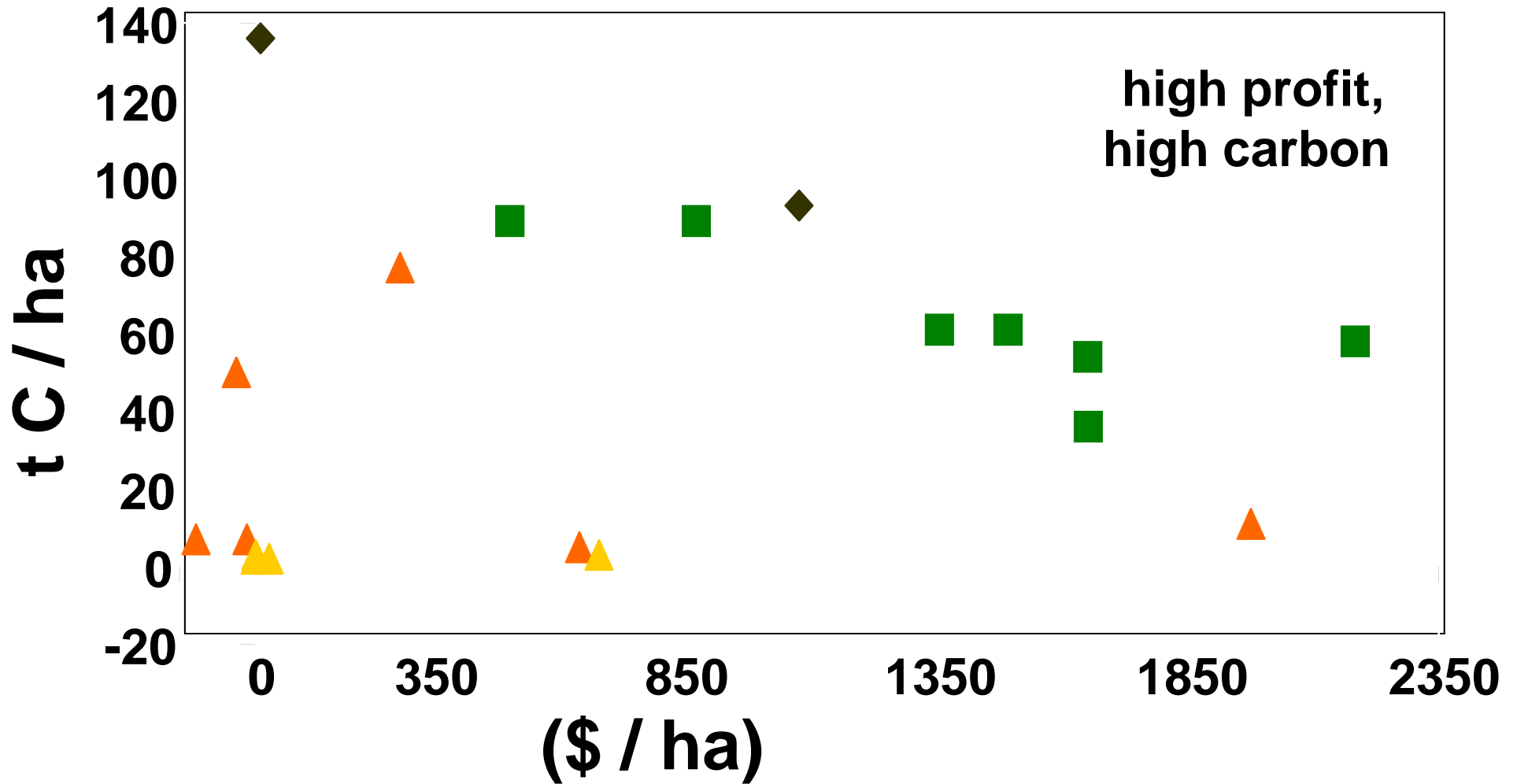


“Alternatives to Slash and Burn” Research Framework

(modified from Palm et al, 2005)



Carbon vs Profits Tradeoffs (Multi-site)



Tradeoffs between environmental goals and food security in Brazil *(adapted from Palm et al, 2005)*



