

“Nitrogen- neutral” Relate to Using Sea-plant

Hiroshi Kitamura¹, Takeo Yano¹, Takashi Mishima¹, Shuichi Karita¹ and Norihiro Nishimura²

¹Graduate School of Regional Innovation Studies, Mie University, Japan

²Graduate School of Medicine, Mie University, Japan

Abstract— As for the problem of the environmental load of the carbon dioxide, it is argued all over the world. But reactive nitrogen load has the same problem to the environment that we cannot ignore.

The consumption of the reactive nitrogen increases in form of the fertilizer, by the expansion of the cultivation area and with the increase in population adds more problems for us to face.

As for the surplus reactive nitrogen, possibility to have various influences on environment is pointed out. The reactive nitrogen may decrease biodiversity by eutrophication of the soil, river water, and seawater. The atmospheric reactive nitrogen causes the acid rain which flows into the ocean and produces dead zone.

By the way, Sea-plant grows without fertilizer and it takes underwater reactive nitrogen. We may conclude that Sea-plant is thought of as “Nitrogen-neutral”

Therefore we are proposing the theory called the recycling society, environment load can reduce by the use of the Sea-plant in various forms that cultivation seems to be possible even if we do not use new reactive nitrogen.

Keywords— Nitrogen. Sea-plant. Seaweed. Circulation. Phosphate. Environment

I. INTRODUCTION

The match which preserves global environment in recent years is performed much. There are 6 kinds, carbon dioxide, methane (CH₄), nitrous oxide (N₂O), hydrofluoro 3 carbons, perfluorocarbons and sulfur hexafluorid as the greenhouse gas by which the annual amount of emission is grasped in the Japanese Ministry of the Environment.[1]

As for the carbonic dioxide, it is thought that influence on global warming is the biggest in greenhouse gas drained artificially. Therefore a match of regulation of the amount of emission based on a concept of carbon neutral is performed about carbon dioxide. Even if raw material in case of plant origin was burned and carbonic dioxide was released, a plant took the carbon in the carbonic dioxide in from carbonic dioxide in the atmosphere by photosynthesis originally, so carbon neutral is a way of thinking of the carbon circulation by which we assume that the carbonic dioxide density in the atmosphere isn't increased. (Fig.1)

We thought that we applied this concept to nitrogen this time. Effluent control was applied to the Kyoto Protocol because the nitrous oxide (N₂O)[2], which are one form of the nitrogen were generation and one of discharged greenhouse gases factitiously, and 310 times of greenhouse effect of carbon dioxide was here. [3]

The thing by which the amount of emission will increase with increasing amount of consumption of chemical fertilizer for a grain production, a rise of a crop production for

livestock feed and a rise of a crop production for biotechnology ethanol for nitrogen from now on is expected. On the other hand, Sea-plant doesn't require a fertilizer and absorbs more reactivity nitrogen in the water.

Therefore I utilize the nitrogen cycle which utilized Sea-plant in a way of thinking that "nitrogen neutral".

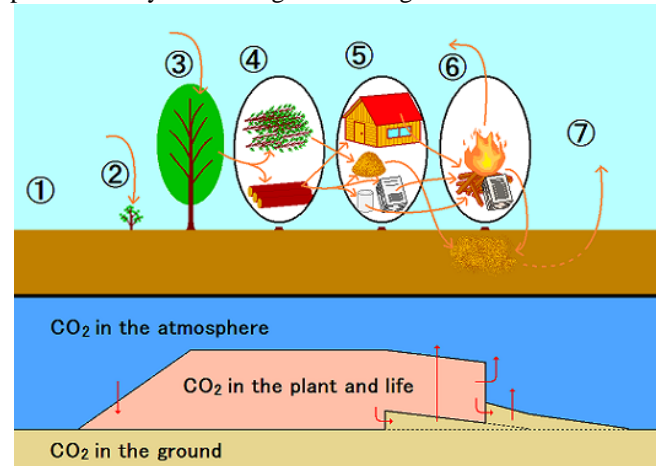


Fig.1 (quote it than Wikipedia)

