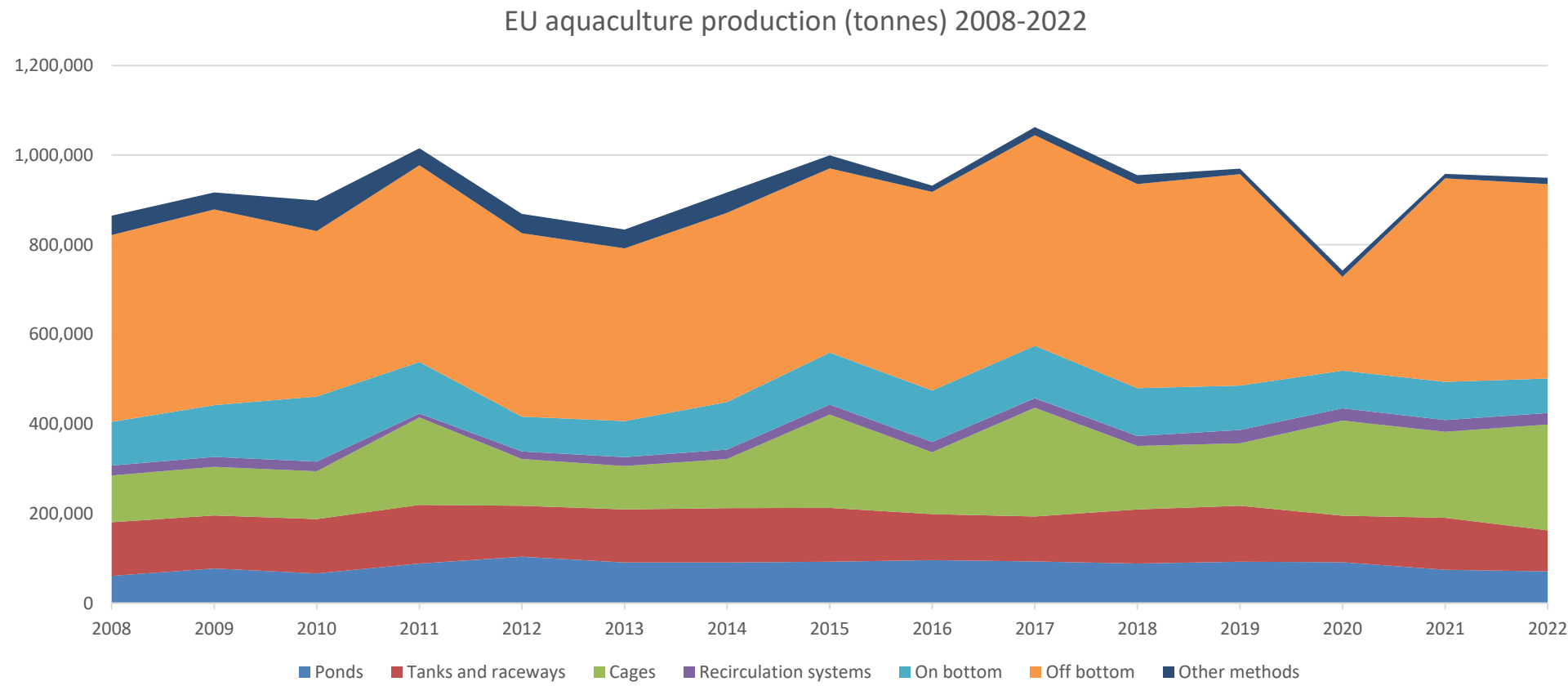
Aquaculture multifunctionality as a response to the challenges of sustainable development

Tomasz Kulikowski, Adam Mytlewski

Making aquaculture a vital part of the European sustainable food system
Brussels, October 14th, 2024

Aquaculture production function



Own evaluation. Source: Eurostat database *(Production from aquaculture excluding hatcheries and nurseries)*

