

A PRACTICAL SCHEME TO PROMOTE GLOBAL WARMING COUNTERMEASURES IN COASTAL AREA - A CASE STUDY OF “YOKOHAMA BLUE CARBON PROJECT”

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Abstract

Yokohama City which is Japan's second largest and bayside city with a population of over three million, has studied the “Yokohama Blue Carbon Project” since 2011. Under this project, the City is examining the following three sub-projects: enhancement of CO₂ absorption by marine organisms (Blue Carbon), reduction of greenhouse gas by optimal utilization of marine resources (Blue Resources) and the development of good relationships between humans and the sea (Creation of a Friendly Ocean). Based on the Project Master Plan 2013, a social experiment for carbon offset was carried out in 2014, based on which the City developed the world's first Blue Carbon Credit Scheme and offset CO₂ emissions from the Triathlon Race in Yokohama. In 2015, the City examined the quantification of fixed CO₂ by regenerating and maintaining eelgrass beds.

Keywords: Blue Carbon, Blue Resources, virtuous cycle of environment-society-economy, carbon offset, citizens-industry-academia-government collaboration, CO₂ fixation on eelgrass bed

1. INTRODUCTION

“Blue Carbon” is carbon captured and fixed by oceanic and coastal ecosystems as a term newly defined in the “Blue Carbon” report by the United Nations Environment Programme (UNEP) in 2009. Conversely, the carbon captured and fixed by forests is known as Green Carbon. The report cited total annual global CO₂ emissions of 7.2 billion metric tons, 0.9 billion tons of which are absorbed by forests and 2.2 billion tons by oceanic and

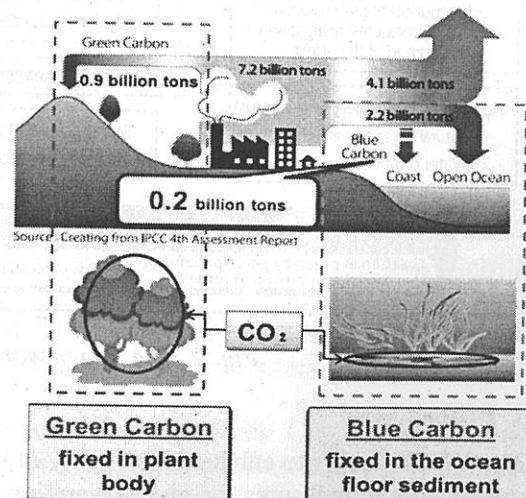


Fig. 1. Global CO₂ Cycle and Blue Carbon

coastal ecosystems. 0.25 billion tons are absorbed by coastal areas as Blue Carbon. The remaining 1.95 billion tons merge directly into marine water.

Also, Japan has the sixth longest coastline in the world and is thus one of the countries with the greatest potential for Carbon Storage. Besides, the blue carbon shows promise for global warming prevention measures.

2. BACKGROUND TO THE YOKOHAMA BLUE CARBON PROJECT

The Blue Carbon, which is promised as a new global warming prevention measure, is not officially approved for carbon sinks in the Kyoto Protocol due to limitation of knowledge for quantification of absorption, compared with that in Green Carbon. In other words, there is no standardized scheme for valuing and promoting Blue Carbon absorption.

Yokohama City focuses on Blue Carbon for global warming countermeasures in the ocean. The city conducts visualization measures and assigns them market values.

3. OUTLINE OF THE YOKOHAMA BLUE CARBON PROJECT

The Yokohama Blue Carbon Project (YBCP) has been implemented by Yokohama City with opinions from the “Blue Carbon Review Committee”. The Committee comprises both experts and local involved parties.

3.1. Frameworks of Activities

Yokohama City, which has a coastline of approximately 140 km, is not only focused on the Blue Carbon (CO₂ absorption by marine organisms) as a countermeasure to global warming in an ocean. The City named rich marine resources such as energy, food and biomass, etc. as “Blue Resources” and focuses on utilizing Blue Resources for the carbon sink. Besides, the City is considering efforts to promote a good relationship between humans and the ocean through these activities. Therefore, the framework of “Yokohama Blue Carbon” comprises Blue Carbon, Blue Resources and the Creation of a Friendly Ocean.

