

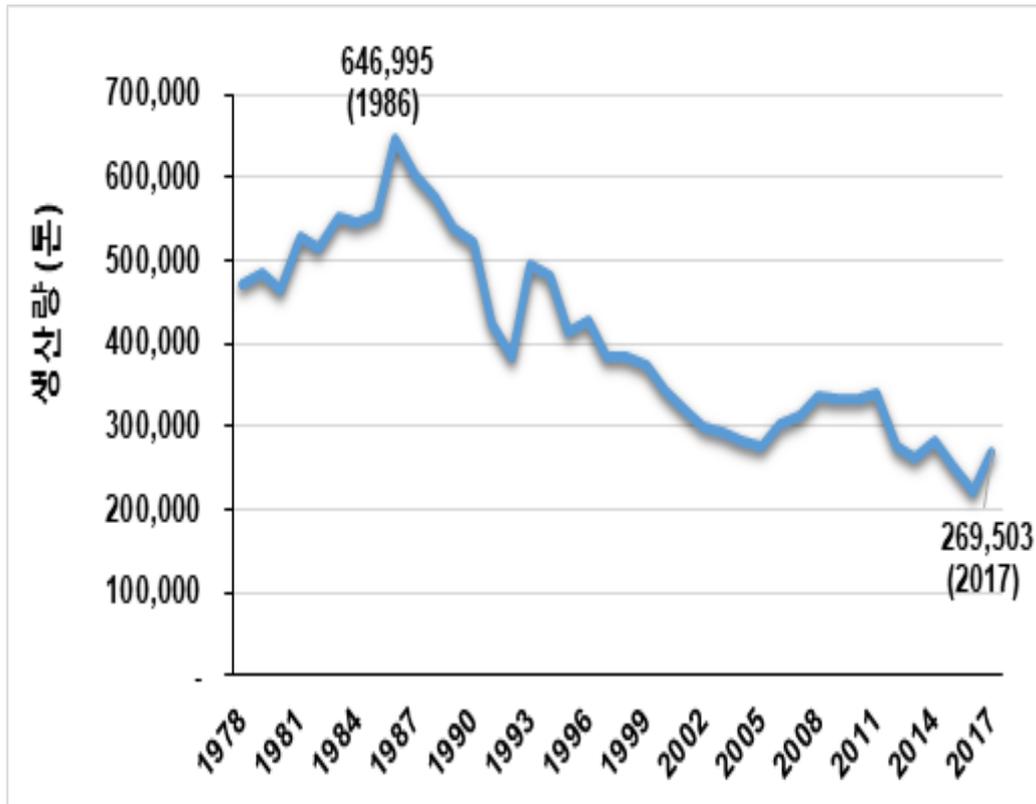
Implementation of the Fishing Vessel Buyback Program in the Yellow Sea of Korea and its Effectiveness analysis

