Current economics and sustainability of shrimp farming

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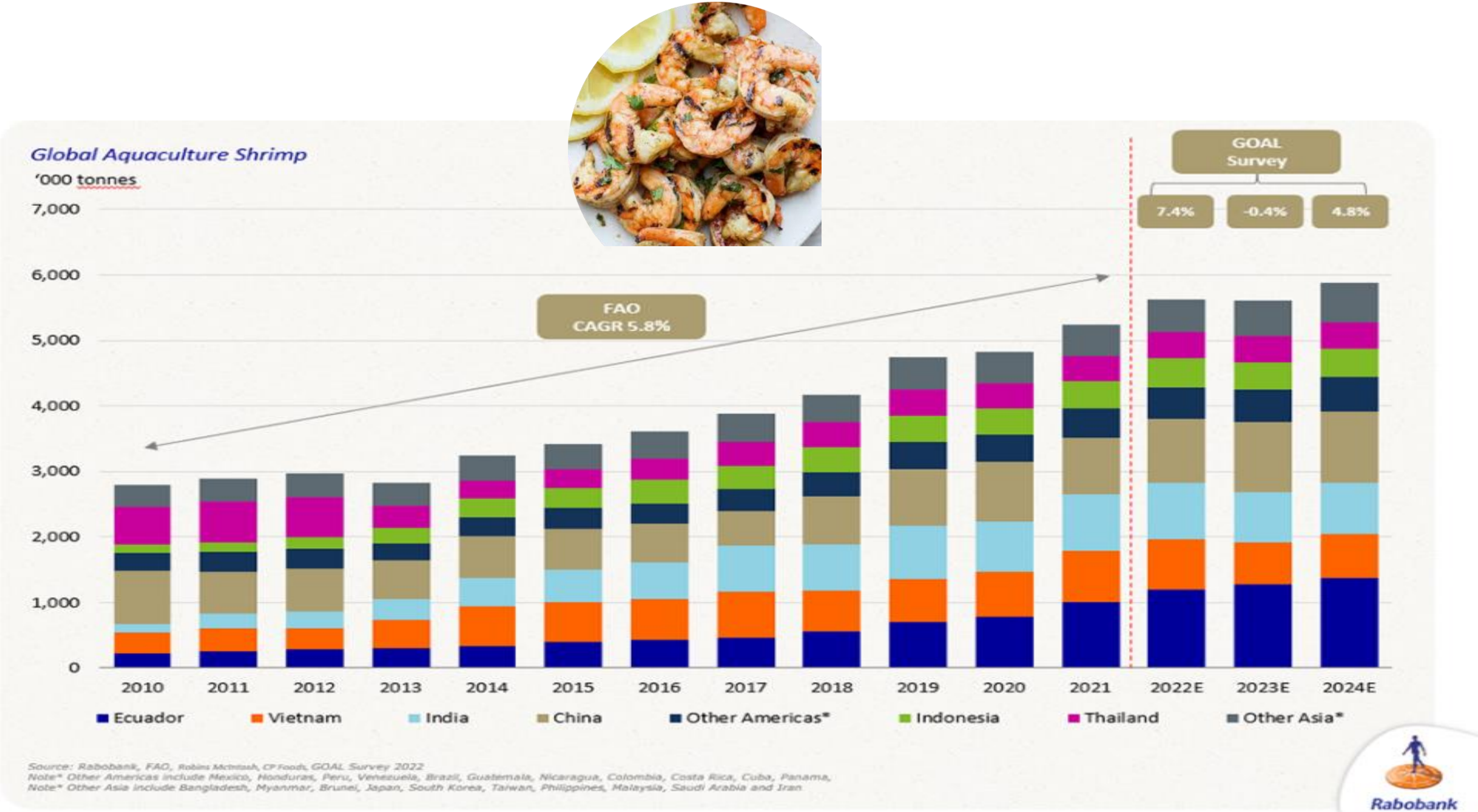
My topics today:

I. The current market
II. Producer's point of view
III. Sensitivity analysis (Ecuador production case)
IV. Efficiency, intensification and sustainability

I. The current market

- In our lifetimes shrimp and salmon have gone from being luxury products to commodities, thanks to aquaculture.
- Market now characterized by oversupply, slow demand, and low prices.
- Complicated by inflation which causes high cost of inputs. Notably feed.
- Producers are struggling and industry consolidation is going on.
- Prices to the consumer have not decreased.



