The Food & Agriculture Organization (FAO) of the United Nations Ecosystem Approach to Aquaculture and Transdisciplinary Approaches to Achieve It

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https://oceanfoods.org

Brummett, R.E. and B.A. Costa-Pierce. 2002. Village-based aquaculture ecosystems as a model for sustainable aquaculture development in Sub-saharan aquaculture, p. 145-160. In: B.A. Costa-Pierce (Ed.) *Ecological Aquaculture: The Evolution of the Blue Revolution*. Blackwell Science, Oxford, UK.

Brugere, C., J. Aguilar-Manjarrez, M. Beveridge and D. Soto. 2018. The ecosystem approach to aquaculture 10 years on — a critical review and consideration of its future role in blue growth. *Reviews in Aquaculture* 0,1–22 https://doi.org/10.1111/raq.12242

Costa-Pierce, B.A. 2021. The social ecology of aquaculture in its new geographies *World Aquaculture* 52 (3): 43-50.

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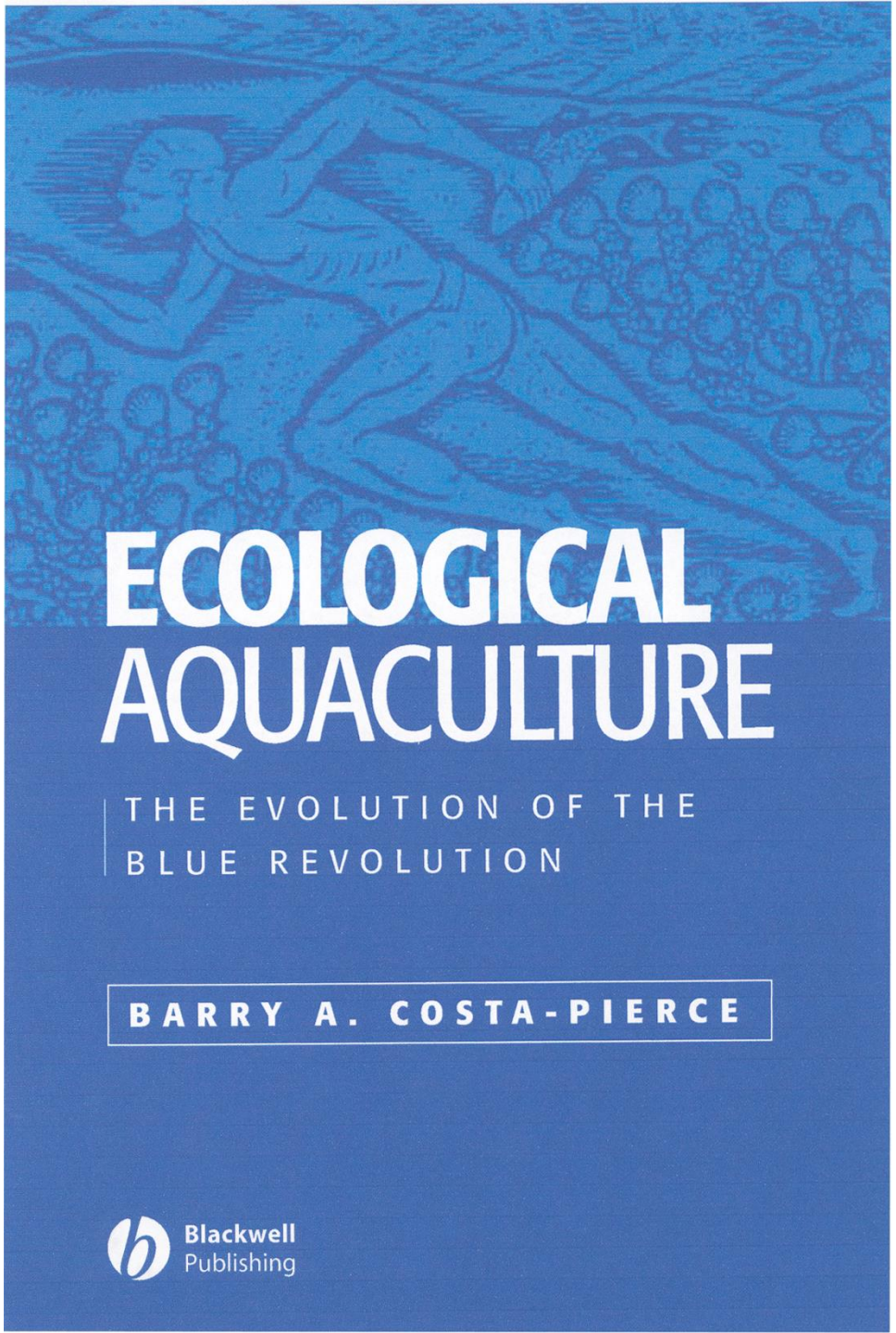
FAO Committee on Fisheries Thirty-sixth Session. 2024. *Guidelines for Sustainable Aquaculture*. 35 p.


ECOLOGICAL
AQUACULTURE
THE EVOLUTION OF THE
BLUE REVOLUTION
BARRY A. COSTA-PIERCE
Blackwell
Publishing

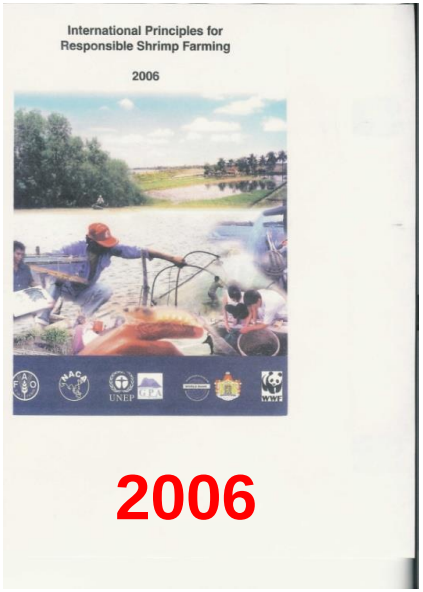
2002

Food and Agriculture Organization of the United Nations

The FAO Code of Conduct for Responsible Fisheries

International Conference on Responsible Fishing

Cancun, Mexico, May **1992**

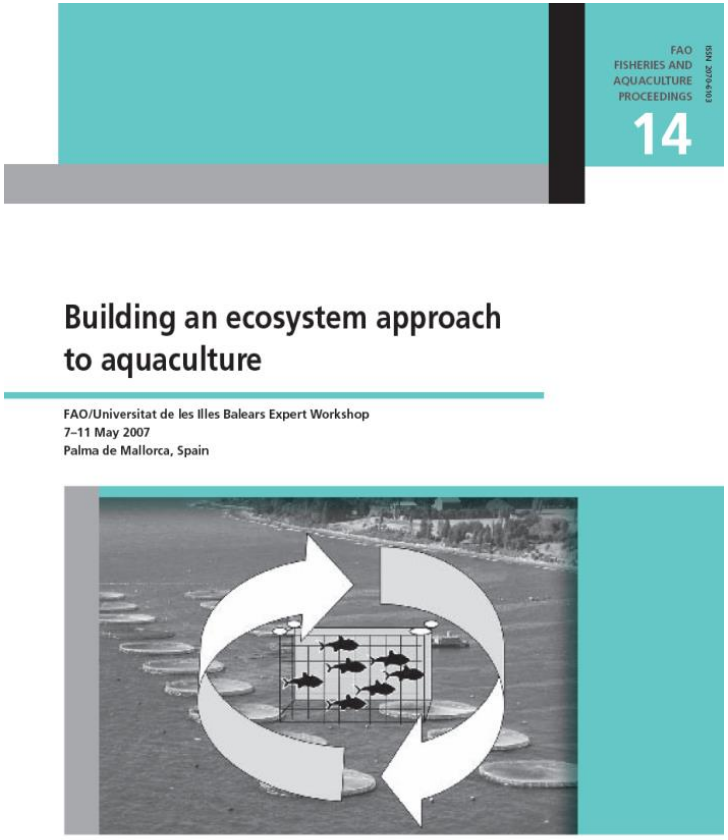


The FAO Ecosystem Approach to Aquaculture

FAO Expert Workshop
Palma de Mallorca, Spain

May 2007

Food and Agriculture Organization of the United Nations



Costa-Pierce, B.A. **2008**. An ecosystems approach to marine aquaculture: A global review, p. 81-116. In: D. Soto et al. (eds). *Building An Ecosystem Approach to Aquaculture*. FAO Fisheries and Aquaculture Proceedings 14. Food and Agriculture Organization, Rome, Italy, 221p.