Summary

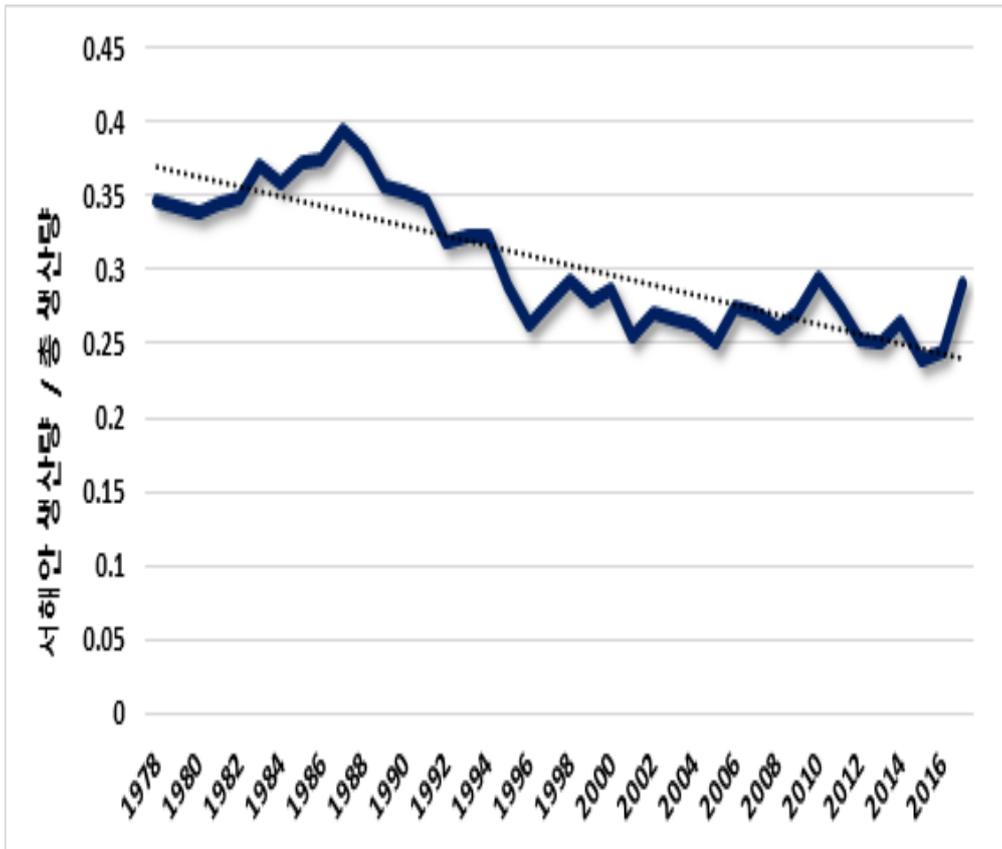
1. Current status of catches and fishing fleets in the Yellow Sea

Catches of the coastal and offshore fisheries in the Yellow Sea of Korea has been on a constant decline over the past 40 years¹. After marking a record high of 646,000 metric tons in 1986, the catch amount has been on a sharp decrease until 2017. The catch in 2017 was equivalent to 58% of that in 1986. It is estimated that the catch was decreased by 2% per year on average between 1986 and 2017.

¹ Catches in the waters of Incheon, Gyeonggi-Do, Chungcheongnam-Do, Jeollabuk-Do and Jeollanam-Do in the Yellow Sea



The proportion of the fishery production in the west coast to the country's total fishery production in the coastal and offshore waters is decreasing. The catch in the Yellow Sea, which had accounted for 40% of the country's total coastal and offshore fishery production in 1986, fell to 23% of the total in 2015. The decreasing proportion of the Yellow Sea catches in the country's total catches which are also on the decline indicates a faster reduction in the catch in the coastal and offshore waters of the Yellow Sea than in the catch in the overall coastal and offshore waters of the country.



Anchovy, squid(flying squid), and blue crabs are the top 3 species in terms of catches in the Yellow Sea of Korea from year 2000 to 2017. Looking at changes in the production of anchovy, after reaching 84,000 metric tons in 2002, the catch of anchovy continued to fall to 64,000 metric tons in 2007. The species recorded a maximum catch of 86,000 metric tons in 2008, but it has been continuously decreasing since then.

The squid also shows a certain degree of variation in the production. It was caught as much as 2,700 metric tons in 2000 and was found to continuously increase in the catch. However, after reaching an amount of 14,000 metric tons in 2006, the

