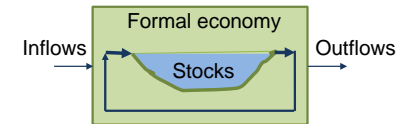


# Food as part of an increasingly circular economy

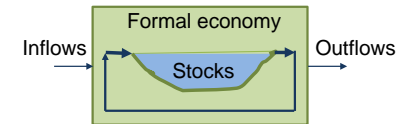
Björn Frostell, Ecoloop AB



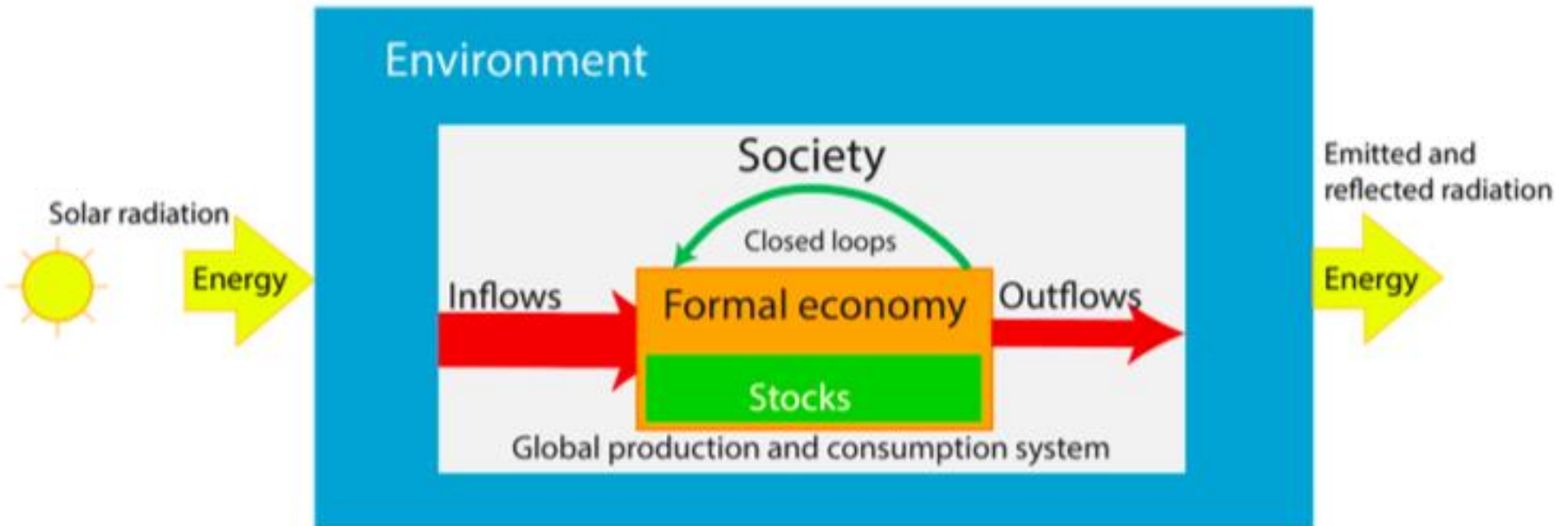
# A Circular Economy

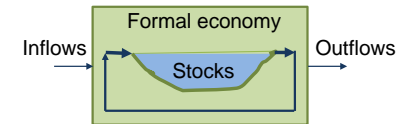
***“circular economy is a sustainable development initiative with the objective of reducing the societal production-consumption systems' linear material and energy throughput flows by applying materials cycles, renewable and cascade-type energy flows to the linear system...”***

Korhonen, J.; Nuur, C.; Feldmann, A.; Birkie, S.E. Circular economy as an essentially contested concept. *J. Clean. Prod.* **2018**, *175*, 544–552.