Universitat de les Illes Balears

Food and Agriculture Organization of the United Nations

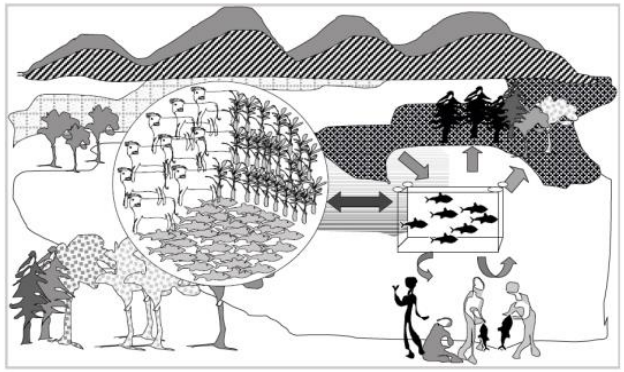
FAO
TECHNICAL
GUIDELINES FOR
RESPONSIBLE
FISHERIES

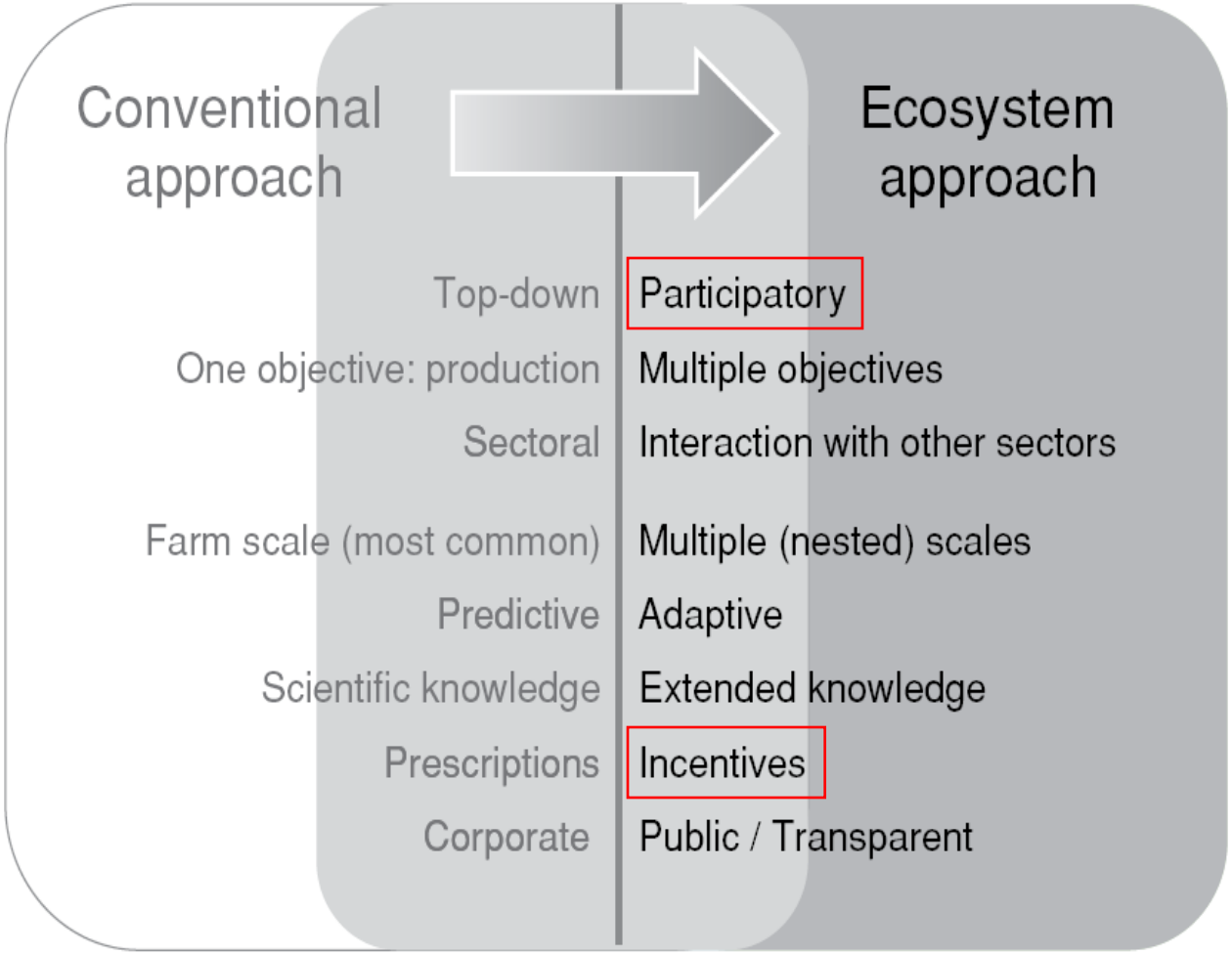
5

Suppl. 4

AQUACULTURE DEVELOPMENT

4. Ecosystem approach to aquaculture




Conventional approach
Ecosystem approach
Top-down
Participatory
One objective: production
Multiple objectives
Sectoral
Interaction with other sectors
Farm scale (most common)
Multiple (nested) scales
Predictive
Adaptive
Scientific knowledge
Extended knowledge
Prescriptions
Incentives
Corporate
Public / Transparent

“An Ecosystem Approach to Aquaculture

is a *strategy* for the

integration of the aquaculture within the wider ecosystem such that

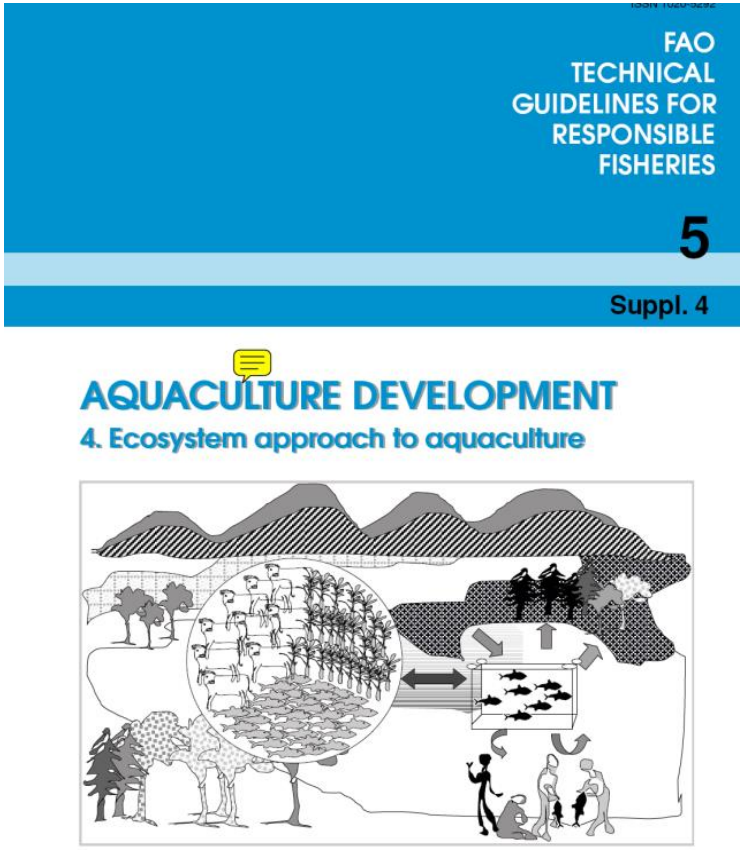
it promotes *sustainable development, equity, and resilience* of interlinked social-ecological systems”.

The ecosystem approach to aquaculture is a strategy…

THEREFORE

It is not only WHAT IS DONE but also HOW IT IS DONE…to build TRUST over the longer period.

The ***participation of stakeholders*** is the foundation of the strategy.



Transdisciplinary EAA Toolkit

- Spatial Planning
- Carrying Capacity
- Governance

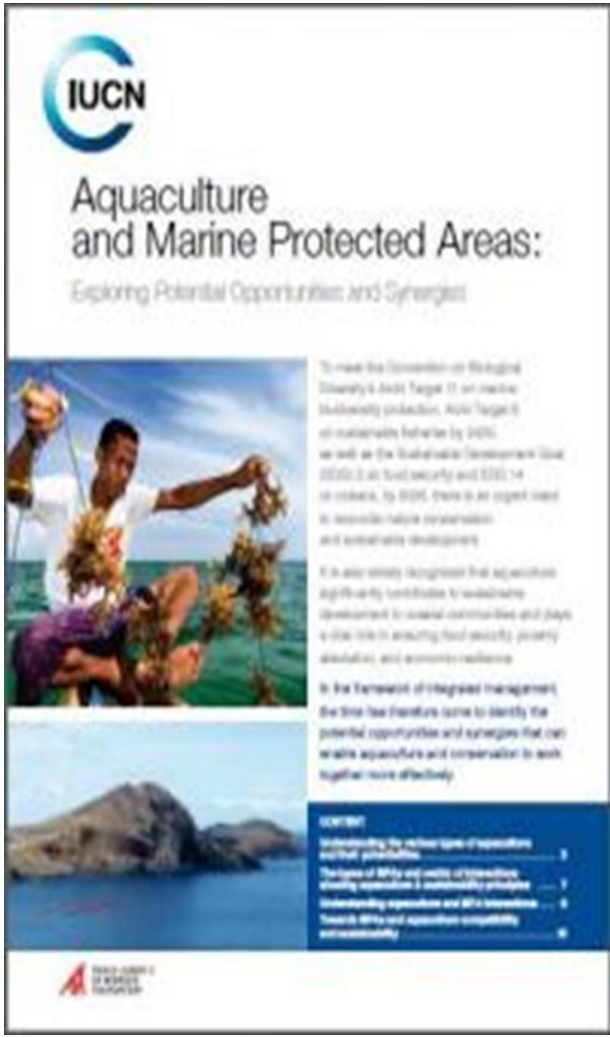
Food and Agriculture Organization of the United Nations

