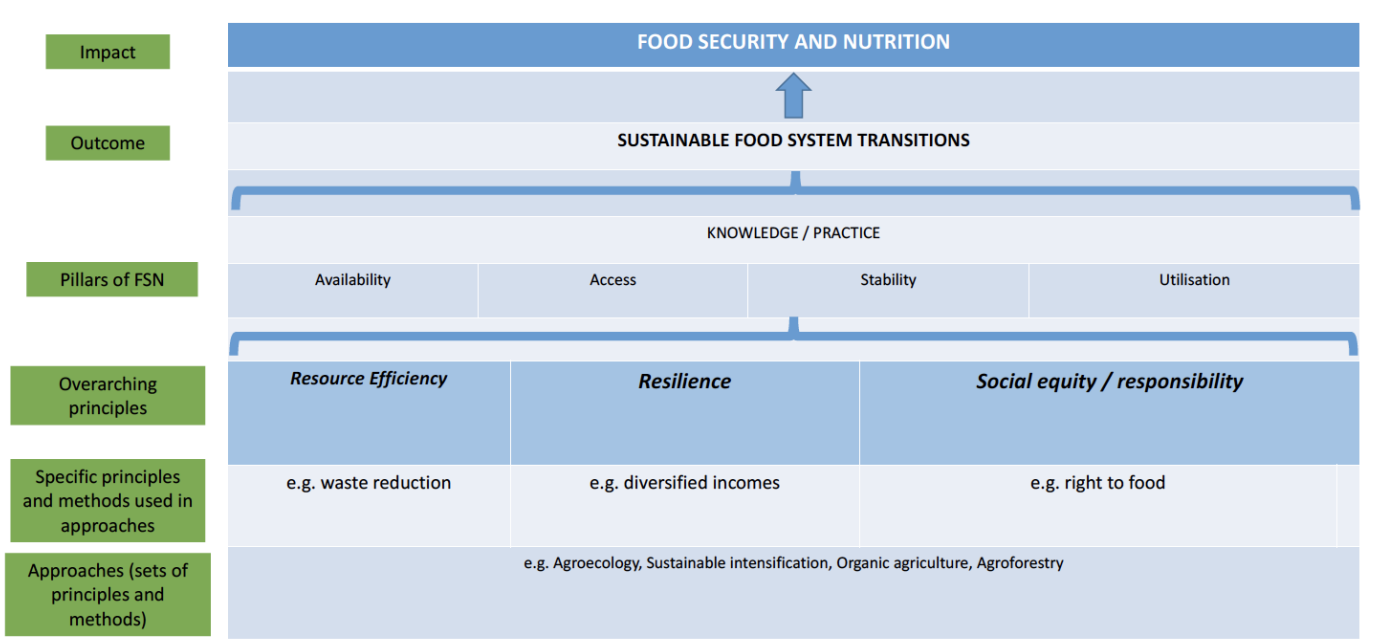
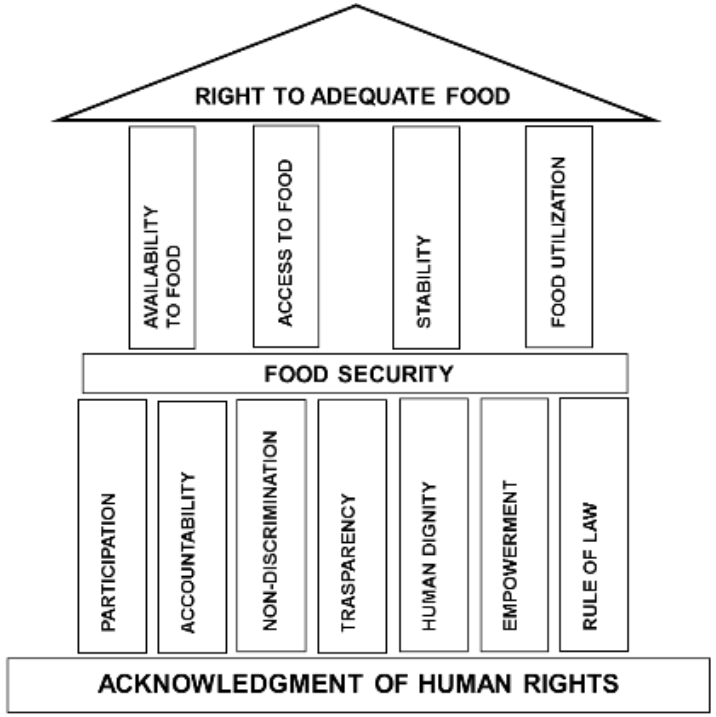
Introduction

- Transformation of food systems required - affecting what people eat and how it is produced, transported, processed and sold.
- Agroecological approaches rising in prominence
- Approaches to FSN have different principles
- Transformation happens via series of transitions
- The report starts from a recognition of human rights as the basis for ensuring sustainable food systems - PANTHER



Definition 1 Innovation approach to FSN
"A well articulated and widely practiced set of principles and methods intended to foster the transition towards more sustainable food systems that enhance food security and nutrition, within an overarching philosophy and strategic vision for the future"

Definition 2 Principles of innovation approaches
"Principles are statements that form a basis for a system of belief or reasoning that guide decisions and behavior. They may be either normative; that is, they assert values (e.g. food systems should be equitable) or, causative, as in scientific usage; that is, they explain relationships (e.g. more equitable food systems are likely to be more sustainable). In either case, to be useful in guiding decisions and actions, they need to be fully explicit."



