SEA CAGE FARMING

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Introduction

Cage culture involves growing fish in the sea while being enclosed in a net cage that allows free water flow. This production system consists of a floating frame of varying dimensions and shapes, net materials, and a mooring system to hold and culture a large number of fish. For economic feasibility, selecting proper designs, ideal construction materials, suitable mooring systems, and good management practices is crucial. Sea cage farming has gained significant attention in recent years from researchers and fishermen. Many small or resource-limited farmers are exploring alternatives to traditional fishing practices. Cage aquaculture is rapidly expanding and offers opportunities even on a small scale.

Understanding its importance, the Central Marine Fisheries Research Institute (CMFRI) initiated cage culture as a research and development activity in 2006-07 to identify appropriate designs and cage suitability for Indian conditions. The first open-sea cage, an indigenously designed and fabricated 15 m HDPE cage with a catwalk for onboard operations, was launched in the Bay of Bengal off Visakhapatnam in May 2007. After several trials and refinements, smaller 6 m diameter cages were developed for ease of operation and economic viability. CMFRI projects that utilizing even 1% of India's inshore waters could accommodate 820,000 cages, with a production potential of 3.2 million tons. Demonstrations continue across all maritime states to promote open-sea cage culture.

Advantages of Sea Cage Farming

Sea cage farming offers distinct advantages over traditional practices:

1. **Cost Efficiency**: Fabricating cages is faster, simpler, and more cost-effective than onshore farms. Initial investments are only 30-40% of those required for conventional pond aquaculture.

2. **Space Utilization**: Utilizes natural water bodies, preserving valuable land resources.
3. **Flexibility**: Cage location and size can be easily adjusted, enabling operational expansion.
4. **Unutilized Areas**: Open seas, lagoons, or sheltered bays can be used with proper permissions.
5. **Ease of Harvesting**: Fish are easier to harvest from cages.
6. **Market Stability**: Enables a steady fish supply to meet market demands.
7. **Livelihood Opportunities**: Provides an alternate livelihood and additional income.

Types of Cages

Cages are categorized based on installation:

1. **Fixed Cages**:
   - Suitable for shallow water bodies (<3 m depth).
   - Basic and low-cost, commonly used in small-scale aquaculture.
2. **Floating Cages**:
   - Supported by a buoyant collar.
   - Designs include square, rectangular, or circular shapes.
   - Materials: GI pipes, bamboos, or plastic pipes.
   - Suitable for water depths of 10-15 m.
3. **Submersible Cages**:
   - Variation of floating cages, allowing depth adjustment.
   - Often used in marine environments.
4. **Submerged Cages**:
   - Made of wooden boxes with gaps for water flow.
   - Anchored to the substrate with poles or stones.

Cage Design

Design considerations include species behavior, site conditions, and economic feasibility. Pelagic species require larger net spaces, making circular or hexagonal cages preferable. Conversely, demersal species thrive in square or rectangular cages, which are easier to assemble and manage.

Key Design Features:

- Technically simple and cost-effective.
- Supports sufficient water exchange.
- Securely holds fish during the culture period.
- Tailored to individual farmer requirements.

Cage Materials and Sizes

1. **Frames**:
    - Materials: Mild steel (MS), galvanized iron (GI), PVC, or HDPE.
    - Circular frames are preferred for better resistance to sea conditions.
    - Low-cost options include epoxy-coated GI frames (lasting 2-3 years).
2. **Net Cages**:
    - Made of HDPE, resistant to seawater and easy to handle.
    - Types:
        - **Predator Nets**: UV-treated HDPE, 3 mm thickness, 80 mm mesh size.
        - **Inner Nets**: HDPE, 0.75-1.5 mm thickness, 12-40 mm mesh size.
        - **Bird Nets**: HDPE or nylon, 60-80 mm mesh size.
    - Ballast pipes maintain net shape, with HDPE pipes preferred for durability.
3. **Sizes**:
    - Marine cages: Larger than freshwater cages.
    - CMFRI's standard designs include 6 m, 10 m, 12 m, and 15 m diameter cages.

Mooring Systems

Mooring systems secure cages against environmental forces such as wind, currents, and waves. The design depends on cage type and site conditions.

Components:

- Anchor or seabed unit.
- Rising line connecting the anchor to the surface system.
- Surface or subsurface mooring grid.

Types of Mooring:

1. **Single Point**:
    - Allows cage rotation.
    - Efficient in waste distribution.
2. **Multipoint**:
    - Retains cages in a fixed orientation.
    - Commonly used in aquaculture.

Stocking and Feeding

1. **Stocking**:
    - Use healthy, uniform-sized fingerlings.
    - Stocking density varies by species.
    - Nursery rearing is essential for hatchery-produced spawn.
2. **Feeding**:
    - Accounts for 60% of input costs.
    - Protein-rich diets (35-40%) are essential.
    - Feeding frequency and pellet size are adjusted based on fish growth.
    - Feed conversion ratio (FCR): 1:2 recommended.

Criteria for selection of fishes

- Survive in marine condition
- Fast growth
- Good FCR

- Minimum culture duration
- Good market price
- Seed availability
- Feed availability
- Disease resistance

Species available for marine cage culture

- Cobia
- Silver Pompano
- Indian Pompano
- Orange spotted grouper
- Seabass
- Red snapper
- Lobster

Species available for marine cage culture

- Silver pompano
- Groupers
- Red snapper
- Seabass
- Pearl spot

Harvesting

Harvesting can be partial or complete based on market demand. Fish are harvested once they reach marketable size, typically after six months. Cage farming enables easy, less labor-intensive harvesting.

Best Management Practices

1. Monitor cages regularly for maintenance and prevent fish escapes.
2. Optimize feeding protocols and use quality feed.
3. Maintain proper stocking densities to reduce stress.
4. Regularly monitor water quality parameters.
5. Clean and exchange nets periodically.
6. Inspect and maintain mooring systems.
7. Implement cage rotation or fallowing practices.
8. Avoid environmentally sensitive areas and ensure site sustainability.

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