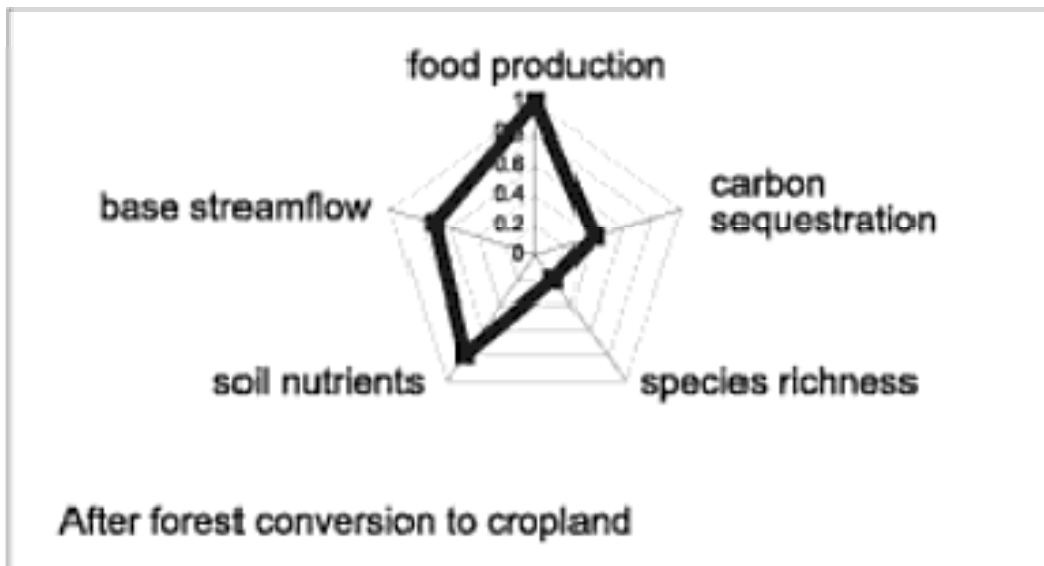
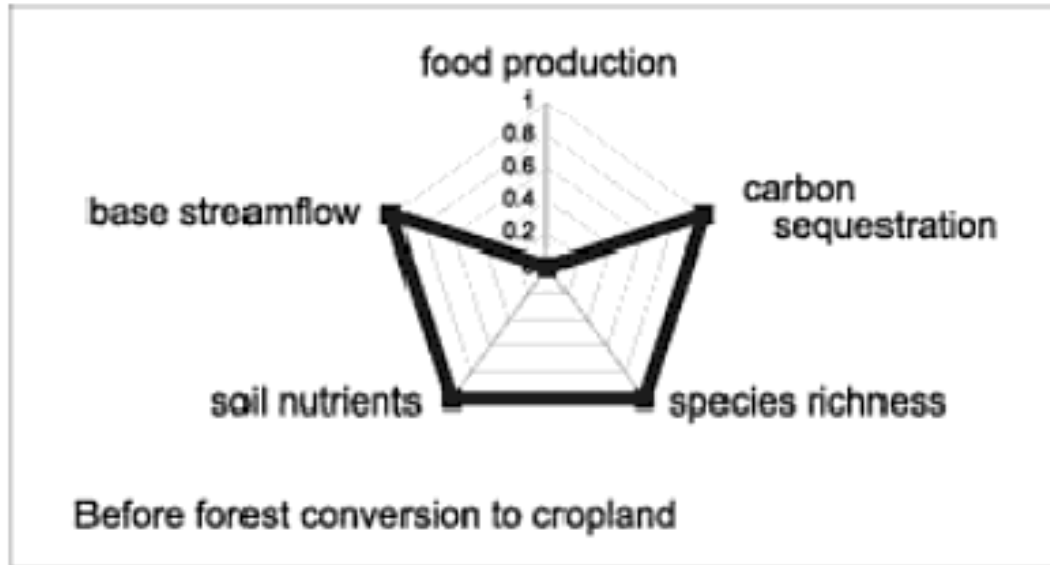
	A/G Carbon Storage	A/G Biodiversity	Household Food Security
	tC/ha (time-averaged)	No. spp/ standard plot	Entitlement Path (operational phase)
Forests	148	80	NA
Managed forestry	~148	NM	\$
Coffee- <i>Bandarra</i>	56	27	\$
Coffee-rubber	56	16	\$
Traditional pasture	3	10	\$, consumption
Improved pasture	3	NM	\$, consumption
Annual-fallow	7	34	\$, consumption
Improved fallow	~3-6	26	\$, consumption