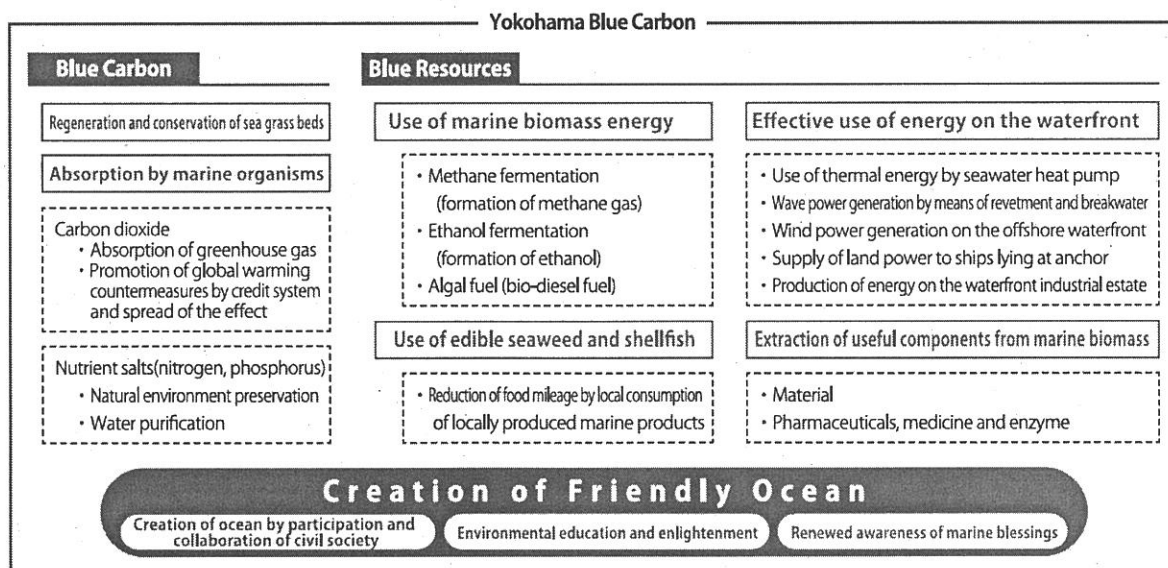


Fig. 2. The Framework of Yokohama Blue Carbon

3.2. Project Goal

The YBCP goal is to enhance the quality of life of citizens. To achieve this, Yokohama City not only implements countermeasures for global warming but also a policy of “Blue Innovation”, which creates a virtuous cycle of “Ocean Environment (ocean)”, “Society (citizen, government)” and “Economy (company, local industry, tourism, etc.)”.

