Workshop on Greenhouse Gas Inventories in Asia Region

13-14 November 2003
Phuket, Thailand

Proceedings

Ministry of the Environment, Japan
National Institute for Environmental Studies (NIES), Japan

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PREFACE

The world needs to reduce its emissions of greenhouse gases in order to address the issues of climate change. To guide policies and strategies, it is critically important to have an accurate idea of GHG emissions and be able to track them over time.

Despite the complexities of calculating these emissions, much progress has been made in recent years with methods based on emissions factors for different activities. The Intergovernmental Panel on Climate Change offers emissions factors for various activities, and many countries have developed their country-specific methodologies, databases and emissions inventories.

But in many cases the IPCC's default emission factors may not reflect the geographical and social conditions in the Asian region. Many Asian non-Annex I Parties under the United Nations Framework Convention on Climate Change (UNFCCC) have submitted national reports on their GHG emissions to UNFCCC, and in the process they have acquired a certain degree of ability to estimate and make inventories of these emissions. But the extent of experience with GHG inventories varies widely in Asia. Meanwhile, over the years, a network of experts working on these issues has been growing in the Asia region.

In this context, this Workshop on GHG Inventories in the Asia Region was held in Phuket, Thailand, on 13 and 14 November 2003, with the expectation that everyone would benefit by sharing information and experience in this field. It was a valuable opportunity for specialists and governmental experts to get together to discuss this important topic. We hope that the momentum gained by this workshop will help to improve the quality of GHG inventories in the region.

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THE WORKSHOP OF GHG INVENTORIES IN ASIA REGION
13-14 November 2003, Phuket Thailand

Chairs and Rapporteur

Dr. Shuzo Nishioka

Dr. Sirintornthep Towprayoon

Dr. Damasa Macandog

Mr. Dominique Revet

Dr. Asdaporn Krairapanond

Dr. Gao Qingxian

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Workshop on GHG Inventories in the Asia Region
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EXECUTIVE SUMMARY

The Workshop of Greenhouse Gas (GHG) Inventories in the Asia Region, organized by the Japan Ministry of the Environment and the National Institute for Environmental Studies (Japan) and hosted by the Joint Graduate School on Energy and Environment (Thailand), was attended by governmental officials and scientists from 11 countries and representatives of two international organizations.

A speaker from the UNFCCC Secretariat (www.unfccc.int) spoke about recent trends relating to National Communications on GHG emissions by non-Annex I Parties under the UNFCCC. He provided information about new guidelines for the preparation of national communications from non-Annex I parties; improved GHG inventory software to aid reporting; new *Good Practice Guidance (GPG) for Land Use, Land-Use Change and Forestry* (LULUCF); expedited financing from the Global Environment Facility for National Communications; the UNDP's National Communications Support Program (NCSP) for Climate Change; a UNFCCC *User Manual for the Guidelines on the Preparation of National Communications from non-Annex I Parties*; and trainings starting in 2004 by the Consultative Group of Experts (CGE) on National Communications from Parties Not Included in Annex I to the UNFCCC. A representative of the Technical Support Unit for the IPCC National Greenhouse Gas Inventories Programme (NGGIP) (www.ipcc-nggip.iges.or.jp) described news and ongoing projects and urged countries to actively use and contribute to the *IPCC Emission Factors Database* (IPCC-EFDB).

Governmental representatives reported on their institutional arrangements relating to GHG inventories. Scientists reported on technical matters in each country. Many non-Annex 1 countries have submitted their initial National Communications, based on default emission factors from the IPCC using 1994 as the base year; but some have developed their own emission factors. Some countries are now preparing their second National Communications. Participants identified problems and challenges they face relating to needs for (a) capacity building, (b) local or regional emission factors, (c) better activity data to generate accurate emissions inventories, and (d) more funding. They felt that the challenge is for each country to build a critical mass (data, experts, infrastructure, etc.) for GHG inventories, after which greater progress can be made, and that cooperation with other countries could help solve some problems.

In terms of recommendations to the national and international communities, participants identified important topics deserving of support: (1) international and national level trainings and meetings; (2) local/sub-regional database(s) of emission factors and activity data; (3) information exchange networks (regional and international); (4) financial and technical support to reduce uncertainty of GHG inventories (emission factors, activity data and methodologies, etc.); and (5) a more proactive role for the IPCC Emission Factor Database (IPCC-EFDB).

Participants found that the following actions were important for them to implement in the future: (1) orient efforts in a way that will contribute to the international community; (2) continue discussions with each other to consolidate the vision on GHG inventories and to maintain the momentum of this workshop with concrete actions (e.g., create an e-mail discussion list, conduct regular workshops and trainings, improve documentation, release publications, etc.); (3) begin planning the next GHG inventory workshop; and (4) link efforts with concrete initiatives such as those of the CGE mentioned above. Participants discussed the idea of a workshop on GHG inventories next year, possibly in China.

Background paper

For

the Workshop on GHG inventories in Asia Region

Background paper for the Workshop on GHG Inventories in Asia Region

1. Overview of the Workshop on GHG Inventories in Asia Region

1-1. Background

The increases of Greenhouse gas (GHG) emissions have been recognized as the primary cause of abnormal weather conditions and sea-level rise. The impacts of these climate variables, particularly in Asia, affect not only one country but also cover the whole area of the continent and island countries. Unexpected Monsoon can cause serious damage from the Philippines up to Southeast Asian countries and continue to Japan, Korea and main land China. According to the IPCC third assessment report (TAR), countries in Asia are known to be vulnerable to the threats of climate change and their adverse impacts. To minimize the cause of climate change and mitigate its adverse effect in Asian region, not only basic scientific knowledge but also the common understandings of the country situation as well as collaborative countermeasures need to be strengthened and shared among the countries in the region. To implement the effective countermeasures of climate change, the improvement of GHG inventories is a major priority. The level of GHG inventories development in Asia-Pacific region varies, and some issues regarding the inventories remain unresolved. To develop good GHG inventories, it is essential to hold a forum exchanging experiences and information among countries and between researchers and governmental officials. In addition, to strengthen regional collaboration, the discussion on country/region specific emission factors, accurate activity data, and inventory analysis assessing the countermeasures also need to be taken into account.

1-2. Objectives

The workshop (WGIA) objectives are:

- To share the experiences of the GHG inventory preparation and to promote mutual understanding of the GHG inventory development among Asia-Pacific countries.
- To address some of the key issues, focusing on the methodologies for developing the GHG inventories in Asia region, from the perspective of researchers and governments
- To facilitate the discussions and close interactions between researchers and governmental officials involved in addressing the GHG inventories as a base of strategies to reduce GHG emissions and to enhance GHG removals
- To explore possible solution strategies to improve the GHG inventories in Asia region

1-3. Expected Outcomes

The expected outcomes of the workshop are:

- Improving capacities for the GHG inventory preparation through discussions
- Determining the direction of sustainable systems to develop the GHG inventories with well-organized contributions from researchers and governmental officials
- Formulating mechanisms to utilize the GHG inventories as a basic strategies against the global warming
- Promoting the contributions of Asia-Pacific developing countries in the international efforts to improve the GHG inventories

2. Purposes of each session and details to be included in presentations

2-1. Opening Session

(1) Purpose

"***Standing on the same starting point***" -- Attempt to find common ground on the significance of the GHG inventories

(2) Details to be included in presentations

It is advisable to include the following subjects in your presentation:

(a) Recent trends in preparing National Communications for non-Annex I countries (Mr. Dominique Revet, UNFCCC)

- "Why do we develop the GHG inventories?"-- Attempt to find common ground on the GHG inventories
- "The level of inventory development in Non-Annex I countries' National Communications" -- Understand the current status of the GHG inventories in Asia-Pacific region
- "What are the ideal GHG inventories?"-- Seek to develop Asia-Pacific regions' inventories
- "What kinds of sources of funding available under the UNFCCC?" -- Explore what we can take advantage in developing the inventories

(b) Revision of IPCC guidelines and development of database for emission factors (Mr. Kiyoto Tanabe, IPCC-NGGIP/TSU)

- "On-going projects under the IPCC National Greenhouse Gas Inventories Programme" -- Explore what we can take advantage to develop the GHG inventories in Asia-Pacific region and seek what can be achieved by each country in Asia-Pacific region to contribute to international efforts to develop the GHG inventories.

2-2. Session I and II

(1) Purpose

"***To share the experiences of the GHG inventory preparation***"

(2) Details to be included in presentations

- "Good Aspects" - Share useful and helpful information on preparing the GHG inventories in each country and utilize it in the process of the inventory preparation for next national communications
- "Aspects of GHG inventory preparation to be addressed" - Raise the issues of the GHG inventory preparation before discussing future direction in Session III

- "Resources (or research program) used in the inventory development (e.g. UNDP, GEF-ADB, US country program, etc.)" - Explore available resources of funding to develop the GHG inventories.

2-3. Session III

(1) Purpose

"***To finalize the conclusion of this workshop***"

(2) Details to be discussed in Session III

To initiate the discussion in Session III, the summary of the country report in terms of regional situation will be primarily reported to the floor by Dr. Sirintornthep Towprayoon as the rapportuer.

The information contained in this background paper is based largely on publicly available information. The Secretariat for the Workshop of GHG Inventories in Asia Region (WGIA) recognizes that there is additional information to be considered for inclusion in this document to gain more accurate understanding of the actual status in each country. The WGIA Secretariat also recognizes that all the participating countries share common issues to be resolved. Currently, the WGIA assumes that the issues in the inventory development in Asia-Pacific region could be classified into the following 3 categories:

A. Issues in institutional arrangements for inventories preparation B. Issues in methodologies for inventories preparation C. Others

A. Issues in institutional arrangements for inventory preparation

a) To build sustainable institutional and technical capacity of local government and researchers

- Sources of Funding
- Cooperation between researchers and governmental officials
- Japan's case; Researchers began developing the GHG inventories as scientific program. Thereafter, the Ministry of the Environment took over the inventory preparation according to the requirement of the Framework Convention on Climate Change.
- The COP8 has adopted new guidelines for the preparation of national communications for Non-Annex I Parties. It could be a good opportunity to develop the institutional arrangements on inventory development.

b) Limited opportunities to improve GHG inventories

- Non-Annex I Parties have submitted elaborate inventories as part of their national communications; however, any official reviews have not been conducted to the inventories of Non-Annex I Parties. Opportunities to improve the inventories were lost.
- In this up-coming workshop, all the participants can explore various options to improve the inventories of Asia-Pacific region.

B. Issues in methodologies for inventory preparation

a) Lack of country-specific or regional-specific emission factors

- Overestimation or underestimation caused by using default emission factors
- To resolve this issue, existing research (literature search) can be utilized, or the country-specific or regional-specific emission factors could be developed. Furthermore, sharing any information relevant to this issue in future workshops would be a great advantage to all participating countries. Data input to IPCC EFDB would also result in international contribution.

b) Lack of activity data required to estimate GHG emissions

- To resolve this issue, domestic statistics, international statistics[1], and existing research (literature search) can be utilized, and activity data could be developed as a research project.

C. Others

This document was prepared by the WGIA Secretariat based largely on publicly available GHGs inventory-related information. If you have any questions, concerns, or additional information to be considered for inclusion in this paper, particularly on Session III, please contact us by email.

[1] Which will be included in the "Annex I: LIST OF INVENTORY REVIEW RESOURCES RELEVANT FOR THE CALCULATION OF ADJUSTMENTS" of "TECHNICAL GUIDANCE ON METHODOLOGIES FOR ADJUSTMENTS UNDER ARTICLE 5, PARAGRAPH 2, OF THE KYOTO PROTOCOL"

Chairman's Summary

Attachment I : Agenda
Attachment II : List of Participants

Workshop on GHG Inventories in Asia Region
13-14 November, 2003
Phuket, Thailand

Chairman's Summary

1. The Workshop of Greenhouse Gas (GHG) Inventories in Asia Region was held in Phuket, Thailand, on 13 and 14 November, 2003. It was organized by the Japan Ministry of the Environment and the National Institute for Environmental Studies (Japan) and hosted by Thailand, particularly the Joint Graduate School on Energy and Environment, comprised of five universities, namely, King Mongkut's University of Thailand, King Mongkut's Institute of Technology North Bangkok, Chiangmai University, Prince of Songkla University and Sirinthorn Institute of Technology at Thammasart University. The meeting was attended by governmental officials and scientists from 11 countries (Cambodia, China, Indonesia, India, Japan, Korea, Lao PDR, Mongolia, Philippines, Thailand and Vietnam), and the representatives of two international organizations (the UNFCCC Secretariat and the Technical Support Unit of the IPCC National Greenhouse Gas Inventories Programme). The overall workshop was chaired by Dr. Shuzo Nishioka, of the National Institute for Environmental Studies (Japan).

Opening Session

2. The opening session was chaired by Dr. Damasa Macandog. Dr. Nishioka welcomed participants to the workshop and described activities in Japan and the Asia region relating to GHG inventories and capacity building. He expressed his hope that the workshop would help to improve GHG inventories in the region and contribute to climate policy of the world. Dr. Sirintornthep Towprayoon, on behalf of the host country and five universities, welcomed participants to Thailand and expressed her hope for a fruitful workshop. Dr. Hideaki Nakane described the objectives and expectations for the meeting.

3. Mr. Dominique Revet, of the UNFCCC Secretariat, spoke about recent trends relating to National Communications by non-Annex I Parties under the UNFCCC. Mr. Revet mentioned five relatively new items. First, he provided details on Decision 17/CP.8, which contains new guidelines for the preparation of national communications from non-Annex I parties. Second, the UNFCCC will modify IPCC's GHG inventory software to aid reporting (including Table 1 and 2 of the new UNFCCC Guidelines). Third, the IPCC had just recently adopted/accepted *Good Practice Guidance (GPG) for Land Use, Land-Use Change and Forestry (LULUCF)*. Fourth, he recommended that Parties use the *IPCC Emission Factors database* (IPCC-EFDB). And fifth, he reported that the *Global Environment Facility (GEF) Operational Procedures for the Expedited Financing of National Communications from Non-Annex I Parties* would be launched at COP9 (this document is available on-line).

4. Regarding future developments, Mr. Revet made a few points. He said that preparations were being made to accept requests for funding for second National Communications by non-Annex I Parties. He said that the UNDP's National Communications Support Program (NCSP) could, if the project proposal is approved by the GEF Council, manage a US$60 million budget aimed at providing financial assistance for up to 130 non-Annex I Parties over 6 years. The UNFCCC has produced a *User Manual for the Guidelines on the Preparation of National Communications from non-Annex I Parties*. And the Consultative Group of Experts (CGE) on National Communications from Parties not included in Annex I to the UNFCCC will start hands-on training in 2004.

5. Mr. Kiyoto Tanabe, of the Technical Support Unit of the IPCC National Greenhouse Gas Inventories Programme (IPCC-NGGIP/TSU), spoke about news and ongoing projects under the IPCC-NGGIP. In the interest of continuous improvement, experts are invited to propose new emission factors, and after evaluation by an Editorial Board, these may be entered into the database. This is one valuable way to increase the availability and use of emission factors relevant in the Asian region. LULUCF is a particularly important aspect of the GHG inventories in Asia, and the IPCC has just recently adopted/accepted a new Good Practice Guidance report on this topic. He also introduced another project to revise the Revised 1996 IPCC Guidelines with a view to completion in early 2006. He stressed that the contributions from experts in this region are significant for this project. More information is available on these topics at http://www.ipcc-nggip.iges.or.jp.

Session I: Governmental Reports on National Systems for Gathering Information on Inventories

6. Session I was chaired by Mr. Dominique Revet of the UNFCCC Secretariat. During this session, the main focus was on institutional arrangements for GHG inventories.

7. To begin with, two speakers from Japan shared their country's experiences with GHG inventories and National Communications. Yoshiteru Sakaguchi of the Ministry of the Environment spoke about Japan's "learning curve," starting with research into CO_2 emissions during the 1980s, the submission of the first National Communication to the UNFCCC in 1994, the benefits of in-country reviews done by other Parties. Now Japan National GHG Inventories are prepared annually, on a routine cycle. In terms of institutional arrangements, he also described the coordinating role played by his ministry, and the creation of various committees and the Greenhouse Gas Inventory Office (GIO). Tomoyuki Aizawa, of the GIO in the National Institute for Environmental Studies, described the progress Japan has made in the development of methodologies and reporting over the years, and the annual cycle and data management system used today in GHG

inventory preparation. During discussion, it was observed that Parties can learn much from each other by sharing experiences relating to GHG inventories.

8. Next, four countries made presentations on institutional arrangements for preparing national GHG inventories. Many valuable points were raised. Dr. Asdaporn Krairapanond of Thailand described her country's experience in developing a GHG inventory, and a positive experience in sharing emission factors with Malaysia; and called for more networking in Asia to develop emission factors in every sector. Mr. Heng Chan Thoeun of Cambodia described the progress and challenges in his country and announced the recent creation of a Climate Change Office. Dr. Damdin Dagvadorj of Mongolia mentioned his country's National GHG Inventory Team and preparations now under way for the second National Communication. Ms. Raquel Ferraz Villanueva of the Philippines mentioned Philippine Inter-Agency Committee on Climate Change (IACCC) and the Technical Working Group on GHG Inventory, and both the successes and challenges faced in her country.

Session II: Expert Reports on Technical Issues Relating to Preparation of Inventories

9. Session II was chaired by Dr. Asdaporn Krairapanond of Thailand and Dr. Gao Qingxian of China. During this session, the main focus was on technical issues relating to GHG inventories. Ten countries made presentations.

