

ECOLOGICAL INTENSIFICATION OF FISH FARMING: TO DEVELOP A METHOD FOR APPLIED GOALS DEFINITION

***PISCiculture EcoLogiquement InTensive:
une approche par écosystème***

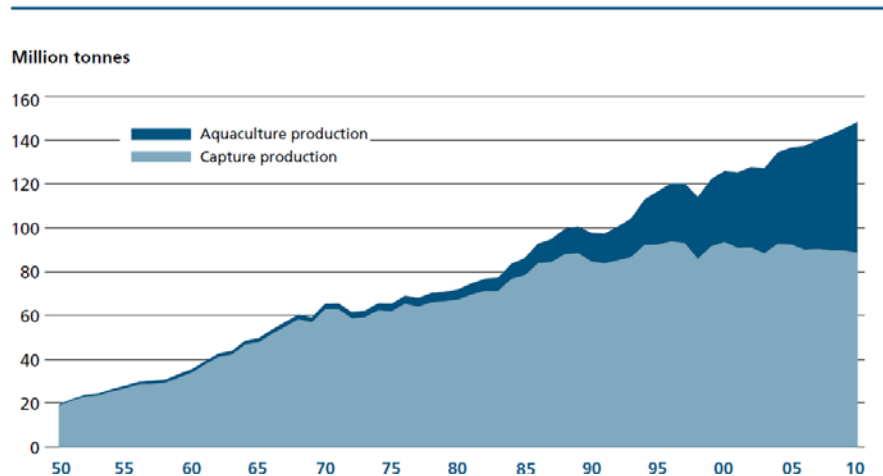
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Global capture fishery and aquaculture production



FAO (2012)

- Feeding the world: 70% more agricultural production by 2050?
- Increasing demand for aquatic products
- Stagnation of fisheries catches
- Different development contexts for aquaculture (i.e. Europe/Asia)
- Increasing demand by society for eco-friendly practices and sustainable development
- Emergence of the "ecological intensification" concept in agriculture
- ...

Ecological Intensification *(Michel Griffon 2010):*

Ecologically/ intensive agriculture means involving the ecosystem and magnifying its productive functions to increase productivity.

Ecological intensification?

Ecosystem productivity is based on:

- **Minimal nutrient losses** : nutrient recycling, concomitant use of completing resources (in time and space)
- Establishing and **maintaining balanced natural cycles** and a high level of biodiversity
- **High level of biodiversity** => biological activity => natural regulation

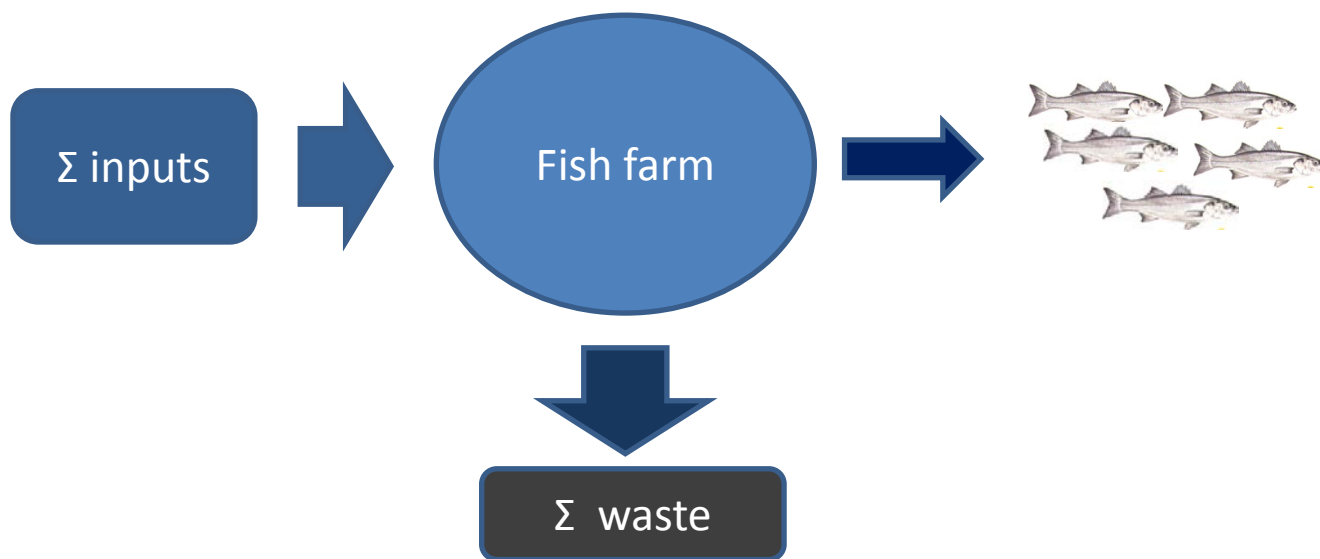
To intensify:

