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## Economics of aquaculture farms

Pascal Raux

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## AfriMAQUA International Conference

Towards a more sustainable aquatic food system: Interdisciplinary research on sustainable marine aquaculture in Africa

23-28 October 2023, Mombasa, Kenya



# MARINE AQUACULTURE TRAINING WORKSHOP

**Mombasa, Kenya, 27<sup>th</sup> – 28<sup>th</sup> October 2023**

Muthu Nyali Beach Hotel & Spa Hotel, Mombasa

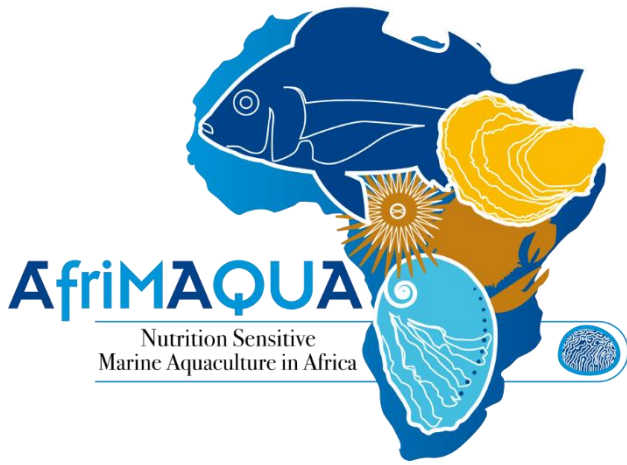
## Farms Economics

How assessing economic performance of a farm?

Pascal Raux<sup>1</sup>

<sup>1</sup> University of Brest, UMR AMURE, Brest, France





## MARINE AQUACULTURE TRAINING WORKSHOP

Mombasa, Kenya, 27<sup>th</sup> – 28<sup>th</sup> October 2023

### **Contents:**

- Aquaculture History
- Farms and Production systems
- Farms Economics
- Application to the case of shrimp farming development in the Indonesian province of Lampung, Sumatra



# MARINE AQUACULTURE TRAINING WORKSHOP

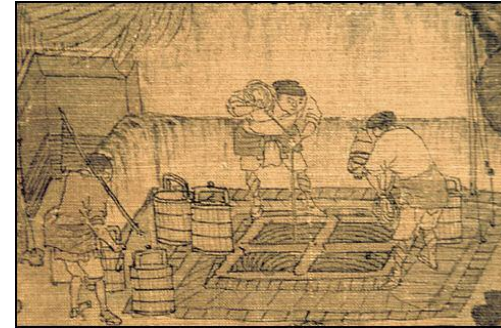
Mombasa, Kenya, 27<sup>th</sup> – 28<sup>th</sup> October 2023

## - Aquaculture History

# Aquaculture History

Although the rapid development of aquaculture is fairly recent (mid-19th century), aquaculture history is very old:

- Centuries-old in Asia: Carp in China (-2000 BC and Koi carp -500 BC), Eels in Japan...
- Fan Lai “The Classic of Fish Culture” -475 BC
- In Egypt, mural paintings in ancient tombs depict aquaculture activities dating back over 3,500 years.
- The Phoenicians, Etruscans and Romans developed fish-farming activities in coastal areas, probably based on Egyptian practices.
- -In 79, Pliny the Elder had described the techniques of fish and oyster farming in his Natural History.



Facsimile of Fan Lai's book (Vth century BC)



Hieroglyph of tilapia farmed in pond

# Aquaculture History

In Roman times, molluscs (mainly oysters), sea bass and sea bream were farmed in coastal areas, estuaries or lagoons, which were considered to be of high quality, and which were quoted extensively in recipe books ("De re coquinaria" by Apicius in the 1<sup>st</sup> century AD). [www.sicilianfishontheroad.com](http://www.sicilianfishontheroad.com)

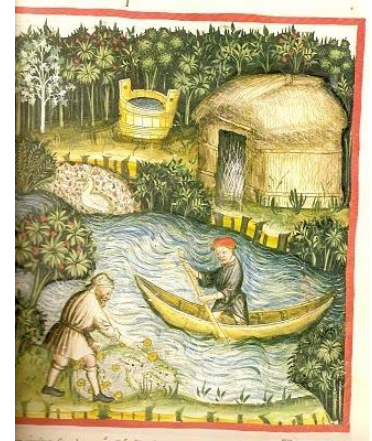
First oyster farming system under ROME (+ spat collection); imported from England and Gaul. First protection measures in 1750. Modern oyster farming second half of the 19<sup>th</sup> century.

The species of fish used for aquaculture were initially very limited. The first ones used in Europe were carp imported from China for pond farming.

First fish farmers were monks who elaborated and developed their practices in the Middle Ages (availability of fish for Friday meals). Valliculture in Italy.



Ancient Roman marine aquaculture farm (Italy)



Aquaculture in medieval times



Engraved glass flask depicting oyster farms in Roman times



Contemporary oyster farms in the Thau Lagoon, France

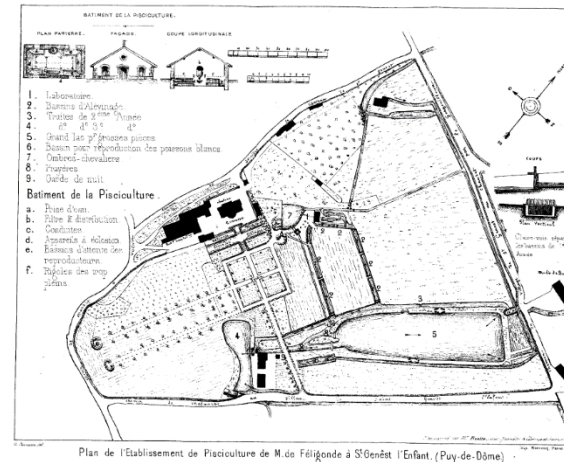
N. Blanc, A. Nercessian, La cuisine romaine antique, éd. Glénat, Grenoble, 1992.



# Aquaculture History

-In the 17th century the depletion of river stocks caused problems and in 1741 Stephen Ludwig Jacobi established the first trout hatchery in Germany.

-**Guillaume Bouchon-Brandely**, *Traité de pisciculture pratique et d'aquiculture en France et dans les pays voisins*, 1876 (available online at Gallica, BNF)



-Further development followed with the control of reproduction and larval rearing (for a long time the hindrance to development). Artificial feeds...

-Intensive mariculture from Japan in the 60s (cage aquaculture).

-Modern (marine and new) fish farming: 80s.





# MARINE AQUACULTURE TRAINING WORKSHOP

Mombasa, Kenya, 27<sup>th</sup> – 28<sup>th</sup> October 2023

- Farms and Production systems



# Diversity of production systems

## Extensive fresh water aquaculture

Ponds are maintained in such a way as to promote the development of aquatic fauna at a yield greater than that found in the natural ecosystem. Density is low and fish feed naturally. Certain producers provide additional feed. These ponds play an important and positive role in the landscape, water management and biodiversity.

**Examples** – Carp, in mixed farming with other species (whitefish, zander, pike, catfish, etc.).

## Aquaculture of marine species in shore-based installations

Marine fishes (particularly flatfishes) can also be bred in artificial shore-based tanks supplied with seawater. Recirculation of the water creates a closed and controlled environment that is necessary for optimal production in hatcheries and nurseries for marine species.

**Examples** – Turbot, common sole, Senegalese sole, sea perch, gilt-head sea bream.

## Extensive brackish water aquaculture

The animals (often brought in by the marine flow) are kept in lagoons developed for this purpose (ex: Italian valliculture, Spanish esterós). The semi-extensive nature of this breeding is reinforced by introducing hatchery fry and providing additional feed. This type of aquaculture plays an important role in conservation of the natural coastal heritage.

**Examples** – Sea perch, eel, common sole, Senegalese sole, sea bream, mullet, sturgeon, shrimps and shellfish.

## Intensive fresh water aquaculture

In intensive systems, fish are bred in tanks until they reach marketable size. There are two techniques: continuous flow (river water enters tanks upstream and leaves downstream) and recirculation (the water remains in a closed circuit and is recycled and 'recirculated' in the tanks). Recirculation systems are more costly (energy), but offer better control of breeding conditions (temperature and oxygen) and water quality.

**Examples** – Rainbow trout, eel, catfish, sturgeon, tilapia, etc.

## Marine cage aquaculture

The fish are kept in cages anchored to the seabed and maintained on the surface by means of a floating plastic framework. This form of breeding is practiced mainly in sheltered zones near shore, but more sophisticated techniques (submersible cages, remote monitoring, automatic feeding, etc.) may make it possible to move further from shore.

**Examples** – Atlantic salmon, sea perch, sea bream, meagre, etc.

## Shellfish farming

Shellfish farming is based on the collection of wild or hatchery spat, which feed on natural nutrients found in the environment (filter-feeding animals). Oyster and mussel farming account for 90% of European production and use a wide range of techniques: bottom-farming, on tables, wooden posts, ropes, etc.

**Examples** – Oysters (oyster farming), mussels (mussel farming), clams and abalones.

# Diversity of production systems

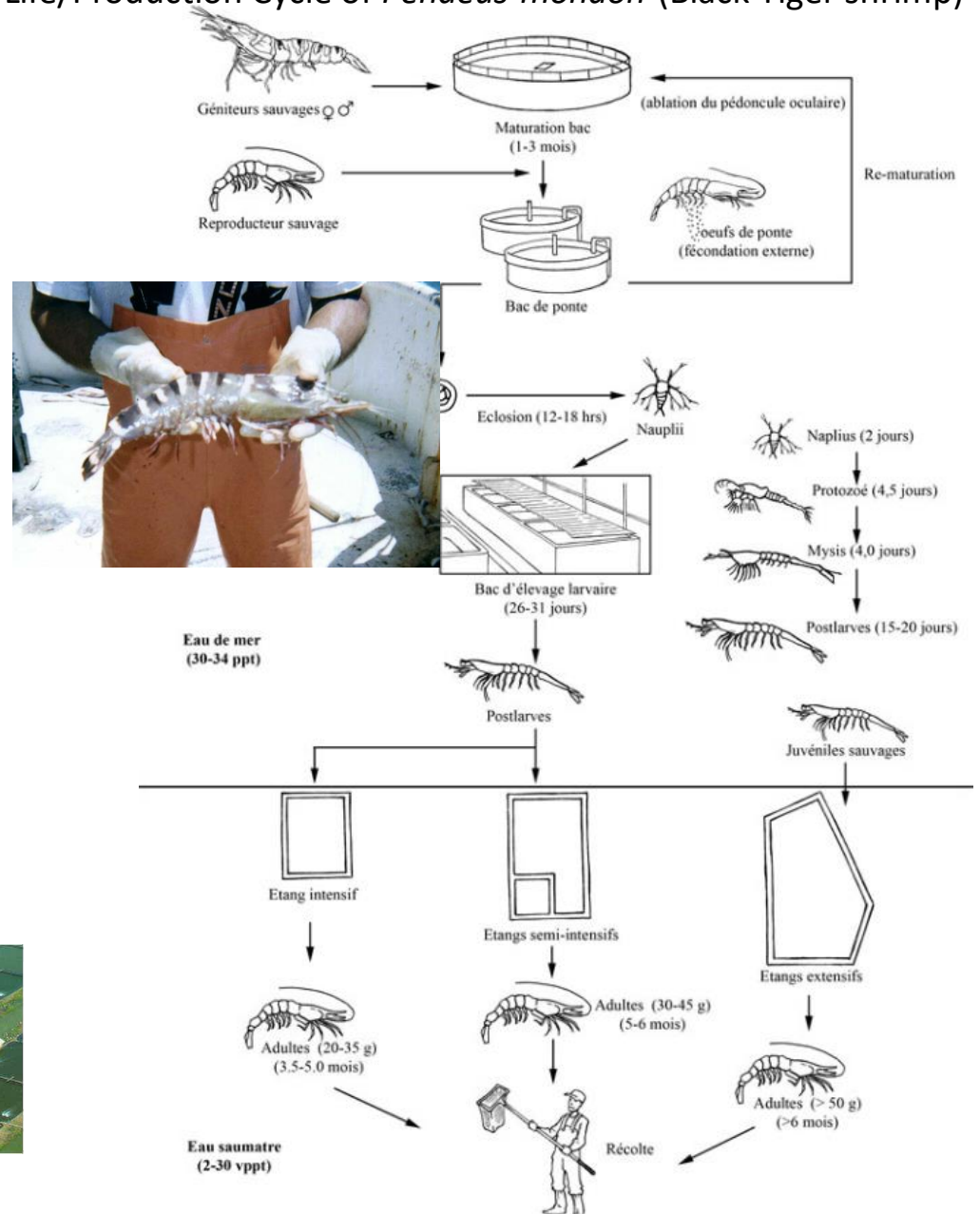
- **A diversity of production systems** according to species (techniques) but also between species (commodity chains) that:
  - underlines strategic and commercial choices
  - underlines constraints of access to production factors (capital, knowledge, land, etc.)
  - highlights constraints and adaptations to the environment (ecological, social and economic)
  - often induces differentiated productions
- Technical systems through intensification or technical leaps (non-linear):
  - Extensive** system (estuaries, semi-confined areas, lagoons, intertidal areas, marshes... in ponds, ropes, baskets...)
  - Semi-intensive** system (intensification in structures similar to extensive ones)
  - Intensive system** (concrete, liner or earthen ponds, offshore or coastal cages)
  - Super-intensive** system (cages, concrete ponds or liner, recirculation, more open environment)
  - ...

But with no real official standards, making comparisons, assessments and regulations difficult because of this diversity, in addition to other definitions (improved extensive, semi extensive, traditional, improved traditional or traditional plus...).

# Example of the diversity of production systems for a single species: shrimp culture



## Life/Production Cycle of *Penaeus mondon* (Black Tiger shrimp)



On the opposite a rather homogenous production system; differences mainly in terms of scale or strategies rather than in terms of technical choices or strategies: pearl culture or shellfish farming (extensive systems)



Differences in management practices (scales, operations, density) rather than in infrastructures and technical choices.

# The Farm



## Infrastructures:

- Pond(s)
- Building(s)
- Water exchange system



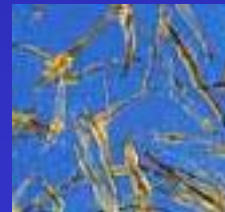
A place to produce seafood based on:



Outputs:  
shrimps,  
shellfish, fish...