Examples of measurable indicators appropriate for assessing short-term, local and long-term, global tradeoffs associated with land-use change

Ecosystem function	Indicators appropriate for assessing short-term, local-scale trade-offs	Indicators appropriate for assessing long-term, global-scale trade-offs
Crop production	Calories/person for local consumption	Revenue from food export
Climate regulation	Rainfall from local convection	Greenhouse gas emissions altering global climate
Disease regulation	Incidence of disease locally	Spatial range of disease vectors
Biodiversity	Local species richness	Extinctions of endemic species
Soil fertility	Soil erosion in catchment area	Requirements for fertilizer to replenish fertility lost from long-term leaching
Freshwater	Groundwater recharged locally	Incidence of downstream flooding

Hypothetical Trade-offs in a Policy Decision to Expand Cropland in a Forested Area

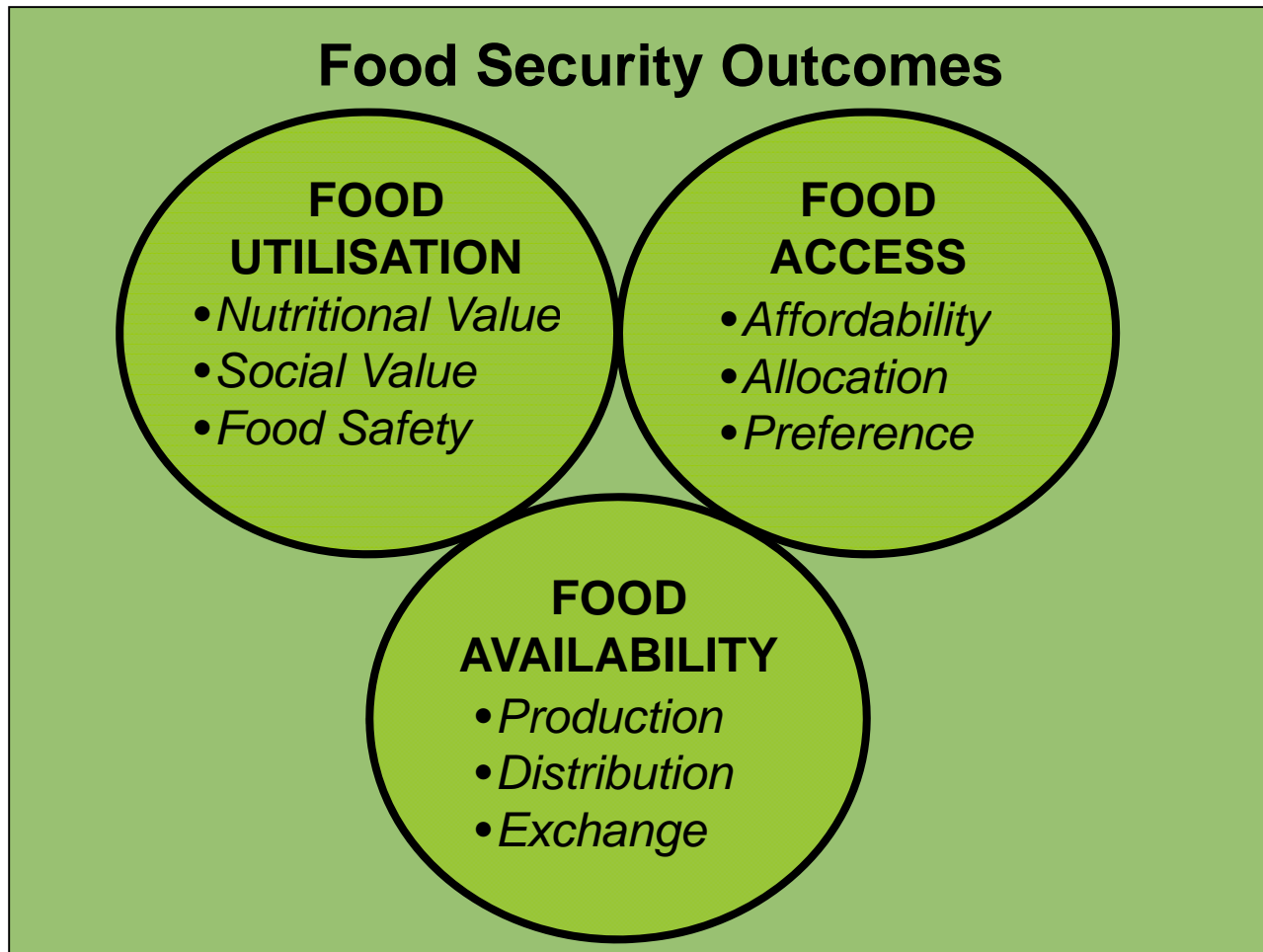
Indicators range from 0 to 1 for low to high value of service.