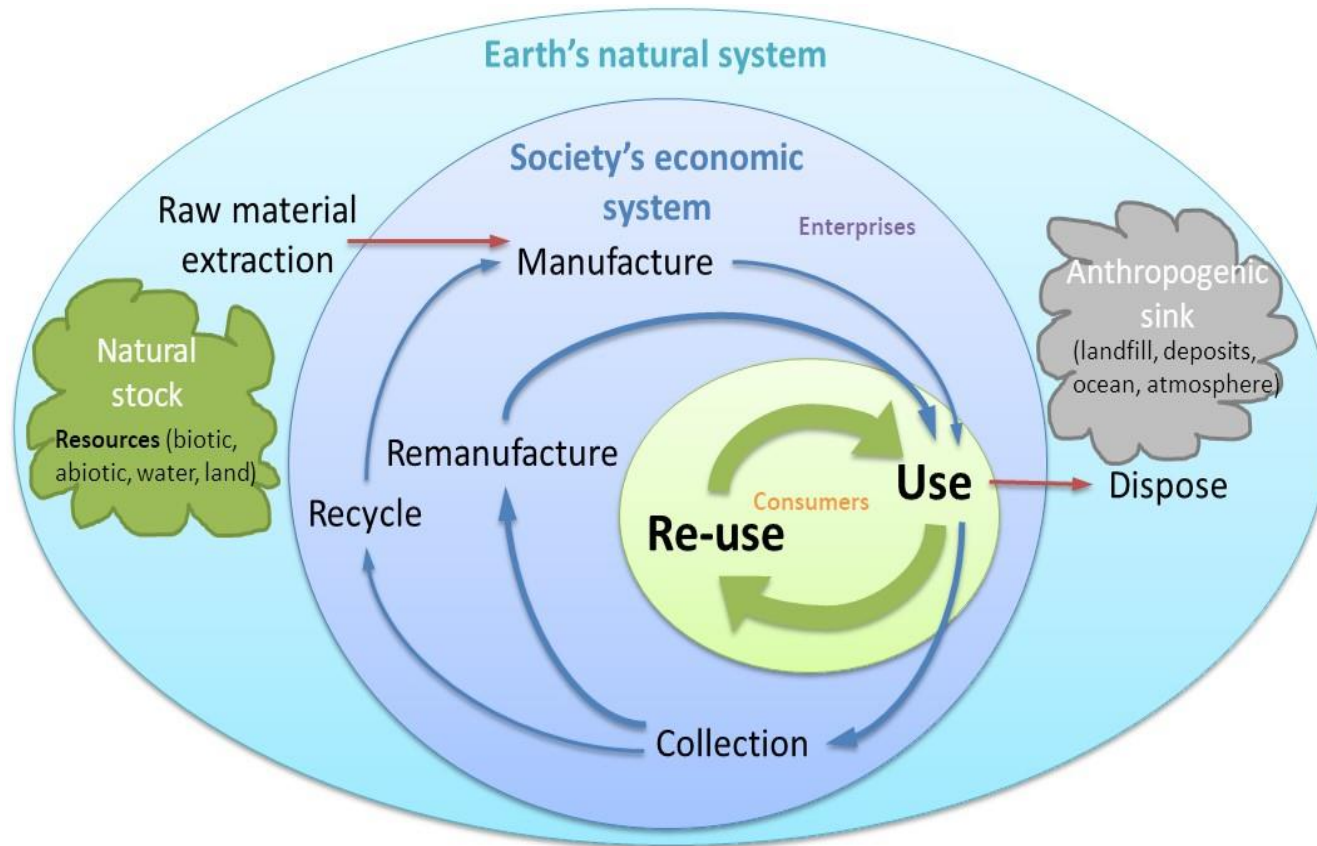


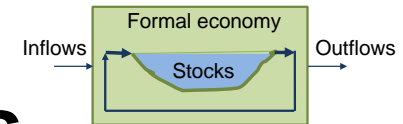
# Illustration of the Economy embedded in the natural environment