- An intensive agriculture production system is one involving high levels of production factors (e.g. feed, fertilizers, machine, labor, energy) per hectare or production unit

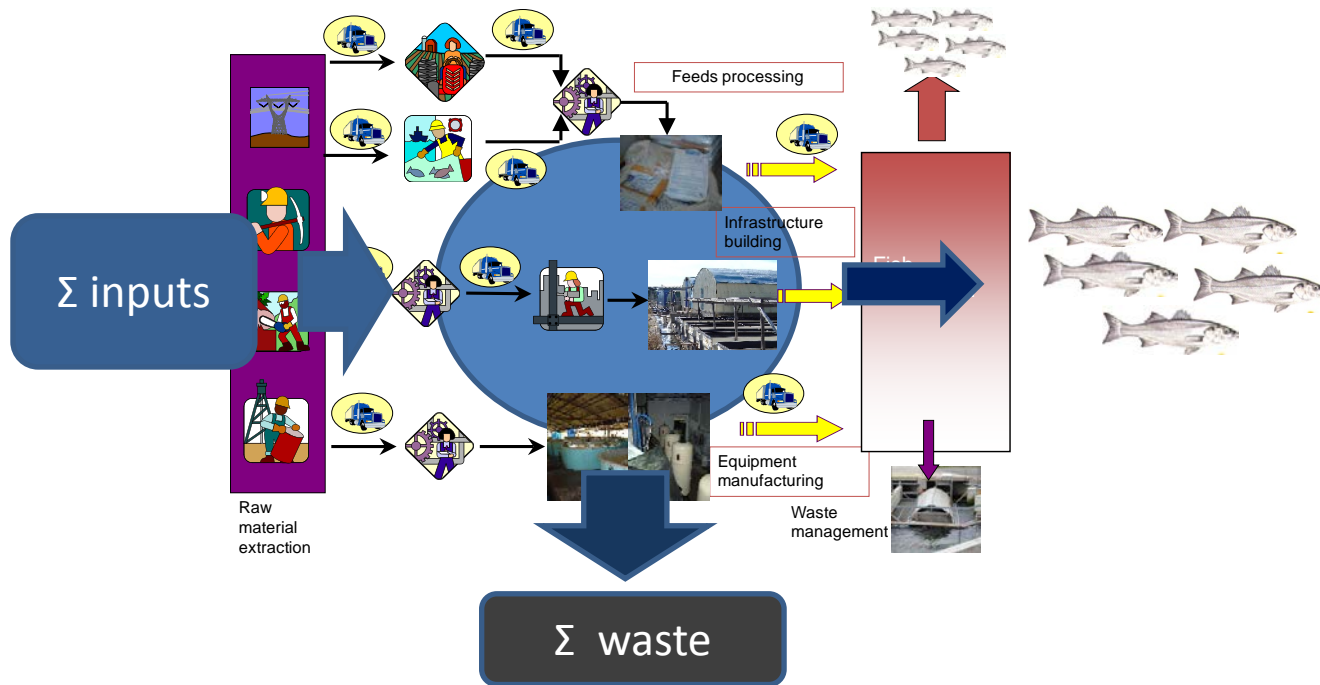
Ecological intensification?

- To increase production system efficiency using ecological mechanisms (to decrease input dependence, respect fragile resources, reduce polluting emissions, etc.)
- To increase production
- To improve integration within territories (biotic, abiotic and human contexts)
- To maximize use of practitioner knowledge

