

# Mussel: FARMING n Hatchery

A low investment activity with very good returns...

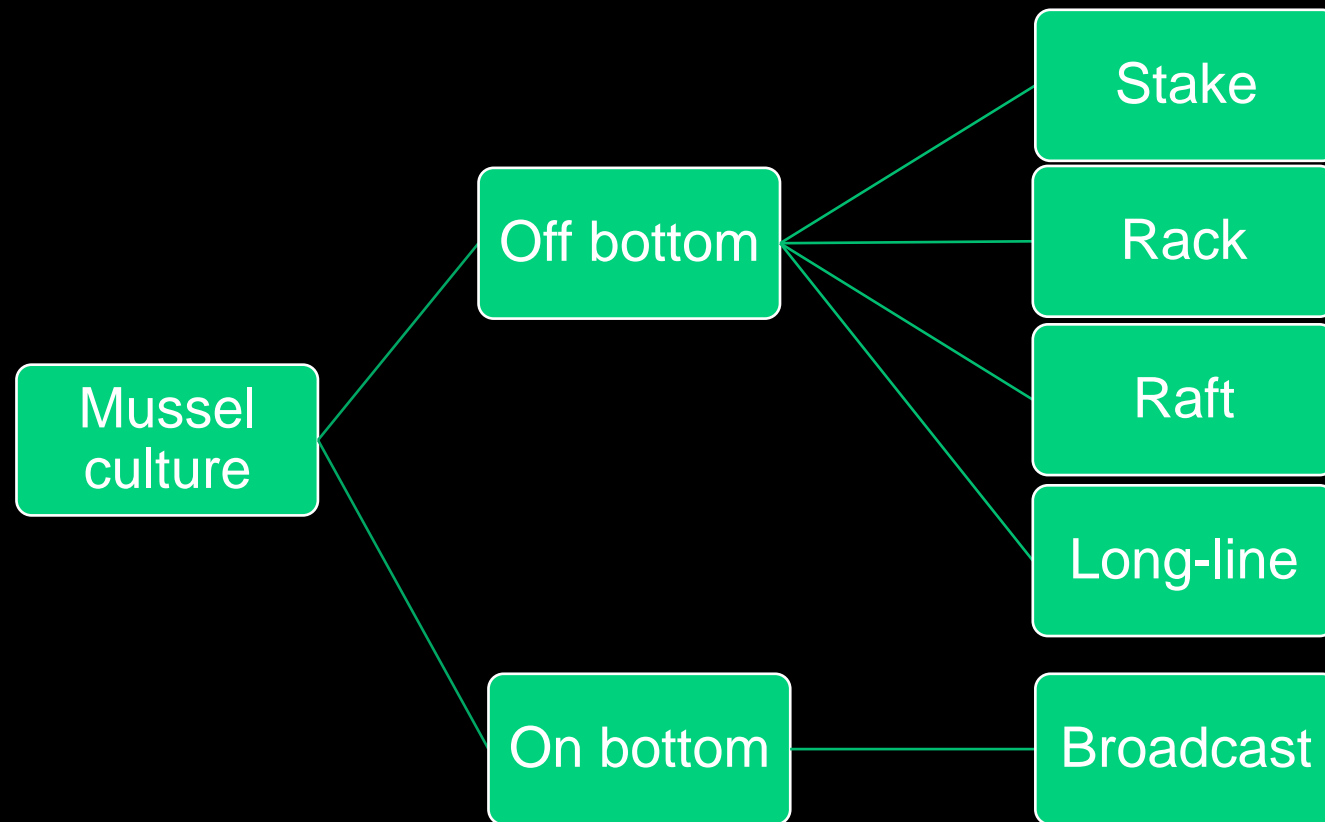


# Introduction:

Molluscs	Inland Aq	Mariculture	Qty total	% by vol.	Value total	% by value
	0.287mt	14.884mt	15.171 mt	22.8	15857 million US\$	11.5

- World mussel production (FAO data, 2010) - **1.81 million tons** valued at 1.572 billion US dollars.
- The world production of ***Perna viridis*** -1,21,322 tons valued at 44.95 million US dollars (2011)
- Total aquaculture production of green mussels in **India** (2008)- 17,000 tons.

