

# POLICY BRIEF

## EXPANDING OPEN SEA CAGE CULTURE IN ANDAMAN AND NICOBAR ISLANDS: BLUE GROWTH PERSPECTIVE

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### PROLOGUE

There is a definitive need to increase the fish production for future through sustainable ways towards alleviating the issues concerning food security, livelihood and employment. Indian fisheries sector faces one of its utmost looming challenges to increase the fish production, to diversify the culture practices and to empower the farming communities by providing sustainable livelihood and employment. Mariculture is an important sub sector in aquaculture that contributes significantly to the global food security, however has met serious challenges in Andaman and Nicobar Islands. Open sea cage culture is a potential sub sector in mariculture that holds greater prospective

towards livelihood and employment in addition to its contributory role in food security. There is an absolute need to address the issues governing the development of open sea cage sector which demands a comprehensive roadmap and suitable policy directives with guiding principles. The attempted policy brief in collaboration with various scientific and development departments aim to address the prevailing issues with potential solutions and innovative approaches in engagement with the depending stakeholders. We strongly believe that the policy brief could be a ready reckoner for policy makers and will play a greater role in development of open sea cage culture sector in the Islands.

Director ICAR-CIARI & the authors



## HIGHLIGHTS

1. Aquaculture sector plays an impressive role in the supply of food protein to the world.
2. Mariculture plays a pivotal role in balancing the fish supplies which were overexploited by the burgeoning marine capture fisheries.
3. Mariculture sector in India have gained wider attention in the past decade due to the technologies developed in breeding and seed production of food fishes and popularization of cage culture activities.
4. The Blue revolution scheme launched by Government of India took further step towards increasing the fish production with plethora of schemes and development plans.
5. Andaman and Nicobar Islands situated in the Bay of Bengal are well known for its pristine waters suitable for mariculture especially cage culture of finfishes.
6. There is an imminent need to address the emerging challenges in successful implementing of cage culture activities in the Islands through a coordinated approach involving various government agencies and stakeholders.
7. The issues pertaining to bio-security, quarantine and invasive species are to be dealt cautiously in order to steer the cage culture sector in right direction without affecting the ecological and environmental conditions.

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## Contributing Institutions

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- 3) Atal Centre for Ocean Science and Technology for Islands, Port Blair, ANI
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# INTRODUCTION

Sea cage culture of marine finfishes began in 2007 when ICAR-CIARI, Port Blair launched low cost wooden cages for capture based aquaculture. Further, the ACOSTI centre in Port Blair deployed four advanced circular 9m dia HDPE cages at North Bay in 2011 to culture finfishes. ACOSTI centre successfully demonstrated the culture of Asian seabass (*Lates calcarifer*) in the cages. In 2016, ICAR-CIARI demonstrated culture of silver pompano (*Trachinotus blochii*) in low cost GI cage of 6m dia at Minnie Bay region in association of fishermen self-help groups. Frontline demonstrations by the research organizations could generate encouraging mindset, however has not attracted the entrepreneurs. The Blue Revolution scheme further stressed the need for increasing the marine fish production through cage culture in the Islands and has promptly initiated various activities to sensitize the stakeholders and investors towards benefits of cage culture activities. A national workshop on cage culture was organized by National Fisheries Development Board in 2018 at Port Blair which has further motivated the stakeholders to take up cage culture activities and also sensitized on the schemes available which could be taken up with the active support of research and development departments. The overriding issues in taking up cage culture

in the islands and the possible solutions to overcome the issues were also debated during the workshop. Some of the important discussions and recommendations that emerged are,

- 1) to strengthen the site selection studies for cage culture,
- 2) to take adequate attention on biosecurity and quarantine requirements and introduction of non-native fishes,
- 3) to develop hatchery and live feed culture facilities,
- 4) to understand the environmental regulations such as Coastal Regulation Zone and its impact on planned cage culture activities and
- 5) to transport fish eggs in larger quantities from ICAR-CMFRI centres to Island research organizations for convenience in seed production.

