

Aquaculture

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Fish as food: per capita supply (average 1999-2001)

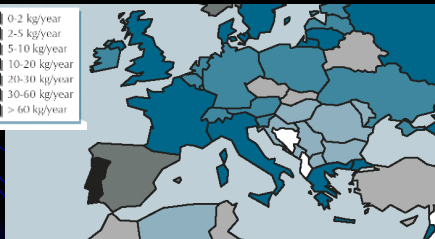
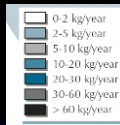
Fish as food per capita



Average per capita fish supply (in live weight equivalent)



Europe



Position of aquaculture in the World Food Production

- World agriculture
- What is aquaculture / capture fisheries
- Aquaculture specifics
- Cultivation of water environment
- What is the product of Aquaculture
- Systems of production

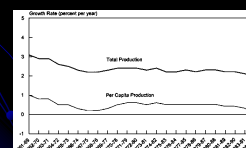


World Agriculture

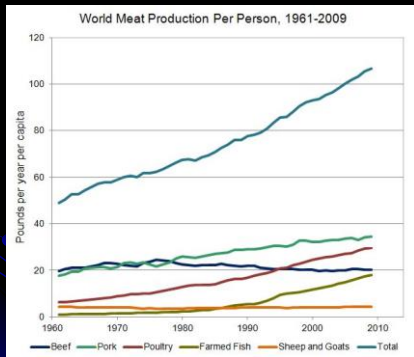
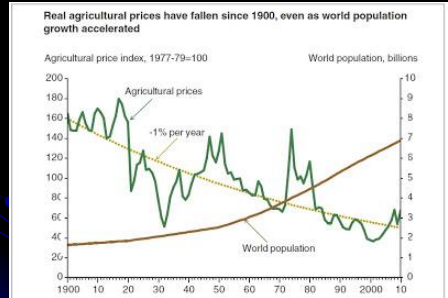
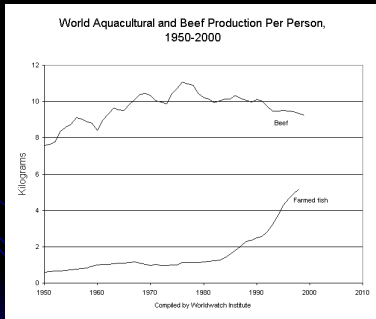
- Increasing of human population
- Demand of land for cultivation
- Degradation of land due to wrong type of cultivation
- New land for cultivation can be obtained by occupation of alluvial plains or by drying up of wetlands

World Agriculture

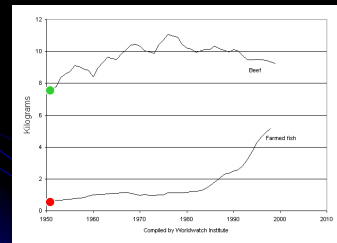
- Increasing of production from available land - only through intensification
- Intensification = energy inputs
- Saturation by fossil fuels
- Genetically manipulated organisms (GMO)



Production of fish in culture and „beef“ in culture / person

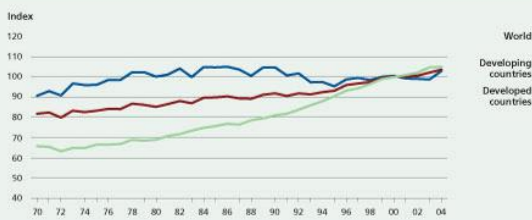


Produkce rybího a hovězího masa na obyvatele



Changes (%) in Agroproduction

FIGURE 45
Long-term trend in per capita food production by region and country group
(Index 1999-2001 = 100)



Introduction

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

What is "Aquaculture"

- "Aquaculture" comprises human activities with aim to obtain biomass from controlled or in some way affected aquatic ecosystem.
- Product of "Aquaculture" is biomass from aquatic organisms used for human nutrition, feeding or technical purpose.
- "Aquaculture" differs from capture fisheries or other aquatic organism exploitation 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, molluscs, 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

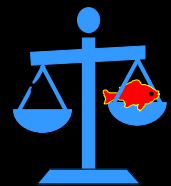
What is Product of Aquaculture

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

Advantages of Aquaculture

- Variable body temperature
- Better converters of foodstuff
- Requires less energy for living