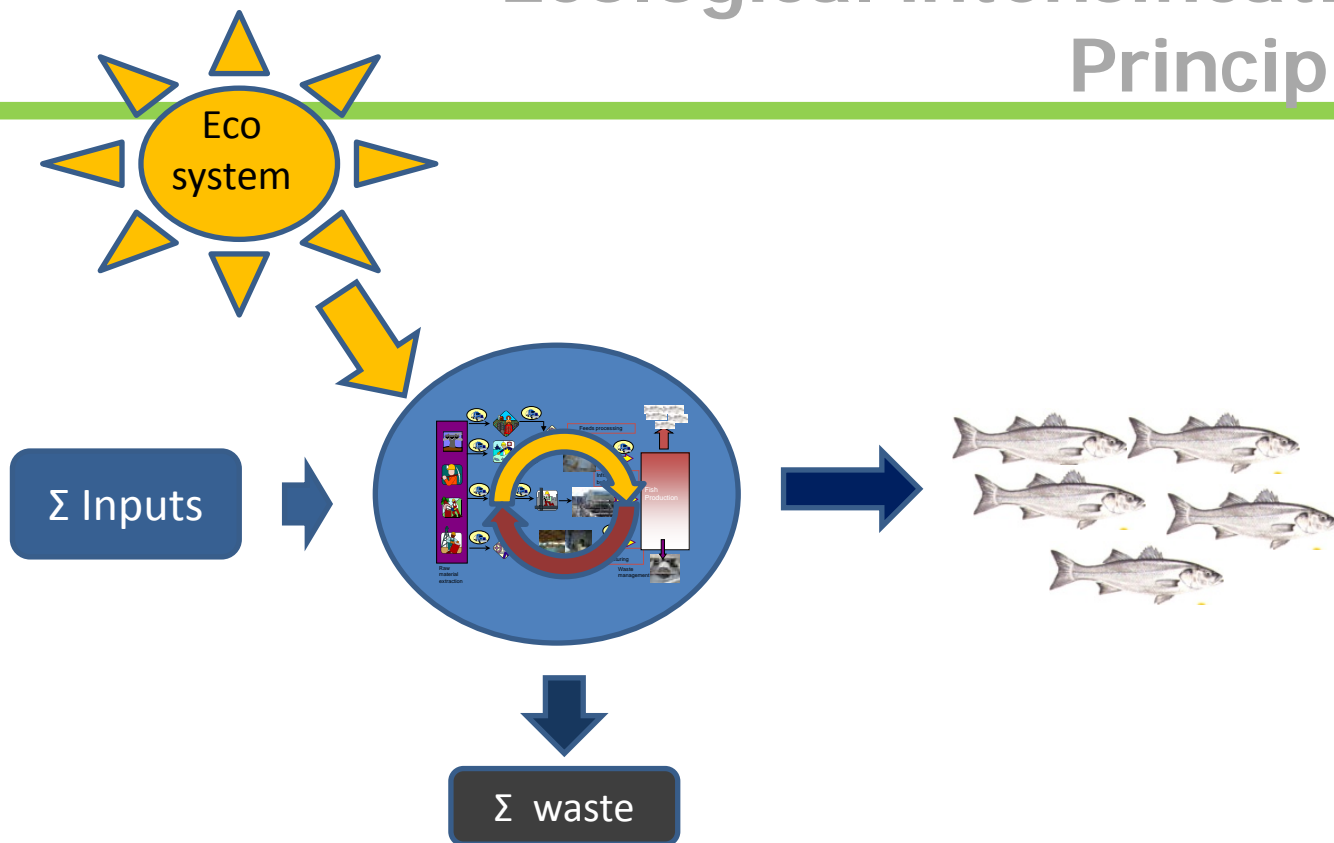
Ecological intensification Principles



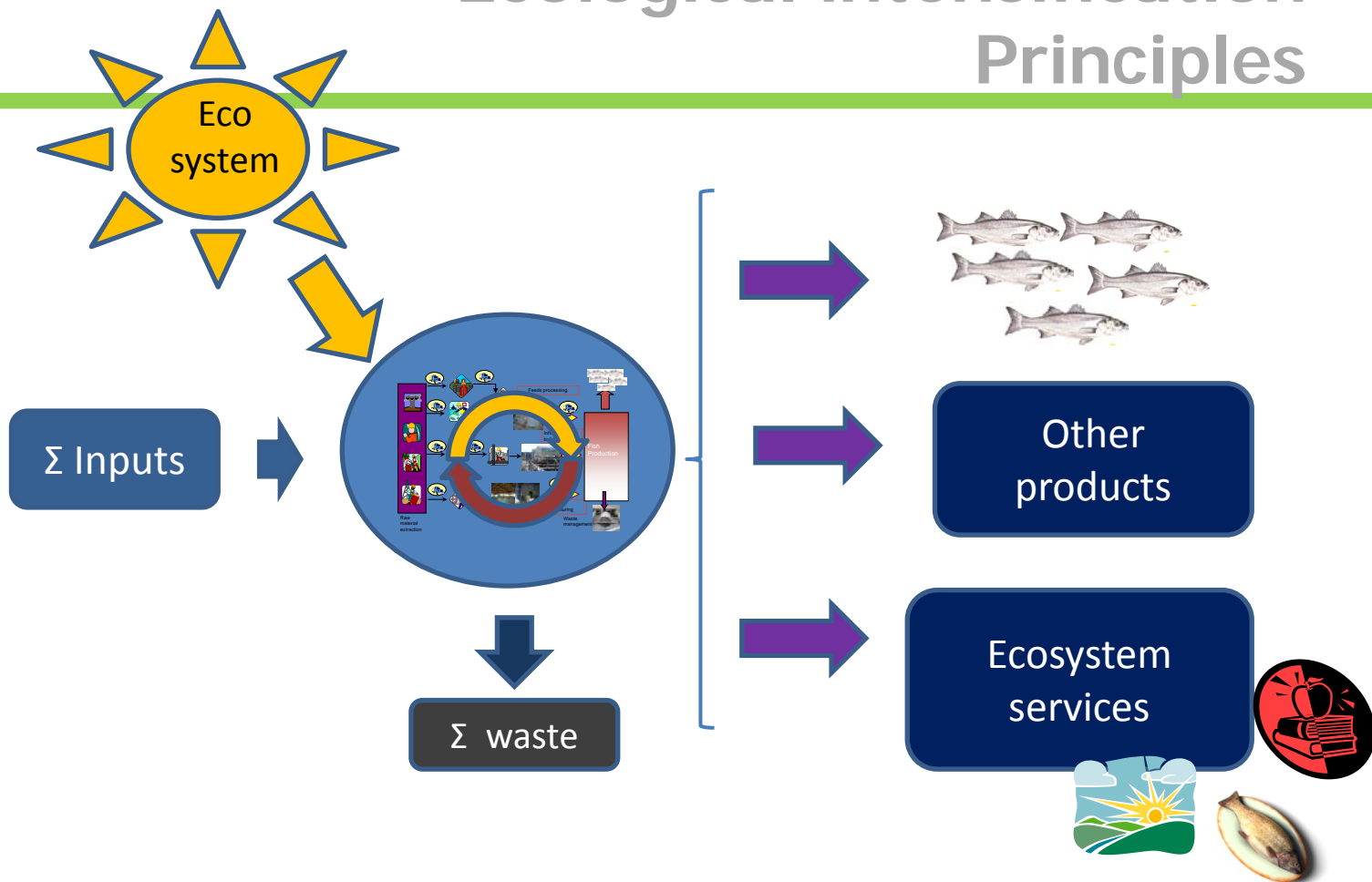
Ecological intensification Principles



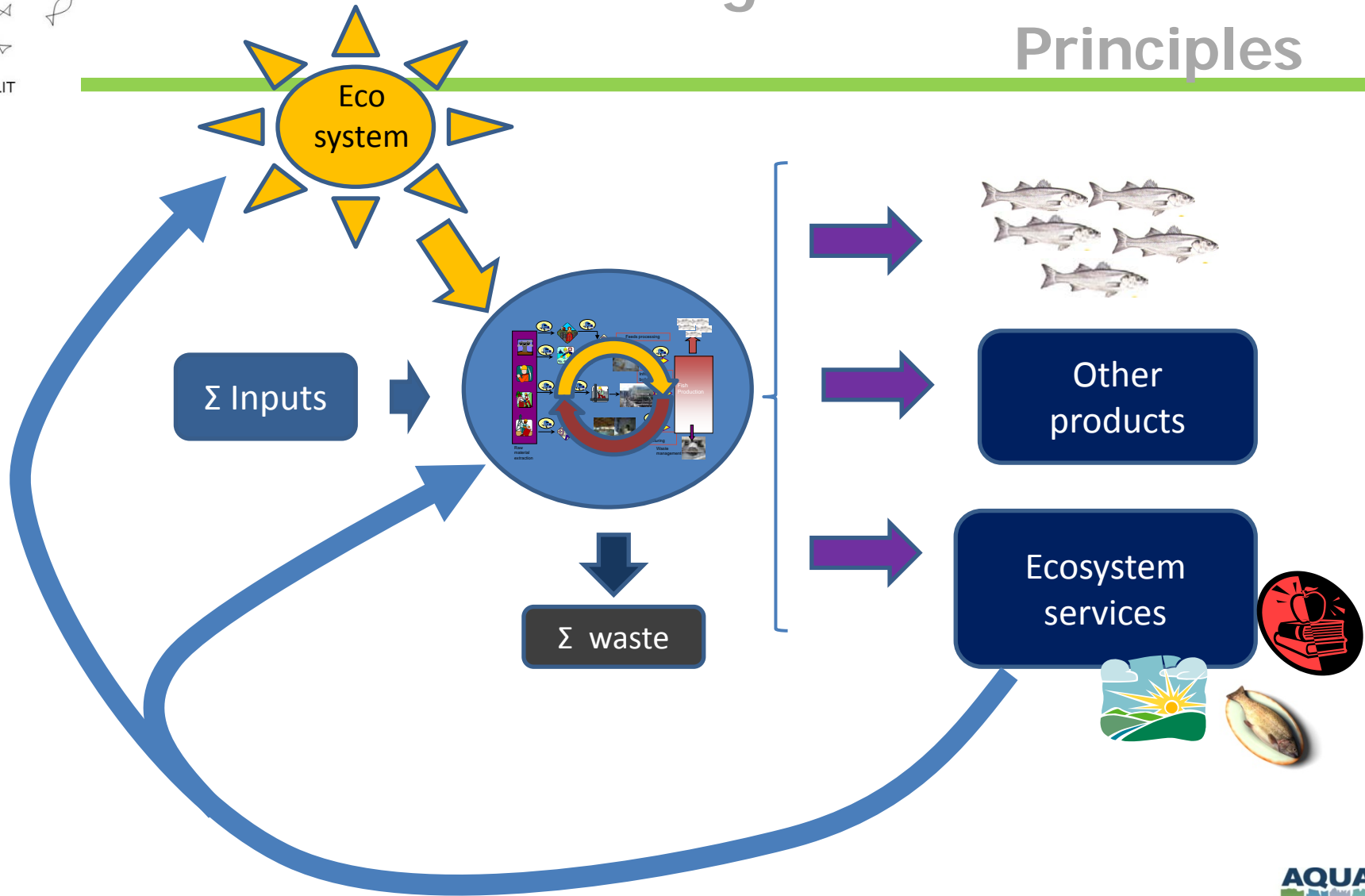
Ecological intensification Principles



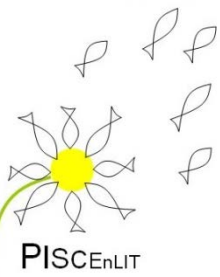
Ecological intensification Principles



Ecological intensification Principles



Adaptation of ecosystem services to aquaculture



- + Primary production
- + Fauna and flora protection
- + Habitat and refuge
- + Plant multiplication
- + Nutrients cycling

IV. Supporting

I. Provisioning

- Food +
- Fresh water +
- Combustible/Fuel +
- Fiber +
- Genetic resources +
- Biochemistry, medicine or pharmacology +
- Ornamental resources +
- Fertilizer +