10. Dr. Gao Qingxian of China introduced his country's National Coordination Committee on Climate Change, introduced a GEF/UNDP Project-Enabling China to Prepare Its Initial National Communication, and work being conducted to prepare the GHG inventory of GHG emissions from the municipal waste sector. Mr. Sum Thy of Cambodia described in detail his country's creation of the first national GHG inventory, using 1994 as the base year, in particular the detailed methodology used for LULUCF emissions, and the result that the more detailed inventory resulted in lower GHG emissions that reported earlier in the country's initial national communication. Dr. Amit Garg of India described the extensive network of institutions involved in his country's national communication, and mentioned the benefit of trying to use the respective strengths of each institution and ministry within a country. Dr. Rizaldi Boer of Indonesia illustrated the steady improvement in emission estimates over time (from U.S. country studies, to ALGAS, and then the national communication), with specific examples from forestry and agriculture, and mentioned a proposal (pending) to UNDP-GEF on regional activities to improve GHG inventories. Dr. Seungdo Kim of Korea gave a detailed explanation of his methodology relating to CH_4 emissions from landfills, and emphasized the value of developing local, more accurate emission factors. Mr. Syamphone Sengchandala of the Lao Republic described his country's experience with its first national GHG inventory, completed in 2000, and mentioned factors affecting achievement of results as lack of local expertise, reliable data,

country-specific/regional-specific emissions factors, and activity data. Finally, Dr. Damasa Macandog of the Philippines shared her country's experience in institutionalization of GHG inventory preparation, by giving a detailed explanation, sector by sector (agriculture, energy, etc.) of what data was obtained from whom, and how the coordination was conducted. Dr. Batima Punsalmaa of Mongolia reported on Mongolia's GHG inventory and emission factors. Mr. Hoang Manh Hoa of Vietnam gave a detailed presentation on the results of his country's national GHG inventory (1994 base year) and emission projections. And Dr. Sirintornthep Towprayoon of Thailand gave a presentation on the results of work in her country on emission factors in agriculture and waste sectors.

Session III
Discussion and Wrap-Up

11. Session III was chaired by Dr. Shuzo Nishioka. To begin, Dr. Towprayoon presented her report of discussions as rapporteur.

12. General Issues: During discussions, participants raised a number of general issues about GHG inventories, including institutional matters, gases covered in inventories, methodology, inventory year, and emission factors.

(a) Institutional organization for coordination, preparation and maintenance of GHG inventories:

- There are often many governmental institutions involved in various aspects of inventories, and some countries do not have an institutional system in place that can facilitate the maintenance of these inventories.
- Some countries have solved this problem by creating a body responsible for coordinating work on inventories, such as an inventory team or national committee.
- Other approaches include (i) contracting inventory work out to experts or academics, (ii), assigning the tasks to a relevant government department, and (iii) promoting multi-institutional involvement in inventories.

(b) Gases covered in inventories

- CO_2, CH_4, N_2O are generally covered in inventories of the countries participating in this workshop.
- NO_X, CO, NMVOC, SO_2 are not covered in some countries.
- HFCs, PFCs and SF_6 (F-gases) are also not covered in some countries.

(c) Methodology

- Most countries in the workshop are using the Revised 1996 IPCC Guidelines.
- The IPCC's Good Practice Guidance is used fully by Japan, and partially by some countries, to the extent their capacities permits, such as China, India, and the Philippines.

(d) Inventory year

- Except for Japan (which used 1990 because it is an Annex I party), Thailand (which

used 1990, 1994 and 2000) and Lao PDR (1990), at present the inventory base year of most countries is 1994.

(e) Emission factors

- Most countries are using IPCC default values, but some are using country-specific or local values based on expert judgement.

13. Problems and challenges: Participants also raised a number of issues relating to (a) capacity building, (b) emission factors, (c) activity data, and (d) funding.

(a) Capacity Building

- Inventory work in some countries suffers from frequent changes of experts, leading to problems with continuity.
- Some participants feel that there is insufficient internal (domestic) cooperation between ministries, etc.
- A shortage of experience, experts, and local expertise is a problem in some countries.
- Some countries face problems with limited number of staff and research capacity and feel that these problems are related to limited funding.
- The lack of a concrete policy framework to support inventories is a problem in some countries.
- The view was expressed that the challenge is for each country to build critical mass of data, experts, etc., for GHG inventories, and after that critical mass is achieved, better progress can be made.
- An insufficiency of public awareness about climate change is seen as a hindrance to building national support for GHG inventories.
- The view was expressed that enhancing international cooperation could help solve problems relating to capacity.

(b) Emission factors

- Most participants feel that more country-specific emission factors are needed
- Some participants feel that their countries lack sufficient quality analysis and quality control (QA/QC) capabilities, compared to the standards of the IPCC's Good Practice Guidelines. They also mentioned that it is important to note the distinction between internal and external QA/QC (i.e., managed within the country, versus reviews by out-of-country reviewers). Also, they feel the need to improve uncertainty analysis.
- Inadequacies in information systems and databases are seen as one cause of the insufficiency of emission factors.
- Improvements are needed in the level of key source analysis.

(c) Activity data

- Some participants experience problems with verification of activity data.
- Improvements are needed in data management of activity data.
- Access to data is sometimes a problem.

(d) Funding

- Participants feel that insufficient funding for in-country research and training is hindering progress with GHG inventories.
- Some feel that more funding from international sources would be important for in order to make greater progress with inventories.

14. Recommendations: Participants concluded that the following items are important topics deserving of support from national and international communities:

(a) International and national level trainings and meetings.

(b) Local/sub-regional database(s) of EF and activity data.

(c) Information exchange networks (regional and international).

(d) Financial and technical support to reduce uncertainty of GHG inventories (emission factors, activity data and methodologies, etc.).

(e) A more proactive role for IPCC Emission Factor Database (IPCC-EFDB).

15. To move forward from the discussions of this workshop, participants agreed that the following items were important for them to implement:

(a) Orient efforts in a way that will contribute to the international community.

(b) Continue discussions to consolidate the vision on GHG inventories and to keep the momentum of this workshop, with concrete actions (e.g., create an e-mail discussion list, etc.).

(c) Begin planning the next GHG inventory workshop.

(d) Consolidate progress through concrete activities. Possible examples include;

- regular workshops and trainings,
- documentation, and
- publications.

(e) Link efforts with concrete initiatives such as the Consultative Group of Experts (training workshops are planned).

16. Participants shared the following ideas for a future workshop on GHG inventories:

(a) Possible venues—China offered the possibility of hosting a workshop, which was positively received.

(b) Contents of workshop—Possible topics include

- Items included above in the “Problems and challenges”
- Sharing experiences, solving problems, exchanging lessons learned on the use of GPG, for example uncertainty analysis, processes for quality control, quality assurance
- 2nd National Communications under the UNFCCC. One possibility is to focus on what has been achieved with 1st NCs, and discuss how integrate lessons into 2nd NCs.

17. The participants thanked Japan for organizing the workshop, and expressed special appreciation to the host organizations in Thailand for the warm hospitality and wonderful venue.

Attachment I

Workshop on GHG Inventories in Asia Region
13-14 November 2003, Phuket, Thailand

Day 1, Thursday, 13 November 2003

9:30~10:00 Registration

10:00~12:00 Opening Session (Chair: Dr. Damasa Macandog) (120 min.)

- Welcome address (3 min.) (Dr. Shuzo Nishioka)
- Welcome speech from host country (5 min.) (Dr. Sirintornthep Towprayoon)
- Overview of workshop and explanation of schedule (10 min.) (Dr. Hideaki Nakane)
- Introduction of participants (10 min.) (each participant)
- Presentation on recent trends in preparing National Communications for non-Annex I countries (Mr. Dominique Revet, UNFCCC) (30 min. + Q&A 10 min.)
- Presentation on revision of IPCC guidelines and development of database for emission factors (Mr. Kiyoto Tanabe, IPCC-NGGIP/TSU) (30 min. + Q&A 10 min.)

12:00~13:30 Lunch

13:30~15:50 Session I (Chair: Mr. Dominique Revet) (140 min.):

Reports by participating officials on the development of national system for gathering information regarding the inventories

- Presentation on recent problems and efforts on preparing inventory in Japan (Mr. Yoshiteru Sakaguchi and Mr. Tomoyuki Aizawa) (25 min. + Q&A 5 min.)
- Presentation on establishment of national system on preparing inventories (13 min. + Q&A 2 min. for each presentation)
  - National system in Thailand (Dr. Asdaporn Krairapanond)
  - National system in Cambodia (Mr. Heng Chan Thoeum)
  - National system in the Indonesia (Mr. Gunardi)
  - National system in Korea (Mr. Seung-Hwan Oh)
  - National system in the Mongolia (Dr. Damdin Dagvadorj)
  - National system in the Philippines (Ms. Raquel Ferraz Villanueva)
- Overall Q&A for session I (20 min.)

15:50~16:05 Tea Break

16:05~18:15 Session II (Chair: Dr. Asdaporn Krairapanond) (130 min.):

Reports by participating experts on technical issues relating to the preparation of inventories (130 min.)

- Presentation on methods applied for the preparation of inventories including methods for collection of activity data and calculation of emission factors
  - Thailand (Dr. Sirintornthep Towprayoon) (12 min. + Q&A 3 min.)
  - China (Dr. Gao Qingxian) (15 min. + Q&A 5 min.)
  - Cambodia (Mr. Sum Thy) (12 min. + Q&A 3 min.)
  - India (Dr. Amit Garg) (12 min. + Q&A 3 min.)
  - Indonesia (Dr. Rizaldi Boer) (12 min. + Q&A 3 min.)
  - Korea (Dr. Seungdo Kim) (12 min. + Q&A 3 min.)
  - Lao Republic (Mr. Syamphone Sengchandala) (12 min. + Q&A 3 min.)
- Overall Q&A for session II (20 min.)

Day 2, Friday, 14 November 2003

9:30~10:35 Session II (continued) (Chair: Dr. Gao Qingxian) (65 min.)

- Mongolia (Dr. Batima Punsalmaa) (12 min. + Q&A 3 min.)
- Philippines (Dr. Damasa Macandog) (12 min. + Q&A 3 min.)
- Vietnam (Mr. Hoang Manh Hoa) (12 min. + Q&A 3 min.)
- Overall Q&A for session II (20 min.)

10:35~10:55 Tea Break

10:55~12:40 Session III: Discussions (Chair: Dr. Shuzo Nishioka) (105 min.)

- Report on Session I and II from Rapporteur (Dr. Sirintornthep Towprayoon)
  -Overview on APN-CAPaBLE project (Dr. Hideaki Nakane)
- Discussion on expanding possibilities for improvements in preparing inventories
  The output shall be reflected in the revision of IPCC guidelines in 2006 and the development of database for emission factors.
- Introduction on APN-CAPaBLE project and suggestions on this project

12:40~14:10 Lunch (during which preparations will be made for Session III)

14:10~15:00 Session III: Wrap-up

15:00~15:20 Closing Session

- Closing Remarks (Dr. Shuzo Nishioka)

- Closing Remarks (Dr. Asdaporn Krairapanond)
- Closing Remarks (Mr. Katsuhiko Naito)

Attachment II

LIST OF PARTICIPANTS
WORKSHOP ON GHG INVENTORIES IN ASIA REGION
13-14 November 2003, Phuket, Thailand

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PRESENTATIONS

Overview of workshop and explanation of schedule
Dr. Hideaki Nakane

GIO Greenhouse Gas Inventory Office of JAPAN 1

Overview of the Workshop of the GHG Inventories in Asia Region (WGIAR)

Hideak NAKANE
Manager,
Greenhouse gas Inventory Office of Japan (GIO),
Center for Global Environmental Research (CGER),
National Institute for Environmental Studies (NIES)

GIO Greenhouse Gas Inventory Office of JAPAN 2

Joint Hosting Organizations

*Ministry of the Environment of Japan
Mr. Katsuhiko Naito

*National Institute for Environmental Studies, Japan
Dr. Shuzo Nishioka

*The Joint Graduate School of Energy and Environment, King Mongkut's University of Technology Thonburi, Thailand
Dr. Shirintornthep Towprayoon

Overview of workshop and explanation of schedule
Dr. Hideaki Nakane

GIO Greenhouse Gas Inventory Office of JAPAN 3

Participants

25 participants from 11 countries and
2 international organizations
UNFCCC; Mr. Revet,
IPCC-NGGIP/TSU; Mr. Tanabe,
are attending.

National Institute for Environmental Studies Center for Global Environmental Research
http://www-cger.nies.go.jp

GIO Greenhouse Gas Inventory Office of JAPAN 4

Expected outcomes and process in the workshop

- To exchange information and experiences on the GHG inventories including the recent trends and development in UNFCCC and IPCC,
  (Opening sessions, Session I and II)
- To discuss and finalize the conclusion on issues raised in the presentations such as;
  (1) institutional arrangements for inventories preparation,
  (2) methodologies for inventories preparation,
  (3) others including future direction and cooperation,
  (Session III)
- To prepare the summary and report,
  (Session III – Wrap-up)
- To clarify the future direction (and action items)

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Overview of workshop and explanation of schedule
Dr. Hideaki Nakane

Details of the Sessions, Chairs, Rapporteur

•Opening Session (Char; D. Macandog)
D. Revet (UNFCCC)
K. Tanabe (IPCC-NGGIP/TSU)

•Session I (Chair; D.Revet)
Reports by participating officials on the national system

•Session II (Chairs; A. Krairapanond, G. Quingxian)
Reports by participating experts on technical issues

•Session III Discussions (Chair; S. Nishioka)
Rapporatuer (S. Towprayhoon)
Overview on APN-CAPaBLE project (H. Nakane)

Role of Chairs

• To introduce yourself,

• To remind what is the subject of the sessions at the beginning of the session,

•Time keeping; please keep 2 minutes for Q&A
with cooperation with the time-keeper (Mr. Sakaguchi)
and ask participants to be punctual

•Very brief closing address may be helpful.

Overview of workshop and explanation of schedule
Dr. Hideaki Nakane

Summary and Report

Wrap-up Session;
Will show Chairman's Summary on screen and discuss

Final printed report:
•Agenda
•Preface
•Contents
•Chairman's Summary
•Rapporteur's Report
•Presentations (powerpoint outputs)
•Background Paper (suggestions for revision are welcome)
•Participants list

Others?

Thank you!!

Recent trends in preparing NAI national communications

- ✓ Why develop GHG inventories?
- ✓ What's new?
- ✓ GHG inventories of the Asia Region
- ✓ What's next?

Dominique REVET
UNFCCC secretariat
DRevet@unfccc.int

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(1) Why develop GHG inventories?

- **Para. 6 of Decision 17CP.8**

  Each non-Annex I Party **shall**, in accordance with **Article 4, paragraph 1 (a)**, and **Article 12, paragraph 1(a)** of the Convention, communicate to the Conference of the Parties a national inventory of anthropogenic emissions by sources and removals by sinks of all greenhouse gases (GHGs) not controlled by the Montreal Protocol, to the extent its capacities permit, following the provisions in these guidelines.

- **Linkage with the mitigation analysis**

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(2) What's new?

- Guidelines for the preparation of national communications from Parties not included in Annex I to the Convention (**Decision 17CP.8**)
- **1st half of 2004**: UNFCCC will modify the IPCC GHG inventory software to produce "table 1 and 2"
- **Last minute**: *GPG for LULUCF adopted by the IPCC*
- IPCC Emission Factors database (**EFDB**)
- **GEF Operational Procedures** for the Expedited Financing of National Communications from Non-Annex I Parties

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(i) Guidelines for the preparation of national communications (17CP.8)

- **Para. 6: Introduction**

  National GHG inventory is a **key element** of the national communication.

  - ✓ should include information on how you **organized** and **approached** your inventory work.
  - ✓ you may want to follow the IPCC diagram containing **various stages** of inventory work.
  - ✓ Be sure to describe the stages of the inventory from which the new work was started.

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Para. 7: Inventory years

- Second NC, inventory year to be reported is **2000**.
- **LDC** can choose any year at their discretion.
- Would be preferable if Parties could report for any of the years from 1994 up to, and including 2000, **if data is available**.
- **Second GHG inventory**, it is advisable **to revise the data** provided for the first inventory (revision may facilitate the understanding of possible changes to the first inventory).
- **Parties wishing to report for years other than for 1990 or 1994 and 2000, are welcome to do so**. This applies also to Parties that are preparing their first or the third NC.

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A. Methodologies

Para. 8: Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories

- Parties should only use the **latest version** (i.e. **Revised 1996**) of the "IPCC Guidelines for National Greenhouse Gas Inventories" (3 volumes, http://www.ipcc-nggip.iges.or.jp/public/gl/invs1.htm).
- The use of IPCC Guidelines is enhanced by the **inventory software**.
- These Guidelines are **complemented** by the IPCC **GPG**.
- The **GPG on LULUCF** was recently adopted by the IPCC and will be distributed to Parties at COP 9.

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Para. 9: Tiers 1 and 2 or 3 methodologies

- The **higher** the number designating the tier, the **more detailed** is the methodology and the more accurate are the emission estimates.
- **Tier 1** represents the **minimum**, or default, methodology. If sufficient data is available, a Party can also try to apply a higher tier.
- **Tiers 2 or 3** involve **more elaborate methods** which could be either source category-specific or technology-based. These methods require more detailed data and/or measurements for their application.
- In the case where a national methodology exists, and is **consistent** with the IPCC Guidelines, it is highly advisable to use the national methodology. The national methodology used should be **fully documented** in order to allow the reader to understand why this particular method is better than the default one proposed by the IPCC.

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Para. 10: Default emission factors and activity data

- The default IPCC methodology may not be appropriate for all countries. It is therefore **important to use country-specific or regional emission factors and activity data**, if available, in order to reduce the uncertainty while estimating the emissions and removals.
- It might be useful to start thinking about the **potential synergies among the countries of the region** and elaborate plans to develop such crucial information, bearing in mind the need to better reflect the national circumstances in terms of emissions and removals.
- The **formulation of cost-effective national or regional programmes** aiming at the development or improvement of country-specific or regional emission factors and activity data can be a good way of dealing with the problem of the inappropriateness of emission factors and activity data.
- It is also important to note that in the future some country-specific and regional emission factors may become available on the **Emission Factor database**, which is being developed by the IPCC (http://www.ipcc-nggip.iges.or.jp/EFDB/main.php).

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- **Para. 11: IPCC Good Practice Guidance (GPG)**

- ✓ GPG provides useful guidance for **selecting** methods (tiered approaches), emission factors and activity data.
- ✓ It helps in selecting appropriate methods and emission factors, in quantifying and analysing uncertainty, in determining **key source categories**, in recalculating emissions data, and in setting up quality assurance and quality control plans.
- ✓ http://www.ipcc-nggip.iges.or.jp/public/gp/gpgaum.htm

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- **Para. 12: Key source analysis**

- ✓ A **key source category** is one that is prioritised within the national inventory system because its estimate has a **significant influence** on a country's total inventory of direct greenhouse gases in terms of absolute level of emissions or trends in emissions, or both.
- ✓ Countries can **prioritize** their **efforts** to improve their overall estimates. Such a process **will lead to improved quality**, as well as greater confidence in the emissions estimates that are developed.
- ✓ It is good practice to identify national key source categories in a systematic and objective manner. The IPCC Good Practice Guidance explains how key sources are determined.