Agroecology (1)

- Dynamic concept, expanded from field and farm to whole food system: science, practice and social movement
- Science: transdisciplinary
- Practices: harness ecological processes in agricultural production – no prescribed set.
- Social movements: political, assert collective rights for smallholder farmers and advocate diversity in agriculture and food systems.
- 13 consolidated principles
- Examples of agroecology being promoted and practiced by large numbers of farmers and other food system actors nationally in Cuba, at state level in India, regionally in France, in relation to specific heritage systems in China, and in various contexts across Africa
- Debate about the extent to which agroecology can feed the world i) to what extent is the amount produced the issue? ii) can enough be produced using agroecological approaches? iii) performance measures that factor in externalities

(need to reconcile sections 1.3.1 and 1.4.5 currently repetition).

Definition 3 Transdisciplinary science transcends disciplinary boundaries and seeks to generate transformative outcomes by having: i) a problem focus (research originates from and is contextualized in 'real-world' problems); ii) an evolving methodology (the research involves iterative, reflective processes that are responsive to the particular questions, settings, and research groupings involved); and, iii) collaboration, including amongst transdisciplinary researchers, disciplinary researchers and external actors with interests in the research (Russel et al, 2008).

This has been interpreted in agroecology to involve integration of different academic disciplines as well as diverse forms of knowledge, including experiential, cultural, and spiritual (Méndez et al., 2015). It contrasts with multidisciplinary science, where people from different disciplines work together, each drawing on their disciplinary knowledge in an additive rather than integrative way; and, interdisciplinary science, where knowledge and methods from different disciplines are integrated, involving a synthesis of approaches (Petrie, 1992).

Definition 4 Agroecological approach to FSN
Agroecological approaches favour the use of natural processes, limit use of external inputs, promote closed cycles with minimal negative externalities and stress the importance of local knowledge and participatory processes which develop knowledge and practice through experience, as well as more conventional scientific methods, and address social inequalities. Agroecological approaches to FSN recognize that agri-food systems are coupled social-ecological systems from production of food to its consumption with all that goes on in-between and involve science, practice and a social movement, as well as their holistic integration to address FSN.

Agroecology (2)

- Many actors involved do not always all agree – allows for flexibility in development of locally situated practices but some tensions between social movements and science
- Divergence on centrality of social social and political elements; relationship with organic agriculture, prescription of practices and certification; the nature and amount of labor required by agroecological approaches.
- Agrocecology espouses approaches to knowledge generation and transfer that put a lot of emphasis on local knowledge, experiential learning and farmer to farmer knowledge transfer demanding a reconfiguration of how research and extension are organized.
- Investment in research on agroecological approaches have been much lower than in alternatives so that significant knowledge gaps about agroecology remain including: yields and performance of agroecological practices relative to alternatives; how to link agroecology to public policy; impacts of adopting agroecological approaches including on resilience to climate change; and, what is needed to support transitions including overcoming 'lock-ins'
- Five phases of transition

Level 5: Build a new global food system, based on participation, localness, fairness, and justice

Level 4: Reconnecting the two most important parts of the food system - consumers and producers, through the development of alternative food networks

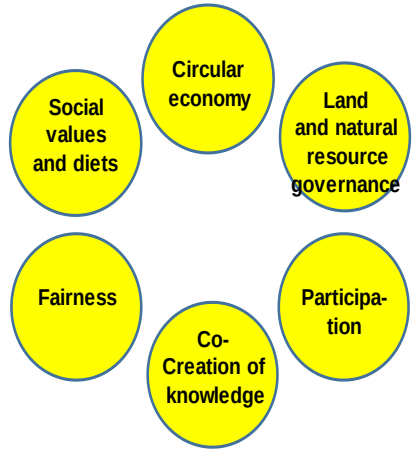
Food system

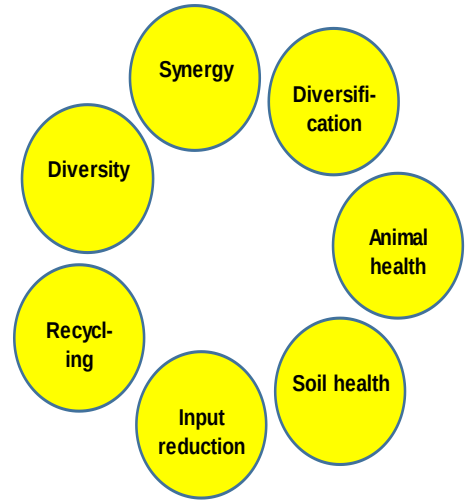
Level 3: Redesign the agroecosystem so that it functions on the basis of a new set of ecological processes that provide system resistance

Level 2: Substitution of conventional inputs and practices with alternatives

Level 1: Increase input use efficiency, reducing the use of costly, scarce, or environmentally damaging inputs

Agroecosystem





Innovation (1)

- Innovation that supports transformation involves challenging the *status quo,* involving changes to rules, institutions and practices. The process of innovation (how change happens) is as important as the product (specific changes).
- Conventional emphasis of innovation has been on introducing new technology but concepts of democratizing and responsible innovation are now gaining traction giving greater emphasis to co-creation of knowledge.
- Innovation in agriculture is inherently localized.
- Sustainable intensification (reformist) and agroecological (transformative) approaches can be distinguished – former requires increasing production per unit of land.
- Approaches overlap, their convergence and divergence evident from analysis of their principles (need to better incorporate response to climate change into generic principles).