FAO
FISHERIES AND
AQUACULTURE
PROCEEDINGS
17
ISSN 2070-6065

The potential of spatial planning tools to support the ecosystem approach to aquaculture

FAO/Rome Expert Workshop
19–21 November 2008
Rome, Italy

Nature-based Solutions



Food and Agriculture Organization of the United Nations

FAO FISHERIES AND AQUACULTURE PROCEEDINGS
21
ISSN 2070-6065

Site selection and carrying capacities for inland and coastal aquaculture

FAO/Institute of Aquaculture, University of Stirling, Expert Workshop
6–8 December 2010
Stirling, the United Kingdom of Great Britain and Northern Ireland

Food and Agriculture Organization of the United Nations

ISSN 1020-5292

Food and Agriculture Organization of the United Nations

FAO
TECHNICAL GUIDELINES FOR RESPONSIBLE FISHERIES

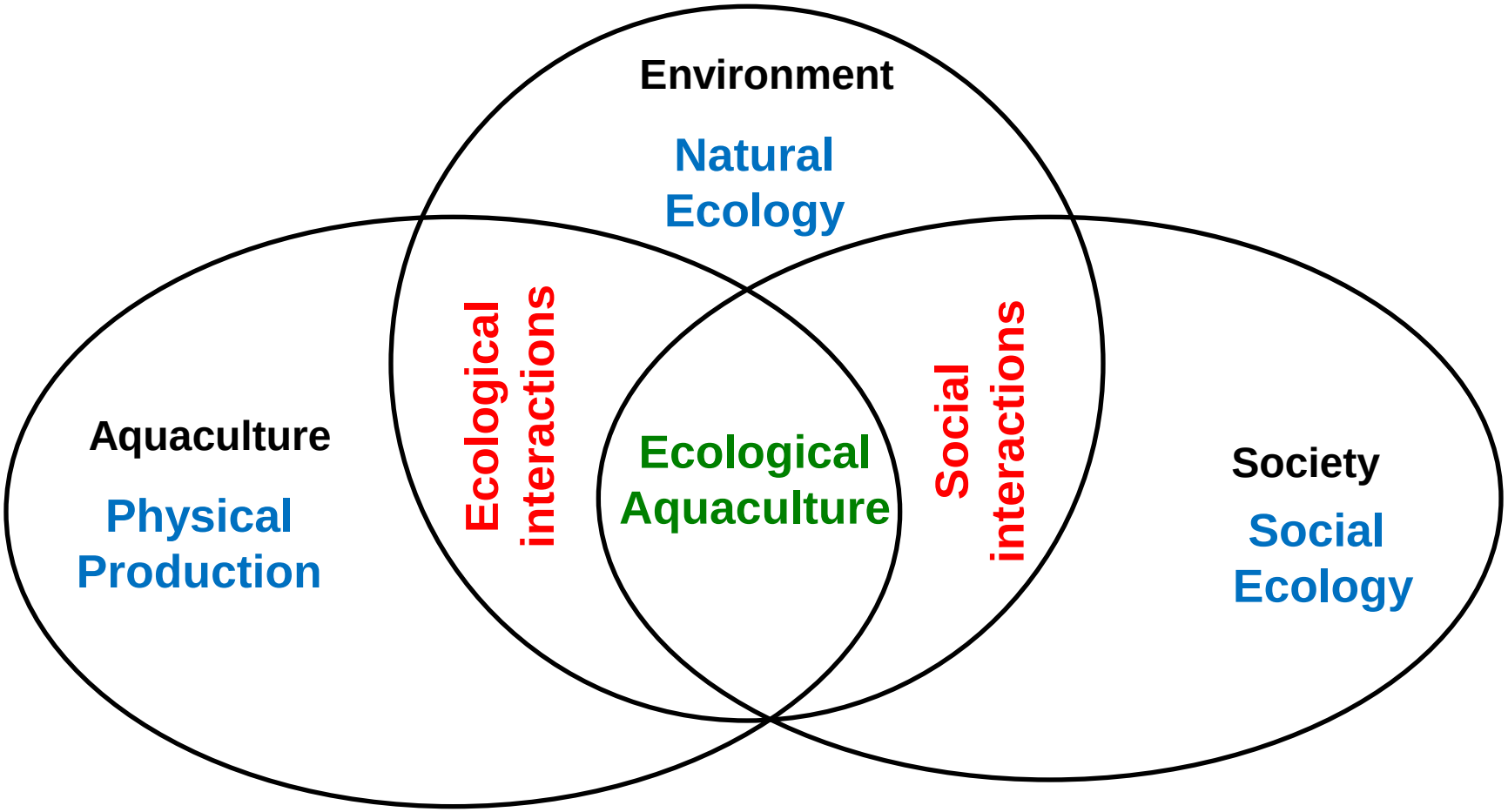
5

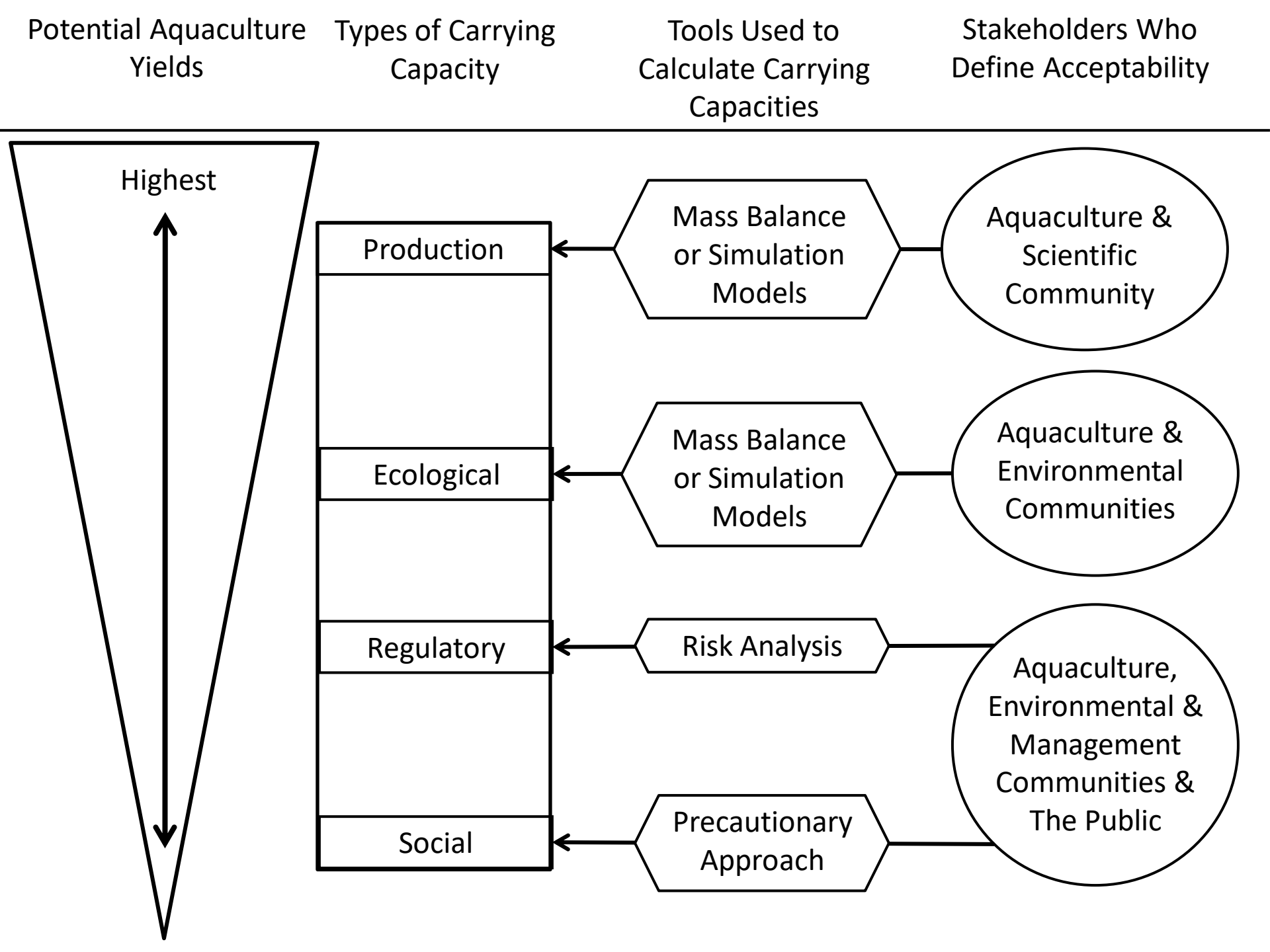
Suppl. 7

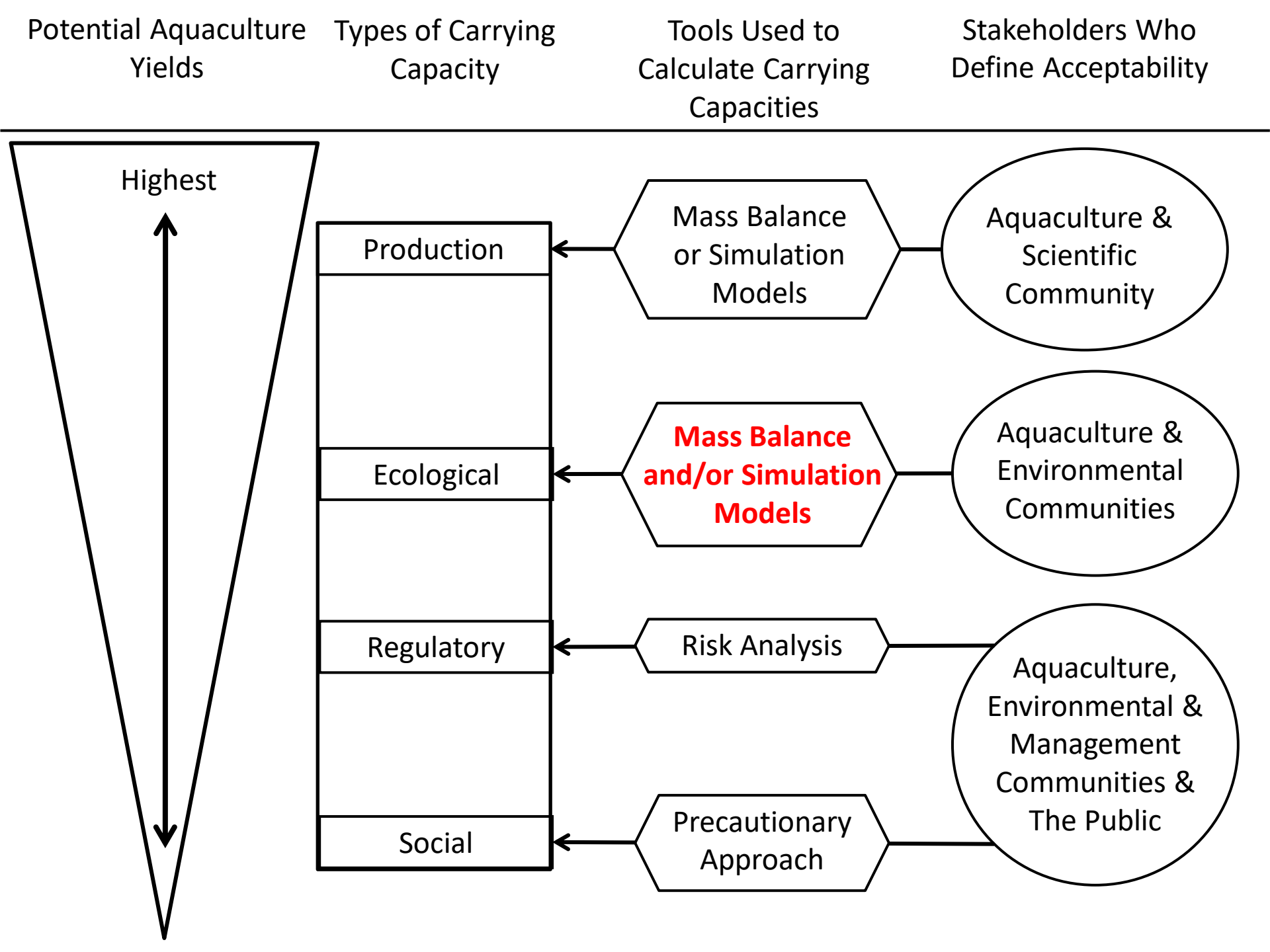
AQUACULTURE DEVELOPMENT

7. Aquaculture governance and sector development

Carrying Capacity Framework




Potential Aquaculture Yields
Types of Carrying Capacity