# Farming practices:



# 1. Bouchot or Intertidal Pole Culture

- In France, started in 1235.
- Well suited to large intertidal mud flats (Gosling, 2007)
- Seeds placed in mesh tubes and transferred to bouchots for growth.
- Harvested from August – December.
- 4-5cm shell length harvested (12-18months old)
- 25 kg of mussels/each pole annually.
- 4000 poles - 100 tonnes

## 2. Stake culture

- In Thailand and Philippines.
- Bamboo poles (6-8m long) staked in soft/muddy bottoms.
- Harvesting: 6–10 months after stocking or when 5–6 cm in length.
- Yield: 8-12 kg mussel/pole
- **Merits:** Economical and easy way.
- **Demerits:** Decay easily and difficult to match with spat fall ; Siltation

### 3. On-bottom culture

- In Netherlands, Denmark and Germany
- Principle: Seed transfer from areas of great abundance to poor culture plots.
- Firm substratum and less of drifting sand and silt particles.
- Waddenzee and Zeeland- *M.edulis*
- Scattered evenly on the beds

## Cont...

- Marketable in Dutch when they are 2-3 years old.
- Production: 8Kg/m<sup>2</sup> mussel plot or 80 tonnes/ha.
- Kept in special lots for 10-14 days for eliminating weak and damaged mussel.

## 4. Long line culture

- Successful open mussel farming
- Vertical ropes - 'droppers'
- Continuous sock-like cotton tube.
- Droppers are 0.5 m apart & 4 m of free space from the bottom.
- S.D may be 300/m depends on the food availability.
- **Demerit:** Smothered by naturally settling juvenile mussels and other fouling organisms.



## 5. Raft Culture

- More suited to areas of dense phytoplankton
- Origin in Spain in the Galician Bay because of *Mytilus galloprovincialis*.
- Average size of the raft - 23 × 23 m (700 ropes)
- Rafts are spaced 80-100m from each other and in groups called parks.
- Suspending ropes in Dec and Jan to catch seeds in Feb and Mar

## Cont...

- Avg wt of seeds/m of rope - 1.5 to 1.7 kg
- After 8 - 12 months ,marketable size of 8-10 cm (Korringa, 1976).
- Growth is less on inshore rafts
- Temperature plays an important part on the growth.
- Production -10 Kg of mussel/m of rope, a raft having 600 to 1000 ropes of 6-9 m may produce 30to 90t mussel/year
- Depuration for 24-48 hours (Korringa, 1976)

## 6. Rack culture

- Simplest method used for green mussel cultivation in India and Philippines
- Poles support the structure
- Construction is labour intensive but simplicity in harvesting and accessibility
- Mussel culture is fast becoming popular in the Malabar area since 1997 following the success achieved by CMFRI
- The total production in 2008 was 16,500 tonnes
- Constraint- Availability of seed; conflicts

## Cont...

- Harvesting: April – May
- Farmers are forced to sell their crop before the onset of monsoon
- At present only a few processing plants purchases cultured mussels
- Local market are flooded with cultured mussels resulting in fall in the prices and thereby affecting the profitability

# Economic aspects

Item	Unit	Culture System		
		Long-line	Rope-Web	Stake
Investment cost /ha		64,663	31,618	1,617
Operating cost /ha/yr		28,560	37,808	102,086
Interest /ha/yr		33,948	16,600	849
Total expenses /ha/yr		127,171	86,026	104,552
Total receipts /ha/yr		528,840	333,450	222,300
Net earnings /ha/yr		401,669	247,424	117,748
Earnings on sales	%	76	74	53