The flow of the plant use and the quantity of carbon change that carbon neutral

- ① The state where nothing is there
- ② Planting a seed where a tree grows. carbonic dioxide is absorbed from the atmosphere.
- ③ Almost grown tree.
- ④ A tree is chopped and processed. Produces wood and junk of trees .
- ⑤ A wood is used to produce paper and building material. More junk of trees increases.
- ⑥ Paper and building material are incinerated. carbonic dioxide returns in the atmosphere. Ashes of junk of trees and a cinder enter in the ground.
- ⑦ Ashes of junk of trees and is then taken apart by a microorganism, and it returns in the atmosphere as carbonic dioxide and methane. The cycle of carbon neutral repeats and continues.

II. REACTIVE NITROGEN AND NITROGEN CYCLE

Nitrogen is an element of the amino acid of which a protein is composed. The biggest reservoir of nitrogen is the atmosphere, and the 78% is nitrogen gas(N₂). Nitrogen gas is a very stable substance also, just as it is, then it can't be used for animals and plants. This nitrogen will be "fixed" by the process called a nitrogen fixation.

In addition to the newly fixed nitrogen, the nitrogen used for animals and plants are being improved while experimenting. The nitrogen used for animals and plants changes

the form to ammonia (NH_3) by decomposition of a discharge and a corpse.

There is toxicity and ammonia that plants and animals can't use, but nitrous bacterium in the ground changes ammonia into a nitrite (NO_2^-). Nitrite also cannot be used by many animals and plants, but nitrate bacterium will change nitrite into nitrate salt (NO_3^-) so that it may be used directly on animals and plants again. Certain nitrate salt (NO_3^-) changes into nitrogen gas via a process of denitrification. A nitrous oxide (N_2O) is sometimes generated by its process.

Surprisingly almost no dinitrogen fixation bacteria is used for nitrogen gas, reactivity nitrogen, melted in sea water, is used by a plant and a seaweed directly including the vegetable plankton which is a main basic producer, and it circulates at the natural world. (Fig.2)

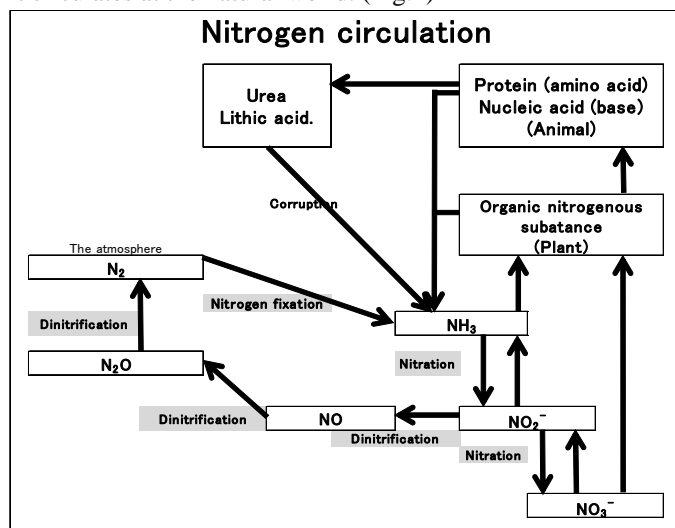


Fig.2 A writer modifies a figure of ("inorganic chemistry of the life" Yoshikazu Matsushima and Yoshimasa Takashima).

It is said that before the nitrogen fixation technology, the amount of the nitrogen produced at the natural world and a balance with activity of the bacteria crowd were produced, the nitrogen circulation seems to have been kept.

However, the reactive nitrogen made by mankind by the year of 2005, consists of 2 times the reactive nitrogen made at the natural world since global birth.