Few entrepreneurs keen on taking up cage culture activities in the islands have already initiated the activities on procuring the cages through financial support, however the auxiliary support to undertake cage culture with adequate requirements needs to be resolved with collaboration of stakeholders. The emerging body of evidence suggests that there are more unsolved issues that still dent the prosperity of cage culture activities in the islands which needs a critical relook.

## REASONS FOR CAGE CULTURE BEING A NON-STARTER IN THE ISLANDS

### Untapped potential in capture fisheries

The annual harvestable marine fisheries potential estimated is 1.48 lakh tones whereas the current harvest (2017-18) is 39284 tonnes. There exists a greater scope to augment fish catches through capture fisheries. Pelagic and demersal fishes are of great demand in local market as well as export market. Hence, a good economic return within shorter fishing trips and low investments are the key criteria that fishers opting for capture fisheries.

### Seed availability

Quality seed availability seems to be one issue that could disrupt the cage culture activities. Till now seeds were imported from mainland which undergoes extensive transportation stress and incurs significant costs. Moreover, the availability of quality seeds in sufficient quantities at required circumstances itself is uncertain. Collection of wild fish seeds for capture based aquaculture cannot be a stand-alone solution to solve the seed issues. Developing finfish hatcheries could be a progressive thought in persuasion of cage culture activities in the islands.

### Feed

After seed, feed is a critical input for sea cage culture as feed constitutes around 60 to 70% of the recurring cost. Cage cultured fishes are mostly carnivorous and hence demands high protein diet (around 45%) and trash fishes to supplement better growth. Feed industries produce commercial fish feeds as per the requirement of the certain fish groups. Additional costs associated with importation of these commercially available feeds from mainland also increases the feed cost at Island conditions which is also a discouraging factor.

### Transportation and logistics

Despite the recent aggressive developments, there are fewer uncertainties prevailing since fish is a perishable commodity. Rapid processing and transportation could be an auxiliary advantage for entrepreneurs. There were few instances of live grouper and table sized marine fish exports taken up by the exporters however, discouraged later due to logistic issues. At present, there are considerable export activities ongoing with regard to shrimps, crabs, fishes, shark fins, etc to mainland India. However, to largely attract the entrepreneurs,

quicker transportation and export facilities are to be developed and strengthened.

### Awareness and sensitization

The availability of an alternative livelihood sector such as cage culture was not much familiarized or sensitized with the island stakeholders till past decade. In the Islands, efforts were mostly directed towards marine capture fisheries sector on the possibilities of expanding the deep sea fisheries sector. Cage culture initiatives on experimental basis began since 2007, and over these years, the sector had generated greater sense of awareness on the cage culture of marine finfishes and its looming benefits with possible employment opportunities.

### Adverse climatic conditions

Though an inevitable one, due to the geographic nature the islands braces frequent cyclones and storms annually causing massive damage to the coastal infrastructure and the associated ecosystems. Despite the nature of protected waters identified for cage culture, natural hazards could disrupt the culture activities affecting the cage stability, water quality and other issues which affect the culture operations.

# Case Study

## Culturing Groupers and Snappers in rectangular wooden cages by ICAR-CIARI

The study was taken up during 2008-10 in Minnie Bay and Marine hill foreshore region. Culture was initiated through capture based aquaculture and the cages were constructed using locally available wooden materials. Seed availability and weather are found to be the issues in the culture. The cages got extensive damages due to monsoon conditions. The culture period could be extended for a period of five months despite achieving better survival of 95% and growth of 80%. Crab and barnacle infestations in cages necessitate frequent maintenance. The model could not be replicated as successful design due to its vulnerability to climatic conditions and its inability to withstand rough weather conditions