Ecosystem services

- + Spiritual
- + Inspiration
- + Education
- + Recreation
- + Attractivity

III. Cultural

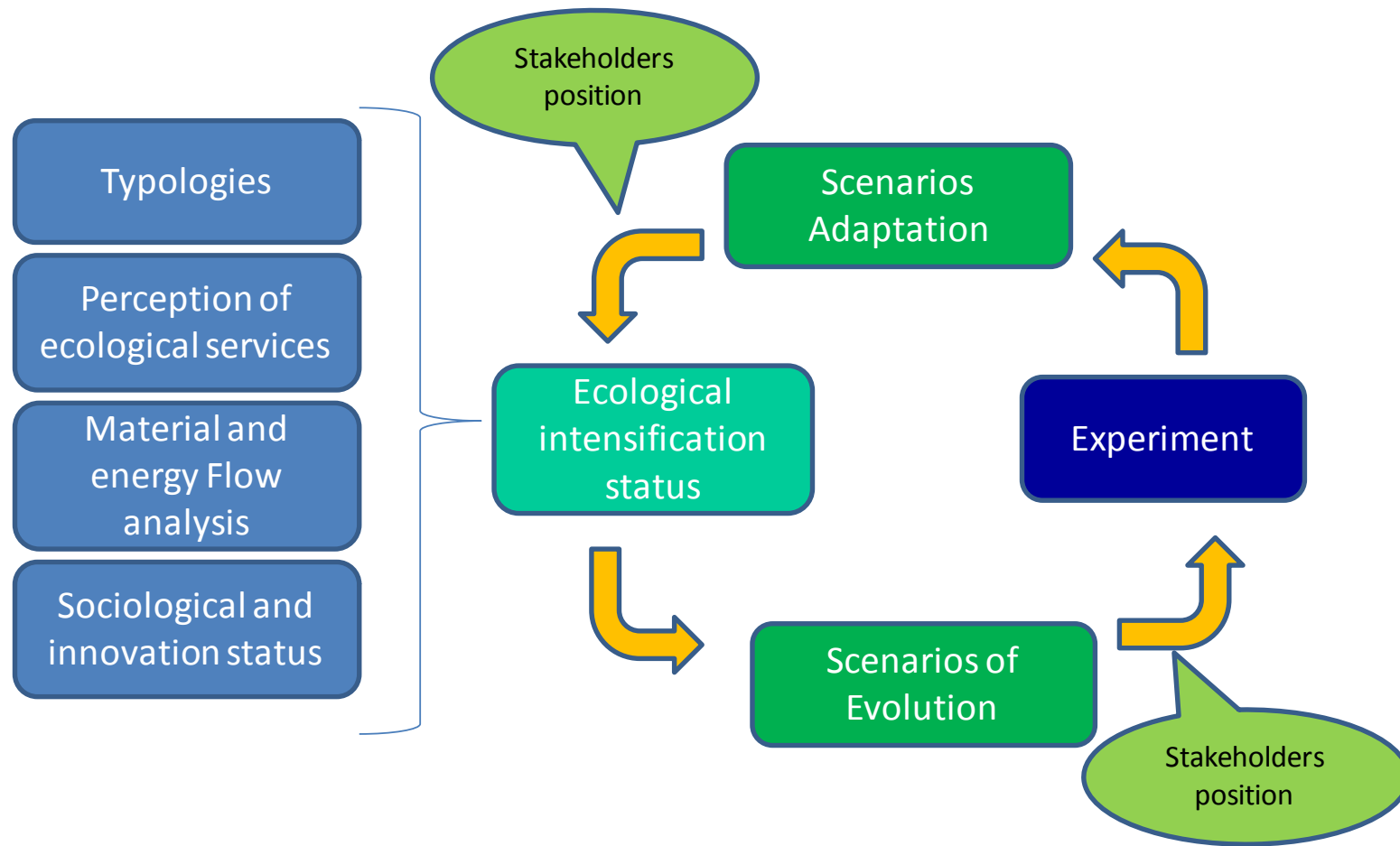


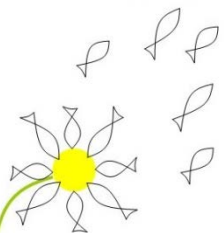
II. Regulation

- Climate +
- Hydrology +