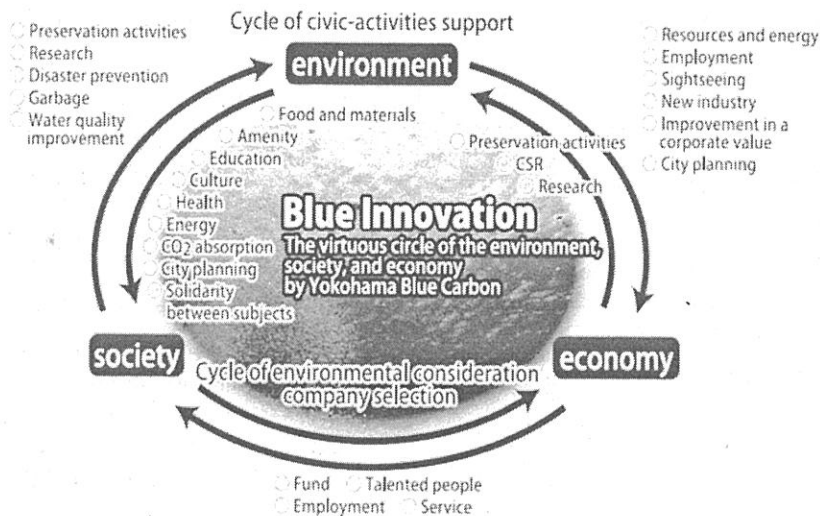


Fig. 3. The Yokohama Blue Carbon Vision

3.3. The Project Aims

In Yokohama City, there are activities involving citizens/NPOs such as improving and maintaining the environment (Recreation of eelgrass beds, Creation of shallow bottoms, cleaning of coastal areas etc.) These play an important role in conserving healthy seaweed forest. The city approves the effect of CO₂ fixation and water purification and biodiversity for monetary value and provides a budget for citizens/NPOs to encourage their activities.

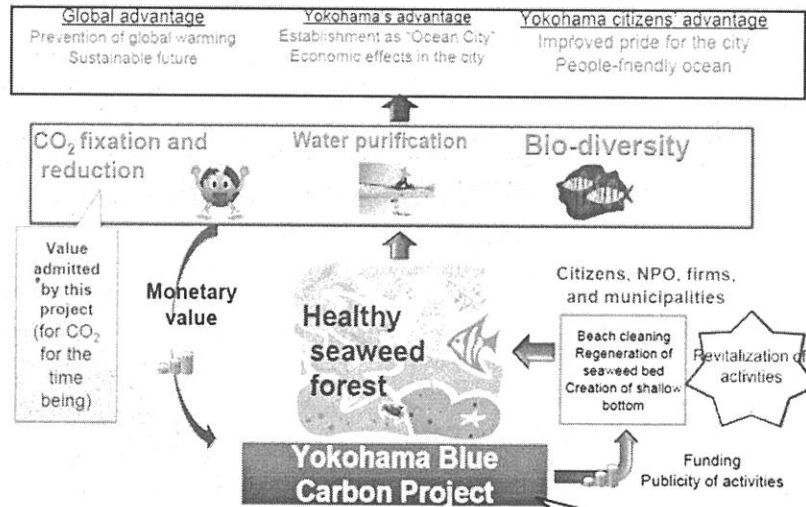


Fig. 4. The Aims of Yokohama Blue Carbon

3.4. The Formulation of a unique Carbon Credit Scheme

The city has examined a Yokohama-unique carbon credit scheme as a promoter of "Blue Innovation". Existing carbon credit schemes (e.g. Japan's J-Credit) set blue carbon as outside the scope, due to the lack of approval by the Kyoto Protocol. Yokohama City needs to create a unique scheme commensurate with the blue carbon global warming countermeasures. (credit means quantities of absorbed/reduced greenhouse gases approved by a third party.)

The city conducted reviews and interviews with Kyoto City and Kobe City, both of which are implementing unique carbon credit programs. Following discussions in the Blue Carbon Committee, the city formulated a draft framework for the scheme, including measures to calculate CO₂ reduction. To start the Yokohama Blue Carbon Credit Scheme from the Financial Year of 2015 (April 2015 to March 2016), the city conducted a social experiment in 2014 to determine operational issues and promote activities.