# The Socio-economic embeddedness of circular economy



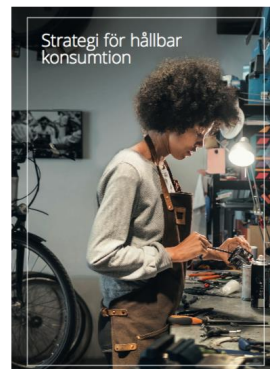
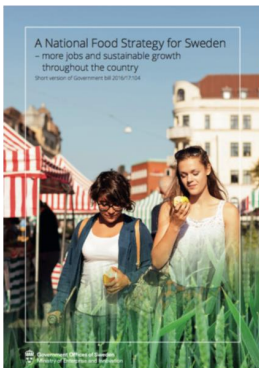


# Important food challenges

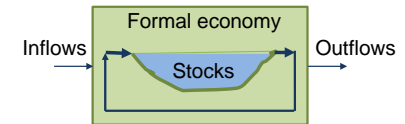
- **Availability of agricultural land - essentially all fertile land on earth is in use**
- **All machinery in mechanised agriculture is fossil driven**
- **Current agriculture is heavily dependent on synthetic fertilizers, insecticides, herbicides and pesticides**
- **A high proportion in agriculture is black or grey work, performed under low-pay, low ethic standard conditions**
- **High yield crops and animals compromise human nutrition and health, as well as animal welfare and ethics**

# Important Swedish Governmental Initiatives

- **A Swedish Strategy for Food Production**
- **A Swedish Strategy for Sustainable Consumption**
- **Innovation partnership programmes – mobilising new ways to meet societal challenges**



**3. Circular and  
bio-based economy**



# Emerging food technologies

## Traditional

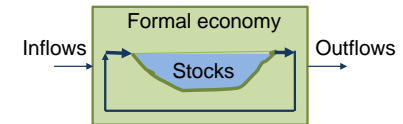
- Genetic modification
- Animal cloning
- Nutrigenomics
- Food irradiation
- Nanotechnology
- High pressure processing
- Pulsed electric field processing

<http://www.ask-force.org/web/Discourse/Frewer-Consumer-Response-Novel-Agri-Food-2011.pdf>

## Here

Technologies using controlled conditions regarding temperature, water, nutrients and using ICT to run processes in a way to establish local and stable ecosystems





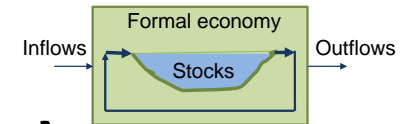
# UrbanFood – A Strategic Innovation Agenda

