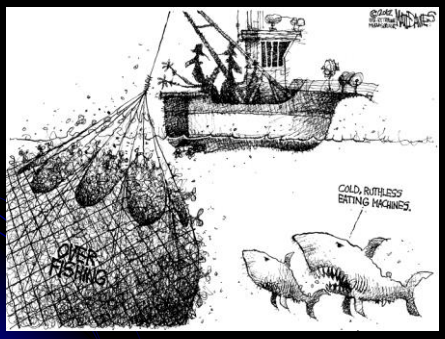
Aquaculture - overview



Introduction

- Presence of sea which was percieved in the past as unlimited resource caused lack of interest in cultivation of water environment
- Efforts to improve and increase production were focused on terestrial ecosystems = proved by cultural landscape

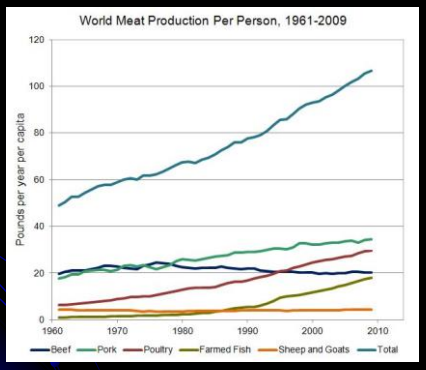
What is "Aquaculture"

- "Aquaculture" comprises human activities with aim to obtain biomas from controlled or in some way affected aquatic ecosystem.
- Product of "Acquaculture" is biomass from aquatic organisms used for human nutrition, feeding or technical purpose.
- "Aquaculture" differs from capture fisheries or other aquatic organism explotation by level of management of aquatic environment or organisms used for production of biomass.
- "Aquaculture" comprises all aspects of production of aquatic biomass.

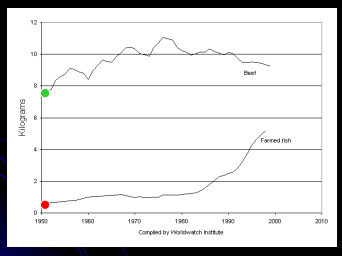
Definition

"Aquaculture is the farming of aquatic organisms, including fish, mollusks, crustaceans and aquatic plants. Farming implies some form of intervention in the rearing process to enhance production, such as regular stocking, feeding, protection from predators, etc. Farming also implies individual or corporate ownership of the stock being cultivated."

SOURCE: FAO FISHERIES CIRCULAR NO. 815 REVISION 8, 1996



Production of fish in culture and beef in culture / person



What is Product of Aquaculture

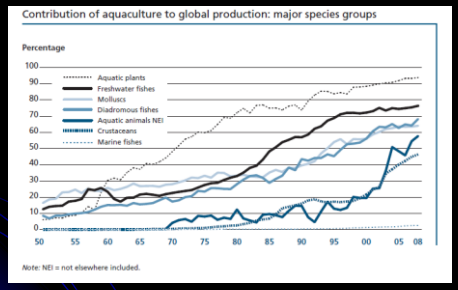
- In aquaculture 210 species in evidence
- 9,7 MT (21,2% of production) was not sorted to species level
- In terrestrial systems– less species
- Cryptic species
- Huge ecological valence
- Genetic information
- Many species - beginning of domestication

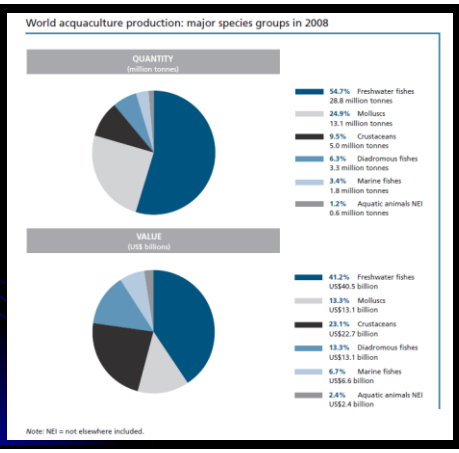
What is Product of Aquaculture

- Aquaproducts
- Not only for human and animal nutrition
- New types of antibiotics
- Antiinflammatory efects - New Zealand mussel
- Agar for technical purpose – algae *Gracilaria lichenoides* and *Gelidium sp.*