	Agroecological and related approaches					Sustainable intensification and related approaches			
Principle focal area	**Food sovereignty**	Agroecology	Organic Agriculture	Agroforestry/ Silvopastoralism	Permaculture	Sustainable intensification	Climate smart agriculture	Nutrition sensitive agriculture	Sustainable food value chains
Resource efficiency									
Regenerative production, Recycling and Efficiency								(not relevant)	(not relevant)
Synergies/Diversity/Integration									
Resilience									
Diversification									
Social equity/responsibility									
Knowledge generation and technology transfer									
Human and social values,-equity									
Human and social values, focus on labor vs. capital									
Connectivity- value chains/circular economies									
Governance- rights, democratization and participation									

Innovation (2)

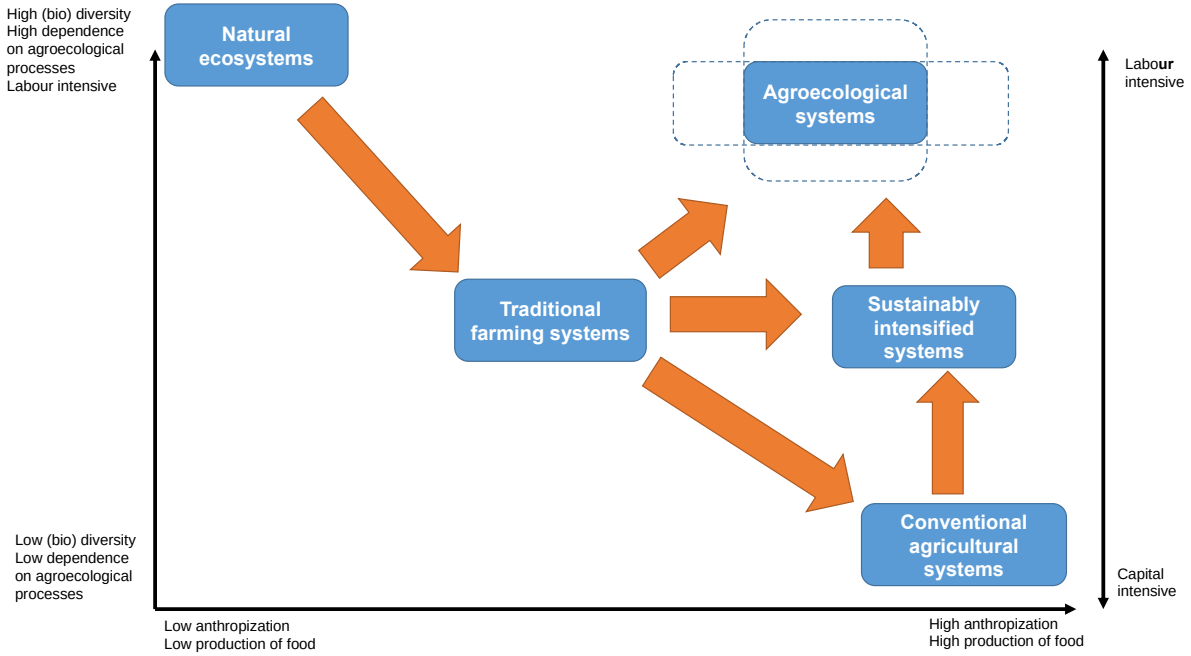
- Comparative analysis of approaches based on the principles involved identify the need to expand the framework for understanding SFS for FSN in two ways.

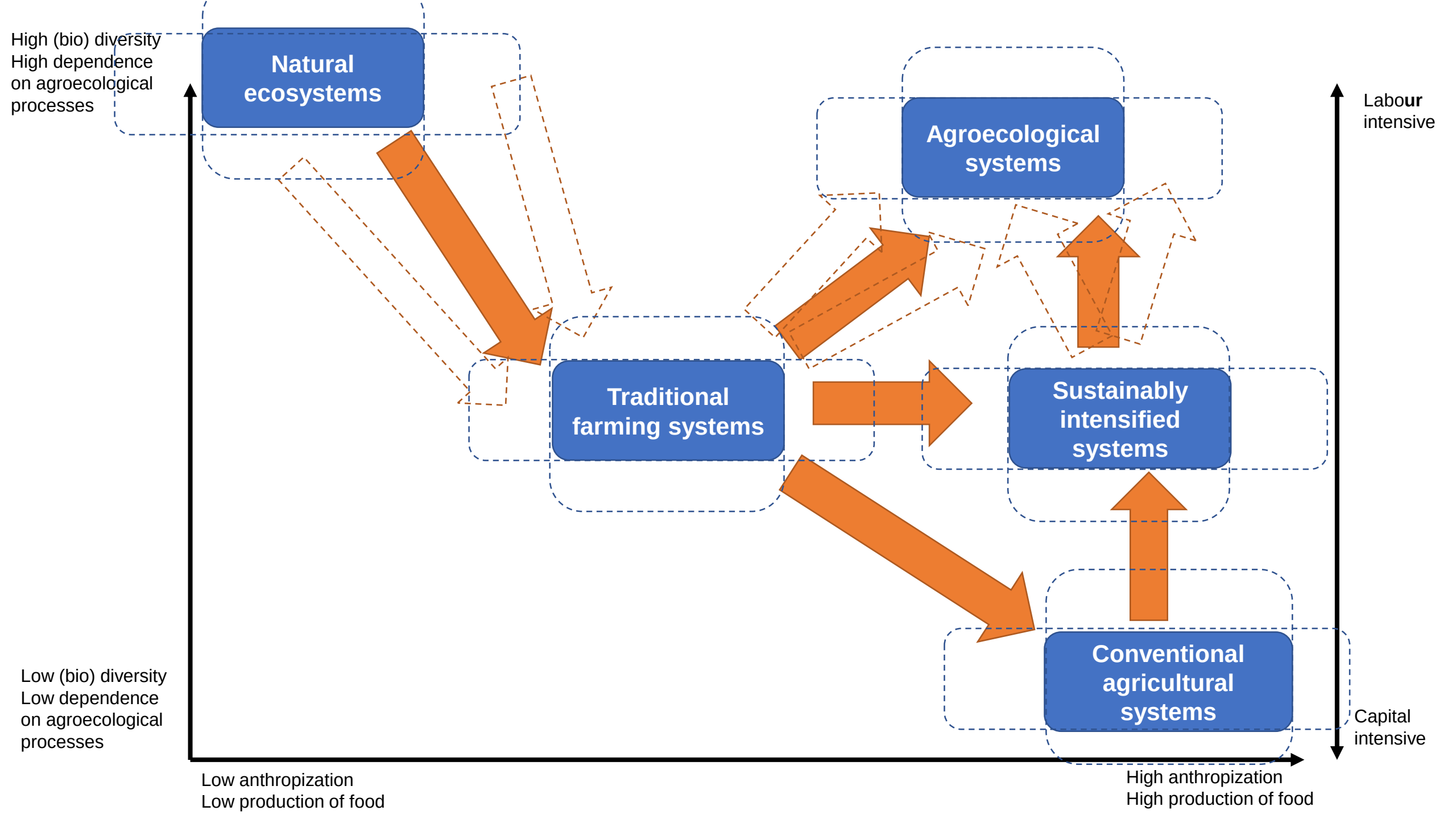
1. Adding a fourth operational principle of sustainable food systems of '**ecological footprint**' that connects consumption (including all externalities) to sustainable capacity to produce and the degradative or regenerative nature of production processes.

