

Fostering Circularity for Sustainable Agro-Food Systems

*Circularity in agriculture:
A pathway to sustainability among
APEC economies*

Ha Noi - 24 and 25 October 2024



**Asia-Pacific
Economic Cooperation**

Circularity « in agriculture » !?

Ever since agricultural systems have become spatially separated from those for whom they produce, « ***circularity in agriculture*** » has limited scope for contributing to its sustainability.

- ❑ **Agro-food systems** are – *by definition* – the target system type for circularity in favour of sustainable agriculture
- ❑ Agro-food systems are **not given / have no given scale**
- ❑ Circularity = logistics = spatial constraints → no dogmatic, uniform approach to circularity : **scale and location, based on potential and need**

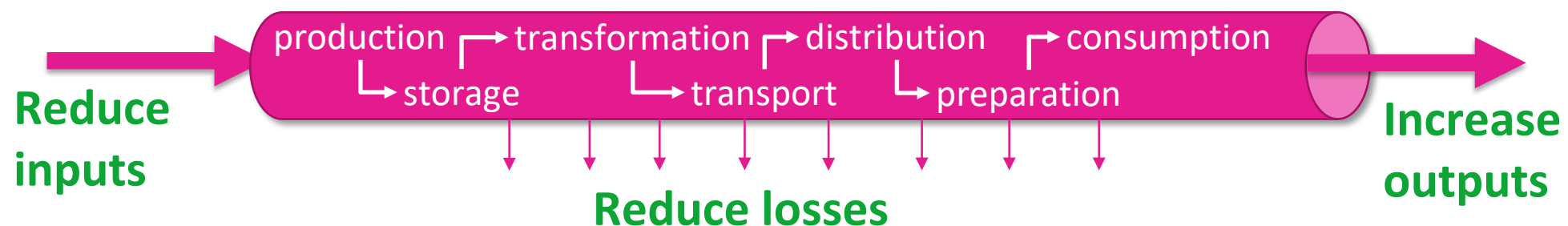
United Nations Food Systems Summit 2021

The food system includes the related resources, the inputs, production, transport, processing and manufacturing industries, retailing, and **consumption** of food as well as its **impacts on environment, health, and society**.

https://www.un.org/sites/un2.un.org/files/2020/12/food_systems_paper-draft_oct-25.pdf

Agro-food system as the target system type for circularity

CIRAD contributes through research across 3 levers of food system circularity



Circularity ambition	Main motivations
Reduce inputs [RI]	Autonomy, resilience, sustainability, carbon footprint
Increase outputs [IO]	Food security
Reduce losses [RL]	Profit, economic development, reduce negative impacts

Location & Scale

1. Identification of a *situation* with need RI and/or IO and/or RL
2. Need + knowledge → initial *system* conception
3. Results → adjust system definition

RI: Reduce dependence on "external" inputs

"Local" or "territorial" food system : value chains that share the same space as the population they contribute to feed.

Justified by a sustainability and resilience concern: reduce dependence on external resources, by definition uncontrolled, and perceived as under "threat"

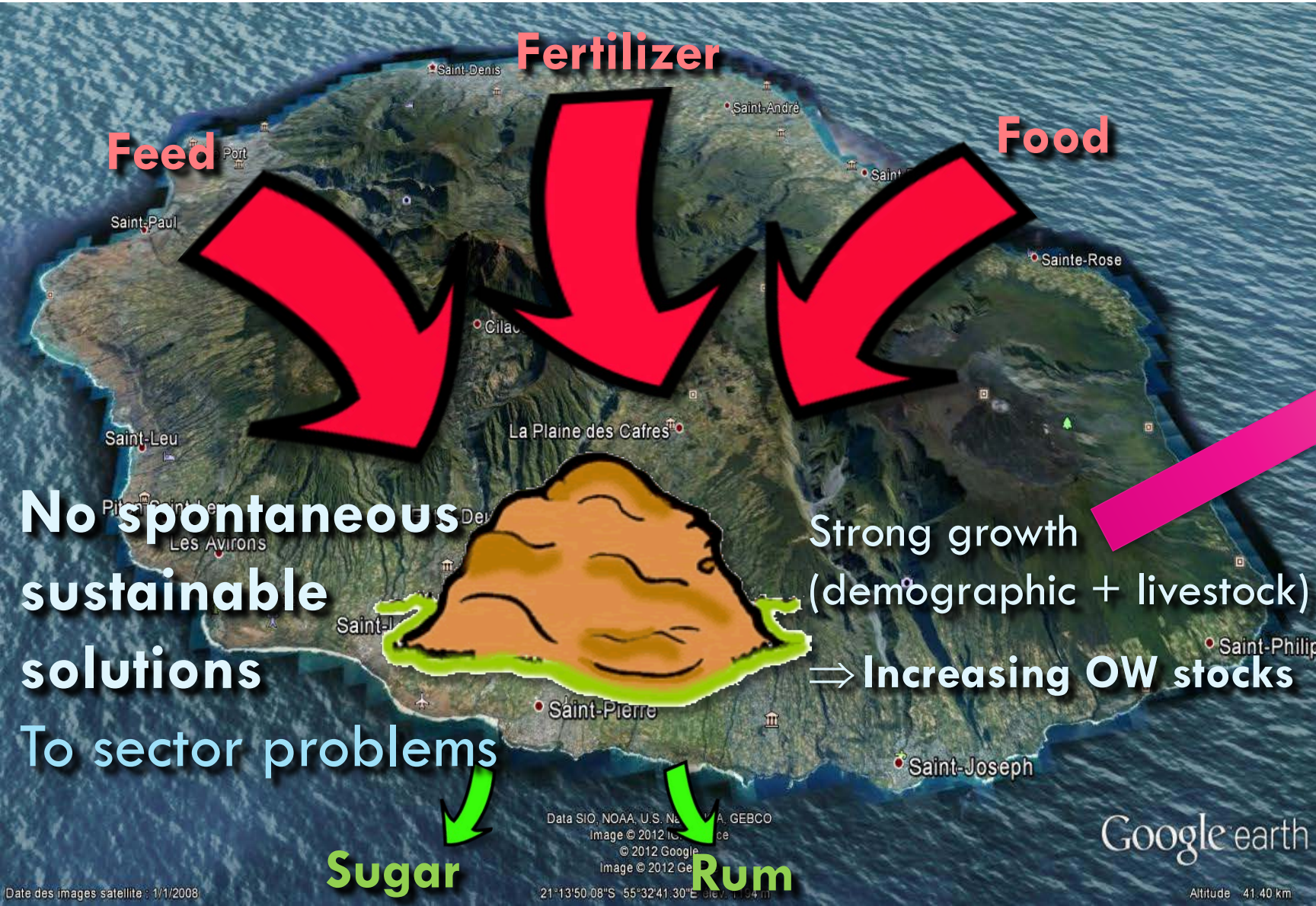
CIRAD's focus:

mobilizing "internal" resources to replace those coming from "outside", while remaining competitive compared with other systems/territories.

Examples of CIRAD initiatives

- **Energy feedstock substitution** in food processing and conservation (activities in Western Africa)
- **Fertilizer substitution** in import-dependant, insular « sinks » (activities in French Overseas territories)

Brokerage of industrial symbiosis synergies



A diversity of increasing non-valued OW flows:

- Pig slurry
- Poultry manure
- Sewage sludge
- Green waste
- Sugarcane vinasse
- Sugarcane filter cake
- ...



Brokerage of industrial symbiosis synergies

0

Build legitimacy through local knowledge acquisition

1

Develop a systemic « plausible promise » on the basis of local and scientific knowledge

2

Co-design industrial symbiosis at 3 levels of participation



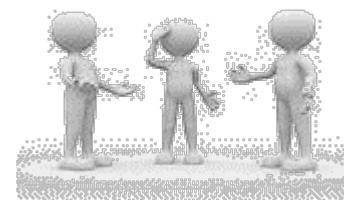
Institutional level:

legitimacy



Technical level:

credibility



Professionnel level:

acceptability

A territorial recycling co-design process
scientists *catalyse, facilitate* and *inform* the process

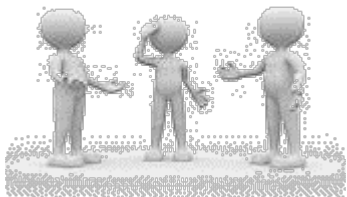
Brokerage of industrial symbiosis synergies