What is Product of Aquaculture

- Four main groups of aquacultural products
- Algae (Seaweed), Mollusks, Crustaceans and Fish
- Main commercial aquacultural products are: shrimps, salmon, Mollusks.
- Increasing of the production: tilapias, seabass (*Dicentrarchus labrax*) and seabream (*Sparus aurata*)





Advantages of Aquaculture

- Invertebrates and lower vertebrates – genetic manipulation
- Chromosome manipulation (polyploidisation)
- All male or all female production
- Manipulation with sex chromosomes
- Production of clonal lineages
- Gynogenesis, androgenesis

Advantages of Aquaculture

- Variable body temperature
- Better converters of foodstuffs
- Requires less energy for body support

1 ½kg feed = 1 kg fish

Advantages of Aquaculture

- Aquaculturists can improve both the fish and the production methods
- Commercial fishers can do little about the fish and must concentrate on improving fishing gear and methods
- Aquaculture is an important source of employment

What are the differences of Aquaculture

- Main source of life on Earth is energy from Sun.
- 70% of the sun radiation incidents the surface of the world oceans
- We get only 10% of animal proteins from the oceans
- Only 1,3% of direct food

Aquaculture production

- There are not big differences in aquatic production systems between animal and plant production
- Number of different technologies
- More then 210 species in aquaculture
- Intensive breeding of fish – similar to chicken farm
- Oyster production – similar to crops production

Cultivation of Water Environment

- More difficult management
- 3D space of the production
- Work mainly only from surface
- Management of environment is more important then of organisms
- Aquatic environment is complex and need complex management approach

Cultivation of Water Environment

- Each aqualocality must be evaluated independently
- Aquaculture works with cold-blooded animals in permanently varying environment
- Each species do best in the environment close to the ideal species niche

Cultivation of Water Environment

- Identification of ideal niches and optimization of the environment need good biological knowledge
- Aquaculture and sheep farmer – find differences
- Thermometer, oxymeter, pH -meter, conductometer…

Restriction of Aquculture

- ! Water !
- Collision: agriculture X industry X trafic X water supply for people
- Negative impact to ecosystem
- Production of pollutants
- Introduction of non native species
- Erosion of genepool of the wild populations

World Fishery Harvest

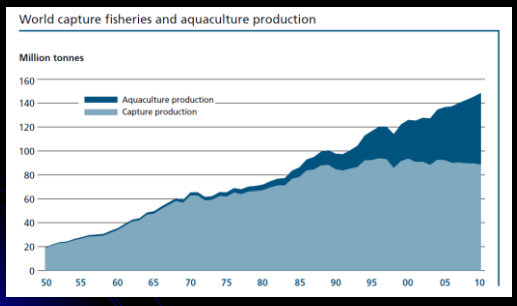
Capture fishery

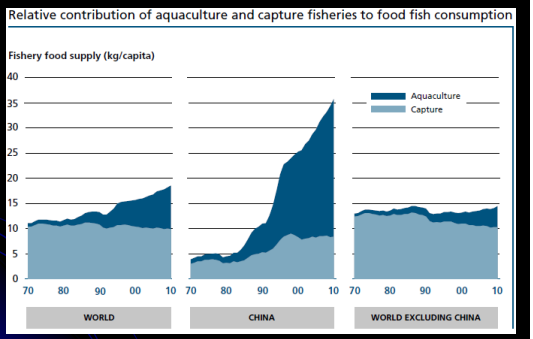
90 MT of fish and shellfish

Aquaculture

79 MT of fish and shellfish

Total finfish and shellfish = 169 million metric tons (MT)