Global Aquaculture Shrimp
'000 tonnes
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
FAO
CAGR 5.8%
GOAL
Survey
7.4%
-0.4%
4.8%
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022E
2023E
2024E
Ecuador
Vietnam
India
China
Other Americas*
Indonesia
Thailand
Other Asia*
Source: Rabobank, FAO, Robins McIntosh, CP Foods, GOAL Survey 2022
Note* Other Americas include Mexico, Honduras, Peru, Venezuela, Brazil, Guatemala, Nicaragua, Colombia, Costa Rica, Cuba, Panama,
Note* Other Asia include Bangladesh, Myanmar, Brunei, Japan, South Korea, Taiwan, Philippines, Malaysia, Saudi Arabia and Iran
Rabobank

Shrimp index benchmark price USD/kg

2014-2024

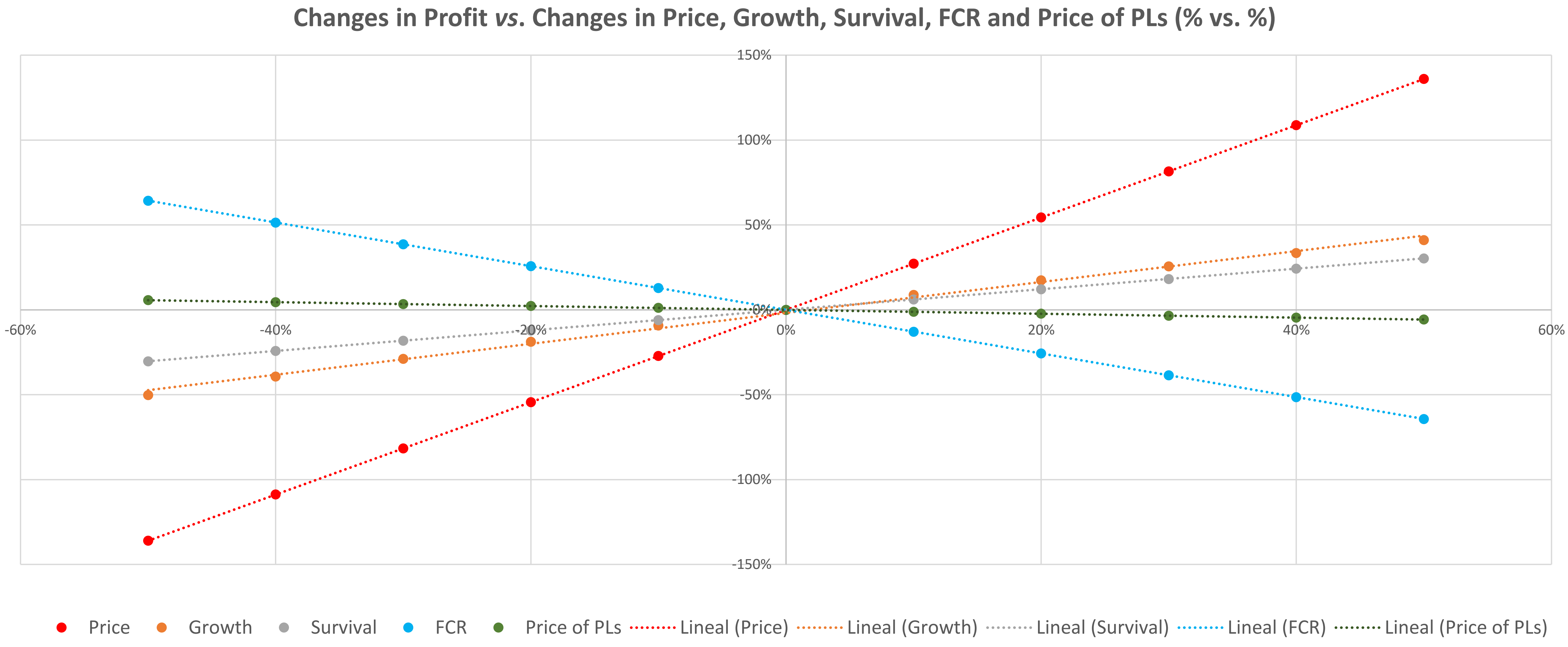
II. Producer's point of view
Five methods to survive the price crisis:

1. Boost consumption
2. Industry consolidation
3. Escape the commodity market
4. Become more economically efficient
5. Become more technically efficient

Prices at a high-end supermarket in Mexico April 2024. $1 USD = 16 MXN

III. Sensitivity analysis. Generalized economic model for an efficient shrimp farm in Ecuador

CATEGORY	VARIABLES/RESULTS	BASE	UNITS	NOTES
Management	**Stocking density**	**18**	**#/m2**	**Variable according to conditions from 15 to 20**
	Juvenile weight at stocking	**0.3**	**g**	**Variable according to nursery from 0.2 to 0.8**
	Harvest weight	**28**	**g**	**According to strategy. Constant in this model**
	Time between cycles:	**24**	**days**	**Variable according to tides and strategy**
	Harvest density	0.35	kg/m2/crop	Variable depending on farm and cropping system
Biology	**Growth**	**2**	**g/week**	**Variable according to genetics and conditions from 1.7 to 2.6**
	ADG	0.29	g/day	Variable 0.20 to 0.40
	Grow-out survival	**70**	**%**	**Variable according to conditions 50 to 90%**
	Nursery survival	**70**	**%**	**Variable from 60 to 80%**
	FCR	**1.6**	**g/g**	**Between 1.3 and 1.8**
Infrastructure	**Pond area**	**10,000**	**m2**	**Typical ponds are 7-12 hectares. Here everything per hectare**
Financial	**PLs Price**	**2.30**	**USD/1000**	**Range 1.80 to 2.40**
	Feed price	**1.20**	**$/kg**	**Feed range from $1000 to $1300 $/t**
	Other variable costs $	**1,000**	**/cycle**	
	Sale price, ex farm	**4.00**	**$/kg**	**Paid to producer pondside**
Results	Days to harvest	97	days	Varies according to conditions and market 50 to 120
	Cycles per year	3	cycles/year	
	Juveniles stocked	180	in 1000/cycle	
	Stocked biomass	54	kg/cycle	
	Harvested biomass	3,528	kg/cycle	
	Annual production	10,647	kg/year	
	Productivity	11	MT/ha/year	
	Annual use of juveniles	543	in 1000/year	
	Annual use of PLs	776	in 1000/year	
	Annual feed use	16,774	kg/year	
Costs	PLs	1,785	/year	
	Feed	20,129	$/year	
	Other variable costs	3,018	/year	
	Fixed costs	**2,000**	**/year**	
	Cost of production	$2.53	/kg	$2.50 to $2.70 on efficient farms
Revenue	Sales	$42,587	/year	
	Profit	**$15,655**	**/year**	



Change (%)	-50%	-40%	-30%	-20%	-10%	0%	10%	20%	30%	40%	50%	Rank
Price	-136%	-109%	-82%	-54%	-27%	0%	27%	54%	82%	109%	136%	1
FCR	64%	51%	39%	26%	13%	0%	-13%	-26%	-39%	-51%	-64%	2
Growth	-50%	-39%	-29%	-19%	-9%	0%	9%	17%	26%	33%	41%	3
Survival	-30%	-24%	-18%	-12%	-6%	0%	6%	12%	18%	24%	30%	4
Price of PLs	6%	5%	3%	2%	1%	0%	-1%	-2%	-3%	-5%	-6%	5