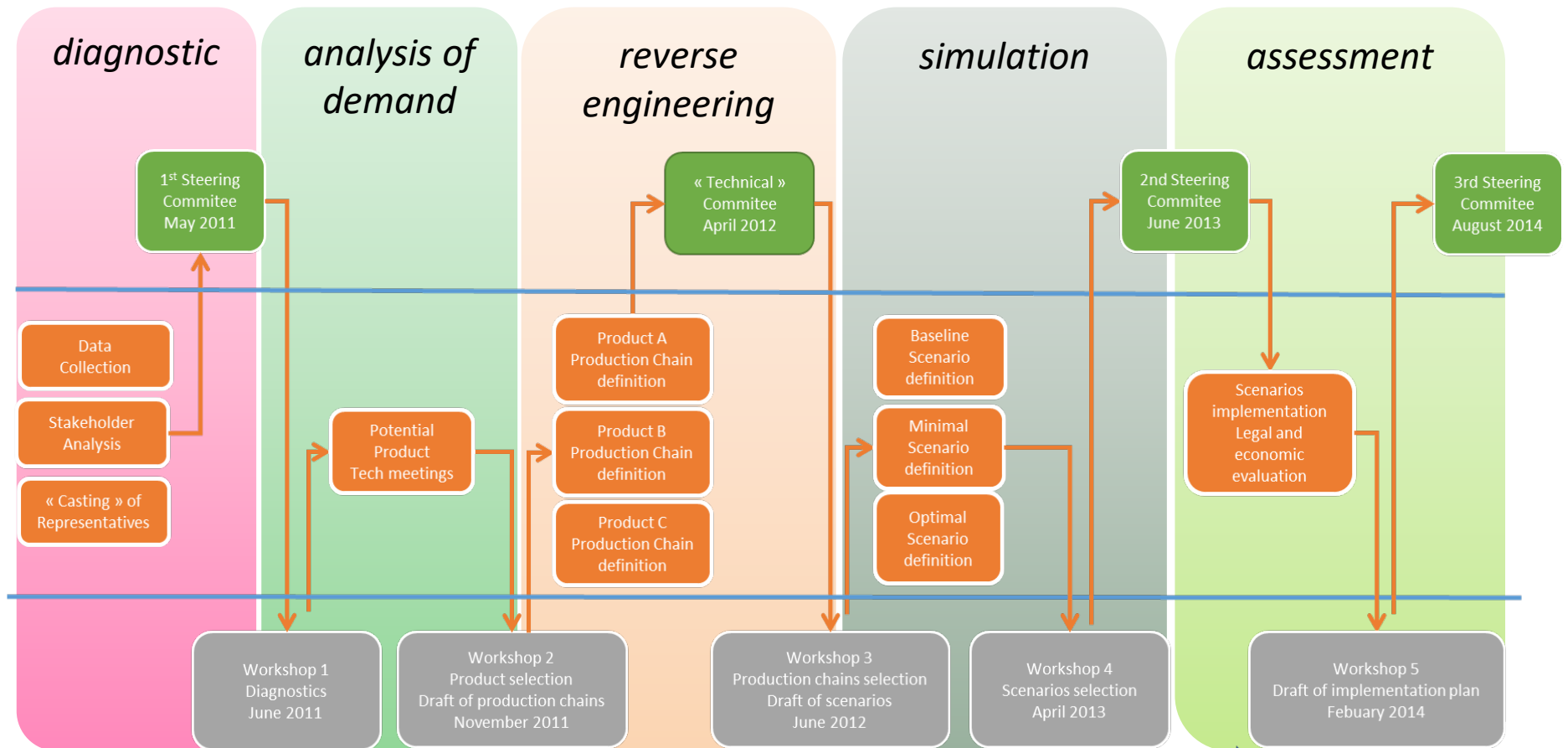
legitimacy



credibility



acceptability



RI Example: Integrated Organic Waste Management in Réunion

The challenge of an informative environmental assessment

Fate of Matter

Molecules

Trace organics

NH₃

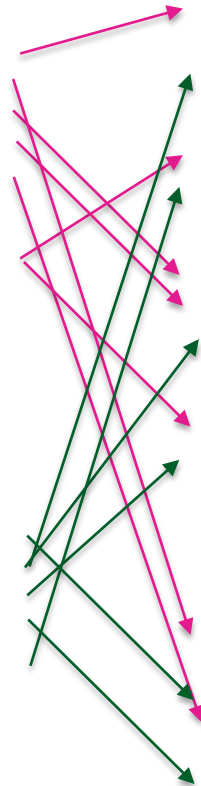
N₂O, CH₄, CO₂

olfactories

Elements

N, P, K, ...

Zn, Cu, Pb, ...



Objectivated Stakeholder Concerns

<i>Inhabitant environment</i>						
<i>environmental item</i>	odor	noise	local food	drinking water	swimming water	visual amenities
<i>environmental phenomena of interest</i>	exposure to composting and spreading odor	exposure to traffic noise	toxic substances in crops	drinking water pollution	-	landscape changes

<i>Metabolic environment</i>				
<i>environmental item</i>	cultivated soil	soil-crop	groundwater	respired air
<i>environmental phenomena of interest</i>	soil productivity decline	crop marketing impact from contaminant transfer risks	-	-

<i>Global environment</i>				
<i>environmental item</i>	Climate	Abiotic resources	Human health	Natural ecosystems
<i>Selected environmental phenomena</i>	contribution to climate change	contribution to global abiotic resource depletion	-	-

Brokerage of industrial symbiosis synergies

Main Challenges at the Science – Society / Science – Policy interface

- Produce reliable ex-ante estimations of agronomic benefits
- Establish a Community of Practice for change to be adopted
- Assure public support for a sustained governance of collective management
- Establish policy measures for new, local value chains to be viable

IO: Increase Productivity

The area to which it can channel its waste “resources”

System definition guided by the needs of a population to boost local food production.

1. rural populations forced to seek food self-sufficiency due to limited access to markets and external agricultural inputs.
2. urban areas attracting large quantities of distant food resources, depriving local populations of these resources

CIRAD's focus:

Requalification and use of waste as inputs to increase the productivity of local farming systems, and consequently their contribution to (urban) supply.

Examples of CIRAD initiatives

- **Agriculture-livestock integration** in rural Sahelian zones (activities in Sub-Saharan Africa)
- Towards **Circular City-Region Food Systems** (initial work around African cities)

RL: Reduce losses and impacts



Situations where losses in the form of waste are identified as problematic:

- Negative externalities (e.g. degradation of water or soil quality)
- Loss of value (or costs) (e.g. waste with good calorific potential)
- Obstacle to development of (third-party) activities (e.g. regulated effluents)

CIRAD's focus:

uses these situations as a starting point to encompass a sufficient range of activities to ensure the identification of systemic and sustainable solutions