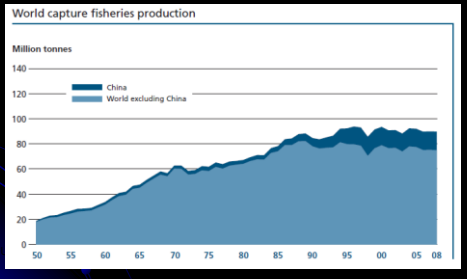


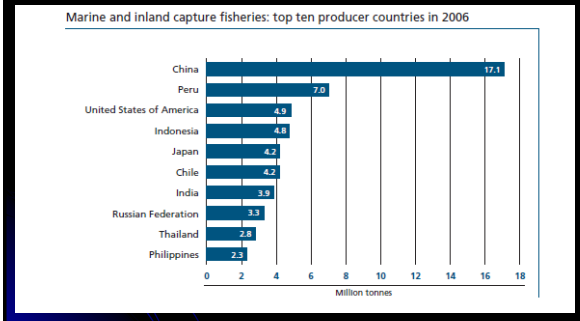
World Production Trends

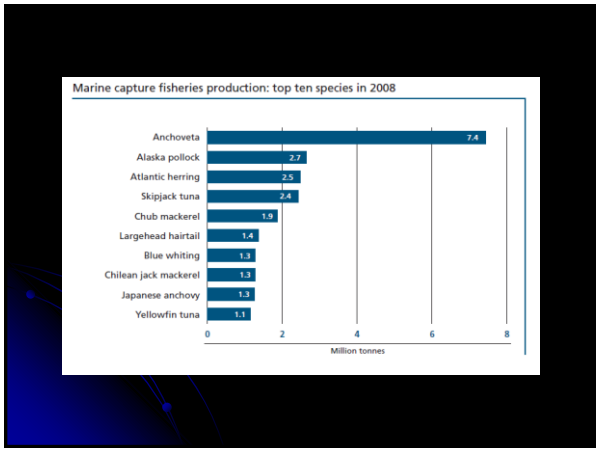
- According to FAO statistics aquaculture's contribution to global supplies of seaweed, mollusks, crustaceans and fish increased from ~5 percent of total production by weight in 70´ to ~30 % in 2000 and ~50% in recent yrs.
- Aquaculture is growing more rapidly than all other animal food producing sectors.

Capture fisheries

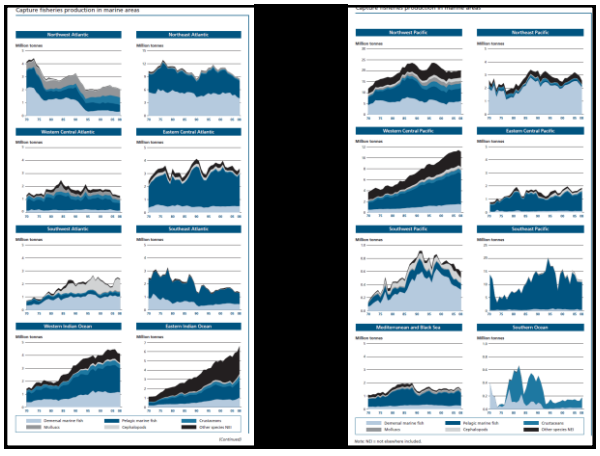
World Production

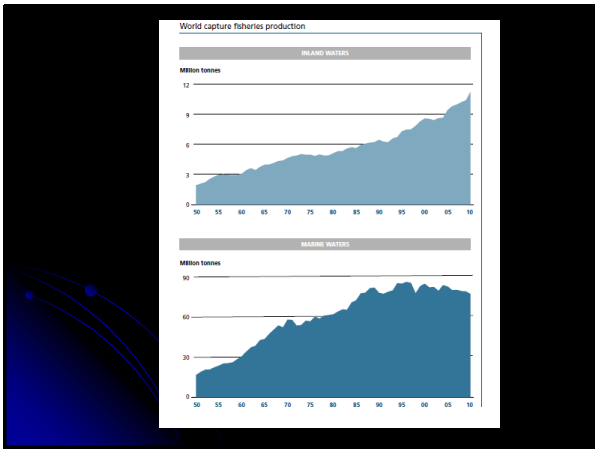





Marine capture fisheries production: top ten species in 2008
Anchoveta
Alaska pollock
Atlantic herring
Skipjack tuna
Chub mackerel
Largehead hairtail
Blue whiting
Chilean jack mackerel
Japanese anchovy
Yellowfin tuna
7.4
2.7
2.5
2.4
1.9
1.4
1.3
1.3
1.3
1.1
0
2
4
6
8
Million tonnes


