Game-theoretic approaches to the joint management of chub mackerel in Northeast Asia seas

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Abstract
One of the major management issues to have arisen as a result of exclusive economic zones (EEZs) is the management of transboundary or shared fishery resources. Given the mobility of most fishery resources, it is inevitable that coastal states, upon establishing 200-mile EEZs, would find that they are sharing some fishery resources with other states. Multilateral exploitation of fishery resources requires the resolution of conflicts in resource use. The 1982 United Nations Convention on the Law of the Sea and 1995 Stock Agreement stipulate that fishing states should cooperate each other, through the Regional Fisheries Management Organization (RFMO), in the management of such fishery resources. In essence, a legal obligation HAS BEEN established for fishing states to cooperate within the RFMO.

Cooperative game theory is a useful approach to study the prospects and likelihood of cooperation among players. Empirically, the theory has been applied to some real fishery cases. Analysis in cooperative game theory is centered around two issues: coalition formation and distribution of gains from cooperation.

Multilateral exploitation of chub mackerel in Northeast Asia seas (i.e., East China Sea, Japan Sea and Yellow Sea) presents a case of potential cooperative management. The main fishing states, China, Japan and Korea, have been utilizing chub mackerel for many years but never have adopted joint management. As a result, the stock is declining.

In this study, our goals are to examine the prospects of cooperative management of chub mackerel under three scenarios and analyze their biological and economic consequences. Each scenario specifies a management objective and a harvest strategy that is to reach that objective. An age-structured bioeconomic model was developed to simulate the outcomes of all possible coalitions for each scenario. The outcomes will show the time paths of stock size and harvest levels as well as the NPV (net present value) of harvest of each country. The sharing rules used to calculate the allocation of gains from cooperation to each player, are the Nucleolus, Shapely value and Nash bargaining solution. The sharing solutions, WHICH WILL BE EXPLAINED IN THE SEMINAR, are useful to serve focal points for negotiation and help us examine the prospects and stability of cooperative agreement.

In this presentation, I would discuss only one scenario (scenario 1: a 35 % effort reduction to reach maximum sustainable harvest). The results show that significant gains can be attained form cooperation. The different sharing rules for the distribution of gains provide different returns to each player. The Shapely value solution stands to be an attractive option to the players. With that solution, the side payment structure is rather stable. This case study points out some particular situations where cooperative management between all players may be possible. However, under these situations, there still exist small economic incentives for some players to free ride the agreement. Thus, it is necessary to establish a legal restriction to ensure compliance. The above analysis is based on a deterministic bioeconomic model. The implications of uncertainty of stock estimates will be further explored.

OUTLINE
I. Management of transboundary fishery resources
II. Motivating questions
III. The fishery
IV. The bioeconomic model

V. The setting of the game
VI. The results
VII. Future study