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B. Reporting

- **Para. 13: Institutional arrangements**

✓ Parties are welcome to provide information about the procedures and arrangements (e.g. institutional) established in order **to sustain the process of data collection and archiving**. This is intended to help make inventory preparation **a continuous process**.

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- **Para. 14: Direct greenhouse gases**

✓ **3 direct GHGs** (CO_2, CH_4, N_2O) should be provided

✓ on a **gas-by-gas** basis (i.e. no single aggregate figure)

✓ in **units of mass** (the IPCC generally uses Gg, i.e. 1,000 tonnes).

✓ This information will be used in **Table 1** and is greatly facilitated by the use of the IPCC **inventory software** which automatically summarizes this information.

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- **Para. 15: Information on HFCs, PFCs and SF_6**
  - ✓ In their INC, some Parties have already reported on emissions of HFCs, PFCs or SF_6. **Table 2**, contained in the annex to the UNFCCC guidelines, provides a framework for the reporting of such emissions.
- **Para. 16:Information on CO, NO_x and NMVOCs**
  - ✓ Reporting in **Table 1** is greatly facilitated by the use of the IPCC **inventory software** which automatically summarizes this information.

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- **Para. 17: Information on SO_x**
  - ✓ Reporting in **Table 1** is greatly facilitated by the use of the IPCC inventory **software** which automatically summarizes this information.
- **Para. 18: Use of reference vs. sectoral approach**
  - ✓ Both approaches should be used.
  - ✓ It would be useful **to explain/discuss the difference** between the two results.
  - ✓ This can help to further improve future GHG inventories by progressively **reducing this level of uncertainty**.
  - ✓ The reporting of both approaches is greatly facilitated by the use of the IPCC inventory **software** which automatically summarizes this information.

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Para. 19: Bunker fuels

- ✓ When data on international bunker fuels is available, Parties **should strive to report it**, providing any breakdown of this information, as a **memo item** (i.e. **not included** in the national total).

Para. 20:Global warming potentials (GWP)

- ✓ Reporting in terms of **aggregate emissions** (i.e. to convert emissions into CO_2 equivalent) serves the purpose of facilitating the comparison between sectors or comparing the relative importance of each direct GHG.
- ✓ If a Party chooses to use GWPs, it should use those provided by the **IPCC** in its **Second Assessment Report**, published in **1995** (i.e.: **1** for **CO_2**, **21** for **CH_4** and **310** for **N_2O**).

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Para. 21: Sources of information

- ✓ It is advisable to describe as precisely as possible the sources of information (activity data and emission factors) and methodologies used, **especially for country-specific sources and/or sinks which are not part of the IPCC Guidelines**.
- ✓ It contributes to the **clarity** of the information and helps the reader to understand what was done and how it was done.
- ✓ It is important for Parties **to identify the data gaps** and to make the **link with further improvement** to be achieved through **capacity-building** in order to facilitate further requests for financial and technical assistance.

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Para. 22: Use of Table 1 and Table 2

- ✓ It is important that Parties **use** Table 1 and Table 2 contained in the annex to decision 17/CP.8.
- ✓ Will be **automatically generated** by the **IPCC inventory software** which **will be modified by the UNFCCC secretariat**.
- ✓ It is also advisable to **read carefully the footnotes** in Table 1 and Table 2. The only **notation keys** to be used by Parties are the ones agreed to by the IPCC and are listed in the footnote of table 1.
- ✓ **Particular attention** should be paid as to **how Table 2 should be presented** in order to suit the data available.

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Para. 23: Sectoral tables and worksheets

- ✓ The **sectoral tables**, which summarize the emissions by sectors, are **automatically generated** by the IPCC inventory **software**.
- ✓ The provision of the **electronic copy** of the worksheets and sectoral tables of the GHG inventory is intended to **facilitate** the **compilation of data** for the preparation of compilation and synthesis as well as other documents. This task can easily be achieved by providing the electronic files generated by the IPCC GHG inventory software in **MS Excel format**.
- ✓ http://www.ipcc-nggip.iges.or.jp/public/gl/software.htm

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Para. 24: Level of uncertainty

- ✓ The **GPG has substantially improved the methodology** for calculating and managing uncertainties (see chapter 7 of the GPG).
- ✓ A major objective of the IPCC methodology is **to help national experts reduce uncertainty** in their GHG inventories to the minimum level possible.
- ✓ However, the approach also recognizes that **significant uncertainties will remain** despite these efforts, and that these uncertainties will vary widely.
- ✓ The provision of such information is intended to help the reader better understand the information contained in the national GHG inventory.

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(ii) GEF Operational Procedures for the Expedited Financing of NCs

- ✓ To be presented at the GEF Council meeting later this month
- ✓ Available on the GEF web site (http://www.gefweb.org/Documents/Council_Documents/GEF_C22/gef_c22.html)
- ✓ Will be officially launched at COP 9 at NAI side event (CC:Forum, 2nd Dec. 2003)

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(3) GHG inventories for Asia region

- ✓ 148 NAI Parties, 106 NCs, 99 GHG Inv. Already available via the UNFCCC on-line database
- ✓ 32 NCs from NAI Parties from Asia
- ✓ Still 22 from Asia to be submitted

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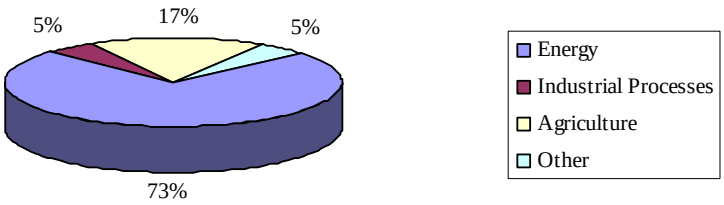
Distribution of GHG emissions from the Asia region (excluding LUCF)



- Total emissions for 32 countries (excluding LUCF): 2 142 Mt CO_2 Equiv.
- LUCF: 42 Mt CO_2 Equiv. (or 2%)

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(4) What's next?

- Start preparing request for **funding of 2nd NC**
- Future development at **UNDP/NCSU**:
  - NCs Programme for Climate Change (60 M$ project over 6 years)
  - Training Manual for GPG
  - Training module in support of the development of inventory systems for LULUCF sector in NAI countries
  - 2 regional projects (Europe/CIS, and West and Francophone Central Africa) on Improving the Quality of GHG Inventories
- **UNFCCC User Manual** for the Guidelines on the Preparation of NCs from NAI Parties
- Consultative Group of Experts (**CGE**) on NAI NCs to conduct hands-on training from 2004
- Why not …?

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Some Useful Web Links

UNFCCC/IMP-NAI http://unfccc.int/program/imp/nimp1.html

UNFCCC on-line searchable database on GHG inventories http://ghg.unfccc.int/default1.htf?time=11%3A27%3A25+AM

UNDP/NCSP(NCSU) http://www.undp.org/cc/index2.htm

IPCC http://www.ipcc.ch/

Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories http://www.ipcc-nggip.iges.or.jp/public/gl/invs1.htm

IPCC Software for National GHG Inventory and Workbook http://www.ipcc-nggip.iges.or.jp/public/gl/software.htm

IPCC GHG Inventory Software Incorporating the Decision 17/CP.8 Tables *(will only available from first semester of 2004)*
http://unfccc.int/program/mis/ghg/index.html

Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories
http://www.ipcc-nggip.iges.or.jp/public/gp/gpgaum.htm

Technical Support Unit (TSU) for IPCC-NGGIP (National Greenhouse Gas Inventories Programme)
http://www.ipcc-nggip.iges.or.jp/tsu/tsustaff.htm

UNITAR/CC:TRAIN *(original CC:TRAIN training materials only available on CD-rom at the moment, should be updated and made available on the UNITAR web site soon)* http://www.unitar.org/cc/

UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE

Revision of IPCC guidelines and development of database for emission factors

Mr. Kiyoto Tanabe

INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE

NATIONAL GREENHOUSE GAS INVENTORIES PROGRAMME

WMO UNEP

On-going Projects under the IPCC National Greenhouse Gas Inventories Programme

Workshop of GHG Inventories in Asia Region

(Phuket, Thailand, 13 - 14 November 2003)

Kiyoto Tanabe, Technical Support Unit

IPCC National Greenhouse Gas Inventories Programme

IPCC National GHG Inventories Programme

Reports & Tools for National GHG Inventories

1995: IPCC Guidelines for National GHG Inventories

1997: Revised 1996 IPCC Guidelines for National GHG Inventories & Software for the Workbook

2000: Good Practice Guidance and Uncertainty Management in National GHG Inventories (GPG2000)

2002: Database on GHG Emission Factors (EFDB) — **On-going**

2003: Reports on Land Use, Land-Use Change and Forestry

- Good Practice Guidance for LULUCF, etc. — **Just Completed**

Preparatory phase

2006: Revision of the Revised 1996 IPCC Guidelines (2006 IPCC Guidelines)

Revised 1996 IPCC Guidelines

- **Coverage:**
  - ✓ **7 major Sectors**: Energy, Industrial Processes, Solvent and Other Product Use, Agriculture, Land-Use Change and Forestry, Waste, Others
  - ✓ **Gases**: CO_2, CH_4, N_2O, HFCs, PFCs, SF_6, NMVOCs, CO, NOx, SO_2
- **Volume I: Reporting Instructions**
  - ✓ General instructions, Reporting tables, Glossary, etc.
- **Volume II: Workbook**
  - ✓ Step-by-step instructions with worksheets, Default values
  - ✓ IPCC Software – a supplement to the Workbook
- **Volume III: Reference Manual**
  - ✓ Scientific background, Methodologies (Tiered approach)

Good Practice Guidance (GPG2000)

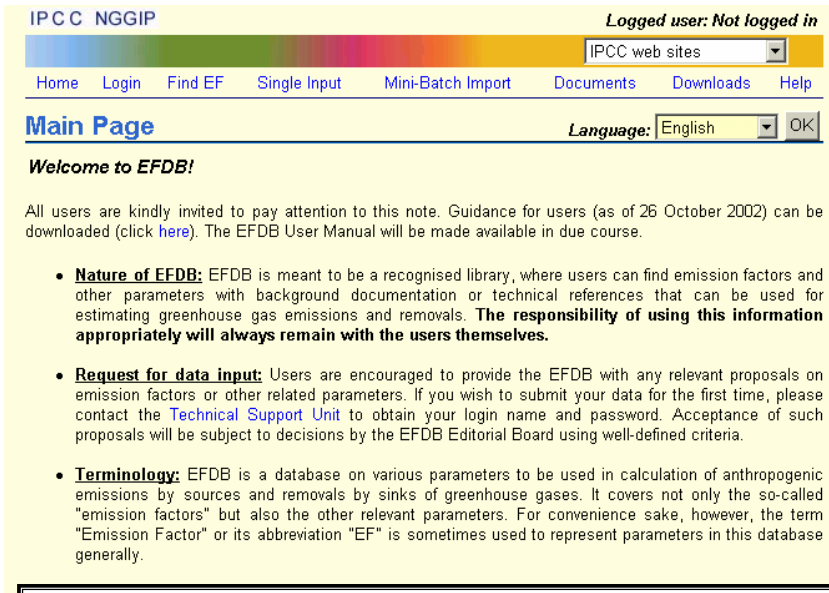
- **Coverage:**
  - ✓ **4 major Sectors**: Energy, Industrial Processes, Agriculture, Waste
  - ✓ **Gases**:CO_2, CH_4, N_2O, HFCs, PFCs, SF_6
- **Elaboration of Revised 1996 IPCC Guidelines**
- **Assist countries in producing inventories**:
  - that are neither over- nor underestimates so far as can be judged
  - in which uncertainties are reduced as far as practicable
- **Provide guidance on**
  - ✓ Choice of methods/emission factors/activity data
  - ✓ Reporting and documentation
  - ✓ Identification of Key Source Categories
  - ✓ Quantification of Uncertainties
  - ✓ QA/QC /etc.

Database on GHG Emission Factors (EFDB)

- Background
  - ✓Reliable emissions factors – crucial in producing accurate GHG inventories
  - ✓Emission factor development – costly, time consuming, requires much expertise
  - ✓Sharing information – cost-effective

=> need for an easily accessible database on emission factors and other parameters used in inventory calculations

In October 2002, EFDB Web version was launched.



Http://www.ipcc-nggip.iges.or.jp/EFDB/main.php

Database on GHG Emission Factors (EFDB)

➢ Nature of the EFDB

- ✓EFDB is meant to be **a recognised library** of GHG emission factors and other parameters.
- ✓Users can find emission factors and other parameters with background documentation or technical references that can be used for estimating GHG emissions and removals.
- ✓The responsibility of using this information appropriately will always remain with the users themselves.

Database on GHG Emission Factors (EFDB)

➢ Criteria for inclusion of new data

- ✓EFDB is open to any proposals
  – the **Editorial Board** will evaluate the data for entry to the database.
- ✓EFDB should assist countries in producing inventories that are neither over- nor underestimates so far as can be judged and in which uncertainties are reduced as far as practicable.
- ✓To this end, the data to be included should be
  - **Robust**
  - **Applicable**
  - **Documented**

Database on GHG Emission Factors (EFDB)

- **At present ...**
  - ✓Web-based
  - ✓Contain only the IPCC default data and the data from CORINAIR94
  - ✓To be populated with data from researchers/ scientists/experts, industry, other databases, …
- **Future of the EFDB**
  - ✓CD-ROM version: annually or biannually;
  - ✓Success – depending on input from the global scientific and inventory society;
  - ✓Continuous improvement on the content and functionality – experiences and feedback important

Reports on Land Use, Land-Use Change and Forestry (LULUCF Programme)

- Background
  - ✓Invitation to the IPCC in the Marrakesh accords LULUCF (Land use, land-use change and forestry) Decision 11/CP.7 (at COP7 in November 2001)
  - ✓IPCC response in three tasks:
    - **Good Practice Guidance for LULUCF** (Task 1)
    - **Definitions and inventory methodologies for 'Degradation of forests and devegetation of other vegetation types"** (Task 2)
    - **Practicable methodologies for factoring out direct human-induced effects from the others** (Task 3)

Adopted/accepted at IPCC XXI (Vienna, 3-7 Nov 2003)

Reports on Land Use, Land-Use Change and Forestry (LULUCF Programme)

Task 1:
Good Practice Guidance for LULUCF

- Complements the IPCC 1996 Guidelines and existing Good Practice Guidance (GPG2000)
- Contents:
  - Chapter 1: Overview
  - Chapter 2: Consistent representation of land areas
  - Chapter 3; LUCF Sector Good Practice Guidance
  - Chapter 4: Supplementary methods and Good Practice Guidance arising from the Kyoto Protocol
  - Chapter 5: Cross-cutting issues

Reports on Land Use, Land-Use Change and Forestry (LULUCF Programme)

Task 2:
Definitions and methodological options for degradation of forests and devegetation of other vegetation types

- Builds on Task 1 methodologies
- Table of contents:
  - ✓ Chapter 1: Overview
  - ✓ Chapter 2: Options for Definitions of Forest Degradation and Devegetation of Other Vegetation Types
  - ✓ Chapter 3: Methodological Options for Estimating Emissions from Forest Degradation and Devegetation
  - ✓ Chapter 4: Implications of Definitional Options for Forest Degradation and Devegetation under Article 3.4 of the Kyoto Protocol

Reports on Land Use, Land-Use Change and Forestry (LULUCF Programme)

Task 3:

Development of practicable methodologies for factoring out direct human-induced changes in carbon stocks and greenhouse gas emissions by sources and removals by sinks from those due to indirect human-induced and natural effects (such as those from CO_2 fertilisation or nitrogen deposition), and effect due to past practices in forests

- Challenging – Good science is not available for development of comprehensive methodologies for factoring out.
- IPCC XXI decided to forward the Scientific Statement to SBSTA - SBSTA19 in December 2003 is expected to consider this issue.

Revision of the 1996 IPCC Guidelines (2006 IPCC Guidelines)

- **Background**
  - ✓Revised 1996 IPCC Guidelines and GPG reports
    - Guidelines about ten year old – partly obsolete
    - Three sets of reports – one user-friendly set
    - EFDB – complement to the GLs and GPG
    - Experience in the use
  - ✓SBSTA 17 (October – November 2002)– invitation to the IPCC – by early 2006
  - ✓IPCC Inventory Task Force Bureau 9th session (late November 2002) – plan for the revision
  - ✓IPCC XX (February 2003) – endorsed preparatory steps for the revision

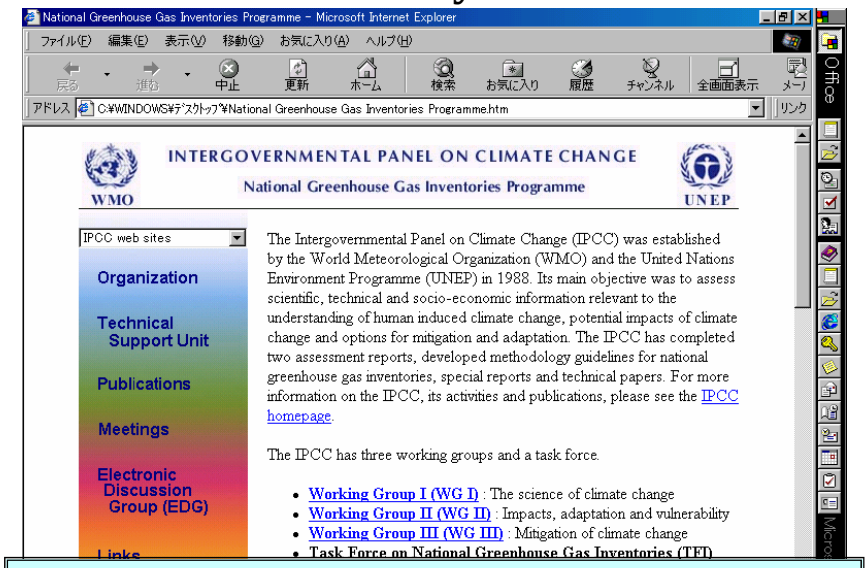
Revision of the 1996 IPCC Guidelines (2006 IPCC Guidelines)

- **Scoping Meeting on the project**
  - ✓A expert group scoping meeting on the project was held on 16-18 September 2003 in Geneva to develop draft TOR, TOC and Work Plan.
  - ✓Various key issues were discussed:
    - Scope of gases
    - Scope of source/sink categories
      - – New sources/sinks
      - – Restructuring new and existing sources/sinks
    - Methodological updates/improvements
    - Improving user-friendliness, linking project level/entity level reporting and national inventories, etc.