## Culture of Silver Pompano in GI Cages by ICAR-CIARI

Further to popularize cage culture, a low cost 6m diameter, Galvanized Iron cage with floats, mooring devices and anchors were constructed locally and nets (Outer net: 2.5mm / 50mm mesh size, Inner net: 1.5mm / 28mm mesh size and bird net) were procured. The cage was successfully launched in 2016 at Minnie Bay, South Andaman. Successful transportation of silver pompano seeds were achieved with 100% survival and the same were stocked in cages with stocking density of 30 numbers/m<sup>3</sup> maintained in the cage. Hatchery produced pompano fingerlings of 1 inch size are initially stocked in a small cage (8 mm mesh size) of 5 meter length, 3 meter width and 3 meter depth, which was placed inside the circular GI cage. The fishes were reared in this cage for 60 days, until they attain 30-40 grams size and thereafter released into the circular cage for further grow-out rearing. Attachment of algae to netting material is considered to be the major problem in the cultured site and regular cleaning of cage was done in two months interval. After 120 days of culture in cage, pompano attained an average length of  $18.64 \pm 0.22$  cm and an average weight of  $93.15 \pm 1.08$  gms from an average length and weight of  $5.54 \pm 0.09$  cm and  $3.12 \pm 0.17$  gms respectively at 1st day of culture. The culture of Silver pompano was carried out over a period of 210 days with the average final harvest of 22.28cm length and 220.65gm of weight. Due to limitations in seed availability the cages were not stocked after completing the culture and harvest of silver pompano. The dependency of seeds from mainland, adverse weather conditions and logistical issues were found to be major limiting factors. Fig. 1 shows the phases of cage construction and rearing activities.





(Fig. 1) Construction of cage (a) and (b); verifying the construction of cage (c); transporting the cage frame to site (d); attaching the cage net and mooring the cage (e); stocking pompano seeds (f); pompano at 1<sup>st</sup> day of culture in cage (g); pompano at 120 days of culture in cage (h); cage deployed at Minnie Bay (i).

## Cage culture of Asian Seabass by ACOSTI in HDPE cages

Open sea cage culture of Asian seabass (*Lates calcarifer*) was initiated by ACOSTI and successfully demonstrated the Asian Sea bass (*Lates calcarifer*) culture (September 2012 – February 2014) in the HDPE cages. The fishes harvested were distributed to the fisherwomen group of Panighat, Port Blair. A harvest of 500 kg of Asian seabass was achieved through the culture practice.



(Fig. 2) Harvest of Asian seabass by ACOSTI, Port Blair

## Cage culture demonstration at Gulf of Mannar and Palk Bay by ICAR-CMFRI

Cage farming of Asian seabass was started by ICAR-CMFRI, Mandapam during 2008 followed by fattening of lobsters in cages. HDPE cages used could withstand the adverse weather conditions. Followed by the success in breeding and seed production of Cobia along with farming demonstrations, immense interest was created among the fishermen and entrepreneurs. Many interested entrepreneurs came forward to take up farming at their own expenses. The interest soon dwindled considerably when they understood the issue with regard to the seed requirement in sufficient quantities. Further, procurement of seeds from RGCA has perfected the seed production technology of cobia in 2011. They also discontinued further as the seed and transportation costs was uneconomical. Further, due to the efforts of CMFRI, Mandapam center, a total of around 65 GI cages were deployed for cage farming by fishermen and entrepreneurs. Farming of fishes in cages along with seaweed culture in rafts surrounding the cages (IMTA concept) was also promoted by CMFRI. This further resulted in increase in the production of seaweeds and profitability to the farmers.

## Lessons Learnt



- Wooden and GI cages in comparison could be cheaper capital investment, however, its endurance to rough weather conditions were doubtful as it requires extensive management and a much protected site. HDPE cages could be sturdier than GI cages however, the sites chosen could also play a crucial role.
- Quality seed and feed unavailability discourage the investors.
- The pervasive concern of invasive species cannot be ruled out if cage activities are to be more dependent on seed imports in future.
- The cost of management delay could be severe in case of poaching and vandalism.
- Although seed and feed could greatly help in mitigating the issues, they were also not capable of completely resolving the prevailing issues.
- Support of local communities is decisive in the success of cage culture activities.



# Challenges Ahead ▶

- Attracting the local as well as mainland investors with convincing economic returns.
- Accessibility and availability of quality fish seeds.
- Developing a functional marine finfish hatchery.
- Suitable site selection without affecting the island biodiversity.
- To provide adequate infrastructure and manpower to achieve the tasks.
- Alternative development sectors such as coastal tourism are on rise and people tend switching over towards remunerative employment opportunities.
- Environmental considerations in cage culture activities.