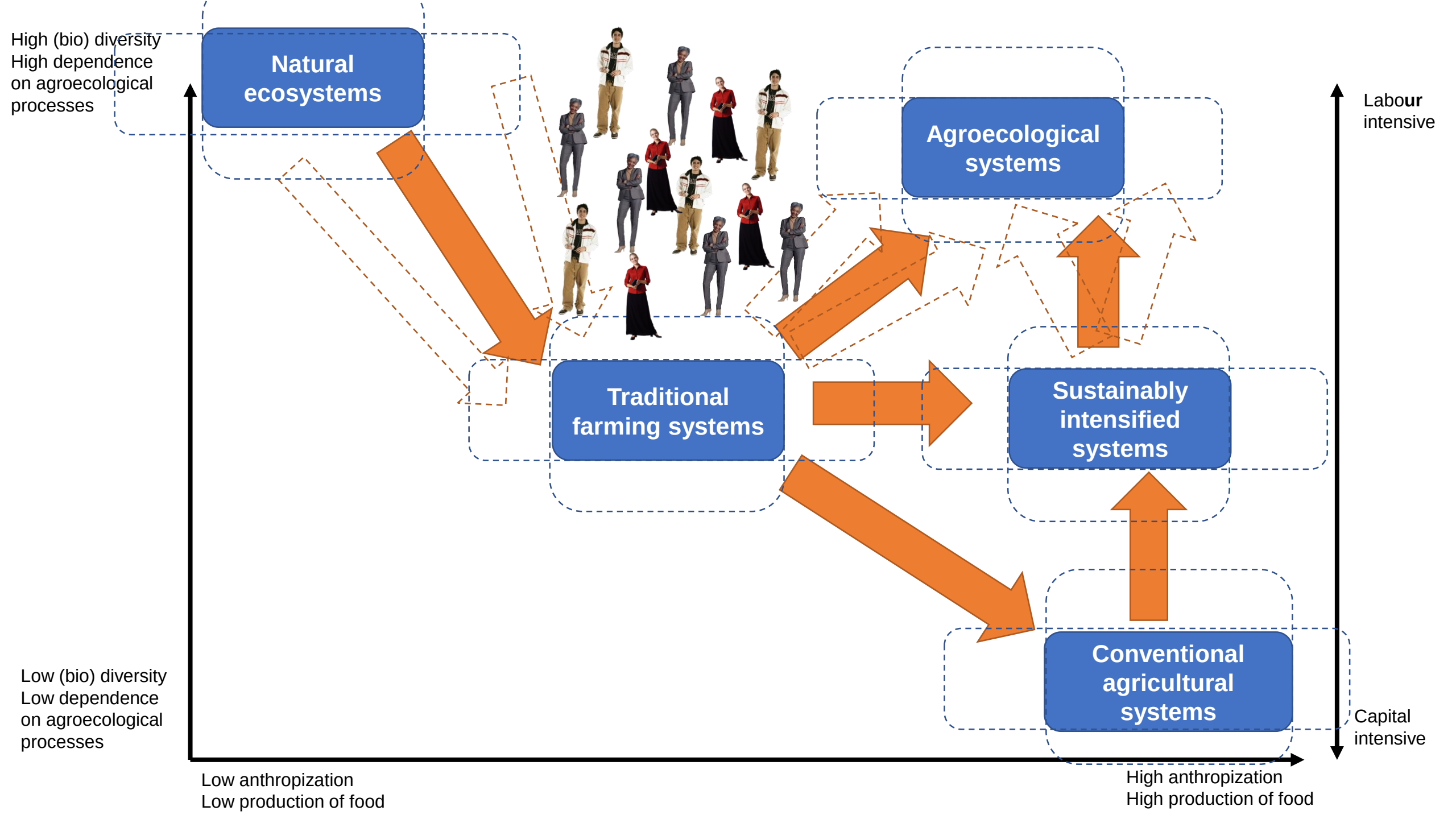
2. Adding '**agency**' as a fifth pillar of FSN. Access currently covers asset-based agency in terms of people accessing food resources but not institution-based opportunity that people have to influence how food is produced, processed, transported and sold – their ability to participate in decisions about how food systems are organized through purchasing decisions and democratic governance mechanisms.