**Proposal for a national strategic innovation agenda on urban-oriented food production**

**Developed by the Swedish Agricultural University in cooperation with KTH, Ramböll and Ecoloop AB**

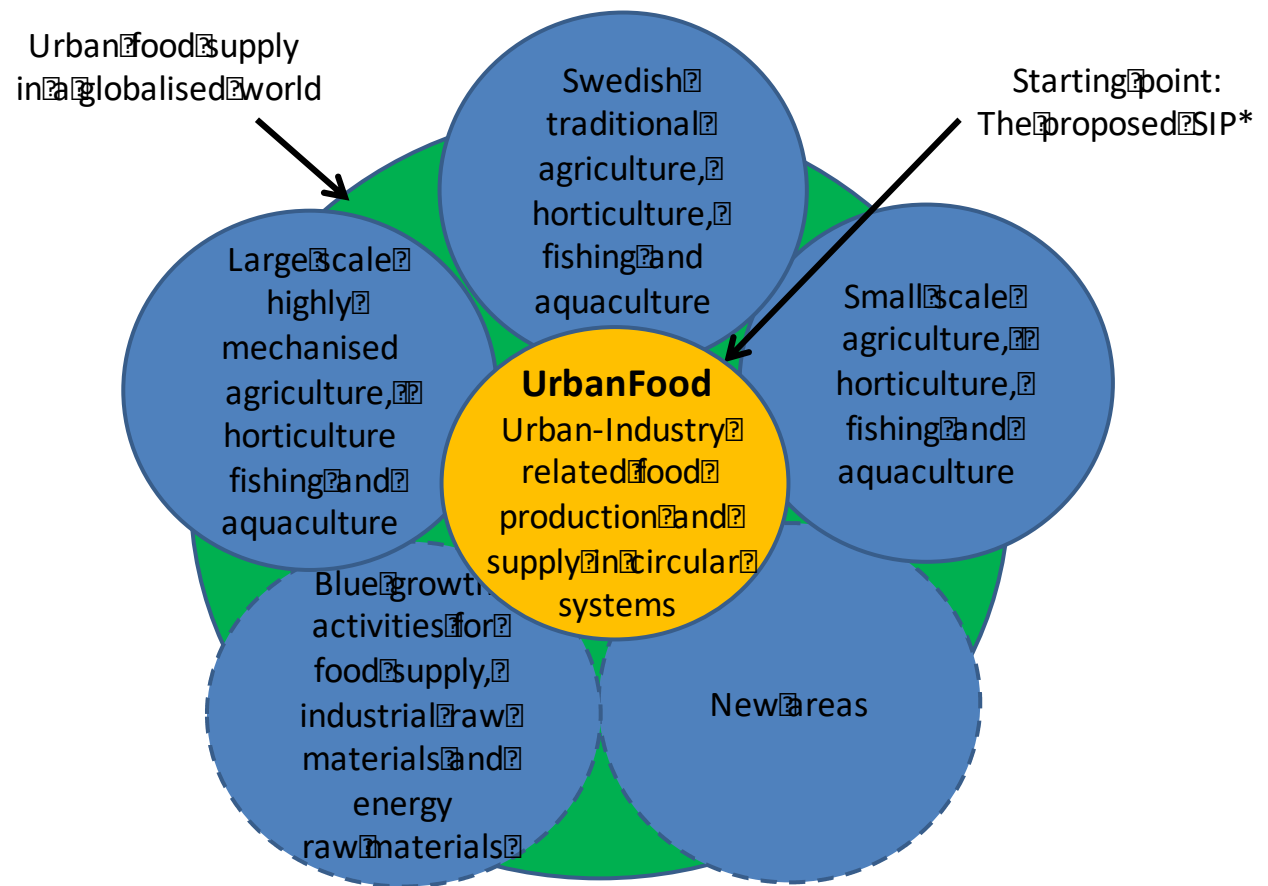
**Key persons involved: Anders Kiessling SLU (chair), Björn Frostell KTH and Ecoloop AB (assistant chair and secretary), Anna Norström, Ecoloop AB, Håkan Sandin SLU, Gunnar Nordberg Ramböll, Torbjörn Lundh SLU, Carl Gustaf Thulin SLU**