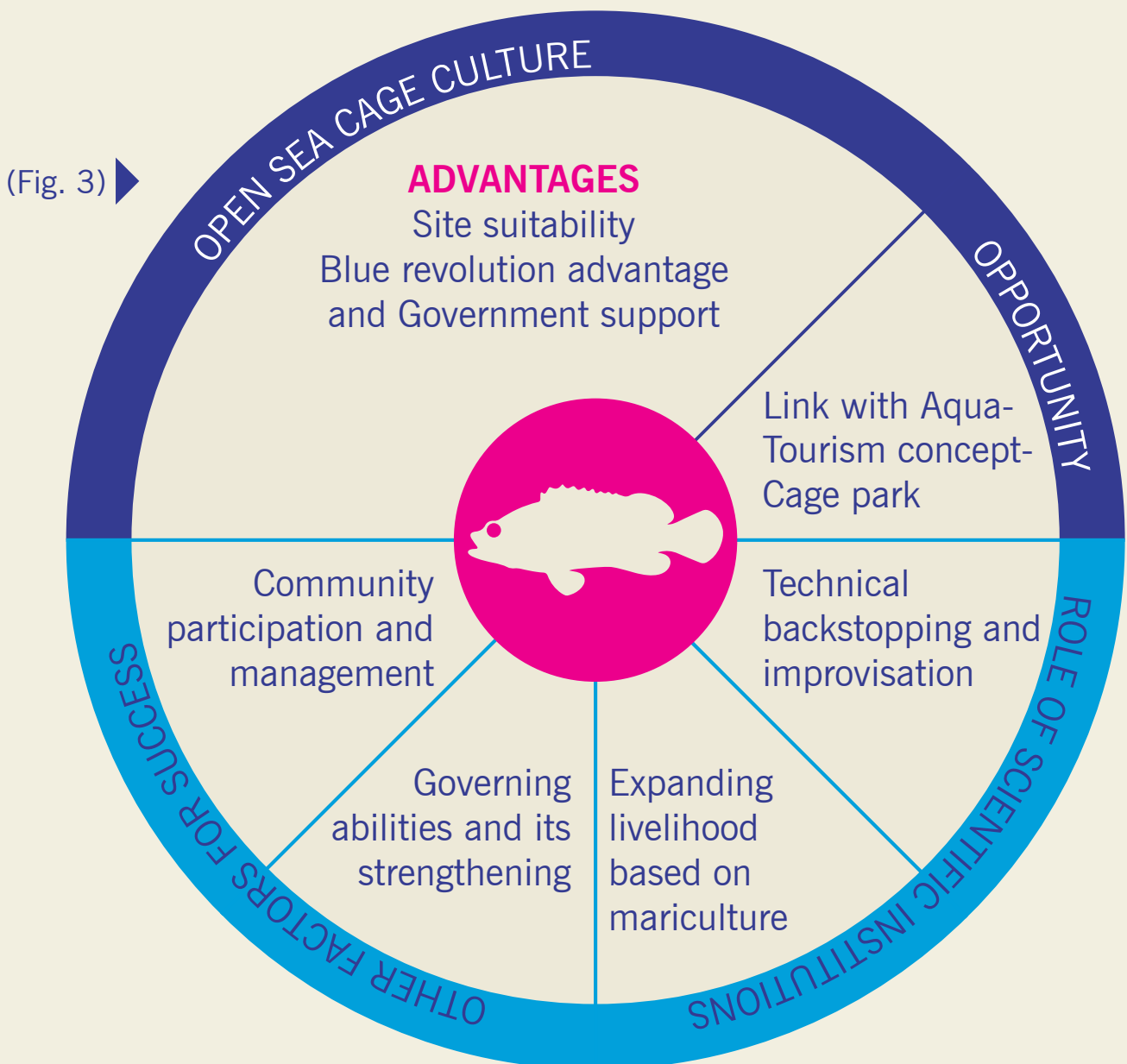


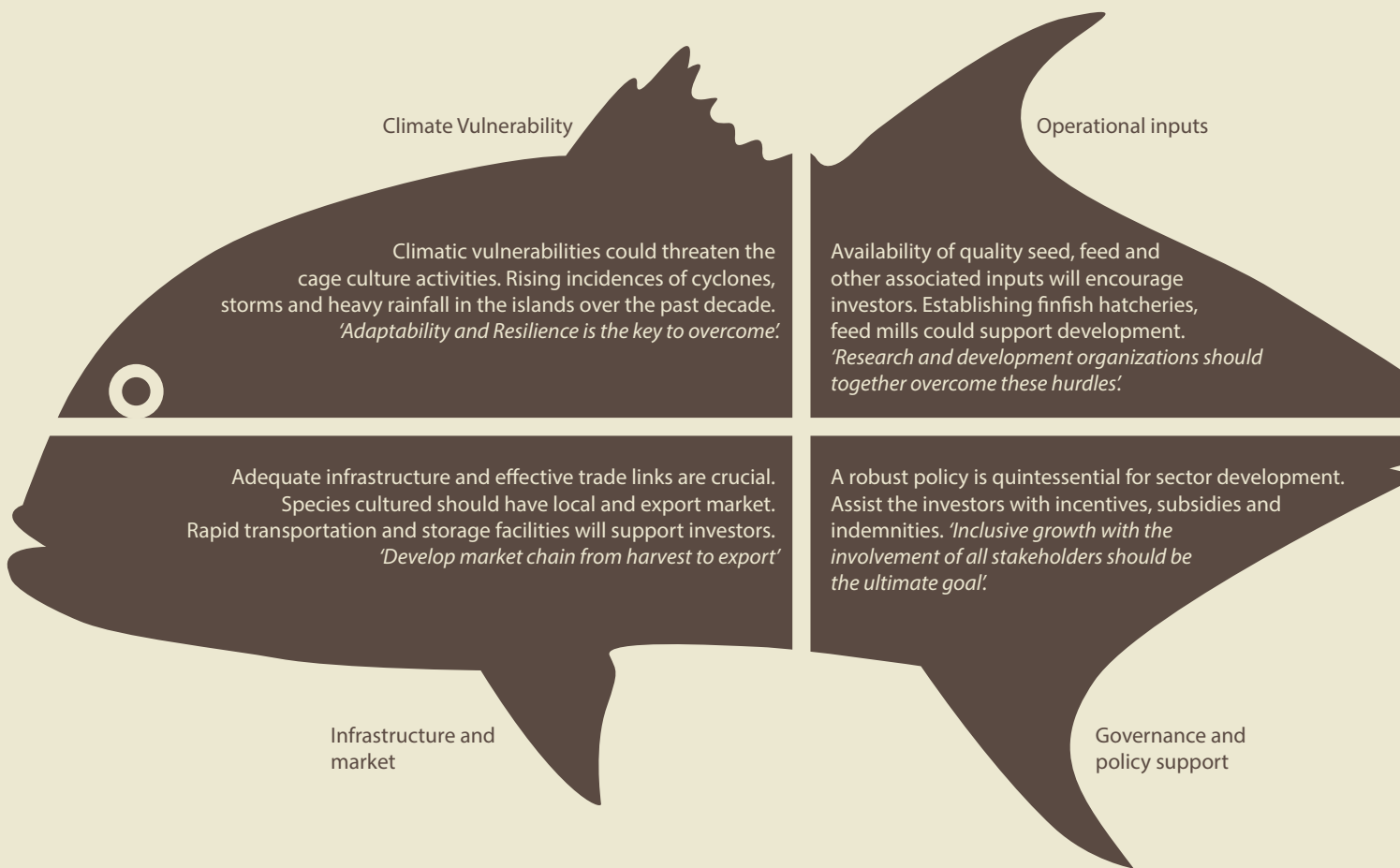
A view of GI cage deployed at Minnie Bay, South Andaman



# “ OPPORTUNITIES AND KEY REQUIREMENTS ”

The availability of several advantages, opportunities could hugely benefit the sector with the active support of local communities and scientific organizations (Fig. 3). The key determinants and drivers for the success of open sea cage culture are shown in Fig. 4, which summarizes the important requirements for open sea cage culture in the islands. All these concerns are to be attended promptly if the sector is planned for development.