Definition 6 Ecological footprint of food systems expresses the impact of food consumed by a defined group of people (an individual, a village, a city, a country or the whole global population), measured in terms of the area of biologically productive land and water required to produce the food consumed and to assimilate the wastes generated.

Definition 7 Agency is the capacity of individuals or communities to define their desired food systems and nutritional outcomes, to take action and make strategic life choices in securing these. This requires sociopolitical systems wherein policies and practices may be brought forth by the will of citizens and be reflected in governance structures to enable the achievement of FSN for all.




High (bio) diversity
High dependence
on agroecological
processes
Natural
ecosystems
Agroecological
systems
Labour
intensive
Traditional
farming systems
Sustainably
intensified
systems
Conventional
agricultural
systems
Low (bio) diversity
Low dependence
on agroecological
processes
Capital
intensive
Low anthropization
Low production of food
High anthropization
High production of food


High (bio) diversity
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Low anthropization
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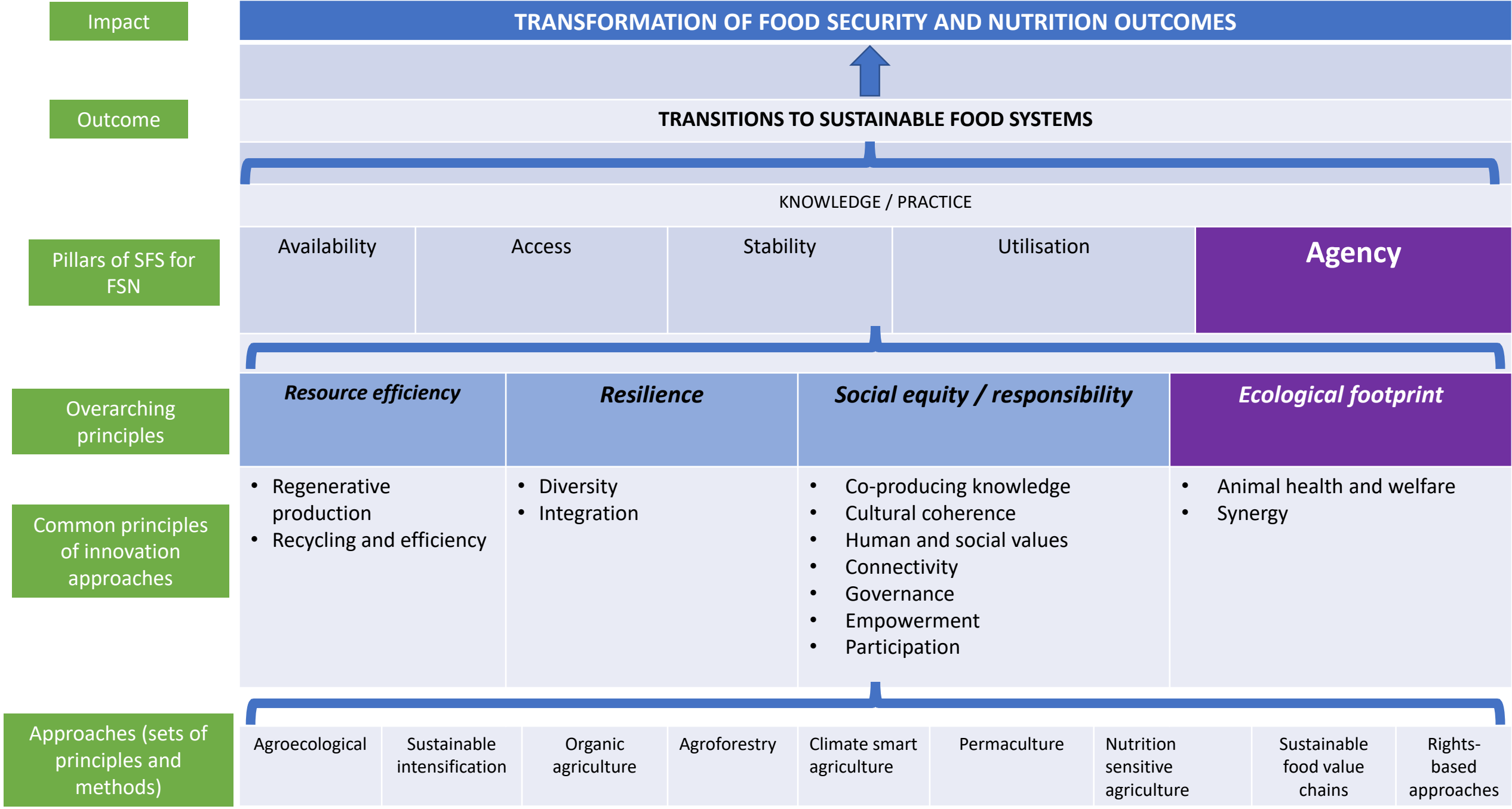
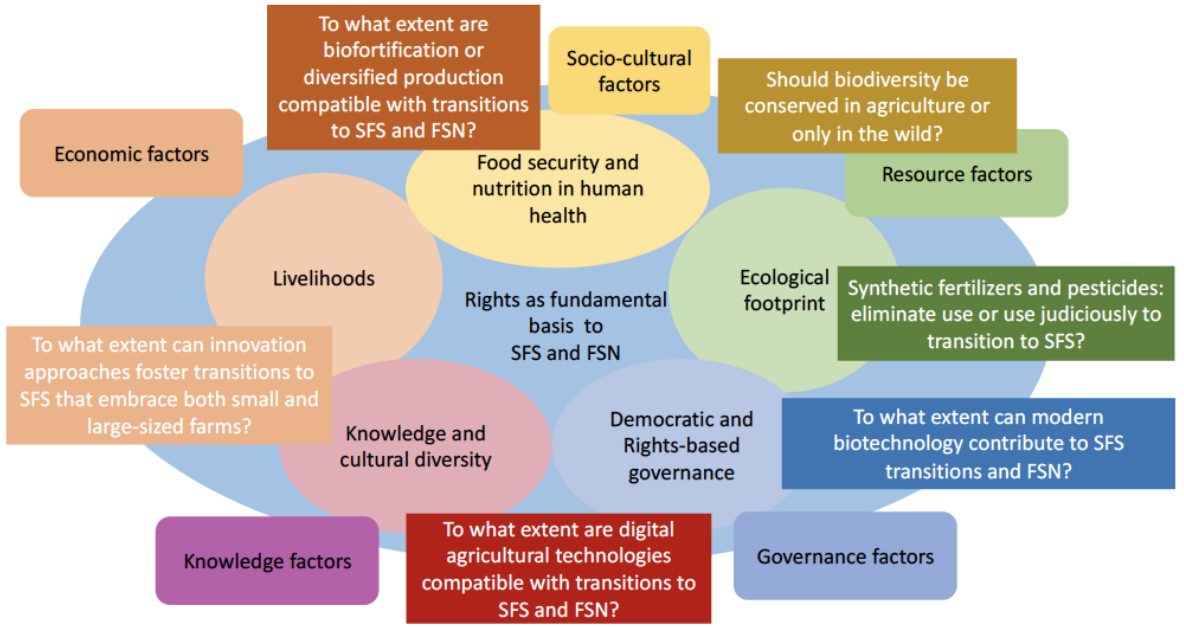