1 ½kg feed = 1 kg fish



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
- Gynogenese, androgenese

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 at the 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 niche

Restriction of Aquaculture

- ! Water !
- Collision: Agriculture X Industry X Traffic 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

100 MT of fish and shellfish

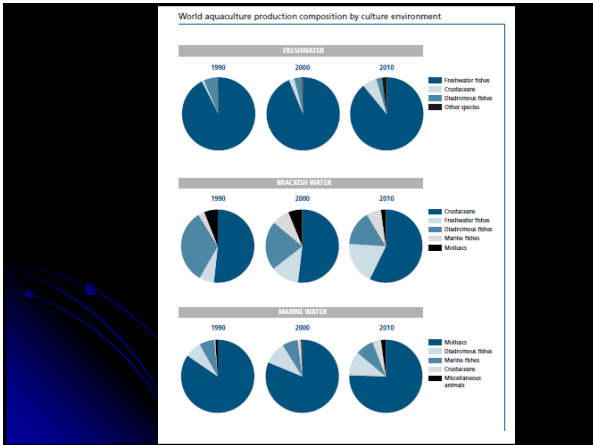
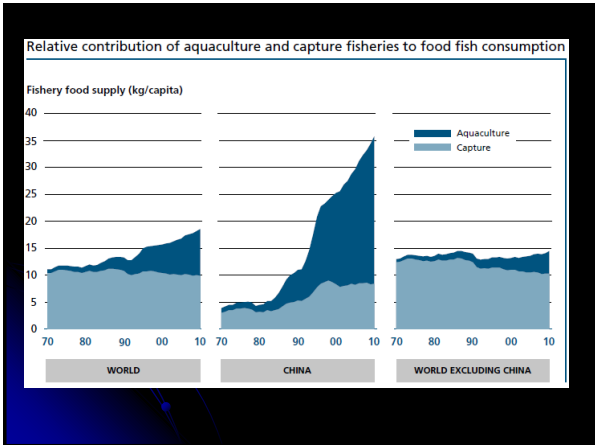
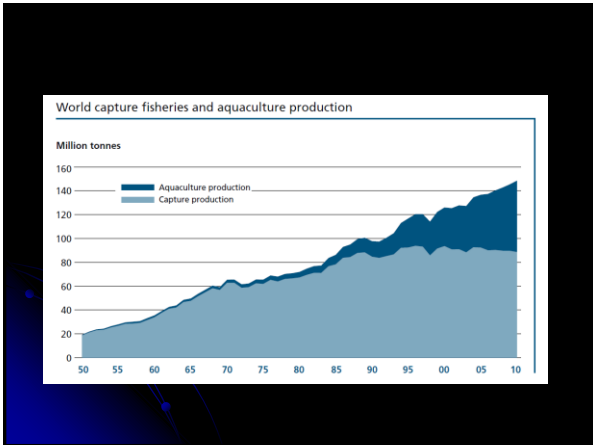


Aquaculture

50 MT of fish and shellfish

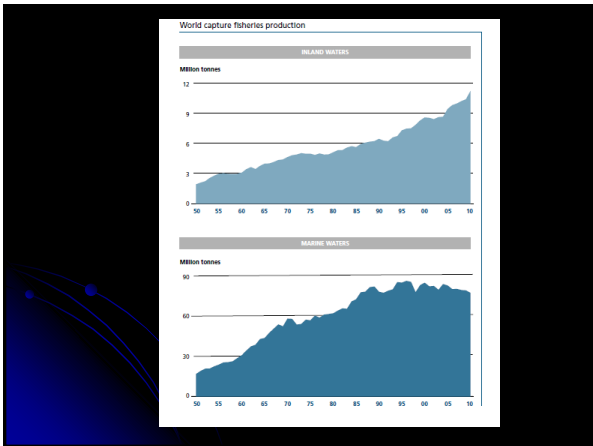


Total finfish and shellfish = 150 million metric tons (MT)