Furthermore, with the reactive nitrogen which occurs by burning fossil fuel such as exhaust gas discharged by a car and a factory, it moves to the atmosphere, the river and the sea. Therefore it is thought that the quantity of the reactive nitrogen which will not be able to circulate in the environment had produces huge burden. [3]

III. MISCELLANEOUS PROBLEMS WITH A POSSIBILITY THAT REACTIVE NITROGEN CAUSES IT

Reactive nitrogen is the most conspicuous nutritional contaminant which forms from human activity. Miscellaneous problems with a possibility that reactive nitrogen causes are reported often, some are pointed out here.

• Air pollution

When a nitrogen takes the form of (NO) and a nitrous oxide (N_2O) (all together, nitrogen oxides NO_x) in the atmosphere, a troublesome by-product is invented and human health is threatened. Nitrogen related air pollution (particle and surface ozone) has an influence on hundreds of millions of people, triggers the occurrence rate of the cardiopulmonary disease and is pressing the death rate up overall. [3]

• Global warming

A research team of Oceanic and Atmospheric Administration discovered that the "sub-nitrogen oxide (N_2O)" which goes out by use of a scientific fertilizer and manufacturing process of chemicals is the substance which destroys an ozone layer most in the present, and it was announced by a scientific magazine dated August 28th in 2009 "science". (C A sub-nitrogen oxide (N_2O) is a strong greenhouse gas and indicates 310 times of greenhouse effect of CO_2 per 1 molecule. The global warming a sub-nitrogen oxide (N_2O) has caused is calculated with about 10 % of global warming by (CO_2) from the present atmosphere intermediate concentration. [3])

• Soil pollution

Factories, cars and the reaction which has begun to leak from a farmland, nitrogen leads to acidify on earth, polluting groundwater and drinking water.

National Institutes of Health, USA (NIH) is reporting that there is a possibility that the fear that several kinds of occurrence of cancer and occurrence risk of Alzheimer's disease and diabetes rise participates in a healthy problem by a rise of the nitrate salt density in the drinking water (Water pollution by the high concentration nitrate salt included in a fertilizer causes much.) [3]

• River marine pollution

When a large amount of the nitrogenous fertilizer dissolves, and eutrophication done river water flows into the sea, vegetable plankton occurs on a large scale, and when those break apart it massively consumes oxygen and get in touch with occurrence in a dead zone.

Reactive nitrogen is also carried by discharge of living drainage of an artificial campaign to the sea from inflow of water including fertilizers from a farmland and feces and urine of cattle and sewage-treatment plants.

Multiplication of an alga by nitrogen and inflow of other nutrient doesn't damage biodiversity to some degrees and makes the productivity of the ecosystem increased. But when it's too much, specific abnormal outbreak of a seed and big multiplication are caused, and I have an influence on all ecosystems. [3]

Actually, according to the report a United Nations environment plan (UNEP) released as "the world environment survey" (GEO) 2003 year edition" said, there were about 150 seas lacking in oxygen "mortal area of sea" in the world, and the life of the seafood was threatened, and it was made clear that there is also a big influence on fishing.

IV. ABOUT NITROGEN ABSORPTION OF SEA-PLANT.

It's often learned about Sea-plant absorbs nitrogen in the seawater and a phosphoric acid, and to make an alga body grow by photosynthesis.

There are various views about nitrogen absorption capacity of the Sea-plant, but we'll calculate by the part of the edible Sea-plant from Mie-prefecture specifically.

The production of the hijiki (*Sargassum fusiforme*) from Mie- prefecture being 200t (the dry weight) and these will absorb about 6t of nitrogen in the ocean. And also, we calculate that about 42 t of nitrogen is absorbed by about 1400 t of hijiki (*Sargassum fusiforme*) production in Japan by the same calculation. (The marine statistics of agriculture and forestry of 2006, 8,209t is converted into the dry weight.)[4]

Then another kind of edible Sea-plant Arame (*Eisenia bicyclis*) in Mie- prefecture an annual production of 200t (the dry weight) according to the calculation which changed, and it'll be the calculation which absorbs about 3.2 t of nitrogen. [5]

