An Optimal Allocation Model of Sea Area Utilization Based on Factor Endowment

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Abstract. Factor endowment characteristics are important factors to be considered in Marine zoning and Marine spatial planning. How to allocate marine space resources is an important issue in Marine zoning and Marine spatial planning. In this paper, an optimal allocation model of sea area utilization is constructed based on factor endowment. According to the difference of factor endowment of different sea areas and the difference of factor structure of intensive use of different sea areas, the model realizes the division of sea area utilization among different sea areas which giving full play to the advantages of factor endowments of sea areas in various regions and improving the utilization efficiency of sea areas. It can provide theoretical reference for Marine zoning and Marine spatial planning.

Keywords: Marine spatial planning; Marine zoning; Factor Endowments Theory.

1. Introduction

Factor endowment is an important factor to be considered in Marine zoning and planning. It has been integrated into Marine zoning and planning in the form of expert experience for a long time.1-4 The existing research focuses on the zoning system, zoning method and management measures.5-9 There are no reports on the theoretical study of factor endowment in Marine zoning and planning.

Swedish economists Heckscher and Ohlin put forward the theory of factor endowment.10 Their theory explains that two countries with difference in factor endowment can produce relatively abundant factor intensive products through international division of labor, which can bring higher output. Through trade exchange, the cost of each relative scarce factor intensive product is lower than that of its own production. The theory of factor endowment improves the total output and achieves a win-win situation. Meanwhile, it also realizes the optimal allocation of resources.

In this paper, an optimal allocation model of sea area utilization is constructed based on factor endowment. According to the difference of factor endowment of different sea areas and the difference of factor structure of intensive use of different sea areas, the model realizes the division of sea area utilization among different sea areas which giving full play to the advantages of factor endowments of sea areas in various regions and improving the utilization efficiency of sea areas.

2. Model Hypothesis

The optimal allocation model of sea area utilization based on factor endowment is a 2×2×2 model. The first 2 represents the sea area A and B in the two regions. The second 2 represents the two types of sea area utilization F and M. The last 2 represents two the sea area factors H and L.

There are differences in the factor use structure of the two types of sea area utilization. PH represents the price of factor H per unit area. PL represents the price of factor L per unit area. HF/LF represents the structure of factors used by sea area utilization type F. HM/LM represents the structure of factors used...
by sea area utilization type M. Figure 1 shows the relationship between the relative demand of factors by sea area utilization types and the relative price of factors. It is similar to the demand curve that relative demand increases with a decrease in relative price and decreases with a rise in price. The relative demand curve of sea area utilization type F is on the right side of M that means a higher proportion of factor H is used in F at the same relative price level. And that is what so called F is factor intensive for H and M is factor intensive for L.

Figure 1. The relationship between the relative demand of factors by sea area utilization types and the relative price of factors.

There are also differences in factor endowments in sea areas between the two regions. It is assumed that the two areas have the same sea area. In sea area A, H factors are relatively abundant, while in sea area B, L factors are relatively abundant.

3. Allocation of Sea Space Resources without Regional Division of Work

The factors of sea area are limited, which restricts the process of sea area utilization. An increase in factors invested in one type of sea area utilization means a decrease in factors invested in another type of utilization. The production possibility boundary of sea area utilization shows the possibility of maximum output after all factors of sea area are put into two kinds of sea area utilization. \( Q_F \) represents the output of sea area utilization type F. \( Q_M \) represents the output of sea area utilization type M.

The indifference curve as CIC_A1 and CIC_B1 represents the demand characteristics for the two types of sea area utilization in each region. Any point on the indifference curve represents a combination of the two utilization types. Undifferentiated is defined as any combination of relationships located on the same indifference curve that yield the same benefit. The level of indifference curve reflects the level of benefit from sea area utilization. The benefit can be economic benefit, which also can be the comprehensive benefit which included ecological benefit and social benefit.

The position as E_A and E_B where the indifference curve is tangent to the production possibility boundary of sea area utilization is the most beneficial position of regional sea area utilization. This position determines the output of the two types of sea area utilization when the sea area utilization benefit is the greatest.

\( P_F/P_M \) represents the relative price of two types of sea area utilization. The relative price line is tangent to the indifference curve and represents the marginal rate of substitution for the two benefits from the point of view of demand. Reducing the utilization of M would lose the benefit \( P_M \) generated by M while increasing the utilization of F, and replace it with the benefit from F with \( P_F \). From the perspective of production, the intersection point between the relative price line and the sea area using the production possibility boundary indicates that invests factors into the utilization of F and increases
the output of F, under the restriction of production possibility of sea area utilization, the benefit P_M has to be lost with reducing the utilization of M. The opportunity cost of M is P_F/P_M.

Figure 2. General equilibrium analysis without regional division of work.

4. Allocation of Sea Space Resources with Regional Division of Work

The relative price of the utilization of the two sea areas is different because of the difference of the production possibility boundary. Under the influence of the difference of factor endowment in different sea areas, the output of different sea area utilization types is different. Sea area A is the H-abundant type, and the production capacity of H-intensive utilization type F is relatively stronger. Sea area B is L abundant type, and L intensive utilization type M has relatively stronger production capacity. P_F/P_M^A is higher than P_F/P_M^B.

Regional division of work reallocates the factors of sea area. More H factor is put into F in sea area A and more L factor is put into M in sea area B. The product of F increases in region A, and the product of M increases in region B. Region A use F to exchange M from region B. The exchange price P_F/P_M^X can be between P_F/P_M^A and P_F/P_M^B.

The position where the two regional indifference curves CIC_A2 and CIC_B2 are tangent to the new relative price line P_F/P_M^X shows the benefit level of sea area utilization after regional division of work. Under the same constraint of sea area utilization production possibility, the benefit level of two areas is higher than before. Each sea area has the advantage of abundant factor intensive utilization. For the benefits generated by non-abundant factor intensive utilization, the opportunity cost obtained through exchange is lower than that of self-production. When the two regions are viewed as a whole, the benefits of both sea areas are increased after the division of work. Regional division of work separates production point from consumption point. Production point as S_A and S_B is shifting to more advantageous sea utilization. The consumption point as C_A and C_B is no longer constrained by the production possibility.
Figure 3. General equilibrium analysis with regional division of work.

5. Conclusion
Based on the theory of factor endowment, an optimal allocation model of sea area utilization of factor endowment is put forward. The factor-intensive sea utilization is defined by relative demand curve. The abundant type of sea area is defined by factor structure. The results of sea area utilization and its benefits are analyzed by using the production possibility boundary and the indifference curve. By comparing the difference of benefit level before and after division of work, it explains that each sea area has the advantage of abundant factor intensive utilization. For the benefits generated by non-abundant factor intensive utilization, the opportunity cost obtained through exchange is lower than that of self-production. When the two regions are viewed as a whole, the benefits of both sea areas are increased after the division of work.

Real problems are more complex than the model's assumptions. In reality, there are multiple regions, multiple elements and multiple utilization types. In practical application, the model needs to focus on contradictory areas. According to the contradiction abstract to the high and low level of the two factors, multiple utilization types can be compared in pairs to determine the more efficient utilization type. More technical problems still need to be discussed in the follow-up empirical research.

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