IV. Efficiency, intensification and sustainability

EFFICIENCY IS ABOUT DOING MORE WITH LESS

SUSTAINABILITY IS AN OVERUSED TERM THAT HAS ALMOST LOST ITS MEANING

Efficiencies of Different Animals

Feed and freshwater required to produce 1 Kg edible meat

8 kg feed
7,028 liters

3 kg feed
2,861 liters

2 kg feed
1,175 liters

1.5 kg feed
1,600 liters

1.5 kg feed
121 liters

0 kg feed
0 liters

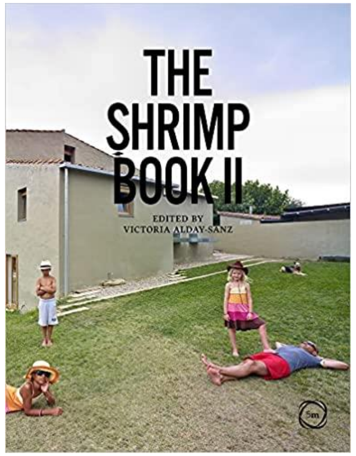
Shrimp farming is an efficient form of animal protein production

Sources:
http://www.nmfs.noaa.gov/aquaculture/faqs/faq_aq_101.html
http://www.salmonfacts.org/feedc.html
https://www.moore.org/docs/default-source/environmental-conservation

Average use of resources per metric ton of Shrimp produced in five countries and a in a hyperintensive farm in USA

Metric	Ecuador	India	Vietnam	Thailand	Indonesia	Hiper-intensive farm in USA
Stocking density (PLs/m^2)	22.5	38.3	57.3	76.5	92.5	150+
Survival (%)	»60	75.8	73.9	70.8	72.5	85
Crops/year	3.6	1.97	1.87	2.25	2.5	3.9
Crop duration (days)	91	115	90	90	100	84
Aeration rate (hp/ha)	9	18	24	43	?	110
Production (t/ha /year)	7.03	7.85	9.3	17.7	22.7	199
FCR	1.32	1.48	1.33	1.49	1.4	1.3
Water exchange (m^3/t)	76,817	126,498	15,100	---	33,475	1,145
Land use (ha/t)	0.19	0.152	0.196	0.12	0.077	0.020
Direct energy use (GJ/t)	24.4	62.1	37.1	38.8	42.8	37.2
Use of fish in feed (t/t)	0.89	0.66	0.63	0.67	0.61	1.69

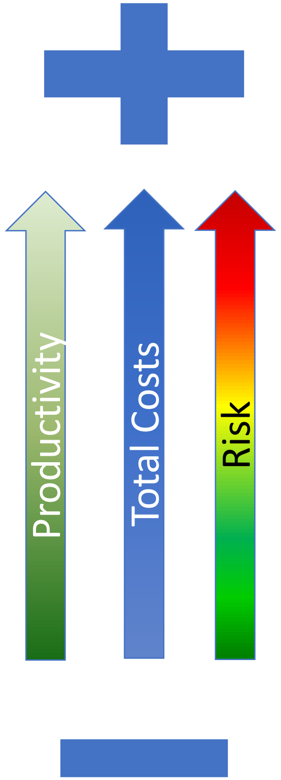
Fuente: Juarez, L.M, C.E. Boyd, A. McNevin, M. Craig and S. Nates. (2022). The Quest for Environmentally Responsible Shrimp Aquaculture. In, Alday V. (Ed). The Shrimp Book II: Research to Application in Penaeid Aquaculture. 5m Publishing, Sheffield, UK.