Aquaculture production function

EU aquaculture structure and dynamics

Main methods	Share by Volume (2022)	Volume Change (2020-2022 vs. 2008-2010)	Share by Value (2022)
Off bottom	46%	-10%	21%
Cages	25%	+101%	46%
On bottom	8%	-32%	11%
Tanks and raceways	10%	-14%	10%
Ponds	7%	+16%	7%
Recirculation systems (RAS)	3%	+21%	3%
All methods		-1%	

Own evaluation. Source: Eurostat database *(Production from aquaculture excluding hatcheries and nurseries)*

Sustainable development (SD) of the European aquaculture

- **„Sustainable development is the management and conservation of the natural resource** base and the orientation of technological and institutional change in such a manner as to ensure the attainment and continued satisfaction of human needs for present and future generations. **Such sustainable development (In aquaculture) conserves land, water, plant, and animal resources, is environmentally non-degrading, technically appropriate, economically viable, and socially acceptable.''** (Code of Conduct for Responsible Fisheries, FAO 1995).
- „Use of the environment and resources that meets the needs of the present without compromising the ability of future generations to meet their own needs". This definition integrates **environmental stewardship with social responsibility and economic gain**, thereby presenting an understanding that exclusive focus on economic growth ignores and impedes social development and environmental protection, thus emphasizing the need to integrate various paths toward the improvement of conditions in the developing world. (United Nations World Commission on Environment and Development, Hove, 2004).

In the context of achieving
sustainable development goals,
the term
'multifunctionality of aquaculture'
often arises.
What is multifunctionality of aquaculture?

Fot. 123rf.com

Example of multifunctionality in aquaculture

Kintai Fish Farm (Lithuania)

Juvenile production

Angling

Main(?) product - carp

Accomodation, events

Water tourism

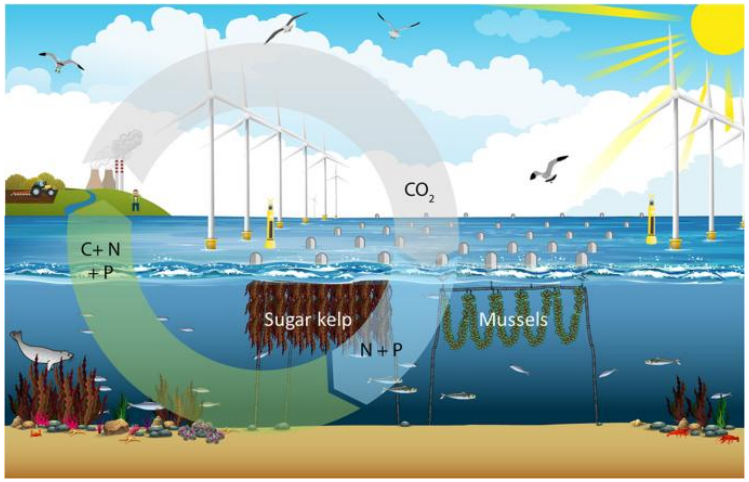
Additional RAS
- African catfish

Own fish processing

Gastronomy

Fot. T. Kulikowski (2) & courtesy of Kintai Fish Farmc

Multifunctionality enhanced by synergies



Wind farm
+ (seaweed & shellfish) mariculture

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Multi-use of offshore wind farms with low-trophic aquaculture can help achieve global sustainability goals

Marie Maar, Andreas Holbach, Teis Boderskov, Marianne Thomsen, Bela H. Buck, Jonne Kotta & Annette Bruhn

Thermal energy from cogeneration / biogas production + RAS

(Germany)

Fot. T.Kulikowski

Multifunctional aquaculture benefits

Production function
(fish production for human consumption)

Main possible economic benefits

- *Creation of Added Value and GDP*
- *Stabilizing the market, reducing dependence on imports, creating short supply chains*

Main possible social benefits

- *Food security & healthy diets*
- *Job creation in rural/seaside areas*
- *Educational services*
- *Uniqueness of the landscape*
- *Cultural identity (heritage)*
- *Community cohesion*

Main possible environmental benefits

- *Production of juvenile for re-stocking*
- *Maintaining biodiversity*
- *Water retention and hydrodynamic regulation*
- *Microclimate regulation*
- *Climate change mitigation*
- *Positive impact on the biochemical quality of water*