Revision of the 1996 IPCC Guidelines (2006 IPCC Guidelines)

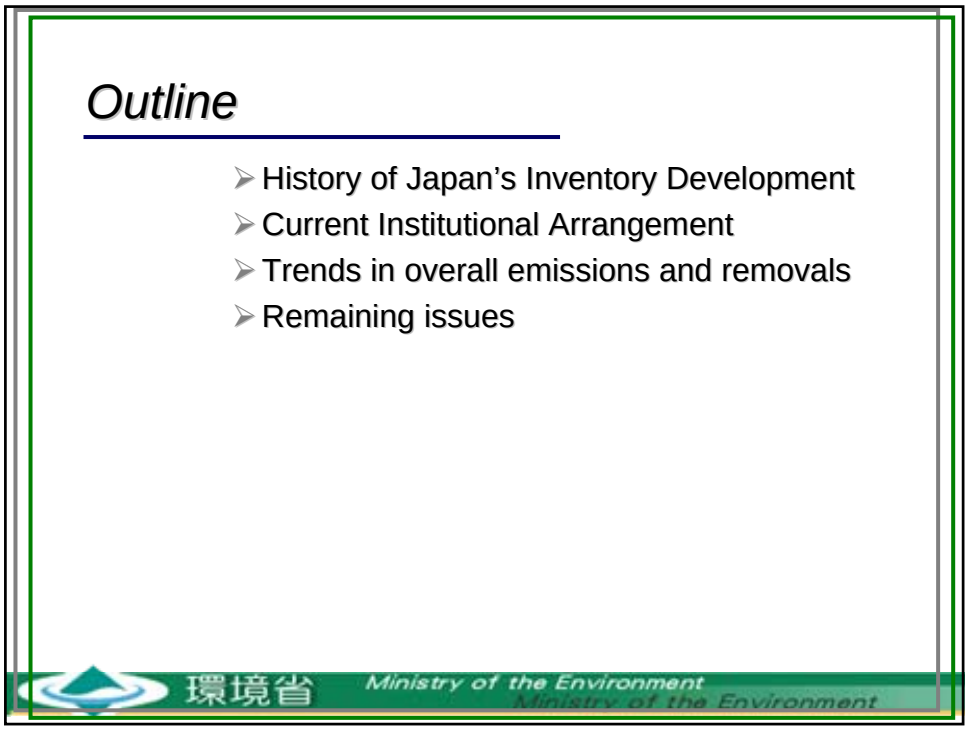
- **Development in the future**
  - ✓IPCC Inventory Task Force Bureau, at its 11th session (19 September 2003), considered the draft TOR, TOC & Work Plan based on the outcomes of the scoping meeting.
  - ✓Draft TOR, TOC & WP (IPCC-XXI/Doc.10) was endorsed with some amendments by the IPCC XXI (Vienna, 3-7 November 2003).
  - ✓Nomination and selection of the authors is envisaged from November 2003 - February 2004.
  - ✓Writing will start in Spring 2004 with a view to completion in early 2006 to meet SBSTA invitation.

Thank you.



http://www.ipcc-nggip.iges.or.jp

Recent problems and efforts on preparing inventory in Japan
Mr. Yoshiteru Sakaguchi



History of Japan's Inventory Development

1980's

Estimation of CO_2 emissions were started by researchers

1989

Development of CH_4 and N_2O emissions estimation methods was started by Environment Agency (predecessor of MOE)

1990

National CO_2 emissions were estimated according to the establishment of "Action Program to Arrest Global Warming"

環境省 Ministry of the Environment

History of Japan's Inventory Development

1992 onward

CO_2 emissions were reported to "Council of Ministers for Global Environment Conservation under the cooperation with ministries.

1994.9

Submission of the first National Communication (NC1)

1996.7

In-depth review of NC1

Guideline for NC2 was established

1996.9

Revised 1996 IPCC Guidelines were approved

環境省 Ministry of the Environment

History of Japan's Inventory Development

1996.10-12

Revision of JNGI (Japan National GHG Inventory) under ad-hoc expert committee to reflect the comment of IDR, revision of IPCC guidelines and the best available scientific information

1997.6

Submission of the second National Communication

1998.10

Annual inventory submission to UNFCCC was started

1999.10

UNFCCC reporting guidelines on annual inventory

環境省 Ministry of the Environment

History of Japan's Inventory Development

1999.11-2000.9

"Committee for the GHG Emissions Estimation Methods" was set up for the revision of JNGI

2000.5

Good Practice Guidance was published

2000.7

Submission of JNGI 2000 (CRF and relevant data set)

(improvement: CRF application, Actual emissions of F-gas, Addition of new sources)

環境省 Ministry of the Environment

History of Japan's Inventory Development

2001.5

Individual review (centralized review) of JNGI 2000

2001.9 – 2002.7

"Committee for the GHG Emissions Estimation Methods" was set up for the Quantitative uncertainty assessment and the development of method

2002.5

Submission of the third National Communication

環境省 Ministry of the Environment

History of Japan's Inventory Development

2002.8

Submission of JNGI 2002 (CRF and relevant data set)
(improvement: Sectoral approach for CO_2 emissions ,etc)

2003.8

Submission of JNGI 2003 (CRF)

2003.9

The first NIR (National Inventory Report) submission

2003.10

Individual review (In-country visit) of JNGI 2003

環境省 Ministry of the Environment

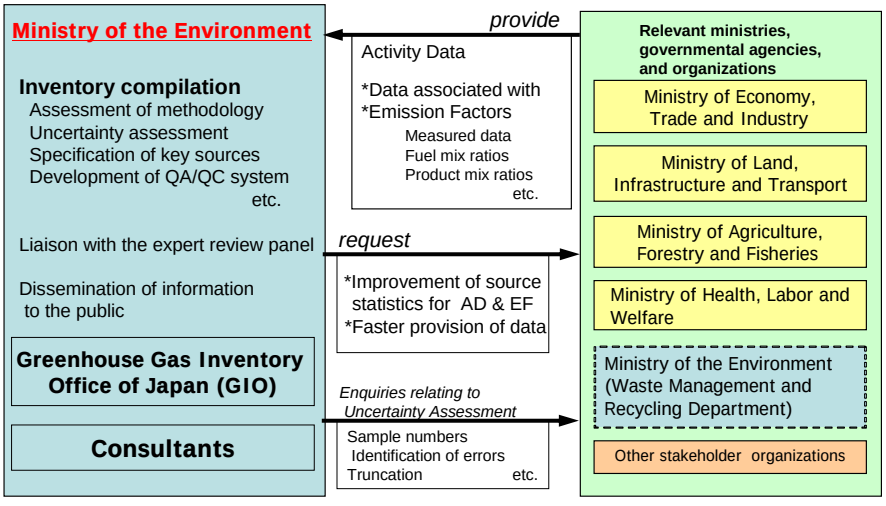
Recent problems and efforts on preparing inventory in Japan
Mr. Yoshiteru Sakaguchi

Current Institutional Arrangement

- MOE compiles Japan's inventory including following information
  - ✧ estimation of GHG emissions and removals
  - ✧ identification of key source categories
  - ✧ uncertainty assessment, etc.
- Relevant ministries, agencies, and organizations provide data for EF and activity data
- Actual task is conducted in Greenhouse Gas Inventory Office (GIO) in National Institute for Environmental Studies, with assistance of consultants

環境省 Ministry of the Environment

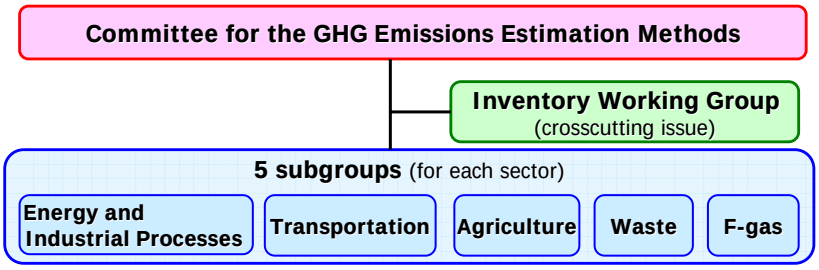
Current Institutional Arrangement



環境省 Ministry of the Environment

Current Institutional Arrangement

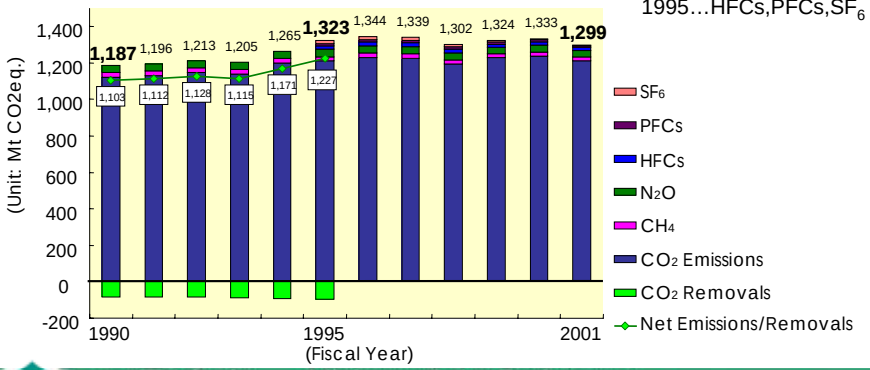
- MOE set up the Committee for the GHGs Emissions Estimation Methods, since 2000
- The committee was in charge of methodological development of the inventory
- Approximately 60 experts participated.



環境省 Ministry of the Environment

Trends in overall emissions and removals

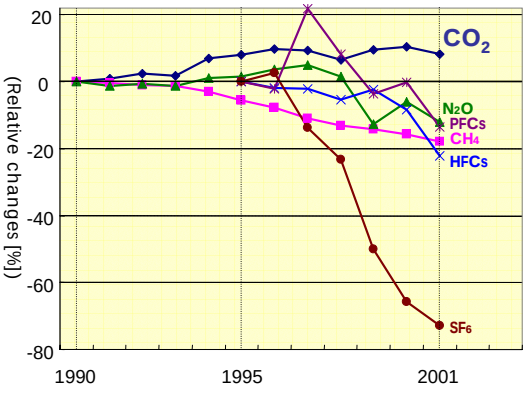
- Overall emission of GHGs:
  - 1,187 [Mt CO_2 eq.] in 1990 (CO_2, CH_4, N_2O)
  - 1,299 [Mt CO_2 eq.] in 2001 (CO_2, CH_4, N_2O, HFCs, PFCs, SF_6)
- Increased by 5.2% since KP's Base Year : 1990…CO_2, CH_4, N_2O 1995…HFCs,PFCs,SF_6

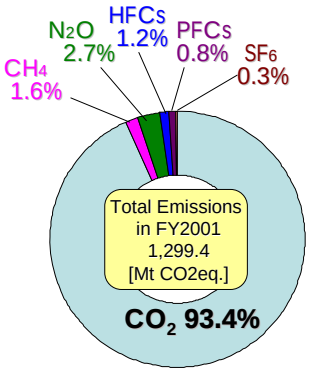


環境省 Ministry of the Environment

Trends in overall emissions and removals

- CO_2 +8.2%, CH_4 -18.0%, N_2O -12.0% (since 1990)
- HFCs -22.1%, PFCs -13.7%, SF_6 -72.9% (since 1995)
- Share of CO_2 amounts to be 93.4%





環境省 Ministry of the Environment

Remaining Issues

- Delay of submission

  According to Dec.11/CP4, Annex I parties are requested to submit annual inventory by 15th April.

  -- Japanese Inventories were submitted on July ~ August these years

- Reporting on a calendar year basis

  1996 IPCC Guidelines: "Inventories are prepared on a calendar year basis." (Jan. ~Dec)

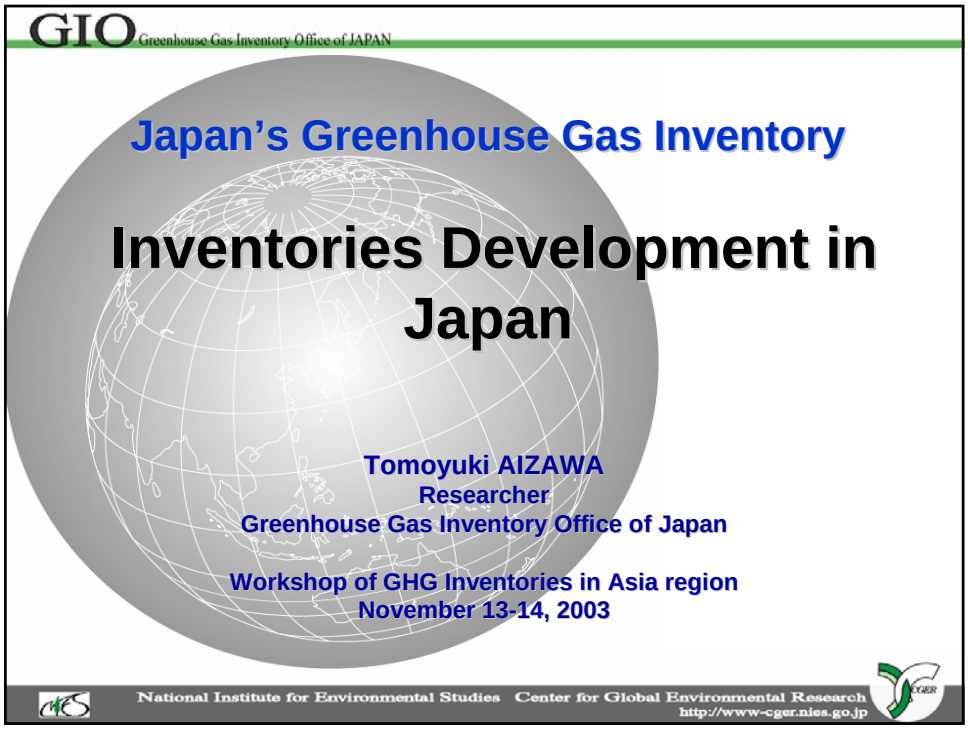
  -- Japanese Inventories are prepared on a fiscal year basis (Apr. ~Mar.).

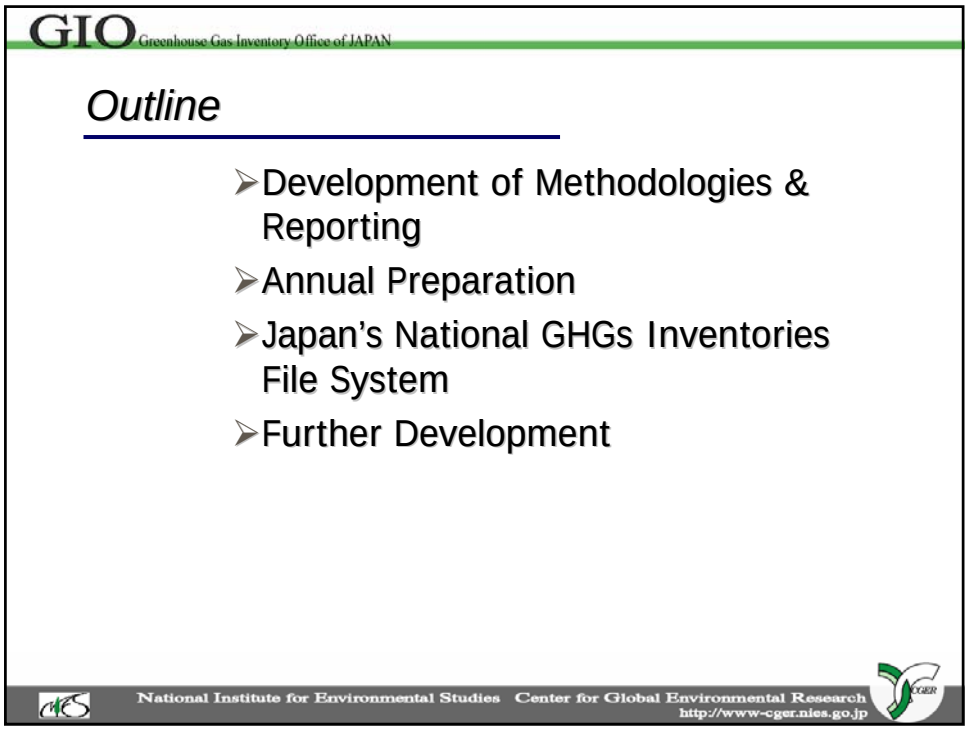
  (Most of Japanese statistics are prepared on a fiscal year basis)

環境省 Ministry of the Environment

Recent problems and efforts on preparing inventory in Japan
Mr. Yoshiteru Sakaguchi

Recent problems and efforts on preparing inventory in Japan
Mr. Tomoyuki Aizawa





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Development of Methodologies & Reporting

- What did drive development and improvement of Japan's inventories?
  - *The international requirement*
    - In-depth review of Japan's NC
    - Publication of Revised 1996 IPCC Guidelines
    - Publication of Good Practice Guidance (2000)
    - Revision of UNFCCC reporting guideline (application of CRF)
    - Annual Inventory Review under FCCC
  - *The domestic requirement*
    - The best available scientific knowledge in Japan
    - Actual measurement of coefficients such as EF by the industrial group, which is substituted for the IPCC default values
    - Revision of statistics used in the inventory preparation

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Development of Methodologies & Reporting

- Japan had developed initial inventory before 1995 IPCC GL, which was not yet transparent, comparable and complete.

