

## **Aquaculture: Problems and Prospects**

### **A. Aquaculture and its Prospects**

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**Aquaculture**, also known as aqua farming, is the farming of aquatic organisms such as fish, crustaceans, molluscs and aquatic plants. It involves cultivating freshwater and saltwater populations under controlled conditions. (FAO). Asia has the largest shares in aquaculture production. Europe ranks at second position. Aquaculture in Africa is still not much developed. African countries largely depend on capture fishery on account of availability of plentiful water bodies. Atlantic salmons and shrimps are the major commodities in aquaculture production. Aquaculture is also involved in production of aquatic plants, e.g. *Kappaphycus alvarezii*, *Euchema spp*, *Laminaria japonica*, *Gracilaria spp*, *Undaria spp.*, *Sargassum fusiforme*, *Spirulina spp.*, *Porphyra spp*. A spectacular growth has been recorded in production of commercial aquatic plants through global aquaculture. An exponential growth in the production of fish in India has been witnessed in the span of last 30 years. Globally, our country India ranks second in production of fisheries and third in aquaculture production. Fisheries sector contributes more than 1% in National GDP and provides employment opportunity to more than 14 million persons. The table below shows that India has a major contribution towards aquaculture although it is still a developing country and has great potential for trade and commerce

<b>Indian Fisheries</b>	
Global position	3rd in Fisheries 2nd in Aquaculture
Contribution of Fisheries to GDP (%)	1.07
Contribution to Agril. GDP (%)	5.15
Per capita fish availability (Kg.)	9.0
Annual Export earnings (Rs. In Crore)	33,441.61
Employment in sector (million)	14.0

India is blessed by diverse and rich water resources. We are surrounded by the marine waters on our three sides and possess more than 8000 km of coastline and 2.02 million s. km. of Exclusive Economic Zone (EEZ). India is criss-crossed by 14 major rivers and together with canals, we have 1,91,024 km of total length. We have reservoirs, lakes and large estuaries as well. This clearly envisages vast water resources in different climatic zones depicting huge potential for aquaculture in India.

<b>Resources</b>	
Coastline	8129 kms
Exclusive Economic Zone	2.02 million sq. km
Continental Shelf	0.506 million sq. km
Rivers and Canals	1,91,024 km
Reservoirs	3.15 million ha
Ponds and Tanks	2.35 million ha
Oxbow lakes and derelict waters	1.3 million ha
Brackishwaters	1.24 million ha
Estuaries	0.29 million ha