“The ability to quantify the ecosystem responses, and reduce them to commensurate units, is fraught with difficulty.”

Food Security Outcomes

Components & Elements

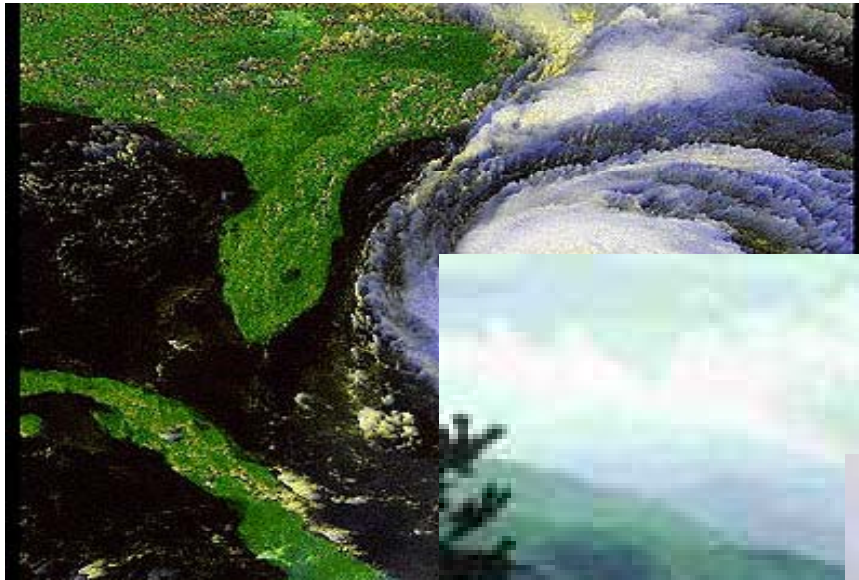


“The ability to quantify the food system outcomes, and reduce them to commensurate units, is fraught with difficulty.”



GECAFS Caribbean semi-quantified food security assessment

(Prototype scenario exercise based on MA storylines)



3 main starting issues

Extreme weather, climate, sea level



Land use esp. “ridge-to-reef”