# Depuration

- Filter feeders
- Accumulate suspended biological materials & harmful microbes
- Depuration is the process of purification of shellfish in which the animals are placed in disinfected recirculating or running seawater and allowed to actively filter feed
- By use of UV-radiation, ozone treatment etc
- Simple depuration is starving the bivalves in clean and filtered seawater/ brackish water for a certain period of time
- More effective depuration by using disinfected water

# Hatchery techniques

- **Collection of broodstock:** Healthy condition, Prevailing environmental conditions
- **Conditioning of broodstock:** The selected broodstock are cleaned thoroughly and placed on a synthetic twine knit PVC frame in FRP tanks
- Filtered seawater well aerated
- **Feed:** Mixed phytoplankton twice a day. The broodstocks are conditioned about 5° C below the ambient temperature.

## Cont...

- **Induced spawning:** Thermal manipulation, **hydrogen peroxide and sodium-hydroxide**.
- **Larval rearing and spat production:** After fertilization, the seawater in the spawning tank containing the fertilized eggs is diluted several times and the eggs were allowed to develop.
- After 24 hours, the D-shaped larvae are transferred to 1000 l FRP tanks @ **2 larvae/ml** of seawater.
- Micro algal food first day after spawning.
- Water change once in two days.
- Mild aeration



## Cont...

- **Nursery rearing:** Spat are transferred to the nursery either in open sea or in enclosed bay systems
- After attaining suitable size, transferred to the farms.

# Developmental stage of mussel seed

**Eggs** - brick red in colour, spherical and 45– 50µm dia

- Fertilization is complete within 20 min of spawning

**The 8-celled stage** - observed after 40 min

**Larvae** with apical tuft of cilia and long flagellum -6–8 h after fertilization

**'D'-hinge veliger** by 20–22 h, transparent with conspicuous granules

- Velum well developed, velar hood with small cilia that aid in fast clock-wise circular movements
- Internal organs - heavily granulated
- Straight hinge larva are active

## Cont...

**Umbo stage:** The straight hinge stage, transform to umbo stage on day 7

- Yellow digestive caeca, concentric ridges
- Clam shaped larvae with both valves equal become more globular and develop mantle folds

**Eye spot stage:** Presence of a black rounded spot below the food mass

- Eye spot and the rudimentary foot distinctly visible by days 13–14
- Eye spot became deeply pigmented and ctenidial ridges develop in the larvae

## Cont...

### Pedi-veliger stage:

- Functional foot develops by the 16–19th day.
- Capable of swimming with the velar cilia as well as crawling with the foot.
- Velar crown reduced in size and the larvae transform from the free swimming pelagic larvae to the creeping, crawling benthic stage ready to attach to the substratum.
- Gill filaments are clearly visible.
- Radial ridges are also distinct and coloration was noticed along the margins of the shells.

## Cont...

### Plantigrade stage:

- Settle on the substratum and become plantigrade
- Begin its sessile life
- Spat settlement from the 21st day onwards.
- Velum disappears, labial palps appear and additional gill filaments appear.
- Concentric growth lines, foot, heart, posterior adductor muscle, mantle edge, visceral mass, intestine and chromatophore pigments are distinctly seen.