## Inputs (production factors):

- Rearing techniques
- Species, seeds, feed, etc.
- Labour characteristics...



→ A production system

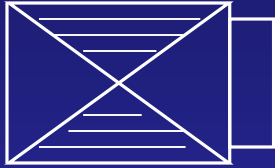


# FACTORS DETERMINING THE OPERATIONAL SYSTEM (example of a Shrimp Farm)

CANAL



FARM BUILDING



FARM

Internal factors:  
Pond Management & Pond Ecology

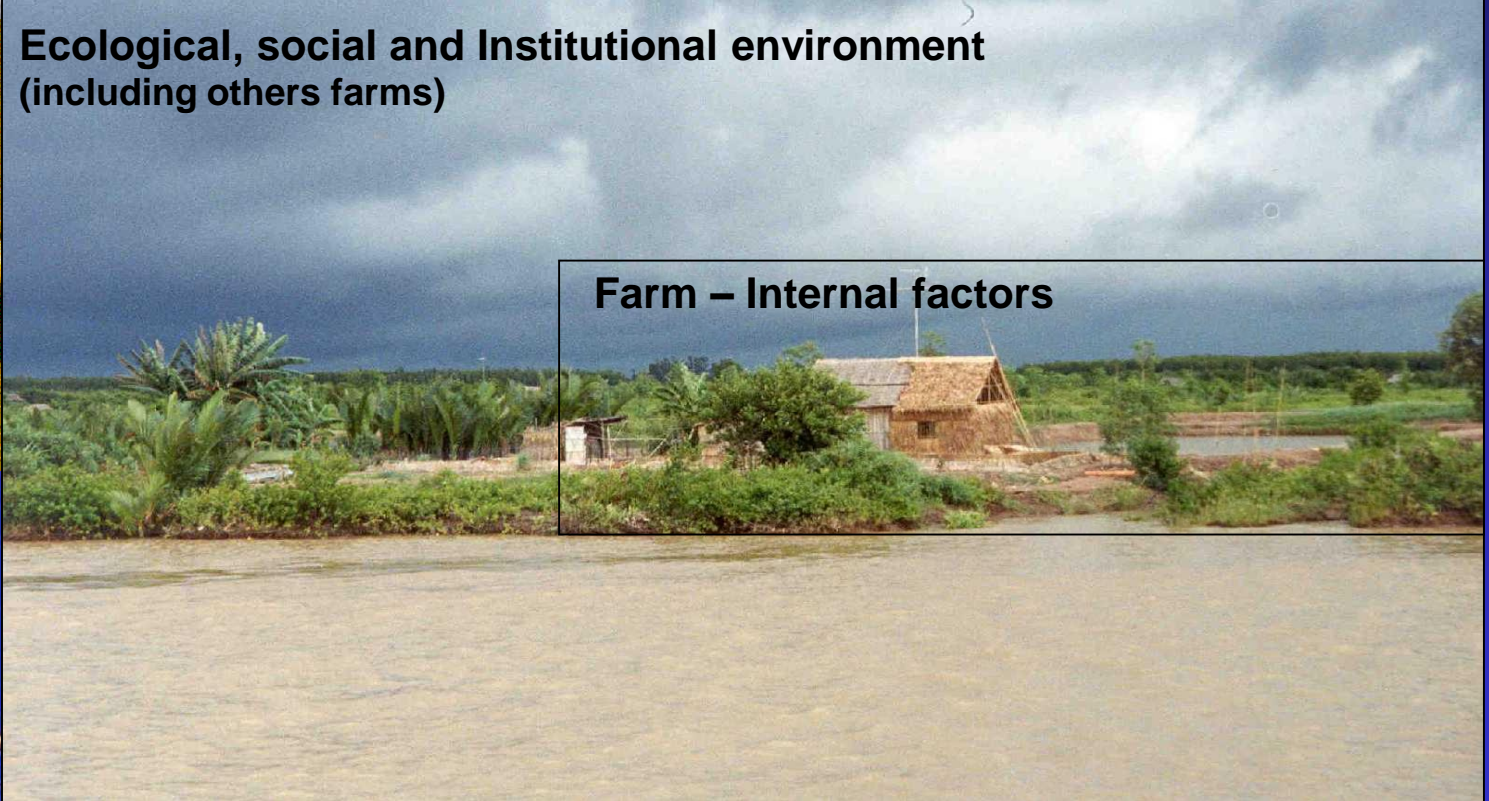
POND

- Farm size
- Rearing technique
- Species, Seeds, Feed, Treatments, etc.
- Labour characteristics such as:
  - General education level
  - Dissemination and access to knowledge (zoot, marketing...)
  - Qualification
- General conditions of access to capital, structure of capital (family, external, etc.)
- Integration level (from hatcheries to marketing)

# Economic context and Markets



## Ecological, social and Institutional environment (including others farms)



### Farm – Internal factors

The Farm is not a closed system

# FACTORS DETERMINING THE FARM OPERATIONAL SYSTEM

## The farm environment

### FARM

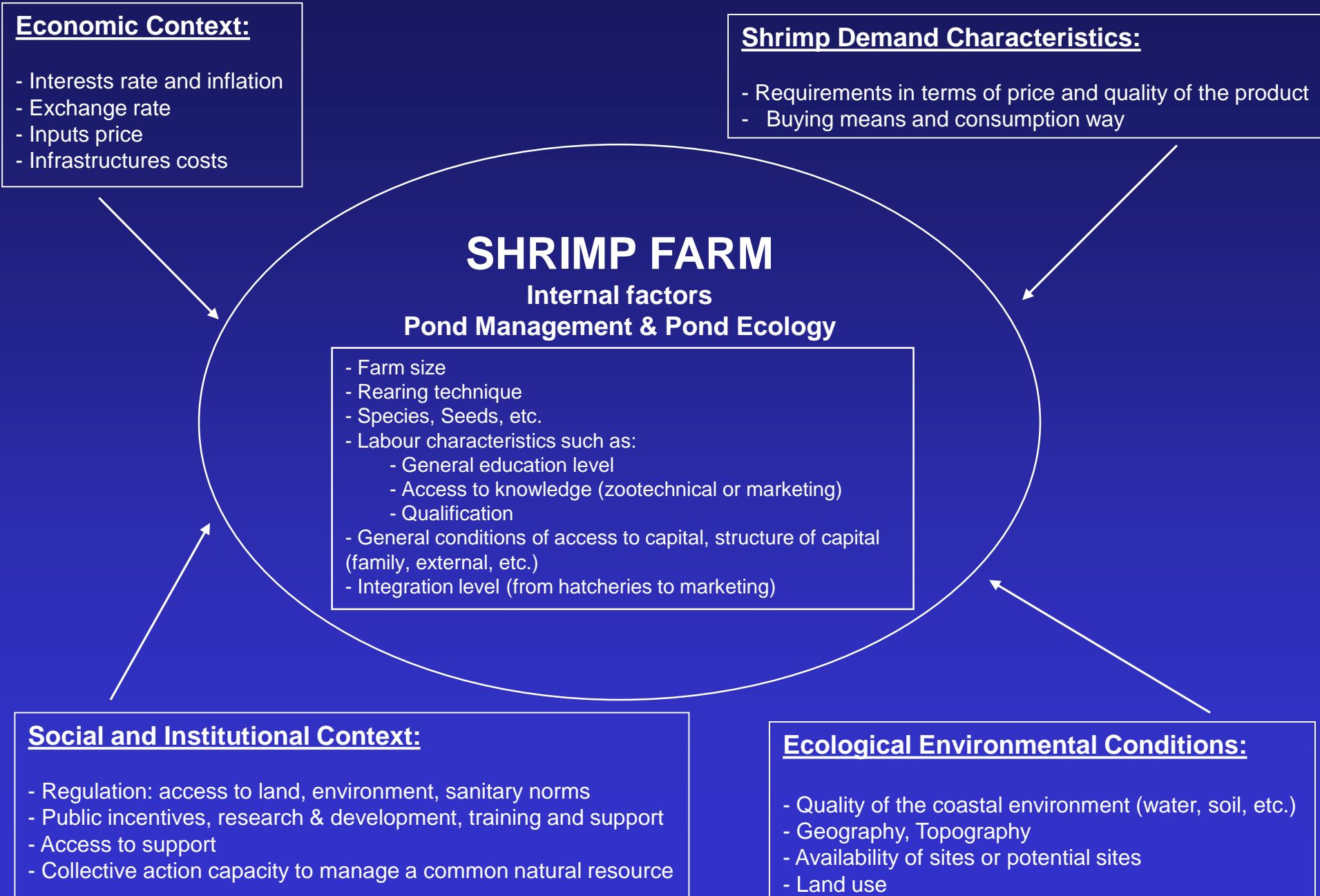
#### Internal factors

- Farm size
- Rearing technique
- Species, Seeds, etc.
- Labour characteristics such as:
  - General education level
  - access to knowledge (zootechnical or marketing)
  - Qualification
- General conditions of access to capital, structure of capital (family, external, etc.)
- Integration level (from hatcheries to marketing/processing)



# FACTORS DETERMINING THE FARM OPERATIONAL SYSTEM

## The farm environment



Then, under such constraints, in order to produce and sell an output, the farmer will have to:

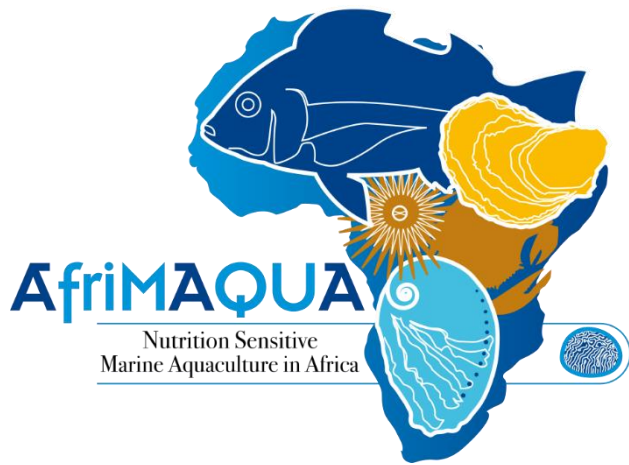


- combine production factors (inputs). This factorial combination will be determined by marketing choices
- Implement a technical choice

## DIFFERENT MODES OF ORGANISATION

### Questions that emerge:

- **What is the best production system? According to what kind of organisation?**
- **What does mean the best one?**
  - the most efficiency from a technical point of view or from an economic point of view (profitability)?
  - the most environmental friendly?
  - the most socially efficient or just?
- **Are these parameters linked on a long run, i.e. in a sustainable way?**
- **Are we able to compare different production systems and how? According to which criteria?**



## MARINE AQUACULTURE TRAINING WORKSHOP

Mombasa, Kenya, 27<sup>th</sup> – 28<sup>th</sup> October 2023

**- Farms Economics: comparing different levels of performance in different contexts**

# MEASURE OF THE ECONOMIC PERFORMANCES

## Measure and indicators

A first element of comparison:  
the **economic performance**

A farmer will have to balance between several options of production factors combination to find the best way to produce. The comparison between the different options can be assessed through several criteria: economics, ecological and/or social. Farms economics will focus on the economic performance, studying and analysing the production process (the way to produce).

- **The profit** The Profit is usually a good indicator of the economic efficiency (excluding redistributive considerations). It is measured as follow:

$$\text{Profit} = \text{Income} - \text{Operational Costs} - \text{Fix Costs} - \text{Interests} - \text{Taxes}$$

Profit before interests and taxes:

$$\text{Profit} = \text{Turnover} - \text{Operational Costs} - \text{Fix Costs}$$



In order to compare the profitability of different production systems, the profit is expressed through a ratio. Several significant ratios can be obtained but the most common is the profit rate expressed by the profit reported to the income (or turnover). The appearance of a profit is a sign of good management of human resources, capital, etc.

# MEASURE OF THE ECONOMIC PERFORMANCES

## Measure and indicators

- **The cost structure**

As the profitability of a farm is function of its costs and income, the cost structure will give information on this profitability and its variability according to the different production factors. Related ratio could be:

- Profit / Operational costs    - Fix costs / Operational costs    - Feed cost / Operational costs    etc.

- **The added value**

The added value underscores the creating role of the farm, what is brought by the farm making the difference with what is bought by the farm. This is not a pure economic performance but rather a global one related to the local fall out of the activity.

### **Added Value = Production – Intermediate Consumptions**

Intermediate Consumptions are Goods and Services bought outside the farm

The added value concept is more significant than the turnover because it reveals exactly the role of the enterprise. In order to compare the different technical level, the added value is expressed through a rate:

### **Added value rate = Added Value / Turnover**

- **Others indicators**

- **The Internal Return Rate (IRR):** you can compare it to the interest rate when you invest or when you deposit some money in a bank. It is defined according to a time scale.