Impact
TRANSFORMATION OF FOOD SECURITY AND NUTRITION OUTCOMES
Outcome
TRANSITIONS TO SUSTAINABLE FOOD SYSTEMS
KNOWLEDGE / PRACTICE
Pillars of SFS for FSN
Availability
Access
Stability
Utilisation
Agency
Overarching principles
Resource efficiency
Resilience
Social equity / responsibility
Ecological footprint
Common principles of innovation approaches
• Regenerative production
• Recycling and efficiency
• Diversity
• Integration
• Co-producing knowledge
• Cultural coherence
• Human and social values
• Connectivity
• Governance
• Empowerment
• Participation
• Animal health and welfare
• Synergy
Approaches (sets of principles and methods)
Agroecological
Sustainable intensification
Organic agriculture
Agroforestry
Climate smart agriculture
Permaculture
Nutrition sensitive agriculture
Sustainable food value chains
Rights-based approaches

Drivers and challenges (1)

- Transitions to SFS and FSN require innovation across social, economic, institutional, environmental and technological dimensions, with collaboration amongst innovation network actors.
- Factors that may act as barriers to food system transition can be grouped into five clusters: governance, economic, knowledge, social and cultural; and resource factors.
- Six divergent narratives are presented in this report that highlight key differences in perspective amongst innovation approaches that affect both the action of drivers on innovation and potential barriers to transition.
- Despite substantial uptake of GM technology, debates continue to be polarised with public concerns about safety, environmental impacts, corporatisation of agriculture and the ethics of gene modification. The products of modern biotechnology will be part of the transition to SFS and FSN because they are already a significant component of the agricultural systems of a number of countries. Recent calls for a global observatory for gene editing proposes increased scrutiny, dialogue and deliberation on the use of such technologies that may reconcile some of the current polarity.



Chapter 3 Drivers and challenges (2)

- Agroecological alternatives are not in opposition to digital technology but to what current effects of the use of the technologies are. Public policy options might expa the uses, access and emphasis of digital agriculture technologies and this could ass in better connecting producers and consumers as well as facilitating citizen science Further research is needed to understand implications of the use of digital agricult and big data, and to explore ways that it could be harnessed to foster sustainable agri-food systems for FSN.
- Economies of scale, that may exist with current regulatory frameworks, subsidies a avoided costs of externalities (impact of pollution, lowering soil carbon or providin less rural labor) would require interventions to avoid market failures resulting in continued degradation of agroecosystems associated with increased scale of operation. While diversity has sometimes been associated with smaller farm sizes, large scale farming operations are starting to address ways in which they may make transitions to more agroecological practices, through diversification that enhances both performance and resilience.

{need to add summary statements for biofortification, synthetic fertilsers and pesticides and land sparing / sharing}

- Market forces, left to themselves, will not result in transitions to SFS because there are many externalities associated with production, processing and transit of food from producer to consumers that are not priced and because the power exerted from the increasingly concentrated agri-food input and retail sector often works against addressing these externalities.
- People can exert pressure to close market failures through their purchasing decisions, if there are products produced sustainably, labelled so that consumer choice can be exerted, are affordable and if the information about how food has been produced is both available and trusted.
- Moves within the private sector to upgrade value chains and establish and participate in certification schemes, either centrally run or more participatory in their genesis, that guarantee sustainability and social justice along food chains, can contribute to enabling this sort of consumer choice.
- Government policy, regulation and moves towards true pricing, hold a promise of internalizing all ecological and social effects of production in the price of food, enabling markets to function in ways that would foster transitions to SFS. This requires harnessing connections between transdisciplinary science on the one hand, that can understand social-ecological systems and social movements and civil society organizations that can trigger and sustain change, on the other.