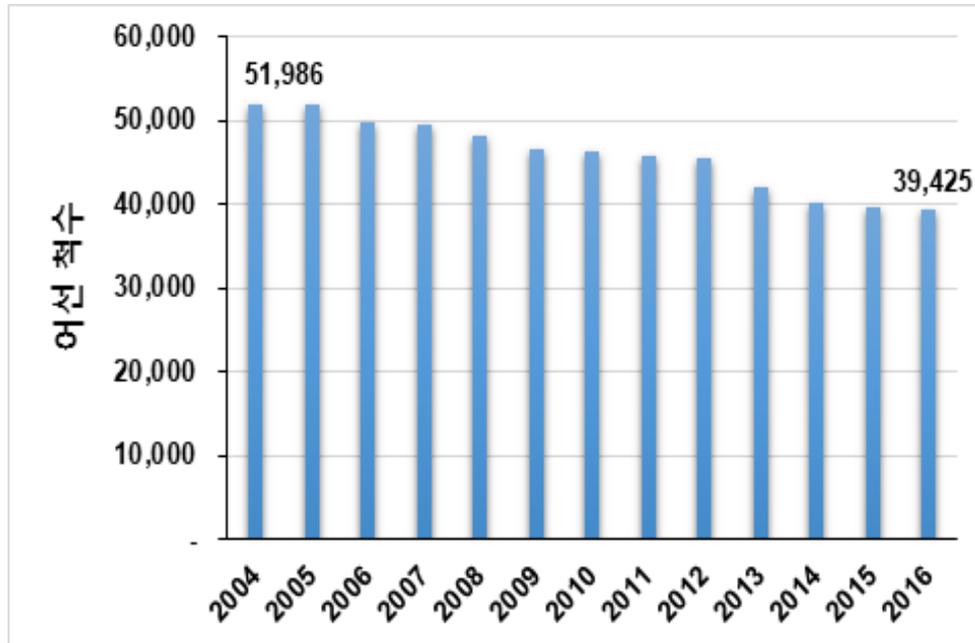
catch plunged to 9,000 tons in 2007 and 2,700 tons after 2 years. The catch of squids recovered to around 13,000 metric tons in 2017.

The blue crab also shows similar significant changes in the production to the two fish species mentioned above. The catch of blue crab, which had recorded 12,000 metric tons in 2000, showed a trend of the increase until 2009. It reached the largest catch of 33,000 metric tons in 2009, recording an approximately 170% increase from the year 2000. Since then, the figure had been maintained at a level of an annual average catch of 24,000 tons until 2015, before it plunged to 11,000 tons in 2016. The catch again rose to 12,000 tons in 2017. It was found that the catch of blue crab was highly variant.

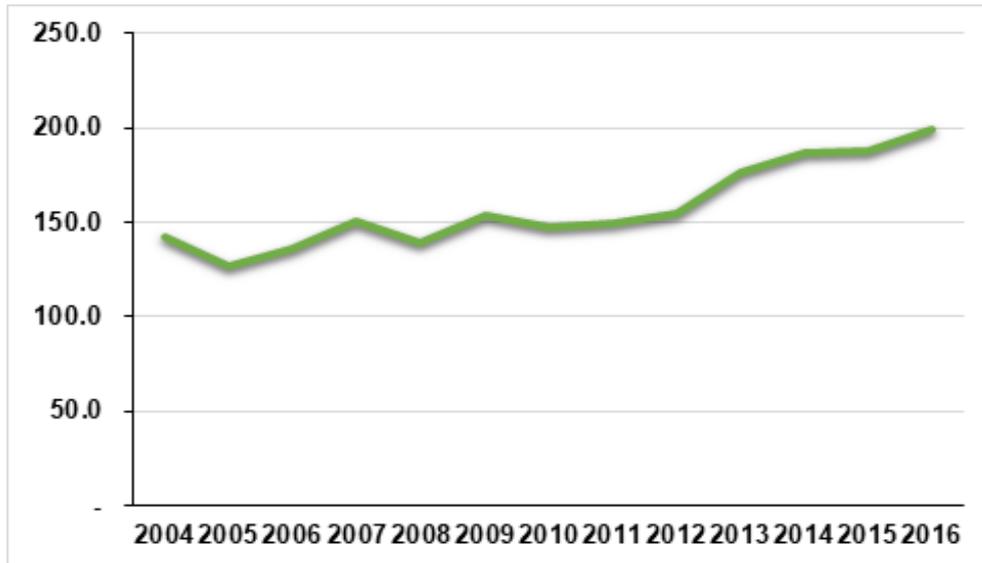
During the eighteen-year observation period from 2000 to 2017, among 28 species in the coastal and offshore waters in the Yellow Sea, some species such as blackmouth angler, spanish mackerel and the like showed increases in their catch. However, most of the fish species showed gradual or sharp falls in their catch production. Considering the catch trends of all the fish species, it can be estimated that the catch amount in the coastal and offshore waters in the Yellow Sea tends to continuously decrease, indicating a steady reduction in fisheries resources in the Yellow Sea.