- **Time of return on investment**

# MEASURE OF THE ECONOMIC PERFORMANCES

## Measure and indicators

Main Indicators	Indicators
Economic performance	Profit rate Return on investment IRR
Explaining factors of the performance	Costs ratio:      Operational costs ratio Depreciation cost ratio
Characterisation of the performance	Added value
Technical criteria	Stocking density or PL cost Technical efficiency (Kg/1000 Fry) Area and Yield Others are translated into economic ratio

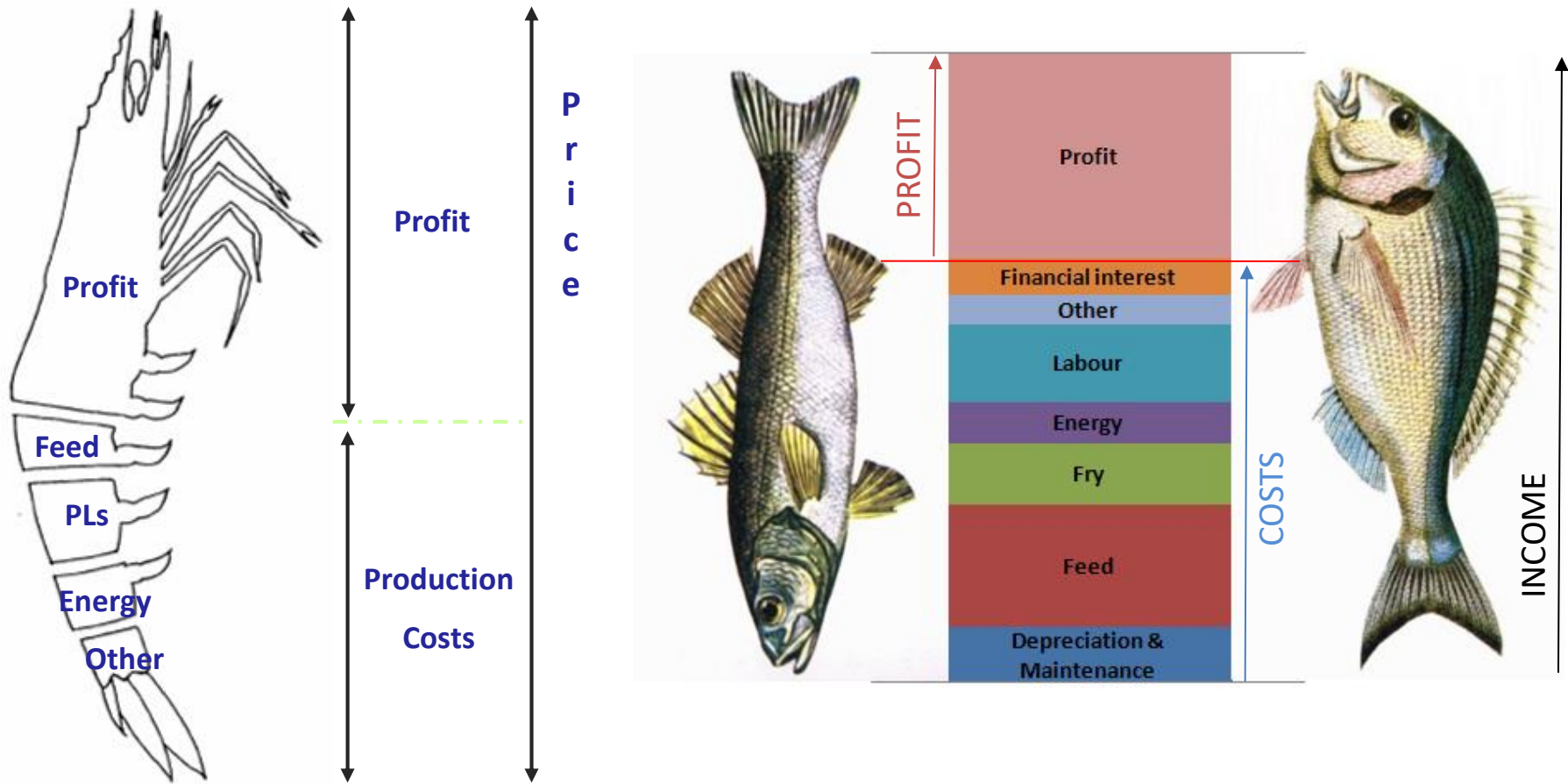
What  
about  
ROA  
(Return On  
Assets)  
and ROE  
(Return On  
Equity)  
?

Application and use of indicators through a **Cost / Benefit analysis**. This the most common way to assess the economic feasibility. It can answer to questions such as:

- Is it profitable to invest ? - What is the operational cost on one crop ?
- What are the main costs and how they influence the economic performance as well as their structure ? - ...

# Examples of cost structures and costs benefit analysis :

To produce 1 Kg of seafood product :



The cost structure illustrates how farmers combine inputs and provides a measure of the economic efficiency of farms. It can also provide indications on how to achieve greater technical efficiency by reducing certain costs.

# MEASURE OF THE ECONOMIC PERFORMANCES

## Measure and indicators

Preliminary remarks before implementing a cost benefit analysis of production systems:

The way to produce rather than the yield: (think quality rather than quantity)

If the result of a crop is a volume of production, its economics translation or the economics measure doesn't attempt to the solely quantification of this result ( $Production \times Price = Turnover$ ). The economic understanding of the output should rather rely on the way to produce, on the qualification of this result.

That means that economic indicators shall be reported to the Kg produced rather than reported to the area (ha), as too commonly observed, that will solely translate a size effect (larger area resulting in larger production and turnover).

Technical performance and economic performance:

On the same way, Stocking Density, pond size, FCR, survival rate, technical efficiency are not indicators of the economic performance, but indicators of the productivity, of the technical choice and the organisation mode.

If the technical choice and its performance will influence the production and the economic performance, that doesn't mean that to a good technical performance will always correspond a good economic performance or a good economic efficiency.

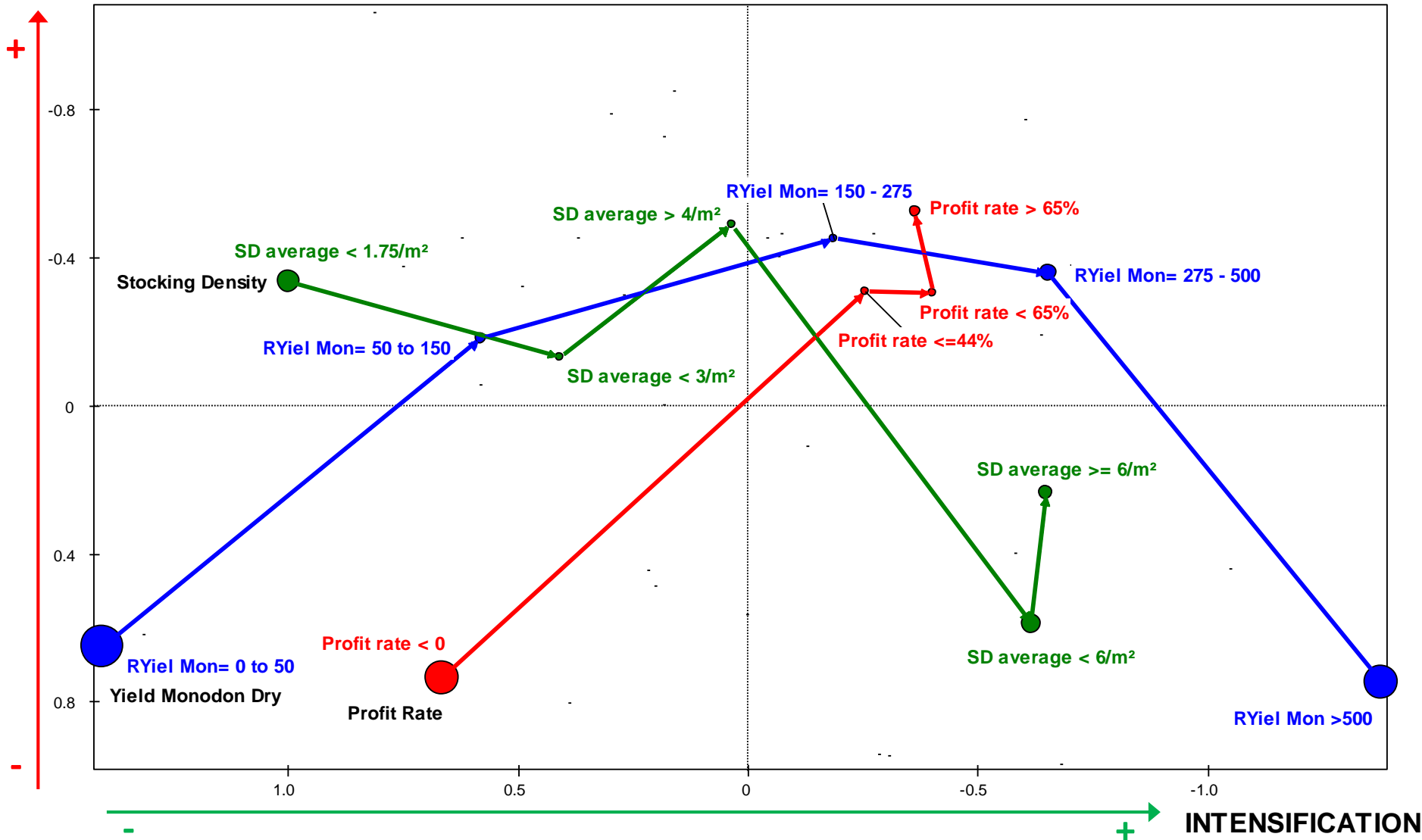


# Example based on a multivariate analysis of shrimp farms in the Mekong Delta (Vietnam), based on technical and economic criteria

Crossing technical and economical criteria: **SD: stocking density (PL/m<sup>2</sup>)** **Ryield: Yield (production/ha)**

**Profit rate: measure of the economic performance (%)**

## ECONOMIC PERFORMANCE



In this case, to the highest technical efficiency does not correspond the highest economic efficiency, but the lowest economic efficiency.

## What information should be used? What data should be collected and how?

**Accounting services:** detailed data but on an accounting and tax basis; access issue. Content poorly adapted to the scale of the production cycle (accounting year vs. production cycle). Aggregates.

**Statistics:** reliability based on a technical classification criterion (standard systems often different from reality in the field, incomplete information, etc.). Aggregates.

**Surveys** are still the preferred means of collecting data for reconstructing farm accounts, albeit with a number of constraints:

- often informal environments with little history or memory gap in production
- a parent population that is often unknown or uncharacterisable in terms of practices

This leads to **face-to-face questionnaires** which must be sufficiently detailed and explicit without being excessively long, and which are structured in a number of stages:

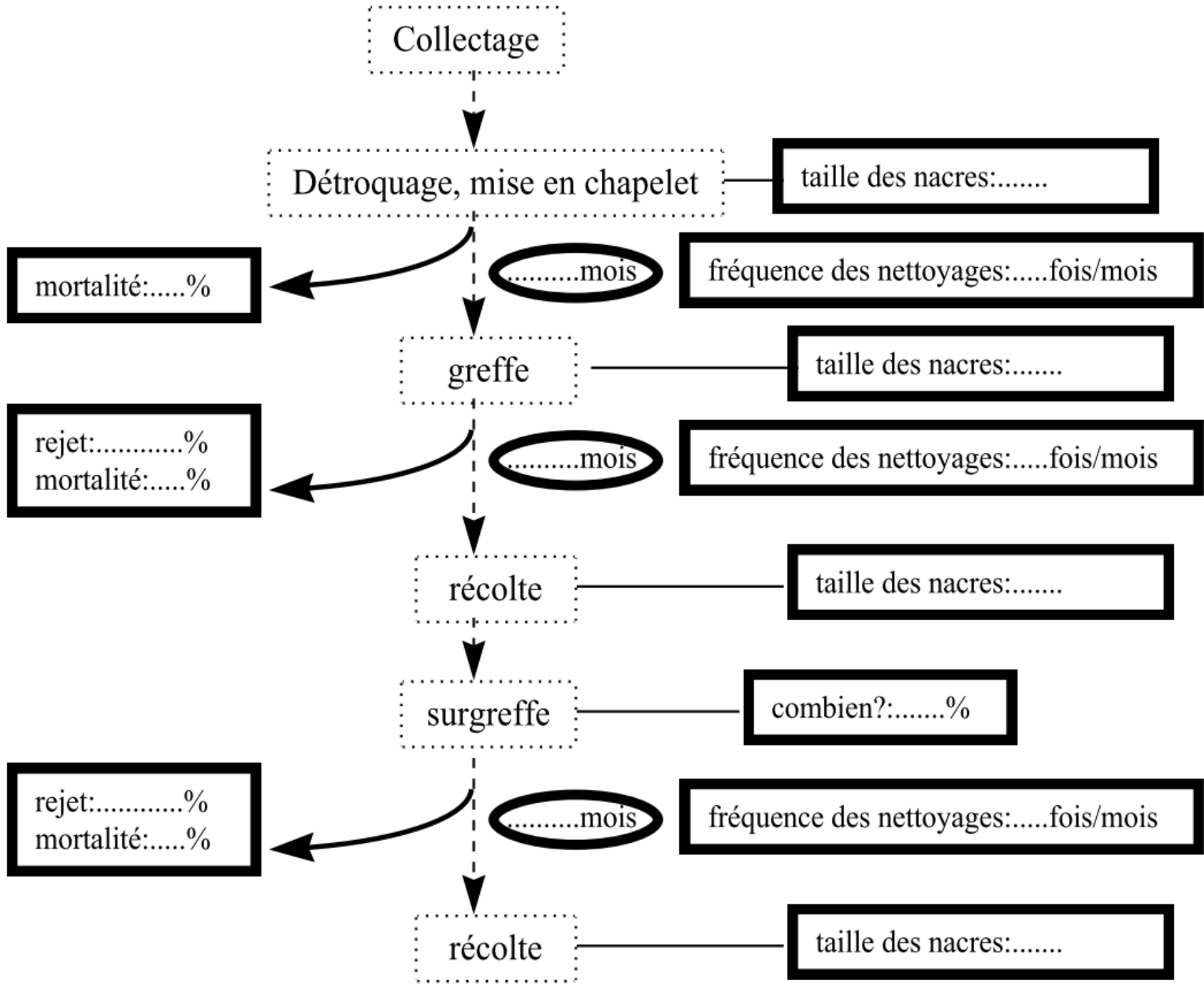
- farm environment (social and economic)
- factors which governed technical and commercial choices
- structured according to the operations calendar to estimate the production cycle (unit of time for the analysis)

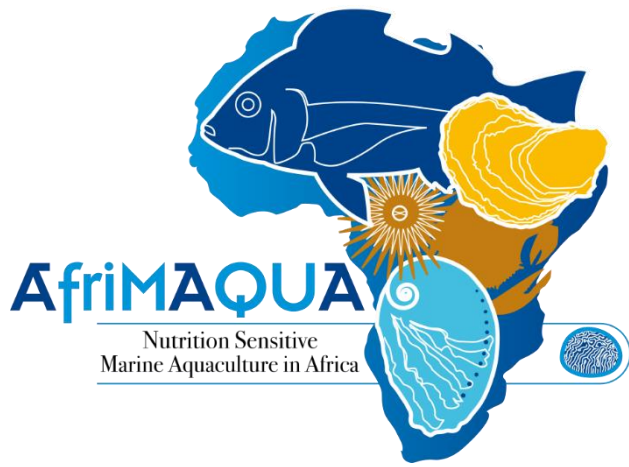
## What information should be used? What data should be collected and how?

