

**Report of the Project:**

**“Scoping Study for Catalyzing the Establishment of  
the Caofeidian Seagrass Beds Marine Protected Area  
in the Bohai Sea, China”**



Photo credit: H. Liu

**Prepared by:**  
3C Environmental Solutions

**Supported by:**  
The Swire Group Charitable Trust

## TABLE OF CONTENTS

A.	Background and Rationale for the Study .....	1
B.	Methodology.....	3
C.	Results of Stakeholder Consultations .....	5
	C1. Fishers .....	5
	C2. Scientists and academia.....	6
	C3. Conservation NGOs.....	7
	C4. Government-related resource management agencies.....	7
	Caofeidian Development Group (CDG).....	7
	Caofei Lake.....	8
	C5. Aquaculture Farms.....	9
	C6. Local Government - Caofeidian District Department of Natural Resources and Planning.....	10
D.	Threats Analysis, Impacts and Governance .....	11
	D1. Land reclamation.....	11
	D2. Unsustainable aquaculture and marine ranching .....	11
	D3. Artificial cement reefs .....	12
	D4. Illegal and overfishing.....	12
	D5. Oil and natural gas exploration .....	12
	D6. Sand extraction.....	13
	D7. Wind power stations .....	13
	D8. Governance .....	13
E.	Looking Forward .....	15
F.	Proposed Strategic Interventions .....	16
G.	Next Steps and Recommendations.....	22
	Annex 1 – Guide Questions Posed to Stakeholders.....	25

## A. Background and Rationale for the Study

In October 2015, a team of scientists from the Yellow Sea Fisheries Research Institute discovered a seagrass bed in the Bohai Sea off the coast of Caofeidian District, Hebei Province, China. This patch of seagrass was not previously mentioned in any scientific study nor seemed to be known among the scientific community. Dr. Liu Hui, the study leader, discovered that *Zostera marina* was the dominant species in the surveyed area (Figure 1) northwest of Longdao (Long Island). The seagrass coverage of approximately 10km<sup>2</sup> is currently the largest discovered seagrass bed in the Bohai Sea, and is 2.5 times larger than the total size of all currently known remaining *Zostera* beds located on China's side of the Yellow Sea. The survey revealed the presence of a diversity of nekton and benthic organisms, as well as juvenile and adult fish and molluscs. Seagrass coverage and shoot density were low, indicating the possibility of a decline in overall seagrass health, probably affected by anthropogenic activities both from land- and sea-based sources such as from land-based pollutants and trawling.

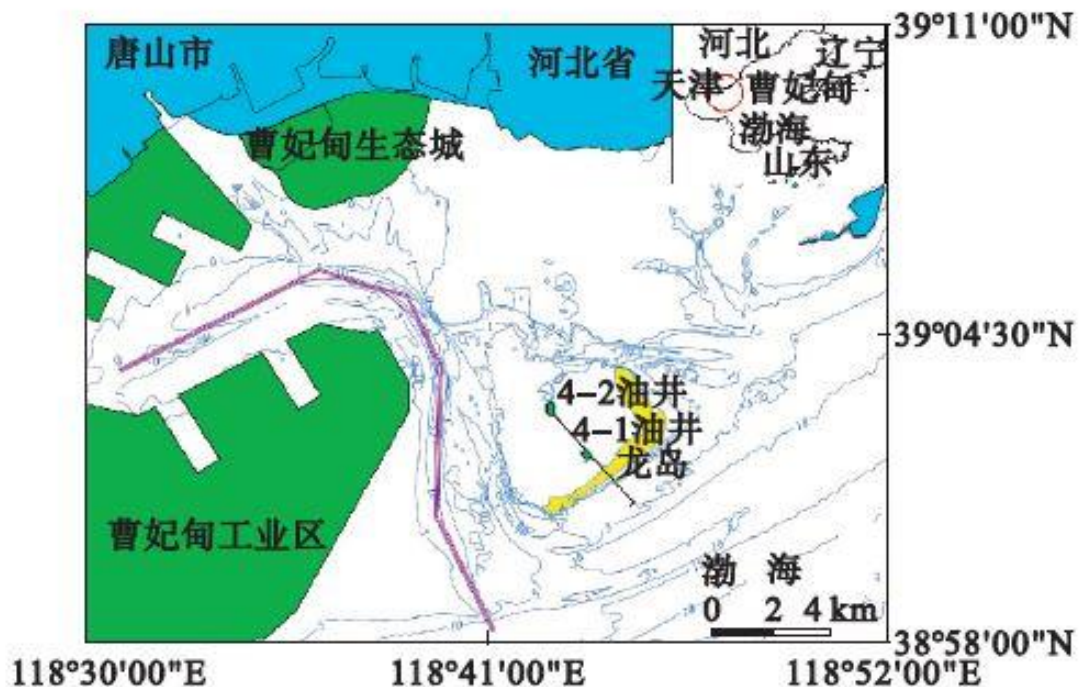


Figure 1. Map of Dr. Liu's survey area (Liu, 2016).

It is recognised that seagrass beds provide habitats and nursery grounds for various marine organisms. This is particularly important to maintain the commercial seafood industry. Collected seagrass samples from Dr. Liu's study also revealed that algae and plankton were found on seagrass leaf blades and in the water column, providing a good source of food for fish, shrimp, and shellfish.

The economic benefits of seagrass include:

- Over 20 species of commercially valuable fish, crustaceans and molluscs inhabit the Caofeidian seagrass beds, most of them being juveniles (Wang, S. pers. comm.).
- The seagrass areas are estimated to sustain commercially important finfish numbering around 40 million individuals (Wang, S. pers. comm.).

- Globally, seagrass serve as fish nurseries which is important to sustain commercially important fish species (Sanger, P. 2013) as well as maintaining ecosystem function and structure.
- Seagrass can help in carbon sequestration (~USD 394/ha/yr via economic valuation) (Dewsbury et al. 2016).

It is also known that Caofeidian's coastal area is under great economic development pressure, while the commercial and artisanal fishing industries also need to be sustained (see the chapter on Threats Analysis). In Figure 2, one can see the coastal reclamation that occurred from 1976 to 2009. Port development followed in the reclaimed area. Reclamation and economic development have altered the hydrodynamics which affect ecosystem health including that of seagrass and marine organisms.

Towards the west, Tianjin, the largest coastal city in northern China and a major port city on the Bohai Sea was already well established. Tianjin is one of the top ten busiest ports of China<sup>1</sup>, and continues with urban and port development, increased shipping traffic, and other industries including petrochemicals, textiles, car and aircraft manufacturing, and metal working. Thus, while Caofeidian embarked on economic development, it cannot compete with Tianjin, yet such activities have caused loss of coastal habitats for birds and marine organisms. Yang et al. (2011) estimated that along the Bohai Bay, approximately one-third of the coastal area has been reclaimed leading to loss of intertidal flats. Each year, millions of shorebirds migrate through this area with 60 species using this flyway, and about 36 species requiring critical habitat and food sources along the Bohai Bay before wintering in Australia.



Figure 2. Comparison of changes in land use in Caofeidian between 1976 (left) and 2009 (right). From Murray, N. (2014).

Furthermore, marine ranching is gradually becoming a popular source of revenue for companies registered in Tangshan City. These include local companies as well as enterprises from other provinces that have been granted a license to operate in Tangshan (Caofeidian District falls under the wider jurisdiction of Tangshan City). Figure 3 illustrates the planned areas for marine ranching around Longdao. The areas to the east of Longdao have been partitioned for marine ranching (light blue blocks), and will likely affect seagrass health. Furthermore, local fishermen that currently utilise the area will be banned from fishing there.

<sup>1</sup> <https://www.chinacheckup.com/blogs/articles/china-shipping-ports>



The red tracts are planned marine ranching areas within the jurisdiction of Caofeidian District. The northernmost tract is located offshore from Longdao where the seagrass is located, thus any development here is likely to impact the seagrass and associated ecosystem services of the area.

If the anthropogenic impacts are left unchecked, this will likely result in a decline of the biodiversity and also ecosystem structure and function, which will further impact the livelihoods of fisherfolk who have little alternative/supplementary livelihood options at present. As such, it is imperative that resource use and management measures are designed and implemented without further delay to ensure that economic development, nature conservation, and local livelihoods may still co-exist.

