B-51.3 Studies on the Assessment of Methodology of National Greenhouse Gas Inventories

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Total Budget for FY1998 15,762,000Yen

Abstract Because the Third Conference of the Parties to the United Nations Framework Convention on Climate Change (COP3) declared that not only CO_2 but CH_4, N_2O, HFC, PFC, and SF_6 are gasses to be reduced, it is now extremely important to make high precision estimates of the emission and absorption of all GHG in order to prepare action plans for the achievement of reduction goals. The gasses and categories of gasses considered by this research study were selected from those in Japan's GHG sources and sinks inventory as ones that should be the object of studies of ways to improve their sources and sinks balance with emphasis on taking action to meet the demands of the Kyoto Protocol, and in particular, those whose estimation in the 1997 greenhouse gas inventory are known to be imprecise, those whose estimation range is incomplete, and those for which new responses are called for under the Kyoto Protocol. The research project involved the collection of GHG data for the above gasses and categories, a study intended to improve emission factors, sources and sinks activities, more appropriate estimation methods, and other related factors, and a study conducted to propose specific improvement methods and to clarify items that should be the objects of concentrated measurement, research, and improvement beginning in the coming year.

Key words: COP3, GHG, GHG inventory, IPCC/OECD guideline, developing countries

1. Introduction

Because parties to the United Nations Framework Convention on Climate Change are obligated by the Convention to submit inventories of the sources and sinks of GHG (greenhouse gasses) in their own countries to the Convention Secretariat in order to effectively promote global warming prevention measures, it is necessary to carry out quantitative evaluation and analyses in various fields related to their emission and absorption. And the recent Third Conference of the Parties to the United Nations Framework Convention on Climate Change (COP3) established reduction targets for the five year period from 2008 to 2012 not only for CO_2 but other reduction target gasses: CH_4, N_2O, HFC, PFC, and SF_6. It is extremely important to make highly precise estimates of the emission and absorption of these GHG in order to prepare action plans to achieve these reduction goals.

In light of these circumstances, this research study was conducted by collecting data on

these six kinds of GHG and using it to study ways to improve emission factors, sources and sinks activities, more appropriate estimation methods, and other related factors. And regarding gasses and categories in Japan's GHG sources and sinks inventory that are considered to be inadequately understood at this time, a study was conducted to propose specific improvement methods and to clarify items that should be the objects of concentrated measurement, research, and improvement beginning in the coming year.

2. Methodology

The gasses and categories selected for inclusion in the objects of this research study were selected as those for which improvement methods should be studied with priority on meeting the needs of the Kyoto Protocol. They include those in the following categories.

(1) Those whose estimation precision is poor (those whose precision evaluation is either L or M)
(2) Those whose estimation range is incomplete (Those whose estimation range is now PART or NE)
(3) Those requiring a new response under the provisions of the Kyoto Protocol

Based on the above, CH_4 and all N_2O, all industrial processes, CO_2 from LUCF and CO_2 from biomass combustion were selected as objects of the study of ways to improve Japan's inventory. The study of each category encompassed the study and organization of ① handling in the 1996 IPCC guideline, ② status in the Japanese inventory, ③ proposals for the Japanese inventory and for improvements in Japan, ④ necessary future research directions, and ⑤ proposals to the IPCC.

3. Results and Discussions

The results of an evaluation of the present status of the Japanese inventory reveal the following research directions that should be applied for each of the categories.

(1) Energy

① Fuel Combustion (stationary emission sources)

The quantity of N_2O emitted from stationary sources is relatively large among all gasses with the exception of CO_2, and research to improve its precision should be done. Of the several varieties of furnaces that make up these sources, the emission coefficient when ordinary coal or charcoal is burned in a fluid bed furnace is extremely high and the improvement of the precision of its emission coefficient is the most necessary measure in this area. Because the emission of N_2O accompanying combustion varies according to the type of furnace and the way each is operated, detailed measurements must be done. But improving the precision above present levels would be so expensive and involve so much work that it would not necessarily be very cost-effective. So considering cost-effectiveness, it would be better to concentrate on research to develop and confirm the effectiveness of N_2O reduction technologies rather than to attempt to improve the precision of the N_2O inventory.

② Fuel Combustion (Transportation)

It is forecast that CH_4 emissions will increase with a rise in the number of CNG vehicles, making it necessary to improve the inventory preparation method. In this case an estimation method based on the quantity of fuel consumed (quantity of natural gas

consumed) rather than on an estimation method based on the number of vehicles based on travel distance. The quantity of N_2O emitted from mobile emission sources is relatively large among all gasses with the exception of CO_2, and research to improve its precision should be done. Because the present trial running mode is a method focused on NO_x restrictions, there is an urgent need for the development of a running mode that incorporates the life cycle of present motor vehicles and research in this field has top priority.

③ Fugitive Emissions from Fuels

Because actual conditions must be clarified, it is probably necessary to visit coal mine operators, oil companies, and gas companies to obtain information and to solicit their support with surveys to clarify the actual extent of leakage. But because this is not a very large emission source compared with other categories and gasses and the quantity of coal mined in Japan is sure to continue declining, this type of research is a low priority matter.