Tools Used to Calculate Carrying Capacities
Stakeholders Who Define Acceptability
Highest
Production
Ecological
Regulatory
Social
Mass Balance or Simulation Models
Mass Balance or Simulation Models
Risk Analysis
Precautionary Approach
Aquaculture & Scientific Community
Aquaculture & Environmental Communities
Aquaculture, Environmental & Management Communities & The Public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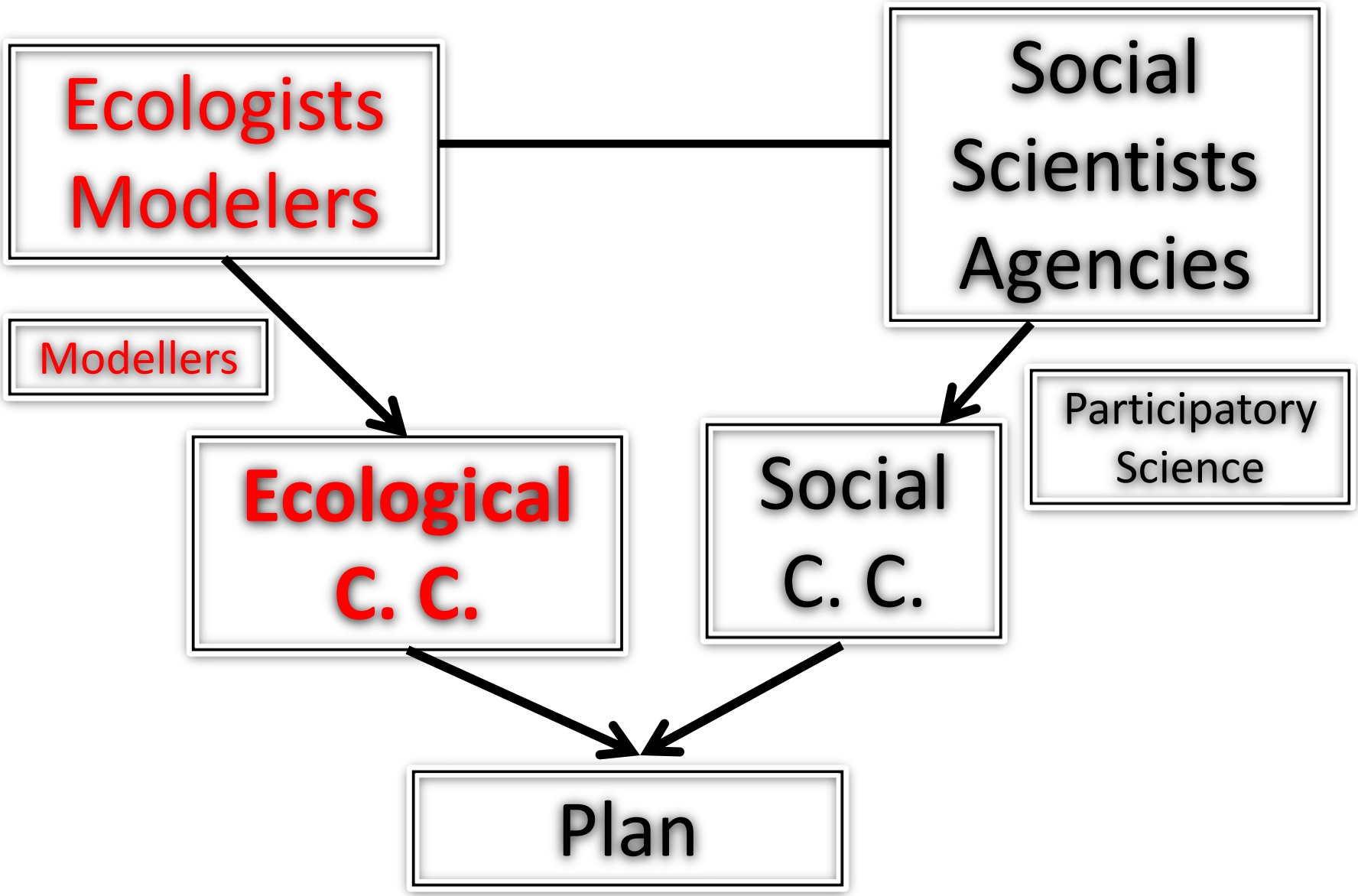
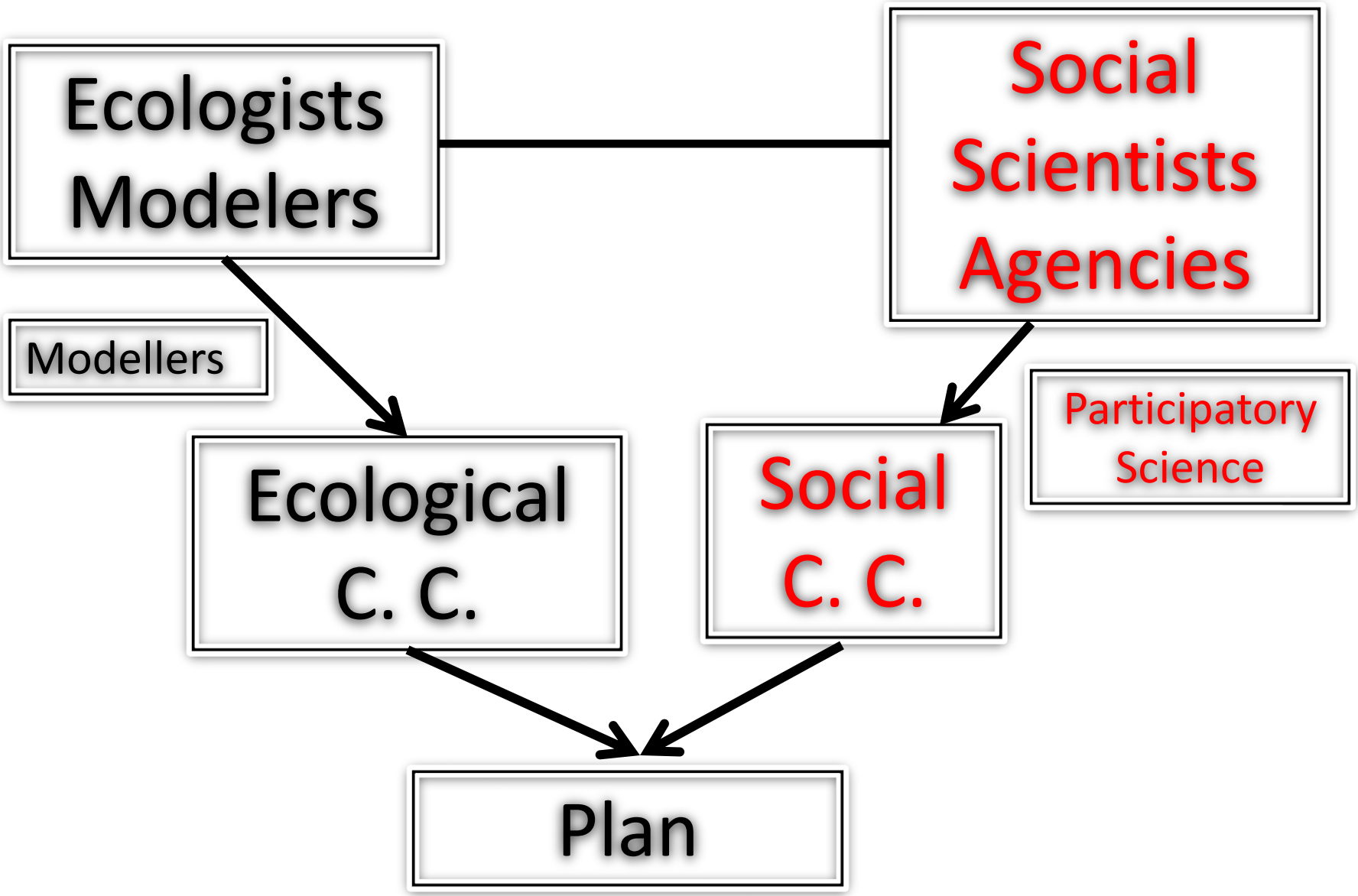

Ecologists
Modelers
Social
Scientists
Agencies
Modellers
Participatory
Science
Ecological
C. C.
Social
C. C.
Plan

McKindsey CW, Thetmeyer H, Landry T, Silvert W (2006) Review of recent carrying capacity models for bivalve culture and recommendations for research and management. *Aquaculture* 261(2): 451–462.

Byron, C., J. Link, B.A. Costa-Pierce, D. Bengtson. 2011. Modeling ecological carrying capacity of shellfish aquaculture in highly flushed temperate lagoons. *Aquaculture* 314: 87-99.

