Reducing Use Conflicts through Marine Functional Zoning

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Key Message

- Marine functional zoning (MFZ) as developed and implemented in the Xiamen Sea areas has proven to be an effective management tool in minimizing multiple use conflicts in coastal waters.
- Appropriate legislative measures were imperative to ensure compliance, although stakeholders' support and participation were also necessary.
- The sea use permit system also helped to generate substantial financial resources for strengthening and sustaining management measures.

Abstract

Sea use conflicts have become a significant management challenge for sustainable utilization of resources in coastal waters worldwide. In order to reduce multiple use conflicts in coastal waters and harmonize human use and nature conservation, a MFZ scheme was developed and implemented in Xiamen as a pilot marine spatial planning practice in China. The positive outcomes of the implementation of MFZ showed that the environmental quality of Xiamen's sea areas remained stable and the endangered marine species were protected despite rapid growth of coastal population and marine economic development. This case study outlines the process of developing and implementing MFZ in Xiamen coastal waters, the outcomes, and the lessons learned.

Background

Xiamen is a coastal city located at the southeast coast of Fujian Province, PR China, facing the Taiwan Strait. The city is also sited at the mouth of the Jiulong River. Xiamen has a land and sea area of 1,699 km^2 and 390 km^2, respectively, and 234 km of coastline.

As one of the four designated Special Economic Zones of PR China, Xiamen has experienced rapid economic development with an average GDP growth of 17.8% per year since 1980. However, the population increased dramatically, reaching 4 million by 2013. As a harbor city and also a popular coastal tourism destination, Xiamen relied heavily on its coastal and marine resources for its economic development. In 2013, the revenues from the marine sector reached RMB 36 billion (US$ 6 billion) accounting for 13% of its total GDP. Nevertheless, the

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environmental quality was maintained in a stable condition despite increasing population and scale of economic development.

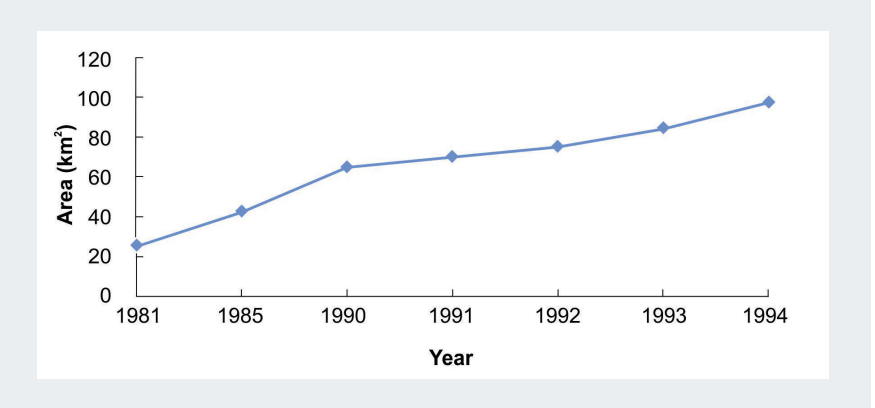
The ability of Xiamen to maintain a balanced development in terms of environmental protection and the economy did not happen naturally. It was the outcome of Xiamen's long-term efforts to resolve conflicts associated with population increase, environmental protection, and economic sustainability since the last quarter of 1990.

When Xiamen became one of the four Special Economic Zones in 1984, the special status brought about a variety of economic activities that involved different levels of coastal and marine resource exploitation and utilization. Although the local economy ballooned in the short term, it also brought a wide-range of environmental and social challenges. There were severe impacts of coastal water pollution and rapid increase of uncontrolled fish farming practices (such as raft and cage culture) in the western and eastern sea areas. The wastes from aquaculture farms and discharges of untreated industrial and domestic wastes heavily contaminated the coastal waters around Xiamen, damaged ecosystems, and caused the decline of marine biodiversity (PEMSEA, 2006). For example, the total amount of chemical oxygen demand (COD) in the Western Sea in 1998 was reported at 11,664 tons, causing eutrophication and algal blooms, which in turn resulted in the loss of 1,000 tons of cultured fish in cages in the Maluan Bay area (Xu, et al., 1998; Zhang, 2001). Due to deteriorating environmental quality, the annual fish catch per unit effort using gill net, fixed net, and trawl in 1995 also dropped by 64.79% compared to that in 1984 (Lu, et al., 1998). The hundreds of unregulated aquaculture farms consequently blocked navigational channels, seriously affected navigation and vessel traffic as well as hampered needed port development activities (Figure 1).

