EXECUTIVE SUMMARY

A Study on Resources Circulation for Marine Debris of Aquaculture Farms

1. Purpose

▸ This study aims to identify the type and volume of marine debris generated in aquaculture farms, presenting improvement measures required for resource circulation- based management of aquaculture farms.

- Through this work, the study intends to contribute to the prevention of the followings; damaging the marine environment and ecosystem resulting from marine debris of aquaculture farms, destroying coastal landscape, microplastic pollution and accidents from entangled rope or floating matter.

2. Scope

▸ The scope of this study includes a quantitative estimation of usage, generation, the status and amount of treatment based on the type of aquaculture equipment used in the field. Having identified domestic and foreign cases of recycling and resource circulation relevant to marine debris, the study aims to seek measures applicable to Korean aquaculture farms, presenting management strategies.

〈Table 1〉 Scope of the study

Classification	Major contents
Chapter 1. Introduction	• Background and purpose of the study • Scope and methods • Status of preceding studies
Chapter 2. Analysis of management status of waste and marine debris	• Analyzing waste management system • Analyzing the current status of managing marine debris
Chapter 3. Analysis of problems of waste management in aquaculture farms and foreign cases	• Current status of the aquaculture industry and relevant fishing gear • Problems of waste treatment in aquaculture farms • Analyzing foreign cases of resource circulation for marine debris
Chapter 4. Analysis of generation and treatment volume of aquaculture waste in Wando-gun and resource circulation technology	• Analyzing generation and treatment amount of waste from aquaculture farms in Wando-gun • Resource circulation model of aquaculture farms • Technology applied to resource circulation in aquaculture farms

Classification	Major contents
Chapter 5. Measures to improve resource circulation in aquaculture farms	• Institutional improvement for resource circulation of aquaculture waste • Building the foundation for resource circulation of aquaculture waste • Direction and support for technological development of resource circulation for aquaculture farms
Chapter 6. Conclusion and policy suggestion	• Conclusion • Policy suggestion

3. Results

1) Summary

▸ The paradigm of South Korea's waste management policy has shifted from 'waste management for creating pleasant living environment' to 'building resource circulation society for preparing climate change and the depletion of raw materials and energy'.

- In accordance with the Framework Act on Resource Circulation (took effect on January 2018), various measures were introduced including the resource circulation performance management, charge on waste disposal and the Assessment of Resource Circulation Utilization, and avoiding reclamation and incineration, while promoting recycling.

- As part of the policy to promote the development, usage and distribution of renewable energy, the government established the

'Environmental-friendly Energy Town'. Driven by the Ministry of Environment, this area is equipped with infrastructures for switching waste resource into energy.

- However, recycling of aquaculture waste is conducted to very limited items including Styrofoam, laver drying screens and derelict fishing nets.
  - Styrofoam buoys are recycled since treatment facilities (Styrofoam volume reducer) have been developed and distributed. Laver-drying screens made of synthetic resins are recycled because producers are easy to collect along with some fishing nets.
  - Incineration facilities of marine debris are not commercialized since local governments have been unwilling to cooperate as well as problems surrounding the operation cost. In addition, technological development for turning waste oil into resource has not begun.
- Aquaculture farms have grown in South Jeolla and South Gyeongsang provinces. While seaweed such as laver and shellfish such as oysters are cultivated with hanging culture, rack culture and cage culture methods, fish farms are using fishing gears made of PP, PE and EPS.

〈Table 2〉 Aquaculture methods, species and major fishing gear for subjects of this study

Types of aquaculture		Fishing gear made of synthetic resins	Aquaculture species
Rack culture	Buoy type	net (PP), rope (PP), buoy (EPS), string (nylon)	Laver
	Pole type	net (PP), rope (PP), string (nylon)	
Hanging culture with long lines		rope (PP), string (nylon), coated yarn (rubber), buoy (EPS)	Oyster, Sea squirt
		rope (PP), string (nylon), buoy (PE etc.)	Sea mustard, Kelp
Hanging culture at shallow waters	Hanging line	rope (PP), string (nylon), coated yarn (rubber)	Oyster
	Horizontal net	rope (PP), string (nylon), plastic net (PE)	
	Horizontal string	rope (PP), string (nylon), packaging string	
Cage culture		main body of cage (PE), rope (PP), net (PP, nylon), net fixing frame (PE), buoy (EPS etc.), string (PE, PP, PVC)	Fish
		main body of cage (PE), rope (PP), net (PP, nylon), net fixing frame (PE), buoy (EPS etc.), string (PE, PP, PVC), shelter (PE, PP, PVC)	Abalone

▸ Derelict fishing gear of aquaculture farms has become the source of marine debris due to the following reasons;

- Derelict fishing gear needs high cost for collection and treatment, which also requires advanced technology. In addition, the range of generation varies per seasons as well as per year and has low value as waste resource.