The number of fishing vessels operating in the coastal and offshore waters in the Yellow Sea of Korea had reached 51,986 in 2004, but decreased to 39,425 in 2016. The number of fishing vessels was reduced by about 12,000 during the 12-year period from 2004 to 2016, falling down to about 75% of the 2004 level. It

can be also said that the fishing vessels were reduced by an average of about 966 fishing vessels every year.



In contrast to the decrease in the total number of fishing vessels in the Yellow Sea, horsepower per vessel has significantly increased, indicating a increase in fishing capacity of each vessel. The estimated horsepower per vessel increased from 142.2 in 2004 to 152.2 in 2012. The horsepower per vessel spiked to 198.9 in 2016. This level of horsepower per vessel is about 40% higher than that in 2004.



2. Current status of the fishing vessel buyback program in the Yellow Sea

The Korean government has been conducting a vessel buyback program since 1994 as it aims to restore fishery resources in the Korean waters and to enhance the productivity of the coastal and offshore fisheries. According to “the 2018 Guidelines on fishing vessel buyback programs in the coastal and offshore waters”, the objective of the programs is to achieve a sustainable fishery production by reducing the number of fishing vessels to a level which is proper for the current stocks of fisheries. This ultimately aims to strengthen the competitiveness of the fishery industry and increase fishermen’s income. The budget assigned for vessel buyback programs in the coastal and offshore waters amounted to approximately 1,589.3 billion Korean won(or about 1,589.3 million

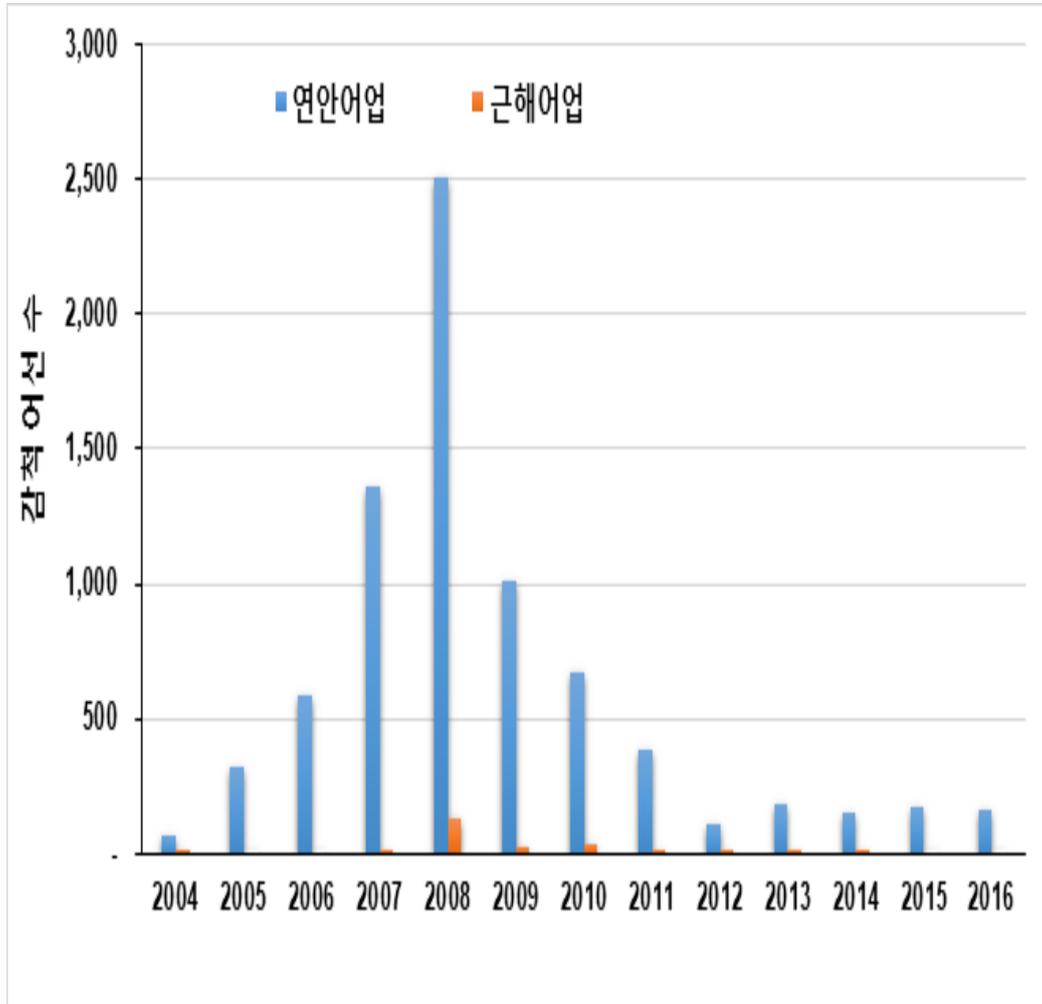
USD) during a period from 1994 to 2013, which resulted in a reduction of 18,560 fishing vessels in the coastal and offshore waters².