Structuring a questionnaire for a farm survey aiming at supporting a socio-economic analysis of farms (e.g. understanding the socio-economic performance). Proposal, to be adapted to each context and research issue:

- 1. General information and structure** of the farm, its history and that of its operator, its environment, its development, the acquisition of knowledge, sizing (size, units, labour and its characteristics...), records of events (disease outbreaks...)
- 2. The technical dimension** of the farm, by setting out the calendar of operations: production, management of production units, technical choices, estimation of the production cycle, etc.
- 3. Farm economics:** inputs and associated costs (fixed and operational); market and commercial choices...
- 4. General questions** about the issues and potential difficulties

# Example of a technical diagram to support data collection on pearl farming practices:





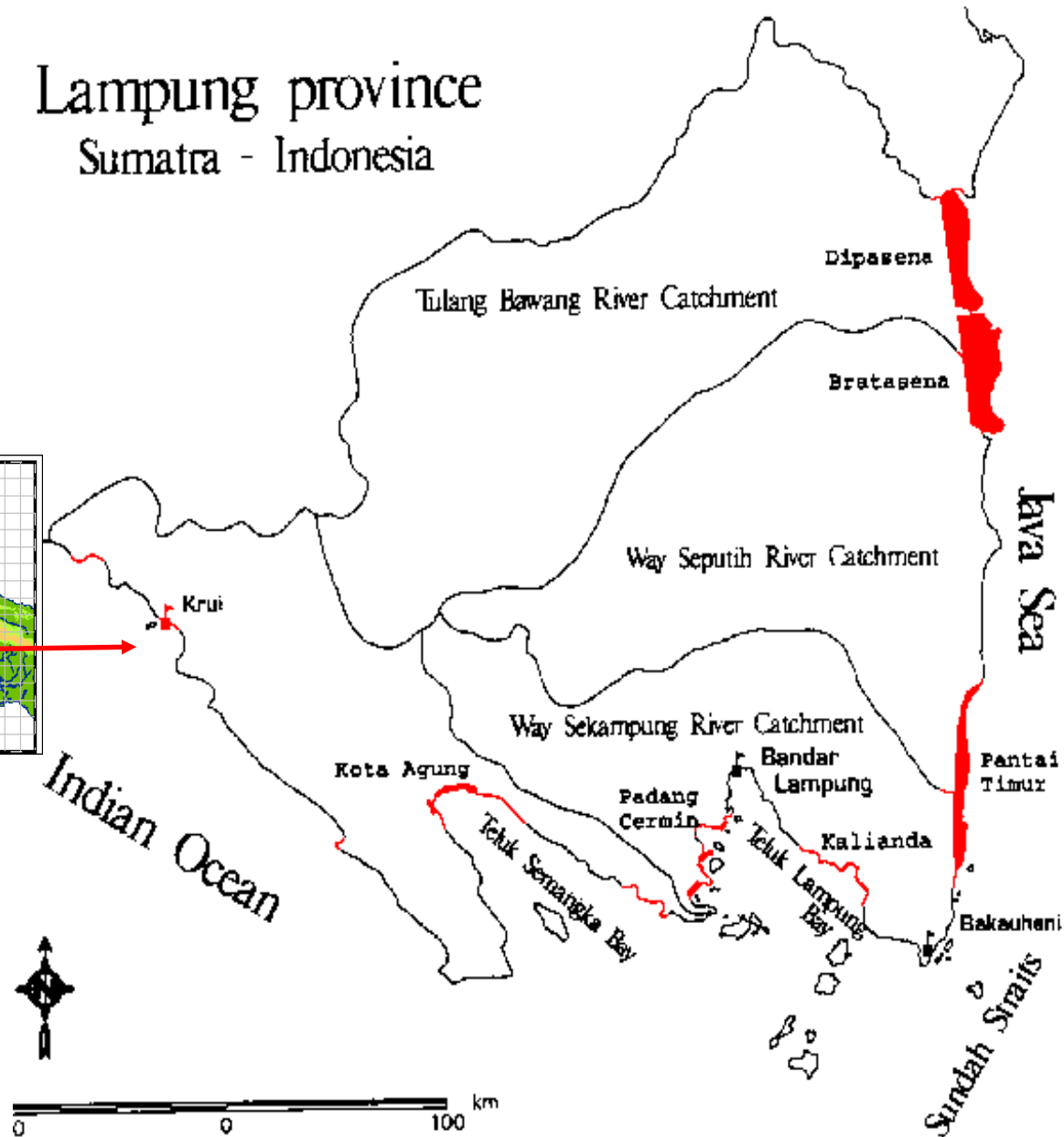
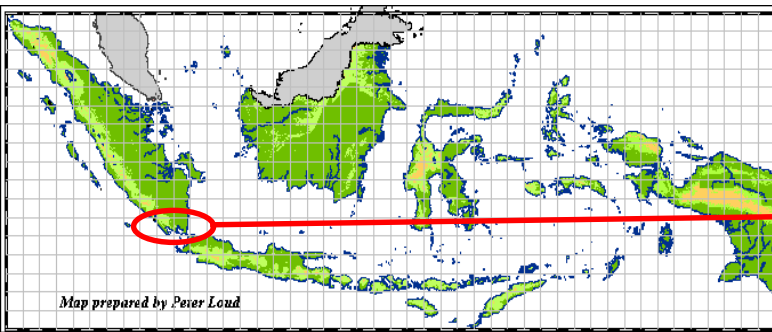
## MARINE AQUACULTURE TRAINING WORKSHOP

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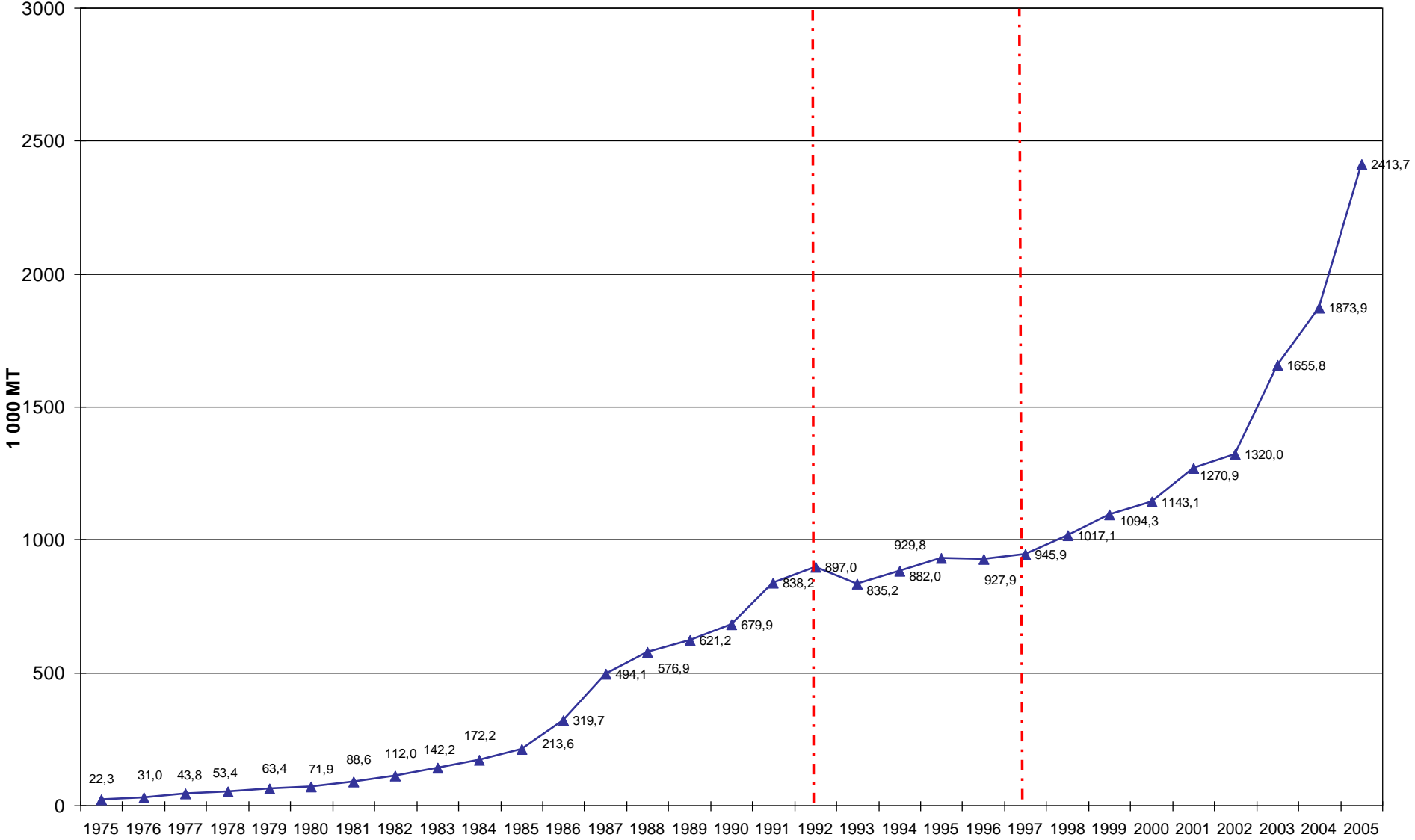
**- Application to the case of shrimp farming development in the Indonesian province of Lampung, Sumatra**

# Shrimp culture on Lampung province Sumatra, Indonesia

Lampung province  
Sumatra - Indonesia



# World shrimp farming production (1 000 MT – Globefish FISHDAB 2006)



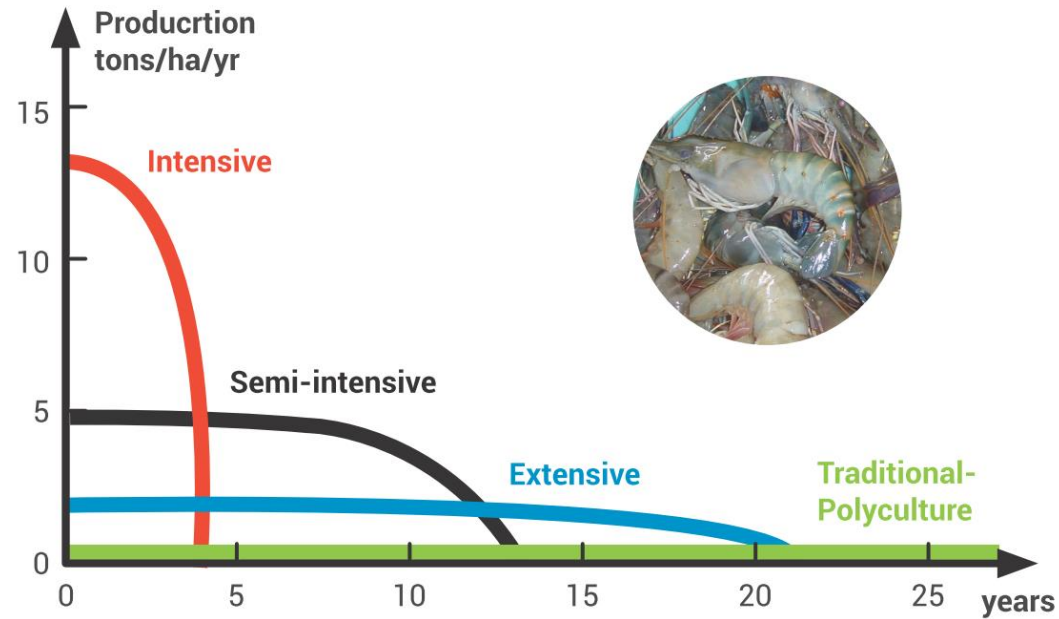




# Diversity of production systems

There is not one aquaculture, but many... different organisation mode

Aquaculture development policies do not take sufficient account of the diversity of production systems. Production systems are also often perceived in terms of intensification (stocking density) and relationship with the environment, as illustrated by the following figure, which underpins the intrinsic unsustainability of industrial shrimp farming (Kautsky et al.)

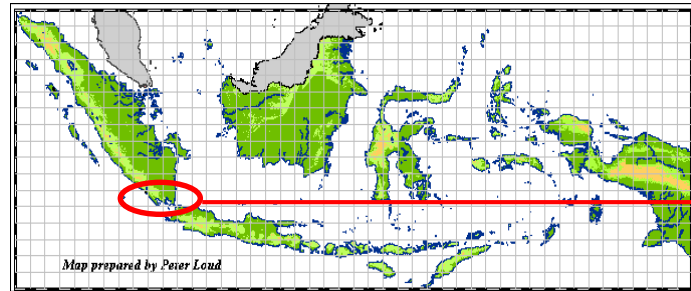
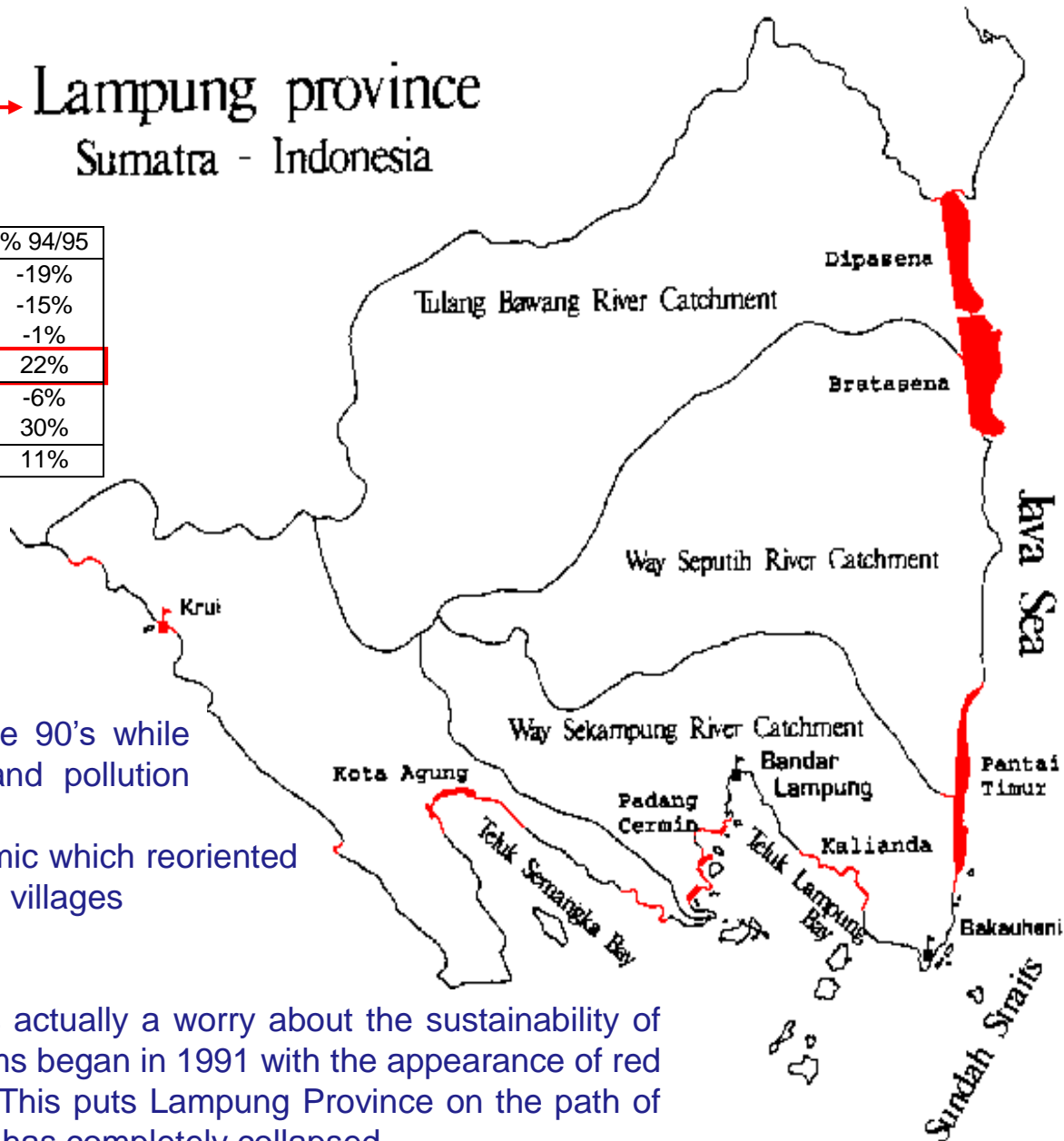


From Nils Kautsky: Graph depicting built-in unsustainability of Industrial Shrimp Farming

Although the figure summarizes fairly well the state of the debate and the issues at stake at the time in the development of shrimp aquaculture (maximizing profit/ha rather than the way it is produced), it can also sometimes appear too simplistic and reductive when the development issues in terms of sustainability are more complex. While there are many examples of shrimp farming development profiles that can confirm this, there are also examples that can refute it if the focus is on development profiles rather than technical systems.