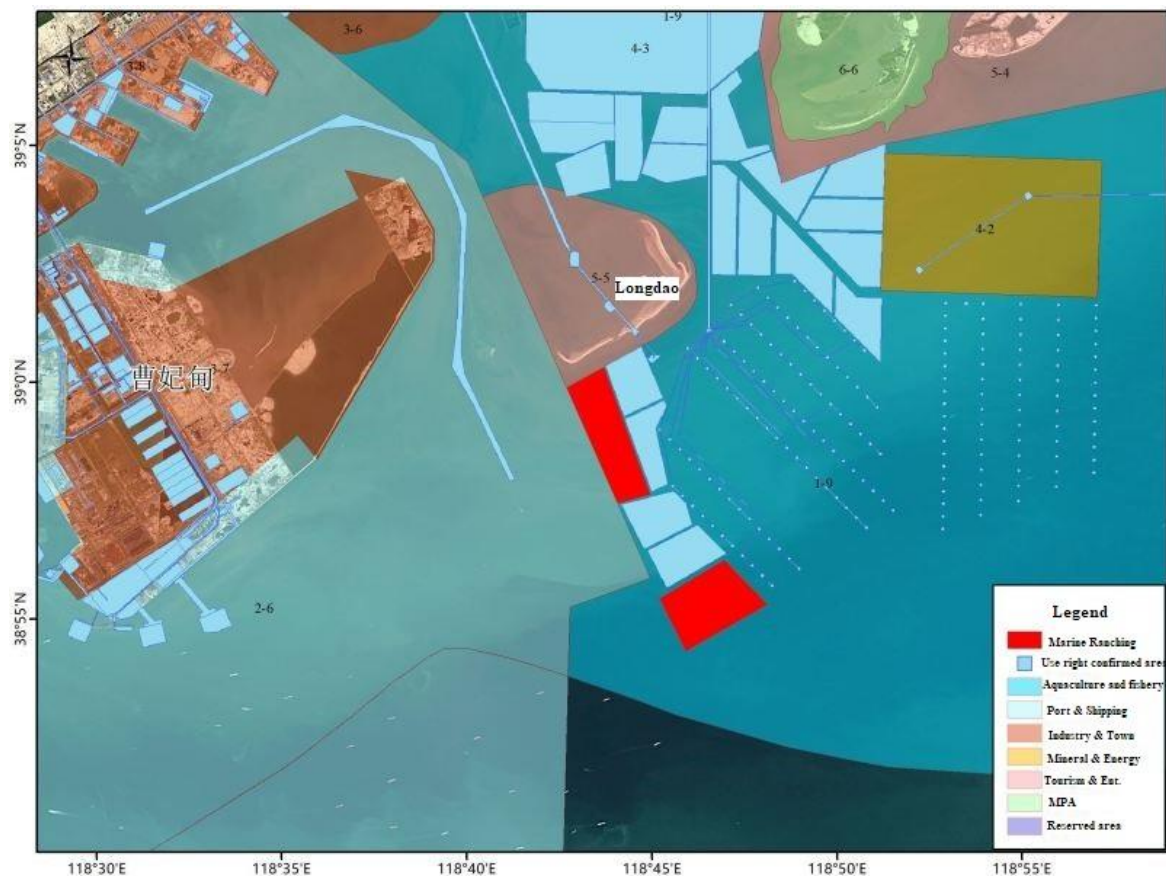


Figure 3. Proposed tracts for marine ranching around Longdao in light blue and red coloured blocks. The southernmost two red tracts are planned marine ranches for Caofeidian Development Group in which to invest (from: Tangshan City, 2018).

In this context, the Swire Charitable Trust has provided financial support to 3C Environmental Solutions (3C) to carry out a scoping study to better understand the threats to the seagrass, gather information on the needs of the stakeholders, and devise management interventions such that the seagrass and associated biodiversity and livelihoods would be protected.

## B. Methodology

The Scoping Study was undertaken in Caofeidian District (Figure 4) during the week of 26 May 2019 by 3C, with assistance from Qingdao Marine Conservation Society, Tangshan China Waterbird Protection Area and Tianjin Coastal Wetland Conservation Society. Dr Liu

from Yellow Sea Fisheries Research Institute provided technical advice and helped to arrange interviews with the fishing community.

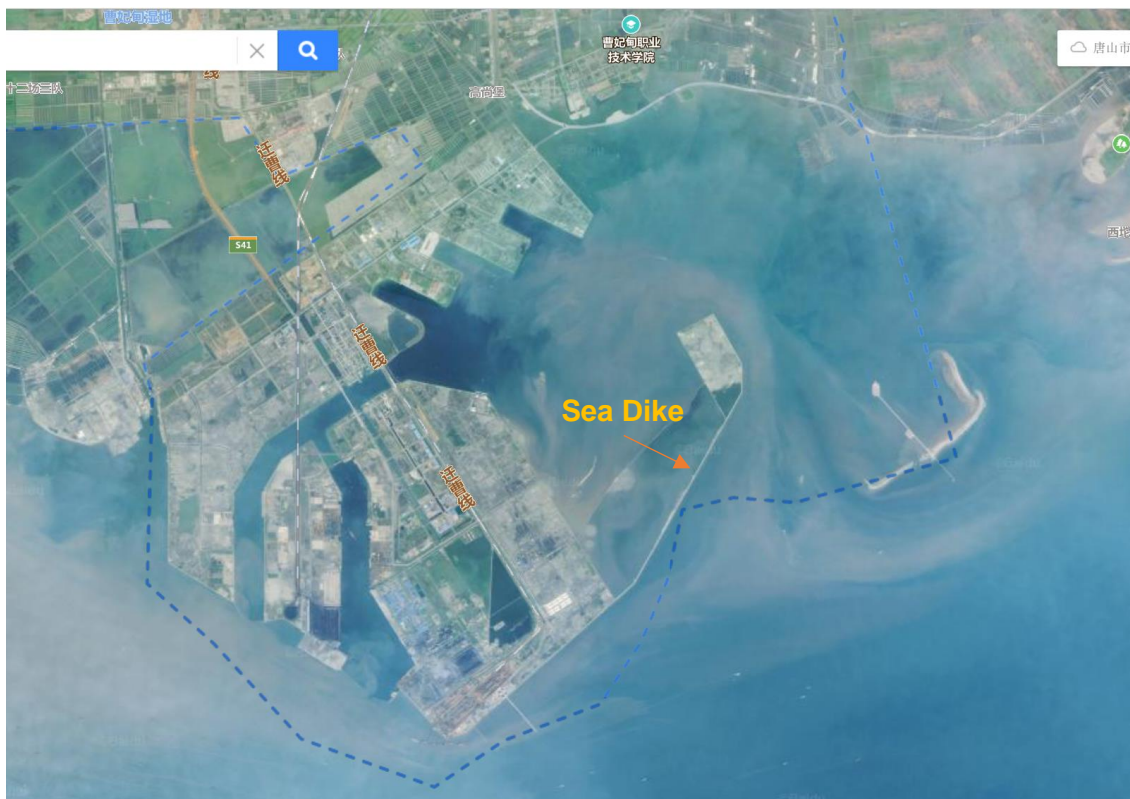


Figure 4. Caofeidian Political Boundary (blue dotted line).

The team carried out participatory stakeholder analysis via interviewing various stakeholders and through literature review of past research projects and government planning documents. The stakeholders interviewed included:

- Fisherfolk
- Scientists
- Conservation NGOs
- Caofeidian Waterbird Wetlands Nature Reserve
- Caofeidian Development Group – a state-owned enterprise that has been granted the authority to monitor the coastal and marine environment of Caofeidian, and is also in charge of managing Longdao (including tourism activities and natural resource use).
- Private sector (aquaculture companies)
- Caofeidian District Department of Natural Resources and Planning

Questions were posed to each stakeholder group to gather information about the study site, obtain updated information on the social, economic, and environmental situation of the area, and gauge stakeholder's vision for the future. Following the gathering of primary and secondary information, this report was prepared, which includes a summary of the findings, future impacts from current situation if left as status quo, and finally recommended strategic interventions to protect Caofeidian's coastal and marine ecosystem. The questions asked of the stakeholders are attached as Annex 1.

## C. Results of Stakeholder Consultations

In general, all stakeholders that were interviewed expressed an understanding of the need for natural resource conservation and better management of Caofeidian's coastal and marine areas.

Conversations with local residents of Caofeidian/Tangshan aged 50 and older revealed that they recalled seeing dense clumps of seagrass leaves floating to the coastal area during their childhood. They also said that their recreational fishing expeditions could easily net fish and clams. While this might not mean that historical seagrass coverage was more extensive than now, it is a good proxy to expect that seagrass density was greater in the past, regrowth occurred regularly each season, and biodiversity in the area was productive. Xu's study (2018) observed floating *Z. marina* clumps in the northern area of the Bohai Sea with the largest clumps located only 6,400 metres from the Caofeidian seagrass beds, and fewer clumps located further from the seagrass beds, attributing the source of the clumps to the same seagrass beds of this scoping study.

As shown in Figure 2, previous land use in the coastal area of Caofeidian was agricultural, pond aquaculture, or unused mudflats, left in its natural state and certainly not built up like it is now. Thirty years ago, the majority of the residents were fisherfolk, labourers, or worked for government agencies. As China resumed foreign relations in the 1980s and embarked on economic development in the 1990s, the outlook for Caofeidian's economic development began to take on ambitious proportions. Given the presence of deep seawaters, a shipping port was built. Mariculture in the nearshore areas was initiated; however, when land reclamation occurred, mariculture farms within Caofeidian District's borders were cleared, and now only aquaculture enterprises are found along the coast and inland. Mariculture still exists in the next district of Laoting. It is not known whether these are sustainable activities, and management of resource use throughout the wider area should take on a transboundary nature.