- Improvement after the In-depth review of Japan's NC & the Publication of Revised 1996 IPCC Guidelines
  - Before NC1 and 1996 IPCC GL, CO_2 emissions allocated to each sector by the electricity consumption along the method developed by Japanese researchers. In the IDR of NC1 **ERT** pointed out that these methods were not follow the IPCC methods, therefore we revised our inventory for UNFCCC without allocation of CO_2 from electricity consumption.
  - We revised the estimation methods of LUCF according to the **ERT's recommendation**.
  - Other small improvement with IDR and IPCC GL

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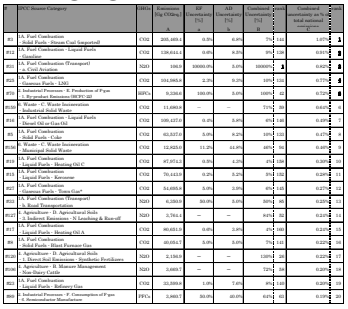
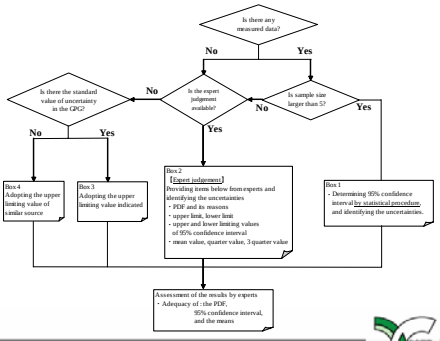
Development of Methodologies & Reporting

- Improvement after the Publication of Good Practice Guidance (2000)
  - Before GPG(2000), only the qualitative uncertainty assessment by expert judgement was submitted. The **quantitative uncertainty** assessment was done along the GPG.





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Development of Methodologies & Reporting

- Improvement after the Publication of Good Practice Guidance (2000) *(cont.)*
  - **Key source category analysis** provided the priority of development cost-effectively.
  - **QA/QC** procedure will make our inventories more accurate and will reduce editorial mistakes. QA/QC was done by inventory agency but it is not still formal implementation.
  - Some revised **default EF** were provided by GPG. So, new sources could be added to Japan's inventories.

⇒GPG made our inventory more accurate and facilitate the inventory development.

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Development of Methodologies & Reporting

- Improvement after the Revision of UNFCCC reporting guideline
  - **National Inventory Report** (NIR) was required to prepare in the UNFCCC GL. In this year, Japan's first NIR was prepared and submitted to UNFCCC.
  - The UNFCCC GL required the fulfillment of the all cells of the CRF with the Notation Keys such as "NE", "NO", etc. This requirement relating to the **Common Reporting Format** (CRF) facilitated checking the completeness. The sources "NE" were tried to estimate in the Committee for GHGs Emissions Estimation Methods.

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Development of Methodologies & Reporting

- Improvement according to the Annual Inventory Review under FCCC
  - Japan's inventories have been reviewed twice in the individual review. The first one was centralized review in 2001. However, NIR was not prepared. So, it was difficult to review without NIR and we could have little point to addressed.
  - In this year, In-country visit review was conducted with 1st NIR. The **ERT** has indicated many **potential point to improve**, which was quite helpful for our inventory development.

    For example
    - ✓ In the category of agriculture, possible improvement of technical aspects in N2O emissions measurement from soils.
    - ✓ In the category of energy, our misunderstandings in establishment of EF of CH_4 and N_2O from fuel combustion, which was considered intake air. Intake air was not considered in the IPCC GL. , etc.

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Development of Methodologies & Reporting

- The best available scientific knowledge in Japan
  - There are many researches on the global warming issue under the research project such as the Global Environment Research Fund of Ministry of the Environment of Japan.
    - ✓ **Category 4. Agriculture**: Enteric Fermentation, Manure Management, Field burning of agricultural residues
    - ✓ **Category 6. Waste**: Wastewater Handling

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Development of Methodologies & Reporting

- Actual measurement of coefficients such as EF by the industrial group, which is substituted for the IPCC default values
  - In the 1st Committee for GHGs Estimation Method, EF of some sources were adopted IPCC default values. In the process and after the process, some related stakeholders such as industrial groups, who thought IPCC default values were not adequate for circumstances of Japan, provide the data of coefficients based on actual measurement and/or estimation.
    - ✓ **Category 1. Energy**: Fugitive emissions (Coal Mining, Town gas production, Oil production, Oil refinery, Natural Gas Production, Natural Gas Processing), etc.
    - ✓ **Category 2. Industrial Processes**: Production of Cement, Lime, Carbon Black, Ethylene, 1,2-Dichloroethane, Styrene, Coke, etc.

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Development of Methodologies & Reporting

These factors below drove the inventories development in Japan.

- The international requirement
  - The international requirement was often the primary motivation of inventories development.
- The domestic requirement
  - The disclosure of process and method of inventories preparation sometimes could be stakeholders' motivation to obtain the actual coefficients such as EF. We think that these data might improve the IPCC's default values as substitute.

⇒The Committee for GHGs Estimation Methods considered issues from these factors above.

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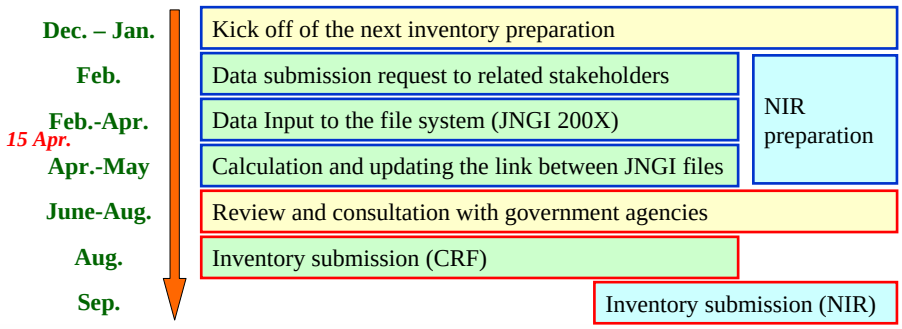
Annual Preparation of GHGs Inventory

- Japan's inventories are prepared in every year according to the Cop decision.
- Approximate timeline of inventories preparation is shown below (case of last year 2002-2003);



Recent problems and efforts on preparing inventory in Japan
Mr. Tomoyuki Aizawa

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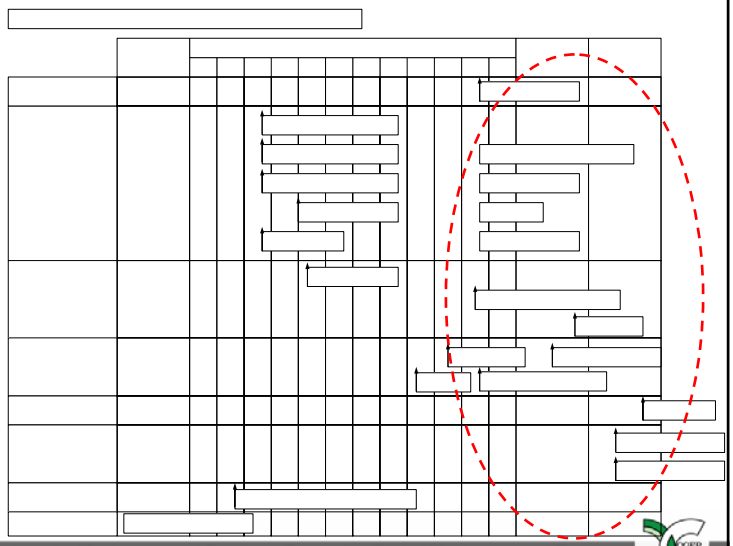
Annual Preparation of GHGs Inventory

- Late submission of Japan's inventories are caused by activity data.



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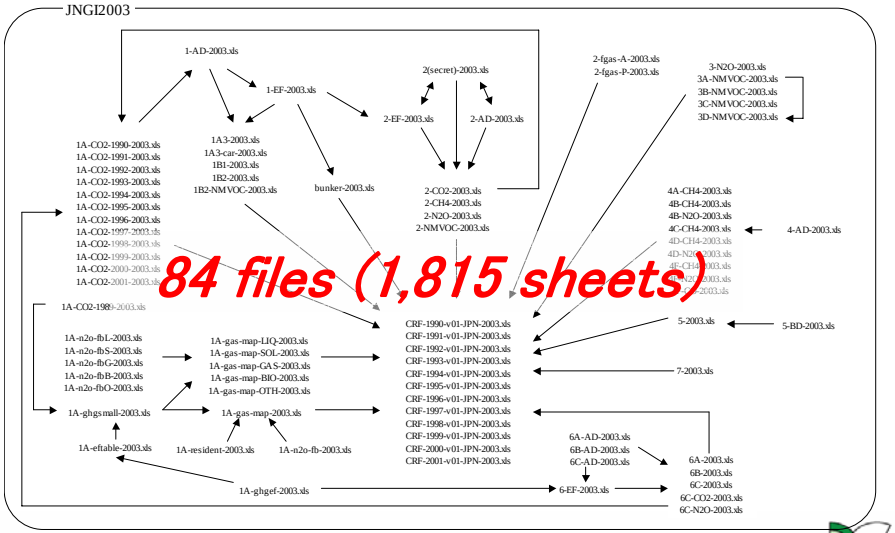
Japan's National GHGs Inventories File System



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Japan's National GHGs Inventories File System

2.A.1. Cement Production

Equation

E= EF× A
A = Aw × (1 - Rw)

Time Series

Estimation

		[Unit]	1990	1991	1992	1993	1994	1995	1996
Aw	Consumption of Limestone (wet)	[t]	92,511,000	96,345,000	99,392,000	98,441,000	100,898,000	100,632,000	101,524,000
Rw	Moisture content	[%]	3.4%	3.3%	3.2%	3.3%	3.2%	3.3%	3.2%
A	Consumption of Limestone (dry)	[t]	89,365,626	93,165,615	96,211,456	95,192,447	97,669,264	97,311,144	98,275,232
MW_lime	Molecular weight of CaCO3	[g]	100.09	100.09	100.09	100.09	100.09	100.09	100.09
MW_co2	Molecular weight of CO2	[g]	44.01	44.01	44.01	44.01	44.01	44.01	44.01
R_co2		—	0.440	0.440	0.440	0.440	0.440	0.440	0.440
P_lime	Purity of limestone	[%]	94.2%	94.2%	94.3%	94.4%	94.4%	94.5%	94.6%
EF	Emission Factor	[t CO2/ t limestone]	0.414	0.414	0.415	0.415	0.415	0.415	0.416
E	Emissions	[t CO2]	37,006,413	38,605,596	39,894,161	39,497,789	40,552,325	40,430,377	40,857,940
		[Gg CO2]	37,006	38,606	39,894	39,498	40,552	40,430	40,858

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Japan's National GHGs Inventories File System

- Feature of JNGI File system
  - **Transparency**: disclosure of all files other than confidential data. If you see these files, you could trace all the estimation process. These files facilitate the review by the third party.
  - **Updating automatically**: Structure of JNGI covers from data input to reporting with CRF.
  - **Same Structure**: Most files have same structure to facilitate making new files such as additional sources, revision of methods.
  - **All time series**: Most files include estimation of all time series. Therefore, it is easy to recalculate and assess the time series consistency.

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http://www-cger.nies.go.jp

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Further Development

- Following the reporting requirement completely.
  - **Transparency**: improvement of the NIR with more explanation
  - **Completeness**: establishment of methods in sources reported as "NE"
  - **Comparability**: improvement of the CRF reporting, which includes inadequate data provision
  - **Consistency**: reporting the data through the all time series
  - **Accuracy**: when the latest scientific knowledge become available, method would be improved. (e.g. carbon balance in the refinery sector, etc.)
  - Formal **QA/QC** procedure
  - **Comparison** with other method (e.g. IPCC default methods)

GIO Greenhouse Gas Inventory Office of JAPAN

Thank you!

ありがとうございました。

Thailand's Experiences in GHGs Inventories

Dr. Asdaporn Krairapanond
Ministry of Natural Resources and Environment
Workshop of GHG Inventories in Asia Region

November 13-14, 2003
Phuket, Thailand

Overview

- **1990: 1st official GHGs inventory prepared in 1997**
- **Mainly supported by US Country Study Program**
- **Partly supported by the Royal Thai Government**

Overview (cont.)

- 1994 national inventory of GHGs represents the 2nd official inventory in Thailand
- Mainly supported by the Royal Thai Government
- Partly supported by GEF
- Used as the official data for National Communication

Methodology used

- 1994 inventory is the result of recent studies conducted by researchers from various research and academic institutes
- 1996 IPCC Revised Guidelines for National Greenhouse Gas Inventories

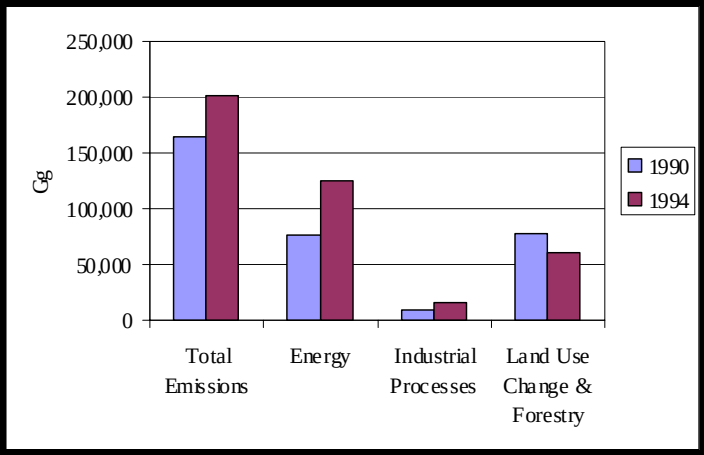
Methodology used (cont.)

- used local activity data to substitute for the default data recommended by IPCC
- Inventory was emphasized with task forces for specific sectors

Methodology used (cont.)

- Experts from academia were utilized while knowledge and capacities were transferred to relevant government officials
- A series of internal review and workshops have been conducted throughout the period of inventory and National Communication preparation

CO_2 Emission by Sources, 1990, 1994



GHGs Inventory

- **Gross CO_2 241 Tg (-sink 39 Tg): Net 202 Tg**
- **Energy emitted more than one-half of CO_2: forest and landuse emited less than that of 1990**
- **Methane 3.2 Tg: About 91 % from rice and livestock**

GHGs Inventory (cont.)

- N_2O 56 Gg; mostly from manure and agriculture soils
- NO_x 287 Gg; mainly from energy
- CO 555 Gg; mainly from land use change and forestry and agriculture
- NMVOC 2.5 Tg; mainly from energy
- *Total 1994 net emissions = 286 Tg CO_2 equivalent*

Experiences Gained

- Information and data on climate change accumulated
- Experts practiced new methodologies on climate change issues
- Capacities of large numbers of scientists and social scientists were enhanced

Experiences Gained (cont.)

- Related officials were trained through workshops and seminars
- Sub-regional and Regional cooperation: emission factors (Malaysia)

Problems and Limitations

- Activity data, local emission factors and methodologies appropriate to national circumstances:
  - limited related research activities to support inventory and National Communication preparation
  - lack of certain government policy
  - lack of high-level decision making awareness

Problems and Limitations (cont.)

- Information system and database
- Experts with capacity built are difficult to maintain
- Trained officials are difficult to maintain

Beyond NC

- Enabling Activity Phase II:
  - mainly supported by GEF
  - focused on Technology need assessment, Observation systematic network and emission factors

Next Step

- Information system and database should be established
- Activity data, local emission factors and methodologies appropriate national circumstances should be improved
- Ways must be searched to maintain and enhance local capacities in preparation of inventory and National Communication

Next Step (cont.)

- Establish task forces composed of experts from academia and related official staff to work together in GHGs inventory preparation
- Mobilize the experiences and engagement of related officials to develop information system for activity data and emission factors

Next Step (cont.)

- Government policy framework and high-level decision making awareness are crucial needed

Suggestion for Regional Cooperation

- Encourage the establishment of data bank and information network on activity data and local/sub, regional emission factors in every sector
- Invited Japanese Government to support the development of local/sub, regional emission factors in every sectors

Suggestion for Regional Cooperation (cont.)

- Call for financial and technical support both through bi- and multilateral cooperation
- Encourage IGES and NIES to be the regional cooperation center
- Welcome more communication

Thank you

- *Dr. Asdaporn Krairapanond*
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- *E-mail: asdaporn@hotmail.com*

Workshop on GHG Inventory in Asia Region
Phuket, Thailand
13-14 November 2003

NATIONAL SYSTEM ON PREPARING GREENHOUSE GAS INVENTORY FOR CAMBODIA

Presented by
Heng Chan Thoeun, Climate Change Office
Ministry of Environment, Cambodia

Outline of the Presentation

- Background
- Institutional Arrangement
- Data Collection and Management
- Issues of GHG inventory preparation
- Future steps

National system in Cambodia
Mr. Heng Chan Thoeum

I. Background

- As Non-Annex I party to the UNFCCC, Cambodia needs to prepare its National GHG Inventory in the form of National Communication
- Cambodia started preparing its first-ever GHG inventory in 1999
- The preparation of the national GHG inventory was done under the UNDP/GEF funded project "Climate Change Enabling Enabling Project"
- Project Duration: Phase I (3 years, 99-01), and phase II (1 year, 02-03)
- The Ministry of Environment (MoE) is the national implementing agency

II. Institutional Arrangement (1)

- Under the "Climate Change Enabling Activity Project", the following committees were established:
  (1) The Project Steering Committee (PSC) : the policy making body of the project consisting of senior technical level officials from concerned ministries, academic institutions, the private sector, and UNDP;
  (2) The National Technical Committee (NTC), played an important role in preparation of GHG inventory, GHG mitigation, V&A assessment and national communication as well.

II. Institutional Arrangement (2)

Representatives from government agencies and academic institutes formed the committees:

- Ministry of Environment
- Ministry of Agriculture, Forestry and Fisheries
- Ministry of Industry, Mines and Energy
- Ministry of Water Resources and Meteorology
- Ministry of Public Works and Transport
- Ministry of Land Management, Urbanization and Construction
- Ministry of Finance and Economy
- Ministry of Foreign Affairs and International Cooperation
- Royal University of Phnom Penh
- Royal University of Agriculture.