V. POSSIBILITY ABOUT THE USE OF SEA-PLANT

The alga body which grew follows the processes which are some kinds eventually, and is released in the ocean as nitrogen. Nitrogen is pooled temporarily and it's important not to do a surplus dinitrogen fixation and for a produced alga body to be used effectively. (Fig.3)

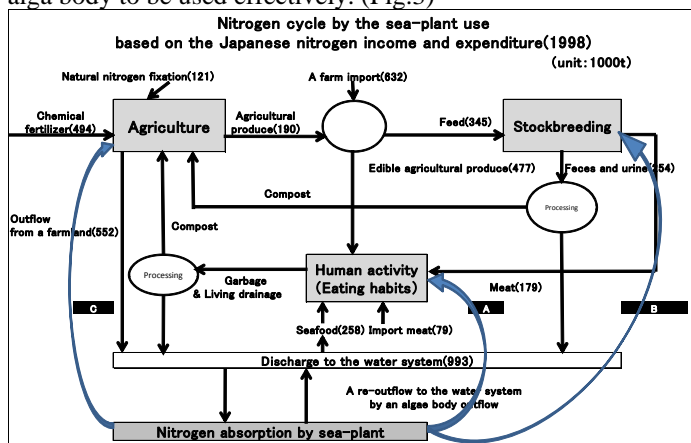


Fig.3 A writer modifies a figure (The Ministry of Land, Infrastructure and Transport, a writer modifies National and Regional Planning Bureau (2000) "state consideration investigation in the area where the continuation which makes the circulation and the symbiosis.)

A Use as a food

We calculate by the hijiki (*Sargassum fusiforme*) consumption of the country, about 500 tons of nitrogen is absorbed.

When kombu (*Laminariaceae* Bory) is assumed to absorb nitrogen as much as Arame (*Eisenia bicyclis*) of the approximation class, about 500 tons of nitrogen is absorbed as expected, and I'm making them circulate.

B Use as feed

Nitrogen circulation of substantial amount is made of using sea-plant (algit) feed.

C Use as a fertilizer

Nitrogen circulation of substantial amount is made of using the akamoku (*Sargassum horneri*) of the hijiki (*Sargassum fusiforme*) approximate kind as a fertilizer.

When leaving them alone in an underseanness without harvesting Sea-plant of one age nature of the dirt tree, the nitrogen and the phosphorus which went bad and absorbed it eventually return to a sea. After taking out a fertilized egg by an alga for 1 year, much of Sea-plant withers up. In that case, by using it in the land to draw the seaweed which absorbed nitrogen up from a sea you can promote circulation of nitrogen and practice nitrogen neutral theory.

Sea-plant as food

As direct use, the first thought is considered to take be taken as food.

The race which makes the various Sea-plants daily food aggressively by the various shapes in the world is said to be the Japanese and the Korean race, in recent years, in China, laver and Sea-plant are being consumed popularly.

Sea-plant as a fertilizer

Since putting it in the farmland around the coast, it has been favored with responsible post as a fertilizer from the old days. The liquid manure produced from Sea-plant also likes the Sea-plant which drifted ashore in a farmland in today, and is sold widely in the other United States of America where a crowded method is performed at the Mediterranean Sea coast various countries and Africa various countries. Use was doing tengusa (*Gelidiaceae*) in a fertilizer at Izu-hanto in the Edo Period in Japan.

Sea-plant as a biotechnology ethanol raw material

A plan of several Sea-plant biotechnology ethanol vapour is announced in Japan at present.

"Apollo and the Poseidon plan, 2025"

The study group in which Mitsubishi Research Institute Inc., Tokyo University of Marine Science and Technology and Kyoto prefectural marine center take the leading part announces it. They plan to say that they grow 65,000,000 t of hondawara (*Sargassum fulvellum*) is grown at 10,000 km2 of farm the Sea of Japan, make on the ocean biotechnology ethanol refinery plant and produce 20,000,000 kl of biotechnology ethanol. They are aiming at production of 1/3 of 60,000,000 kl of annual increased fuel consumption.