As arable land became scarcer with a growing population, few residents gravitated towards a more urban lifestyle. Reclaimed land offered to provide cheaper yet more modern housing with new "eco-cities" built, but did not provide for alternative livelihoods. Both local residents and investors from other provinces shifted to aquaculture, mostly shrimp farming, opened small businesses, or remained in artisanal fishing and farming.

### C1. Fishers

The liveliest conversation of the stakeholder consultations occurred when meeting with fishermen from Dazhuanghe Village. This is a village of approximately 2,700 residents from 700 households with the majority engaged in artisanal fishing and some in producing shrimp paste limited to household use, as fish product processing factories are not operating regularly, preventing alternative income to the fisherfolk. There is little out-migration from the village and the alternative livelihoods are to work at urban construction sites.

Fishermen place ground cages into the seagrass beds to harvest crayfish, crabs, shrimp, octopus, whelk, oysters, clams, seabass, rock fish, small yellow croaker, and mullet, as the main species. They informed that seagrass coverage is "scattered" compared to three years ago, and the number of benthic organisms is reduced. Ground cages are deemed particularly efficient over floating nets as seaweed and floating seagrass clumps get caught in floating nets. Gill nets and pot cages are also used.

Fishermen generally operate boats up to 10m in length with 100 horsepower. They fish in any place where they think they will obtain a good harvest. They stated that they now have to go further out to sea, spend up to 20 days at sea, with a harvest of only one-fifth of previous

catches compared to five years ago. What little surplus from their harvest can be sold to a middleman, but the excess amount is now drastically reduced. Despite this, the price for fisheries products has increased dramatically as a result of decreased supply. Currently, overall income remains similar (or even higher) than before. Daily income is 800 – 1000 RMB, with about half spent on fuel. There is concern that while monetary income is sufficient for the moment, the source of income does not seem sustainable. There is a fishing subsidy only for larger boats (e.g. 300 horsepower and above) at around 3-5 million Chinese Yuan per year. Thus, the concern for the survival of artisanal fishing remains.

Fishermen must renew their operating licenses annually, and there have been no more new fishing parcels issued in the past 20 to 30 years. Still, there are cases of illegal fishing, mostly by inland farmers that already own farmland and now are competing with long-time fishers that have no other livelihood options without skills training or access to information on where short-term job opportunities might be.

During the nationally banned fishing season from 1 May to 31 August, fisherfolk have no alternative/supplementary livelihood, with some expressing the need for this. They mostly stay home, and families carry out maintenance of fishing boats and gears. The banned fishing season is a fixed time for all of China without regard for species life cycle and migratory patterns. In Caofeidian and surrounding areas of the Bohai Sea, the best time for catching large commercially valuable fish is May. When the fishing season resumes in autumn, some migratory stocks have swum to offshore ecosystems and/or warmer waters which are too far and not economically viable for artisanal fishers to pursue.

Fishermen expressed concerns on the planned marine ranching in which they will be banned from fishing in and around these ranches, further reducing their fishing grounds. In fact, some of them have experienced being chased from public fishing grounds located near the proposed marine ranches. Wind power farms have started operations which have caused fish to avoid previously abundant fishing grounds. There were mixed outlooks on changing their lifestyle from being independent fishermen to becoming employees of the marine ranches due to lack of capacity to use modern technologies.

## C2. Scientists and academia

Due to lack of funding, comprehensive surveys of the Caofeidian seagrass beds were carried out only in 2016 to 2017, with no further surveys from 2018 onwards. Conversations between scientists and local fishers revealed that in 2015, seagrass were present along the shores of Caofeidian mainland. These were absent the following year, and fragmentation of the seagrass beds were observed in 2017, suggesting that the seagrass is degrading, and such disturbances have to be minimised.

There is no known wide-ranging biodiversity or ecosystem services assessment of the Caofeidian area, only preliminary assessments are available. This creates challenges for understanding the baseline and applying ecosystem-based management of the natural resources to complement economic development.

An estimated 20,000 ground cages are estimated to have been placed by fisherman into the seagrass beds due to more severe competitive coastal and marine resource use. Marine ranching will further increase this competition with the fishermen likely to become more disadvantaged.

Intensive dam construction on the rivers on the mainland have reduced sediment flow to the coastal and marine areas that the seagrass requires for growth. The construction of a sea dike and land reclamation (Figs. 2 and 4) have drastically altered the hydrology where tide tables are no longer a reliable source of information to guide ship traffic to and from Caofeidian



Port. Previous surveys of the seagrass beds required that survey teams sometimes had to wait for nearly the entire day before the tide was high enough for boats to dock at the mainland port and/or on Longdao. Fishermen also are victims of the unpredictable tide where if the tide does not rise, some of their boats are stranded in the village. The southeast coast of Longdao is now suffering from coastal erosion.

Stakeholders from academia expressed the view that protection of these natural resources is a must and many options are available (see the chapter on Proposed Strategic Interventions). It is imperative that such protection and management considers environmental, social and economic affects and impacts, and that all stakeholders are involved in planning from the onset.

### C3. Conservation NGOs

Conservation efforts around Caofeidian are still in their infancy. The scoping team met with an NGO that focuses on rescuing and healing injured birds such as the Oriental stork, bar-headed goose, green peafowl, and birds of prey such as buzzards and hawks. The rescue centre is located next to originally natural wetlands, some of which were later converted to salt farms and rice paddies. The rescue centre is to be commended on its work focusing on bird rescue and environmental education for local school children. There was no information that could confirm that holistic conservation efforts are carried out. After the birds are healed, they either remain at the centre or are released into the wild. An example of failed bird release was an Oriental stork that was taken to Qinghai in western China, but failed to be released as no official permission had been requested for release. The bird was subsequently taken back to the rescue centre and remains there.

The rescue centre engages in bird banding and tracking of each banded individual. Data are quite extensive but kept only within the centre and seems not to be applied for wider management purposes. Data show that some species alter their stopover sites from year to year, but no robust analysis of the cause for this has been undertaken. Thus, there seems to be little link among bird release health, bird habitat and food status, and resource management. This is not due to a remiss in conservation efforts of the rescue centre, as there is insufficient funding and capacity to address all issues, but serves as an indication of the need for science-based conservation and management and the need for strengthening cooperation between NGOs, academia and management agencies.

There are no NGOs working on seagrass protection in the immediate vicinity of Caofeidian.

### C4. Government-related resource management agencies

#### Caofeidian Development Group (CDG)

The Caofeidian Development Group is a state-owned enterprise consisting of many sub-companies. CDG is responsible for managing natural resources and their use on and around Longdao. There are bungalows for tourists to stay overnight on the island and the impacts of these anthropogenic activities need to be considered together with resource management, particularly as there are plans to further develop Caofeidian as a tourist destination. Although the seagrass beds lie within the “Ecological Redline (2014-2020)” which will be revised soon, the local government intends to change the area into an “ecological entertainment zone.” Another company, the Longdao Construction Co. Ltd, also affiliated with Caofeidian Development Group, is responsible to further explore tourism opportunities on Longdao. Thus, it may be difficult to establish a seagrass protected area unless management plans allow for proper conservation that complements multi-use of the resources.

The Tangshan Caofeidian Blue Marine Science and Technology Co. Ltd. (BMST), also a member of the CDG, was delegated two years ago by Tangshan Municipal Government to provide services on marine environment monitoring. It has absorbed the former Caofeidian Marine Environment Monitoring Center including the laboratory and equipment.

BMST currently takes care of the regular and emergency marine environment monitoring (mainly on water quality, no biological variables) with full funding from Tangshan Municipal Government. This is the first effort in Tangshan for marine environment monitoring operated by the private sector.

An online environment monitoring platform has been established by including monitoring data from both land-based monitoring stations and from autonomous floating buoys. The online platform is not accessible to the public, according to China's national policy on data disclosure. All data will be submitted to the North Branch of National Marine Environment Center located in Qingdao. Monitored variables include water temperature, pH, nutrients, salinity, current, wind, wave, amongst others. BMST provides regular marine environment monitoring reports to Caofeidian District Government. Monitoring on Longdao occurs during March, May, August and November, lasting one week for each survey. The water quality around Longdao is deemed "good," and there is no evidence of leaks from the two nearby oil wells.

There is a plan to restore and replant seagrass northwest of Longdao in the same area where Dr. Liu discovered the seagrass beds. BMST is currently working with a professor from Ocean University of China on this. BMST suspects a high probability that seagrass also exist northeast of Longdao. Seagrass restoration is planned in areas with the least anthropogenic disturbance and with proper environmental conditions for seagrass growth (light, current, sediment). Under this initiative, cages placed in the seagrass beds will be removed. Ownership and regulatory permissions of the cages need to be clarified before removal in order to not impact local livelihoods and create conflicts in resource use.