III. Data Collection and Management

Activity data was collected from

- Relevant reports
- National documents
- National database
- National Statistical Books etc.
- Field survey (LULUCF in phase 2)

- Activity data were grouped into specific sector: energy, agriculture, industrial processes, LULUCF, and waste management
- Emission factors: no national emission factors, but used IPCC default values
- GHG emission estimated based on the IPCC methodology (1996)

IV. Issues of GHG inventory preparation (1)

Institutional Arrangement:

- Relatively insufficient inter-ministerial/agency cooperation and coordination
- Lack of experiences, limited technical capacity of local staff, limited financial resources, no national experts in the country
- Difficulty in recruiting or keeping qualified staff to work for the project (Low incentives for qualified local staff)
- Limited participation in climate change activities
- No climate change research/training institutions in the country
- Inadequate national climate change policy/strategy
- No formal institutional arrangement for GHG inventories

IV. Issues of GHG inventory preparation (2)

Technical issues:

- Extremely weak activity data for all sectors.
- Complete absence of local emission factors for all sectors.
- Weak data management skill.
- Difficulty in following the Revised 1996 IPCC Guidelines, especially for LUCF sector (Differences in forest classification).
- Lack of GHG inventory experts available in the country.
- Difficulty in conducting uncertainty analysis. Inability of local staff and insufficient information.
- Quality and accuracy issues (No substantial technical comments or advice from concerned agencies).

V. Future steps (1)

MoE recently established Climate Change Office (CCO). Main duties are:

- Undertake all the technical activities related to UNFCCC and other climate change related tasks, GHG inventory, National Communication, CDM as well.
- Provide information and advice the the Royal Government in preparation of its position for international meetings and in establishing of national policies, legal instrument and plans in the field of climate change.

V. Future steps (2)

- Promote research activities and human capacity building in the field of climate change in Cambodia.
- Develop new climate change related project proposals for submitting to donor agencies.
- Strengthen networks with national and international agencies.
- Promote public awareness and education on climate change.

Thank You for Your Attention!

GHG Inventories in Asia Region

13-14 November 2003, Phuket, Thailand

NATIONAL SYSTEM IN MONGOLIA

D.Dagvadorj, Mongolia Met Agency
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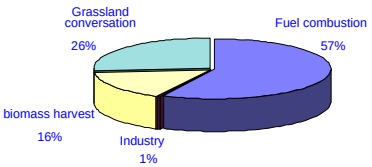
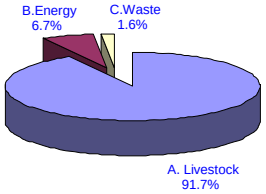
GHG emissions in Mongolia (1)

Main GHGs are Carbon Dioxide and Methane in Mongolia.

Anthropogenic activities associated with the largest sources of carbon dioxide in Mongolia are combustion of fuel for power generation, heat production and conversion of grasslands to crops. The most significant source of methane is enteric fermentation in livestock. Emissions of nitrous oxide, nitrogen oxides and carbon monoxide are insignificant relative to total emissions of carbon dioxide and methane.

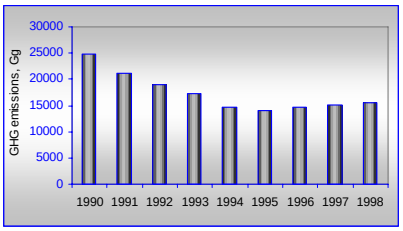


CO_2 emissions by sector for 1994



Methane emissions by sectors, 1994

GHG emissions in Mongolia (2)

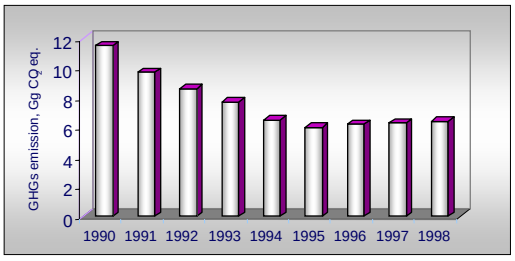


Net emissions of GHGs in CO_2-equivalents

The Mongolia total GHGs emissions is very low.

The sharp decrease of GHGs total emission since 1990 till 1995 is mostly due to socio-economic slowdown and subsequent recovery. The emissions of CO_2 and CH_4 start to increase from 1996 as a result of some increased economic activities in coal mining and liquid fuel import. Shortly emissions level follow country's economic growth.

GHG emissions in Mongolia (3)



Dynamics of per capita emissions of GHGs, Gg CO_2-equivalent

Even though the Mongolia total GHGs emissions is very low, the annual per capita emission of GHGs in CO_2-equivalent is relatively high compared to other countries. It can be explained as very low population (2.4 million) and high requirement of heating for long duration.

National context (1)

Mongolia's GHGs inventories include emissions of carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), nitrogen oxides (NO_x) and carbon monoxide (CO). Emissions of other greenhouse gases, such as NMVOCs and PFCs, have not been included in the inventory.

Emissions were estimated for years 1990 to 1998, but according to the COP Guidelines for the preparation of Initial Communications by non-Annex I Parties to the UNFCCC, more detailed data are presented for 1994 as the base year for the inventory.

National context (2)

- **Because of the historical, geographical, climatic and economic circumstances of the country, some sources of GHGs such as methane emissions from oil and gas systems, emissions from savanna and agricultural residues burning, methane from rice cultivation, and use of fertilizers on agricultural soils are not applicable.**
- **A major limitation of the GHG Inventory data was the accuracy of the base data used. The main source of data was the Statistical Yearbook, which presents the only official inter-sectoral balance of energy and material flow in Mongolia.**

National context (3)

- **Some country-specific sources of GHGs i.e. land used for open mining are considered as a source of CO_2 due to the conversion of grasslands for this purpose and accidental manmade steppe and forest fires in Mongolia occur often in spring and autumn, are the sources of greenhouse gases such as carbon dioxide, carbon monoxide, methane, nitrogen and nitrous oxides.**
- **However, while the last is believed to be a significant source of GHGs in Mongolia, it was not included in the national emission totals considering that the IPCC Guidelines do not consider this as an anthropogenic source at this time.**

Institutional arrangements (1)

National Agency for Meteorology, Hydrology and Environment Monitoring was designated by the Government of Mongolia as a leading agency for climate change related studies, including GHG inventories.

The Agency is responsible for Establishment of National GHG Inventory Team, Collecting activity data and Emission Factors, Compiling, Archiving, Updating, and Managing GHG Inventories.

Institutional arrangements (2)

Participating Organisations:

- **Ministry of Nature and the Environment**
- **Ministry of Infrastructure**
- **Ministry of Agriculture**
- **Ministry of Food and Agriculture**
- **State Statistical Office**
- **Ulaanbaatar City Governor's Office**
- **Universities**
- **Private sector and NGOs**

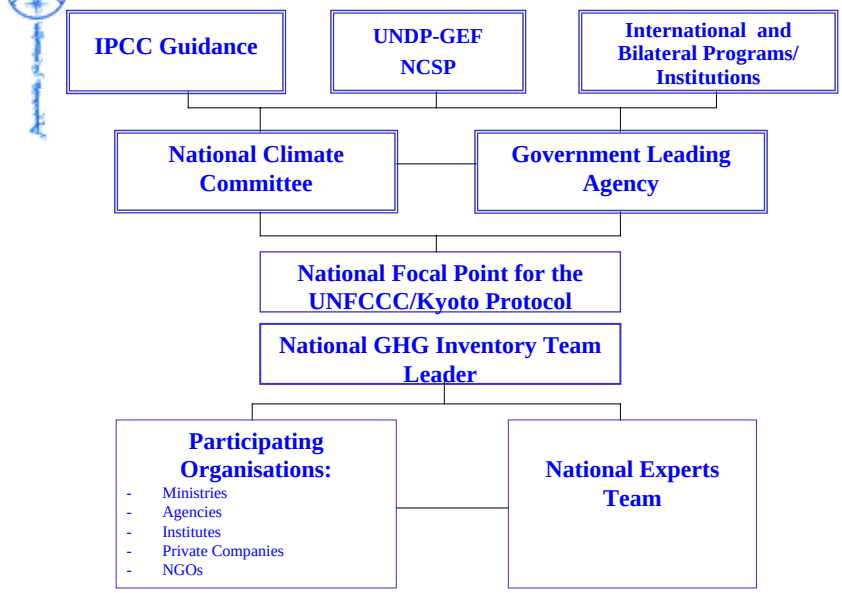
Institutional arrangements (3)

National GHG Inventory Team was created. But, the Team is not permanent. National experts work on the contract basis when a inventory activities are necessary.

National Team Leader in National Agency for Meteorology, Hydrology and Environment Monitoring

National system in the Mongolia
Dr. Damdin Dagvadorj

Organisational chart



Planning Immediate Objectives

1. Strengthening of national arrangements for compiling, archiving, updating, and managing greenhouse gas inventories
2. Create a Sustainable institutional process
3. Enhance technical capacity for preparing national inventories
4. Improve emission factors and methods

National Strategy (1)

The main strategies of the country are:

- **to improve the quality of the GHG inventories to be included in the Second National Communication.**
- **to sustain Technical and Institutional capacity**

National Strategy (2)

Activities to strengthen national arrangements :

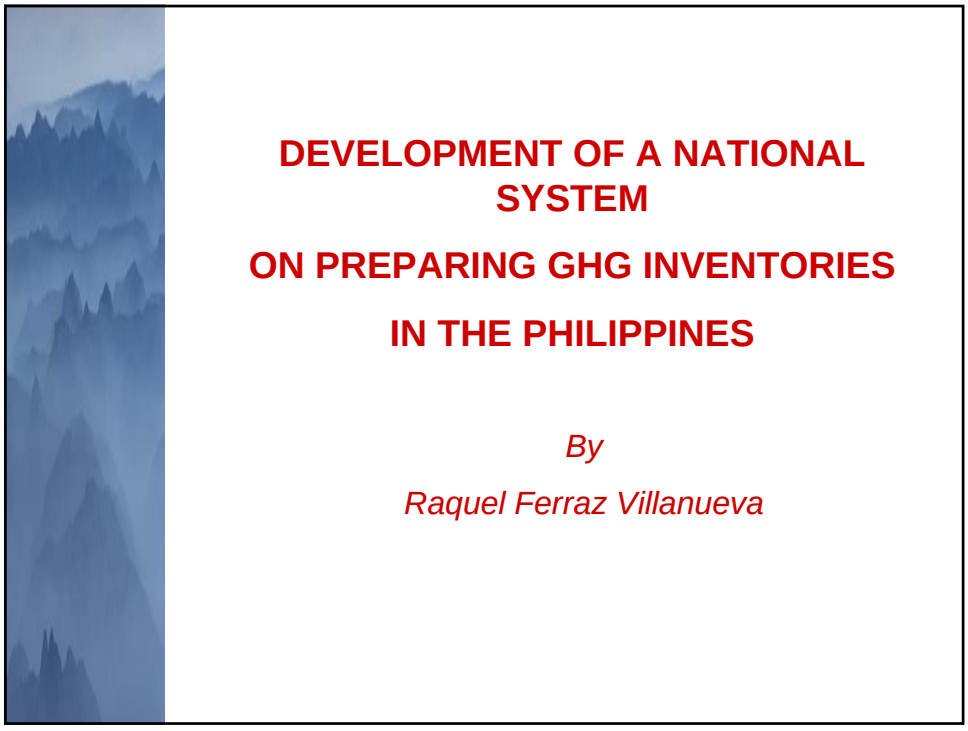
- Training of National GHG Inventory Team in the IPCC's Good Practice Guidance
- Development of Long-term National Strategies to improve inventory preparation
- Identification of the national institutions and organisations to be targeted for long-term involvement in the inventory process.
- Development of a manual of procedures for preparing a national GHG inventory

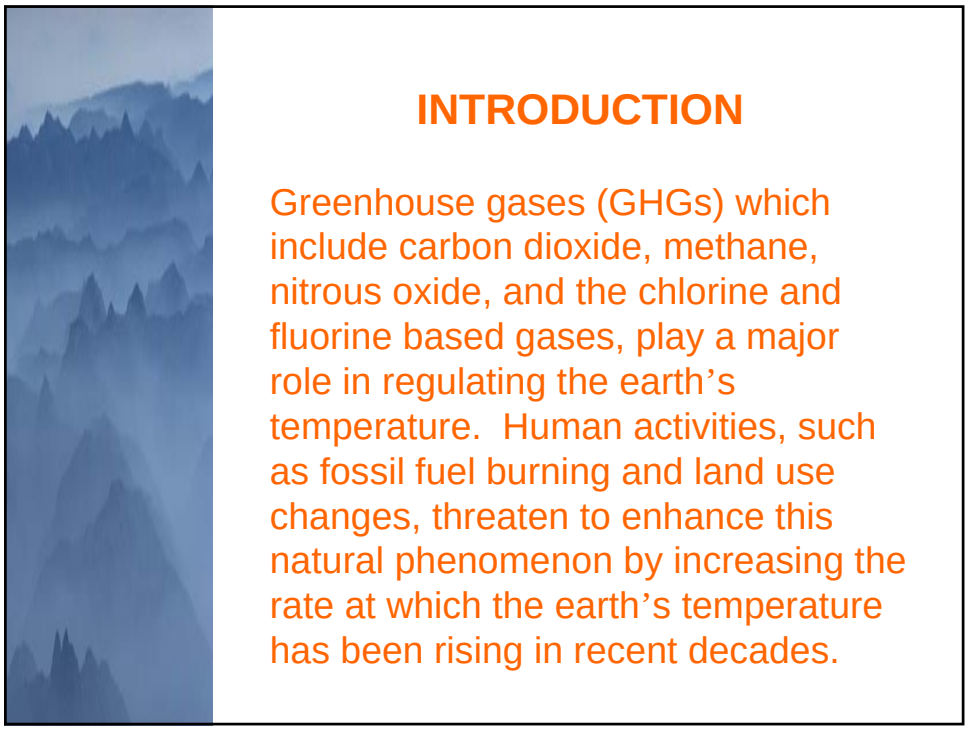
National Project Strategy (2)

Activities on improving selected emission factors and methods:

- Systematically documentation of the reliability of the emission factors and re-estimation of EFs.
- Preparation of key source inventory.
- Training of National experts in quality analysis and quality control (QA/QC) procedures
- Development of plans of the QA/QC that can be put into place for Second National Communications.
- Archiving of all activity data and emission factors

Thank you


DEVELOPMENT OF A NATIONAL SYSTEM
ON PREPARING GHG INVENTORIES
IN THE PHILIPPINES
By
Raquel Ferraz Villanueva


INTRODUCTION
Greenhouse gases (GHGs) which include carbon dioxide, methane, nitrous oxide, and the chlorine and fluorine based gases, play a major role in regulating the earth's temperature. Human activities, such as fossil fuel burning and land use changes, threaten to enhance this natural phenomenon by increasing the rate at which the earth's temperature has been rising in recent decades.

The national GHG inventory is a critical instrument in climate change policy. When taken in its historical context, the inventory provides an immediate way of differentiating the responsibility of mitigating climate change through the reduction of GHG emissions. On the national scale, the inventory also provides an effective way of identifying those sectors which contribute significantly to a country's GHG emission total. It can be an important index of efficiency and sustainable development.

In cooperation with various government agencies, experts from the Philippine Atmospheric, Geophysical, and Astronomical Services Administration (PAGASA) conducted the first national inventory of GHG emissions for 1990. This was with the assistance from the U.S. Country Studies Program. The Inter-Agency Committee on Climate Change initiated a similar activity in 1999, collaborating with a research team from the Manila Observatory, to complete an emissions inventory for 1994, this time under a grant from the UNDP-GEF Enabling Activity program. This inventory, together with information about national policies and vulnerability and adaptation assessments, was included in the Philippines' initial national communication to the UNFCCC.

Compiling a national GHG emissions inventory in a developing country context is hampered by a variety of constraints, such as the lack of financial, technical, and human resources. One of the most critical barriers is the absence of an institutional environment that will facilitate the inventory process itself. Institutionalizing or regularizing the process on a national scale will help sustain the activity and effectively utilize existing resources and expertise.

The Institutional Environment: The Inter-Agency Committee on Climate Change

The Philippine Inter-Agency Committee on Climate Change (IACCC) was instituted in 1991 by virtue of Administrative Order No. 220 in recognition of the need to establish an intergovernmental mechanism to address issues related to climate change. The role of IACCC in institutionalizing the GHG inventory process is crucial because it acts as the coordinating body for all climate change activities in the Philippines.

The IACCC is tasked to formulate policies and response strategies to climate change and to evaluate climate change-related projects insofar as these are consonant with national policy. It also approves any information submitted to the UNFCCC, including the national emissions inventory and the national communication.

Its membership formally includes representatives from 13 government agencies or offices and an umbrella network of non-governmental organizations (NGOs). The Secretaries of the Department of Environment and Natural Resources (DENR) and Department of Science and Technology (DOST) serve as co-chairs of the committee. At present, PAGASA represents DOST in this capacity.

In addition to DENR, DOST, and PAGASA, committee members include the Department of Foreign Affairs (DFA), Energy (DOE), Transportation and Communication (DOTC), Public Works and Highways (DPWH), the National Economic and Development Authority (NEDA), the Philippine Senate, the Environmental Management Bureau (EMB-DENR), Forest Management Bureau (FMB), the National Mapping Resource and Information Agency (NAMRIA), and the Philippine Network on Climate Change (PNCC).

The EMB-DENR serves as the secretariat to the IACCC. It provides administrative support to the Committee and coordinates its meetings and activities. It is also responsible for drafting proposals for projects and policies, which are given to members for comments and review.

The IACCC represents the country in the regular meetings of the UNFCCC, such as the Conference of the Parties, and the Subsidiary Bodies. In its ten years of existence, the committee's level of activity has varied according to its leadership and organizational constraints. Understanding these constraints on IACCC's role of institutional oversight is critical because these overlap with those that concern the institutionalization of the GHG inventory process.

Constraints on Institutionalization

The development of the inventory system in the Philippines encountered some constraints especially on organizational/legal limitations and technical issues.

Organizational and Legal Limitations

1. Abstract nature of the issue

Many of the challenges posed by the existing institutional environment stem from the relatively abstract nature of climate change issues. A term such as “deforestation” invokes a sense of familiarity that most people associate with the sight of bare mountains; but the word “climate change” is still an intangible concept for the average person. Since government often behaves as a reactionary force to public pressure, it is understandable why the government as a whole has remained relatively inactive on climate change issues thus far. Consequently, few government policies exist that address the Philippine approach to climate change issues.