# Cont...

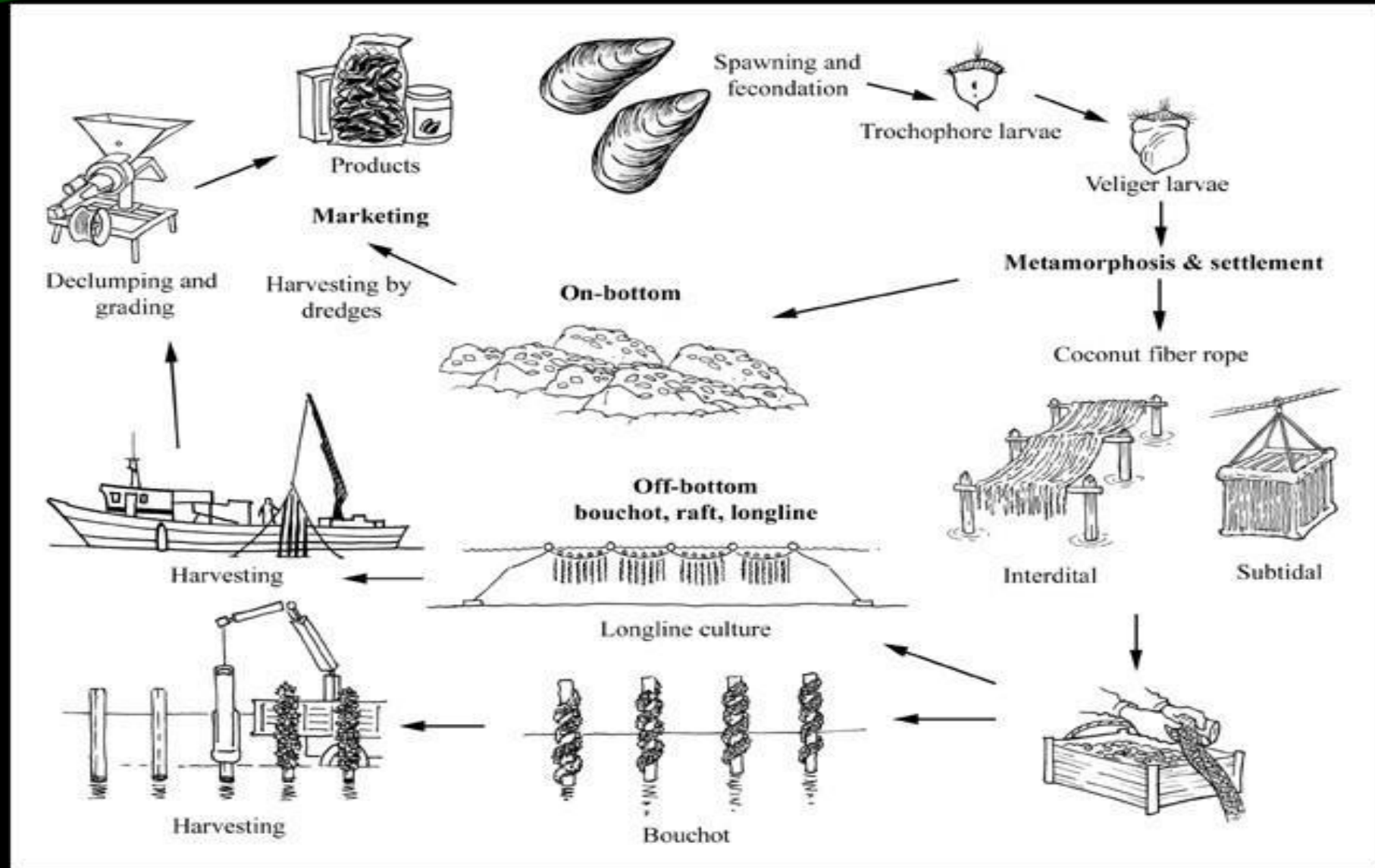
## Spat:

- Plantigrade transform into young spat by developing the characteristic adult shell
- Typical oblong shape like the adult mussel
- Hinge line, the anterior and posterior auricles and the byssal notch typical of the adult mussel are formed
- Spat attached to the bottom substratum by secreting the byssus threads
- Spat fall or settlement began on the 21st day and continued up to 35th day
- Spat measure  $510 \times 390 \mu\text{m}$  on 21st day and  $910 \times 460 \mu\text{m}$  on 28th day

# Hatchery production in general

- Conditioning adult mussels using **algal food and temperature control**.
- *M. edulis* spawning induced by thermal shock or by stripping.
- After 24 hours- straight hinge stage.
- Larvae are fed *ad libitum* and allowed to grow until they are ready to set onto ropes (13-15 days).
- Transferred at a 1 mm size to a nursery, until they reach 6-10 mm.
- Spat moved outdoors into grow-out system.