Provision	Contents
<p align="center">Article 9 ‘Voluntary application for fishery business subject to buybacks’</p>	<p>To obtain the designation of a fishery business subject to vessel buyback, fishery owners' organizations, etc. in receipt of a notice under Article 8 shall submit a plan for buybacks of fishing vessels and gear, including the following matters, to the Minister of Oceans and Fisheries if the relevant business is the coastal fishery business and to the competent Mayor/Do Governor if the relevant business is the coastal fishery business or fishery business within a demarcated zone.</p>
<p align="center">Article 10 ‘Ex Officio designation of fishery businesses subject to buybacks’</p>	<p>If necessary to establish a sustainable production base for the coastal and offshore fisheries, when no fishery owners' organization, etc. apply for the designation of a fishery business subject to buybacks during the application period for designation specified in Article 8, the Minister of Oceans and Fisheries or a Mayor/Do Governor may designate a fishery business subject to buybacks ex officio.</p>
<p align="center">Article 11 ‘Selection of persons subject to buybacks of fishing Vessels’</p>	<p>The Minister of Oceans and Fisheries or a Mayor/Do Governor shall select a person subject to buybacks of fishing vessels, upon receipt of an application from a fishery owner who runs a fishery business designated as a fishery business subject to buybacks pursuant to Article 9 or 10. In such cases, an owner of a fishing vessel which is unable to be put in operation due to the restriction on the number of vessels in operation under Article 20 of the Fishery Resources Management Act shall be preferentially selected as a person subject to buybacks of fishing vessels, if the owner wishes for a buyback.</p>

Source: Guidelines on fishing vessel buyback programs in the coastal and offshore waters, Ministry of Oceans and Fisheries (2018)

² Shin et al. (2015). “Direct Economic Effects and Optimal Vessel Reduction Scales in Coastal and Offshore Fisheries”. *Journal of Fisheries and Marine Sciences Education*, 27(3), 821-832.

It was confirmed that from 2004 to 2016, a total of 7,882 fishing vessels were reduced in the coastal and offshore waters in the Yellow Sea of Korea



The number of reduced fishing vessels in the coastal and offshore waters of Yellow sea is 7,882, or 46% of the total number of reduced fishing vessels in the Korean coastal and offshore waters.

	Whole country [A]	Yellow Sea [B]	Proportion [B/A]