## Shrimp culture on Lampung province

Lampung province  
Sumatra - Indonesia



Shrimps exportations (head-less) - unit: tons.

Province	1992	1995	% 94/95
JAKARTA	11 705	10 947	-19%
MEDAN	14 193	12 114	-15%
SURABAYA	25 992	18 164	-1%
<b>BANDAR LAMPUNG</b>	<b>2 807</b>	<b>10 194</b>	<b>22%</b>
Sub Total	54 697	51 419	-6%
Others	45 758	58 651	30%
Total INDONESIA	100 455	110 070	11%

Fisheries Statistics of Indonesia ; Jakarta March 1996

### Lampung is a province :

- With a rapid economic development
- Shrimp culture developed rapidly in the 90's while other regions were hit with disease and pollution problems
- A very high profitability induced a dynamic which reoriented completely the economy of many coastal villages

After few years of rapid growth, there is actually a worry about the sustainability of this development. Environmental problems began in 1991 with the appearance of red tide and first disease outbreak in 1993. This puts Lampung Province on the path of many other regions where shrimp farming has completely collapsed.

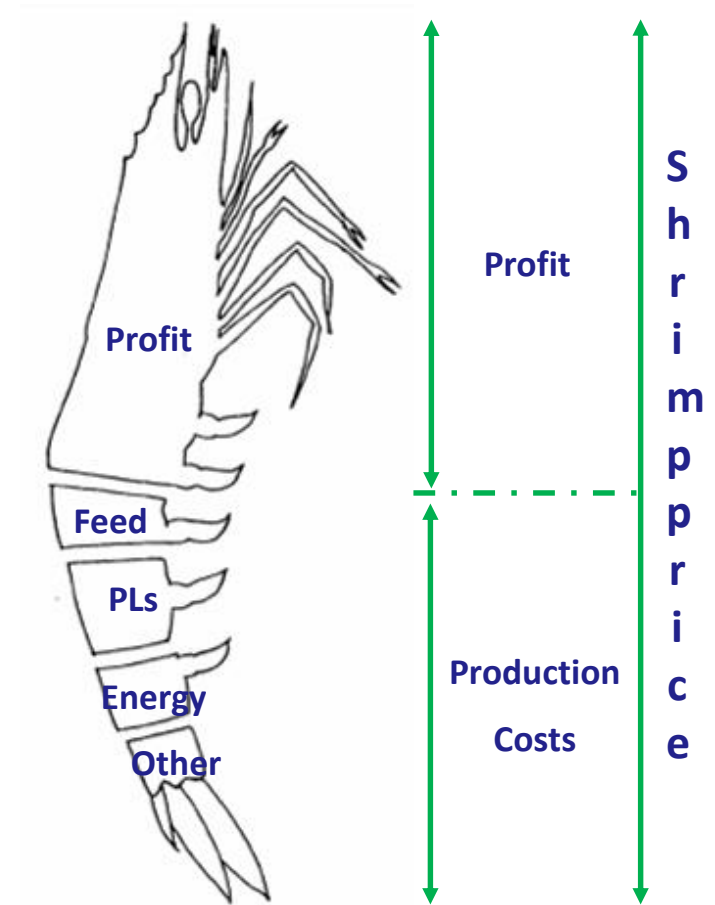
# Costs Benefits Analysis: the rationale

To produce 1 Kg of shrimps:

**Comparing the profitability of different production systems at different levels of intensification**

Studying the investment and analysing the costs and benefits in terms of level and structure of different production systems provides the basis for a comparative analysis.

Stocking density is the criterion used to classify farms by level of intensification.



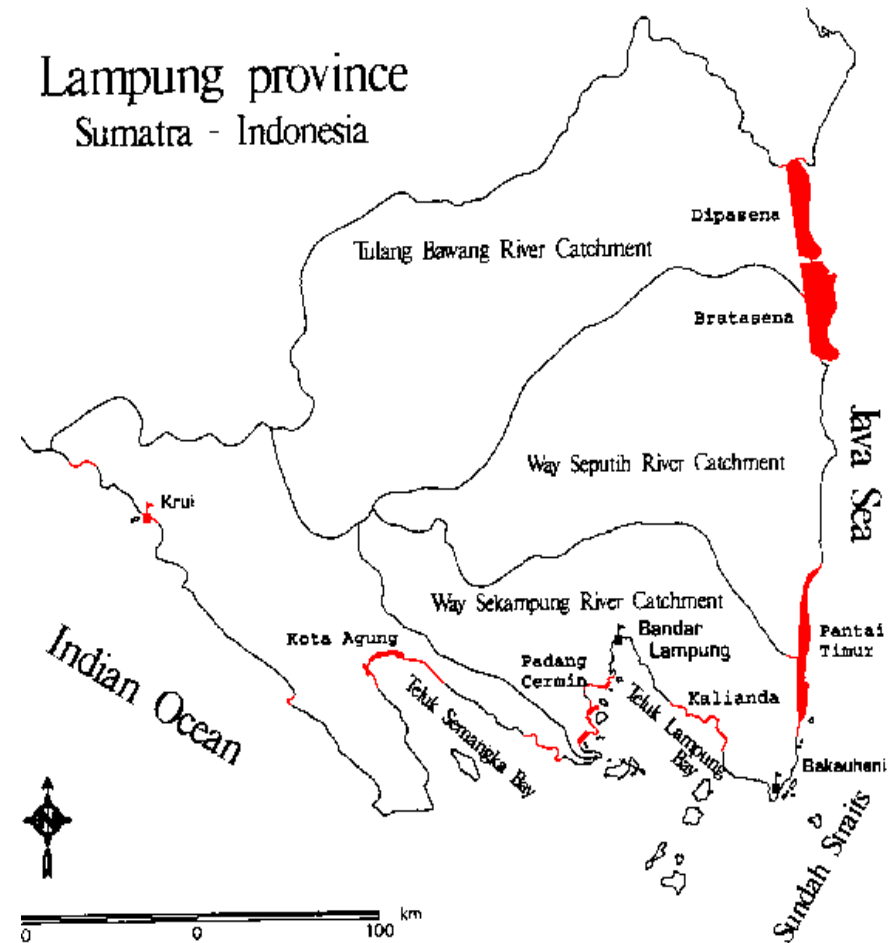
The cost structure illustrates how farmers combine inputs and provides a measure of the economic efficiency of farms. It can also give indications of how to achieve greater technical efficiency by reducing certain costs.

# Economic analysis of shrimp culture on Lampung province

Data: a detailed survey of 100 farms;  
a general survey of 1000 farms.

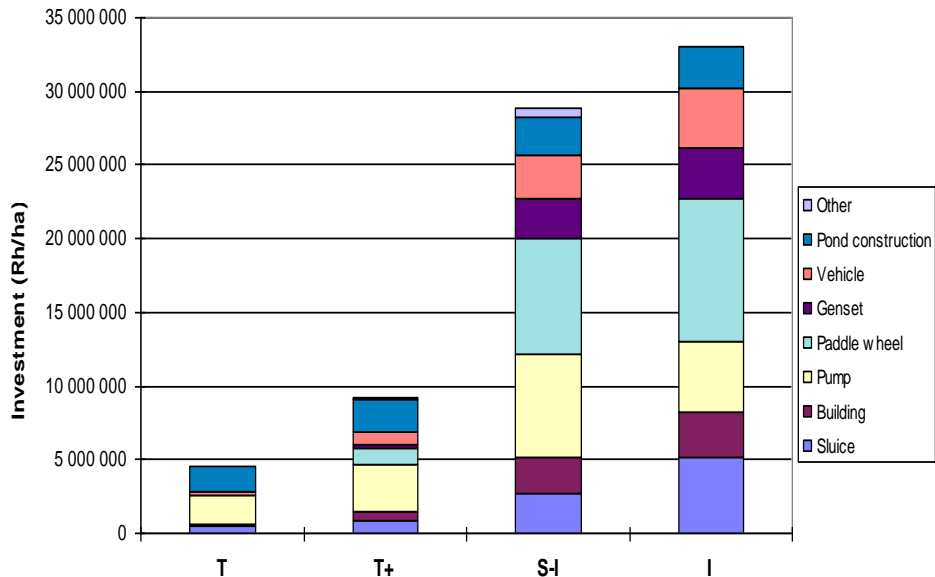
4 technical systems identified and compared: traditional (T), traditional plus (T+), semi-intensive (S-I) and intensive (I). Classification based on factorial analysis.

The results show that although there are differences in terms of investment levels and structures, the overall economic performance of the different systems is very good and comparable on average, with the exception of T+. Differences in terms of risk affect this performance (T+).

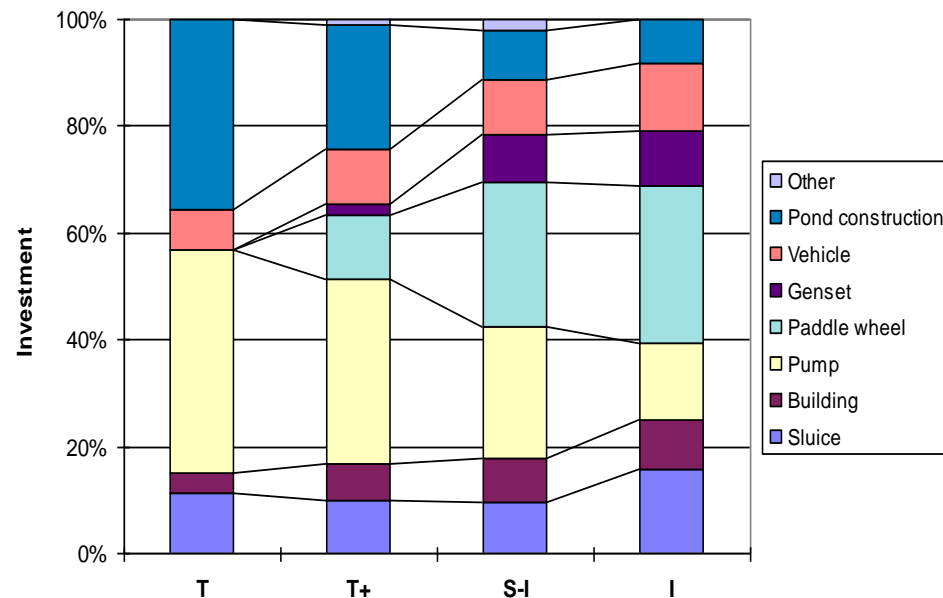


# Comparing the profitability of different levels of intensification

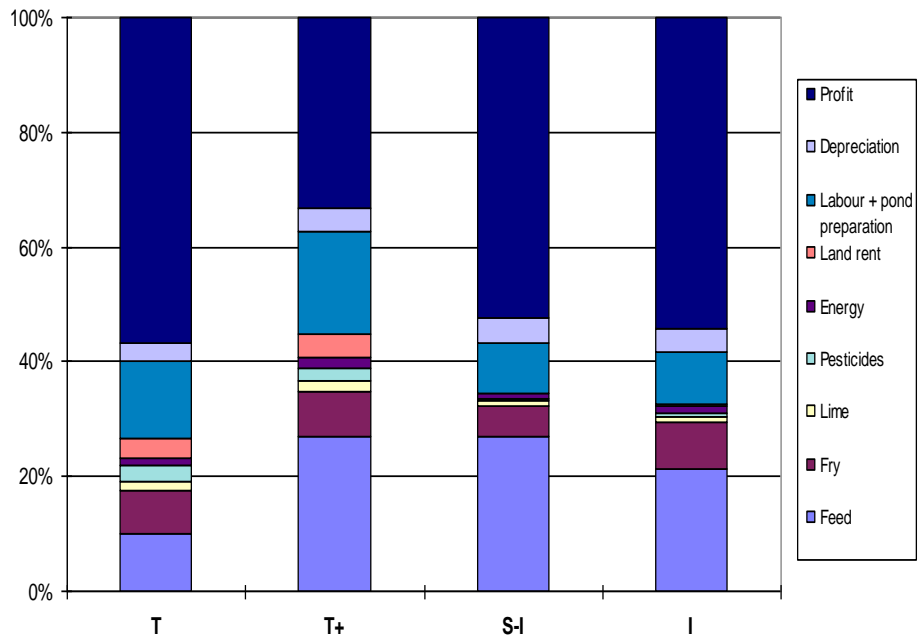
**Structure of investment cost (10 years: 5 crops)**