- The classification of the type of waste (domestic waste, industrial waste) is not clear under the Wastes Control Act. The foundation

is not sufficient in terms of disposal and storage facilities befitting to fishing communities as well as recycling. In addition, the number of private treatment companies falls short and the regulation concerning the unit cost of treatment is unrealistic.

- The commercial value of specialized treatment agency for aquaculture waste is low due to its small generation volume. Therefore, selecting an agency for entrusting the treatment is quite difficult.

▸ The US, Japan and Europe have made efforts to circulate and turn marine debris into resources. For this purpose, countries rearranged the recycling system for aquaculture waste, building an optimal system from collection to treatment.

- Representative cases include 'Fishing for Energy' of the US, promotion project for the management of floating and drifting matters in Fishing grounds of Japan and 'Circular Economy package' of Europe. These campaigns aim to recycle marine debris including aquaculture waste after recovering the energy or extracting resource material from the waste.

- Taking these into action, countries rearranged relevant regulations, while supporting the local governments or fishermen to treat marine debris. At the same time, countries have developed recycling technology and established a system from collection to recycling.

- Recently, the development of up-cycling products has generated the demand of marine debris as waste resource.

▸ The annual amount of aquaculture waste generated in Wando-gun stands at 25,679 tons, among which 70.3% are treated by systems such as recycling and incineration. However, 24.0% are left on land unattended, while 15.7% are carried away or dumped at sea.

- From the amount treated by the systems, 51.0% were recycled, 15.7% was incinerated while 3.7 was treated as waste by local governments.

〈Table 3〉 The amount of aquaculture waste generated and treated in Wando-gun

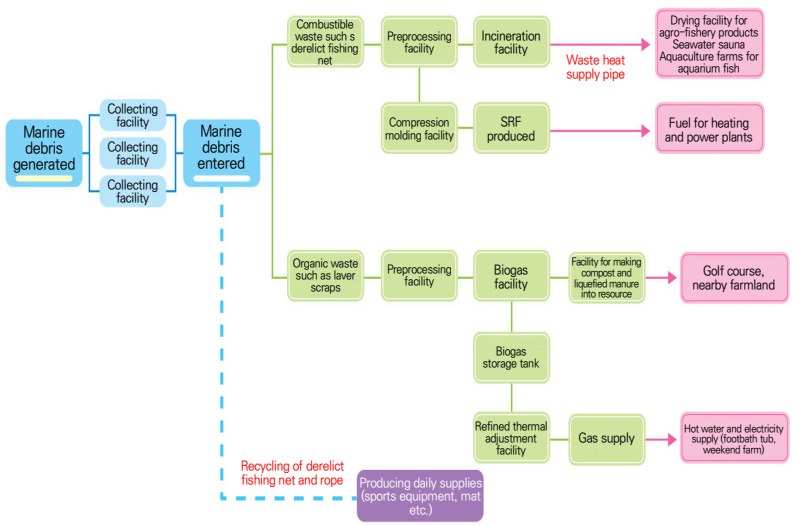
Aquaculture industry		Total generation (ton/yr)	Waste treatment (ton/yr)				
			Wash away or dump	Recycling or sale	Incineration	Leave unattended	Waste treatment
Laver	Pole type	255	-	-	-	-	255
	Exposed Buoy type	2,040					
Seaweed mustard, Kelp	Long line method	4,593	2,772	-	911	820	91
Abalone	Marine cage method	16,119	302	10,172	-	5,080	564
Abalone seed	Ground aquarium method	2,672	-	2,672	-	-	-
Total		25,679	3,074	12,844	911	5,900	910
Ratio (%)		100.0	15.7	51.0	5.7	24.0	3.6

▸ Resource circulation of aquaculture farms means having a circulation structure in which a local community, where

aquaculture waste is generated recycles the waste or collects the energy and then gives back the benefit to local residents.