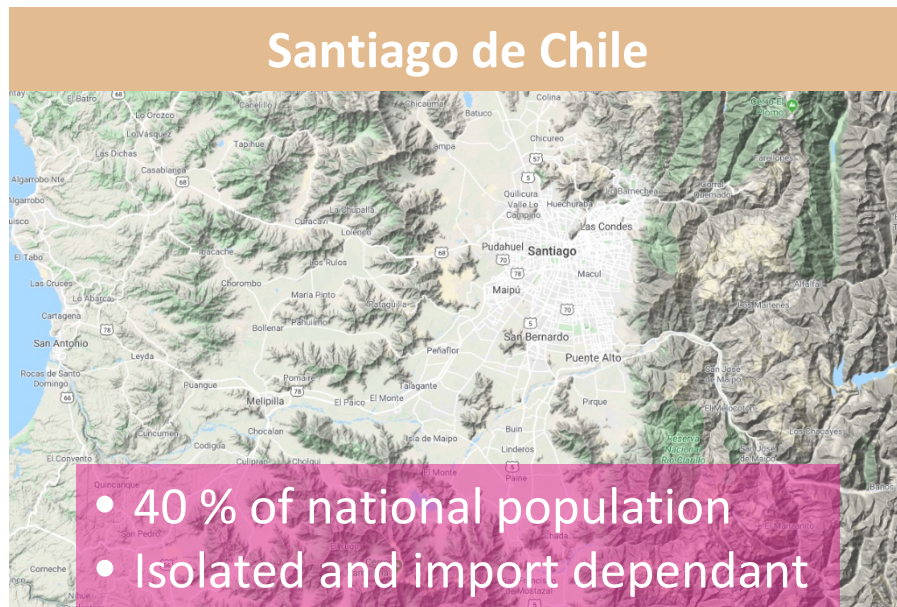
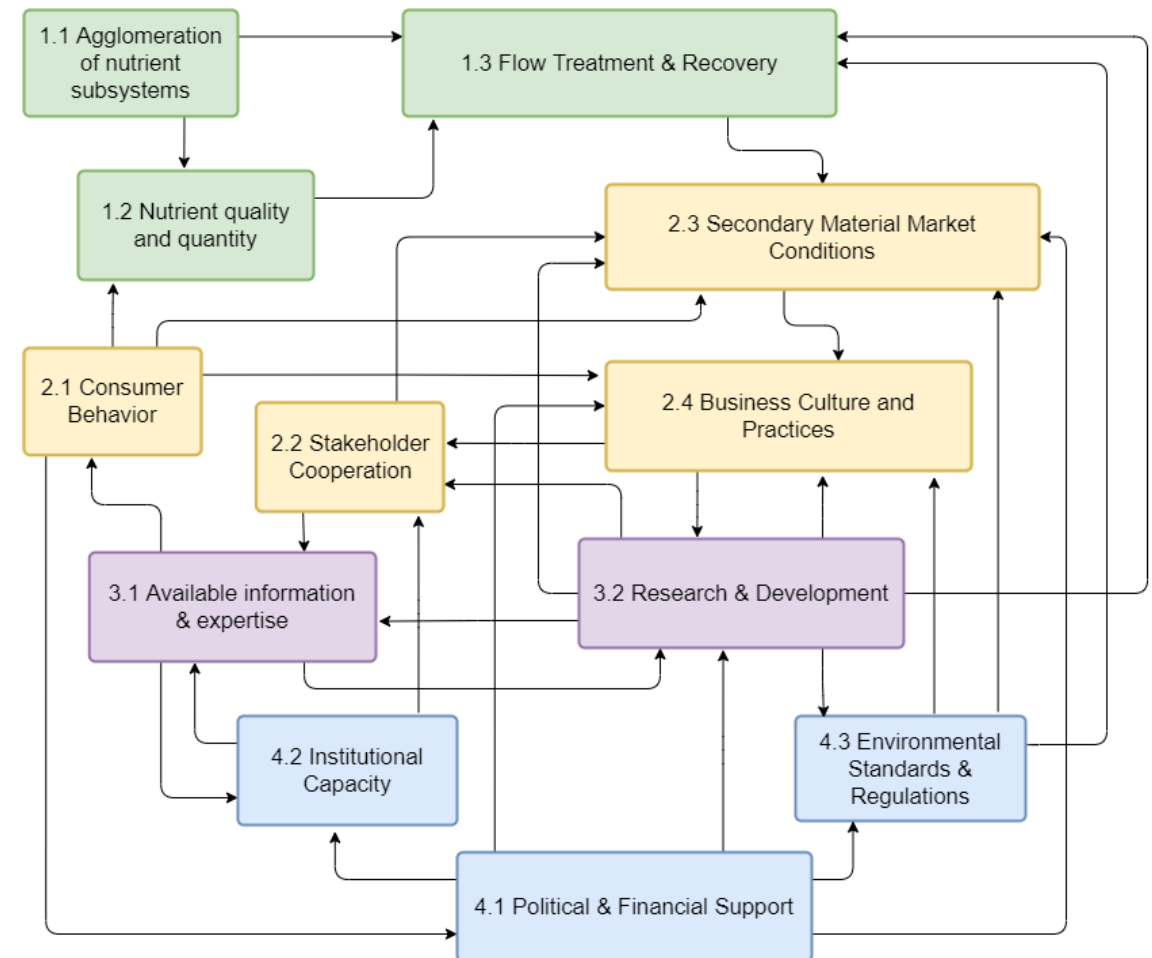
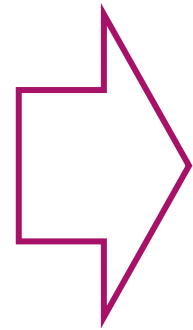
Examples of CIRAD initiatives

- **Weakening link between (urban) food waste and livestock**
(initial work in Viet Nam)
- **Towards reducing losses in large urban nutrient “sinks”**
(initial work around Latin American cities)