(2) Industrial Processes

Because actual conditions must be clarified, it is probably be necessary to visit private companies to obtain information and to solicit their support with surveys to clarify actual conditions at factories etc. And because this is a relatively large emission source compared with other categories and gasses and it will be necessary to correctly reflect the reduction efforts of industrial companies, research to improve precision and broaden the estimation range in this category is a top priority theme.

(3) Solvents and Other products Use

Nothing in particular considering their estimation precision and range.

(4) Agriculture

① Enteric Fermentation

Research related to the generation of CH_4 by ruminants conducted in order to improve feed-energy conversion efficiency has achieved progress in almost all ranges. But in Japan where a sharp increase in the number of feeding animals is forecast, it is essential to quickly reexamine the CH_4 emission coefficient for beef cattle that will account for a large percentage of total emissions.

In Asia, there is a serious shortage of basic data regarding CH_4 emissions from livestock, making the early collection of such data an important matter. Because under part of the IPCC guideline, it is possible to overestimate the emission coefficient of water buffalo, this data should be confirmed. Because 97% of all water buffalo are found in Asia, completion of this task will make a big contribution to Asia. Although the kinds of feed used differ between Japan and Asia, it will be possible to apply Japanese methods to Asia by collecting data to develop an appropriate correction factor. The default values must be expanded beyond region and species so that it will be possible to include other elements such as body weight and productivity, body weight and body weight gain, and feed composition and feed quantity.

② Manure Management

To deal with the definite shortage of emission quantity data for cases of physical treatment and other forms of treatment with inherent CH_4 and N_2O generation mechanisms,

it is necessary to collect data related to emission coefficients that consider processing methods and operating management methods.

③ Rice Cultivation

The quantity of emissions in this category is relatively large compared with other gasses and categories, and because the emissions are susceptible to the effects of environmental factors, it would be difficult to improve the precision of the current emission coefficients, but it is necessary to collect emission data for cases where water management, soil type, application of organic material, or the weather differ and to survey the application of rice straw.

Regarding wet rice fields in Asia, it is necessary to study each country considering its soil, cultivation system, quality of the discharged water etc. Because it is believed that the quantity of CH_4 generated by rice cultivation in some countries is strongly effected by whether or not it is possible for water to be drained outside the wet field rice growing season, the IPCC has to study this matter in the future.

④ Agricultural Soils

This category is a high priority item in the study of the volume of N_2O generated by agricultural activities. The major problem is the emission coefficient and reliable data must be collected to improve its precision. Research is needed to incorporate the effects of [1] fertilization (quantity, kind), [2] soil moisture content, [3] ground temperature, [4] soil type, [5] crops in the emission coefficient. It is also essential to conduct continuous high precision measurements including leaching at a number of test locations for long periods of at least a year. Because a sharp increase in the quantity of nitrogen fertilizer consumed is predicted to occur in Asia, research on emission coefficients to be used to estimate emissions in Asia must be undertaken and activity data has to be organized.

(5) Land Use Changes and Forestry

a) Development of a biomass direct measurement system

The conventional method has been to measure the lumber volume of a forest then use a conversion model to calculate the quantity of carbon it fixes. But because the conversion parameters used by a model actually vary between regions and for different varieties of trees, it is necessary to develop a biomass direct measurement system in order to directly estimate the quantity of biomass to cross-check the appropriateness of existing methods and at the same time to provide more precise parameters.

b) Development of a model to represent the dynamic fluctuation of a natural forest.

Data revealing exactly how much carbon a natural forest fixes is in short supply world wide. But even in Japan, 60% of the land is covered with natural forests and because many of these natural forests are Sato-yama (community forest) used to supply fire wood until the 1960s and which have grown substantially since that decade, it is now necessary to clarify Japan's natural forest resource statistics to scientifically evaluate the carbon fixing capacity.

c) Evaluation of the carbon fixing capacity of lower vegetation and small d

iameter trees.

Measurement of the lumber volume has been limited to trees with a trunk diameter of 4 cm or more, but smaller trees and the lower vegetation have been ignored because they could not be used by the forestry industry. They must, however, be studied in the future because it is reported that they account for between 2% and 10% of total biomass.

d) Forest land forestry residue

Forest biomass following cutting includes the quantity that is transported to the market as lumber and the quantity that is left behind in the forest as left over forestry residue. The quantity of forestry residue produced, the time required for it to decompose, and whether or not it emits carbon into the atmosphere are questions to be answered.

e) Evaluation of the carbon content of soil

Carbon is stored in soil as organic matter, but its quantity varies according to cutting, changes in the density of the standing trees, and other aspects of the way a forest is handled. Because no survey has ever been carried out to estimate the nation-wide scale of changes in the carbon content of soil, a method of calculating this value must be developed.

f) Quantity of wood produced by the demolition of buildings

Statistics revealing the number of buildings demolished each year are available, but it is not clear how much lumber is produced by these demolitions. Because the quantity of wood produced varies according to the original construction method and the year of construction, a survey must be performed to discover precisely how much lumber is produced by the demolition of buildings.

