Fishery income fluctuation by selecting fishing ground in the Japanese coastal squid jigging fishery

Osamu Tamaru*[1], Kazushi Miyashita[2], Yasuzumi Fujimori[3], Toshihiro Watanabe[1] and Teisuke Miura[4]

[1]National Research Institute of Fisheries Engineering, Fisheries Research Agency [2]Field Science Center for Northern Biosphere, Hokkaido University [3]Faculty of Fisheries Science, Hokkaido University [4]Hokkaido Industrial Technology Center

Fisheries Research Agency

1. Introduction

Many fishermen have been in financial trouble, because of rising fuel price (Fig.1) and falling fish prices(Fig.3) (Baba 2008)

The rate of fuel cost of squid jigging fishery is higher than the other fisheries

Many fishermen operate their fishery with their own knowledge and intuition

People make a risky choice when they are in bad situation (Kahneman and Lovallo 1993)

Many fishermen may make risky choices

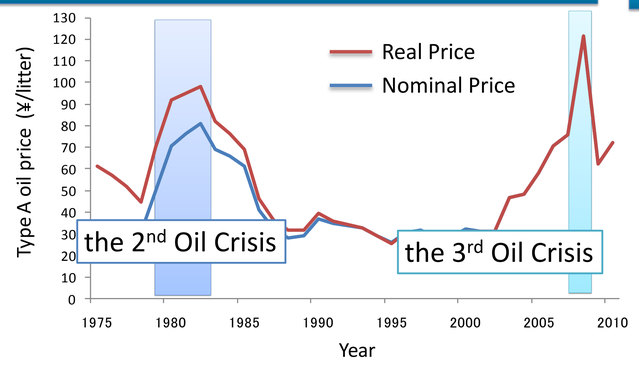


Fig.1 Fluctuation of type A oil in Japan

1. Quantify squid jigging fisheries management
2. Clarify usability of fishermen's past experiences in the 2nd Oil Crisis

by using the fishery income simulation model

2. How do we increase income of fishery households?

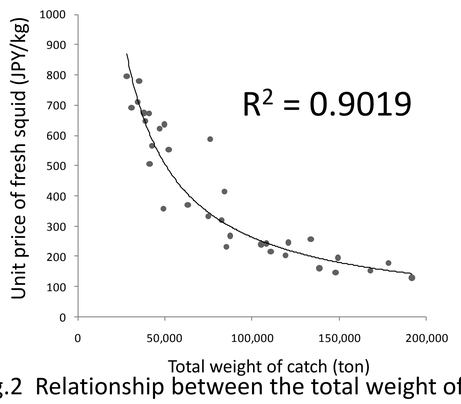


Fig.2 Relationship between the total weight of catch and the unit price of Japanese common squid

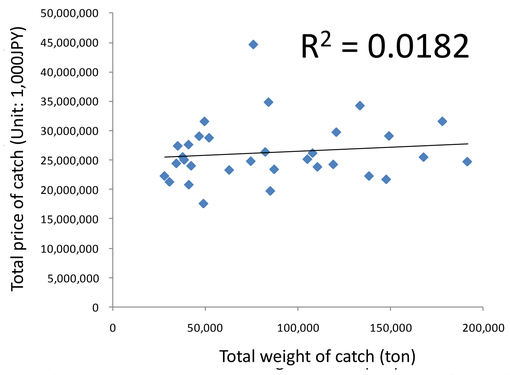


Fig.3 Relationship between the total weight of catch and total trade price of Japanese common squid

The unit price got lower, according as the total catch of squid increased ⇒ Increasing of total weight of catch didn't cause increasing of total price of catch

It may be assumed that effective method for improving managements of squid jigging fisheries households isn't increasing of weight of catch but decreasing of cost.

3. Construct the fishery income simulation model

$E=P-O$ ← $O=M+F+W$

E: Income (JPY)
P: Price of catch (JPY)
O: Cost of operation (JPY)

F: Fuel cost (JPY)
W: Cost of form polystyrene case with ice (JPY)
M: Employment cost (JPY)

$P=C \bullet r$ r: Unit price of squid (JPY/case)

C: Amount of catch (case)

$W=C \bullet y+i \bullet j$ C: Amount of catch (case)

i: Unit price of ice (JPY/kg)
j: Total amount of ice (kg)
y: Unit price of a foam polystyrene case (JPY/case)

$F=f \bullet R$ f: Total fuel consumption (litter)

R: Unit price of type A oil (JPY/litter)

$f=m_m \bullet d+h_o \bullet m_o$ ← $h_o=H-h_m$

m_m: Mileage in moving (litter/km)

d: Moving distance (km)

m_o: Mileage in operating squid jigging (litter/h)

h_o: Continuative tense of squid jigging operation (hour)

H: Total operation time (hour)

h_m: Continuative tense of moving (hour)

$m=0.5177 \bullet s^{2.6236}$ s: ship speed (km/h)