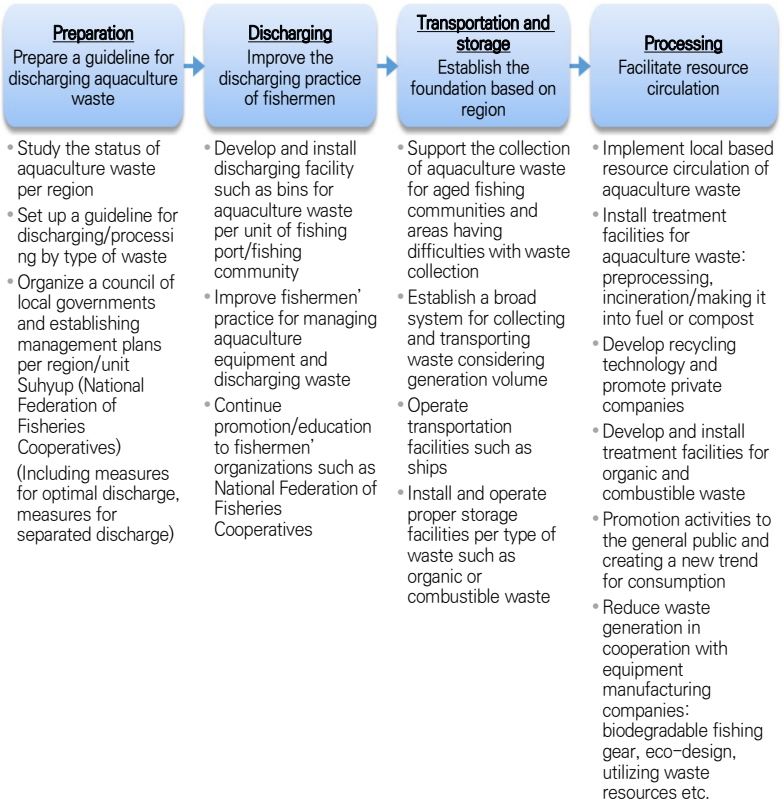
- Able to reduce non-recyclable resources or the use of energy
- Able to cut the amount of waste generated from aquaculture farms
- Able to collect energy from waste, which is not available for reuse or recycling

〈Picture 1〉 Diagram of resource circulation in aquaculture farms



- The successful establishment of resource circulation model for aquaculture farms needs requirements for each step as follows;

〈Picture 2〉 Stage-based guide for resource circulation of aquaculture waste



▸ Technologies of resource circulation applicable to aquaculture waste are listed below;

- Buoy for fish farming: turning solid waste into fuel and refined fuel oil, thermal decomposition and turning it into hydrocarbon, source for recycled products

- Plastic and wood equipment and facilities for fish farming:

thermal decomposition and turning it into hydrocarbon, source for recycled products

- Fishing net and rope: thermal decomposition and turning it into hydrocarbon, source for recycled products
- Organic waste (laver scraps, dead fish etc.): turning it into biogas or compost

2) Improvement measures for resource circulation of aquaculture farms

▸ Institutional improvements required for resource circulation of aquaculture waste

- Expand the application of the Extended Producer Responsibility (EPR) to aquaculture equipment
- Conduct the Durability Evaluation for aquaculture equipment and facilities
- Establish the ordinance for strengthening the responsibility of local governments

▸ Requirements for building the foundation for resource circulation of aquaculture waste

- Draw a guideline on discharge and treatment of aquaculture waste
- Build and operate facilities relevant to resource circulation of aquaculture waste

- Improve the awareness of stakeholders including fishermen

▸ Support for the technological development of resource circulation in aquaculture farms

- Policies for supporting the technological development of equipment for aquaculture farms considering resource circulation: (a) continuing the technological development of biodegradable fishing gear and strengthening the collection of derelict fishing gear, (b) investing to technology for shell recycling, (c) developing the technology for turning organic waste into resource and (d) developing environmentally-friendly technology for aquaculture equipment.

▸ Strategies for a stable resource circulation of aquaculture waste

- First, rearranging laws and regulations for managing aquaculture farms based on resource circulation
- Second, establishing the standards for the durability evaluation for aquaculture equipment and facilities
- Third, conducting a systematic investigation on wastes generated from aquaculture farms
- Fourth, supporting the recycling of marine debris and relevant industry driven by the nation

3) Expected benefits including policy contribution

▸ Participating in the ‘Planning Research on the Technological

Development of Resource Circulation Marine Debris' conducted by the Ministry of Oceans and Fisheries

- Participating in an experts meeting (Sep 18, 2018) organized by the Korea Research Institute of Ships and Ocean engineering (KRISO) and discussing measures to turn waste into the source for eco-friendly industry and energy.
- Participating in an experts meeting (Oct 8, 2018) organized by the Korea Marine Environment Management Corporation (KOEM) and discussing a direction of the technological development for managing the life cycle of marine debris
- Participating in an experts meeting (Dec 4, 2018) organized by Korea Institute of Ocean Science and Technology (KIOST) and making presentation on marine debris policies and recycling cases and discussing measures for recycling fishing nets and plastic waste

▸ Reflecting the contents of this study into 'The Third Basic Plan on Marine Litter Management'

- Government tasks for the technological development of marine debris recycling
- A pilot project for building marine waste-free fishing community
- Promoting projects for recycling marine debris