Intensification

Adding resources to increase productivity

Traditional ranges of aquaculture intensity



RANGES	FEEDING	AREATION	PRODUCTION (kg/ha/Year)
Hiper-intensive	Complete hi-tech feed (+ floc)	>40 HP/Ha	>10,000
Super-intensive	Complete feed	30 HP/Ha	5,000 - 10,000
Intensive	Good feed	20 HP/Ha	3,500-5,000
Semi-intensive	Inexpensive feed	Emergency	1,000 - 3,500
Extensive	Fertilization	No	200 - 1,000
Natural	No	No	50-200

Global pond area and Shrimp production[1]

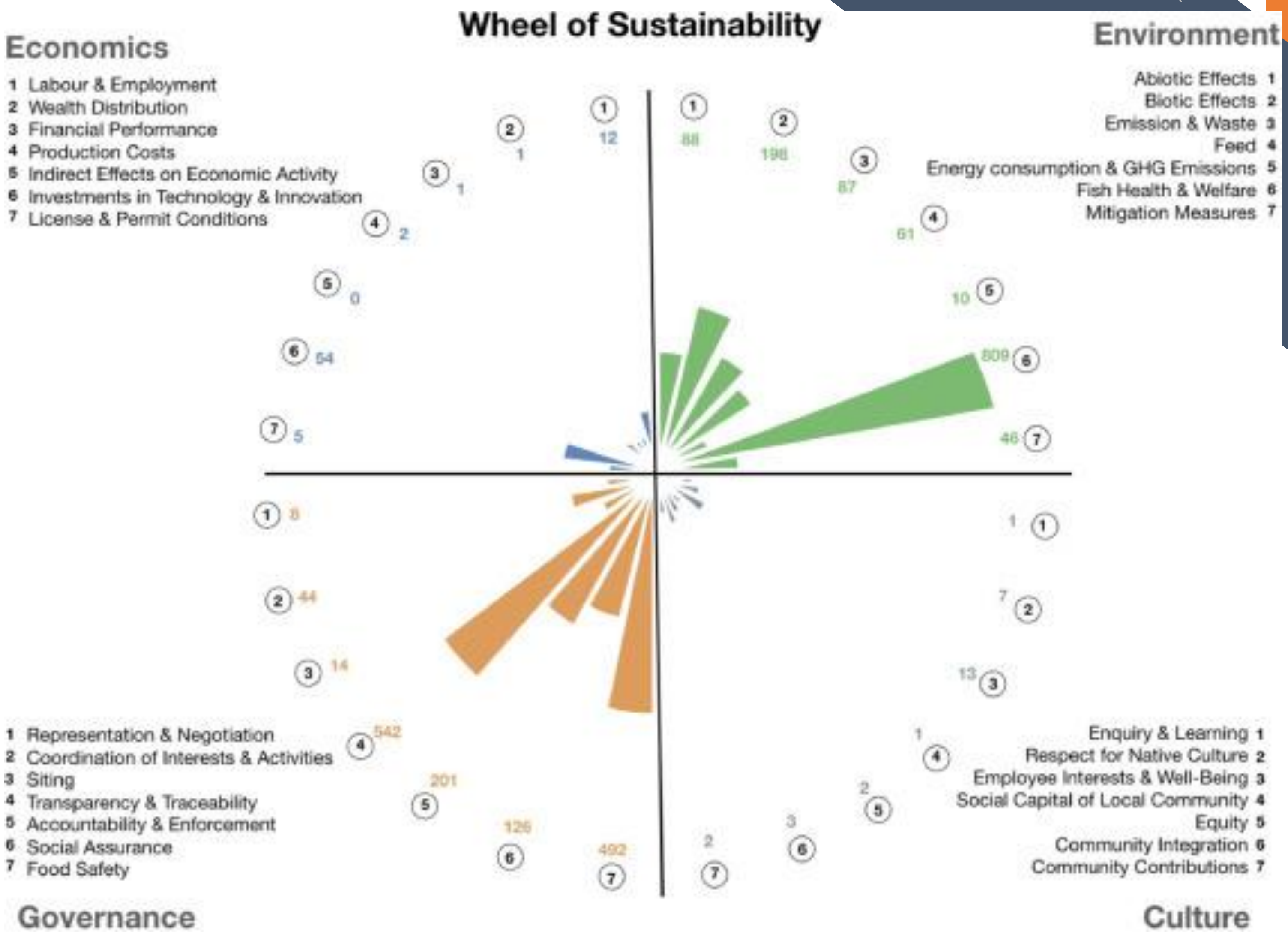
		AREA		PRODUCTION	
kg/ha/y	**PRODUCTIVITY**	**Million ha**	**Percent**	**Million t**	**Percent**
>300	Medium and high	1.4	58%	5.2	95%
<300	Low (extensive)	1.0	42%	0.3	5%
Totals		**2.4**	**100%**	**5.5**	**100%**