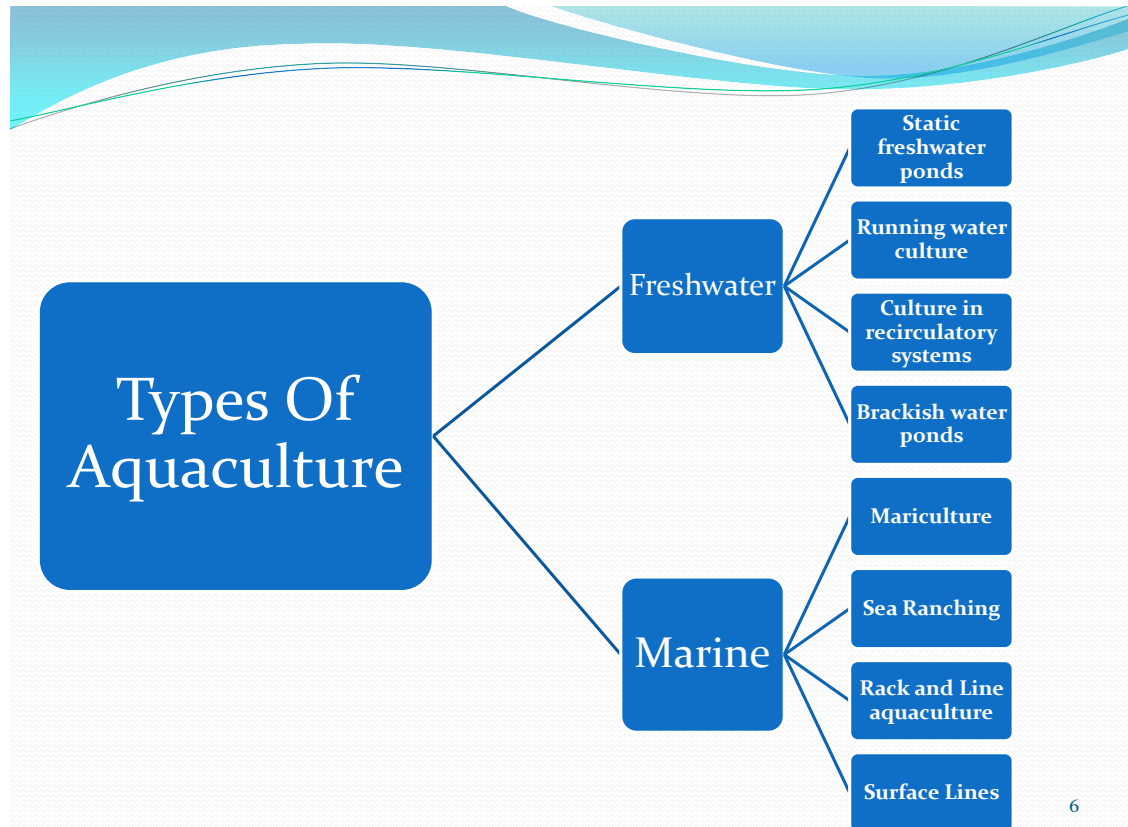
### **OBJECTIVES OF AQUACULTURE**

Prime objectives of aquaculture include-

- Production of protein rich, nutritive, palatable food benefiting the whole society through availability of plentiful food supplies at low or reasonable cost.
- Produce new species besides strengthening stocks of existing fish in natural and man-made water-bodies through artificial recruitment and transplantation.
- Production of sport fish and ornamental fish.
- Recycling of organic wastes of human and livestock.

## Types of Aquaculture

Depending on quality of water, aquaculture may freshwater and in a broad sense. In can be further subdivided in sub-categories for each type (Fig. below)



However, depending on patterns of culture, purpose, medium of water and density, Aquaculture may be grouped in following categories-

- Experimental (EX),
- Extensive (E),
- Semi-intensive (SI),
- Intensive (I),
- Freshwater (F),
- Brackishwater (B), and
- Saltwater (S).

### Fish species suitable for Aquaculture

- Huet and Timmermans (1972) list the following criteria for evaluating the suitability of a species for culture purpose:

- 1) It must withstand the climate of the region in which it will be raised.
- 2) Its rate of growth must be sufficiently high.
- 3) It must be able to reproduce successfully under culture conditions.
- 4) It must accept and thrive on abundant and cheap artificial food.
- 5) It must be acceptable to the consumer.
- 6) It should support a high population density in the ponds.
- 7) It must be disease resistant.

## Principal aquatic species under aquaculture in Asia.

Common name	Scientific name	Culture system	Environment
<b>Finfishes</b>			
Milkfish	<i>Chanos chanos</i>	E, S, I,	F, B, S
Freshwater eel	<i>Anguilla japonica</i> <i>Anguilla spp.</i>	EX, E, I	F
Grey mullet	<i>Mugil cephalus</i>	EX, E, I	F, B, S
Cockup .	<i>Lates calcarifer</i>	EX	F
Grouper	<i>Epinephelus spp.</i>	EX	S
porgy	<i>Mylio macrocephalus</i> <i>Mylio spp.</i>	EX	S
Red porgy	<i>Chysophry major</i>	S,I	S
Black porgy	<i>Acanthopagrus schlegeli</i>	S	B,S

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Tilapia	<i>Oreochromis mossambicus</i> <i>O. nilotica</i> <i>Tilapia zillii</i> <i>O. Aureus</i> <i>O. mossambicus x O. niloticus</i> <i>O. niloticus x o. aureus</i>	SI E,SI S S S S	F,S F,S F F F F
Red tilapia	<i>Oreochromis spp.</i>	S,I	F,B,S
Sweetfish, ayu	<i>Plecoglossus altivelis</i>	I	F
Goldfish	<i>Crassius auratus</i>	E,S	F
Common carp	<i>Cyprinus carpio</i>	E,S	F
Crucian carp	<i>Crassius crassius</i>	E,S	F

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Puntius carp	<i>Puntius gonionotus</i>	E,S	F
	<i>Puntius opp</i>		F
Rohu	<i>Labeo rohita.</i>	EX, S	F
Mrigal	<i>Cirrhina mrigal</i>	EX,S	F
Bottom carp	<i>Cirrhina molitorella</i>	E,S	F
Catla	<i>Catla catla</i>	EX,S	F
Grass carp	<i>Ctenopharyngodon idellus</i>	E,S	F
Black or snail carp	<i>Mylopharyngodon piceus.</i>	E,S	F
Silver carp	<i>Hypophthalmichthys molitrix.</i>	EX,E,S	F
Bighead carp	<i>Aristichtys nobilis</i>	ES,E,S	F
Nilem	<i>Osteochilus hasselti</i>	EX,E	F
Walking catfish	<i>Clarias batrachus</i>	E,S	F
	<i>Clarias spp.</i>		F