As shown in Figure 3, two marine ranches are proposed by BMST, but as yet, it is not clear what species will be cultured. One idea is to deposit artificial reefs made of concrete into the marine ranches hoping to attract fish and oysters. The marine ranches will prevent fishermen from fishing in the area, and BMST stated that it plans to recruit local fisherman to work in the ranches or in the marine tourism industry in the future.

### Caofei Lake

A private company, the Tangshan Caofeidian Wetland Protection Company, jointly with Caofeidian Wetlands and Waterbird Provincial Nature Reserve (NR) Management Bureau, is responsible to protect the waterbird habits including both the Caofei Lake area and nearby aquaculture farms. The company's main responsibility is to patrol within the reserve boundaries for "illegal" construction. Land use in the NR consists of aquaculture farms that were present before the reserve was established, and "illegal" construction refers to modifications and repairs to aquaculture farms and residential facilities of the local community residing therein undertaken without prior approval from the NR. In 2012, the NR boundaries were redrawn to exclude the wetlands area that contains hotels and two golf courses. Figure 5 shows the areas under the jurisdiction of the NR with the grey-shaded area in the east clearly excluding the lake from the NR boundaries. The core zone of the NR in red consists solely of aquaculture farms. There is no regular monitoring on water quality and biodiversity carried out by either management body due to lack of capacity although the equipment is already there.

After establishing the NR, the land rental for aquaculture was reduced from 700 – 800 RMB/Mu<sup>2</sup> to 80-100 RMB/Mu. However, from September to November each year,

---

<sup>2</sup> 1 mu = 666.66 square metres

aquaculture operators are banned from entering the area due to this being the migratory and stopover season for the Oriental stork. There is no compensation for not being able to farm during this period, and moreover, the aquaculture farmers have been requested to provide fish to feed the storks. Farmers are reluctant to cooperate, as the fish will eat the shrimp that they are raising.



Figure 5. Map illustrating the boundary of the Caofeidian Wetland and Waterbird Provincial Nature Reserve. Orange=core zone, yellow=buffer zone, green=experimental areas.

## C5. Aquaculture Farms

Caofeidian contains extensive areas of aquaculture farms. In fact, the majority of the Caofeidian Wetland and Waterbird NR consists of aquaculture. Aquaculture operations do not directly impact the seagrass, but some farms impact the natural surroundings of their immediate vicinity. The Huitong Shrimp Farm is located within the Wetland Protected Area of Caofeidian (southeast part). There are both indoor and outdoor ponds with the former used from November to mid-June. The outdoor ponds are able to provide food for migratory birds.

Large-scale enterprises are able to operate year-round regardless of where they are located. However, as already mentioned above, household level farmers may be subjected to restrictions especially if located within a protected area. Moreover, the large-scale aquaculture enterprises have more opportunity to use modern technologies to improve the living environment in the aquaculture ponds, thus anticipating a better quality of the yields. For example, the Minghua Aquaculture Company is able to produce two shrimp harvests a year. This company treats its own wastewater and recycles its water through a recirculating aquaculture system. Such measures can help reduce pollutant loads to groundwater and

beyond. Solar panels arrays were also observed installed in some outdoor ponds to provide shade above the ponds, as well as generate electricity for aquaculture enterprises to re-sell.

No known enterprises are members of internationally certified aquaculture/marine seafood standards. Thus, there are opportunities to make aquaculture (and future marine ranches) more in line with good practices of blue economy by having companies sign on to globally recognized certifications that could also provide increased revenue in parallel with more sustainable practices.



Figure 6. Aquaculture farm in Caofeidian.

#### C6. Local Government - Caofeidian District Department of Natural Resources and Planning

In recent years, local governments (Tangshan Municipal Government and Caofeidian District Government) have started to pay more attention to environmental protection and ecological restoration, in line with the central government's policy of 'lucid waters and lush mountains are invaluable assets' proposed by President Xi Jinping.

The Hebei Provincial Government has approved a special fund for seagrass restoration in Longdao, but details on how restoration should be carried out requires further consultation with stakeholders, the methodology on how to do so requires additional technical input, and the areas for restoration should be chosen considering various natural, social and economic factors. Government agencies plan to put more efforts towards coastal restoration and marine environment monitoring in the future. However, there is lack of expertise on both technological and managerial aspects.

At present, while the local government realises the need for seagrass and wider environmental protection, they prefer to proceed gradually in order to not impede the local economic development agenda. An opinion was given that while there did not seem to be any threats to seagrass (no sea-based pollution has been observed although river mouths seem to be polluted), its restoration has been expressed as a first step. Should this be successful and a

need for elevating protected actions be approved, the local government will carefully consider these options. In China, MPA establishment often takes a top-down approach with the targets set at government levels higher than local ones. Caofeidian local government stated that should such an order be made, they will carry out conservation with best efforts considering the feasibility, ecological significance, and social impacts. The examples of the Caofeidian and Nanpu wetlands were given as examples of poor protected area delineation. The Nanpu wetlands enclose a prison within the protected area!

Steel and mining industries, port development, and aquaculture were stated as some of the local industries that might threaten seagrass health. It was stated that fishing is deemed to be sustainable as fish prices have increased and more fish should be present as they reproduce without threats during the closed fishing season.

Given the information described throughout this chapter, these are short-term situations with no known projection of their sustainability, and it would be more advantageous to implement preventative measures over reactive ones.

#### **D. Threats Analysis, Impacts and Governance**

Primary and secondary data collection revealed various threats to Caofeidian seagrass beds and nearby ecosystems.

##### D1. Land reclamation

Coastal land reclamation in China has been carried out on a tremendous scale with Caofeidian being one of the largest and most talked about project in the country. Economically speaking, land reclamation can provide increased revenue and GDP, but in the case of Caofeidian this instead led to:

- uninhabited new cities
- development of a port that is less competitive than the previously established larger ports nearby
- 58% of reclaimed land is unused
- loss of habitat for marine and avian species
- loss of livelihood for mariculture farmers
- change in coastal hydrology

##### D2. Unsustainable aquaculture and marine ranching

Aquaculture is already widespread with marine ranching planned in areas adjacent to the seagrass. Again, such economic activities are expected to increase revenue to the private sector and government-affiliated enterprises. However, if carried out without prior robust assessments of their impacts, the seagrass and local fisheries may be affected.

At present, there is no comprehensive study of the amount of untreated waste discharged from aquaculture farms. It is highly unlikely that all farms are operating the way of Minghua Aquaculture Company, and farms that are operating unsustainably will be discharging excess nutrients to the sea, perhaps also using beyond safe standard amounts antibiotics. Such practices also impact the health of aquaculture workers.

Marine ranching has been planned in areas close to the seagrass beds. None of the ranches have been delineated based on the species to be raised, nor on the physical and biological characteristics of the sea area. If the ranches are operated unsustainably, they will certainly



impact seagrass health. Just the idea of constructing a physical structure near the seagrass will affect seagrass health from the onset of increased ship traffic to transport of construction materials. Once built, the physical structure may also change the hydrodynamics of this area.

Commercially valuable species are expected to be farmed at the ranches. If non-local species are raised, the risk of escapees from introduced species could pose an ecological risk if they should cause an imbalance to ecological structure and function.

A question is also raised as to the feeding of the farmed species and whether feed would be artificial or need to be sourced from the wild thereby further reducing wild stocks. As the marine ranches will be located in the open sea, water flow would be more constant, thus allowing for contaminants and organisms to move more freely across areas.

It is obvious that the establishment of ranches will affect fisherfolk's livelihoods. They will be banned from fishing near the seagrass. The opportunity for the fisherfolks to be employed by marine ranches is not very promising unless capacity building will be provided, as they may lack capacity to master the modern technologies of aquaculture. Moreover, even if ranches employ fishermen, some may not wish to alter their livelihoods. The amount of income and life habits from changing lifestyles is unknown and may not suit some fishermen.

#### D3. Artificial cement reefs

The planned artificial reefs made from cement is an idea for marine ranches on which shellfish could attach. Like above, negative impacts to the seagrass and wider natural environment are expected. Artificial reefs would likely have to rest on the seabed thus destroying benthic habitats. During construction, the churning up of the seafloor will affect water quality and marine organism survival.

#### D4. Illegal and overfishing

Illegal and overfishing impact all involved in the industry where fishing efforts are increased but not all can benefit from their added effort. While there might be higher fish catch initially with increased effort, these are only short-term benefits and the amount of fish stock will be depleted faster than usual. The benefits are usually enjoyed by only a small portion of the fishers most likely using illegal equipment, fishing without license, and not reporting their catch. The most disadvantaged group is the artisanal fishers that spend more effort but harvest less.

During the closed fishing season, illegal fishing still occurs with the setting of cages particularly ground cages that easily net octopus and various shellfish. If the illegal cage setters are not caught, they will be able to harvest a substantial amount of seafood. During the closed fishing season, these products bring in high prices. Illegal fishing in the seagrass beds offshore is more difficult to monitor than in near shore areas, and is widespread according to the feedback from local fishers. Illegal fishing occurs not only by fisher fold from nearby villages, but also from farmers on land, who are already allocated farmland. If these activities continue unchecked, they will reduce habitats for marine organisms as well as marine stocks, resulting in fewer resources for all in the longer term.