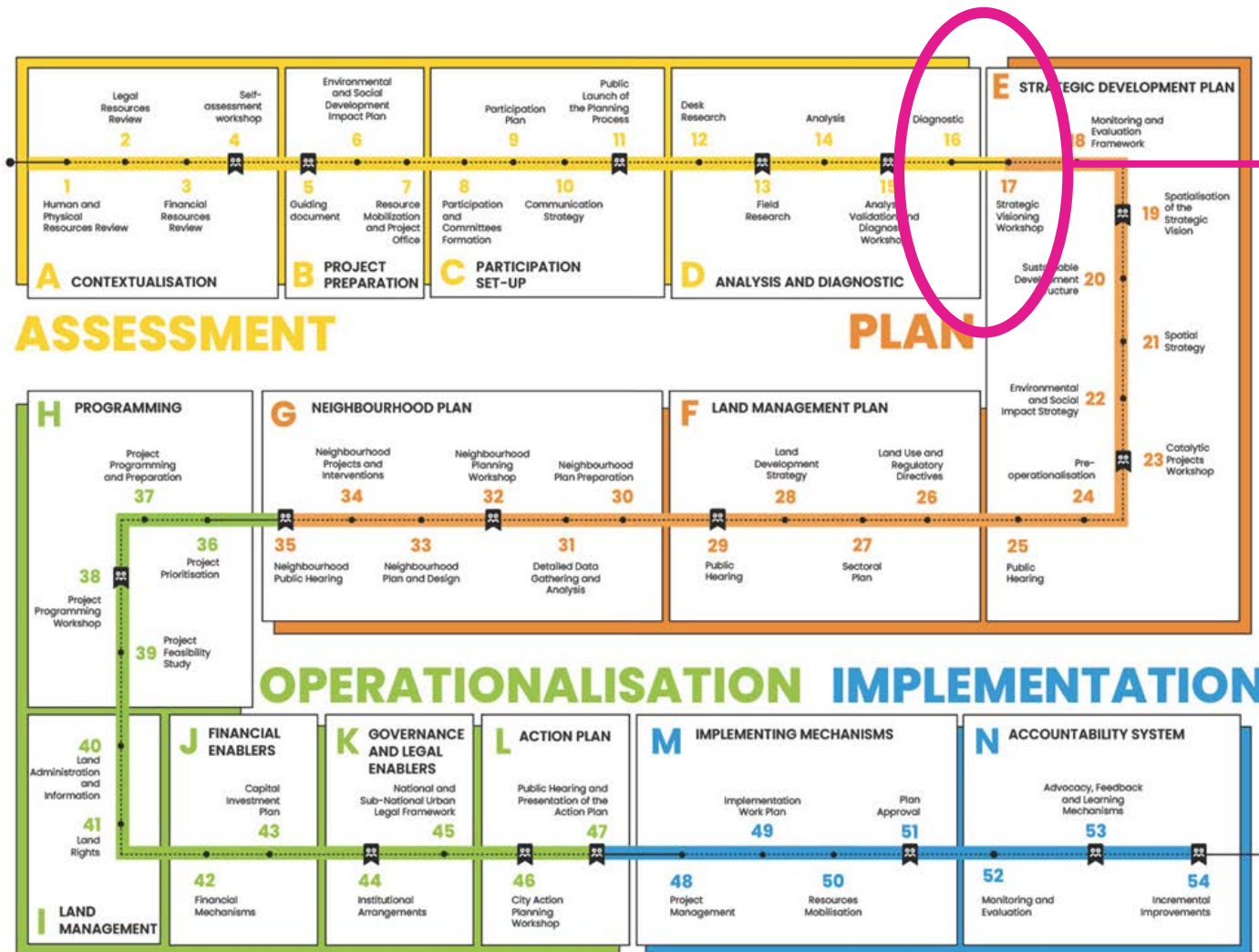
RL example: Linking urban metabolism and urban planning in an APEC metropolitan region

Santiago de Chile: a forerunner in Latin America in terms of Nutrient Circularity Capacity

- Material Flow Potential
- Value Chain Characteristics
- Knowledge Base
- Institutional Support