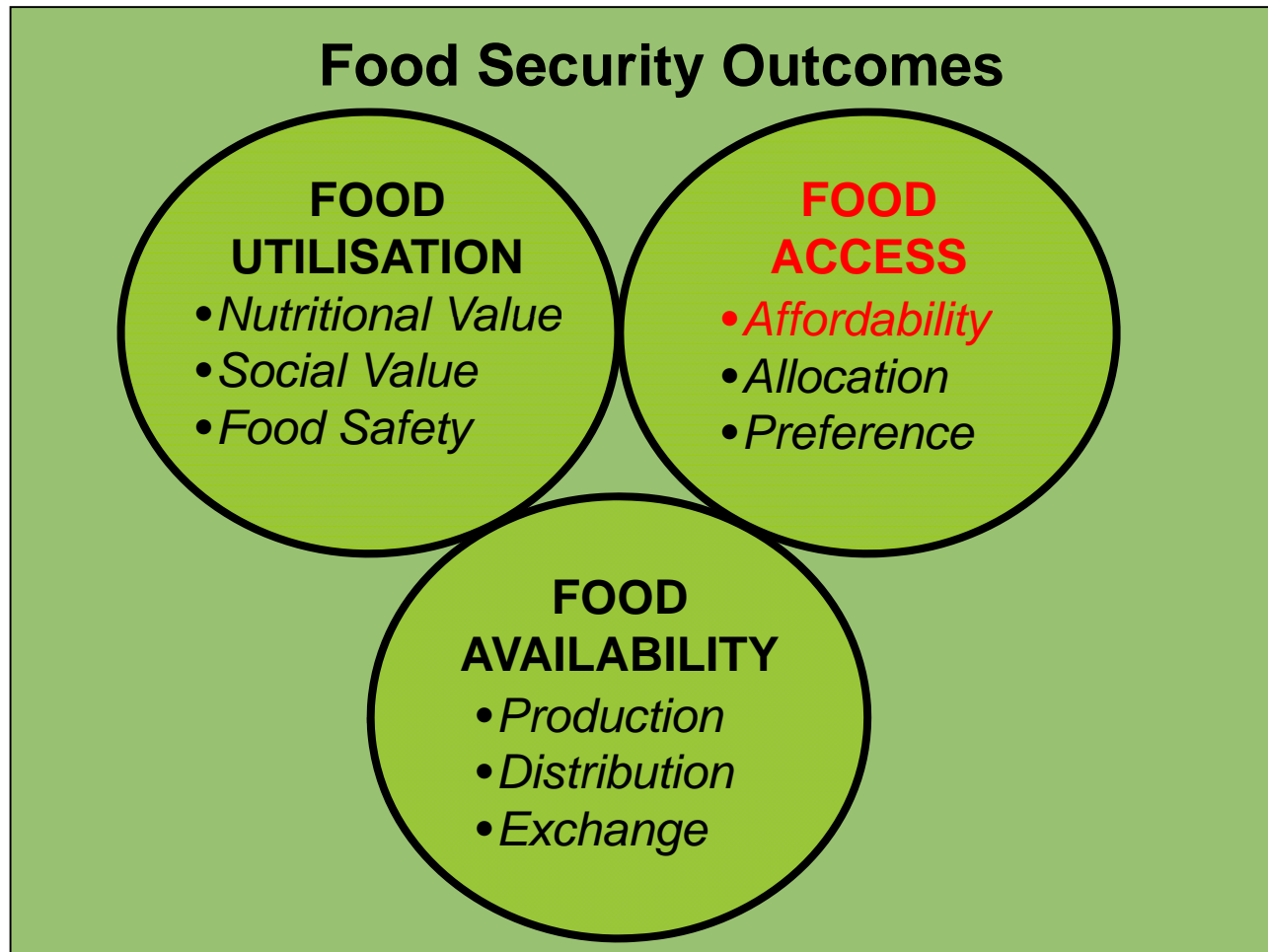
Regional governance & CSME

Preferential trade



Food Security Outcomes

Example based on Affordability



Assessing Food Systems OUTCOMES [1]

*Developments **described** per scenario for each Food Security element (example for Food Access component)*

Food Access	Global Caribbean	Caribbean Order from Strength	Caribbean TechnoGarden	Caribbean Adapting Mosaic
Affordability	<ul style="list-style-type: none"> • Lower food prices • Income increase • Fish price goes up, due to limited availability 	<ul style="list-style-type: none"> • Lower economic growth, less income • increase in food prices, also of staple food GEC shocks 	<ul style="list-style-type: none"> • Incomes increase • Different national situations as some countries are richer, dampened effect over time 	<ul style="list-style-type: none"> • Moderate increase in wealth outweighed by food price increases
Allocation	etc...			
Preference	etc...			

Assessing Food Systems OUTCOMES [2]