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River catfish	<i>Pangasius sutchi</i>	EX, E	F
	<i>Pangasius spp.</i>		F
Japanese common catfish	<i>Pararilum arotus</i>	S,	F
Snakehead	<i>Ophicephalus striatus</i>	E,S	F
	<i>Ophicephah spp.</i>		F
Kissing gourami	<i>Helostoma temmincki</i>	EX,E	F
Giant gourami	<i>Osphronemus goramy</i>	EX,E	F
Siamese gourami	<i>Trichogarter pectoralis</i>	E,S	F
Sand goby	<i>Oxyeleotris marmoratus</i>	EX	F
Large mouth bass	<i>Mircopterus salmoides</i>	S	F
White fish	<i>Culter erythropterus</i>	E	F
Rainbow trout	<i>Salmo gairdneri</i>	I	F

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Rice-field eel	<i>Fluta alba</i>	S	F
Wu-chang fish	<i>Megalobrama amblycephala</i>	S	F
Japanese sea perch	<i>Lateolabrax japonica</i>	S	F
Yellow-fin sea bream	<i>A. latus</i>	S	B,S
Sea bream	<i>Sparidea spp.</i>	E	B,S
Mud skipper	<i>Boleophthalmus chinensis.</i>	S	S
Pond loach	<i>Misgurnus anguillicaudatus</i>	S	F
Freshwater pompano	<i>Colossoma bidens</i>	S,I	F
Snapper	<i>Lutjanus spp.</i>	E	B,S
Rabbitfish	<i>Siganus spp.</i>	E	B
Jacks	<i>Caranx spp</i>	E	B

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<b>Crustaceans</b>			
Grass prawn	<i>Penaes monodon</i>	E,S,I	B,S
Kuruma prawn	<i>P. Japonicus</i>	E,S,I	S
Fleshy prawn	<i>P. chinensis</i>	E,S	S
Red tail prawn	<i>P. penicillatus</i>	S	B,S
Banana prawn	<i>P. merguensis</i>	EX,E,S	S
Indian white prawn	<i>P. indicus</i>	E,S	S
Red-legged prawn	<i>P. semisdcatius</i>	EX	S
San shrimp	<i>Metapenaeus ensis</i>	EX,E,S,I	B,S
Short-homed shrimp	<i>M. brevicornis</i>	EX,E,S,	S
Giant freshwater prawn	<i>Macrobrachium rosenbergi</i>	EX, E, S, I	F

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<b>Molluscs</b>			
Japanese oyster	<i>Crassostrea gigas</i>	E,I	S
Cupped oyster	<i>Crassostrea spp.</i>	E	S
Hard clam	<i>Metrix lusoria</i>	I	S
Small abalone	<i>Haliotis diversicolor</i>	I	S
Corbiculas	<i>Corbicula fluminea</i>	E	F
Purple clam	<i>Sotellina diphos</i>	E	F
Apple snail	<i>Ampullarius insularum</i>	E	F
Blood clam	<i>Tegillarca granosa</i>	S,I	F
Cockle	<i>Andara granosa</i>	S	S
Green sea mussel	<i>Mytilus sarracudinus</i>	E	S

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<b>Reptiles</b>			
Soft shell turtle	<i>Trionys sinensis</i>	I	F
Crocodile	<i>Crocodylus siamensis</i>	I	F
<b>Amphibians</b>			
Bull Frog	<i>Rana catesbiana</i>	S,I,	F
Tiger Frog	<i>R. tigrina</i>	I	F
<b>Seaweeds</b>			
Nori	<i>Porphyra spp.</i>	E,S,I	S
Wakame	<i>Undaria pinnatifidia</i>	E,S,I	S

EX = experimental, E = extensive, S = semi-intensive, I = intensive.  
 F = freshwater, B = brackishwater, S = saltwater  
 (Adapted from Ling 1977; Liao 1986; and Rabanal 1987 .)

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## **Prospects of Aquaculture:**

- Aquaculture provides holistic development of the fisheries sector through enhancement of fish production and productivity.
- Aquaculture supplements nutritious protein for the growing population.
- Aquaculture accelerates the overall economy of the country.
- Aquaculture improves health, economy, exports, employment and tourism in the country.
- Problem of overfishing can be curtailed by promoting Aquaculture.
- Aquaculture can promote new researches in fish biomass production by enhancing the muscle growth promoting genes in fish. IGF-1 and GH.
- Aquaculture can be instrumental in the field of fish nutrigenomics by application of secondary metabolites from plant extracts to modify gene expression, e.g. *Curcuma longa* and *Withania somnifera* etc.

## **Suggested Readings:**

- The State of World Fisheries and Aquaculture (**SOFIA**) 2016.
- Huet, M and J.A. Timmermans, 1972. Textbook of fish culture. Breeding and cultivation of fish. London Fishing News(Books) Ltd. 436p
- Liao, I.C,1988. East meets West: An Eastern perspective of Aquaculture. Presented at the 19<sup>th</sup> Annual Meeting of the world Aquaculture Society, Honolulu, Hawaii, 4-8 January 1988.
- <http://nfdb.gov.in/about-indian-fisheries.htm>
- <https://www.daf.qld.gov.au/fisheries/aquaculture/overview/types/hatcheries>