# Overall production cycle

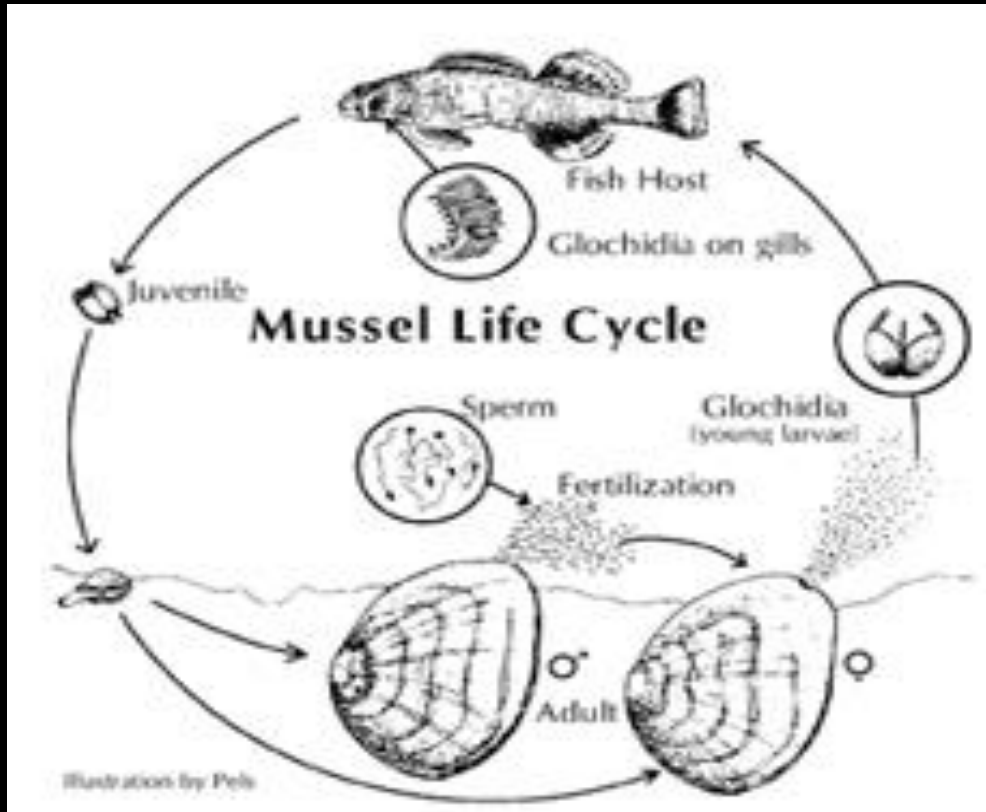




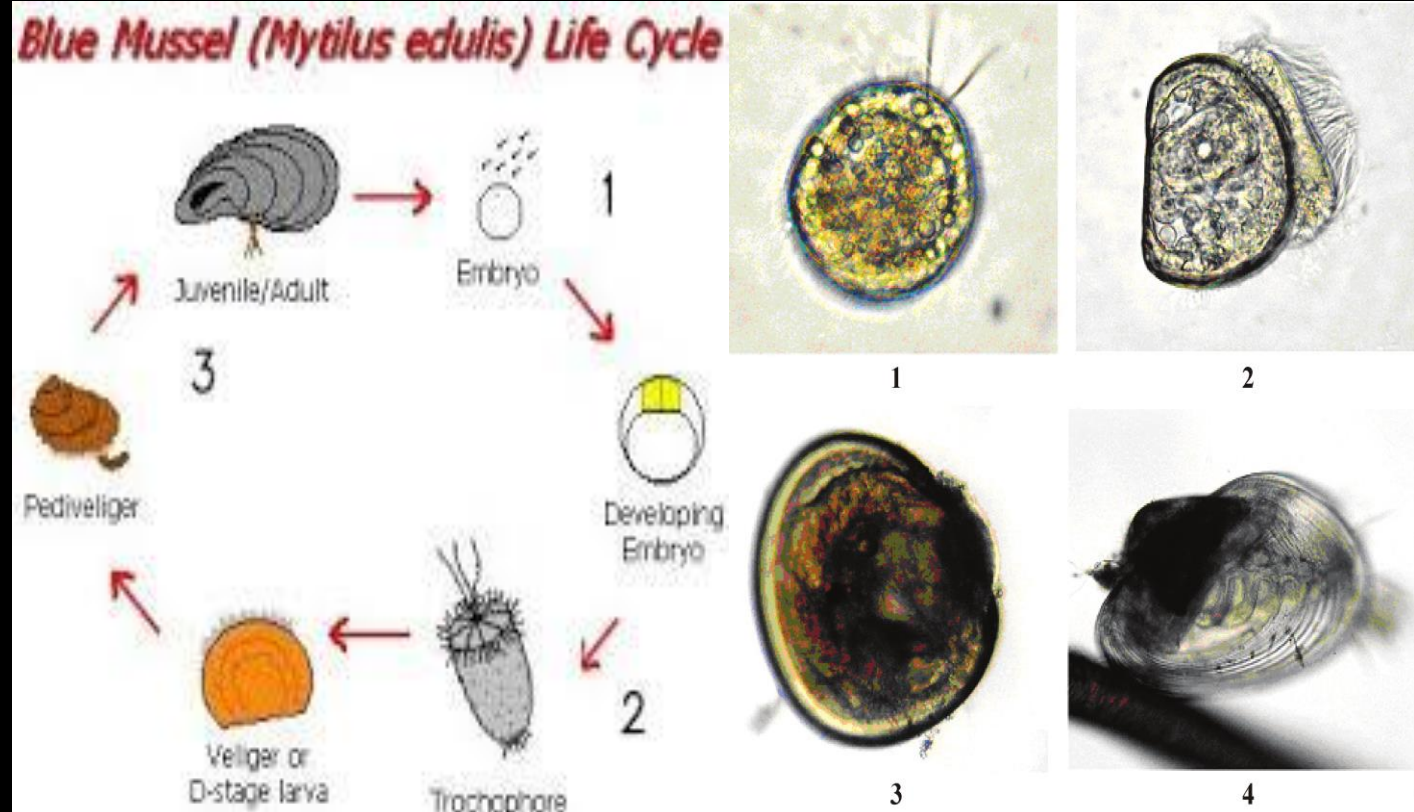
# Larval stages of Mussel

Marine Mussels

Freshwater Mussels



## Blue Mussel (*Mytilus edulis*) Life Cycle



Cont...



Various development stages in seed production cycle of Perna indica

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# Constraints in culture

- Bird predation and water quality deterioration - constraints on the expansion of existing mussel farming operations.
- Two main problems for the mussel industry can be linked closely to its future development: seed shortages and bio-toxins that lead to long-term industry closures.

# Recent...

- **Development of oocyte cryopreservation techniques in blue mussels *Mytilus galloprovincialis***, Japanese society of Fisheries science 2014
- **Goa Velha man raises green mussels**, Paul Fernandes, TNN | Jun 9, 2014, (Times of India | The Economic Times)

# Conclusion

- Scientific feasibility studies to demarcate potential culture sites
- Mussel farming is a decade and half old farming practice in India
- Tool for **women empowerment in the coastal areas and can stimulate a healthy socio-economic development in the area**
- Better post harvest technologies - attractive value added products.
- Since very good export markets -further scope of extending the farming practice to suitable areas



**...UOY KNAHT**