13.Conceptual Design and Inclusive Impact Assessment for a Multi-purpose Floating Structure

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1. Introduction

Ocean Thermal Energy Conversion (OTEC), which generates electricity by utilizing deep ocean water (DOW), has attracted significant attention for its large potential and low environmental risk. OTEC situated on a floating structure has comparatively lower land use and impact than land-based installation, and could be combined with other offshore technologies to reach higher ecology and economy synthesis benefits, as areas where DOW flows upward from the deep ocean to the surface have been observed to have high primary productivity and fish production.

This research has improved the system design of a conceptual multi-purpose floating platform proposed by Duan (2019) and evaluated the sustainability of it.

2. Conceptual System Design

The conceptual system design is similar to previous research (Duan, 2019), and the system boundary is shown as Fig.1.

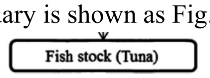

Fig.1 System Boundary

It is based on a modular floating structure with the design lifetime of 50 years. Tuna aquaculture, microalgae cultivation and processing, and OTEC energy infrastructure are integrated here for profitable applications in the South China Sea, where 90% of China's ocean thermal energy resource is distributed and microalgae growth rate is high. Due to the high cost and large raw material requirement of large-scale floating structures, however, the inclusive performance of the previous system is relatively poor. Therefore, we adopted the high-yield photobioreactor microalgae cultivation system, instead of the open pond system, and a low-cost barge type floating structure, instead of semi-sub structure, in order to reduce the required area and cost of the floating structure and improve the sustainability of the system.

3. Inclusive Impact Assessment

The Inclusive Impact Index "Triple I light" (IMPACT Research Group, 2006) was calculated to evaluate the environmental sustainability and economical feasibility of the floating system. It is defined as the following equation:

$$III_{light} = (EF-BC) + \gamma(C-B) \quad (1)$$

where *EF*, *BC*, *C*, *B*, and γ represents Ecological Footprint, Biocapacity, Cost, Benefit, and the conversion factor from economic to environmental value, respectively. The result shows that the new system becomes environmentally neutral (*EF*=*BC*) at the lifetime of 11.5 years, and shows sustainability ($III_{light} \leqslant 0$) at a lifetime of 20 years.

4. References

Fengjun Duan (2019). Integrated Ocean Resources Utilization Contributing to Climate Change Mitigation: A Case Study in East China Sea. The Proceedings of the Twenty-nineth International Ocean and Polar Engineering Conference (ISBN: 978-1-880653-85-2), pp. 643-646

IMPACT Research Group (2006). Report on the Large-Scale Marine Utilization and Environmental Impact Assessment Method (in Japanese).