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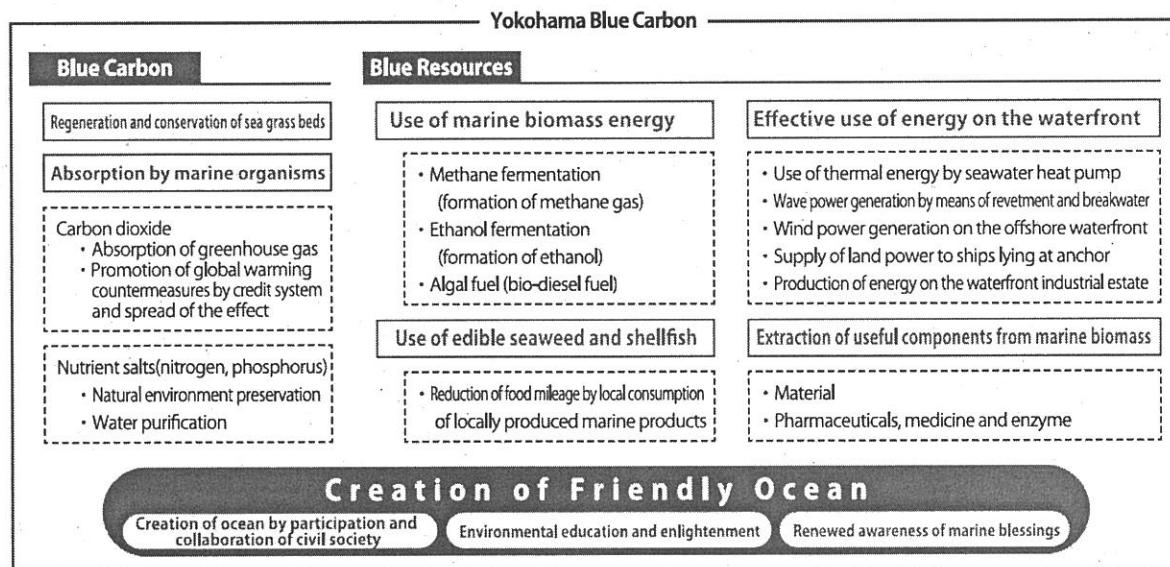


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The result of examination and discussion in a social experiment in 2014, which involves gaining CO₂ credits from the Fisheries Cooperative Association of Yokohama and Yokohama Hakkeijima Inc. producing seaweed, consuming and introducing heat-pump facilities and utilizing the credit at the Triathlon Games in Yokohama.

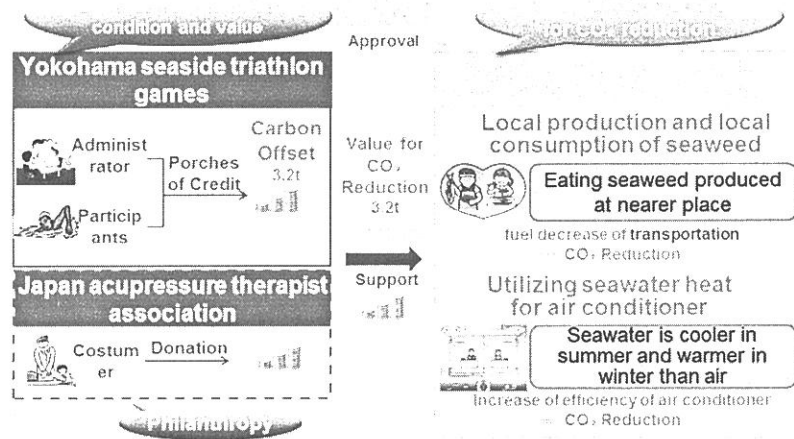


Fig.5. Outline of Carbon Offset in 2014 (Social Experiment)

4. OUTLINE OF SOCIAL EXPERIMENT in 2014

The outline of the social experiment for carbon offset is shown below:

(1) To approve the quantities of CO₂ reduction through measures (seaweed production and consumption and utilization of the heat-pump system) as performed by the Fisheries Cooperative Association of Yokohama and Yokohama Hakkeijima Inc. as a carbon credit.

(2) The Executive Committee of the Triathlon Games purchases credit for carbon offset for CO₂ emissions from the games.

(3) The purchase money is utilized for carbon absorption and reduction activities by the Fisheries Cooperative Association of Yokohama and Yokohama Hakkeijima Inc.

The executive committee also requested a voluntary donation from participants of 30 Japanese yen for carbon offset, to which a total of 64.9% of participants agreed. Besides, the Japan Massage Practitioner Association, a booth exhibitor at the Triathlon Games, also agrees with YBCP and donated all its income from massage treatment at the game.

5. OUTLINE OF SOCIAL EXPERIMENT in 2015

Until 2014, the main topics of examination included methods of calculating quantities of CO₂ reduction from Blue Resources. In 2015, the city examined the means of calculating quantities of CO₂ fixation from Blue Carbon, which is the core of the YBCP. The city examined the quantification of CO₂ fixation by regenerating and maintaining eelgrass beds.