**Structure of investment cost in % (on the basis of costs in Rp/Kg) for 5 years of operation (10 crops)**

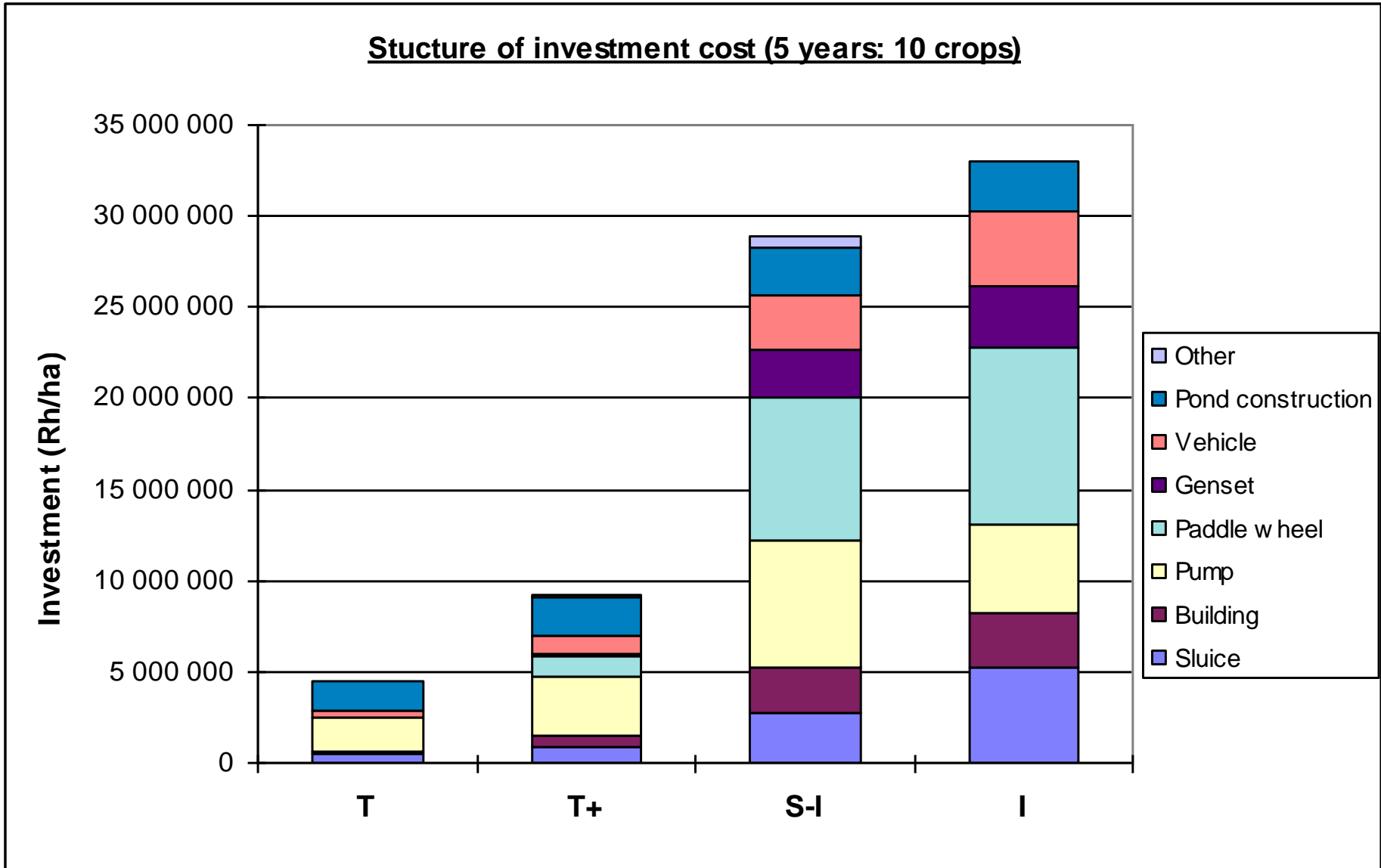


**Cost and revenue structure of production systems (% on the basis of costs in Rp/kg)**



	T	T+	S-I	I
<b>Farm area (ha)</b>	2,5	2,9	2,9	4,9
<b>Stocking density (1.000 fry/ha)</b>	26	45	115	239
<b>Production per crop (Kg/ha)</b>	312	514	1 569	2 335
<b>Technical efficiency (Kg/1.000 fry)</b>	12,4	11,5	13,8	10,1
<b>Price (1.000Rp/kg)</b>	16,6	16,7	17,2	17,1
<b>Total cost (1.000Rp/kg)</b>	7,2	11,2	8,2	7,8
<b>Benefit (1.000Rp/kg)</b>	9,4	5,5	9,0	9,3
<b>Benefit/cost ratio</b>	1,48	0,59	1,21	1,38
<b>Added value ratio</b>	0,73	0,55	0,66	0,67
<b>Investment (1.000 Rp/ha)</b>	5 543	8 542	17 791	20 979
<b>IRR (2 crops, 1 year)</b>	6%	-20%	41%	73%
<b>IRR (6 crops, 3 years)</b>	30%	26%	57%	69%
<b>Profit rate</b>	56,3%	33,1%	52,2%	54,1%
<b>Return on investment (months)</b>	11	17	7	5

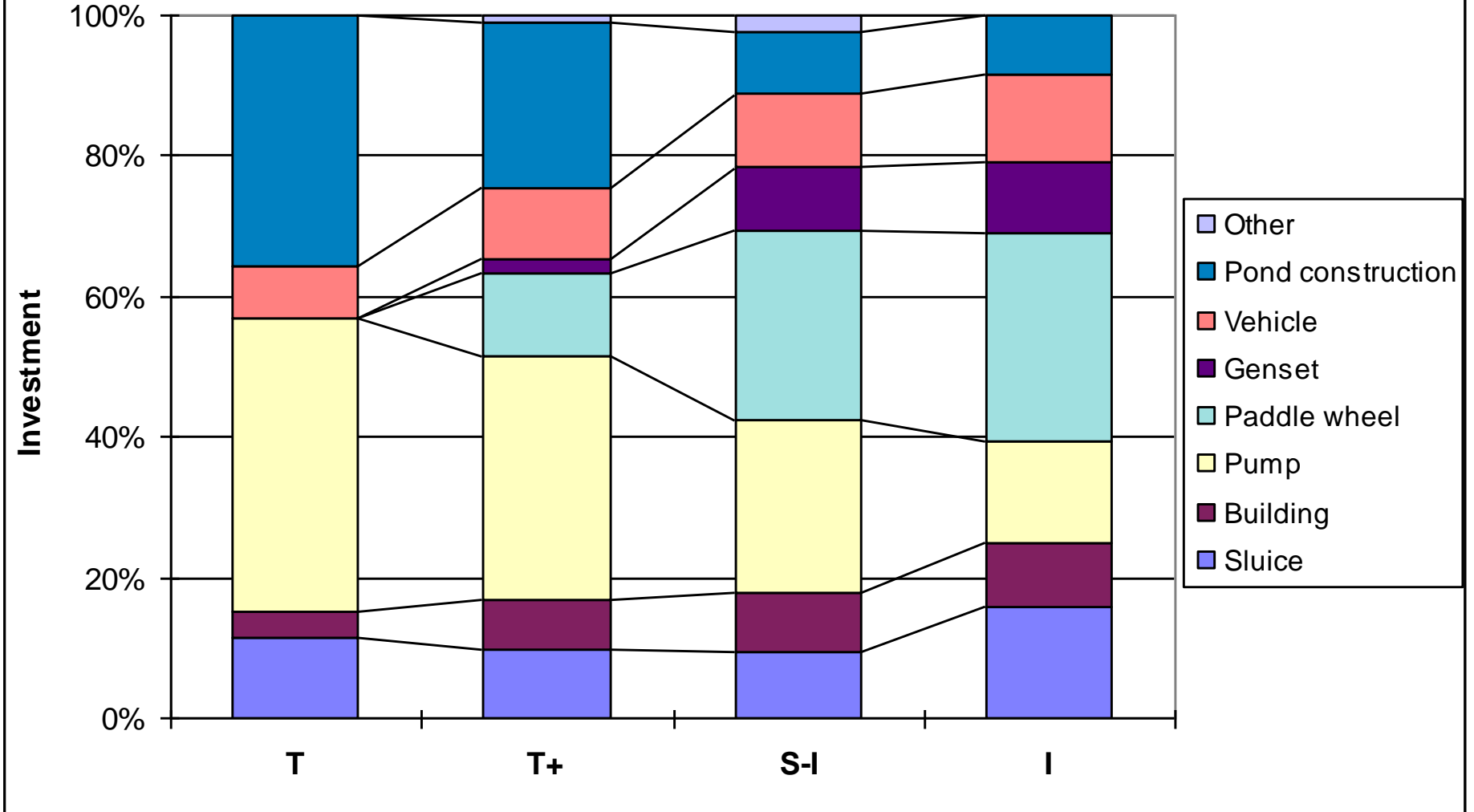
Structure of investment cost (5 years: 10 crops)



Well differentiated in terms of investment level → Different intensification levels

# Investment cost per ha

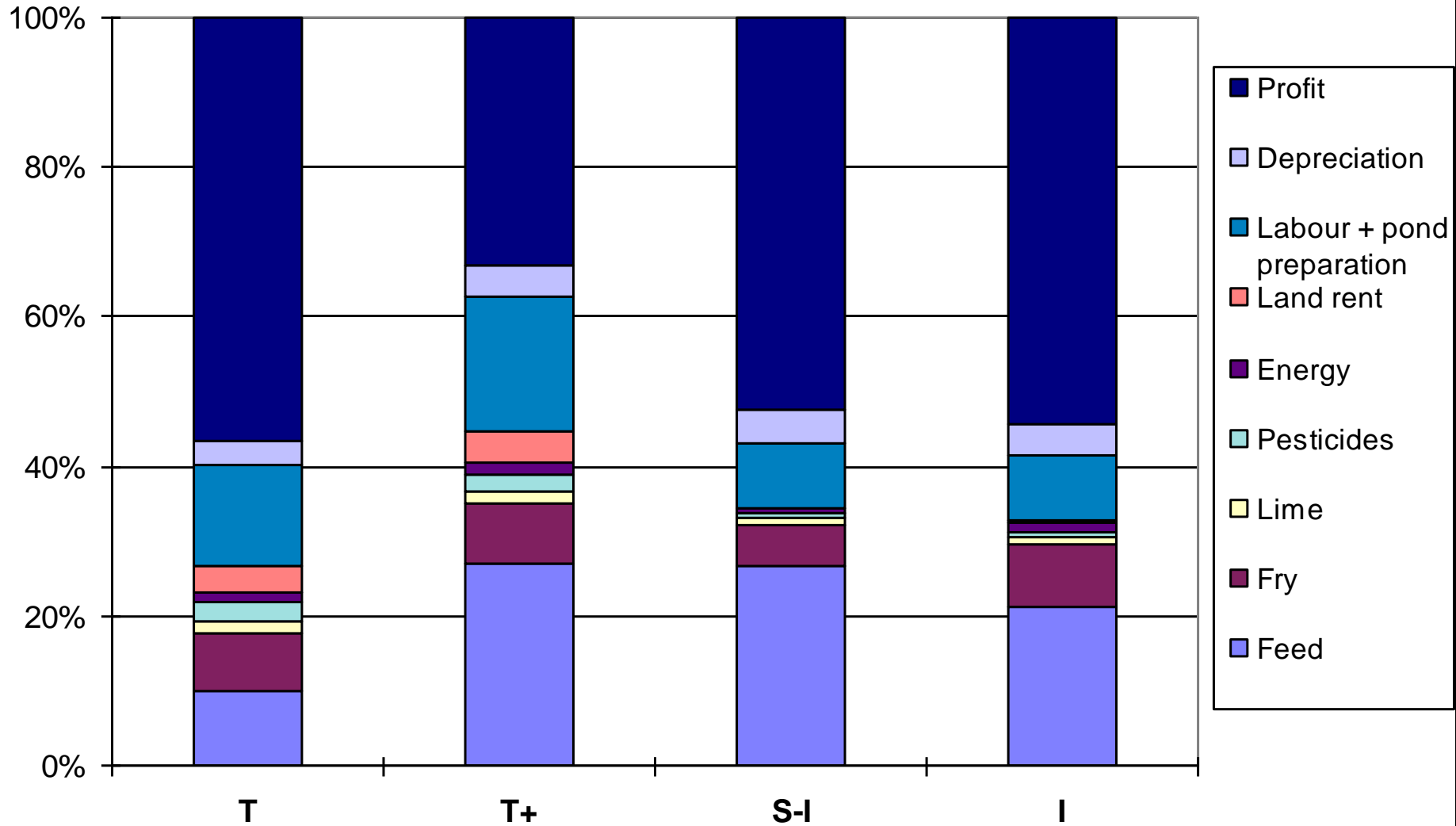
**Structure of investment cost in % (on the basis of costs in Rp/Ha)  
for 5 years of operation (10 crops)**