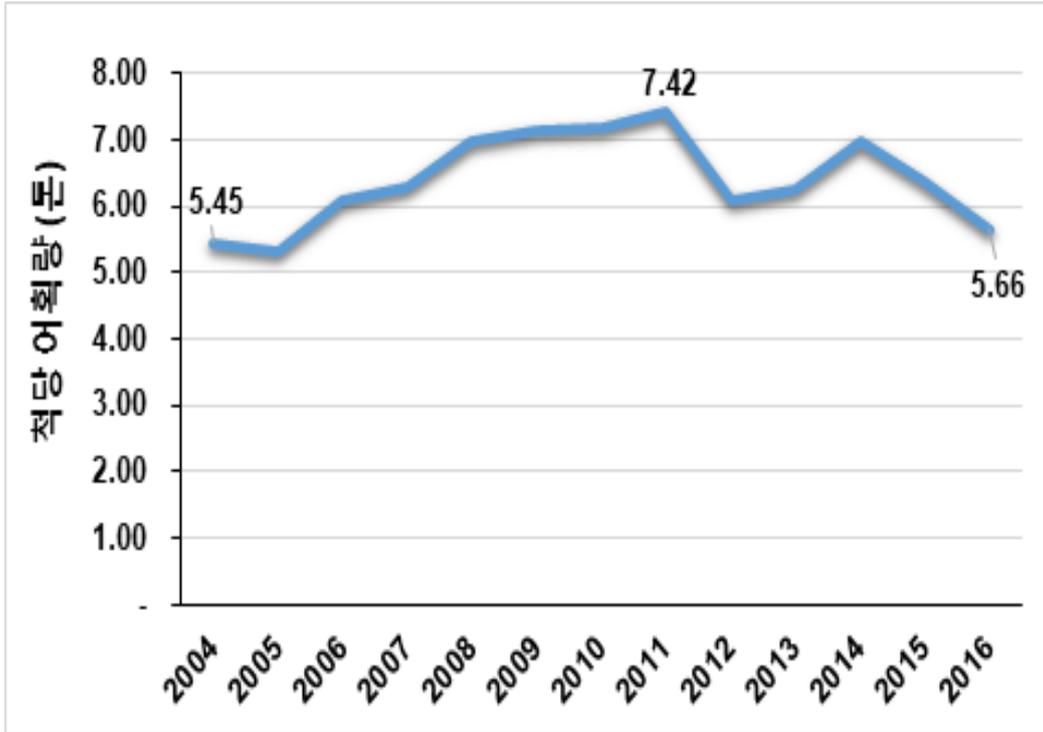
Coastal fishing vessels	16,490	7,657	46%
Offshore fishing vessels	787	225	29%
Total	17,277	7,882	46%

3. Analysis of the effects of the vessel buyback program in the Yellow Sea

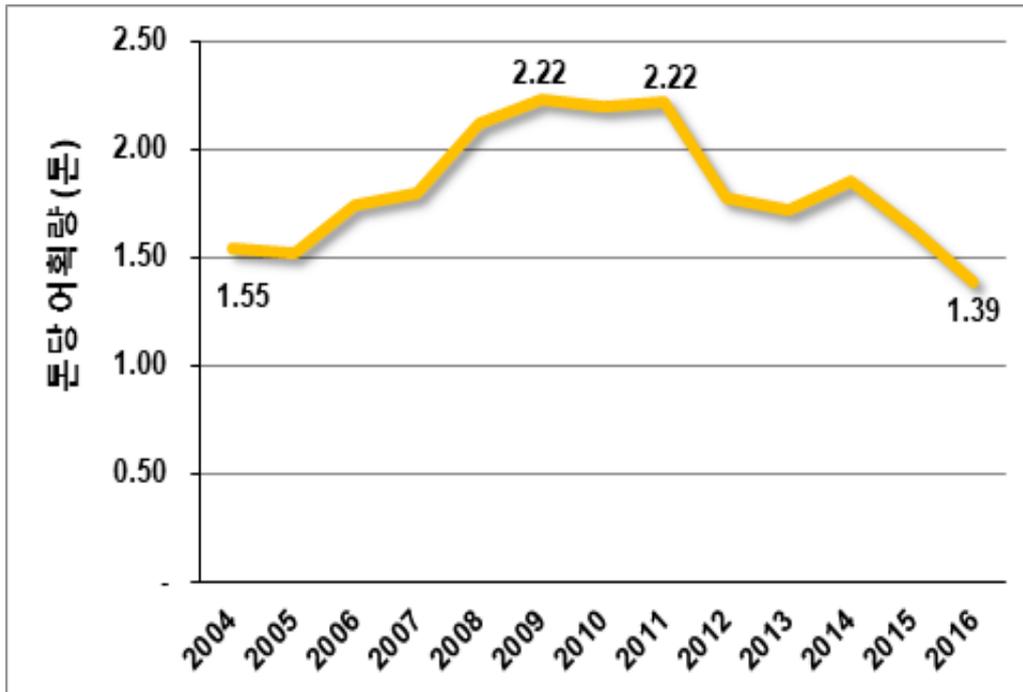
A direct analysis of the effects of the vessel buyback program in the Yellow Sea requires data on fish stocks by species, fishermen’s income by fishing gear or vessel, etc. However, it is very hard to acquire such data at present. Hence, this study analyzed the effects of the vessel buyback program utilizing CPUE (Catch Per Unit Effort) data, which is a proxy indicator for the quantity of resources and fishery productivity³.