- Protection against natural hazards +
- Pollution and depollution control +
- Regulation of erosion +
- Biologic regulation +
- Disease regulation +



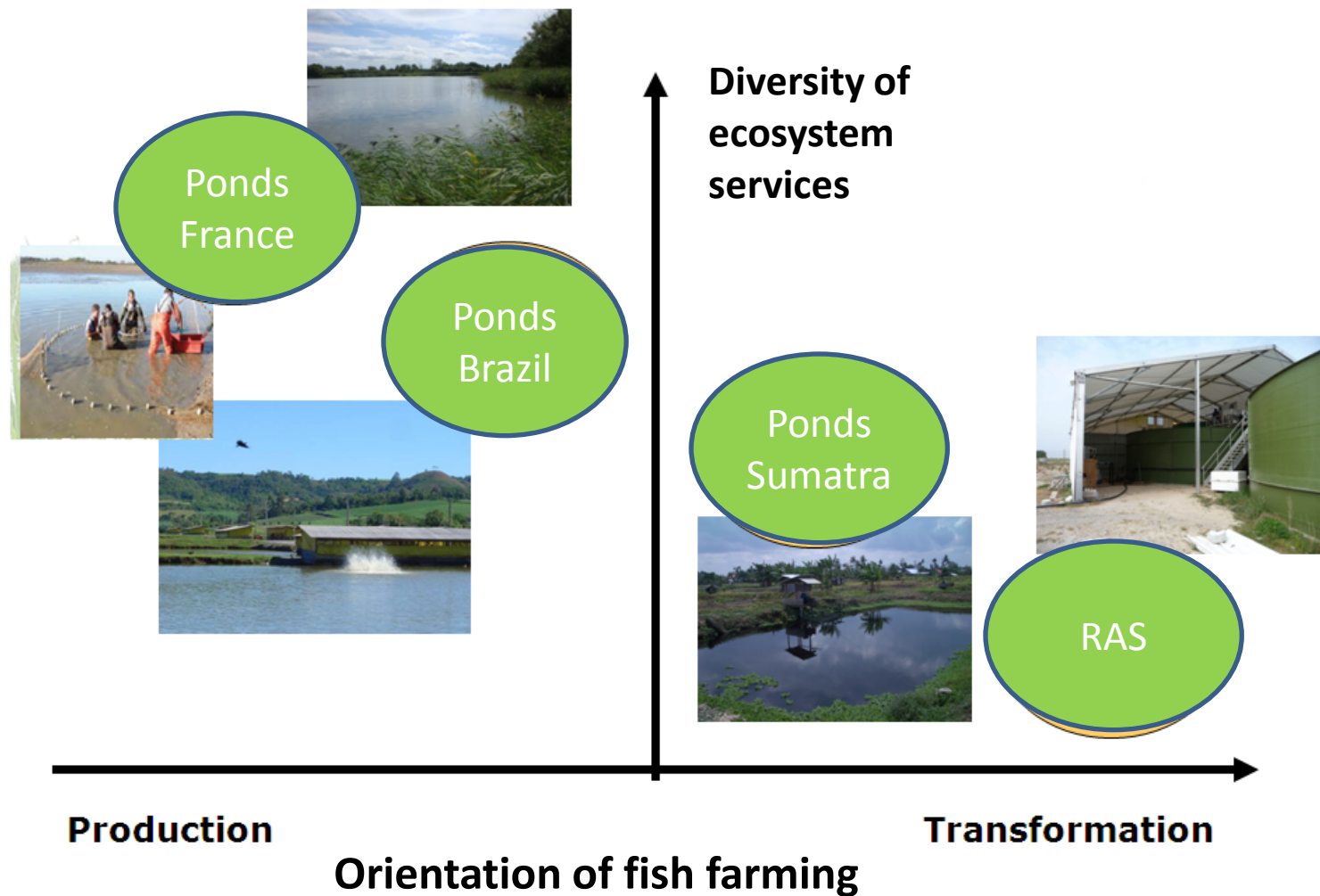
Adapted from Millennium
Ecosystem Assessment, 2005