#### D5. Oil and natural gas exploration

Exploration for crude oil in the Bohai Sea began in the middle of the 20th century (Zhu et al. 2016), with this sea area being the second-largest crude oil production base in China (Zheng and Yang 2019). The discovery of a natural gas field at a Bohai oilfield in early 2019 is the largest discovery in the Bohai Bay Basin in the past 50 years which could meet the growing demand of the country for energy in northern and eastern China (Zheng and Yang 2019).

The scoping study team observed the presence of oil drills and storage facilities of China National Offshore Oil Corporation (CNOOC). Many of the oil drills along the roads were not in operation with explanation given that there is no more oil in that particular area where the drills are located. The CNOOC storage facility was described as only a storage facility without drilling taking place nearby.

Given the advancement in technology to locate new oil and gas reserves driven by usage demand, it is possible that this becomes viewed as an opportunity for business advancement, and oil exploration could expand to further areas of the Bohai Sea including areas around Caofeidian. Should this occur, there is the threat to further destruction of the coastal and marine ecosystems as well as impacting where local communities could fish.

#### D6. Sand extraction

Sand extraction occurred extensively in the past along the coast, but has now stopped due to land reclamation and depletion of sand. However, around Longdao and other islands that are sandbars, sand is still present and there is a risk to extract these resources even for small scale construction of which nearby marine ranches could be a possibility for its use. The loss of the sandbars will result in loss of marine habitats of which seagrass will be affected, and fishing and resting areas for fishermen.

#### D7. Wind power stations

Wind power stations have already caused fish to migrate to other quieter areas. Fishermen and birds also can suffer from the noise produced by rotor blades, with the possibility of avian mortality from wind turbines. Fisherman avoid the areas where the power stations are located, sometimes having to detour in order to reach fishing grounds.

There is currently no monitoring of avian mortality or migration detour from Caofeidian's wind power stations. Further analysis of data collected by the local bird conservation NGO could provide preliminary information on this.

#### D8. Governance

Most of the impacts from the above actions can be mitigated through improved governance. There currently exists numerous policy and legislation related to ecosystem management of Caofeidian. Management interventions proposed in Section F should be carried out in a holistic manner to ensure that a wide range of governance mechanisms are addressed and in line with local, provincial and national policies. Policies relevant to ecological conservation specific to Hebei Province and Caofeidian are summarised below.

- **National policies to restrict reclamation in China**

The laws and regulations for reclamation in China is less developed compared to Japan and Holland, for example. These are countries that have implemented large reclaimed projects but have strict environmental and ecological protection measures accompanying the reclamation activities. Only in 2006 did China have its first National Reclamation Plan, carrying out total quantity control of the reclaimed land. In contrast, in order to boost the economy, in 2013, the Department of Land and Resources in Hebei Province implemented a fast and simplified procedure for land reclamation approval. However, in 2014, the former Ministry of Land and Resources imposed stricter management and supervision measures on land reclamation, in particular to ban reclamation in bays that have a small mouth and thus lower capacity for self-replenishment, such as Bohai Bay.

As authorised by the State Council, the former State Oceanic Administration implemented the National Inspection on Marine Environmental Protection in 2017. Hebei was one of the six

provinces identified for additional issues identification related to monitoring impacts of reclamation. According to the result, 68% of reclaimed land in Hebei Province remain unused with 58% unused in Caofeidian. Moreover, among the 18,424 ha of aquaculture farms, only 27% obtained the proper right to use the marine area that have been occupied by the aquaculture farms. The Hebei provincial government did not fulfil its obligation in supervising and managing the reclamation and marine area usage. Some of the provincial policies are in contrast with the national ones. Thus, the inspection group suggested to restore the reclaimed land which has already posed severe environmental and ecological damages, and to completely stop reclamation in Bohai Bay. The state recalled the ownership of reclaimed land that remained unused, and stopped all the reclamation projects that were as yet to be carried out although already approved.

On 14 July 2018, the State Council of China announced the regulation on 'Strengthening the coastal wetland protection, and enhancing the management and control of reclamation in Bohai Bay'. The new regulation will stop approving all new reclamation activities, except for projects designated as national strategic priority. The regulation also contains declarations on carrying out ecological conservation and restoration during the reclamation process and to existing reclaimed areas, punishment of illegal reclamation, as well as the economical and effective use of the reclaimed land. This regulation is deemed to be the strictest regulation in the history on the reclamation management and control in China.

- **Ecological Redline**

According to the Ecological Redline Planning of Hebei Province, the ecological redline in the coastal area falls into the areas along costal zones of Qinhuangdao, Tangshan, and Cangzhou City, aiming to protect the marine ecosystems, restore the habitats of fish and the safeguard forest along the coast. The total area of the coastal ecological redline is 1,880 km<sup>2</sup>, accounting for 26.02% of the sea area owned by Hebei Province. Longdao lies within one of the six areas under the category of 'Coastal Tourism Area' of the ecological line.

- **Marine Functional Zoning and Marine Major Function Oriented Zoning**

According to the Marine Functional Zoning of Hebei Province, Longdao falls into the category of 'Marine tourism and entertainment area' (Figure 7). There are fishing areas (including the marine ranching) planned around Longdao.

According to the Marine Major Function Oriented Zoning of Hebei Province, Caofeidian (including Longdao) belongs to the category of 'prioritised areas for development', and is assigned as one of the industrial areas close to the cluster of ports (i.e. Qinhuangdao Port, Tangshan Port and Huanghua Port). Based on its port location, Caofeidian is expected to become the manufacturing base for steel of superior quality and heavy machinery. Tourism will be promoted in Longdao, together with marine ecological and environmental restoration and protection on and around the island.

- **Ecological Assessment and restoration for the reclaimed land**

In February 2019, the 'Ecological Assessment Report for Caofeidian Reclamation' and 'Ecological Restoration and Conservation Plan' was approved by local government. According to the plan, artificial reefs are planned to be deployed around Longdao. Meanwhile, the habitats for avian species will be restored (i.e. southwest coast of Longdao). It is also recommended in the Plan that efforts should be made on designating nature reserves for the seagrass bed, as well as to develop the seagrass conservation plan of Longdao. It is a good opportunity for implementing the ecological restoration plan in order to reduce the impacts from land reclamation on hydrological dynamics and biodiversity, strictly control the total area of reclaimed land and make optimal use of the coastal resources of Longdao.

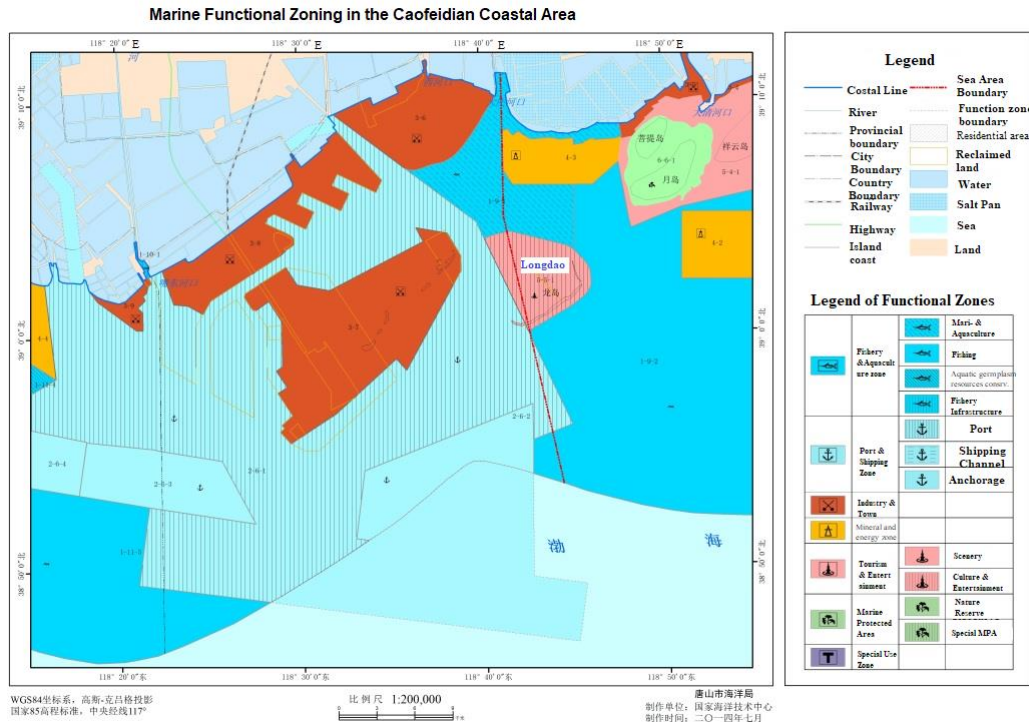


Figure 7. Marine Functional Zoning of Hebei Province (2014).