Byron, C., J. Link, B.A. Costa-Pierce, D. Bengtson. 2011. Calculating ecological carrying capacity of shellfish aquaculture using mass-balance modeling: Narragansett Bay, Rhode Island. *Ecological Modeling* 222: 1743-1755.

Byron CJ, Costa-Pierce BA (2013) Carrying capacity tools for use in the implementation of an ecosystems approach to aquaculture. In: LG Ross, TC Telfer, L Falconer, D Soto, J Aguilar-Manjarrez (eds) *Site Selection and Carrying Capacities for Inland and Coastal Aquaculture*, pp. 87–101. FAO, Rome, Italy.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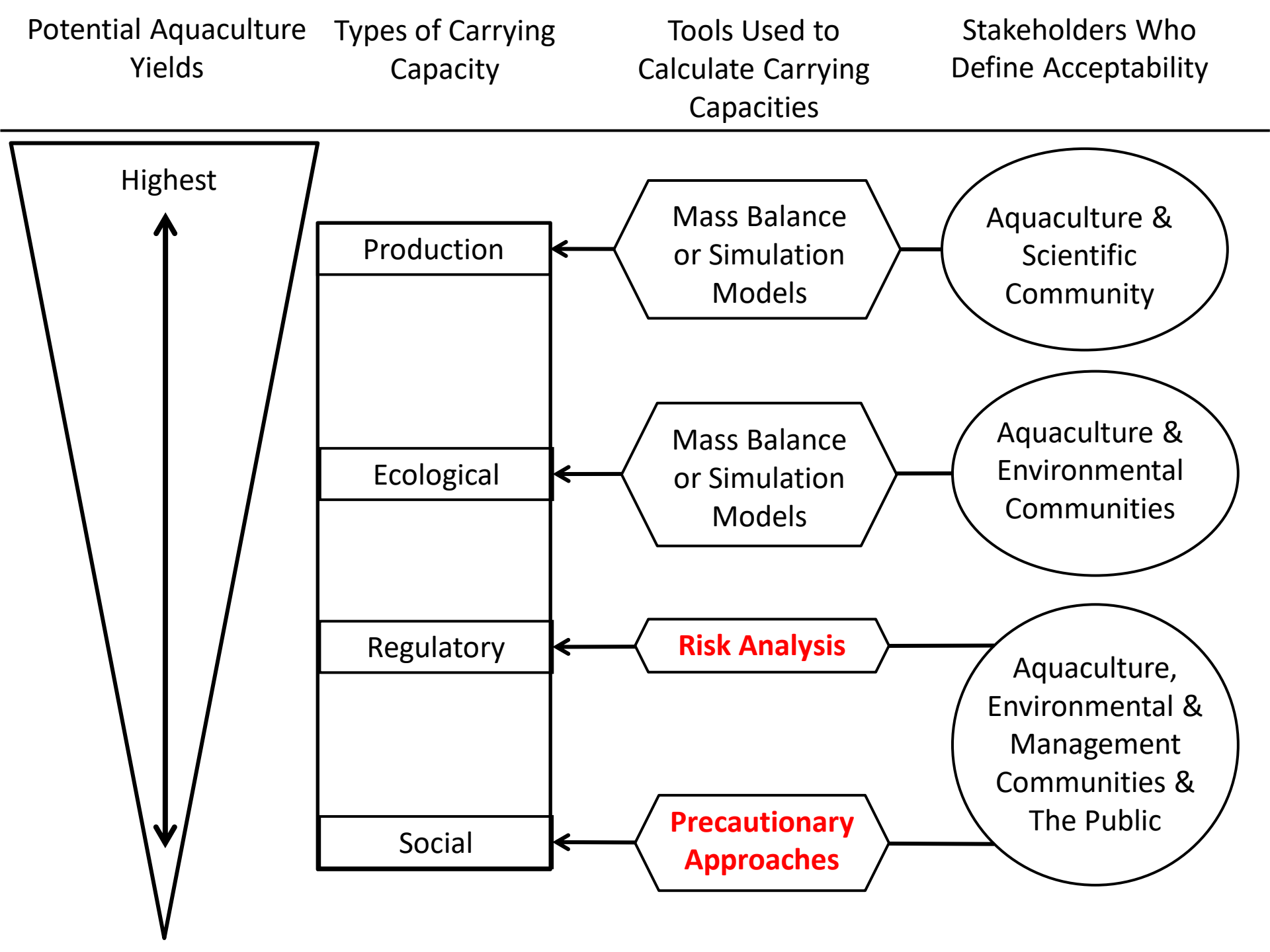
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Risk Analysis
Precautionary Approaches
Aquaculture & Scientific Community
Aquaculture & Environmental Communities
Aquaculture, Environmental & Management Communities & The Public

Transdisciplinary Research …

in Principle

and

in Practice

Bailey C (2008) Human dimensions of an ecosystem approach to aquaculture. In: D Soto, J Aguilar-Manjarrez, N Hishamunda (eds) *Building an Ecosystem Approach to Aquaculture*, pp. 37–46. FAO, Rome, Italy.