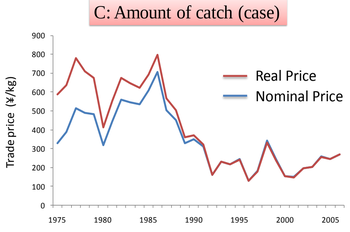


Fig.4 Fluctuation of the unit price of fresh squid

The total operation time was set as 20 hours ⇒ h_m get larger and h_o get smaller, according as the distance from the harbor to the fishing ground increased

Change these factors which were in the red boxes at the fishery income simulation

4. Classified and quantified the social situation

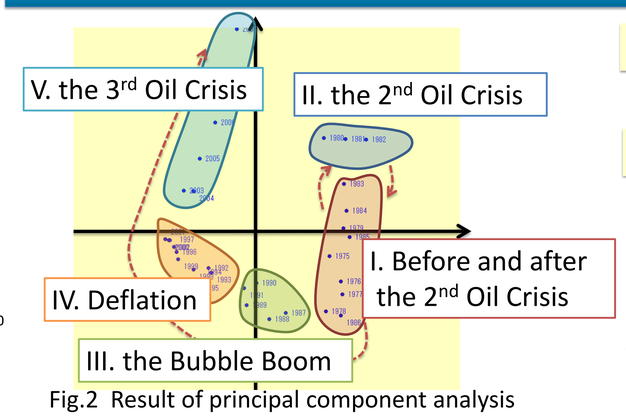


Fig.2 Result of principal component analysis of income determination parameters

Step 1: Hierarchical cluster analysis

⇓ for classifying social situations

Step 2: Principal component analysis

for quantifying the characteristics of each cluster (Fig.2)

The forward direction of X-axis means increasing of the unit price of fresh squid and decreasing of the employment cost. The forward direction of Y-axis means increasing of the unit price of type A oil.

5. Income fluctuation estimated with the fishery income simulation

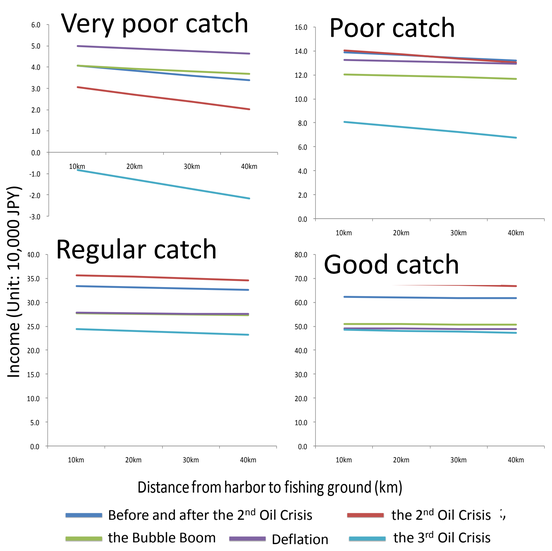


Fig.6 Relationship between the fishery income and the distance from the harbor to the fishing ground

the 3rd Oil Crisis

In all social situations and all catch conditions ⇒ the lowest income

the 2nd Oil Crisis

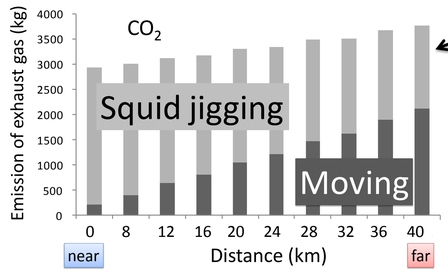
In the poor and very poor catch conditions ⇒ lower income

In the regular and good catch conditions ⇒ higher income

In "the 3rd Oil Crisis", fishermen should not operate their fishery in a similar way which operated in "the 2nd Oil Crisis".

Operating squid jigging near the harbor increased fishery income in each catch condition.

6. Exhaust gasses from squid jigging vessel at fishery operation



The emission of exhausted NO_2 has similar trend

Operating squid jigging near the harbor decreased the emissions of exhausted both CO_2 and NO_2 gasses.(Tamaru et al., submitted)

Fig.7 Relationship between the emission of exhausted CO_2 and distance from the harbor to the fishing ground

7. Conclusion and Future works

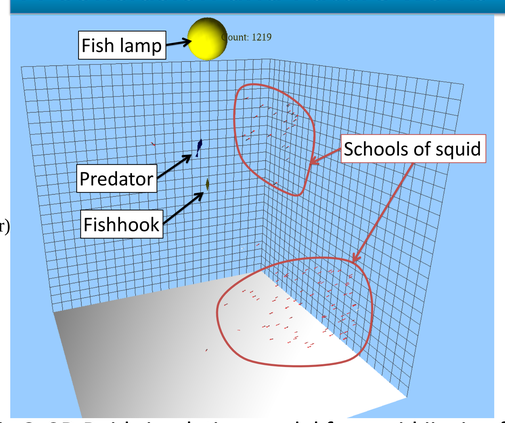


Fig.8 3D Boid simulation model for squid jigging fishery

The fishery operating simulation model make it possible to quantify coastal squid jigging fisheries management

Now, we are constructing the squid schooling model with the Boids algorithm for clarifying the influences of fish lamp when squid school under vessels. The fishery income simulation will be considered the influences of fish lamp by incorporating the squid schooling model.