Box 18 The cross scale land equivalent ratio metric (LERM) for holistic measurement of agricultural performance

$$LERM_s = \gamma_{P,s} \sum_i P_i / P_{i,ref} + \gamma_{R,s} \sum_j R_j / R_{j,ref} + \gamma_{C,s} \sum_k C_k / C_{k,ref}$$

Plot-to-landscape scale metric for multifunctional land use, perspective S

Societal weighting of provisioning (P) services

Current vs reference services per unit land

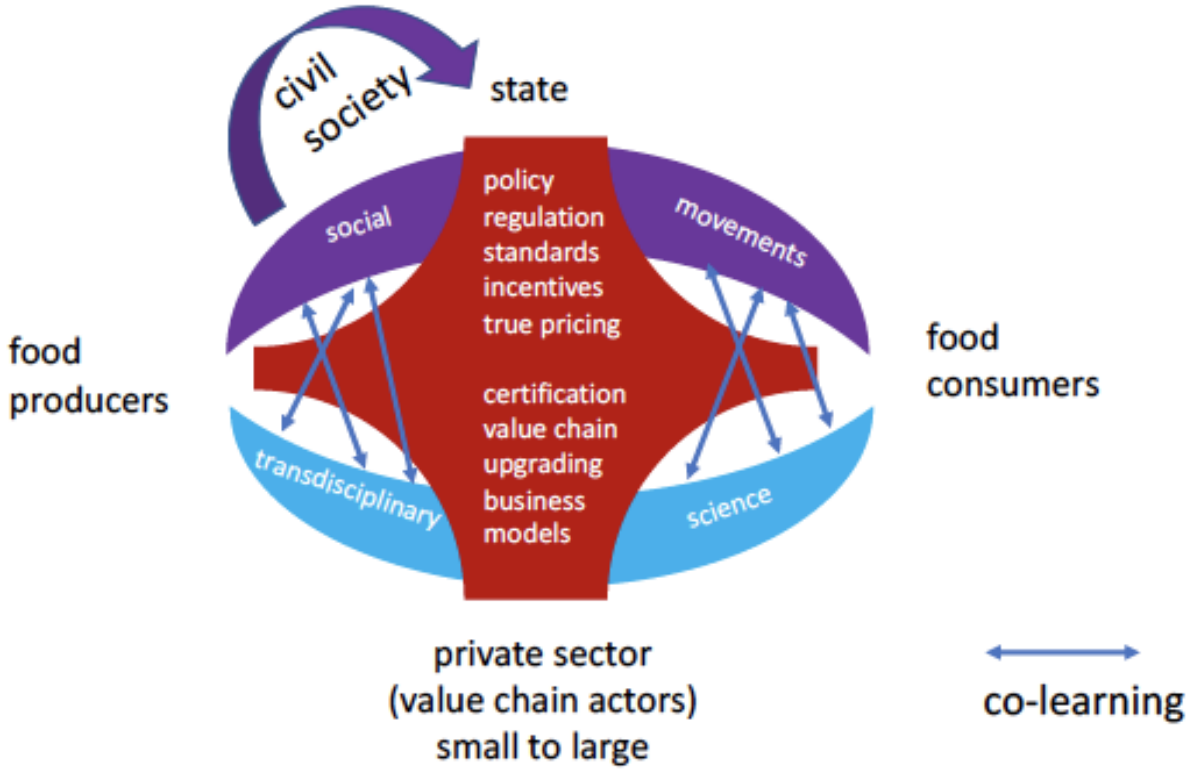
Societal weighting of regulating (R) services

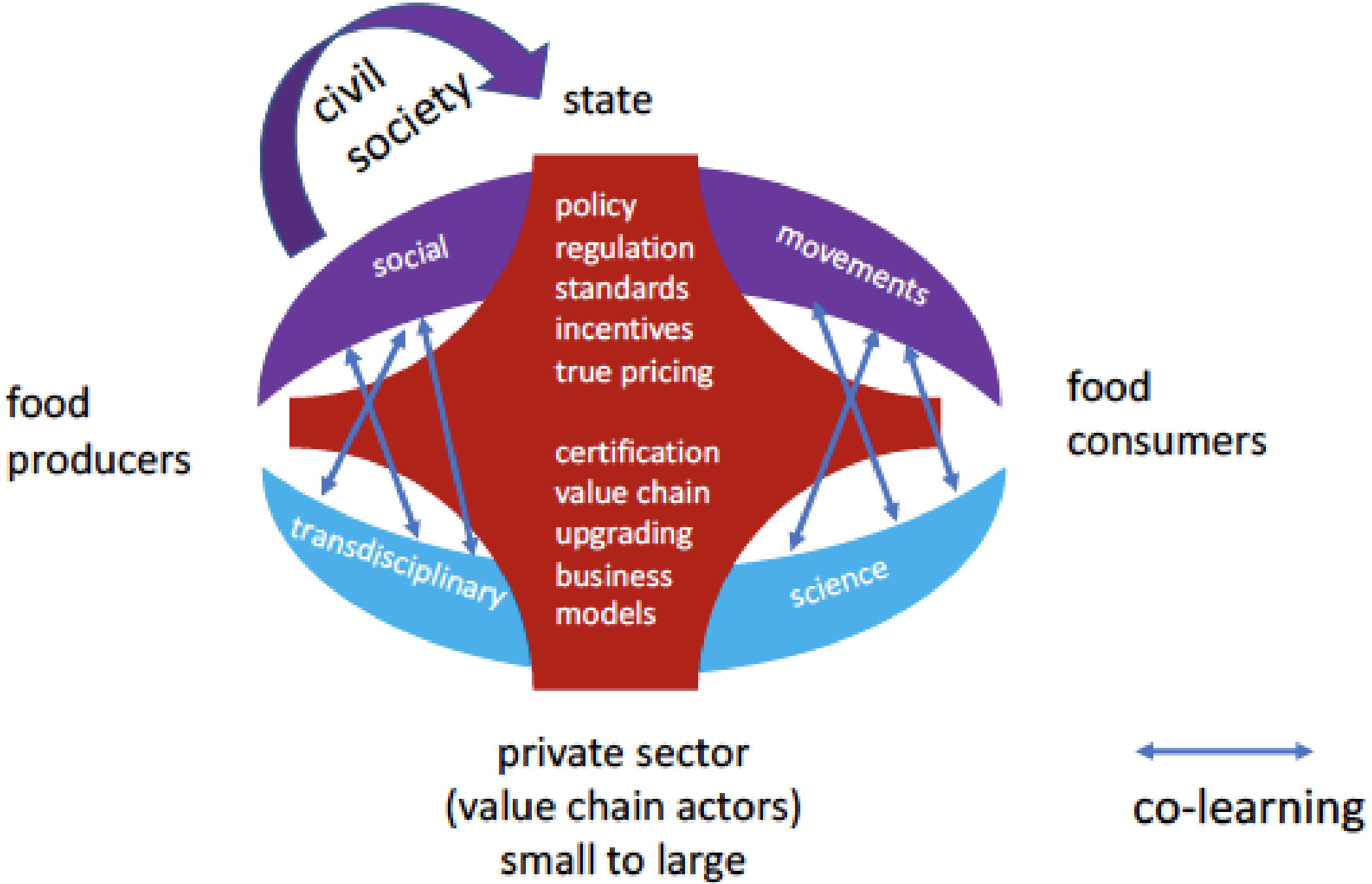
Current vs reference services per unit land