In December 2018, an ‘Action Plan for Integrated Management and Governance towards the Major Challenges in Bohai Sea’ (hereinafter ‘Action Plan’) was published by the Ministry of Ecology and Environment, National Development and Reform Council and Ministry of Natural Resources, in order to improve coastal water quality, as well as to increase the coverage of natural coastlines. The Action Plan provides clear roadmap and timelines. According to the Action Plan, in the next three years, the land- and sea- based pollutants will be significantly reduced; the strictest land reclamation control will be implemented and the ecological function in the coastal area will be continuously improved and the depleted fish stocks will be gradually restored. Until 2020, there is expected be no less than 6,900 ha of coastal wetlands and at least 70 km of coastlines will be restored.

Finally, according to the ‘Island Protection Plan for Hebei Province (2012-2020)’, Longdao belongs to the ‘moderate use type’ of islands. Its major function is tourism and entertainment. Strict regulation on management and control for the exploitation of Longdao will be implemented to ensure the sustainable use of the island based on its ecological carrying capacity. According to the plan, the damaged ecological function of the island should be restored.

## E. Looking Forward

All stakeholders that were consulted declared that they wish to see more efforts contributing to nature conservation, and that protection of the Caofeidian seagrass is important through seagrass regeneration and/or designating the area as a no-take zone. However, each stakeholder remains dedicated to its agenda and there are differences in the specifics of each group’s future vision.

The fishing community wishes to maintain healthy fishing grounds in their current fishing areas. They wish to have regular regeneration of fish stocks, especially of commercially important species. Seafood prices should at least be maintained and not decreased. The closed fishing

season should be modified to be more relevant seasonally and species-based for the local Caofeidian area. Thus, protecting and expanding the seagrass coverage would benefit fishers. They also would like to have access to temporary job announcements for the four-month closed fishing season, and skills training for supplementary livelihood options.

Scientists would like additional funding to survey and update knowledge on the known seagrass and also possibly unknown areas where seagrass might be. They hope for more cross-sector dialogue and inter-disciplinary approaches on future development plans where stakeholders are consulted and impacts to local livelihoods are considered before development projects are initiated.

There are no local conservation NGOs addressing seagrass protection; however, local NGOs that were interviewed expressed that protection of seagrass would allow for more fish and clam nurseries and habitats which would provide food for birds. The NGOs also would like bird population to increase which requires a more holistic approach to conservation through cooperating with different stakeholders.

Government agencies and their designated subsidiary companies would like to increase seagrass coverage through seagrass regeneration. They also would like to have a solid monitoring programme with enhanced skills in water quality monitoring and analysis. At the same time, economic development is a priority for this stakeholder with tourism and marine ranching around Longdao to be expanded.

The common vision to protect seagrass and Caofeidian's ecosystems can serve as the central point around which conservation carried out among economic development can be demonstrated. The economic activities of Caofeidian with the historical inadequate planning of land-use are well-known around China. These ventures will not be destroyed due to cost and handling of construction waste. Therefore, *if conservation and development in Caofeidian can complement each other with minimum negative impacts, it could serve as a model for other places in China facing similar problems.* Proposed interventions in this context are described in the next chapter.

## **F. Proposed Strategic Interventions**

The results of the scoping study and proposed interventions are not limited to protecting only seagrass, but can be applied into an operational framework to guide management of the wider Caofeidian coastal and marine resources including addressing socio-economic issues that impact natural resources.

The series of proposed interventions are for stakeholders to form the basis of an area-based management plan that can be adopted by local planning authorities and management bodies to guide management decision making and investments. It is important to improve science-based management of Caofeidian's resources such that Caofeidian could serve as an example of how integrated development and conservation may complement each other. Management planning and implementation must be based on sound science and knowledge. Information on the ecological, biophysical, socio-economic conditions (as well as consideration of the political and cultural context and prevailing governance systems) all must be included.

In addition, empowerment entails building the capacity of communities and government to effectively manage their resources. This ability to exercise management of resources and institutions to enhance livelihood opportunities and secure sustainable use of resources upon which communities depend is most effective when done in conjunction with established agencies of government. By strengthening local coastal communities' access and control over



coastal resources, there is a greater chance that economic benefits will accrue locally. Therefore, the proposed interventions should be carried out through consultations with, and agreement by multiple stakeholders. The table at the end of the chapter lists the responsible parties for each management action.

In the list of proposed interventions below “S” refers to immediate actions that should be carried out in the short-term within the following one to two years. “L” refers to longer-term actions that require more time of 3+ years. At the end of the chapter, for quick reference, Table 1 summarises the proposed interventions and suggestions for which stakeholders should be responsible for each action.

- Biodiversity assessment and monitoring – S, L

A comprehensive assessment of ecosystem services of Caofeidian should be carried out before further development projects are implemented. Such an assessment will guide managers and policy makers to know what natural resources are present and where, which ones are being depleted, and the impacts of development to ecological systems. Knowing the biodiversity (including habitat health) will also guide its management with respect to livelihoods of local communities.

- Seagrass restoration – S

Seagrass monitoring and traditional knowledge have revealed that seagrass coverage is decreasing, and restoration is required. Capacity building is needed to identify the areas and methods for restoration. It is recommended that demonstration sites for restoration is first carried out to ensure that methods are successful. Restoration should first be trialled in areas with less disturbance and suitable environmental conditions for seagrass growth (e.g. adequate visibility and sediment, current patterns, water quality).

- Establishment of aquatic germplasm resources - S

A protected area for preserving aquatic germplasm resources could serve as a nursery for seagrass and other marine organisms. Such an area would not be subjected to the full restrictions of a Marine Protected Area under Chinese regulations, and these seed and germ banks can serve as “insurance” to regenerate the ecosystem. The *Z. marina* germplasm in Rongcheng, Shandong Province could serve as a model.

- Seagrass monitoring – S, L

Monitoring seagrass and other resources should be a regular activity. Capacity building and consistent financial support is required for robust monitoring. Results of monitoring according to regulated acceptable forms should be made public as part of awareness building and policy influence. Capacity building should also be enhanced for water quality analyses. The use of citizen science where local communities assist in sample collection and reporting can be introduced if proper training and quality control can be ensured. In order to ensure sustainability of on-site seagrass monitoring carried out by local community, it is important to make sure that local communities could benefit from this exercise, e.g. link the monitoring results with their own fishing activities through showing increase in fish stocks.

- Fish stock assessment – S, L

As above, fish stock assessment and monitoring should be an on-going activity. By knowing any changes in fish stock, adaptive fisheries management can be implemented. In addition, adjustments to the timing and areas of the closed fishing season should be considered based on fish species life cycle, abundance, age, migratory patterns.

- Avian monitoring – S, L

As part of overall ecosystem monitoring, avian monitoring should be enhanced to understand the impacts of land-use change such as construction of wind power stations on avian mortality.

Capacity of local NGOs engaged in bird conservation should be enhanced with data sharing of bird migration and stopovers among conservationists, resource managers, and policy makers. These data should be applied towards management of habitats and maintaining the food chain. The data can also assist in siting of future wind power stations and marine ranches.



Figure 8. Banded bird at Daqinghe Bird Rescue Centre.

- Assessment for marine ranching – S

Related to the above interventions, prior to the parcelling and establishment of marine ranches, impacts assessment should be carried out to determine the best locations and species for marine ranching. Impacts to local livelihoods also need to be carried out.

- Environmental Impact Assessment (EIA) on tourism at Longdao – S

As economic development is a high priority for Caofeidian, this should not be done out at the expense of destroying the environment. EIA for developing tourism should be robustly implemented prior to further developments. Eco-tourism, when carried out properly, could be a win-win situation for local authorities, the private sector, and fisherfolk that switch livelihoods.

- Improving post-harvest technology and market access – S

A market access study is needed to determine the opportunities for supplementary livelihood of fisherfolks in producing fish products beyond household use. Issues to consider include promoting investments in a regularly operating fish processing factory and establishing an industry for selling fishery products produced from the household/community level.

- Alternative job opportunities – S

A platform on temporary job openings particularly during the closed fishing season would be very helpful for fishing communities. With the advance of smart phone apps and wide usage by fishermen, such information can be publicised in this manner in addition to tradition methods such as posting hard copies of job openings and having village leaders inform of opportunities.

- Vocational skills training – S, L

Given that artisanal fishing in Caofeidian is become more difficult to sustain, skills training for fishermen to work in other industries is required. It is increasingly likely that fishermen may have to change their livelihoods to work on marine ranches, in factories, on construction sites, or start their own business. However, without enhanced skills, they have a low probability to be hired for such jobs or to succeed in running a business.

- Compensation assessment – S

Residents around Caofei Lake that cannot access their shrimp farms during bird migration should be adequately compensated for this loss in income. An assessment for the level of compensation should be carried out, as well as finding a common ground for continuing access to one's enterprise. There are many examples globally of successful multi-use zones in protected areas that can be adapted for this particular case where awareness of biodiversity protection, enforcement of illegal resource use, and citizen science can be integrated for ecosystem-based management.