RL example: Linking urban metabolism and urban planning in a metropolitan region



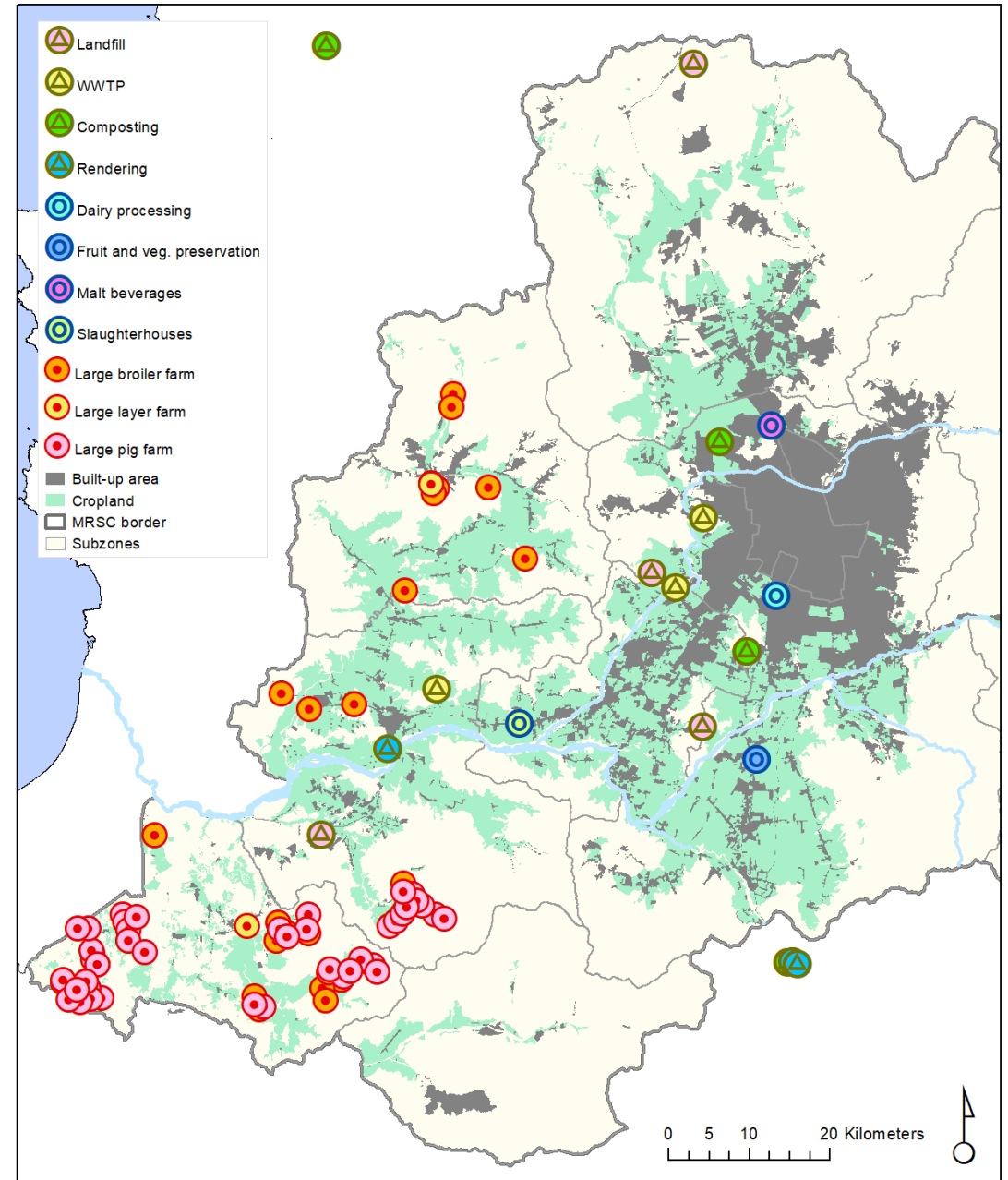
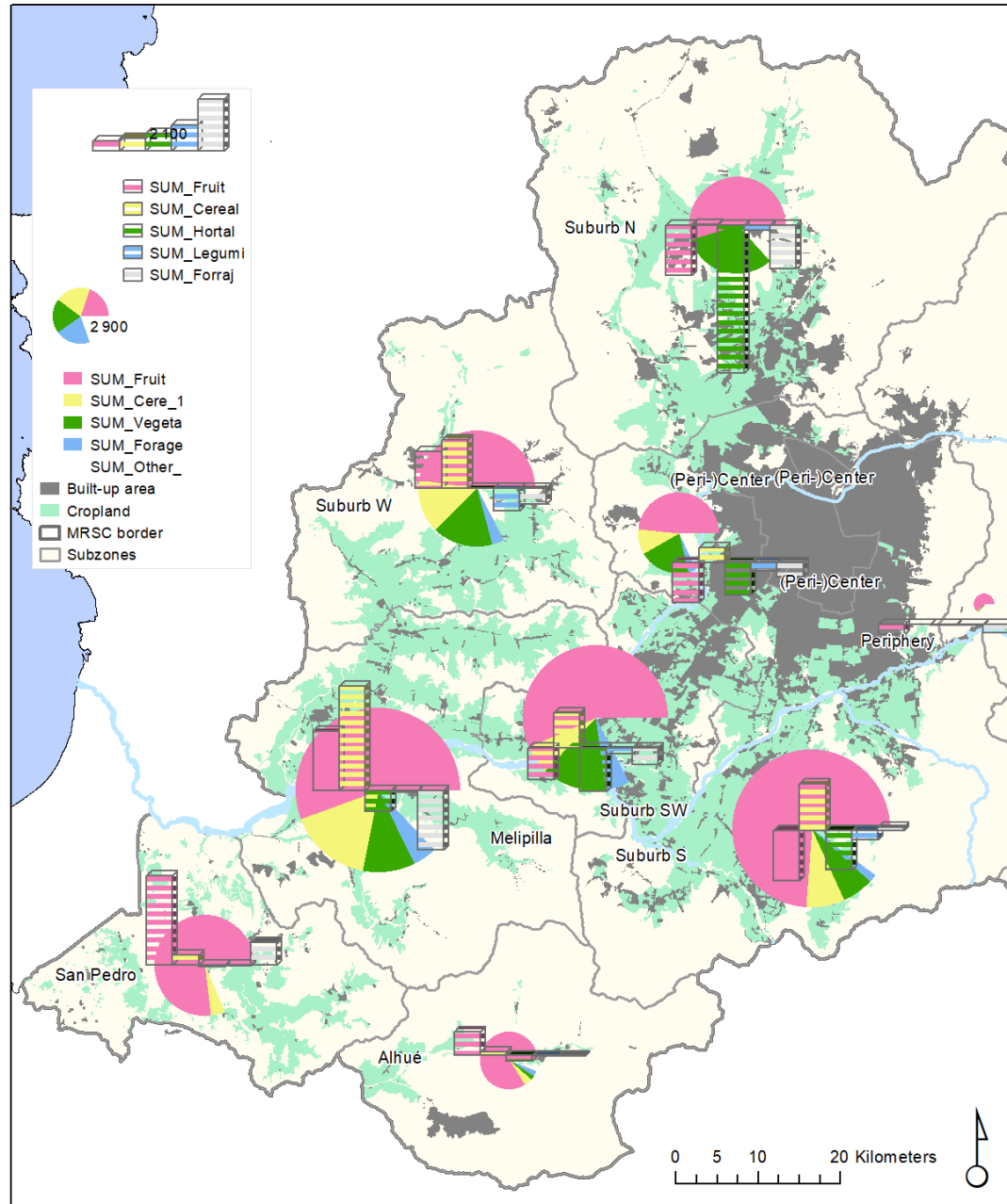
The role of science in such an ambitious setting:

Develop Narratives






On the basis of a shared Information System covering

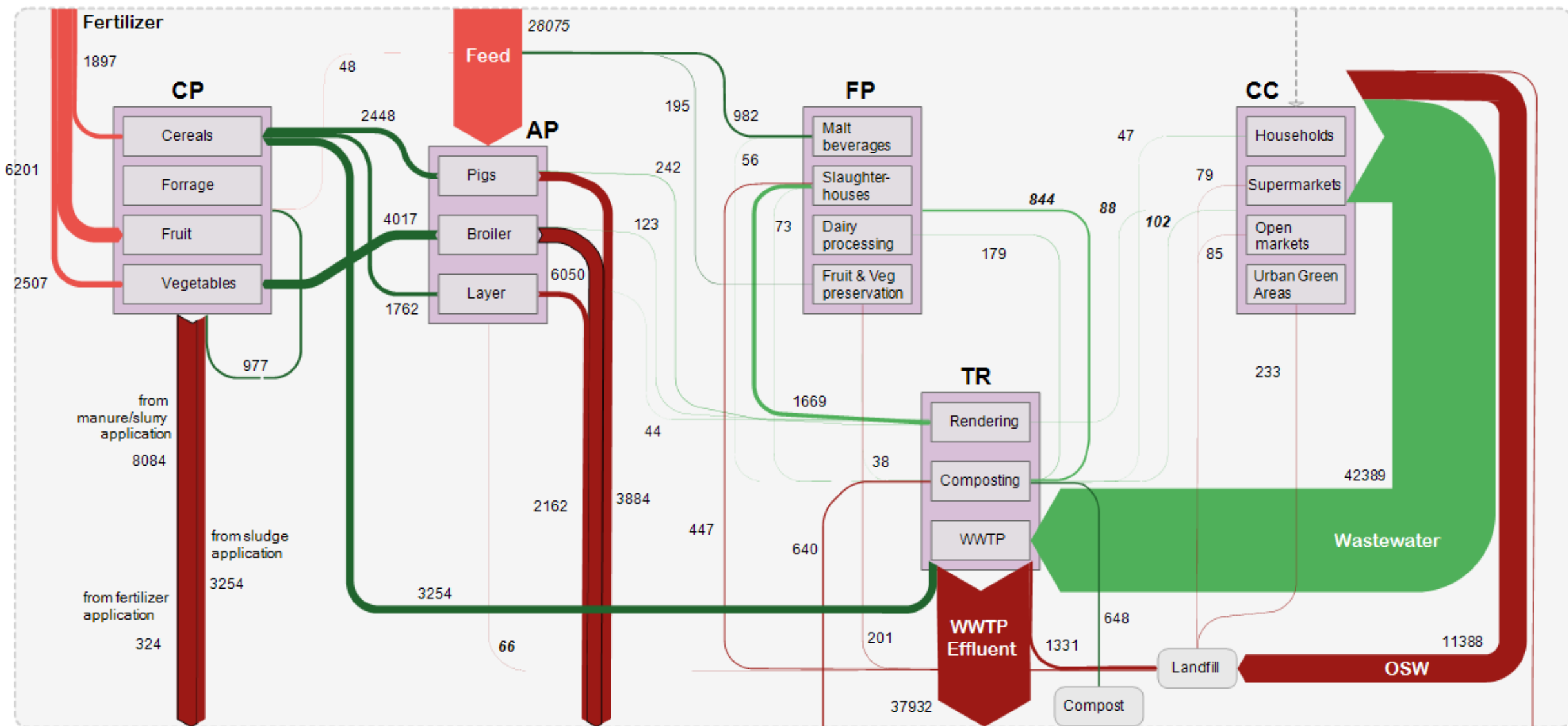
- Space
- Flows
- People

Agri-food-waste system activities in the Metropolitan Region of Santiago de Chile