Institutional and sectoral conflicts were another set of management challenges. There were up to 15 ocean-related agencies and departments in the 1990s with jurisdiction over Xiamen's sea areas under the city and national governments. However, there was a general lack of institutional/sectoral cooperation and coordination. Many agencies and departments had overlapping functions, resulting in waste of resources and increase of management costs (PEMSEA, 2006).

The realization to mitigate the aforementioned problems brought about the need and urgency to harmonize multiple uses in the coastal waters of Xiamen through adequate, long-term sea use planning and integrated management to ensure orderly and sustainable economic development for the rapidly developing city.

Figure 1. Aquaculture areas in Xiamen Sea area (Xu, et al., 1998).



Approach and Methodology

In 1994, Xiamen City government began to implement an Integrated Coastal Management (ICM) Demonstration Project under the GEF/UNDP/IMO-funded Regional Project for the Prevention and Management of Marine Pollution in the East Asian Seas. The purpose was to demonstrate the effectiveness of the concept and practice of the ICM program in protecting the marine environment in the Xiamen sea areas towards achieving the goals of sustainable development (Zhou and Lu, 2006).

In 1997, a sea use zoning scheme, commonly known as marine functional zoning (MFZ) in China, was developed. The MFZ refers to classifying the sea areas and islands into different functional zones with different use types and environment quality requirements, based on marine resources status, current economic development status, and environmental and ecological characteristics, while considering sustainable economic and social development (Fang, et al., 2011). The MFZ remained a concept for several years but was first tested in Xiamen. Its operational procedures were verified and improved.

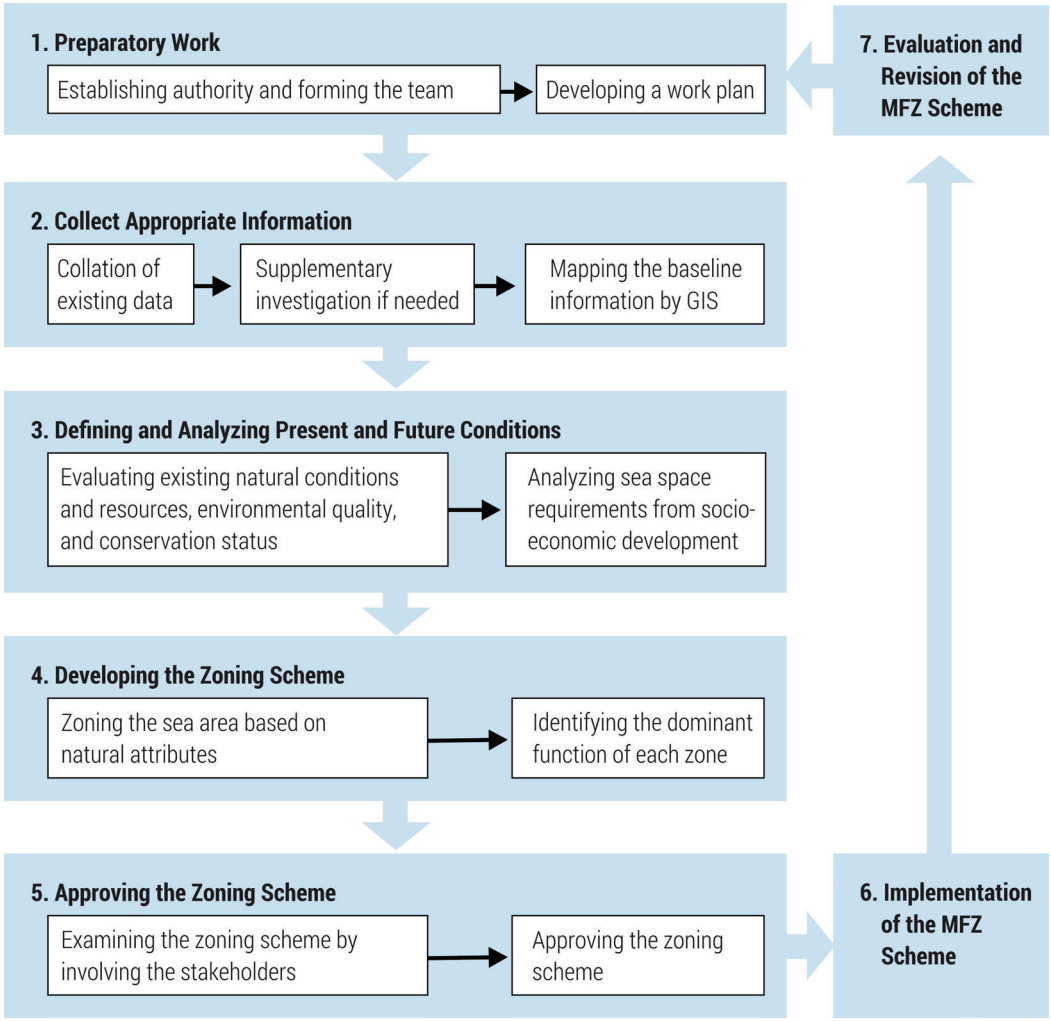
The objectives of MFZ are to effectively address multiple use conflicts as well as those arising from sea uses and marine environmental protection to achieve maximum net social and economic benefits and long-term stability of the marine environment and biodiversity conservation (PEMSEA, 2006). Specifically, MFZ aimed to address conflicts of different functions and transboundary effects of sea uses, coordinate exclusive demands on sea areas, and existing and future uses (Lu, et al., 2015). In other words, MFZ is designed to ensure orderly, rational, and efficient uses of the coastal/sea resources.