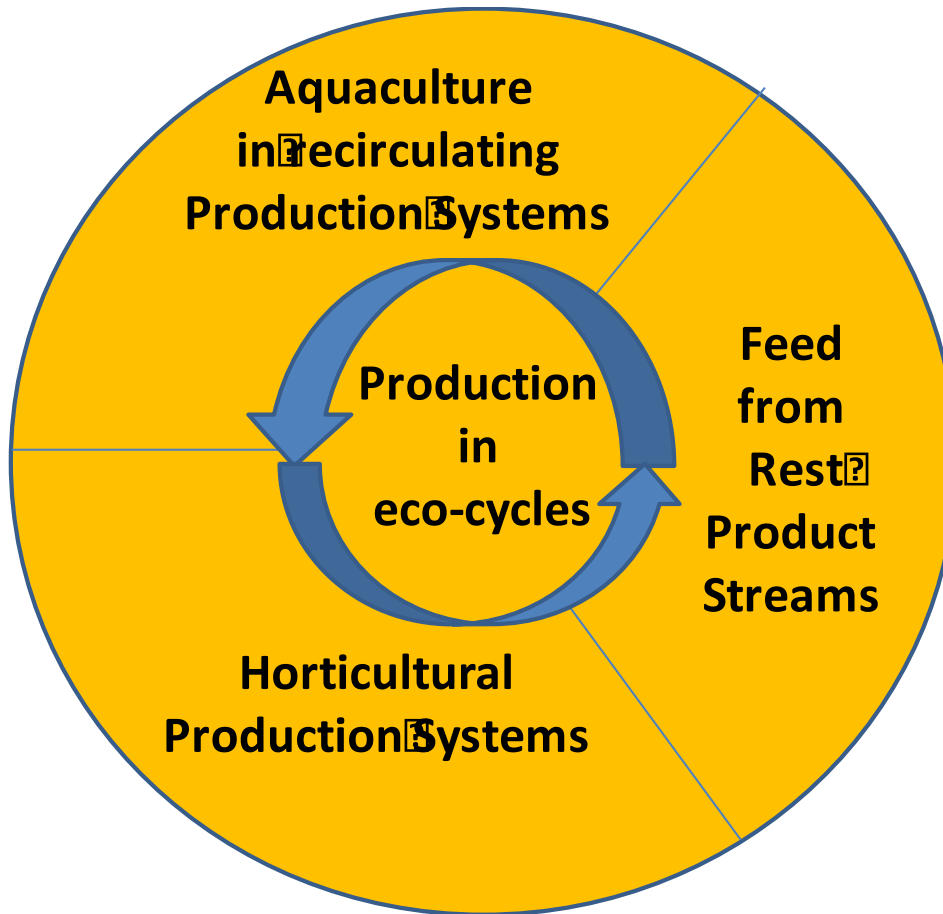
# The Strategic Innovation Area (SIA)

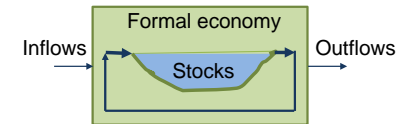
## Urban food supply in a globalised world



\*SIP = Strategic Innovation programme

# Proposed focus areas of the strategic innovation programme (SIP)

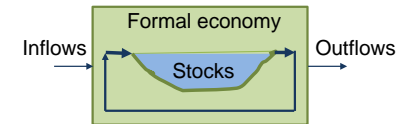




# Challenges for Urban Food Production

## “The Road from Enthusiasm to Reality”

- **Education/Learning=>Reorientation of mindset=> A new view on what is economical?**
- **How do we motivate consumers to pay for sustainable and local food products?**
- **Technical improvements – e.g. energy aspects and digitalization**
- **New business models – how to connect producers and consumers?**
- **More resources to those in overalls and boots – let the enthusiasts and entrepreneurs try**



# A huge field to explore

- **Combinations of fish, plants and treatment technologies**
- **Energy solutions and energy contributions**
- **Business solutions, costs for cultivation volumes and space**
- **Financing and funding solutions for R&I**
- **Is it necessary to go large scale?**

# Example 1

## New Business Models

### Farmer & Butcher

City - & Locally produced

A completely new platform for food with product, producer and customer in focus.

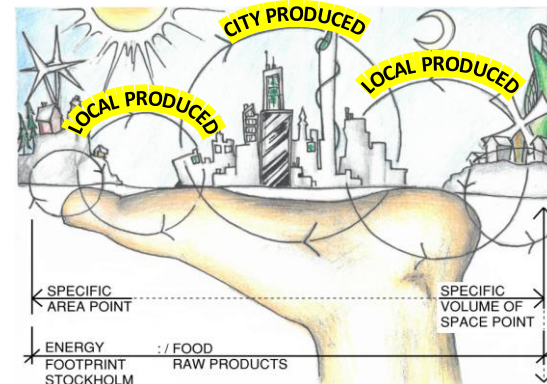
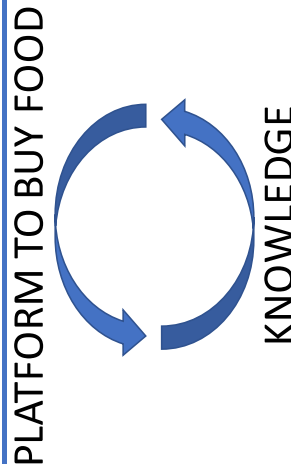
A network where all parts, more or less, are working together for a minimal ecological footprint.