The city engaged in mathematizing the CO₂ fixation using the wet-weight of eelgrass beds. It also formulated a feasible field survey method of standing eelgrass stock for local citizens' associations. A field test of quantification was conducted in the Sea Park in Yokohama City.

5.1. Scheme to quantify CO₂ fixation

In the examination, quantities of CO₂ fixation are determined as quantities of persistent decomposed bodies accumulated on the sea bed and produced from eelgrass beds along a coast. It is difficult to monitor the amount of accumulation since the carbon from eelgrass is accumulated on the seabed. The quantification of CO₂ fixation by eelgrass bed are thus calculated from the field surveyed wet-weight of the eelgrass bed and coefficient of carbon fixation from the previous study. The formulation is as shown below. The area of the eelgrass bed is measured by the ratio of the bare area from the aerial photo.

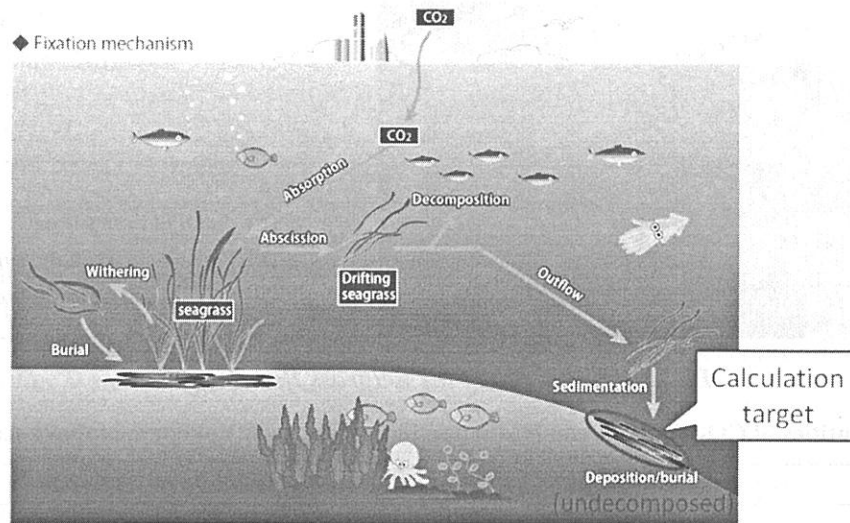


Fig. 6. Schematic Diagram to Calculate CO₂ Fixation by eelgrass bed

Annual quantity of CO₂ fixation (kg-CO₂/year)
 = Wet-weight of eelgrass bed (kgWW) * (1- water content ratio) * Carbon content of eelgrass (kg-C/kgDW) * coefficient of CO₂ fixation * 44 /12
 = Area (m²) * unit wet-weight (kgWW/m²) * (1-0.874) * 0.323 * 0.115 * 44/12

5.2. Field Survey

To obtain the wet-weight of eelgrass bed in the Sea Park in Yokohama City, the area and unit wet-weight survey was conducted. The survey was conducted inside the administration area of the park and coordinated by related authorities. An outline of the field survey is shown in Table 1.

Table 1. Outline of the Field Survey

	Area Survey		Unit wet-weight
	Aerial Photo	Field Survey*1	
Date	21 May, 2015 (Thu.)	20 June, 2015 (Sat.)	2 July, 2015 (Thu.)
Location	Sea Park	Same as on the left	Same as on the left
Conducted by	Yokohama City	Yokohama City Yokohama Hakkeijima Inc. Citizens participation*2	Yokohama City
Method	Taking a picture by Unmanned aerial vehicle (UAV)	(1) Shallow Bed 1-1) Taking a picture of the edge of the eelgrass bed by smartphone with GPS data. 2-1) Uploading the picture to web site and checking the real time progress of survey. (2) Deeper Bed Record the location data of the edge of the eelgrass bed by GPS by diver. (3) Calculation of Area Based on the location data of the edge of eelgrass bed, the area is calculated.	Setting 11 cultivation sites (every 15m from the shore line) in the eelgrass bed and cultivating them.*3, *4