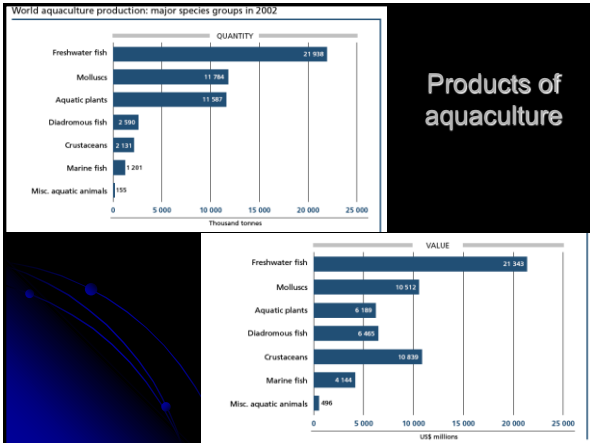
Take out

- 179 MT total aquatic production
- 100 MT capture fisheries
- 79 MT aquaculture

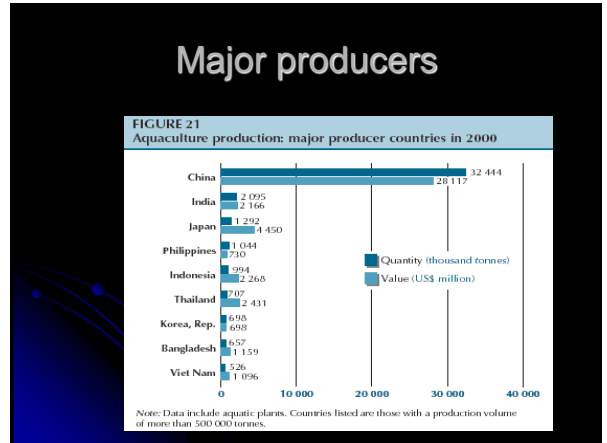


What is Product of Aquaculture

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



Products of aquaculture



What is Aquaculture ?

Farmer's Choice 32% 1/8" FLOATING FISH FEED

Young fish

Fish harvest from a cage

Fish feed pellets

Harvesting fish from a pond

Aquaculture began in China

Fish ponds in China

Silver carp

Bighead carp

Common carp

Grass carp

CHINA

71 % of world aquaculture harvest

Seaweed

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

Laminaria japonica (kelp)

Marine Algae



Molluscs

- Main exporters China, Thailand
- Production 14.2 Mt
- Scallop
- Oyster
- Clam
- Mussel
- Cephalopods

Crassostera gigas Pacific cupped oyster



Oysters

Rafts used to suspend oysters in baskets



Oyster bed on ocean floor



Harvesting a rope of oysters



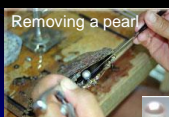
Raking oysters from bed



World yield of whole oysters was about 4,5 MT in 2003

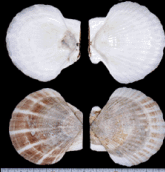


Pearl Oyster



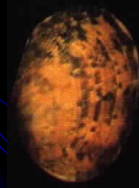
Patinopecten yessoensis Yeasso scallop

1,27 MT.
1,62 bil. US\$



Ruditapes philippinarum Japanese carpet shell

1,12 MT
1,52 bil. US\$



Crustaceans

- Production 6 Mt
- Shrimps - *Peneaus monodon*, *P. vannemi*, *P. stylostris*
- *Macrobrachium* – fresh water
- Most traded commodity
- 25% of aquaculture (1,1 mil. tun)
- Importer: Japan, USA, EU
- Exporter: Thailand, Ecuador, Indonesia, India, Mexico, Bangladesh, Vietnam

Peneus monodon Gigant tiger prawn

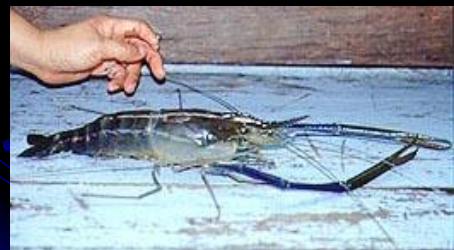
3,93 bil. US\$



Marine Shrimp



Macrobrachium rosenbergii Giant freshwater prawn

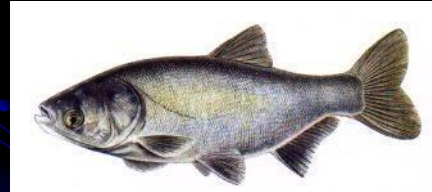


Finfish

- Production 40Mt
- 65% of all products from aquaculture
- 68% carps "Cyprinids" of China and India
- Salmon
- Trouts
- Tilapias Costa Rica, Ecuador, Columbia, Taiwan, Indonesia, Thailand, China, Zimbabwe...