Engraulis ringens
Anchoveta
West cost of South America

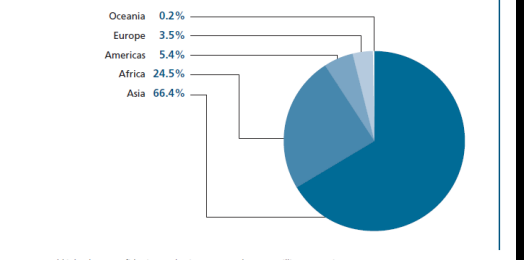

Capture fisheries production in marine areas
Northwest Atlantic
Northeast Atlantic
Western Central Atlantic
Eastern Central Atlantic
Southwest Atlantic
Southeast Atlantic
Western Indian Ocean
Eastern Indian Ocean
Northwest Pacific
Northeast Pacific
Western Central Pacific
Eastern Central Pacific
Southwest Pacific
Southeast Pacific
Mediterranean and Black Sea
Southern Ocean


World capture fisheries production
INLAND WATERS
Million tonnes
MARINE WATERS
Million tonnes

Inland Capture Fisheries

- 10 Mt
- 11% world capture fisheries in total
- China 25% of world production
- Developing countries – animal proteins
- Developed countries – hobby, recreation

Inland capture fisheries by continent in 2008

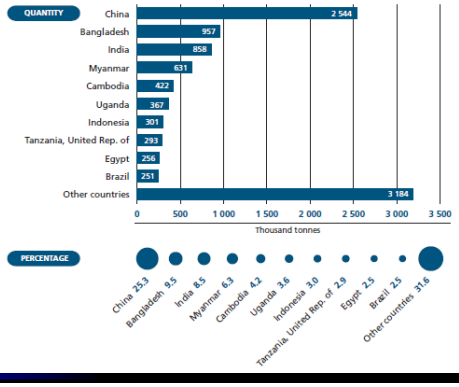


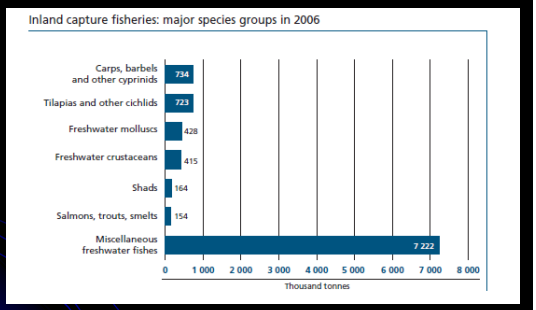
Note: World inland capture fisheries production amounted to 10.2 million tonnes in 2008.

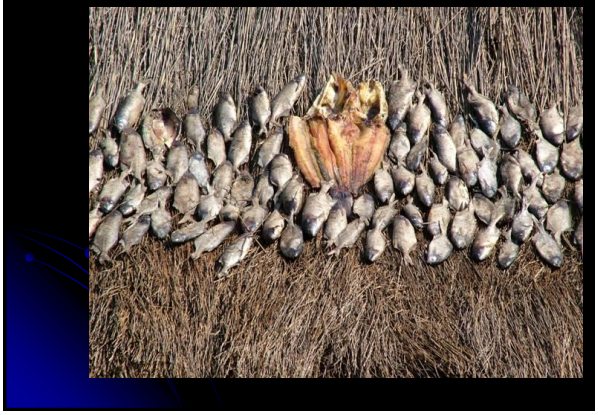
Inland capture fisheries production by continent and major producer

Continent/country	2004	2010	Variation 2004–2010	
	(Tonnes)	(Tonnes)	(Tonnes)	(Percentage)
Asia	5 376 670	7 696 520	2 319 850	43.1
China	2 097 167	2 289 343	192 176	9.2
India	527 290	1 468 757	941 467	178.5
Bangladesh	732 067	1 119 094	387 027	52.9
Myanmar	454 260	1 002 430	548 170	120.7
Africa	2 332 948	2 567 427	234 479	10.1
Americas	600 942	543 428	–57 514	–9.6
Europe	314 034	386 850	72 816	23.2
Oceania	17 668	16 975	–693	–3.9
World total	**8 642 262**	**11 211 200**	**2 568 938**	**29.7**