Little DC, Murray FJ, Leschen W, Waley D (2013) Socio-economic factors affecting aquaculture site selection and carrying capacity. In: LG Ross, TC Telfer, L Falconer, D Soto, J Aguilar-Manjarrez (eds) *Site Selection and Carrying Capacities for Inland and Coastal Aquaculture*, pp. 103–115. FAO, Rome, Italy.

“Transdisciplinarity today is characterized by its focus on “*wicked problems*” that need *creative solutions*, its reliance on *stakeholder involvement*, and engaged, socially responsible science.”

Bernstein, J. H. 2015. Transdisciplinarity: A review of its origins, development, and current issues. *Journal of Research Practice 11(1):* R1.

Types of Cross-Disciplinary Science

(Rosenfield, 1992)

- **Multidisciplinary** - researchers in different disciplines *work independently* or sequentially, each from his or her own disciplinary-specific perspective, to address a common problem
- **Interdisciplinary** - researchers *work jointly*, but from each of their respective disciplinary perspectives, to address a common problem
- ***Transdisciplinary*** - researchers work jointly using a *shared conceptual framework* that draws together discipline-specific theories, concepts, and approaches, to address a common problem

Benefits of Transdisciplinary Scientific Collaboration

- Greater Explanatory Power
- Methodological Diversity
- Real World Problems
- Learning Cohorts/Lifelong Networks

Outcomes of Collaboration

- Novel Integrated Ideas
- Societal and Scientific Advances
- Training Outcomes
- Institutional Changes
- Policy Innovations
- Industry Progress

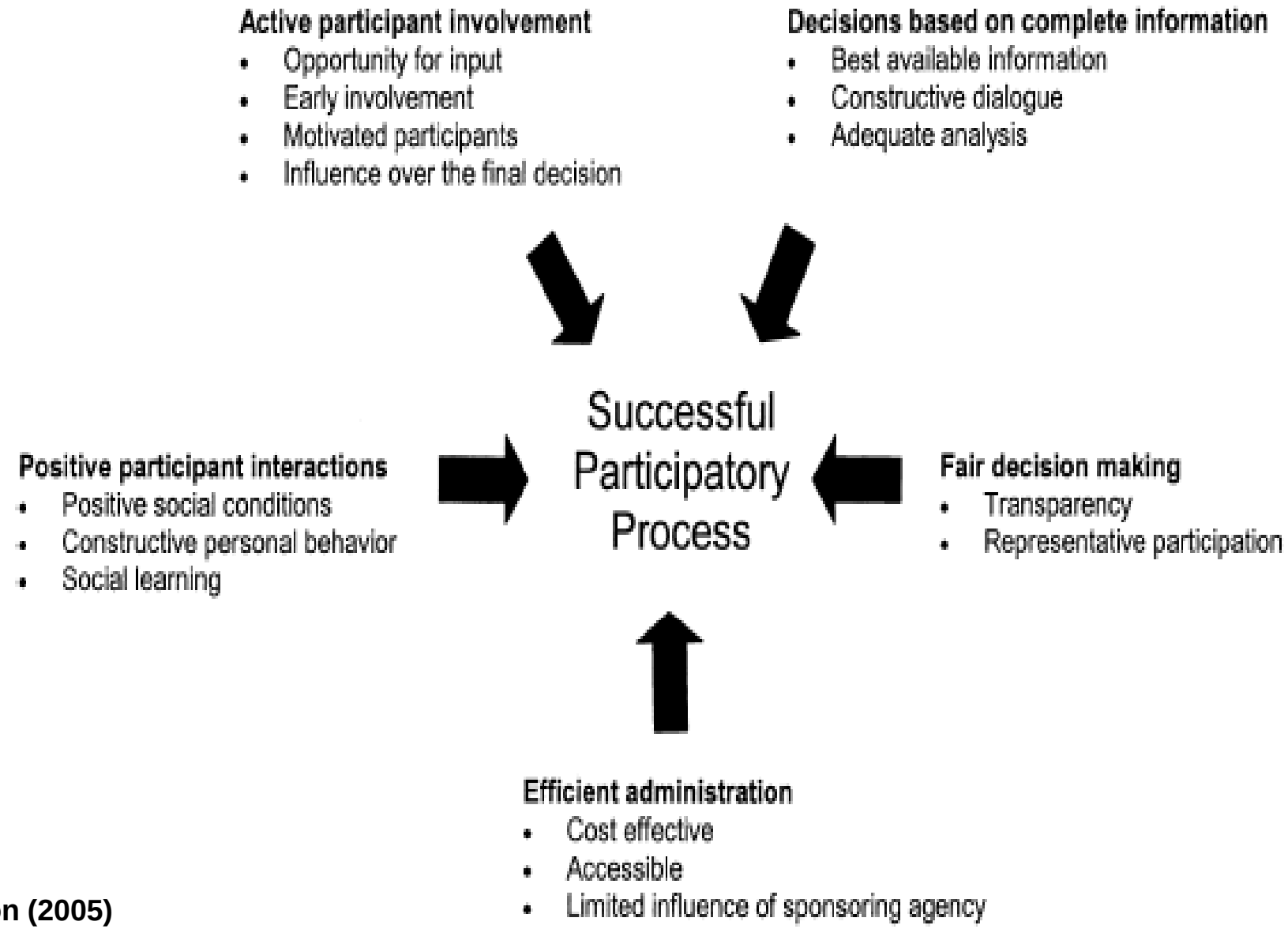
Potential Costs of Transdisciplinary Scientific Collaboration

- Labor Intensive and Conflicts *Many*
- Administratively *Complex*
- Analytic Breadth vs. Depth Tradeoffs
- Diffuse vs. Focused *Conceptual Models*

Some Qualifications

- *Fewer precedents & people in this type of research*
- *Little prior agreement on the meaning and intended outcomes of transdisciplinary research*
- *Non-random selection of professionals into collaborative research ventures*
- *Non-neutral status of evaluators*
- *Different timeframes for evaluation - 5 - year program evaluation vs. multi-decade impacts perspective*

Social Ecology of Aquaculture



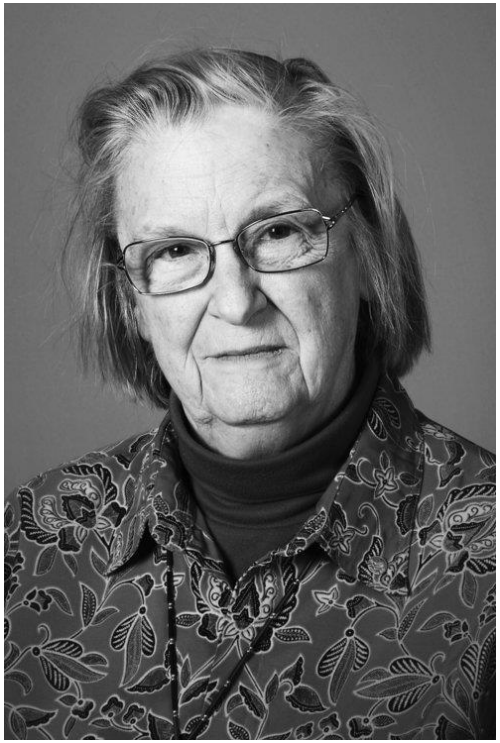
Dalton (2005)
***Conservation Biology* 19: 1392-1401.**

Social Carrying Capacity

Hardin's
Tragedy of the Commons

vs.

Ostrom's
Enlightened Self Interest



TRAGEDY OF THE
UNMANAGED COMMONS!