Hypophthalmichthys molitrix Silver carp

2,88 mil. t.
2,79 bil. US\$



Ctenopharyngodon idella Grass carp



2,44 mil. t.
2,23 bil. US\$

Cyprinus carpio Common carp



1,99 mil. t.
2,42 bil. US\$

Oerochromis niloticus Nile tilapia



1,7 mil. t.

Tilapia



Nile Tilapia



Red Tilapia



Indoors in the USA



Outdoors in Ecuador and

Indonesia



Aristichthys nobilis
Bighead carp



Rainbow trout



Atlantic Salmon



Sparus aurata
Sea bream



Dicentrarchus labrax Seabass

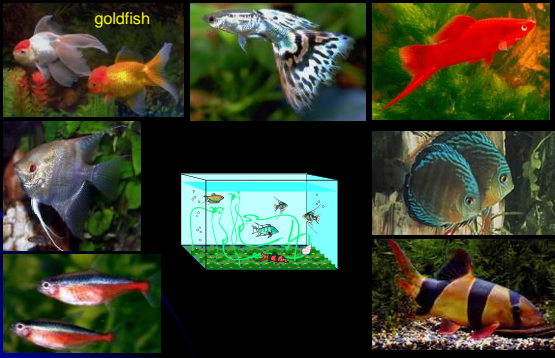


Baitfish Species

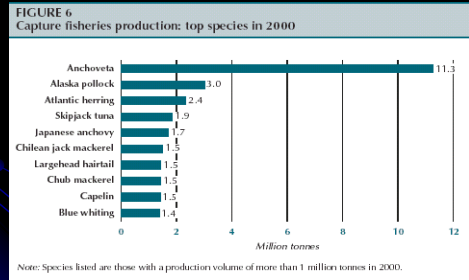
- Fathead minnows
- Golden shiners
- Brown Shrimp
- Mullet
- Bull minnows



Ornamental fishes



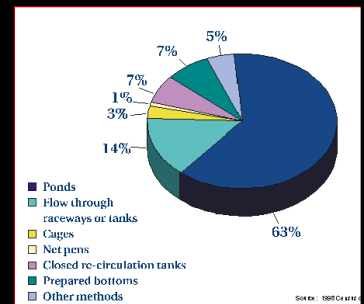
Top Species of Capture Fisheries



Production methods

- Ponds
- Cages
- Raceways
- Closed re-use systems

Production Methods



Ponds



Ponds

- Spawning
 - Broodstock
 - Hatching of eggs
- Fingerling
- Grow-out to market size

Spawning

0.1 acre

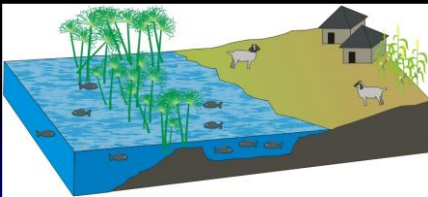
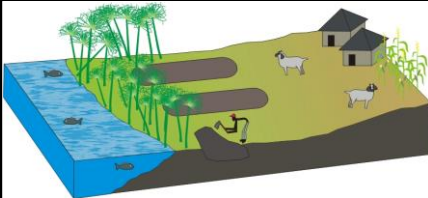
Fingerling

0.5 ha

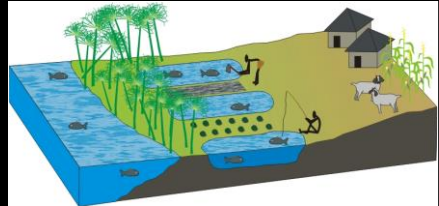
Food size

10 ha

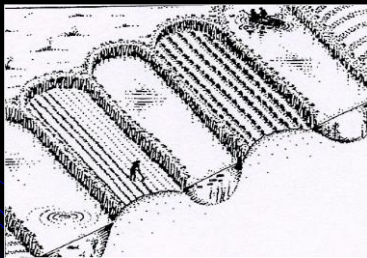
Fingerpond systems – construction and flooding