[1] Fuente: *Boyd, C.E. and McNevin, A.A. (2018) Land use in shrimp aquaculture. World Aquaculture 49(1), 28-34.*

Sustainability

Approach	Meaning
Public domain	Persistence over time while maintaining a healthy environment
United Nations Development Program	Development that meets the needs of the present without sacrificing those of future generations
Economics	Total capital remains constant over time within a bounded system. It includes human, natural and economic capital
Sociology	Promotes the well-being of an organization's members and community
Ecology	Promotes the diversity, adaptability, resilience, and biological productivity of ecosystems
Law	Acceptable practices and procedures under applicable environmental laws
Business	The company remains profitable and its performance is predictable over time
Practical approach	Choose the best available alternatives in terms of practices, procedures, and methods. Codes of ethics.
Resource Efficiency	Use of practices to maximize efficiency in the use of specific resources. Quantitative approach

Sustainability



Source: Osmundsen, Tonje C, et al. "The Operationalisation of Sustainability: Sustainable Aquaculture Production As Defined by Certification Schemes." Global environmental change, v. 60

Some producing countries of interest

INDICATORS	THAILAND	INDIA	ECUADOR	MEXICO
Production 2019 (t)	450,000	790,000	690,000	170,073
Production 2023 (t)	450,000	850,000	1,363,000	227,060
Crops per year	2.3	2.0	3.0	2.3
t/Ha/yr average	17.7	7.9	9.0	2.0
Pond Stocking densities #/m2	60-80	20-40	15-25	20.0
Pond sizes (Ha)	0.25 to 4	1 to 10	7 to 12	2 to 10
Stocks used	SPF	SPF, SPT	SPT	SPT
Use of nurseries	High	Low	High	Low
Improved nutrition	High	Medium	High	Medium
Use of demand feeders	High	Low	High	Low
Aeration HP/Ha	43	18	9	0
Biosecurity	High	Low	Low	Medium
Impact of genetics	High	Medium	High	Medium

Environmental effects	Environmental advantages of intensive systems
Loss of habitat Mangroves and other sensitive habitats, terrestrial ecosystems	Use of land reduced; more shrimp in less footprint
Ocean discharges in concentrated points: Suspended solids and particulate organic matter Soil erosion. Uneaten feed, chemicals, drugs	Discharges much reduced
Inefficient use of resources such as land, water, feeds	Reduced use of land and water Improved feed conversion, especially under biofloc conditions
Escapes: genetic effects, translocation or shrimp species or diseases	No escapes, higher biosecurity

In summary:

- Global oversupply of commodity shrimp has resulted in low prices.
- Complicated by higher costs, especially of feed.
- Crisis is accelerating industry consolidation.
- Price, cost of feed, FCR, and ADG are the main profit drivers.
- Possible solutions involve:
  - Boosting consumption or reducing supply
  - Industry consolidation
  - Find niche markets
  - Improving technical and economic efficiencies; also helps with sustainability
- Global trend towards intensification, but the most intensive systems are not yet competitive

Thanks a Lot!
¡Muchas Gracias!

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