3 different structures of investment

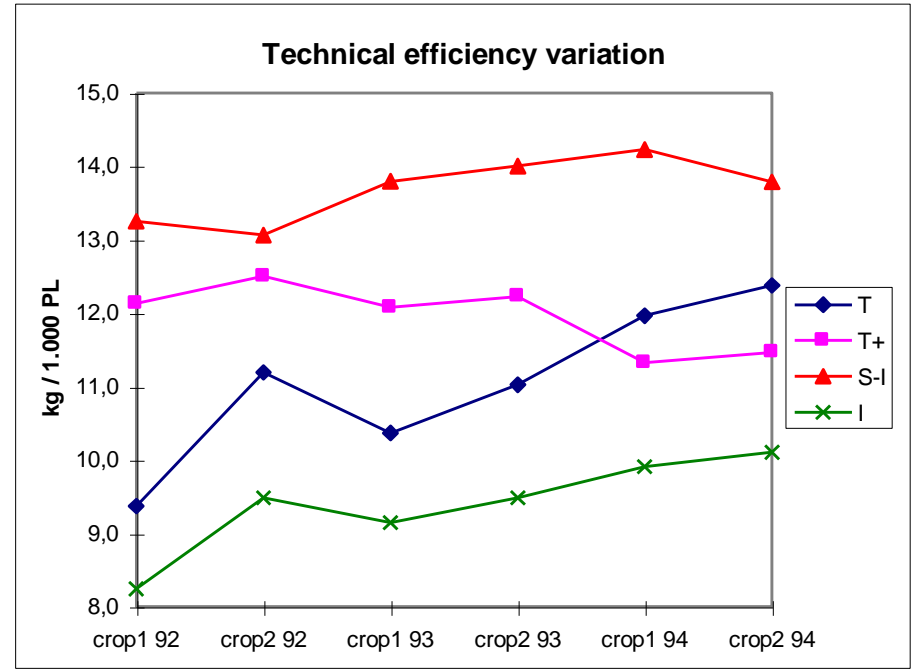
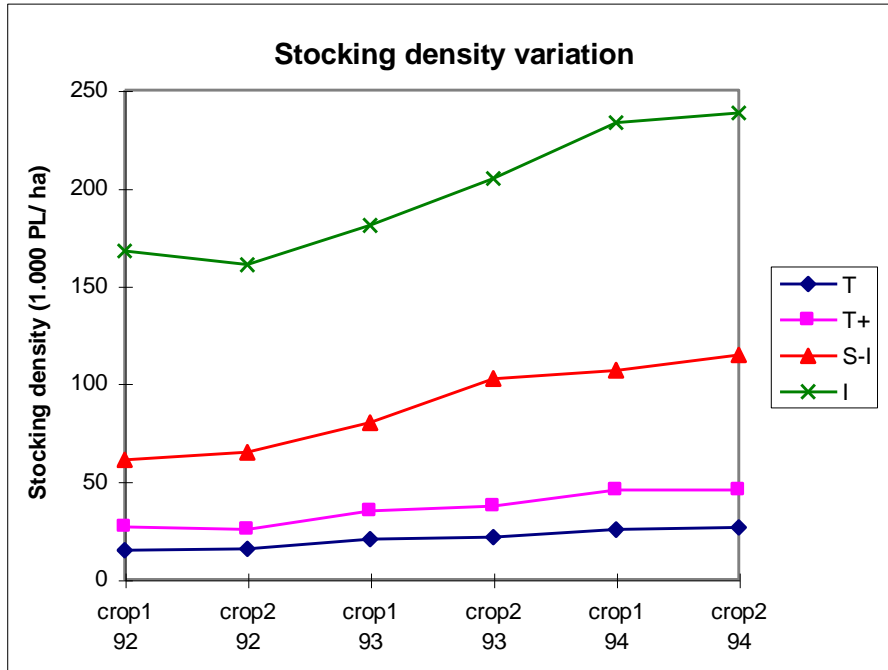
S-I close to I

Cost and revenue structure of production systems





# Rentabilité et Intensification, efficacité technique



Variation of stocking density per technic			
	crop1 92	crop2 94	Evolution
T	15	26	77%
T+	27	45	70%
S-I	61	115	88%
I	168	239	42%

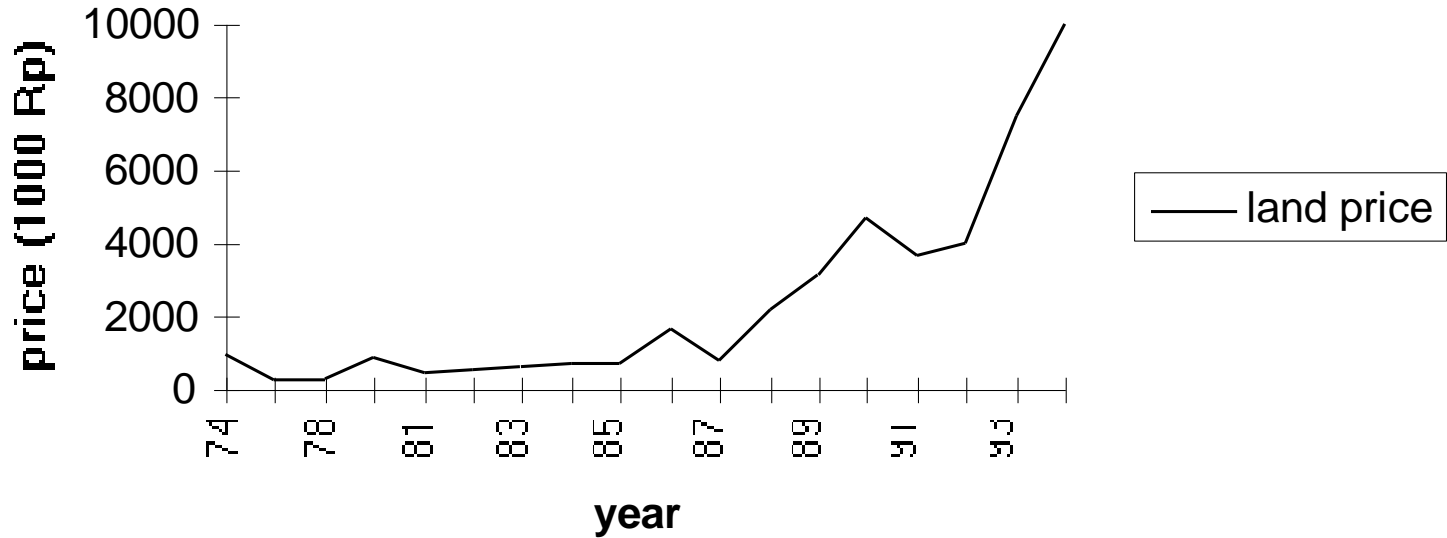
1.000 Rp = 0,4 US\$ (1996)	T	T+	S-I	I
Farm area (ha)	2,5	2,9	2,9	4,9
Stocking density (1.000 fry/ha)	26	45	115	239
Production per crop (Kg/ha)	312	514	1 569	2 335
Technical efficiency (Kg/1.000 fry)	12,4	11,5	13,8	10,1
Price (1.000Rp/kg)	16,6	16,7	17,2	17,1
Total cost (1.000Rp/kg)	7,2	11,2	8,2	7,8
Benefit (1.000Rp/kg)	9,4	5,5	9,0	9,3
Benefit/cost ratio	1,48	0,59	1,21	1,38
Added value ratio	0,73	0,55	0,66	0,67
Investment (1.000 Rp/ha)	5 543	8 542	17 791	20 979
IRR (2 crops, 1 year)	6%	-20%	41%	73%
IRR (6 crops, 3 years)	30%	26%	57%	69%
Profit rate	56,3%	33,1%	52,2%	54,1%
Return on investment (months)	11	17	7	5

-Economic incentives are strong; but no significant difference among traditional, semi-intensive and intensive systems in terms of economic efficiency (profit rate above 50%) or wealth distribution (added value between 65 and 73%)

-Low results of traditional plus system

-No evidence of economic motives to support a technical system against another one (excepted at intermediate levels of intensification)

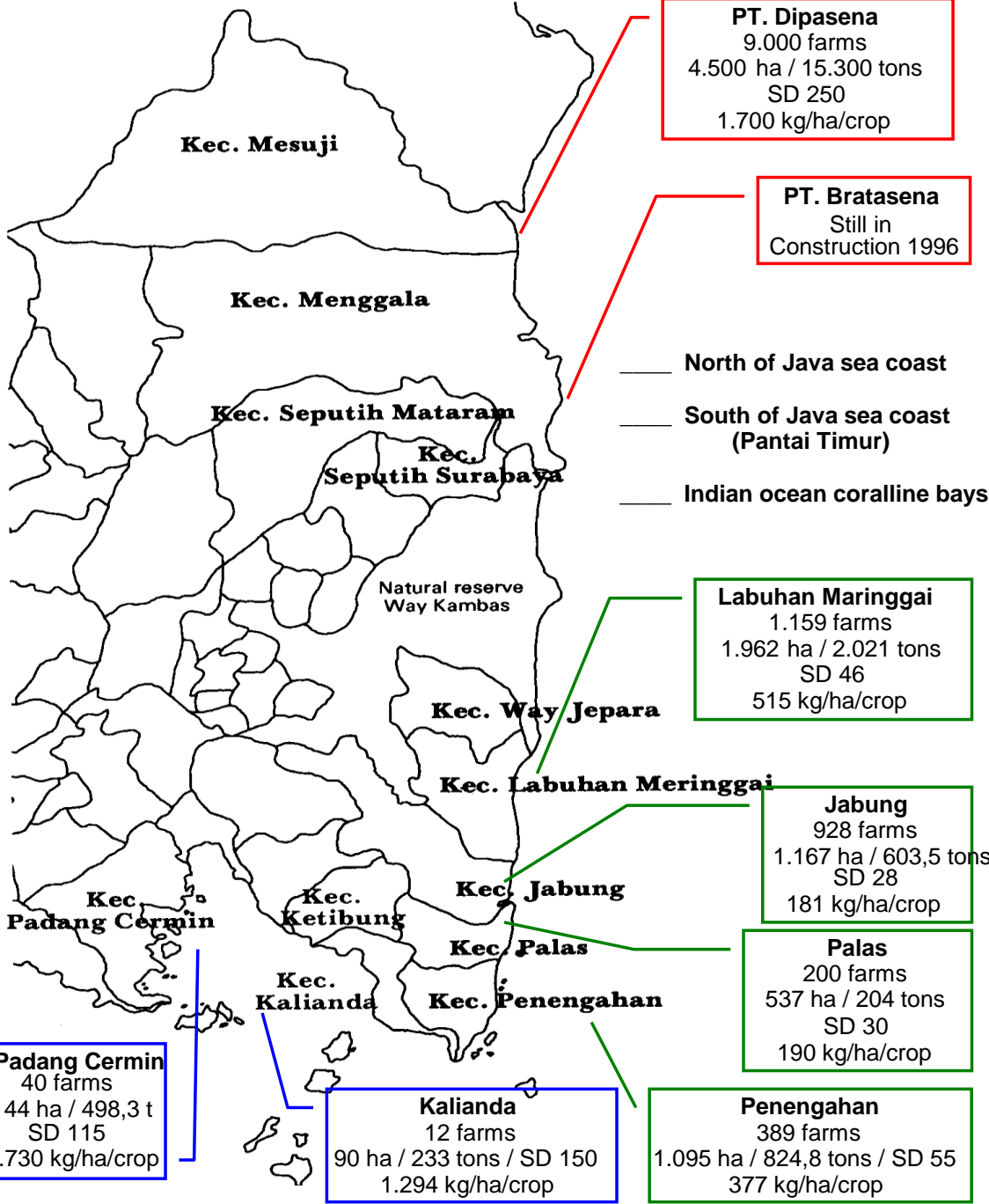
## Land price evolution



## Added value and structure

Share of added value/kg	T	T+	S-I	I
AVR	0,73	0,55	0,66	0,67
Added value/kg	12 200	9 222	11 288	11 476
Share of labour in added value	13,8%	18,0%	8,9%	9,0%
Valorisation (price Rph/kg)	16 621	16 707	17 190	17 050
Labour (Rp/kg)	2 271	2 989	1 527	1 521

1.000 Rp = 0,4 US\$ (1996)	T	T+	S-I	I
Farm area (ha)	2,5	2,9	2,9	4,9
Stocking density (1.000 fry/ha)	26	45	115	239
Production per crop (Kg/ha)	312	514	1 569	2 335
Technical efficiency (Kg/1.000 fry)	12,38	11,46	13,79	10,11
Price (1.000Rp/kg)	16,6	16,7	17,2	17,1
Total cost (1.000Rp/kg)	7,2	11,2	8,2	7,8
Benefit (1.000Rp/kg)	9,4	5,5	9,0	9,3
Benefit/cost ratio	1,48	0,59	1,21	1,38
Added value ratio	0,73	0,55	0,66	0,67
Investment (1.000 Rp/ha)	5 543	8 542	17 791	20 979
TRI (2 crops, 1 year)	6%	-20%	41%	73%
TRI (6 crops, 3 years)	30%	26%	57%	69%
Return on investment (months)	11	17	7	5
Profit rate	56,3%	33,1%	52,2%	54,1%
Profit/total cost	1,48	0,59	1,21	1,38
Profit/operational cost	1,60	0,64	1,35	1,50
Depreciation/operational cost	0,08	0,07	0,11	0,09
Depreciation/total cost	0,07	0,06	0,10	0,08
Operational cost/total cost	0,93	0,94	0,91	0,91
Feed cost/total cost	0,23	0,41	0,56	0,47
PL cost/total cost	0,19	0,12	0,12	0,18
Profit/ha/crop (1.000 Rp/ha)	3 034	3 045	14 746	23 050