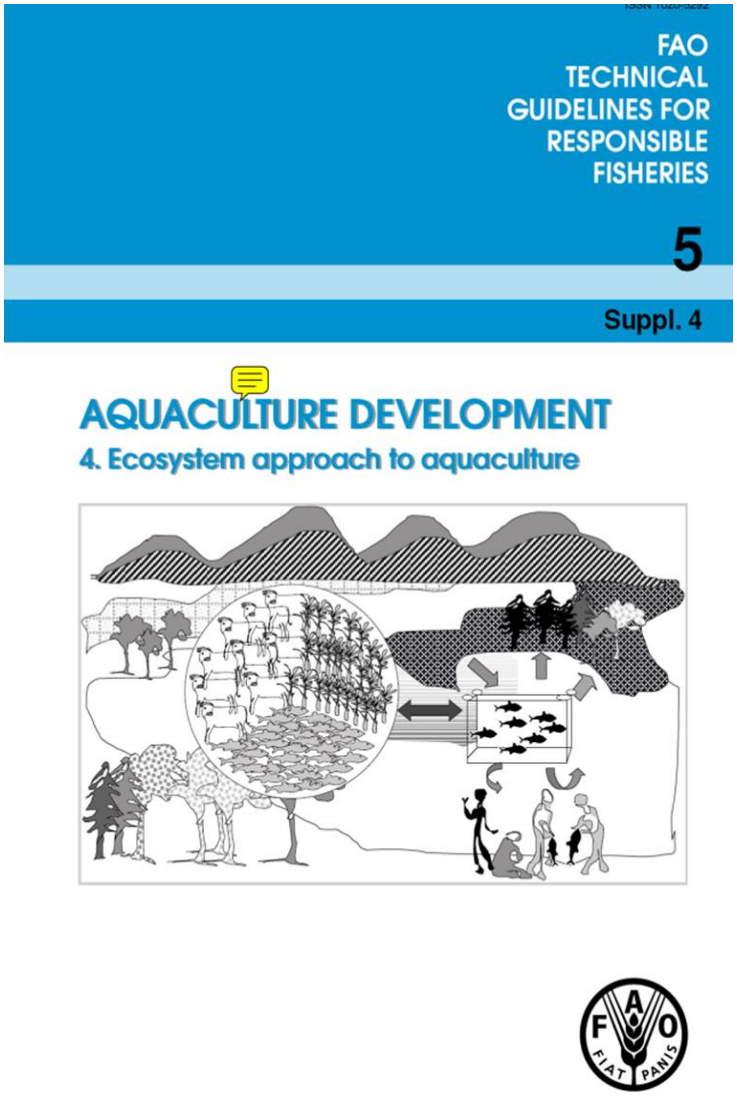
Why Is the FAO Ecosystem Approach to Aquaculture So Important?

Aligns to Planetary Boundaries, Planetary Health, Planetary Diets

Creates an International to Local Learning Community

Aligns to Rural Economic Development
for example it is INCLUSIVE of Fishing
= **Ostrom NOT Hardin**

Goes Beyond Certifications



APPLIES TO ALL JURISDICTIONS

Nation states – Indigenous Nations

Provinces – states – regions

Businesses

Industry

Academic centers

NGOs

Faiths

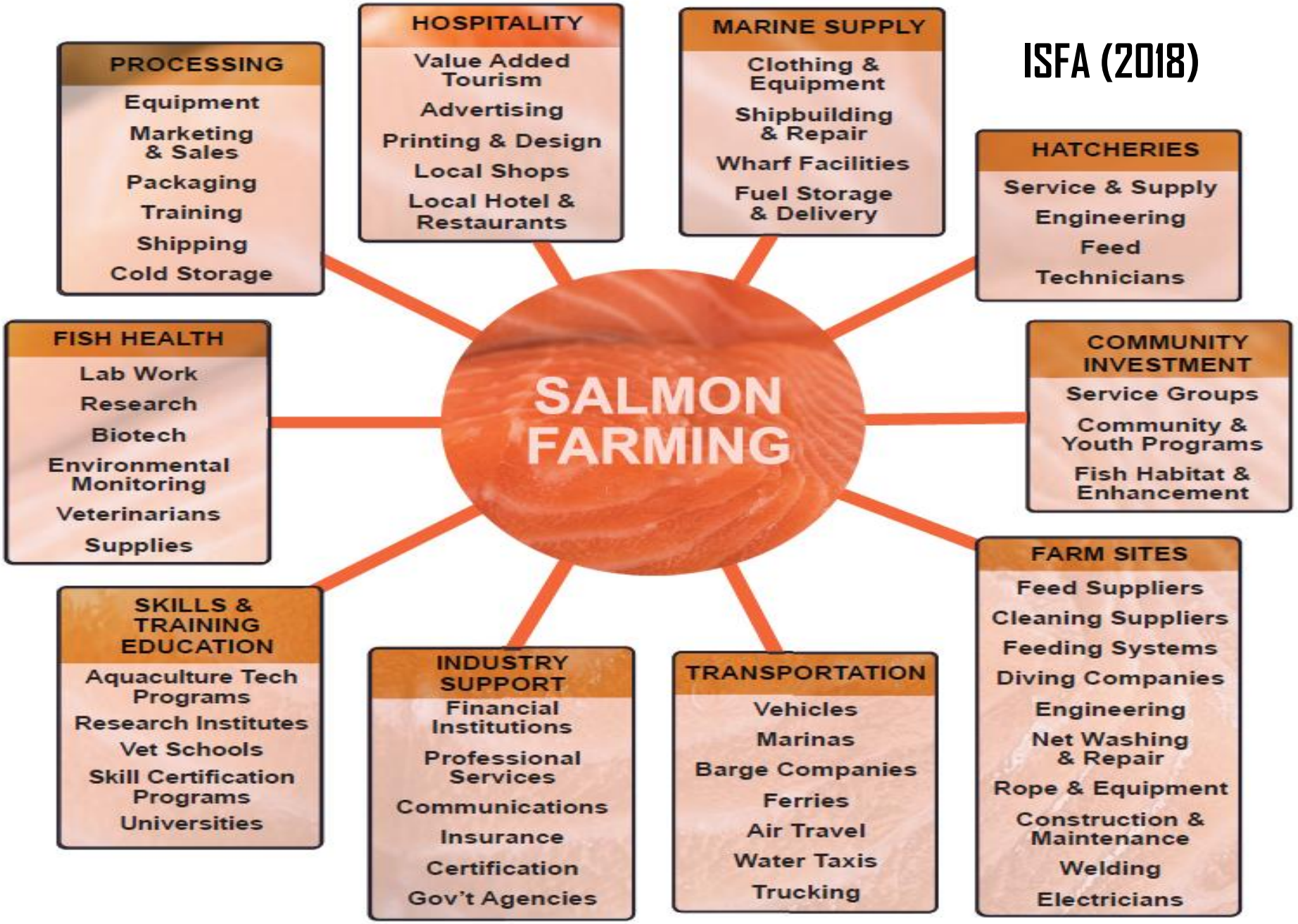
Significant Advances in Common Property Resources

Aquaculture as Rural Development

Aquaculture Tourism – NOAA Sea Grant, West Coast of Sweden, Red Sea Development Company/Aquaculture

Many examples: Rwanda – Mountain Gorillas

…supporting communities to confront history, shape new narratives, collectively heal and project new possibilities for the future…


ISFA (2018)
SALMON FARMING
PROCESSING
Equipment
Marketing & Sales
Packaging
Training
Shipping
Cold Storage
HOSPITALITY
Value Added Tourism
Advertising
Printing & Design
Local Shops
Local Hotel & Restaurants
MARINE SUPPLY
Clothing & Equipment
Shipbuilding & Repair
Wharf Facilities
Fuel Storage & Delivery
HATCHERIES
Service & Supply
Engineering
Feed
Technicians
FISH HEALTH
Lab Work
Research
Biotech
Environmental Monitoring
Veterinarians
Supplies
COMMUNITY INVESTMENT
Service Groups
Community & Youth Programs
Fish Habitat & Enhancement
SKILLS & TRAINING EDUCATION
Aquaculture Tech Programs
Research Institutes
Vet Schools
Skill Certification Programs
Universities
INDUSTRY SUPPORT
Financial Institutions
Professional Services
Communications
Insurance
Certification
Gov't Agencies
TRANSPORTATION
Vehicles
Marinas
Barge Companies
Ferries
Air Travel
Water Taxis
Trucking
FARM SITES
Feed Suppliers
Cleaning Suppliers
Feeding Systems
Diving Companies
Engineering
Net Washing & Repair
Rope & Equipment
Construction & Maintenance
Welding
Electricians

BUT!

Why does planning for aquaculture come AFTER development?

Too much trial and error and money wasted by producers!