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Studied sites



Sumatra striped catfish pond systems

Stakeholder goals

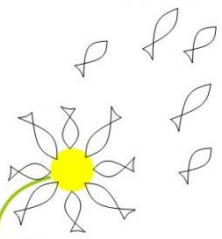
- Increase production yields (Provisioning)
- Diversify production (Provisioning)
- Improve nutrient recycling, i.e. reusing waste water as a nutrient source for crops (rice, palm, banana, taro) (Provisioning and support)
- Maintain / develop biodiversity around ponds (Support)
- Improve farmer education and to create technical and innovation (Cultural)



Sumatra striped catfish pond systems

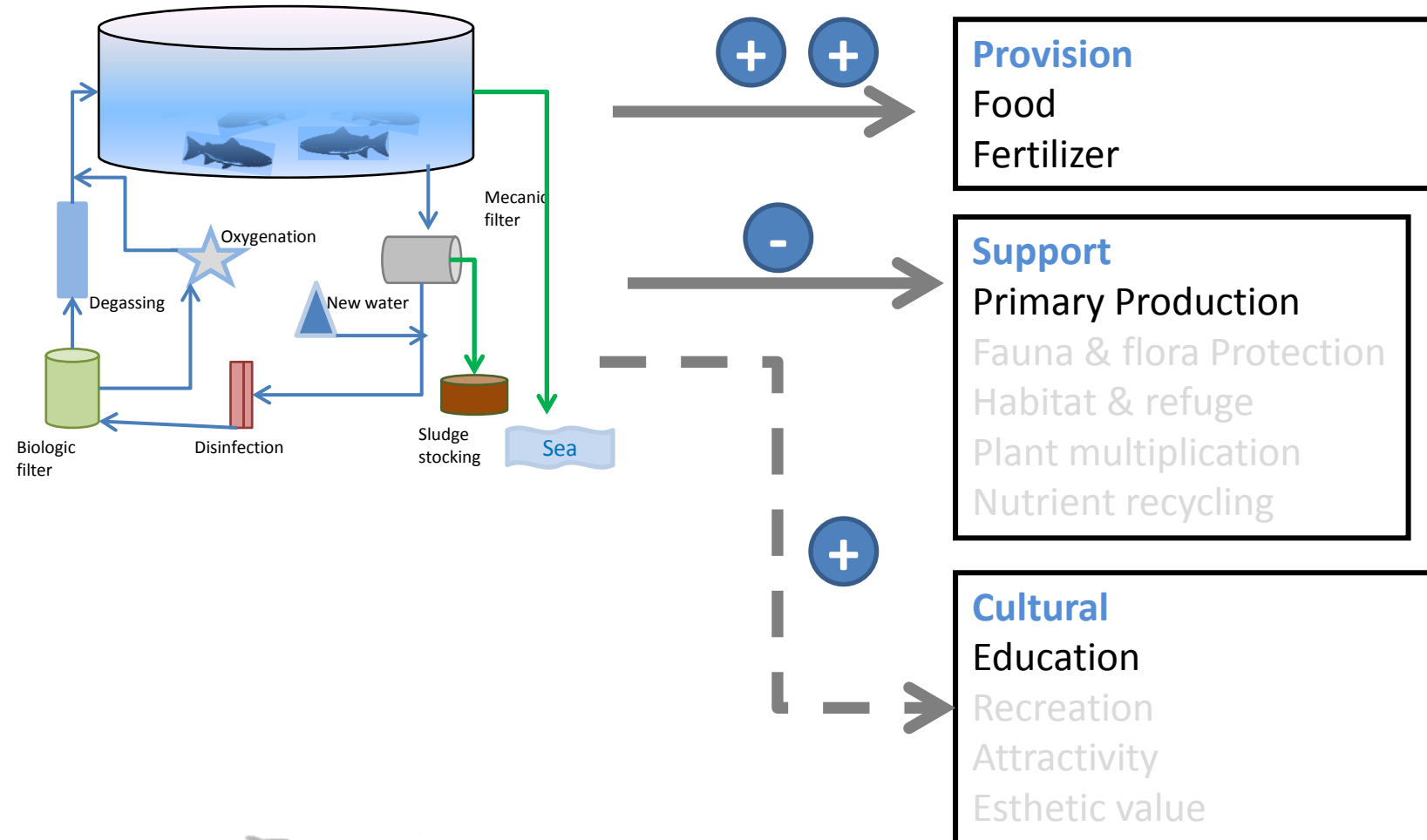
Proposal for System Change

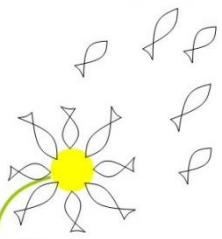




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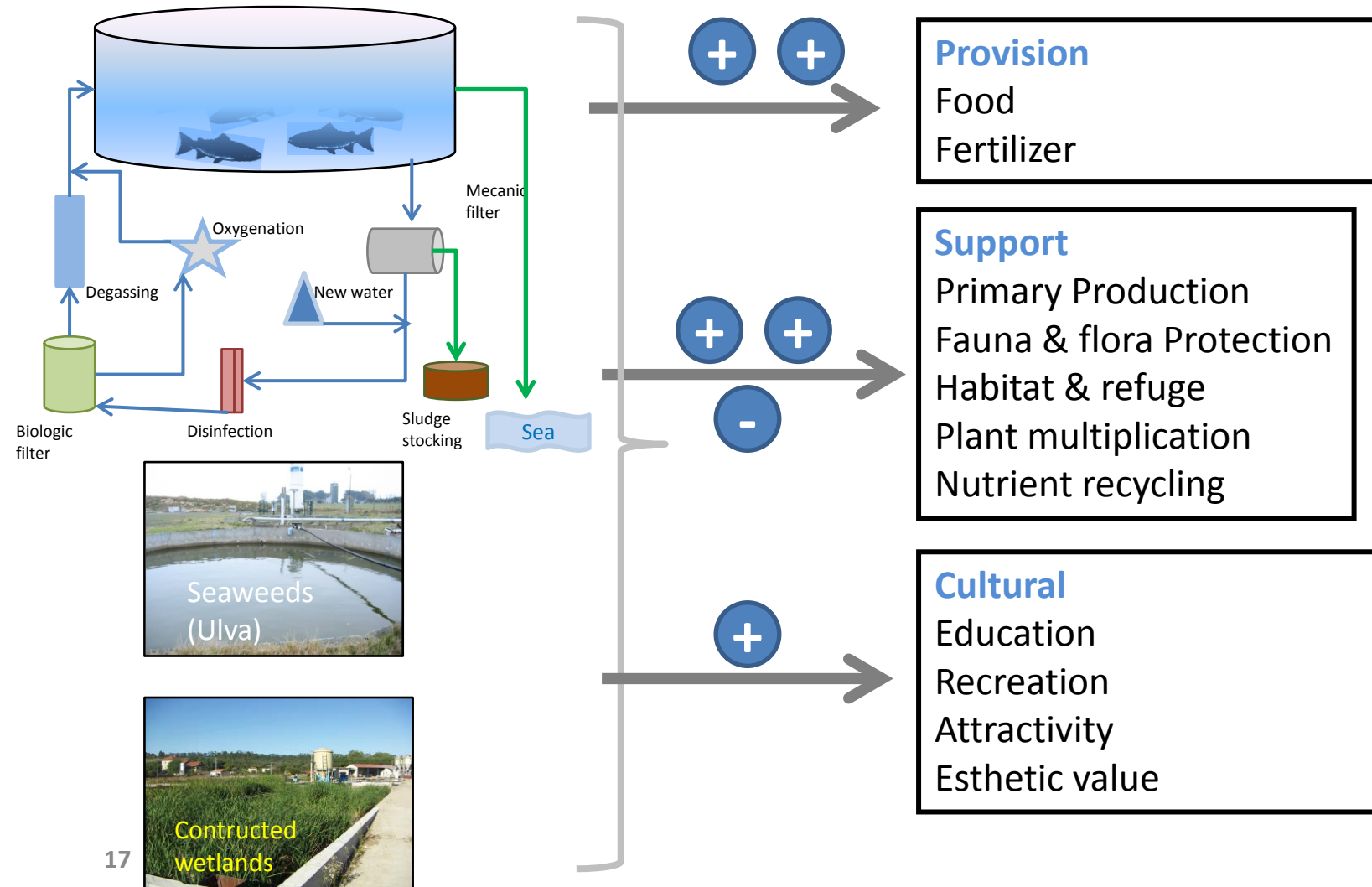
Salmon Recirculating System in France

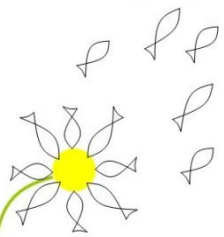




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Salmon Recirculating System in France





Conclusion

- Surveys in this study show that social expectations of fish farming are multiple: productivity, biodiversity support, providing cultural and biophysical services.
- To improve the number and quality of ecosystem services, fish farming systems have to remain productive (within carrying capacity limits) and integrate ecosystem complexity.
- Ecological intensification based on ecosystem-service development is on the way. It will propose a framework for more eco-efficient, and socially integrated aquaculture systems.