The operational process of MFZ in Xiamen included both technical and management aspects. The technical aspects included classifying various sea uses and dividing sea areas into zones based on their dominant, compatible, and restricted (limited) functions. The management aspects included consultation with and participation of all stakeholders during the preparation and finalization of the functional zoning schedules before submission for approval to the government.

The Technical Directives for Marine Functional Zoning issued in 2006 proposed an overall working procedure summarized in seven steps as indicated in Figure 2 (Fang, et al., 2011).

In the case study of Xiamen, a lead group under the Xiamen City government was established for organizing and supervising the overall work of developing the MFZ scheme. An advisory body consisting of experts from ocean-related disciplines was also established to provide technical advice (i.e., Marine Experts Group, MEG). A working team, consisting of professional technical staff and representatives from relevant departments, was formed to develop work plans. Then, data were gathered, including oceanographic and other natural environmental features, ocean-related activities, status of marine resources as well as socioeconomic conditions in adjacent land areas. In cases where relevant data were not available, supplementary investigation was conducted. Based on the collected data, the prevailing conditions, including marine hydrological and ecological characteristics, marine resources, environmental quality, and the conservation status, were analyzed and mapped in GIS. Future sea space requirements arising from future marine economic development were also analyzed. The functions of each zone were identified largely based on natural attributes of sea areas and sea use demands. A draft zoning scheme was developed, reviewed, and revised by experts in consultation with other stakeholders, before being submitted to and approved by the city government.

Figure 2. Process for the development of MFZ scheme (Fang et al., 2011).



Results

To date, Xiamen has implemented four ICM program cycles (PEMSEA, 2006, 2009). The first program cycle achieved significant outcomes in terms of wastewater treatment and marine pollution abatement. A sea use functional zoning scheme was developed and implemented during the second ICM program cycle to verify its effectiveness in resolving multiple use conflicts in Xiamen coastal sea areas.