"Ocean·Sunrise plan"

Tokyo marine promotion association announces it. They plan to cultivate 150,000,000 t of seaweed using 1-2% over the area of sea about 4,470,000 km2 together with the Japanese territorial waters and the exclusive economic zone (EEZ) and produce 4,000,000 t of biotechnology ethanol.

VI. SEA-PLANT USE IN MIE- PREFECTURE

There are about 9000 kinds of Sea-plant in the world, about 1500 kinds in Japan, and about 350 of them live in Mie-prefecture. Amongst these, only about 20 types of Sea-plant are being used.

The phenomenon by which Seawater damage came across in recent years, and a match of submarine forest revival is performed. We participate in amamo (*Zostera marina*) bed revival as "the environment and ecosystem preservation active support business" and arame (*Eisenia bicyclis*) place revival, too. But the Sea-plant family of the played underwater forest isn't being used, because the primary focus is put in the maintenance by which goals of underwater forest revival are an ecological system and biodiversity. Or when time comes, an alga body is washed away and the nitrogen increased Sea-plant absorbed will be returned by underwater forest revival in the ocean.

In addition, the Sea-plant which was not used conventionally is much kombu (*Laminariaceae* Bory) such as sea lentils or the arame (*Eisenia bicyclis*) such as hondawara (*Sargassum fulvellum*) large-sized Sea-plant. When quantity of nitrogen taken in will be a great deal of, we can imagine them. It's also tied with activation in the fishing village part and is the problem for promoting nitrogen circulation, to create new use of unused Sea-plant; we think that it is nitrogen neutral tints definitely.

VII. THE NITROGEN NEUTRAL THEORY AND SEA-PLANT USE

Way of thinking as nitrogen neutral Using the reactive nitrogen which is already fixed, if we circulate and useful of it in daily life, as a result there will not be influences on fluctuation of the nitrogen total volume. This is prescribed as "nitrogen neutral".

The reactive nitrogen which began to flow to water systems in that will remain in the natural world except that a lot of quantity is absorbed by sea-plant and vegetable plankton till it is done denitrification by denitrification bacteria. It's too minute to leave for land and use it artificially, and difficult, so using the Sea-plant family is only material for nitrogen circulation.

We can propose that we use these for realization of the "nitrogen neutral tints" society positively, because it is we Asian who used Sea-plant in various lives without only by food culture.

Since chemical fertilizers appeared in 1913, and the sudden increase in the population of the world from 1,000,000,000 people to a little more than 6,000,000,000 people during less than 100 years. And to correspond to sudden population growth, a yield rise of agricultural produce was planned for by new reclamation in land, land improvement and fertilization. These react, don't suppose to forget that it's benefit by nitrogen. This theory also reacts, the reaction such as not using nitrogen, which doesn't advocate extreme restriction and reduces the production of the

new reactive nitrogen, and its existence, one proposition in the match that the number to reduce environmental load by suggesting circulation of nitrogen is here.

ACKNOWLEDGMENT

This research was supported by Mr.Taizo Hiraga of Sea-Folk Museum (Tokai Marine Science Association) and Kitamura Co. Limited. We would like to thank Mr.Taizo Hiraga.

REFERENCES

- [1] Makoto Omori & Boyce Thorne-miller: Marine Biodiversity, 2006
- [2] Ministry of Environment, Japan,
<http://www.env.go.jp/earth/ondanka/ghg/index.html>
- [3] Alan R. Townsend / Robert W. Howarth: Fixing the Global Nitrogen Problem (SCIENTIFIC AMERICAN February 2010)
- [5] Kazumi Nimura: Simple and rapid determination of nitrogen content in *Eisenia Arborea* sporophyte (Bull.Shizuoka Pref. Fish.Exp. Stn.) 2007
- [6] Yoshio Okuyama: The compound culture which reduces environmental load of culture of fish, (Fisheries experiment station, Wakayama-Pref.)2007