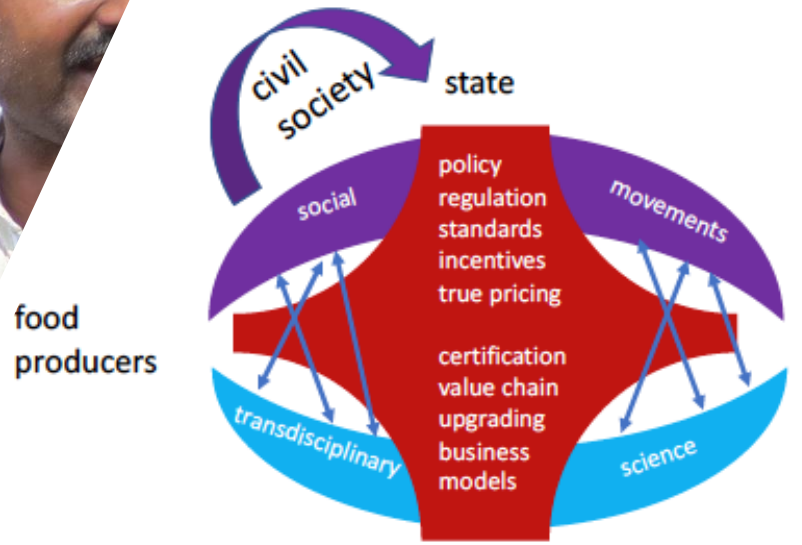
Societal weighting of cultural (C) services

Current vs reference services per unit land

Source: van Noordwijk et al., 2018[mcccxlvii]




civil society
state
social
movements
policy
regulation
standards
incentives
true pricing
certification
value chain
upgrading
business
models
transdisciplinary
science
food producers
food consumers
private sector
(value chain actors)
small to large
co-learning



food producers

food consumers

private sector
(value chain actors)
small to large

co-learning

Wheel Zero
Land preparation – initial (shallow / no) tillage, initial inoculation

1

First Wheel

Bijamrita
(Seed treatment)

2

Second Wheel

Jiwamrita
(No fertilizers
No Pesticides)
Use of inoculum

3

Third Wheel

Mulching
(Soil, straw & live)
Cover, biomass transfer (+/- incorp)

4

Fourth Wheel

Waaphasa
(Soil moisture)

This is part of the mechanism rather than a practice?

Appropriate crop varieties / densities ?

Nutrients other than C & N ?

Animal breed

Root exudates

Microbial diversity

Carbon and nutrient dynamics

Crop yield

Carbon accumulation

Macrofauna

Crop diversity

rapid humus formation

Nutrient use efficiency and budget

N - fixation

Water holding capacity

Structure

4

Water use efficiency

Aeration

Atmospheric water absorption

Resilience to drought, flood, cyclone

PROMOTE AGROECOLOGICAL AND OTHER INNOVATIVE APPROACHES IN AN INTEGRATED WAY TO FOSTER FOOD SYSTEM TRANSFORMATION

States, local governments, international and regional organizations, civil society and the private sector learn from agroecological and other innovative approaches key aspects necessary to improve resource efficiency and ecological footprint, strengthen resilience and secure social equity / responsibility.

All stakeholders should:

a) Take into account and value the **diversity** of food systems and their contexts across scales when developing transition pathways to sustainable food systems.

b) Recognise the importance of improving the **ecological footprint** of food systems as an operational principle for transitioning to sustainable food systems, and encourage agricultural practices that maintain or enhance rather than deplete natural capital.

c) Broaden **performance metrics** for food systems to take into account all environmental, social and economic impacts of food production and consumption.

d) Encourage integration of **transdisciplinary science and local (including indigenous) knowledge** in participatory innovation processes that transform food systems.

CFS / FAO should:

e) Consider the emerging importance of the concept of **'agency**' and the opportunity to add it as a fifth pillar of food security and nutrition addressing critical aspects of right to food.