Based on the number of fishing vessels, CPUE steadily increased from 5.45 metric tons in 2004 to 7.42 metric tons in 2010. However, it plummeted to 6.06 metric tons in the following year, and through transient ups and downs, 5.66 metric tons were recorded in 2016, which is similar to that in 2004.

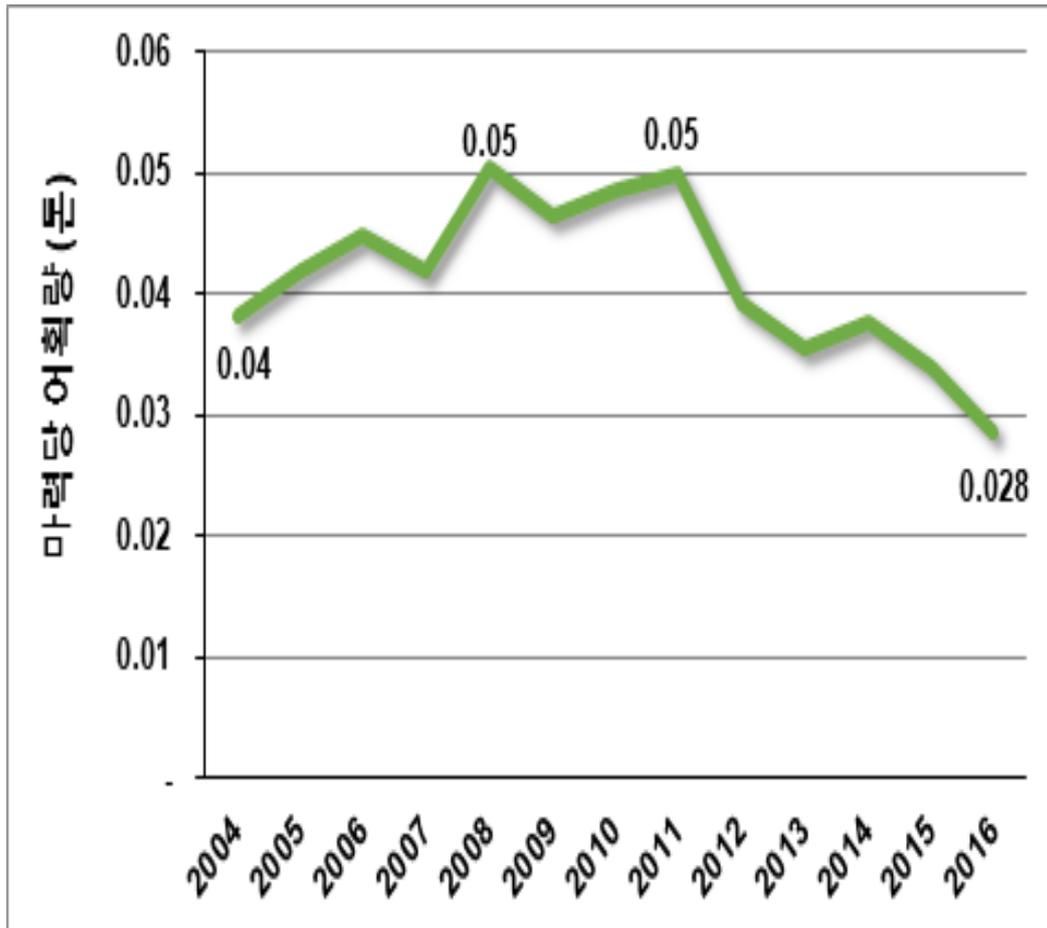
³ CPUE is often used as a proxy indicator for the quantity of resources in spite of its limitations. A decline in catches with the same amount of fishing effort indicates a decrease in fishery stocks. In order to obtain CPUE, the number of, the tonnage (MT) of and the horsepower (HS) of fishing vessels are used as data of fishing efforts.