2. Lack of awareness

One effect of the abstract nature of climate change is a lack of awareness about the variety of issues it touches. If stakeholders were more aware of the impacts that climate change can have on local people – especially with respect to the Philippines’ vulnerability to these impacts – they might be more likely to view national commitments such as the greenhouse gas inventory as a priority.

3. Unstable policy environment

Within agencies that have already recognized climate change activities as a priority, the continuity of these activities is perennially threatened by every change in administration. It is the standing secretaries of these agencies who have designated funds and personnel to implement these programs. The priorities of subsequent secretaries may not include comparable allocations for climate change activities.

4. Poor communication among organizations with data

The coordination among groups with access to activity data – in both private and public sectors – is insufficient or nonexistent for compiling the inventory in an efficient manner. Individual government agencies do not regularly share data, they sometimes require private firms to report the same data. Inadequate coordination hinders the information management aspect of the inventory process and leads to problems in data access and consistency.

5. Inability to require submission of data

The IACCC cannot require GHG emission source sectors to report the data necessary to complete the inventory without an appropriate directive. Since private firms and government agencies are not mandated to produce some of the essential figures, some sectors lack a system capable of providing the IACCC with the input that it needs. This lack of authority on the part of the IACCC prevents the inventory team from completing the inventory without voluntary cooperation.

6. Conflict of interest

Private firms refuse to comply with requests for data from government agencies because they believe that some of these data are proprietary and thus might compromise their long-term viability. While some fear that their high levels of emissions would damage their public image, others see the possibility of mandatory emissions reductions following a period of voluntary monitoring as something that could threaten their continued operation. Consequently, they are reluctant to report emissions as individual entities.

7. Insufficient funding

Most agency budgets provide little or no funding for information systems management, emission factors research, or staff training related to climate change issues. As a result, technical expertise and potentially useful statistical resources remain untapped in many cases.

8. Inadequate number of personnel

Without a directive to tackle matters related to climate change, government personnel cannot be officially assigned to include climate change activities in their daily work. Since this means that any government staff who attend to IACCC matters do so on their own time and in addition to their regular duties, many others are unwilling to get involved. However, regular staff operations overlap with some components of the inventory process; a system in place ensures that the workload demanded of agency personnel is minimal.

Technical Issues

Technical issues were encountered during the development of the system and were also encountered by those involved in the inventory compilation. These are:

1. Inconsistent and unreliable information
2. Inefficient data management systems
3. Absence of localized emission factors
4. Lack of a process for quality assurance and quality control

Institutionalizing the GHG inventory process

By using the experiences both in the international and domestic context, the Philippine GHG inventory process benefited from the constraints encountered and the strategies that worked in these contexts.

The Philippines, as a developing country, was able to relate better to the levels of institutional development in non-Annex I countries than those in their Annex I counterparts.

Institutionalization of the Philippine inventory system included a phase wherein international donors funded its development. The mechanisms used to develop the GHG inventory systems were extremely transparent.

Keeping in mind the lessons learned from institutionalization in other contexts and the experience of agencies involved in the inventory process, the Philippines formulated strategies for systematizing and regularizing the compilation of the national GHG emissions inventory.

Four central strategies were employed in order to institutionalize the inventory process. These are:

a. informing strategically positioned people about concerns of climate change and training people in the inventory process;

b. strengthening the IACCC as an institution;

c. establishing within the IACCC a technical working group on the GHG inventory; and

d. developing an information system to prepare the inventory.

A. Awareness building and technical training

The complex nature of climate change prevents many people from understanding it which leads to indifference toward or ignorance about the inventory process.

To encourage cooperation with the inventory process, a basic understanding of climate change issues must be achieved at both the technical and managerial levels of the agencies involved in the process. Government, executive and legislative decision-makers were briefed regularly on the ever-evolving issues of climate change.

These briefings were designed in such a way as to facilitate the formulation of mandates needed to act on various climate change concerns, one of which is the inventory process. Technical staff were also informed since they were the ones who are involved in inventory compilation.

Technical capacity was also developed among those involved in the inventory process and those who are in the position to train others within their organizations.

B. Institutional strengthening of the IACCC

Three pre-requisites were established to pursue the existing authority of the IACCC. These are:

A. A Full Time Secretariat

B. Continuous financial support

C. Ability to enforce compliance

C. Technical Working Group on GHG Inventory

An overall central steering committee composed of organizations with experience in conducting inventories and representatives from the lead agencies of each of the Sectoral Working Group (SWGs) is called the GHG Technical Working Group (GHG-TWG).

The GHG-TWG shall oversee all technical aspects of the inventory process, focus on cross-cutting issues, act as final mediator in any dispute among members of the SWGs, and will be responsible for synthesizing the sectoral inventory results from the SWGs into the final national inventory.

By providing administrative support for the technical functions of the members, the IACCC Secretariat will act as the driving force behind the completion of the periodic inventory.

The GHG-TWG served as the venue to formalize these new ties and to solidify pre-existing relationships, allowing contributing organizations to discuss difficulties or conflicts that arise. In order to establish a continuous system for completing the inventory, the GHG-TWG specified four components of the reporting process:

- ❖A timetable for agencies to submit data,
- ❖The flow of information from the source agencies to the central team,
- ❖The level of data analysis to be conducted at each reporting level, and
- ❖A strategy for ensuring compliance with the established requirements.

D. GHG information management system

Considering the volume of data required to complete the inventory, a process without an organize data management system is doomed to fail. In the system currently employed to source the data and complete the inventory worksheets, too many people were needed to sift through files and convert measurements from one reporting format to another. In order to maintain a continuous reporting schedule, more efficient methods were developed for compiling the statistics necessary to complete the reports.

To facilitate data submission by the reporting agencies and to minimize paperwork among agencies, a computer/internet based system for reporting GHG emissions was established. Implementing this type of database would eliminate the need for so many “middle men” in the inventory process. It would minimize the time required to compute the emissions from the activity data by enabling a user to input the activity data directly into the database, with the conversion factors already programmed into the system.

Freed from the need to evaluate worksheets for human error and to discuss minute details of translating data into actual emissions, members of the GHG-TWG and SWGs would have more time to focus on cross-cutting issues, local emissions research, managing uncertainties and designing a more complete QA/QC process.

Good Day!

Thank You....

Technical issues related to the preparation of the GHG inventory:

A Study of Thai Emission Factors in Agriculture and Waste Sector

Workshop on Greenhouse Gas Inventories in Asia
13-14 November 2003, Phuket, Thailand

Sirintornthep Towprayoon
The Joint Graduate School of Energy and Environment
King Mongkut's University of Technology Thonburi

GHG Inventory

- Inventory year : 1990, 1994, 1998
- Source categories : CO2, CH4, N2O, NOx, CO, NMVOC
- Methodologies : 1996 IPCC revised Guideline
- Emission Factor : Mostly IPCC default

Emission factors used in inventory

Sector	IPCC default	Country specific	Development of EF
Energy	√		√
Industry	√		
Agriculture	√	√	√
LULUCF	√		
Waste	√		√

Agriculture sector : Rice field

Emissions of methane from rice fields can be represented as follows:

EQUATION 1

$$F_C = EF \times A \times 10^{-12}$$

where:

F_C = estimated annual emission of methane from a particular rice water regime and for a given organic amendment, in Tg /yr;

EF = methane emission factor integrated over integrated cropping season, in g/m^2;

A = annual harvested area cultivated under conditions specified above. It is given by the cultivated area times the number of cropping seasons per year, i.e., in m^2/yr.

Study of emission factor in rice field

- Factor effecting emission
- Scaling factor
- Model implementation

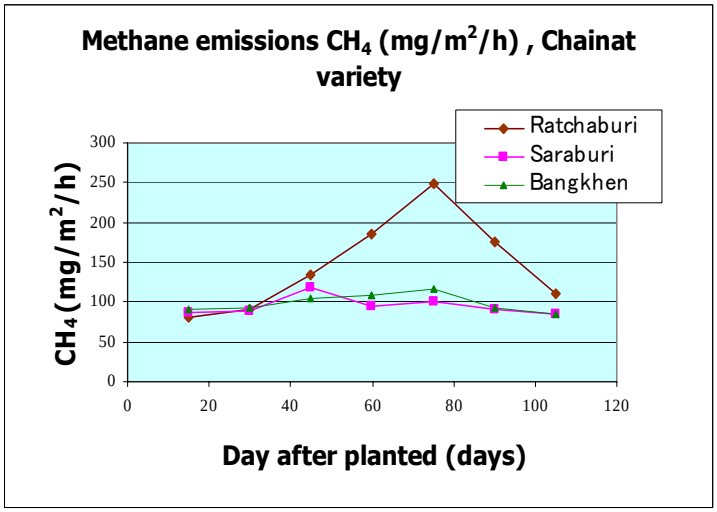
Factor influence emission

-Soil type
-Rice variety
-Rice ecosystem
-Fertilizer application
-Drainage System

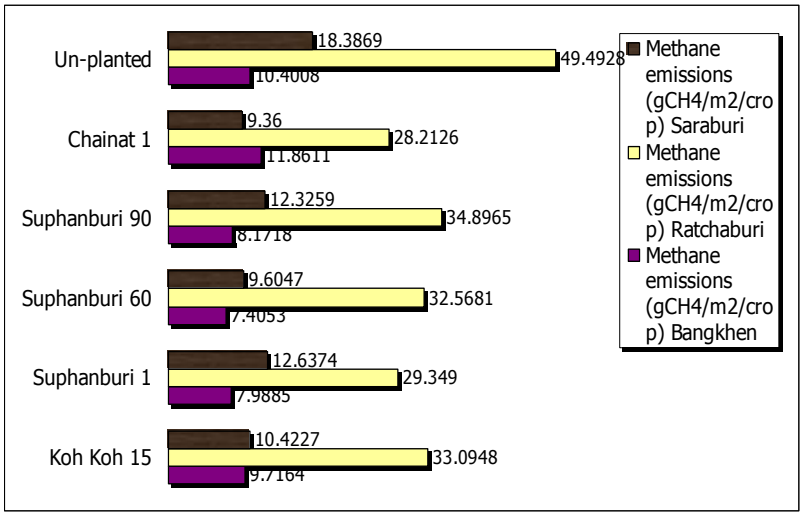
Methane emission involved with methane production and methane transportation via plant stem

Nitrous oxide involved with water drainage system

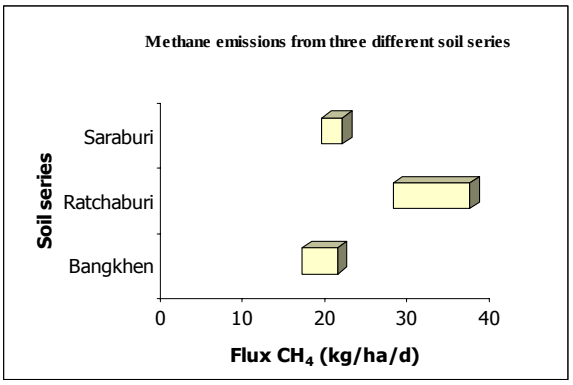
Factor effecting emission : Soil type



Factor effecting emission : Soil type and rice varieties

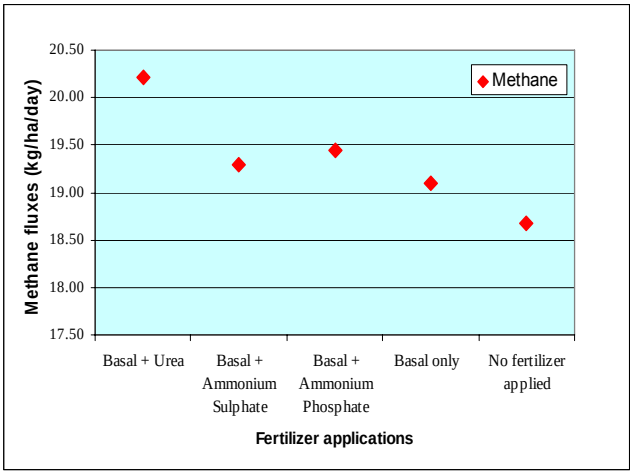


Factor effecting emission : Soil type and rice varieties



Soil series	Methane emission (kg/ha/d)	
	Maximum	Minimum
Bangkhen	16.50	4.26
Ratchaburi	27.57	9.33
Saraburi	18.86	2.54

Factor effecting emission : Fertilizers



Factor effecting emission : Fertilizers

Fertilizer	Methane emissions		Grain yield	Emission per yield
	(kg/ha/d)	(g/m2/d)	(kg/rai)	(kg CH4/kg yield)
Basal + Urea	20.22	2.02	774.70	0.47
Sulphate	19.29	1.93	743.48	0.46
Phosphate	19.45	1.95	750.00	0.46
Basal only	19.10	1.91	530.77	0.65
No fertilizer applied	18.67	1.87	398.25	0.84

Factor effecting emission : Water level management

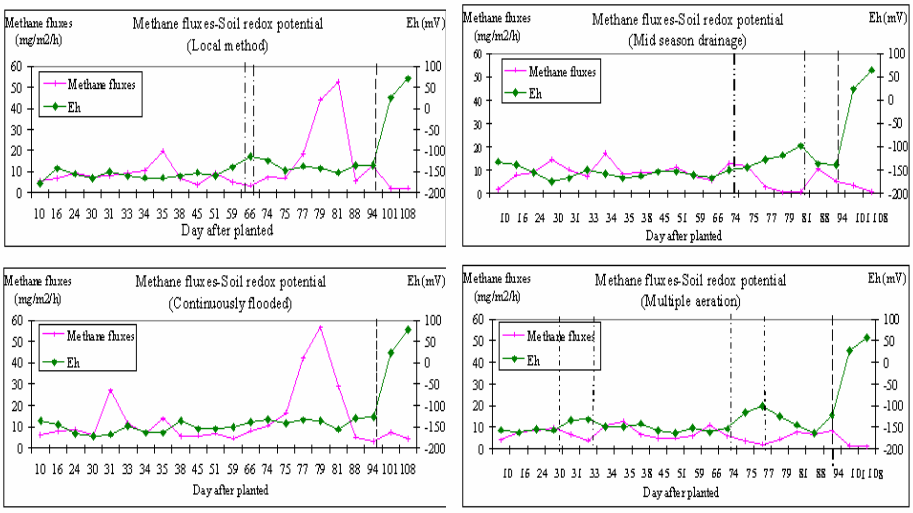
Water management	Methane emissions (Ratchaburi soil series)		
	(kg/ha/d)	(g/m2/d)	kgCH4/ha/crop
Flooded every 7 days (5 cm.)	20.06	2.01	359.41
Flooded every 7 days (2.5 cm.)	19.71	1.97	353.29
Saturated soil (no water above ground)	19.42	1.94	348.08
7 cm depht flooded	20.48	2.05	367.06

Factor effecting emission : Drainage System

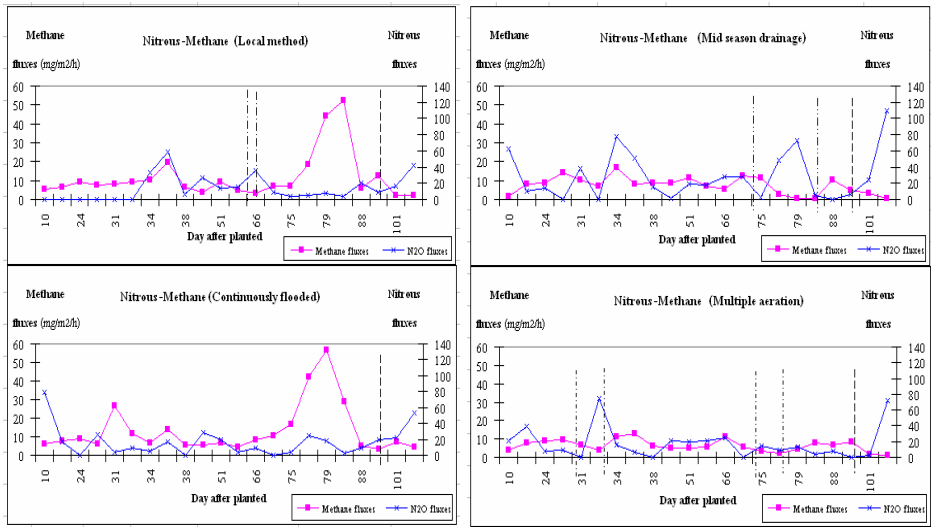
4 different drainage system

local method – drain 1 time during vegetative period
Continuous flood – no draining
Midseason drainage – drain 1 time during flowering period
Multiple drainage – drain 2 times during vegetative and flowering period

Methane emission and soil redox potential from 4 different drainage rice fields



Nitrous oxide and methane emission from 4 different drainage rice fields



Emissions and grain yields from 4 different water management

Treatment	Product	Emissions		Emissions		Net GHGs		
		CH_4	N_2O	CH_4	N_2O	CH_4	N_2O	Total
	kg/ha/crop	mg/m2/day	ug/m2/day	kg/ha/crop	kg/ha/crop	GWP/ha/crop	GWP/ha/crop	GWP/ha/crop
Local Method	4,375	213.88	291.66	239.55	0.33	5,030.54	102.43	5,132.97
Continuously flooded	4,350	217.50	331.68	243.60	0.37	5,115.59	115.16	5,230.75
Midseason drainage	4,075	155.02	545.63	173.62	0.51	3,646.12	159.28	3,805.40
Multiple aeration	3,875	139.99	343.60	156.79	0.38	3,292.49	119.30	3,411.79

grain yields

Mid season drainage < Local method **6.86 %**

Multiple aeration < Local method **11.43 %**

Net GHGs

Mid season drainage < Local method **25.86 %**

Multiple aeration < Local method **33.53 %**

Scaling factor

Scaling factor : water management

Rice ecosystem	Seasonal emission (g/m^2)			Reference
	Min.	Max.	Average	
Irrigated Thailand	12.40	55.20	38.76	Katoh et al 1999a
	17.40	68.20	39.14	Katoh et al. 1999b
	34.80	61.30	44.95	Katoh et al. 1999c
	0.45	44.29	15.00	Jermsawatdipong et al. 1994
	4.00	75.00	34.50	Yagi et al. 1994
	19.20	21.90	20.55	Karnchanasuntorn 1994
	0.50	59.04	9.38	Charoensilp et al. 1995
	6.93	10.02	8.38	Wongkumpoo 1999
	8.19	30.54	22.42	Jittasatta 1999
	1.76	38.10	21.46	Wanichpongpan 1993
	5.80	59.30	30.00	Chairoj et al. 1994
	-	-	26.624	Jermsawatdipong et al. 1999[a]
	7.608	16.848	10.569	Saenjan et al. 2000[b]
Rainfed Thailand	15.20	32.90	24.05	Teawyuenyong 1994
	1.90	71.00	41.11	Chairoj et al. 1994
	-	-	18.72	Jermsawatdipong et al. 1999[c]
Deep water Thailand	4.90	63.00	17.29	Charoensilp et al. 1996

[a,c] Reported in Thailand's First National Communication to UNFCCC (Draft) on March, 2000
[b] Unofficial report to TRF

Scaling factor : water management

Rice ecosystem	Seasonal emission (g/m^2)			Reference
	Min.	Max	Mean (per ecosystem)	
Continuously flooded	12.400	55.200	23.236	Katoh et al 1999a
	17.400	68.200		Katoh et al. 1999b
	34.800	61.300		Katoh et al. 1999c
	0.450	26.240		Jermsawatdipong et al. 1994
	4.000	75.000		Yagi et al. 1994
	19.200	21.900		Karnchanasuntorn 1993
	0.500	29.600		Charoensilp et al. 1996
	8.190	30.540		Jittasatta 1999
	1.760	25.700		Wanichpongpan 1993
	5.800	59.300		Chairoj et al. 1994
	-	26.624		Jermsawatdipong et al. 1999[a]
	7.608	16.845		Saenjan et al. 2000[b]
Multiple aeration	8.010	9.140	8.568	Wongkumpoo 1999
Rainfed Flood prone	15.200	32.900	35.970	Teawyuenyong 1994
	1.900	71.000		Chairoj et al. 1994
	-	18.720		Jermsawatdipong et al. 1999[c]
Deep water	4.90	17.80	13.400	Charoensilp et al. 1996

[a,c] From Thailand's First National Communication to UNFCCC (Draft), March, 2000.
[b]Unofficial reports to The Thailand Research Fund.