Fingerpond systems – in use

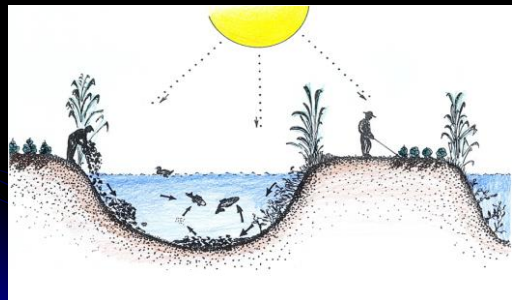


Fingerponds system



Fingerpond systems

Fingerpond systems scheme



Fingerpond systems

Rice-fish production with poultry and azolla



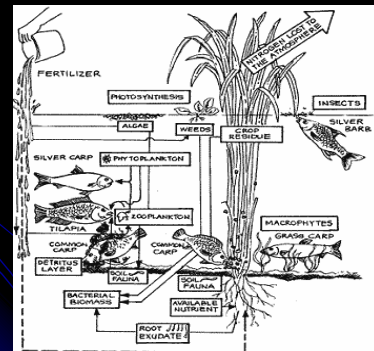
Faeces as Fertilizer



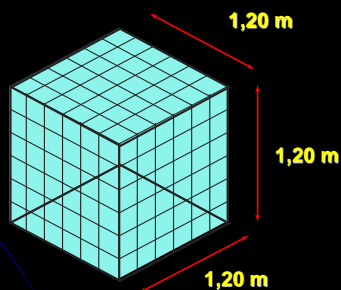
Central Situated Refuge



System



Cages and Pens

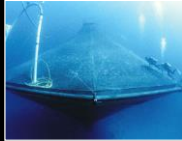


Production Phase Definition

- Securing and spawning of brood stock
- Hatching of eggs
- Growing fry to produce fingerlings
- Stocking and grow-out of fingerlings to marketable size

Cage and Net Pen Culture

- Allows existing bodies of water for production
 - Lakes
 - Bays
 - Offshore
- Low to high investment
- Decrease in production rates versus open ponds



Pangasius

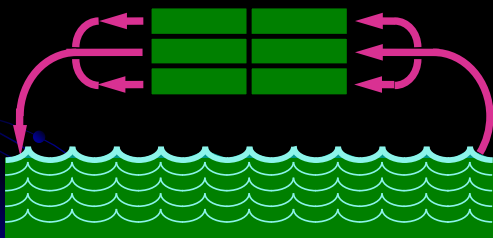
Pangasius bocourti - basa



Pangasius hypophthalmus - Tra



Raceways



Raceways

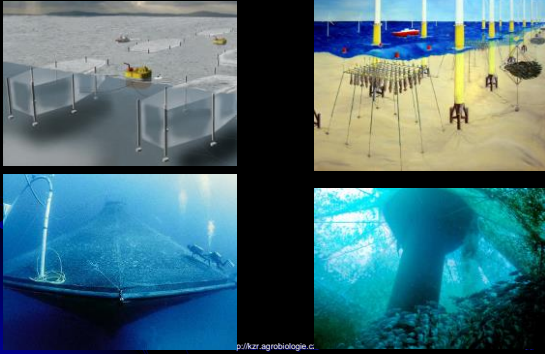


Concrete Raceway

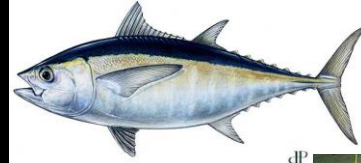


Earthen Raceway

OFFSHORE AQUACULTURE



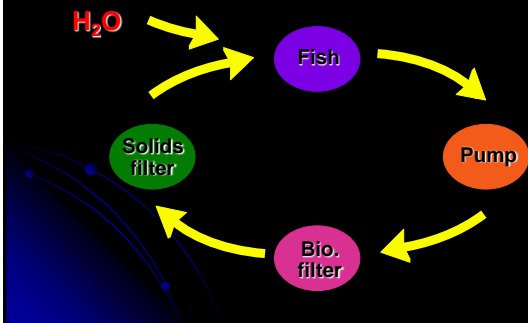
Tuna



VIDE
Ω



Water Re-use Systems



Recirculation systems