Inland capture fisheries: top ten producer countries in 2006

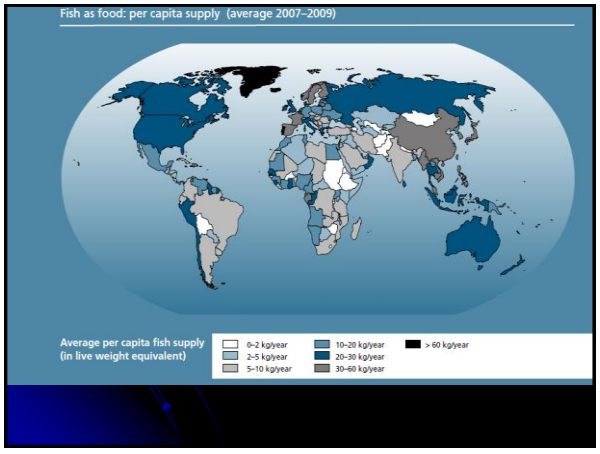


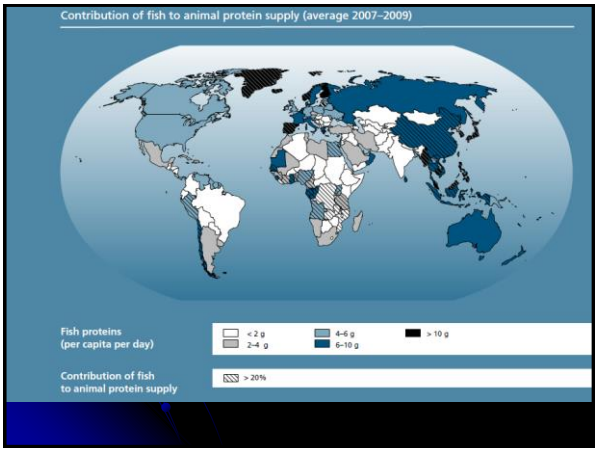

Inland capture fisheries: major species groups in 2006
Carps, barbels and other cyprinids
734
Tilapias and other cichlids
723
Freshwater molluscs
428
Freshwater crustaceans
415
Shads
164
Salmons, trouts, smelts
154
Miscellaneous freshwater fishes
7 222
0
1 000
2 000
3 000
4 000
5 000
6 000
7 000
8 000
Thousand tonnes



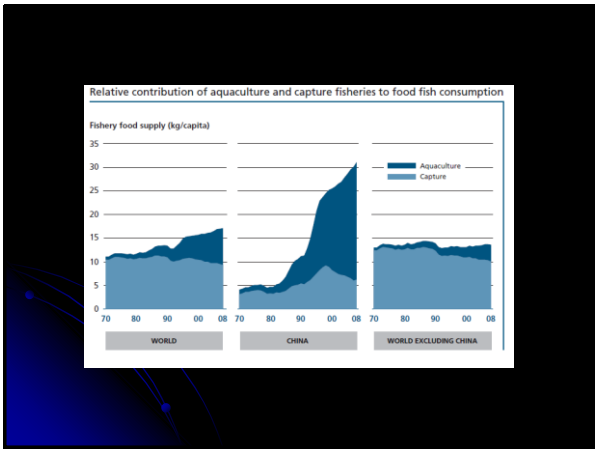
Take out

- 169 MT
- 90 capture fisheries
  - 80 MT marine
  - 10 MT inland
- 79 aquaculture including plants
- 60 MT aquaculture fish and shellfish
- 19 MT aquatic plants (seaweed)


Fish as food: per capita supply (average 2007–2009)
Average per capita fish supply (in live weight equivalent)
0–2 kg/year
2–5 kg/year
5–10 kg/year
10–20 kg/year
20–30 kg/year
30–60 kg/year
> 60 kg/year


Contribution of fish to animal protein supply (average 2007–2009)
Fish proteins (per capita per day)
< 2 g
2–4 g
4–6 g
6–10 g
> 10 g
Contribution of fish to animal protein supply
> 20%


In Europe
0-2 kg/year
2-5 kg/year
5-10 kg/year
10-20 kg/year
20-30 kg/year
30-60 kg/year
> 60 kg/year


Relative contribution of aquaculture and capture fisheries to food fish consumption
Fishery food supply (kg/capita)
35
30
25
20
15
10
5
0
70 80 90 00 08
Aquaculture
Capture
WORLD
CHINA
WORLD EXCLUDING CHINA