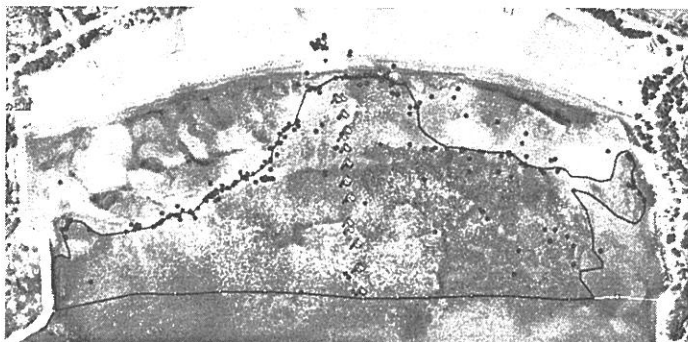
*1 Eelgrass bed species observation event is conducted on the same day by Yokohama Hakkeijima Inc.

*2 Including the participation of students of Yokohama City University and local windsurfers. In total 17 participants.

*3 Cutting above the sea bed part, *4 the cultivation area is 50cm*50cm at each point.

5.3. Result of Field Survey and Case Examination of Quantification

The result of the field survey in the Sea Park is shown in Fig. 7 and a case examination is shown in Table 2. As a result, the area of the eelgrass bed in the Sea Park is 55,031m² and the quantities of CO₂ fixation and reduction are 1.1t-CO₂/year.



Legend	
—	: The result of area survey
●	: The Plots of smartphone survey by citizens
□	: The locations of unit wet-weight survey

Fig. 7. The Results of the Eelgrass Bed Survey

Table 2. Quantities of CO₂ Fixation and Reduction in the Sea Park Yokohama (above seabed part)

Items		Result
Area	m ²	55,031
Unit Wet-weight (above seabed)	kgWW/ m ²	1.175
Wet-weight (above seabed)	kgWW	64,662
Water content ratio*Uchida 2011	-	0.874
Carbon content ration of eelgrass body*Yasuda et al. 2005	kg-C/kgDW	0.323
Coefficient of CO ₂ fixation*Fisheries Research Agency et al. 2012	-	0.115
Quantity of CO ₂ fixation in Sea Park eelgrass bed (above seabed)	t-C/year	0.3
	t-CO ₂ /year	1.1

5.4. Lessons Learned

The good and weak points of the 2015 survey method are below. To formulate the methodology in 2015, there is a need to examine the feasible methodology for a field survey.

(Good Points)

- Through the survey, the actual area of the eelgrass bed can be measured.

(Weak Points)

- To measure the ratio of the bare area, periodical aerial photos should be taken.
- It is slightly difficult to determine the eelgrass edge by citizen participants. There is the potential for overestimation.

Besides, values from previous studies include data from the Seto Inland Sea without clear notification of the target part of eelgrass body (above or below the sea bed), with remaining issues of accuracy. To prevent overestimation, only the above part of eelgrass is used in this study. It is better to use the entire eelgrass portion, including that below the seabed, to quantify CO₂ fixation and reduction of the eelgrass bed.

6. CONCLUSIONS

In Yokohama City, we have been carrying out the “Yokohama Blue Carbon Project” since 2011, with the intention of generating a virtuous cycle involving the environment, society and economy. The “Yokohama Blue Carbon Project” comprises “Blue Carbon”, “Blue Resources” and “Fostering the feeling of attachment to the sea”. The city formulated a world-first scheme to promote global warming countermeasures in the coastal area through a social experiment in 2014. Also, the actual action for carbon offset from Triathlon Games was implemented. In 2015, the city performed examinations to quantify CO₂ fixation and reduction to further boost credit and partners. For institutionalization in 2016, accuracy issues need to be resolved.

7. ACKNOWLEDGEMENTS

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