With the support of the Xiamen MEG, which is attached to the Coordinating Mechanism for the implementation of ICM program, the Xiamen City government initiated the implementation of its first MFZ in 1997. The sea use types in Xiamen were classified into ten categories (with 33 subcategories) according to the types and characteristics of sea uses and natural resources. The sea areas around Xiamen were divided into four major geographical zones: the Western Sea area, the Tongan Bay area, the Eastern Sea area, and the Dadeng Sea area. Each of the sea areas was zoned to various uses, which were separately identified as dominant, compatible, controlled, and conservation or restricted functions. Based on the analysis, the dominant function of the Western Sea area was identified for port and transportation development, while that of the Eastern Sea area was for tourism development. The aquaculture farms in these two areas were transferred to Tongan Bay area and Dadeng Sea

area. Figure 3 indicates the results of the zoning scheme in 1997.

The MFZ scheme could be adjusted according to prevailing development needs but without sacrificing environmental integrity. With the adjustment of economic structure to include emerging new marine industries, the Xiamen City government made revisions to its zoning scheme. The latest scheme was revised in 2012. The government issued several regulations such as the Regulation on the Sea Area Use and Management to ensure compliance with and implementation of the formulated zoning scheme.

With the implementation of the MFZ, the most significant outcome was the reduction of sea use conflicts, thereby ensuring orderly use of the sea areas. For example, the number of deepwater berths increased from 11 in 1995 to 248 by 2013, and the total cargo handling capacity of the port reached 191 million tons against 13.13 million tons in 1995 (Du, 1996). Besides these, the functional zoning scheme also accommodated the development of emerging uses such as the sailing industry, with a potential GDP contribution estimated at RMB 6.5 billion (US$ 1 billion).

In terms of marine environmental quality, monitoring results show that COD concentration remained stable while GDP increased sharply (Figure 4). As regard to protecting endangered species, an obvious improvement was the increased visibility of the Chinese white dolphins after a national marine protected area in the Western Sea area was set up in 1999. Field monitoring data indicated that the population of these dolphins

Figure 3. Xiamen MFZ scheme in 1997.