- Promotion of sustainable aquaculture – S, L

All aquaculture farms should be monitored for sustainable and safety standards in order to lessen pollutants discharged into the sea. Aquaculture farms should be encouraged to sign on to global certifications such as Aquaculture Stewardship Council and/or Marine Stewardship Council to operate under environmental and social safety standards. Additionally, having these certifications allows for the setting of higher product prices and generating higher profits to the seafood farms.

- Economic incentives for eco-cities – L

As changes in livelihood particularly for fishermen may be unavoidable, incentives are needed for people to inhabit the new eco-cities. This will be a long-term undertaking to ensure that migrants to the eco-cities will have the skills and market access to sustain a new livelihood. Urban developers to advise and create cities beyond only physical structures are needed to guide on this.

- Science-policy dialogues – S, L

Dialogues among different stakeholders is very much needed, particularly those that can drive science-based management. It has been mentioned earlier that assessments are needed prior to siting of marine ranches and wind power stations. A policy review should be carried out to determine the best sites for these initiatives and also whether such initiatives should forge ahead.

Experience exchange in best practices for aquaculture farms in wastewater treatment, recycling farm water, low residual feeding methods and low-to-zero chemical input can lead to wider and cleaner operations and products.

Mariculture farms are present in the next district, Laoting, which is close to the seagrass beds. Caofeidian District authorities do not know if the mariculture is sustainable or not. Transboundary surveys and cross-district management is required to mitigate any transboundary impacts from unsustainable mariculture operations.

Dialogue, data sharing, and cooperation between conservation NGOs and management agencies should be enhanced so that information is effectively applied for wider holistic natural resource management.

- Data sharing - L

Open access to data in China is governed by strict regulations to ensure national security, and it is not expected that any change in policy will occur in the near future. However, data products and information based on scientific data regarding seagrass and ecosystem health should be available to the public to guide management and resource use. Data products can also help to raise public awareness on the need for ecological protection.

- Awareness raising - S

Public awareness and participation for all stakeholders could be a good tool to elevate the consciousness and caring of seagrass and ecosystem protection. Awareness campaigns

should be targeted to each audience and should be a continuing effort so that people are reminded and do not become complacent of the situation.

- Improved enforcement of illegal fishing – S

Enforcement of illegal fishing needs to be strengthened so that equal access and sustainable harvest of resources is available to all. Clear and widespread broadcasting is suggested on the policies for ground cages and other legal fishing gear that can be used in seagrass beds.

- Improving ocean circulation - L

Land reclamation and the construction of artificial structures in the Caofeidian coastal areas have resulted in changes to the physical and chemical characteristics of the ocean. Tide tables are no longer reliable and sediment do not flow to the seagrass. A sea dike offshore from Caofeidian (Fig. 4) does not serve much purpose and could be considered to be removed to allow better circulation and exchange of waters between the near and far shores.

- Broadening financial support and collaborative partnerships – S, L

In order to implement the listed recommended interventions, additional financial and technical support are required. Therefore, stakeholders should pool resources together for bigger impacts from their initiatives. There are numerous donors that might be willing to support a few of the interventions. Many US- and European-based foundations, UN-affiliated agencies, and foreign embassies are sources to tap into, as well as approaching bilateral programmes under which China is a player. There are also domestic NGOs and foundations that could provide support to community conserved or co-managed protected areas. Given the analysis above, as it is less likely to establish an MPA for protecting the seagrass bed in Longdao in the immediate future, it might be a good attempt to establish a community-based, or co-managed or collaborative demonstration site at Longdao for seagrass protection through support from non-governmental funds. Another option is to carry out seagrass conservation through academia, NGOs and other stakeholders in collaboration with local government, thus financial support can be expected from the government through government purchased services.

**Table 1.** Table of responsibilities for proposed interventions.

<u>Intervention</u>	<u>Timeline</u>	<u>Responsible Parties</u>
Biodiversity assessment and monitoring	S, L	<ul style="list-style-type: none"> <li>• Academia</li> <li>• Government</li> </ul>
Seagrass restoration including capacity building	S	<ul style="list-style-type: none"> <li>• Academia</li> <li>• Blue Marine Science and Technology</li> <li>• Government</li> <li>• Coastal communities</li> </ul>
Establishment of aquatic germplasm resources	S	<ul style="list-style-type: none"> <li>• Academia</li> <li>• Government</li> </ul>
Seagrass monitoring and citizen science	S, L	<ul style="list-style-type: none"> <li>• Academia</li> <li>• Blue Marine Science and Technology</li> <li>• Government</li> <li>• Coastal communities</li> </ul>

<b><u>Intervention</u></b>	<b><u>Timeline</u></b>	<b><u>Responsible Parties</u></b>
Fish stock assessment	S, L	<ul style="list-style-type: none"> <li>• Academia</li> <li>• Government</li> <li>• Fisherfolk</li> </ul>
Avian monitoring	S, L	<ul style="list-style-type: none"> <li>• Academia</li> <li>• Government</li> <li>• Conservation NGOs</li> <li>• Caofeidian Wetlands NR</li> <li>• Investors</li> </ul>
Assessment for marine ranching	S	<ul style="list-style-type: none"> <li>• Academia</li> <li>• Blue Marine Science and Technology</li> <li>• Government</li> </ul>
EIA on tourism at Longdao	S	<ul style="list-style-type: none"> <li>• Academia</li> <li>• Blue Marine Science and Technology</li> <li>• Government</li> <li>• Investors</li> </ul>
Improving post-harvest technology and market access	S	<ul style="list-style-type: none"> <li>• Academia</li> <li>• Government</li> </ul>
Alternative job opportunities	S	<ul style="list-style-type: none"> <li>• Academia</li> <li>• Government</li> <li>• Coastal communities</li> <li>• Private sector</li> </ul>
Vocational skills training	S, L	<ul style="list-style-type: none"> <li>• Academia</li> <li>• Government</li> <li>• Coastal communities</li> <li>• Private sector</li> </ul>
Compensation assessment	S	<ul style="list-style-type: none"> <li>• Academia</li> <li>• Government</li> <li>• Caofeidian Wetlands NR</li> </ul>
Promotion of sustainable aquaculture	S, L	<ul style="list-style-type: none"> <li>• Academia</li> <li>• Government</li> <li>• Aquaculture &amp; mariculture enterprises</li> <li>• Fisheries-related NGO</li> <li>• Investors</li> </ul>
Economic incentives for eco-cities	L	<ul style="list-style-type: none"> <li>• Academia</li> <li>• Government</li> </ul>
Science-policy dialogues	S, L	<ul style="list-style-type: none"> <li>• All</li> </ul>



<u>Intervention</u>	<u>Timeline</u>	<u>Responsible Parties</u>
Data sharing	L	<ul style="list-style-type: none"> <li>Academia</li> <li>Government</li> </ul>
Awareness raising	S	<ul style="list-style-type: none"> <li>All</li> </ul>
Improved enforcement of illegal fishing	S	<ul style="list-style-type: none"> <li>Government</li> </ul>
Improving ocean circulation	L	<ul style="list-style-type: none"> <li>Academia</li> <li>Government</li> </ul>
Broadening financial support and collaborative partnerships	S, L	<ul style="list-style-type: none"> <li>All</li> <li>Donors</li> </ul>

Table 1. Table of responsibility for proposed interventions.

### **G. Next Steps and Recommendations**

An integrated management plan based on the proposed interventions is one of the immediate actions needed in order to protect Caofeidian's seagrass and the wider coastal and marine areas. At present, as economic development appears to be a higher priority than environmental protection, *there is all the more reason to start empowering stakeholders and accepting that co-management with complementary roles played by different stakeholders is the best path to take.*

In this context, the scoping study recommends that science-based actions are the next steps towards protecting these resources. From the list of proposed management interventions, the following actions should be taken as high priority:

- 1) Rapid biodiversity assessment of the area within and around the seagrass bed that will include the status of other habitats.
- 2) Economic valuation of the seagrass' value to fisheries and carbon sequestration.
- 3) Capacity building in seagrass restoration especially for Caofeidian Development Group who is tasked with monitoring the area and other interested stakeholders such as marine ranch managers and NGOs.
- 4) Exploration with communities fishing in the area regarding more seagrass-friendly fishing methods and sustainable aquaculture operations, as well as alternative livelihood options.

The scoping study team has a good network of experts that are able to fulfil the tasks listed above, if sufficient financial support can be obtained.

A Chinese language summary of the interventions is planned to be produced and will be available in late 2019 so that local stakeholders may be able to draw upon this report's information and act accordingly. The summary will be distributed to the stakeholders that the scoping study team met, and also shared with other Chinese partners that the team members normally collaborate with.