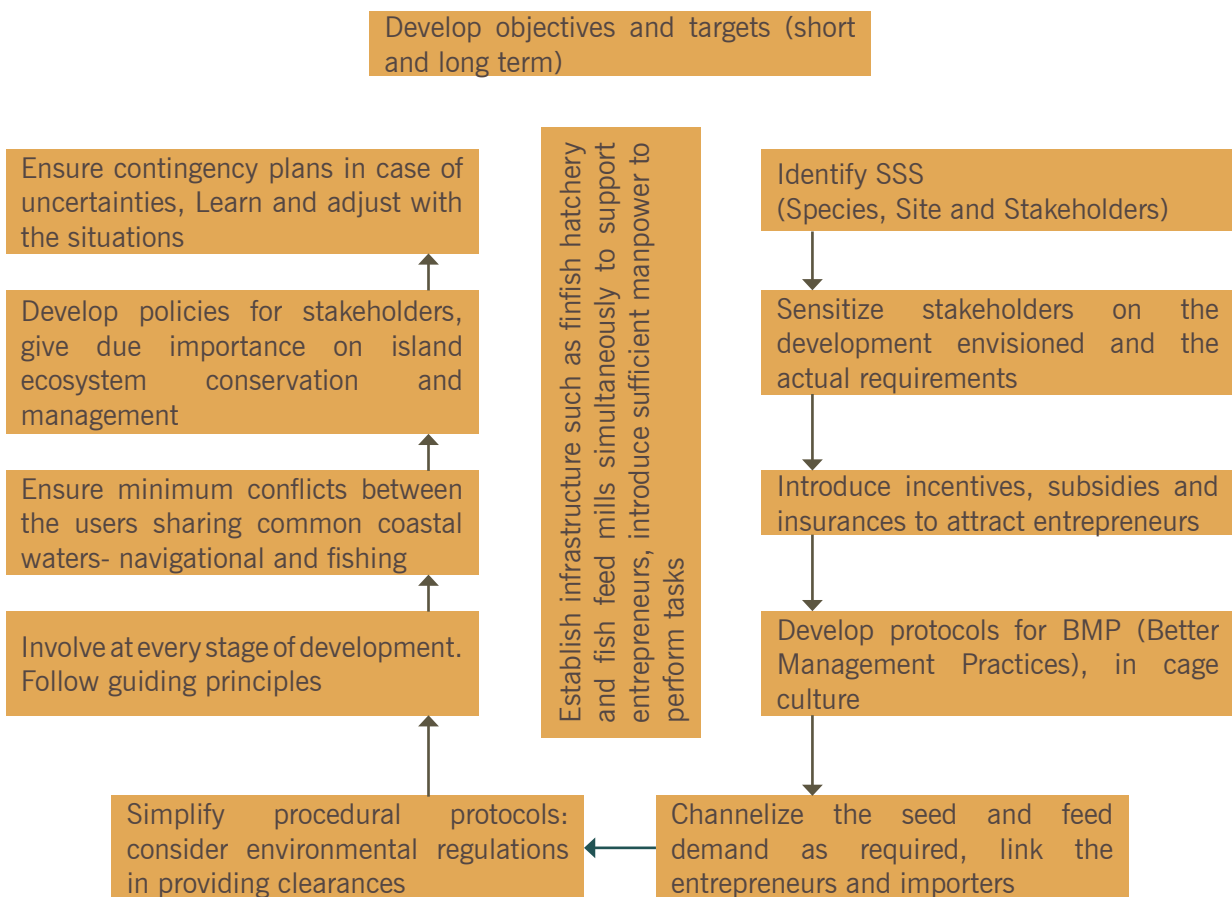
## CONSIDER THESE CRITERIA'S IN SECTOR DEVELOPMENT

- 1. Innovation:** Technologies that were best suited for other environmental conditions may not aptly work for the Island conditions. Innovating or refining the existing technologies to modify in accordance with the Island conditions is essential.
- 2. Coordination:** Developing sea based culture systems involves multi organizational efforts in terms of offering clearances, management protocols and regulatory principles. However, these organizations also should understand that these efforts are mostly directed towards achieving a national goal and hence coordinated efforts in terms of management is essential towards a Win-Win situation.
- 3. Regulation:** Sector development should not be at the cost of environmental sustainability and hence, all concerned organizations should ensure the safety and sustainability of the environment. Stringent regulatory actions should be incorporated without affecting the progress of the sector. Necessary regulations should be enforced and if required amended from time to time for the benefit of stakeholders.
- 4. Evaluation:** Development programmes aimed towards achieving a broader target should be scrutinized thoroughly at periodic intervals through a statutory body capable of advocating necessary reformations and ideas which could enhance the performance of the activity. Administration should enforce capable units comprising of scientific and administrative personnel to inspect the activities.
- 5. Reaction:** The feedbacks of the stakeholders are crucial. The suggestions of stakeholders should be incorporated towards reorienting the developmental programmes for the betterment of the cage culture sector in the Islands.

◀ (Fig 4) Key factors and drivers of open sea cage culture

Suitable sites, Candidate species and Seed production technologies: *Decisive factors*

FLOW OF ACTIVITIES PROPOSED FOR PROGRESS OF SECTOR