FACTS AND STATISTICS  
ENGINEERING  
ARCHITECTURE  
SUSTAINABILITY  
NEWS



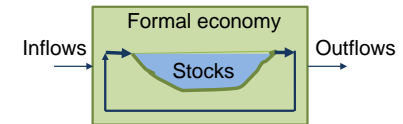
InnovationFarm- Is a platform created to offer customers easily accessed information about the ecological footprint of a specific product, while also promoting an understanding of what there is to gain from decreasing the ecological footprint all over the world.



Prepared by Filip Åberg (filip.berg@sweco.se)

## Example 2

# Will it be necessary with large scale?

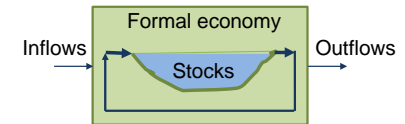


These 3000 small Tilapia will in 8 months provide 1200 kg useful food enough for 24 families to consume 1 kg of fish per week during 1 year.

Total estimated cultivation area requirement =  $< 50 \text{ m}^2$  + green house area  $150\text{-}200 \text{ m}^2$

Film recorded August 2018 at Bjursätter, Fräkentorp Säteri, Malmköping, Sweden

This is **Small Large Scale**



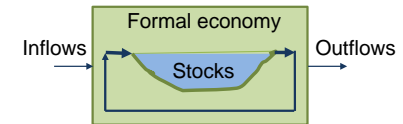
# Conclusions

- **Circular Economy is an emerging paradigm for a reorientation of economic activity from linear physical resource flows to circular**
- **Swedish governments at national and regional level have adopted several aspects of Circular Economy and shaped plans and policies for it**
- **The food system – thanks to its main products passing the human body and thus inherently life-friendly – could become the first human production/consumption system to become circular**
- **There are vast fields of knowledge and practices to conquer – go out and try!**

**Thank you!**

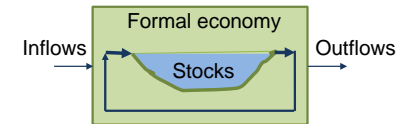
Contact: [bjorn.frostell@ecoloop.se](mailto:bjorn.frostell@ecoloop.se)





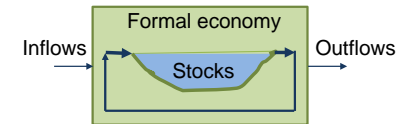
## Some suggested readings on Systems Thinking for Physical Resource Management at an over-arching societal level:

- Frostell, B., (2013) Life Cycle Thinking for improved resource management: LCA or?, In J. Kauffman, K.-M. Lee (eds.), *Handbook of Sustainable Engineering*, pp. 837-857, Springer: Dordrecht.
- Ranhagen, U., Frostell, B., (2014) Eco-Cycle Model 2.0 for Stockholm Royal Seaport City District, feasibility study – final report, City of Stockholm & KTH School of Architecture and the Built Environment, July 2014.
- Laurenti, R., Singh, J., Frostell, B., Sinha, R., Binder, C. (2018) The Socio-Economic Embeddedness of the Circular Economy: An Integrative Framework, *Sustainability*, 2018, 10, 2129; doi:10.3390/su10072129.