Seaweed

- 19 mil tun
- Food
- China and Korea, Philipinas, Tanzania
- Chile - Agar
- species: Porphyra red seaweed, Undaria (brown seaweed) Euchuma (red seaweed)

Saccharina (Laminaria) japonica
(kelp)

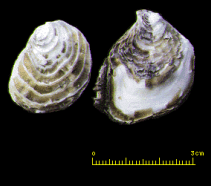
Marine Algae

Mollusks

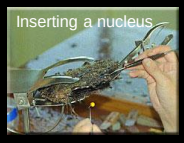
- Main exporters China, Thailand

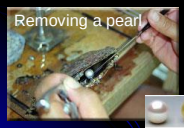
- Scallops
- Oysters
- Clams
- Mussels
- Cephalopods

Crassostera gigas
Pacific cupped oyster



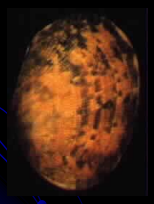
Pearl Oyster





Patinopecten yessoensis
Yeasso scallop

Ruditapes philippinarum
Japanese carpet shell



Crustaceans

- *Peneaus monodon*, *P. vannemi*, *P. stylorostris*
- *Macrobrachium sp.* – fresh water
- Main product of aqacult. in trade
- Importers: Japan, USA, EU
- Exporters:Thailand, Vietnam, Ecuador, Indonesia, India, Mexico, Bangladesh,

Peneus monodon
Gigant tiger prawn

Marine Shrimp

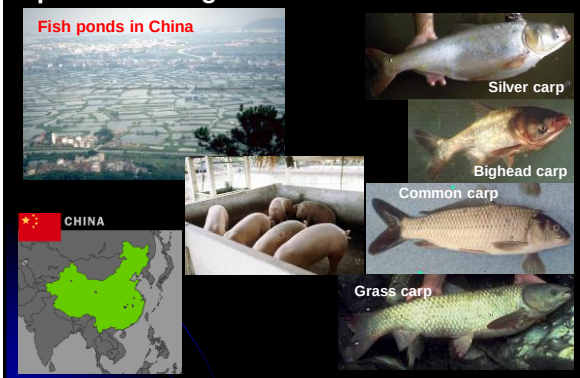
Macrobrachium rosenbergii
Giant freshwater prawn

Figure 1. Giant freshwater prawn (Macrobrachium rosenbergii)

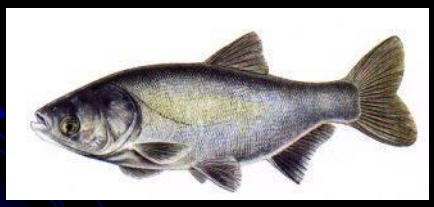
Fish

- Carps “Cyprinids” of China and India
- Salmonids
- Tilapias
- American catfish
- African catfish
- *Pangasius* Vietnam
- Seabas a Seabream

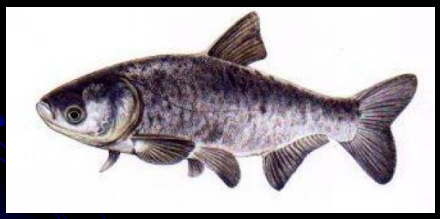
Aquaculture began in China



Hypophthalmichthys molitrix
Silver carp



Hypophthalmichthys nobilis
Bighead carp



1,41 mil. t.
1,31 bil.US$

Ctenopharyngodon idella
Grass carp

Cyprinus carpio
Common carp

Oerochromis niloticus
Nile tilapia

Salmo salar
Atlantic Salmon

Oncorhynchus mykiss
Rainbow trout

Ictalurus punctatus
American catfish
(Channel catfish)

Clarias gariepinus
African catfish
(Walking catfish)

Pangasius
(Pangasius sp.)

Sparus aurata
Sea bream

Dicentrarchus labrax
Seabass

Baitfish Species

- Fathead minnows
- Golden shiners
- Brown Shrimp
- Mullet
- Bull minnows

Nearly 1,600 bait minnow farms are in operation in the United States.

The largest bait farm in the U.S. has about 2,500 acres of water and produces about 3 million pounds per year.

6,329,000 kg with a value of 57 million dollars was produced in the U.S. in 2003

Ornamental fishes

goldfish