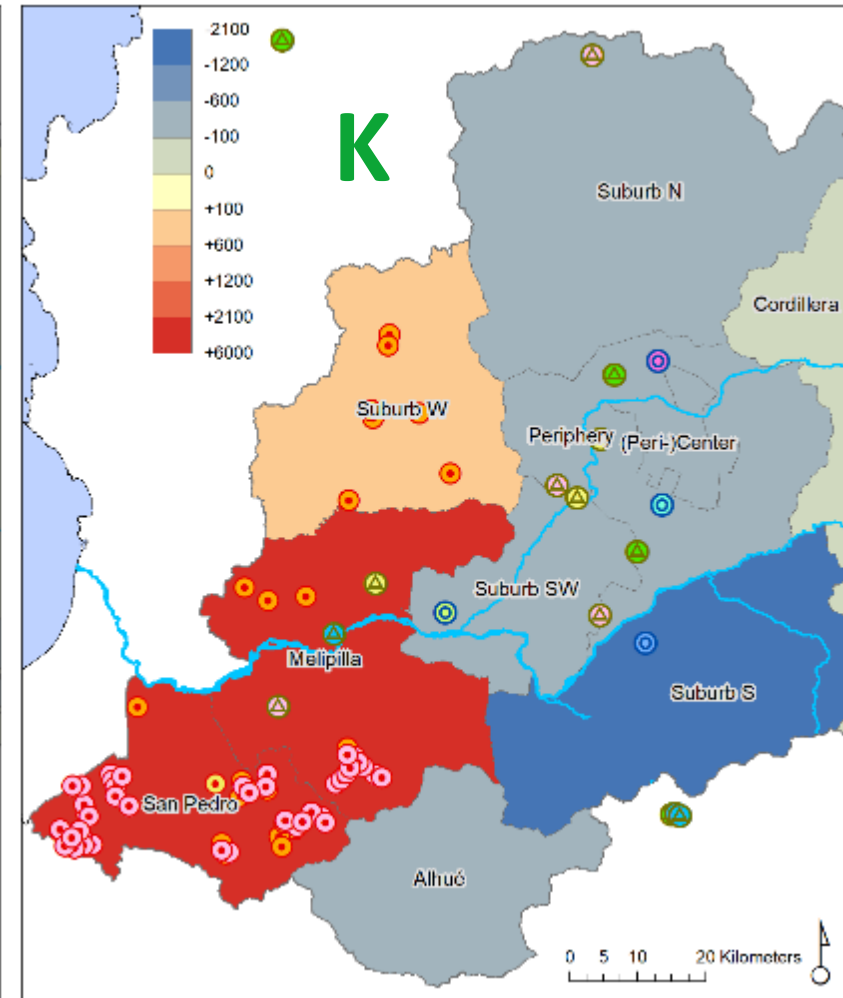
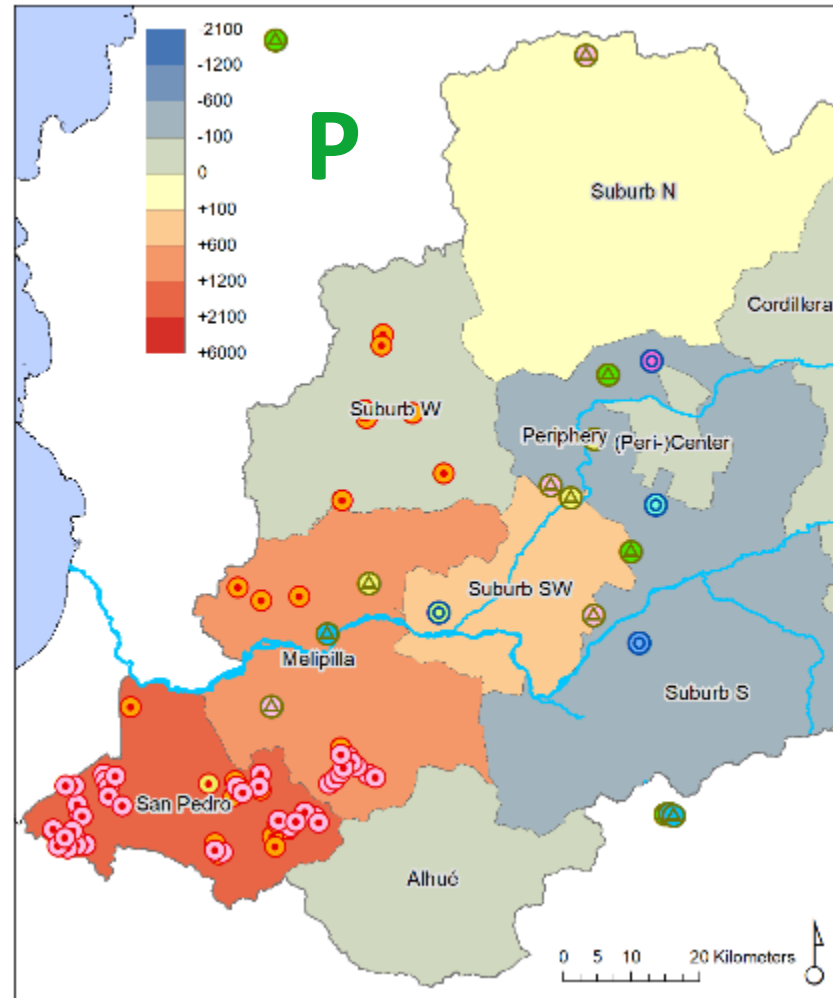
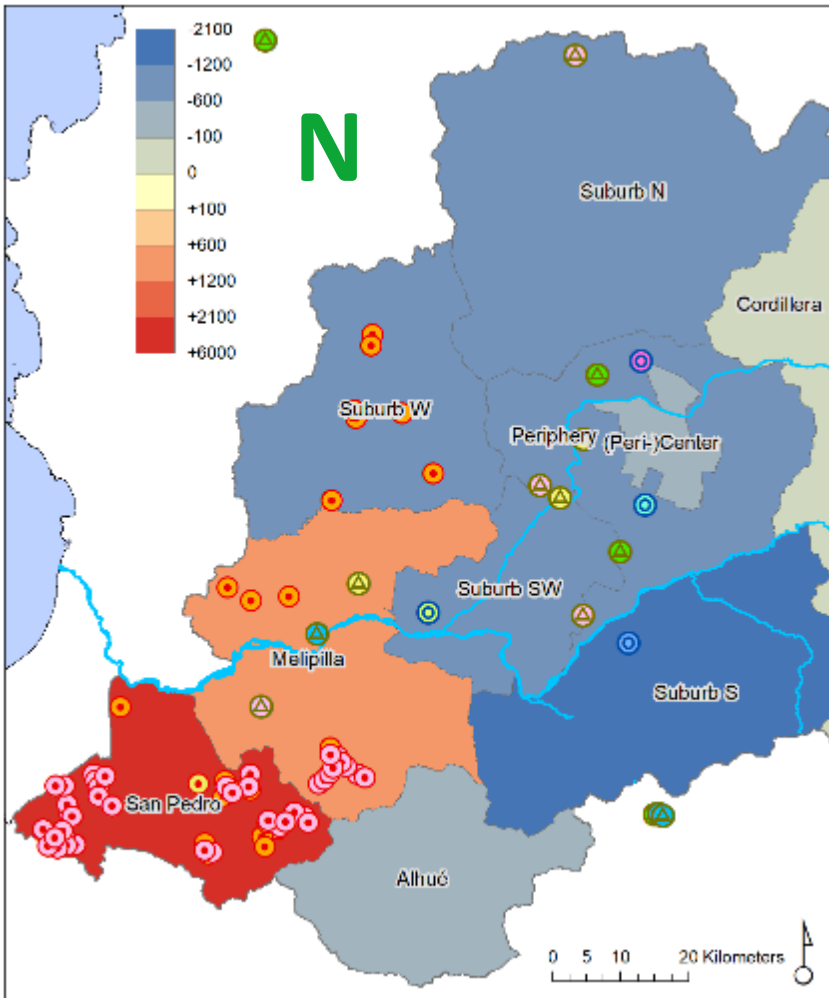


N flows of main agrifood-waste system activities in the MRSC (t/y)

-  System boundary
-  Import
-  Recovered
-  Reused
-  Lost



Heatmaps of surplus or deficiency per geographic zone, based on the nutrient demands of Crop Production activities and nutrient supply from Animal Production activities



Conclusion: Activate the Capacity for Circularity in APEC Economies

No silver bullet business models, but a rigorous approach

- to identify the **right innovation**
- to deliver the **right impact**
- for the **right place***

- Location
- Scale
- (Adaptive) System Definition

In many APEC economies, a large, growing « Circularity Capacity » allows to envisage the progressive, structural transformation of City-Region Food Systems

→ **Strengthen the Science-Policy Interface:**

Sustainable
and Resilient
Economies

Science can (only) legitimately **catalyse** and **inform**

Public Authorities to **engage** stakeholders in **planning** and **design** policy measures

Responsible, open,
inclusive and engaged science
for sustainable development



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