A schematic flow of activities recommended for the expansion of cage culture activities is shown as Fig. 5 (Flow diagram)



## IMPROVED BIO SECURITY AND QUARANTINE SHOULD COMPLEMENT THE SECTOR

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Finfish seeds are the major input for cage culture activities in the Islands and there could be a massive demand for fish seeds in future. Unless a fully functional finfish hatchery is established, the efforts for expansion could be sprawling for years to come. Further the import of finfish and shell fish seeds are also to be taken care as it involves inadvertent attraction of pests and invasive species into the Islands. Freshwater ecosystems have already attracted lot of invasive and exotic species in to the islands (Kiruba-sankar et al., 2018). It should be mandatory to

establish a bio security and quarantine facility in the Islands with trained manpower and expertise in order to facilitate the inspection and certification of such seed imports in future. Any certified seeds imported into the Islands also need verification of their authenticity and reliability to allow the seeds in the Islands. Import and export inspection departments should be established in the islands and should play major role in monitoring and control of such incidences. However it is also pertinent to understand that not all introductions could lead





towards destruction. Many instances of introductions were also proved to be constructive and beneficial for sector development. One classic example could be the case of introduction of *Penaeus vannamei* in India. Introduction of *P. vannamei* have generated positive impact on shrimp production, employment generation and economic growth in India over past decade (Ravisankar et al., 2019). Despite the flip sides, introductions could be more beneficial if well managed and planned. Understanding the biology and habitat of the selected species could be