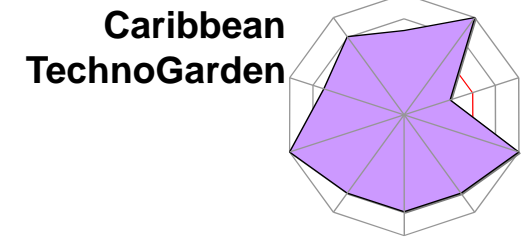
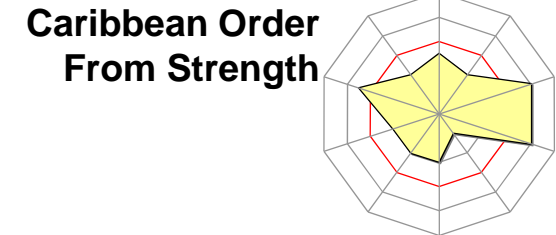
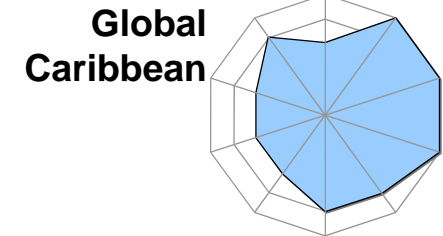
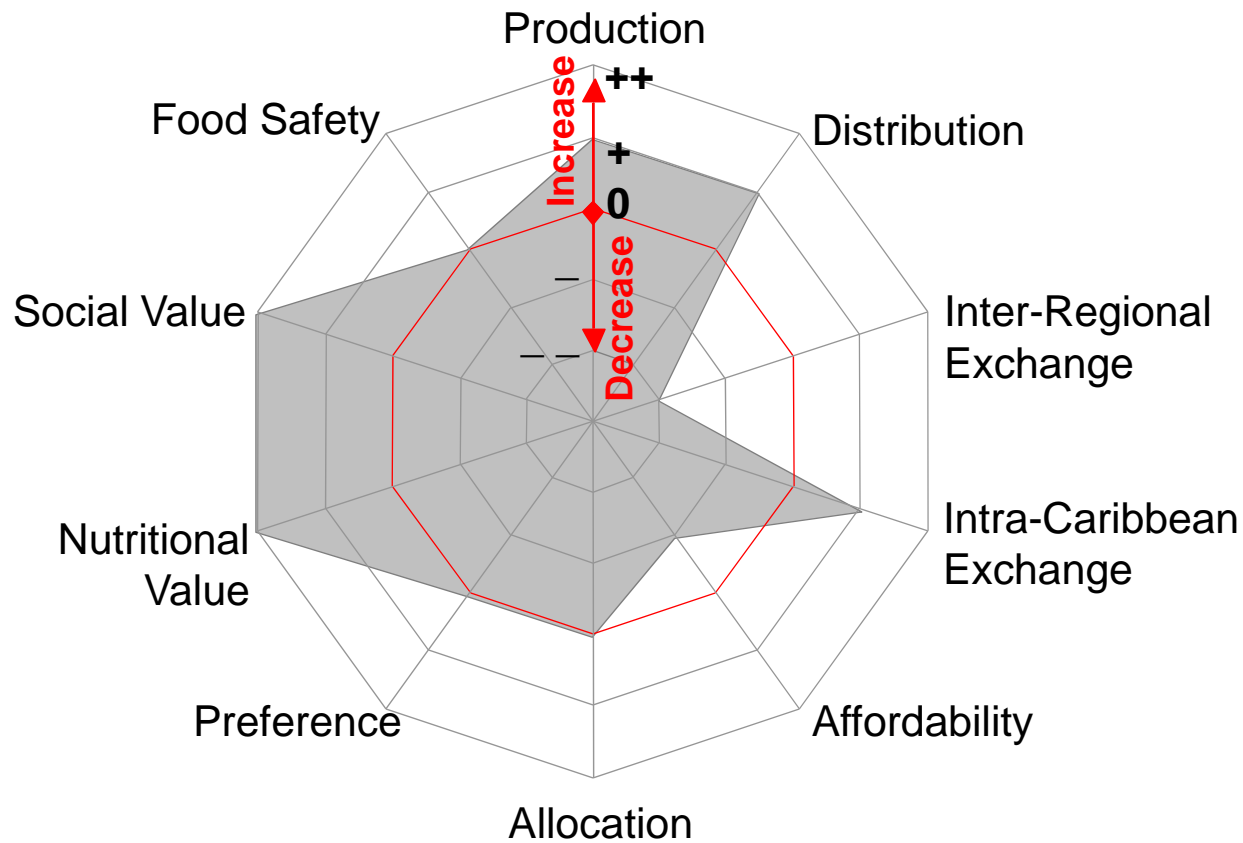
Developments **systematically assessed** per scenario for each Food Security element (example for Food Access component)

Food Access	Global Caribbean	Caribbean Order from Strength	Caribbean TechnoGarden	Caribbean Adapting Mosaic
Affordability	+	--	+	-
	<ul style="list-style-type: none"> • Lower food prices (+) • Income increase (+) • Fish price goes up, due to limited availability (-) 	<ul style="list-style-type: none"> • Lower economic growth, less income (--) • Increase in food prices, also of staple food (--) • GEC shocks (-) 	<ul style="list-style-type: none"> • Incomes increase (+) • Different national situations as some countries are richer, dampened effect over time (-) 	<ul style="list-style-type: none"> • Moderate increase in wealth outweighed by food price increases (-)
Allocation	+	-	+	0
Preference	0	-	+	+ / -

Assessing Food Systems OUTCOMES [3]