The predispositions of selected types of aquaculture for multifunctionality

		Production and economic benefits	Social benefits	Environmental benefits
Inland RAS		High intensivity per water volume and per employee	Growing demand for know-how and education	Easing the burden on other production systems (inc. more polluting farming)
Finfish mariculture in cages		High intensivity per water volume and per employee	Job creation in seaside areas	Easing the burden on other production systems (inc. fisheries)
Macroalgae mariculture		Moderate intensivity per employee	Job creation in seaside areas	CO_2 sequestration N, P reduction
Pond aquaculture		Low-intensivity per employee and per area	Job creation in rural ares Community integration, heritage, cultural role, landscape	Habits & biodiversity Water retention Microclimate regulation

Development determinans

	Market challanges	Economical (financial) viability	Climate change resilience	Energy consumption	Resource consumption (water, space)
Inland RAS	Market challanges with high prices	High CAPEX and OPEX, technological risks	Isolation from environmental factors	Moderate to high consumption	Low land requirement, low fresh water consumption
Finfish mariculture in cages	Easy market access (high demand)	Reasonable profitability	Moderate resilience on climate change	Low energy consumption	No freshwater consumption, moderate sea space internsity
Macroalgae mariculture	Important market challanges	Technological issues, low profitability	High resilience on climate change	Low energy consumption	No freshwater consumption, moderate sea space internsity
Pond aquaculture	Moderate market challanges	High CAPEX, low to moderate profitability	High dependence on water availability, moderate dependence on extreme weather events	Moderate energy consumption	High land requirement, High water demand

Multifunctionality assesment

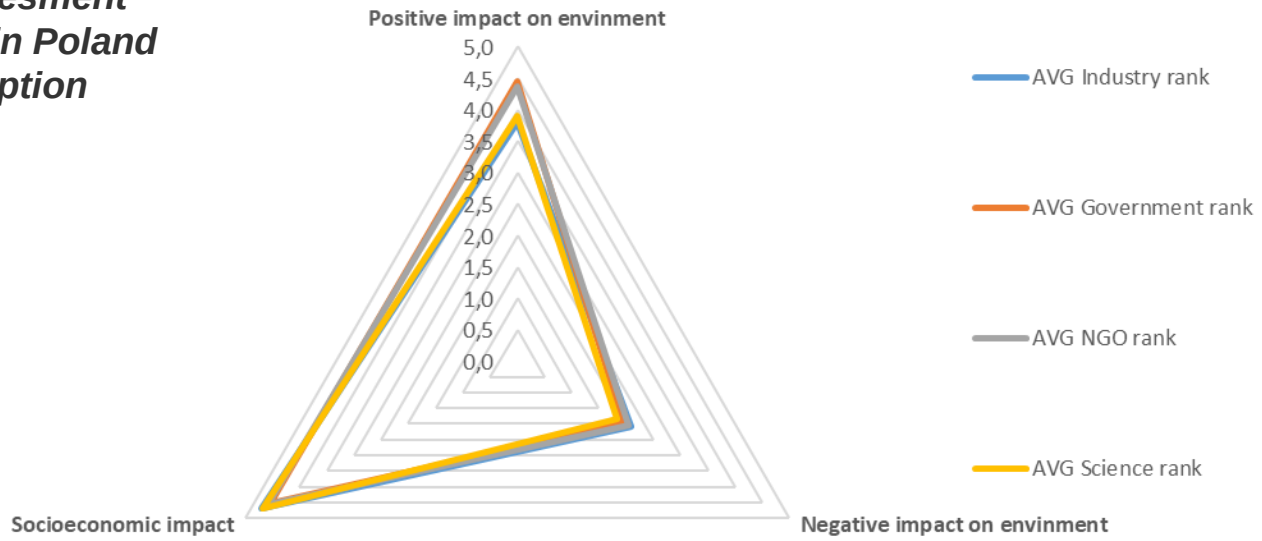
While a general assessment of the benefits and risks associated with the development of a particular type of aquaculture is relatively straightforward,
there is **a lack of a coherent, transparent, and recognized system for valuing individual environmental and social benefits**, as well as an **established parametric assessment of aquaculture**.