Based on the tonnage (MT) of fishing vessel, CPUE shows a continuous rise for 5 years from 1.55 metric tons in 2004 to 2.22 tons in 2009. CPUE, which had remained at around 2.22 tons in the following years, dropped to a level of 1.77 tons in 2013. After a steady decline, it hit 1.39 tons in 2016. This figure is lower than 1.55 tons of 2004 as well as the record low of CPUE over the entire analysis period.



Based on the horsepower (HS) of fishing vessels, CPUE was 0.04 metric tons in 2004 and then rose to 0.05 tons in 2008. It fluctuated around 0.05 tons until 2011, but it started to sharply decline from 2012, hitting 0.028 tons in 2016. This was analyzed that 0.012 ton got lowered compared to the CPUE in 2004, which was 0.04 ton.



The CPUE data based on the three types of fishing effort indicators (number, tonnage, and horsepower of fishing vessels) all showed a generally upward trend from 2004 to 2009 or 2010. However, since 2012, CPUE has been analyzed to decrease again. In particular, CPUE derived from the tonnage and the horsepower of fishing vessels was assessed to be lower than the level of CPUE of 2004. These results show that despite the continuous reduction in the number of fishing vessels in the coastal and offshore waters in the Yellow Sea through the ongoing vessel buyback program, the actual fishing efforts of individual fishing vessels in terms of the vessel tonnage or horsepower have been increasing. As a result, CPUE of fishing vessels has also been generally declining up to the present since 2011-

2012. It means that despite the implementation of the vessel buyback program, a significant increase in fishery productivity has not been brought.

It should be considered that this study has only analyzed changes in CPUE due to lack of available data. The effects of the vessel buyback program should be reviewed in a more diverse and detailed manner through stock surveys and assessments by fish species, analysis of fishery business management (such as increases in fishing revenues and decreases in fisheries costs) by fishery, satisfaction surveys of participating and nonparticipating fishermen in the vessel buyback program, etc.

4. Conclusions and Policy implications

The existing fishery restructuring projects centered on vessel buyback programs were simply aimed to control fishing capacity by reducing the number of fishing vessels. However, in order to control the increase in actual fishing efforts, it is critical to impose regulations on the horsepower of fishing vessels or the amount of fishing gears as well.

In order to recover and manage fishery resources in the Yellow Sea and to develop sustainable fisheries in the future, it is recommended to actively implement policies to protect adult fish and immature fish like closed zones and seasons, size limits, etc. in addition to the fishing vessel buyback program. Along with these input control, output control measures should be actively examined as tools to recover and manage fisheries resources in the Yellow Sea. The Total Allowable

Catch (TAC) system in Korea currently targets a total of 11 fish species including blue crabs, mottled skate, sandfish and chub mackerel and 14 types of the coastal and offshore fishing fishery. However, it is necessary to further expand TAC target species and types of fishery in the future and strengthen cooperation with neighboring countries including China to protect and manage fisheries resources in the entire area of the Yellow Sea.

In addition, studies to identify the main causes of changes in fisheries resources should be more actively conducted to manage fishery resources in the Yellow Sea. Various factors such as overfishing, changes in marine environments, rising water temperatures by climate change, fierce competition with neighboring countries for fishing operation and illegal fishing may be pointed out as causes for the reduction and change in fishery resources. A more effective recovery and management of fishery resources could be achieved through in-depth studies to identify causes for changes in fish stocks by species in the Yellow Sea.