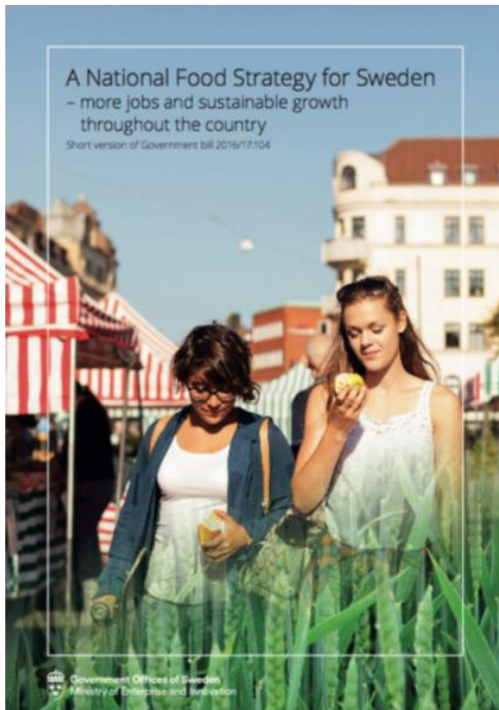
## Some suggested readings on Aquaculture and Aquaponics where Björn Frostell took part:

- Kiessling A., Frostell B., Norström A., Nordberg G., Sandin H., Lundh T and Thulin C.G. (2015) Urban food supply in a globalized world, Proposal for a national strategic innovation agenda, 81 pp. (In Swedish).
- Kiessling A., Frostell B., Norström A., Nordberg G., Sandin H (2015) UrbanFood – Urban-industry related food production and supply systems, Strategic Innovation Programme (SIP) description, Vinnova, 30 pp.
- Björn, E. (2017) A circular production of fish and vegetables in Guatemala, An in depth analysis of the nitrogen cycle in the Maya Chay aquaponics systems, M.Sc. Thesis at the department of Sustainable Development, Environmental Science and Engineering (SEED), Royal Institute of Technology (KTH), Stockholm.



# A Swedish Strategy for Food Production

## Three strategic areas



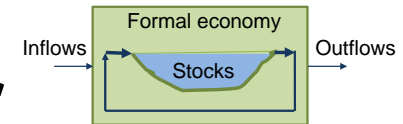
- Rules and regulations
- Consumers and markets
- Knowledge and innovation

## Regional food strategies exist for the following counties:

Gotland, Halland, Norrbotten, Kalmar, Kronoberg, Södermanland, Värmland, Västernorrland, Västra Götaland, Östergötland

[https://www.government.se/498282/contentassets/16ef73aaa6f74faab86ade5ef239b659/livsmedelsstrategin\\_kortversion\\_eng.pdf](https://www.government.se/498282/contentassets/16ef73aaa6f74faab86ade5ef239b659/livsmedelsstrategin_kortversion_eng.pdf)

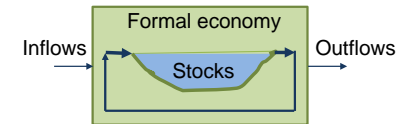
# A Swedish Strategy for Sustainable Consumption



## Focus areas

- Increase knowledge and cooperation
- Stimulate sustainable means of consumption
- Make resource use more efficient
- Improve information about enterprises sustainability work
- Phase out dangerous chemicals
- Increase security for all consumers
- Focus on food, transport and living

<https://www.regeringen.se/4a7e12/globalassets/regeringen/dokument/finansdepartementet/pdf/2016/strategi-for-hallbar-konsumtion/strategi-for-hallbar-konsumtion--tillganglighetsanpassad.pdf>



# Innovation partnership programmes – mobilising new ways to meet societal challenges

1. The next generation's travel and transport
2. Smart cities
3. Circular and bio-based economy
4. Life sciences
5. A connected industry and new materials



“We must use a coherent approach to manage food supply, energy issues and the transition to a circular and bio-based economy. This means new ways of using the world's resources. Sustainable and non-toxic raw materials production is fundamental. The aim of the partnership programme 'Circular and bio-based economy' is to jointly mobilise innovation initiatives to ensure that the proportion of the bio-based economy grows, and promotes circular solutions.”

<https://www.government.se/articles/2016/07/innovation-partnership-programmes--mobilising-new-ways-to-meet-societal-challenges/>