g) Fuel use rates for building demolition scrap, small diameter trees, and forested land residue wood

Another way that wood is expected to contribute to mitigating the greenhouse effect is the use of scrap wood produced by building demolition, forested land residue, and scraps produced at wood processing plants as fuel in order to supply energy. This is an established business practice in Northern Europe and North America, but in Japan, it has neither been done nor considered by researchers. It is, therefore, essential to quickly evaluate the cost and supply capacity of the use of this biomass to supply energy.

h) Development of waste wood recycling systems

Although large quantities of building construction materials are already being recycled, almost 90% of scrap wood produced by demolition work in recent years has been disposed of as waste material. Because part of the reason for this is the fact that present building methods make it difficult to recycle wood, both building construction systems planned accounting for the reuse of building material after demolition and demolition scrap wood recycling systems will be developed.

i) Evaluation of the carbon fixing capacity of forests in tropical regions

Afforestation with early maturing tree varieties in tropical regions has attracted attention as a CDM (Clean Development Mechanism) called for by the Kyoto Protocol. The carbon fixing capacity obtainable in this way will be evaluated and an environmental assessment method to be used for large scale afforestation will be established. When this

has been done, it will be possible to evaluate the quantity of carbon fixed as wood, and in the building construction field, to assess the quantity emitted in the form of scrap wood from building demotion. In brief, it is essential to do this very carefully because of the potential for double counting of carbon.

(6) Waste

① Solid Waste Disposal on Land

It is necessary to collect many measurement data regarding the emission of CH_4 at landfill sites over a long periods of time by for example, monitoring gas collection facilities and by performing observations of total emissions using an open pass type FTIR. This is an urgent matter. And to verify estimated values, case studies of the waste material decomposition process and of changes over time in the quantity of CH_4 emitted at landfill sites must be collected around the world.

② Wastewater Handling

With regard to domestic wastewater, it is necessary to systematize the flow of contaminated water and sludge accompanying the treatment of domestic wastewater (in other words, quantitative clarification) and to determine their respective CH_4 emission coefficients: two objectives calling for fact-finding surveys. As explained below, because it is assumed that N_2O emissions accompanying wastewater treatment are extremely important, it is also necessary to carry out similar fact-finding studies of N_2O. The quality and quantity of industrial wastewater must be organized in a way that conforms to the IPCC guideline. Another fact finding survey must be carried out to clarify the CH_4 emission coefficient . And because as explained below, it is assumed that N_2O emitted accompanying wastewater treatment is also extremely important, it is also necessary to carry out a similar study of N_2O.

And because this is a matter closely related to population growth, the clarification of the state of emissions in developing countries in Asia and other regions where the population is growing rapidly is an extremely important way to mitigate the greenhouse effect. This means that in this area, Japanese researchers must work to not only improve Japan's inventory, but also face a strong demand to conduct research to prepare and improve inventories in developing countries in Asia.

a) Domestic wastewater

In the developing nations of Asia, it is believed to be possible to apply the IPCC guideline because wastewater is either discharged without treatment or it is treated using anaerobic methods in order to guarantee hygienic safety. But although the default values stipulated in the guideline are the theoretical maximum conversion rates, the emission coefficients matched to each value are not yet fully defined. According to the default values in the guideline, the maximum quantity discharged is 22 Tg/year for a population of 6 billion. Japan must provide Asia with support for research on the setting of emission coefficients that quantitatively represent the effects of wastewater treatment for two reasons: present population growth is being borne by developing nations in Asian and it is possible to reduce the quantity discharged by changing operating methods used to treat wastewater.

b) Industrial wastewater

It is believed that it is basically possible to apply the IPCC guideline, but the extent to which data regarding activity can be obtained is an unanswered question. As cooperative research, case studies have to be conducted in certain countries and problems abstracted from the results. With economic activity increasing particularly rapidly in the developing countries in Asia, industrial wastewater could become a huge source of discharged wastewater in these nations. If this happens, Japanese researchers will have to conduct research in this area.

Because in the revised 1996 IPCC guideline, the basic wastewater treatment method is assumed to be anaerobic treatment, the direct emission of N_2O has not been considered. Only the quantity emitted by the nitrification - denitrification that occurs after its emission into the environment is evaluated. But in order to use the value of N_2O produced by farmland when nitrogen fertilizer is applied to the land as the emission coefficient, it is essential to decide whether or not it is correct to apply it in this way.

Regarding the direct emission from wastewater treatment, after anaerobic treatment has been replaced by aerobic treatment, there will be a high probability of occurring a nitrification and denitrification. But under present circumstances, not enough data has been gathered for this calculation. Because considering a nitrogen flow focussed on feed, its emission potential is high, a study of the future addition of a new provision to the IPCC guideline must be undertaken.

It is forecast that in Asia and similar regions, economic development and improved energy conditions will be followed by a switch over to aerobic treatment methods. The addition of provisions concerning the emissions that such treatment will produce should be taken up in the future.