The scoping study team will continue to source for financial and the best technical support to assist in implementing the proposed management actions. It is hoped that local, provincial, and national stakeholders will do likewise, as since the completion of the scoping study, there

has been an elevated interest from government agencies (e.g. the new draft version of Chinese Fishery Law highlighting seagrass protection for the first time) and civil societies in Bohai-Yellow Sea conservation. The Ministry of Natural Resources is in the process of drafting a “National Protected Area Plan” with Caofeidian to be included into the plan. The scoping study team will maintain active interaction with the scientists involved in Plan, particularly those from the First Institute of Oceanology, and share information on the scientific and societal importance of the Caofeidian seagrass towards future protected area designation and management plan development. This report and the proposed science-based actions represent a solid information source for other stakeholders such as advocacy groups and environment issues media to influence key governmental decision makers.

## References

- Dewsbury, B.M., M. Bhat, and J.W. Fourqurean. 2016. A review of seagrass economic valuations: Gaps and progress in valuation approaches. Article in *Ecosystem Services*, April 2016.
- Liu, H., X. Huang, Y. Wang, Z. Liang, B. Gu, and J. Su. 2016. Newly discovered seagrass bed and its ecological characteristics in the coastal area of Caofeidian, Bohai Sea. *Chinese Journal of Ecology*. 35(7): 1677-1683.
- Sanger, P., D. Gartside, and Funge-Smith, S. 2013. A review of mangrove and seagrass ecosystems and their linkage to fisheries and fisheries management. Report to Food and Agriculture Organization of the United Nations Regional Office for Asia and the Pacific Bangkok, Thailand.
- Xu, M., Y. Zhou, T. Zhang, and Y. Zhang. 2018. The distribution of large floating seagrass (*Zostera marina*) clumps in northern temperate zones of Bohai Bay in the Bohai Sea, China. preprint first posted online Jul. 19, 2018.
- Zheng, X. and C. Yang. New gas find in Bohai Sea to help upgrade energy mix. *China Daily*, 27 February 2019.
- Zhu, W., G. Zhang, K. Zhong. 2016. Oil and gas exploration progress of China National Offshore Oil Corporation during the 12th Five-Year Plan and its prospects for the 13th Five-Year Plan. *China Petroleum Exploration*, Volume 21, Issue 4, July 2016.
- 唐山市曹妃甸区国土资源局, 国家海洋局北海环境监测中心. 2018 年 12 月。曹妃甸区围填海项目, 生态保护修复方案. Tangshan City, Caofeidian District Land and Resources Bureau, State Oceanic Administration, North Sea Branch Environmental Monitoring Center, December 2018. Caofeidian District Reclamation Project, Ecological Protection and Restoration Program.

## **Annex 1 – Guide Questions Posed to Stakeholders**

- i. What are the dominant ecosystems, habitat types in the area, besides seagrass? What are the main marine organisms?
- ii. What ecosystem historically dominated the landscape?
- iii. Are coastal ecosystems being degraded? Is there evidence of ecosystem degradation and habitat fragmentation? What are the drivers of degradation? What is the level of the impact? (low, medium, high)
- iv. Is there evidence of coastal erosion, sedimentation, coastal pollution (solid waste, sewerage, industrial waste, other)?
- v. Are the critical coastal habitats/natural resources nearby protected under Protected Areas management (formal or informal)? Where are the Protected Areas? Are the dominant ecosystems protected by national legislation?

### Government agencies

- i. What are the main coastal and marine goods and services? e.g. fisheries products, tourism, aquaculture, mining, ports, services; fishing, tourism/ recreation.
- ii. Population/demographics – Is the local population or a subsection of the local population directly dependent on natural resources for livelihood?
- iii. What are the current/major conflicts in resource use? What do you predict will be key future conflicts in resource use given current trends?
- iv. What are the primary markets of goods and services in which each product is primarily sold? (local, regional, international)
- v. What are the main fishing gear/fishing methods used in the area?
- vi. What traditional knowledge and practices that relate to ecosystems management and sustainable resource use exist?
- vii. Are natural resources being overexploited? e.g. over fishing/harvesting, destructive fishing, overexploitation of land and water resources. What is the level of the exploitation? (low, medium, high)
- viii. What are the major industries in the area? Do they have direct or indirect impact on local coastal ecosystems?
- ix. What changes have occurred over the past 2 to 3 decades that define the current socio-economic situation today e.g. infrastructure, technological changes, economic and societal change, population (immigration/emigration)?
- x. What past projects have had an influence in the area and what influence have they had? e.g. infrastructure/reclamation projects, habitat restoration projects, coastal management projects.
- xi. Are there existing management plans, sustainable development plans, economic development plans for the area? And what are the short- and long-term priorities (for both social/economic development and environmental protection) in this area?
- xii. Is enforcement of existing laws and regulations effective?
- xiii. What community-based management, co-management, exist or have existed in the past? (formal or informal)
- xiv. Is there any local/national plan for Caofeidian seagrass protection?

### NGOs

- i. What are the activities/natural resource uses in the area?
- ii. What are the current/major conflicts in resource use? What do you predict will be key future conflicts in resource use given current trends?
- iii. What are the main fishing gears/fishing methods used in the area?
- iv. Population/demographics – Is the local population or a subsection of the local population directly dependent on natural resources for livelihood?
- v. What are the major industries in the area? Do they have direct or indirect impact on local coastal ecosystems?

- vi. What past projects have had an influence in the area and what influence have they had? e.g. infrastructure projects, habitat restoration projects, coastal management projects.
- vii. What activities NGOs have already taken on environmental conservation in particular for seagrass protection (e.g. public education and advocacy? Reporting illegal activities? Preparing policy suggestions to government? Etc.) and what kind of activity they are interested in the future protection of Caofeidian seagrass?

#### Scientists and Academia

- i. What are the main coastal and marine goods and services? e.g. fisheries products, tourism, aquaculture, mining, ports, services; fishing, tourism/ recreation. Give location, timing, season, high-medium-low value of each good.
- ii. Population/demographics – Is the local population or a subsection of the local population directly dependent on natural resources for livelihood?
- iii. What are the current/major conflicts in resource use? What do you predict will be key future conflicts in resource use given current trends?
- iv. What are the primary markets of goods and services in which each product is primarily sold? (local, regional, international)
- v. What are the major industries in the area? Do they have direct or indirect impact on local coastal ecosystems?
- vi. What changes have occurred over the past 2 to 3 decades that define the current socio-economic situation today e.g. infrastructure, technological changes, economic and societal change, population (immigration/emigration)?
- vii. What are the trends of ecological degradation/improvement? What are the changes or threats to marine ecosystems?
- viii. What past projects have had an influence in the area and what influence have they had? e.g. infrastructure projects, habitat restoration projects, coastal management projects.

#### Fisherfolk

- i. What are the activities/natural resource uses in the area, besides fishing? What is the seasonality of each activity?
- ii. What are the current/major conflicts in resource use? What do you predict will be key future conflicts in resource use given current trends?
- iii. What are the primary markets of goods and services in which each product is primarily sold? (local, regional, international)
- iv. What are the main fishing gears/fishing methods used in the area?
- v. What is the household use of coastal and marine goods and services? Which goods and services are sold locally or externally and which are used/consumed at the household level?
- vi. What traditional knowledge and practices that relate to ecosystems management and sustainable resource use exist?
- vii. Are natural resources being overexploited? e.g. over fishing/harvesting, destructive fishing, overexploitation of forest resources, water resources. What is the level of the exploitation? (low, medium, high)
- viii. What is their opinion on the closed fishing season?
- ix. What are the major industries in the area? Do they have direct or indirect impact on local coastal ecosystems and livelihood?
- x. What changes have occurred over the past 2 to 3 decades that define the current socio-economic situation today e.g. infrastructure, technological changes, economic and societal change, population (immigration/emigration)?
- xi. What past projects have had an influence in the area and what influence have they had? e.g. infrastructure projects, habitat restoration projects, coastal management projects.
- xii. Is enforcement of existing laws and regulations effective?



- xiii. What community-based management, co-management, exist or have existed in the past? (formal or informal)
- xiv. What informal property rights, land tenure, stewardship arrangements, customs and traditional practices exist for managing coastal resources?
- xv. Is fishery the main source of their income? Are there any alternative livelihood options?
- xvi. What are their attitudes towards the protection of seagrass in Caofeidian?

Private Sector (Caofeidian Development Group, aquaculture farmers)

- i. What are the value of the goods and services? (high, medium, low)
- ii. What are the primary markets of goods and services in which each product is primarily sold? (local, regional, international)
- iii. What are the major industries in the area? Do they have direct or indirect impact on local coastal ecosystems?
- iv. What changes have occurred over the past 2 to 3 decades that define the current socio-economic situation today e.g. infrastructure, technological changes, economic and societal change, population (immigration/emigration)?
- v. What past projects have had an influence in the area and what influence have they had? e.g. infrastructure projects, habitat restoration projects, coastal management projects.
- vi. Is enforcement of existing laws and regulations effective?
- vii. What are the risks for their business?
- viii. What are their attitudes towards the protection of seagrass in Caofeidian?