**Plasma Farms**

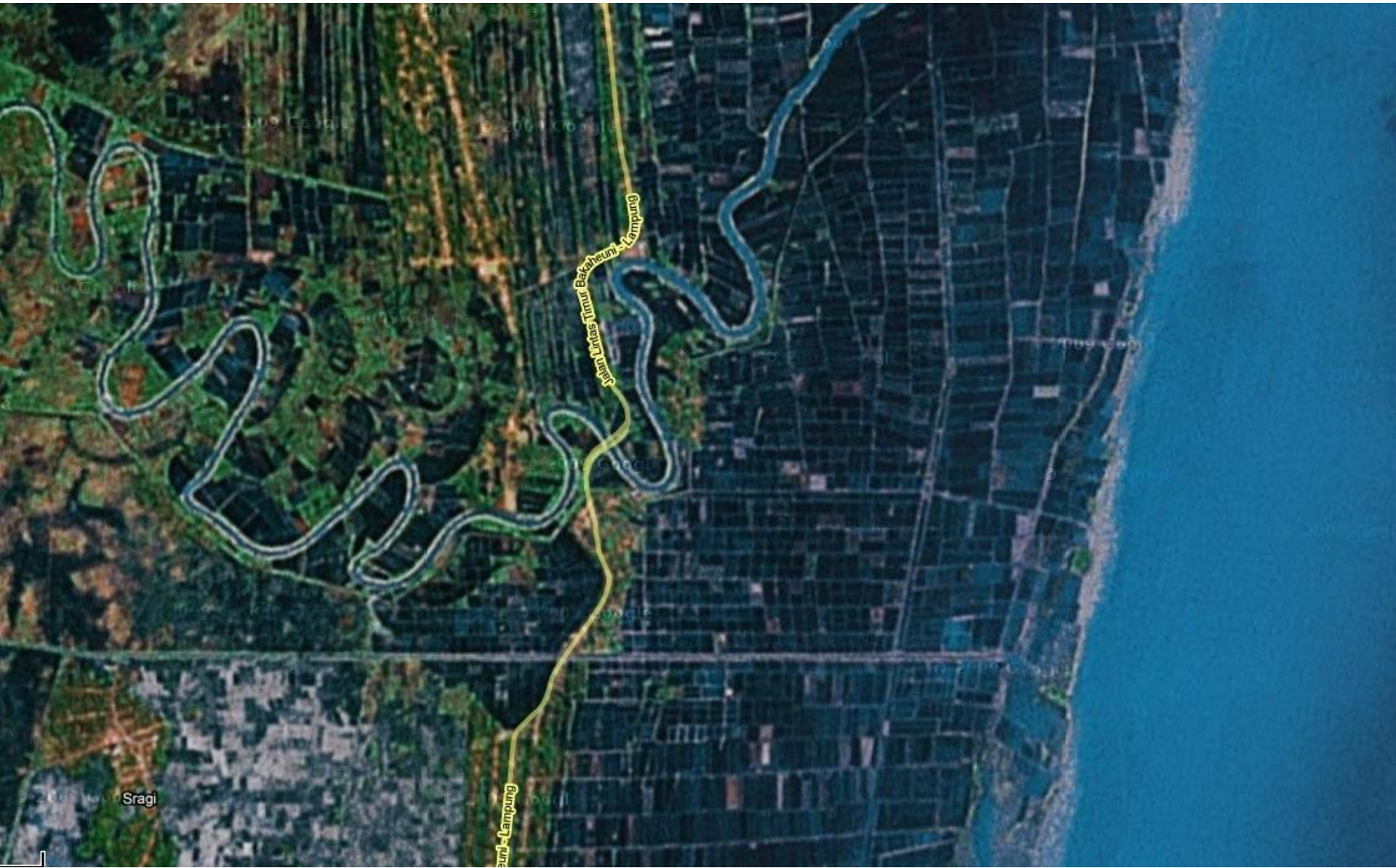


**Typical farm of South of Java sea coast**

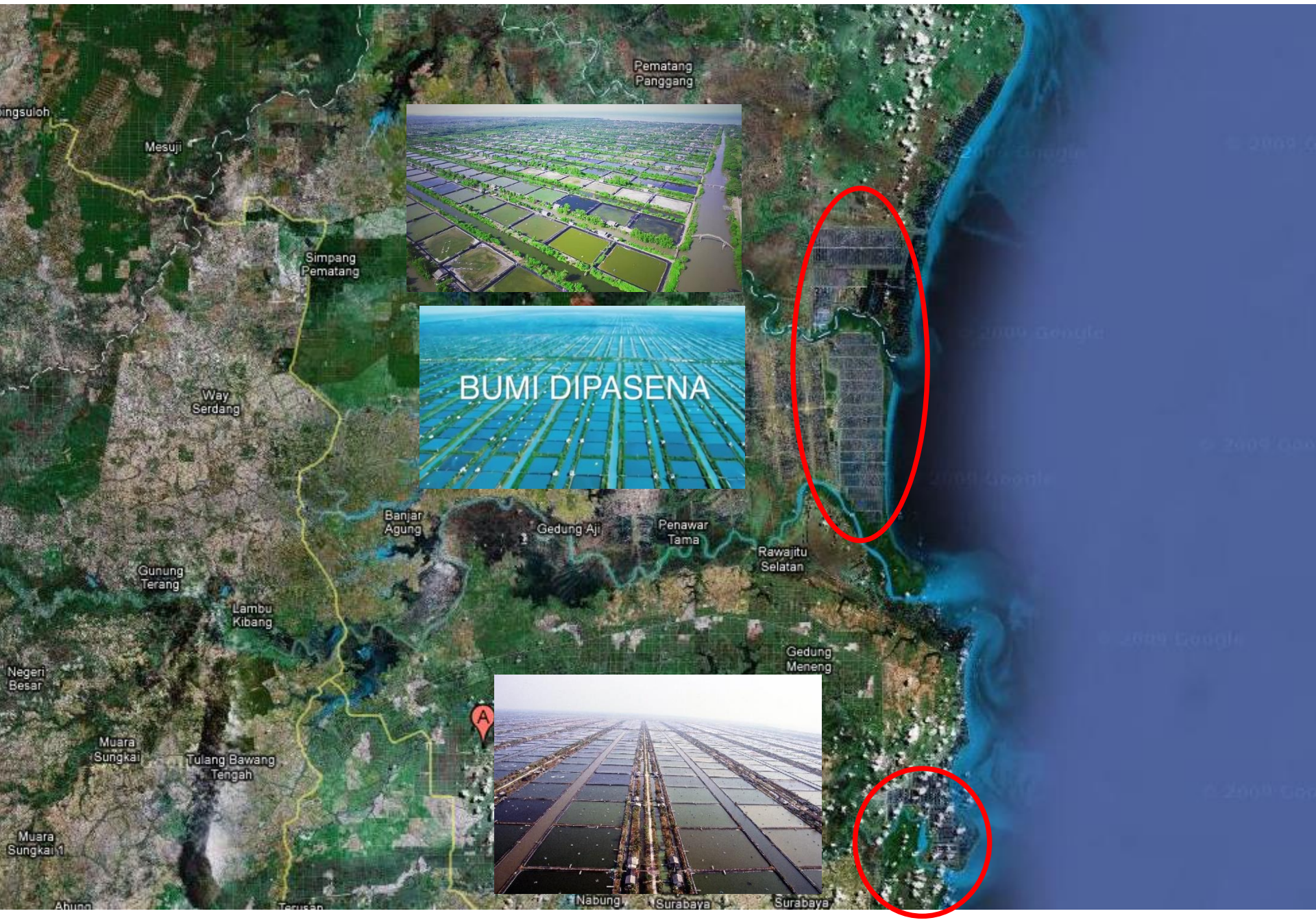
Always contextualize

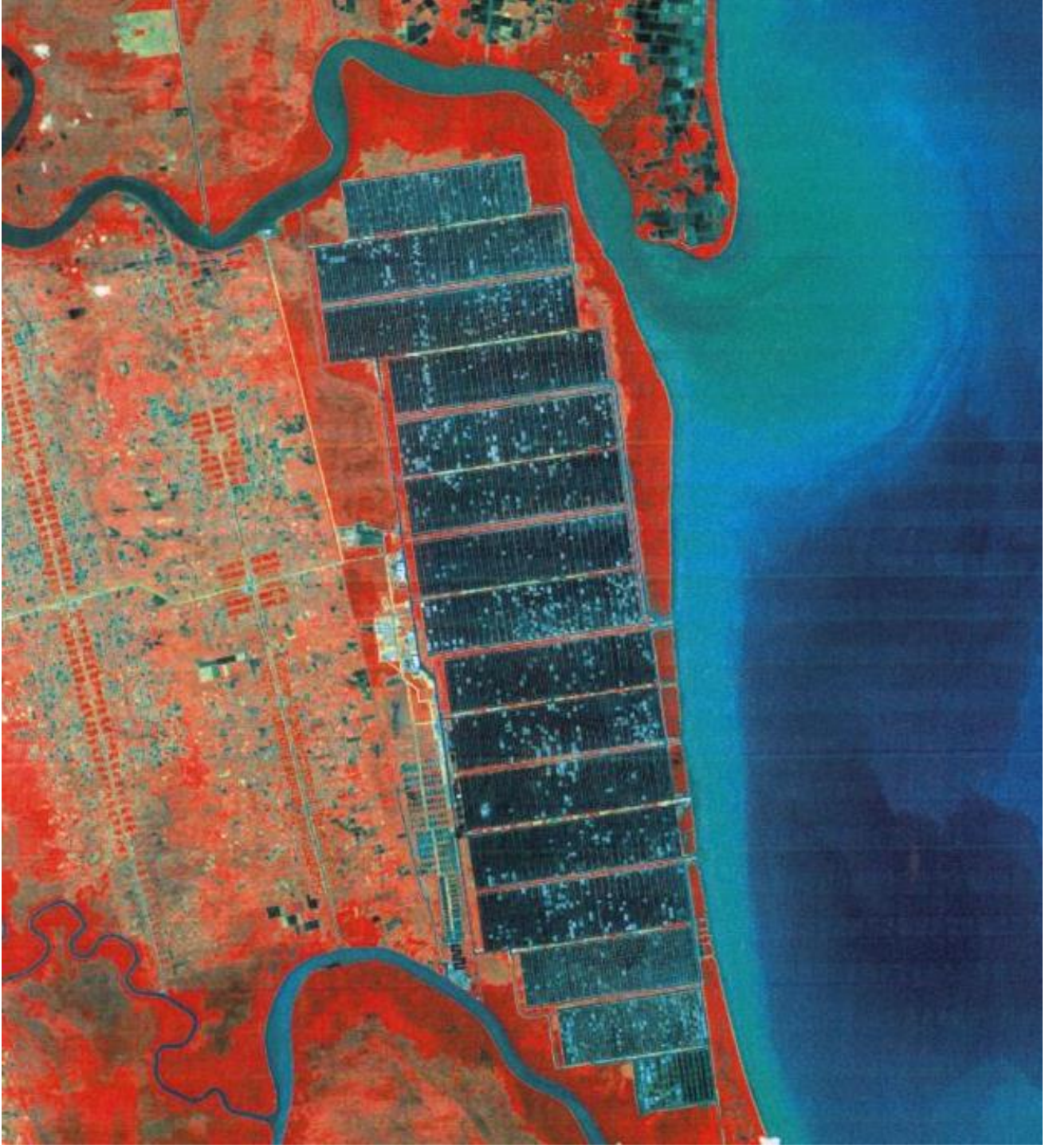
SD: Stocking Density in 1.000 PL / ha as a global indicator.

East Lampung : Java Sea – Small scale private or family based farms (endogenous development)



# East Lampung Est : Java Sea – Plasma Farms

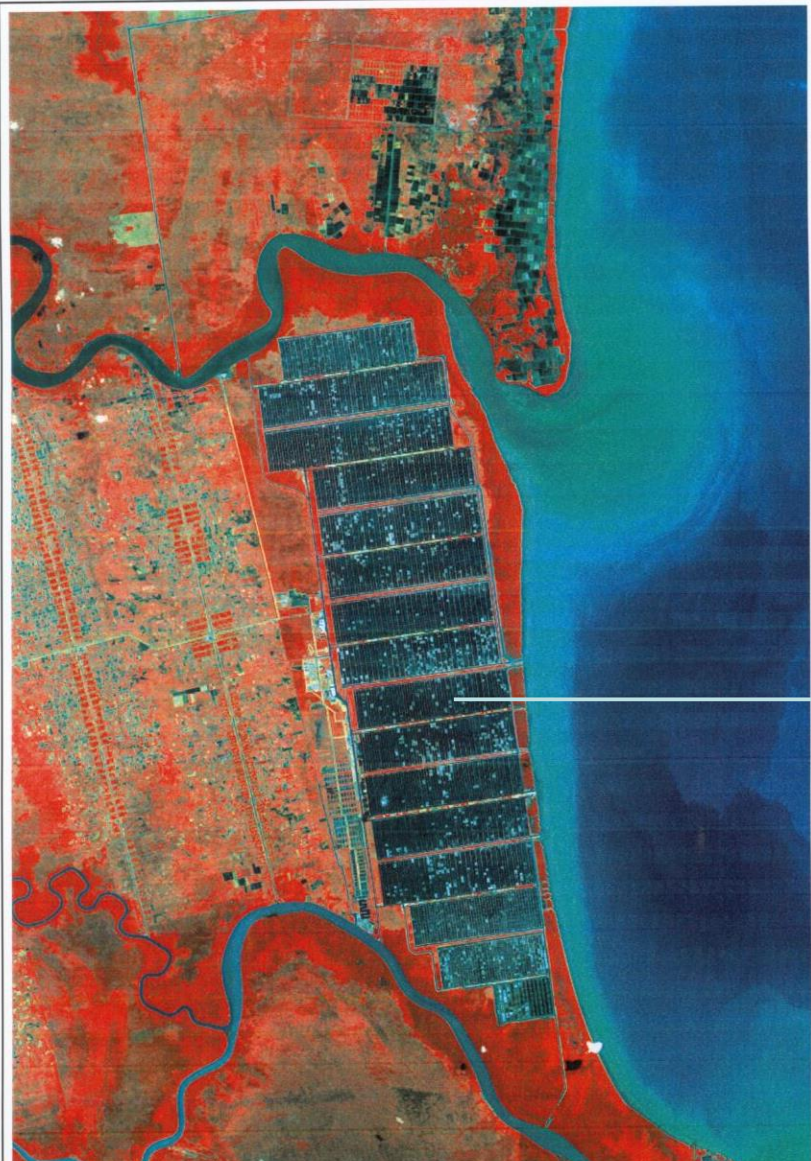






## Inti Plasma system

Dipasena site - scale 1/ 150 000



## Dipasena:

9,000 Farms

18,000 ponds

16,250 ha of which 4,500 ha of ponds

More than 20,000 people: farmers  
(households) and employees



# South Lampung : Kalianda, coraline bay site



## Summary and conclusion for the comparison of the 3 development profiles identified:

-The plasma system is based on large areas developed by a single investor providing technology, inputs and market outlets to selected farmers and managing two 0.25 ha ponds under a leasing system. Two units of this type existed in 1996, with a total of 4,500 ha of ponds developed and a further 9,000 ha planned. They are installed in previously uninhabited mangrove areas with a coastal environment under low anthropic pressure, but at an intermediate level in terms of containment. Production is very intensive, with relatively low technical efficiency on average (7 kg/1000 PL) but very good economic results, with very high overall pressure on coastal waters (discharges). Compared with other areas, the pressure on the coastal ecosystem is very high and it can be said that in the short term environmental sustainability has been fairly well controlled. Part of this success can be explained by centralised management of water (the resource), technology and marketing. However, the social conditions and environmental sustainability of such a development are more questionable. As a consequence, the system had to face a social collapse.

-Endogenous local development in the coastal villages of the south coast along a 50km stretch of coastline illustrates the difficulty of mastering technology and water quality management among more than 2,700 small-scale farmers. This is typical of rapid, disorganised development in which all local resources have been invested. It performed very well at low and intermediate levels of intensification in the early stages of development. But today this development is more under threat from disease and pollution problems. Technical performance varies greatly from one place to another. The ability to generate effective collective action is crucial to ensuring the future of shrimp farming.

-The small semi-intensive and intensive farms scattered around the coral bays have good technical efficiencies (10 to 15 kg/1,000 PL) and benefit from the best water quality and few problems of interaction between farms. But they face stiff competition for access to production areas and the sea from other activities such as tourism.