Hatcheries

- Design & Bioengineering
- Genetic Prospecting, Improvement & Biotech
- Technicians
- Equipment, Supplies & Services

Farming Sites

- Bioengineering
- Diving
- Maintenance
- Equipment, Supplies & Services

Marine Supply

- Wharf Facilities
- Fuel Delivery, Storage
- Vessel Technology
- Ship Building, Maintenance, Repairs
- Equipment, Supplies & Services

Research, Education & Training

- High School & Tech Programs
- College Programs
- Certifications
- Research & Development Grants, Awards
- Conference Services
- Equipment, Supplies & Services

Processing

- Product Development
- Drying & Storage
- Packaging
- Marketing & Sales
- Training
- Equipment, Supplies & Services

Transportation

- Shipping
- Fleet Vehicles
- Air Freight & Travel
- Barge Companies
- Trucking Companies
- Marinas
- Water Taxis
- Ferries
- Equipment, Supplies & Services

Industry Services

- Financial Services
- Professional Services
- Permitting
- Insurance
- Communications

Product Health

- Consumer Safety
- Environmental Monitoring
- Permitting
- Certifications
- Biotech
- Equipment, Supplies & Services

Hospitality

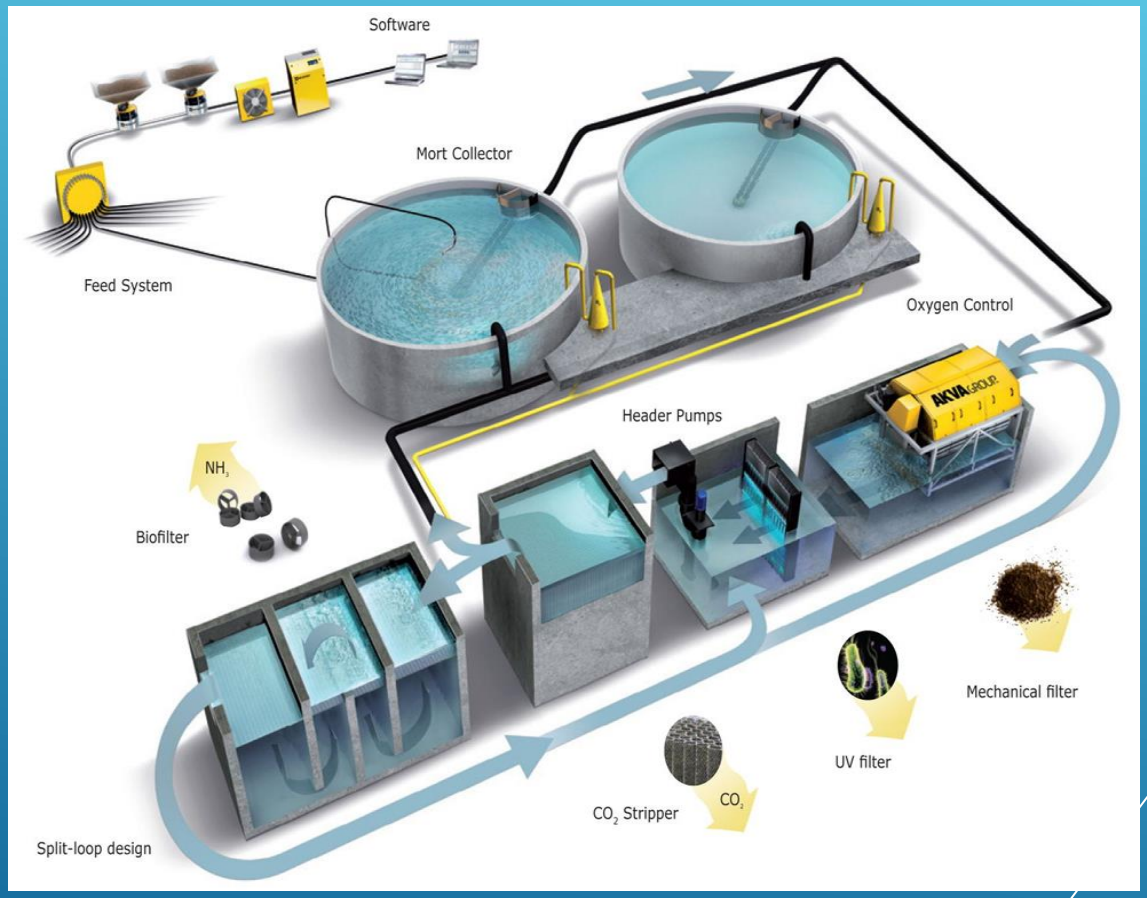
- Aquaculture Tourism
- Design Services, Advertising
- Restaurants
- Hotels
- Tourist Shops
- Equipment, Supplies & Services

Community Support

- Service Groups
- School/Youth Programs
- Adult/Senior Programs
- Environmental Programs
- Philanthropy

Costa-Pierce, B.A. 2022, forthcoming. *Radical Aquaculture*. 5 m Press, London.

Recirculating Aquaculture Systems(RAS)




50,000 to 100,000 MT?
Scaling OUT
Sustainable Rural Development
RAS as an Aquaculture Ecosystems
Develop Profitable Business Models
at Community/Regional Scale
1,000 to 10,000 MT
Restoration
Education
Energy
Biogas
Aquaponics
Value Chain
Logistics
Tourism

Integration of Tourism and Aquaculture

Tourism contributes to ~10% of global GDP
Businesses that incorporate sustainable tourism into aquaculture can be very successful

Tourism can increase demand for a product with higher profit margins

Ecological Aquaculture:
Synergies with the Local Economy, Technological, Educational Advancements

Lamar S.A., Kameiros Skala, Rhodes, Greece

Lamar S.A., Kameiros Skala, Rhodes, Greece

*300T sea bass, red sea bream, gilthead sea bream, meagre for local markets

*Cooperate with a dive center - to snorkel, dive, tour - Visitors can swim with fish in a designated cage

*Food for tourists sourced from local fish farms is fresher, have less environmental impacts; support local livelihoods

*Hellenic Centre for Marine Research - water quality research assists aquaculture management programs; data shared freely

*Cooperate with Wings ICT Solutions a local telecommunications company on a monitoring/management platform (cameras/sensors) to help to optimize farming conditions, ensure the well-being of fish and mitigate potential risks

*Education – in farming practices, the necessity to grow aquaculture in Europe, the relationship between aquaculture and the environment, biodiversity and environmental protection

Owners aim to turn their farm into a Marine Protected Area (MPA)

Aquaculture conflicts in New Geographies - Iceland

Arctic Charr are a traditional food in the Nordic, Arctic, and Subarctic regions… innovative connections between culinary, heritage-based, and nature-based tourism and the Arctic Char aquatic food system

Guðrún Helgadóttir et al (2022) Wild and Farmed Arctic Char as a Tourism Product in an Era of Climate Change


Experiences

Casual Crabbing with Tia

…lauded as one of the most popular Airbnb Experiences in the world…

Frontiers Research Topic (frontiersin.org)

Ocean/Aquatic Food Systems: Interactions with Ecosystems, Fisheries, Aquaculture, and People

Barry Antonio Costa-Pierce, USA and PORTUGAL
Helgi Thor Thorarensen, NORWAY
Åsa Strand, SWEDEN

82 authors in 10 articles: 4 original research, 2 reviews, 2 perspectives, 1 policy, and 1 hypothesis/theory

Recurring themes:

- Marine and freshwater food systems in capture fisheries and aquaculture are managed as if they are independent entities separate from markets.
- **Transdisciplinary research approaches co-produced with consumers and the wider public will be required for aquaculture to expand.**
- Ocean/aquatic and terrestrial food production systems remain siloed from each other with few studies addressing their combined contributions.
- Promotion of diverse aquaculture scales may allow development of new ecological and social synergies for smaller farms to achieve economic viability at regional scales

Transdisciplinary Research "Readiness"

- What disciplines do you need to partner with?
- What will be some of the challenges in partnering? How might you overcome these challenges?

- Similarity of **worldviews**
- Spatial, functional, and electronic **connections among investigators**
- **History of collaboration** on prior projects--*preparation, practice, and trust*
- Members **strongly committed** to transdisciplinary work
- **Formative evaluation - what's working/not working** processes to facilitate collaboration
- **Institutional support** for transdisciplinary collaboration

Costa-Pierce, B.A. 2021. The social ecology of aquaculture in its new geographies. *World Aquaculture* 52 (3): 43-50.

Brugere et al. (2018) reviewed progress towards adoption of the EAA

uptake of the EAA was “**relatively low**”

The EAA was ***not playing its anticipated roles in guiding*** the work, strategies and interventions of international and regional development players in the fisheries and aquaculture organizations

The main constraints were:

**legislative and regulatory issues
**ineffective interagency integration and coordination
**financial constraints
**lack of human resources

**and an ambiguity in the perceived benefits of these approaches by administrators and producers..”

New International Transdisciplinary Graduate Programmes

- Team science, social work
- Local-Global to Global-Local
- Required stakeholder/industry connections
- Transdisciplinary thesis project
- Cross cutting: Sustainability, production, climate change, social, indigenous, gender, equality issues

Tusen takk

Tack så mycket

Thank you

Muchas gracias

Muito obrigado

Shukran jazilan

Mahalo nui loa

Tack så mycket

Terima kasih