Fot. D.Tarasiewicz

Multifunctionality assesment

On the example of assesment of ponds aquaculture in Poland based on expert perception

Fot. T.Kulikowski



	Positive impact on envinment	Negative impact on envinment	Socioeconomic impact
AVG Industry rank	3,8	2,1	4,7
AVG Government rank	4,5	2,0	4,5
AVG NGO rank	4,4	2,0	4,6
AVG Science rank	3,9	1,8	4,7
Overal average rank	4,2	2,1	4,6

Source: Assessment of Environmental Benefits of Aquaculture and Challenges and Opportunities in Promoting those Benefits CINEA/2022/OP/0014 Specific Contract No. 01

Multifunctionality assesment

Fot. T.Kulikowski

The aim of this analysis is to calculate these payments, in order to answer the question: "how much collectively should be paid for the "other" functions which aquaculture farmers carry on, that's to say, for aquaculture multifunctionality?". The multifunctional subsidy (Sm) may be considered as:

$$Sm = \mu ea + \mu gea + \mu apa + \mu nsda + \mu woa + \mu hha$$

where each μ will be a payment for different externalities :

- μea = eutrophication
- μgea = greenhouse effect
- μapa = air pollution
- μnsda = natural stock depletion
- μwoa = working opportunities
- μhha = human health

AN INTERPRETATIVE MODEL OF AQUACULTURE MULTIFUNCTIONALITY: A METHODOLOGICAL FRAMEWORK DEFINITION*

G. De Blasi[1], C. Acciani[1], A. De Boni[1], R. Roma[1]

Many trials have shown a beneficial effect of fish intake corresponding to a daily consumption of 1g of omega-3 (on average, 2 fish meals in a week). In fact, men who were instructed to eat fish had a 29% decline in all-causes mortality linked to cardiovascular diseases, as compared with those in the placebo group. We can assess the benefit on human health as a monetary value making reference to the frequency of cardiovascular diseases in Italy (1.200.000 admissions to hospital) and to the corresponding public expenditure for treatments (855 million €). The monetary value for the positive effects on human health should be calculated as

$$\mu hh = Ap * C\Omega 3 * Pes$$

where
Ap= aquaculture production (Kg)
CΩ3=Ω3 contents of fish species (g/kg) (only edible part)
Pes= public expenditure saving €

Source: Assessment of Environmental Benefits of Aquaculture and Challenges and Opportunities in Promoting those Benefits CINEA/2022/OP/0014 Specific Contract No. 01

Key condition for multifunctionality

Maintaining the primary production function is essential. In most cases, additional benefits are strongly correlated with the efficiency of the production function (e.g., the ecological benefits of macroalgae cultivation are directly proportional to the level of production; ponds cease to provide most water-related environmental services as production stops).

The process of pond degradation (exemplified by a site in Grójec near Krakow, Poland), resulting from the cessation of aquaculture. Visible is the gradual overgrowth and shrub encroachment, along with the shrinking water surface area.
Source: Szczepański, 2022

Recommendations

- Developing the monitoring and research of environmental, social and economic benefits of aquaculture - **the calatogue of main benefits and negative impact**.
- **Valuation** and supporting of environmental and social benefits provided by aquaculture.
- **Inventory of resources** and conflicts (space, water resources, labour)
- **Support of productivity** in aquaculture (new technology, new feed, new infrastructure, new markets)
- Efficiency and sustainability regulation and promoting (**developing the multi-level scoring system of aquaculture**)

Aquaculture on the agenda

- The Polish Ministry of Agriculture and Rural Development **views with appreciation the inclusion of aquaculture among the key priorities** of the Hungarian Presidency in 2024.

- **The Polish Presidency, starting on 1 January 2025, will continue these efforts, recognising the role of aquaculture in ensuring the EU's food security.**

Thank you!

Tomasz Kulikowski; Adam Mytlewski, Ph.D.
tkulikowski@mir.gdynia.pl
Department of Fisheries Economics
National Marine Fisheries Research Institute