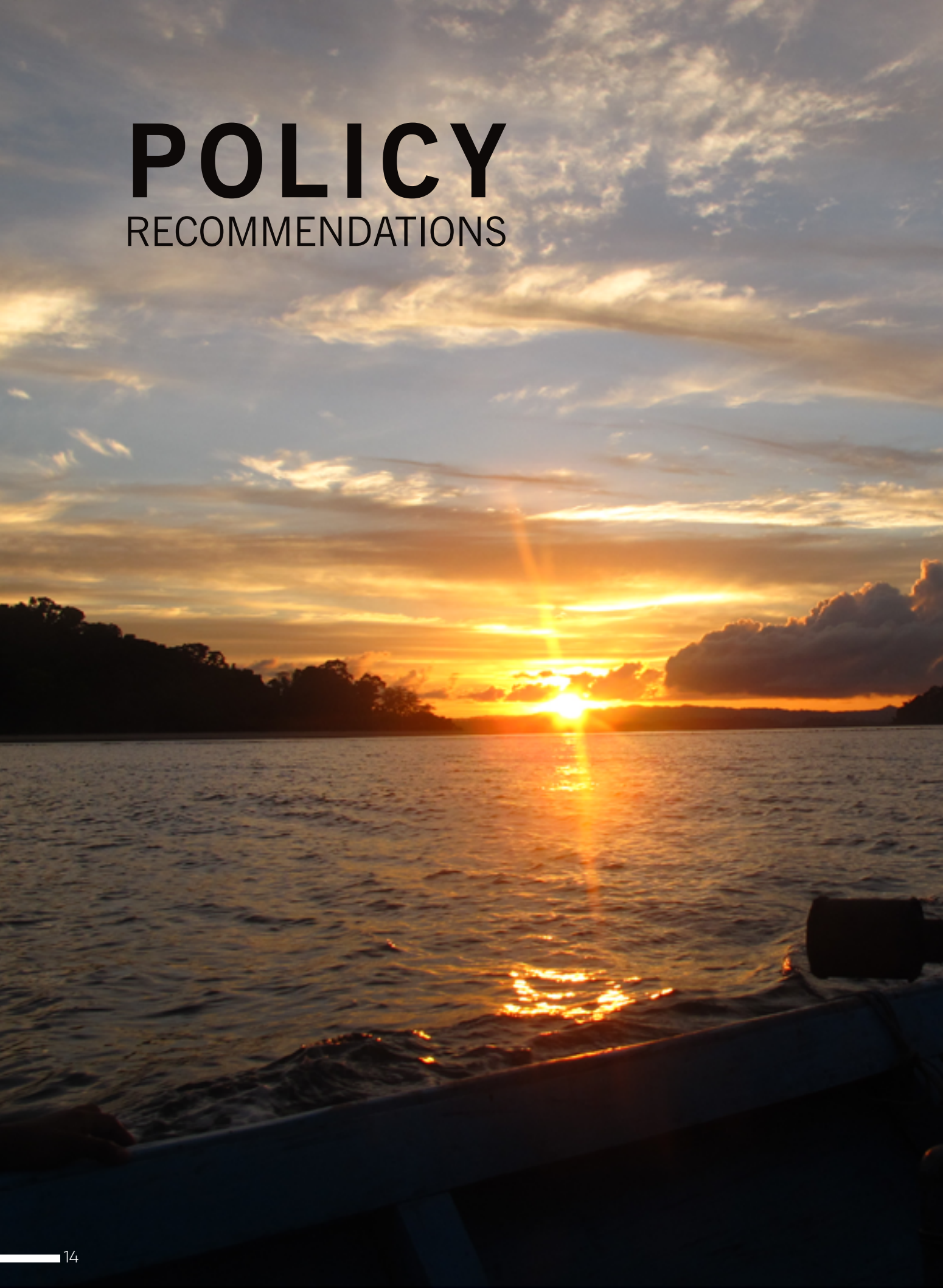
decisive factor. Especially while culturing in open waters, there are greater chances of farmed species escaping in to natural waters. The habitats where the cages were deployed are also crucial as the nature of introduced species should not be known for impacting the surrounding waters or the species and the associated ecosystem. Scientific organizations should take forward these issues and should play crucial role in providing critical recommendations to the administrators explaining the upside and downsides of the introductions.





# POLICY

## RECOMMENDATIONS





- Establish functional finfish hatcheries with the aid of scientific and research organizations.
- Establish finfish brood banks for maintaining healthy broodstock with the support of scientific organizations which would support stakeholders depending on cage culture.
- Biosecurity and quarantine is a key component - establish state of art research labs to compliment the sector development.
- More precautionary approaches are essential in case of consideration towards introducing non-native fishes in to Island environment
- Incentivize investors and support long term investments in the industry. Support adequately with insurances in case of uncertainties. Subsidize operational inputs to a certain period to attract and motivate the investors.
- Encourage industrialization in fisheries - organize investors meet and conclaves and attract the investors in fishing industry.
- Implicate the local communities largely in the development activities as their support could be crucial in the success.
- Link aqua-tourism with cage culture - develop marine cage parks integrated within coastal tourism concept so that tourism and cage culture sector can prosper together.
- Develop a model coastal tourism park integrating cage culture within the purview of coastal tourism in potential water sport locations and evaluate its feasibility. Engage the tourists involved in snorkeling, sea walk and water sports in to cage tourism concepts as an inclusive tourism package.

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