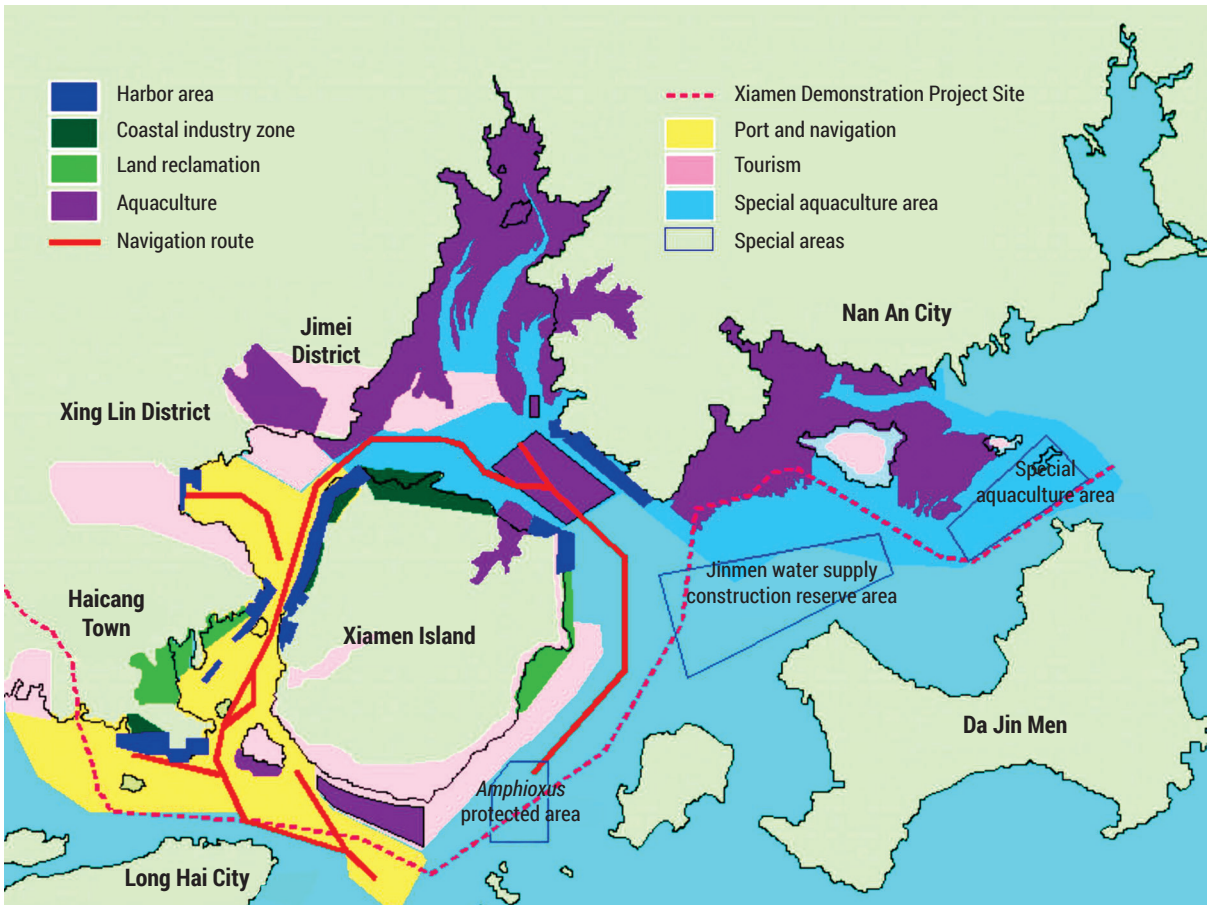
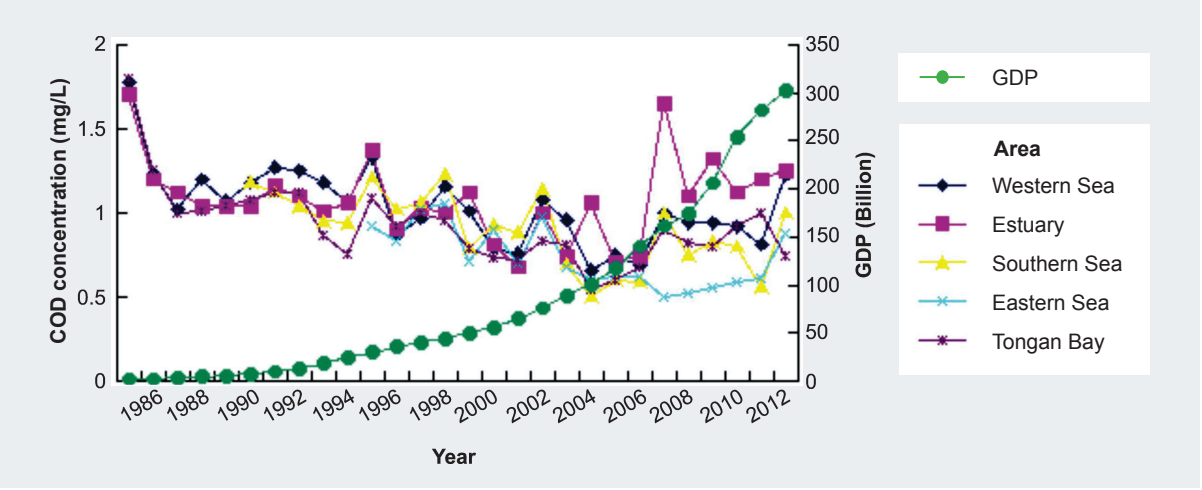


Figure 4. **The trend of COD concentration in Xiamen Sea area and of GDP of Xiamen** (Zhang, et al., 2013).



remained steady in recent years (Figure 5). The young population increased from 9.75% in 2003 to 26.2% in 2010 (XOFB, 2010; Huang, 2012).