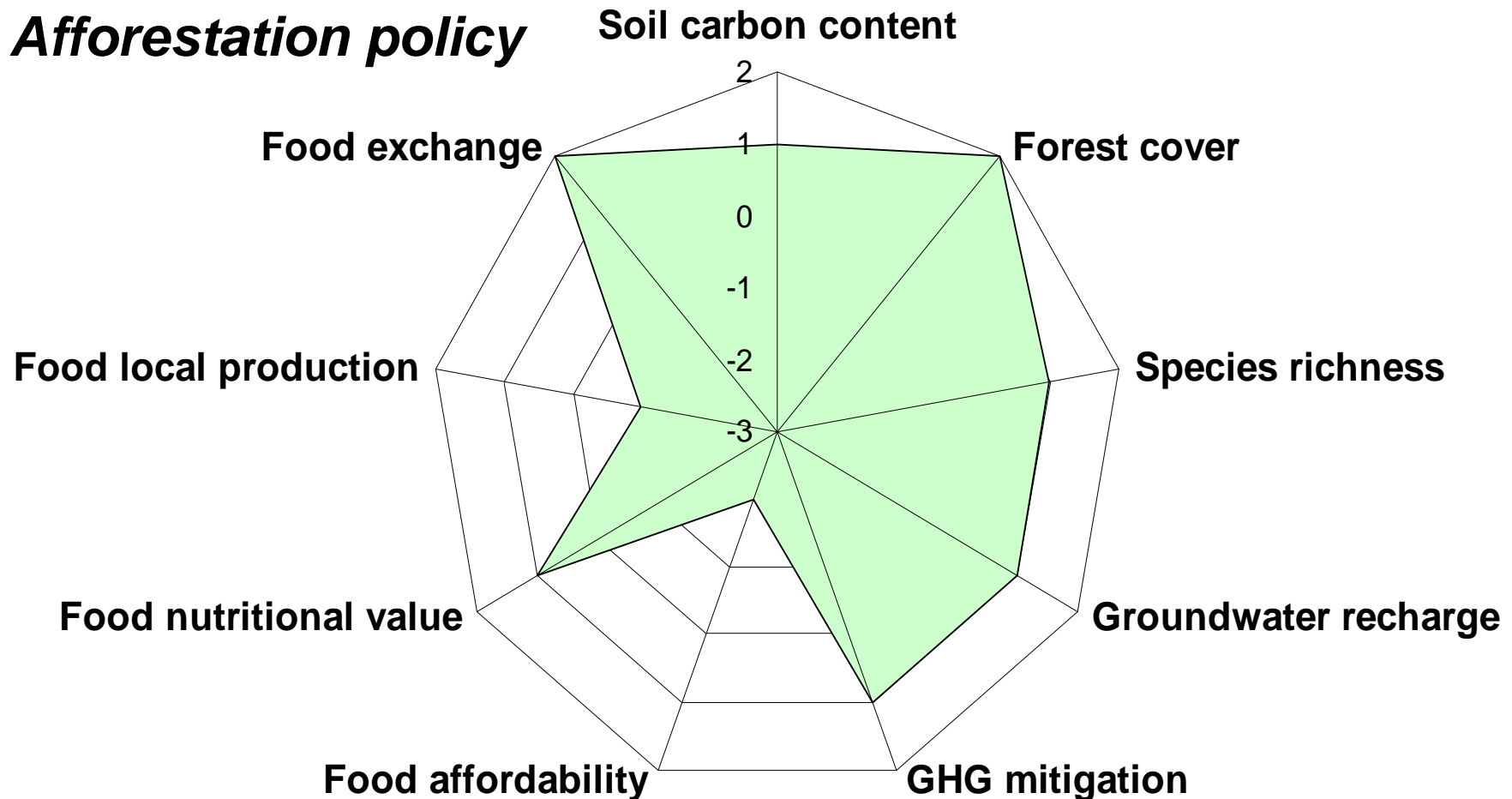
Food security tradeoffs plotted

per scenario



How to quantify and assess very different types of variables to understand and communicate tradeoffs?

Afforestation policy



Conclusions

***For determining food security/environment tradeoffs
we need to:***

- ✓ Understand and quantify food security components commensurate with environmental components
=> food system concepts can help

- ✓ Assess and compare different types of key variables (apples and oranges problem)
=> semi-quantitative approaches can help

- ✓ Improve science/policy dialogue and communication
=> scenarios exercises & spider diags can help