Lessons Learned

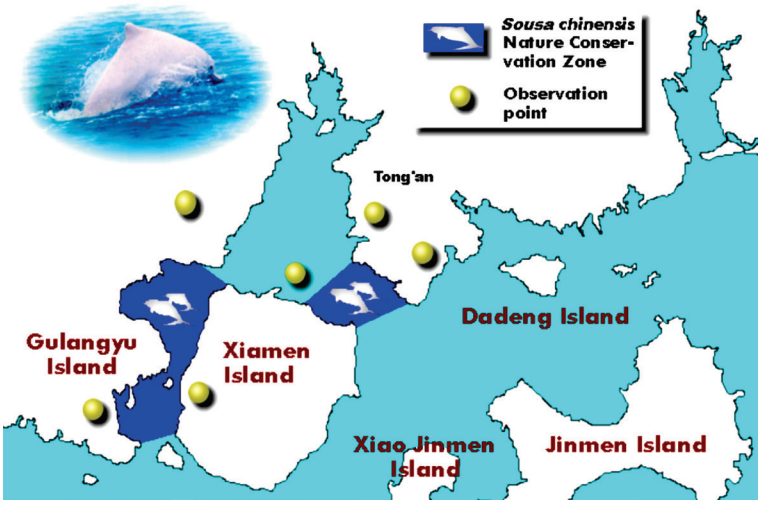
1. ***The MFZ is an important governance tool.*** The MFZ in Xiamen was a successful showcase in moving ICM conceptual framework into a concrete practice. Sea use management including MFZ was the major element of Xiamen ICM governance framework because the process of implementing MFZ was fully embodied in the key components of ICM system. To ensure effectiveness, the Xiamen City government enacted legal instruments to support compliance and enforcement of the approved zoning scheme. Such instruments formed the basis for the successful implementation of the integrated law enforcement operations by concerned agencies and departments in Xiamen. Key governance and management elements of ICM were also reflected through the development and implementation of the MFZ including interagency coordination, policy integration, public awareness, stakeholders' participation, and application of science.

2. ***The MFZ lays the foundation for the development of a blue economy.*** The development of a blue economy requires a thoughtful balance between a thriving economy and the dynamics of the marine ecosystem with due consideration to present and future needs. In actual fact, MFZ was a form of a marine spatial planning (Douvere, 2008) which enabled effective and sustainable use of marine space and resource therein. This scheme maximizes ecological potential as well as designated areas that ensured protection and conservation of endangered species.

3. ***The MFZ is effective in conservation and enhancement of environmental quality.*** Since implementing MFZ, the marine environmental quality of the sea areas remained stable and endangered wild species, such as Chinese white dolphins and egrets, were protected (Jiang and Fang, 2015), without hampering the designated sea space for economic development.

4. ***Implementation of MFZ can generate financial resources for supporting management measures.*** Xiamen was able to issue sea use permits to various marine users operating within Xiamen sea areas. In 2011, the total sea area covered was 2.23 million m^2 and sea use fees collected amounted to RMB 27

Figure 5. **Chinese white dolphins (*Sousa chinensis*) nature conservation zone.**



million (US$ 4.2 million) (XOFB, 2011). The huge amount of revenue constituted the main financial resources of the city for undertaking marine management measures.

5. ***Involving stakeholders in the revision of subsequent zoning schemes.*** Recognizing the significance of stakeholders' participation, the Xiamen City government involved those from sea use sectors and marine industries, as well as local scientists and conservationists in the revision of subsequent MFZ schemes.

6. ***Xiamen provides a good example of local practice for scaling up MFZ.*** The MFZ implementation in Xiamen demonstrated its effectiveness in regulating the use of sea areas, protecting the marine environment, and promoting the rational and sustainable use of marine resources. The experience in Xiamen has contributed to the upscaling of MFZ throughout the coastline of PR China. The national Law on the Management of Sea Uses in 2001 mandated that all uses of sea areas in the country should comply with approved MFZ schemes. Thus, MFZ became the basis for marine development planning, marine resource management, and establishment of marine nature reserves (Ge, 2001; Lu and Ai, 2001; Guan and Wang, 2002). Consequently, MFZ in PR China covered four scales of operation at national, provincial/municipal, city, and county levels. Xiamen was a pioneer local government in implementing MFZ at the city level. Its success in MFZ provided a good working methodology and experience for other coastal cities/municipalities in formulating functional zoning schemes.

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