Scaling factor : water management

Category	Sub-category		Scaling factors (this study)	Standard emission factors(EF), g/m^2/season[a]
Upland	None		0[b]	0[c]
Lowland	Irrigated	Continuously flooded	1	23.236
		Intermittently flooded – Single aeration	---	No data
		Intermittently flooded – Multiple aeration	0.369	8.57
	Rainfed	Flood prone	1.548	35.970
		Drought prone	---	No data
	Deep Water	Water depth 50-100 cm	0.577	13.400
		Water depth > 100 cm	---	No data

[a] Estimated from field experiments listed in Tables 3.
[b, c] The only one study conducted in upland systems of Thailand obtained on emission rate of 5.29 g/m^2/season [Karnchanasoonthorn, 1993]. However, emission rates should normally be close to 0 because true upland systems do not create anaerobic conditions for significant periods of time.

Scaling factor : organic amendment

Type & Amount applied (tons /ha)		Estimated Scaling factor	Reference
Azolla	0.6250	1.446	Charoensil et al. 1996
Compost	6.250	6.515	Charoensil et al. 1996
Compost	2.069	2.250	Wanichpongpun 1993
Green Manure	30.000	13.390	Jermsawatdipong et al. 1994
Green Manure	12.500	4.312	Charoensil et al. 1996
Rice Straw	2.000	12.850	Jermsawatdipong et al. 1994
Rice Straw Burned	12.500	1.190	Charoensil et al. 1996
Rice Straw Compost	3.100	0.686	Jermsawatdipong et al. 1994

Methane emissions (kg/hec/day) from difference soil type and fertilizer applications

Province Name	Soil series	NF	CF	CF+OM	Average
Pathumthani	Rangsit	0.45	2.33	1.11	0.763
Ratchburi	Nakornpathom	1.13	5.24	5.93	3.127
Surin	Roi Et	3.77	1.17	6.33	5.170
Chiangmai	Hang Dong	0.89	6	1.31	1.320
	Average	1.56	2.56	3.67	2.595

Remarks: NF = No fertilizer application, CF = Chemical fertilizer, CF + OM = Chemical and organic fertilizer

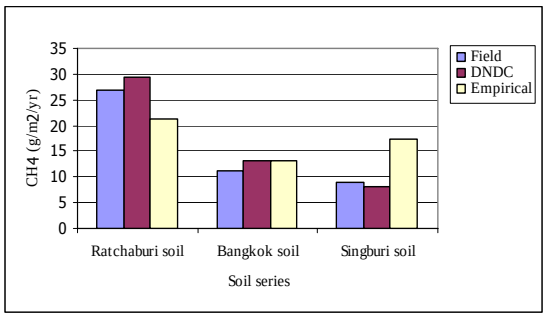
Reference: Jermsawatdipong et al., 1993 in Office of Environmental Policy and Planning, 2000b

Model implementation

- Process model- DNDC site and regional mode
- Empirical model

Model implementations : soil type

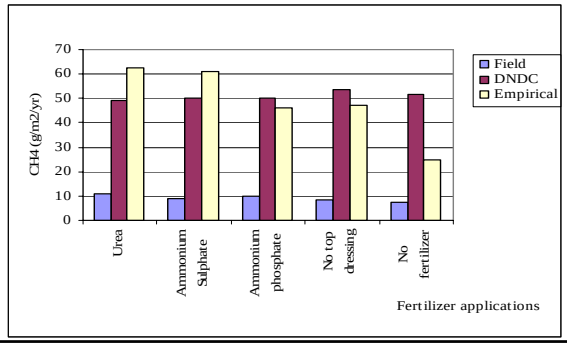
Treatments	Methane emissions		
	Field observed	DNDC model	Empirical model
	g/m2/yr	g/m2/yr	g/m2/yr
Ratchaburi soil	26.87	29.44	21.29
Bangkok soil	11.29	13.15	13.13
Singburi soil	8.91	8.13	17.35



DNDC model (Li et al., 1992)
Empirical model (Huang et al., 1998)

Model implementations : fertilizer application

Treatments	Methane emissions		
	Field observed	DNDC model	Empirical model
	g/m2/yr	g/m2/yr	g/m2/yr
Urea	10.89	49.17	62.67
Ammonium Sulphate	8.8	49.94	61.01
Ammonium phosphate	9.71	49.94	46.19
No top dressing	8.4	53.75	47.13
No fertilizer	7.44	51.83	24.91

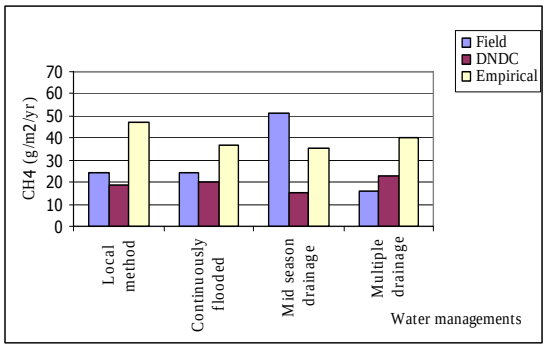


DNDC model (Li et al., 1992)

Empirical model (Huang et al., 1998)

Model implementations : drainage system

Treatments	Methane emissions		
	Field observed	DNDC model	Empirical model
	g/m2/yr	g/m2/yr	g/m2/yr
Local method	23.96	18.42	47.47
Continuously flooded	24.36	19.99	36.93
Mid season drainage	51.38	15.51	35.26
Multiple drainage	15.68	22.88	40.23



DNDC model (Li et al., 1992)

Empirical model (Huang et al., 1998)

Waste sector : Solid Waste Disposal Site (SWDS)

- Tier 1

EQUATION I

Methane emissions (Gg/yr)

=

$(MSW_T \times MSW_F \times MCF \times DOC \times DOC_F \times F \times 16/12 - R) \times (1\text{-}OX)$

Tier 2

LFG = 2LoR(e+kc - e-kt)
LFG = Total amout of landfill gas generation in current year (m3/yr)
Lo = Total methane generation potential of waste (m3/ton)
R = Average annual waste acceptance rate during active life (ton)
k = Decay constant for the rate of methane generation (1/yr)
t = Time since landfill opened (yr)
c = Time since landfill closure (yr)

Waste Sector: Landfill

Locations	Nakornpathom	Huahin	Suphanburi
Ambient temp.(^{O}C)[1/]	35.3	34.1	34.8
Velocity (m/s) [1/]	0.43-0.45	0.23-0.30	0.31-0.36
Flow rate (m^3/s) [1/]	0.0075-0.008	0.0018-0.0024	0.0024-0.0029
Temp.(^{O}c) [1/]	37.5-38.6	35.1-36.5	36.6-37.5
Humidity (% rh) [1/]	56.1-56.4	53.6-54.4	54.7-55.1
% CH_4 [2/]	19.21-28.36	4.08-13.74	8.53-13.84
% CO_2 [2/]	12.23-18.38	2.27-8.69	5.10-8.74
Flow rate (m^3/yr) [1/]	236,520-252,288	56,765-75,686	75,686-91,454
CH_4 (m^3/yr) [3/]	45,438-71,678	2,318-10,399	10,214-15,358
Total waste in landfil, Flow rate (m^3/yr) [4/]	977,616	545,574	252,287
Total CH_4 (m^3/yr) [4/]	234,233	57,545	38,888

[1/] Field measurements

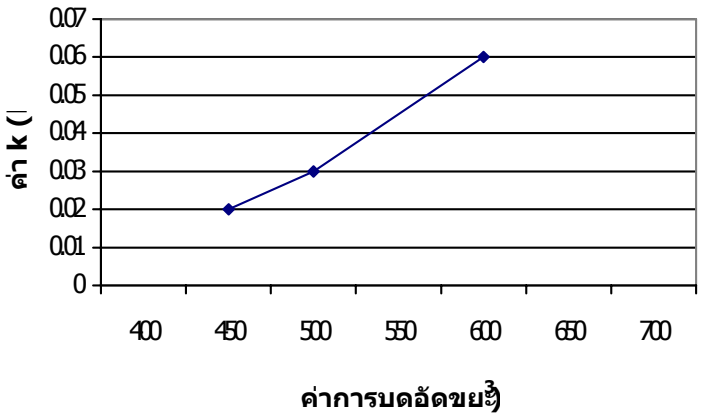
Waste: Landfill

K value (l/yr)

Municipal	k (l/yr)	Compaction ration (kg/m^3)
Suphanburi	0.02	450
Huahin	0.03	500
Nakornpathom	0.06	600

Lo value

Locations	Lo (m^3/ton)
Municipal	121.4
Bangkok	103.7



Waste: Landfill

Methane emission (Mg/yr) from landfill using actual Lo

Municipal	1990	1994	2000	2005	2010
1.Khonkean	132*	364*	1,352	2,422	3,216
2 Chantaburi	36*	73*	1,179	1,840	2,113
3.Chiangrai	56*	120*	1,267	1,932	2,203
4.Chiangmai	508*	898*	3,112	5,305	6,929
5. Nakornpathom	243*	505*	2,240	3,475	4,390
6.Nakornratsima	434	1,130	2,976	4,178	5,069
7.Nakornsawan	181	450	1,855	2,834	3,551
8.Udonthani	61*	150*	1,190	1,942	2,496
9.Phisanulok	86*	191*	1,311	2,109	2,696
10.Songkhla	1,256	2,626	5,804	7,528	8,806

* ใช้วิธีการกำจัดขยะโดยการเทกอง ใช้ค่า Lo = 60.7 m3/ton เนื่องจากการกำจัดขยะโดยวิธีการเทกองจะถือว่ามีการเกิดก๊าซฝังกลบมีปริมาณเป็นครึ่งหนึ่งของการกำจัดขยะโดยวิธีการฝังกลบ

Waste: Landfill

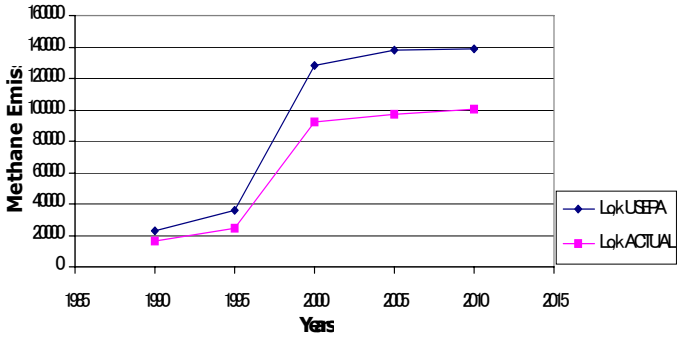
Methane emission (Mg/yr) from landfill using actual Lo

(continuous)

Municipal	1990	1994	2000	2005	2010
11.Ubonratchathani	59*	131*	901	1,791	2,448
12.Samutprakarn	159	561	2,410	4,485	6,010
13.Chonburi	312*	742*	4,128	7,677	9,935
14.Nakornsithammarat	212*	407*	1,882	2,934	3,713
15.Prachubkirikhan	60*	140*	1,133	1,850	2,379
16.Suphanburi	50*	99*	862	1,565	2,085
Total	3,848	8,587	33,602	53,867	68,039
Bangkok	12,280	16,180	58,661	43,465	32,200
Grand total	16,128	24,767	92,263	97,332	100,239

* ใช้วิธีการกำจัดขยะโดยการเทกอง ใช้ค่า Lo = 60.7 m3/ton เนื่องจากการกำจัดขยะโดยวิธีการเทกองจะถือว่ามีการเกิดก๊าซฝังกลบมีปริมาณเป็นครึ่งหนึ่งของการกำจัดขยะโดยวิธีการฝังกลบ

Comparison of methane emissions estimated using Lo and k value from USEPA and actual value



The End

Sawasdee

Organization for preparing inventory in China

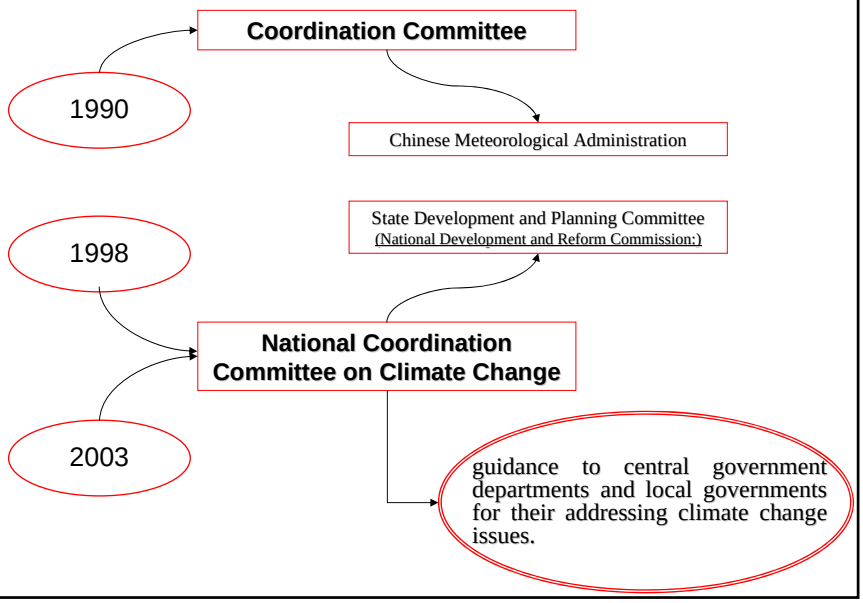
Gao Qingxian
Center for Climate Impact Research, SEPA of China

Content

- **Introduction of National Coordination Committee on Climate Change of China**
- **Introduction of GEF/UNDP Project-Enabling China to Prepare Its Initial National Communication (ECPINC)**
- **Introduction of Preparing for Inventory of Greenhouse Gas Emission from Municipal Waste Sector**

Report by participanting experts on technical issues : China
Dr. Gao Qingxian

1 Introduction of National Coordination Committee on Climate Change of China



National Coordination Committee on Climate Change

Division of work of the National Coordination Group:
National Development and Reform Commission:
Coordination on Climate Change Policies and Actions Adopted by Various Departments;

Ministry of Foreign Affairs:
Take the Lead for Participating in International Climate Change Negotiation;

State Meteorological Administration:
Take the Lead for Participating in the Work of Intergovernmental Panel on Climate Change (IPCC).

The Office of the NCCCC responsible for routine work of the Committee

Members of the National Coordination Committee on Climate Change are senior officials from:

Ministry of Finance
Ministry of Commerce
Ministry of Agriculture
Ministry of Construction
Ministry of Communications
Ministry of Water Resources
State Forestry Administration
Chinese Academy of Science
State Ocean Administration
State Environmental Protection Administration
Chinese Meteorology Administration
Civil Aviation Administration

Office of NCCCC

Chairman:

Ma Kai, Chairman of National Development and Reform Commission

Executive Deputy Chairman:

Liu Jiang , Vice Chairman of National Development and Reform Commission

Deputy Chairmen:

Zhang Yesui,Deputy Minister, Ministry of Foreign Affairs
Deng Nan, Deputy Minister, Ministry of Science and Technology
Qin Dahe, Administratorl, China Meteorological Administration
Zhu Guangyao, Deputy ministerl, State Environmental Protection Administration

Members:

Li Yong, Deputy Minister, Ministry of Finance
Yi Xiaozhun, Assistant Minister, Ministry of Commerce
Zhang Baowen, Deputy Minister, Ministry of Agriculture
Qiu Baoxing, Deputy Minister, Ministry of Construction
Hong Shanxiang, Deputy Minister, Ministry of Communications
E Jingping, Deputy Minister, Ministry of Water Resources
Li Yucai, Deputy Director-General , State Forestry Administration
Chen Yiyu, Deputy President, Chinese Academy of Science
Chen Lianzeng, Deputy director general, State Ocean Administration of China
Liu Shaoyong, Deputy director general, Civil Aviation Administration of China

2 Introduction of GEF/UNDP Project-Enabling China to Prepare Its Initial National Communication (ECPINC)

- Project brief

Project No.: CPR/00/G31/A/1G/99
Project Title: Enabling China to Prepare Its Initial National Communication (ECPINC)
Duration: 2 Year and 4 Months
Management Arrangement: National Execution
Designated Institution: State Development Planning Commission
(National Development and Reform Commission:)
Project Sites: Beijing and Provinces

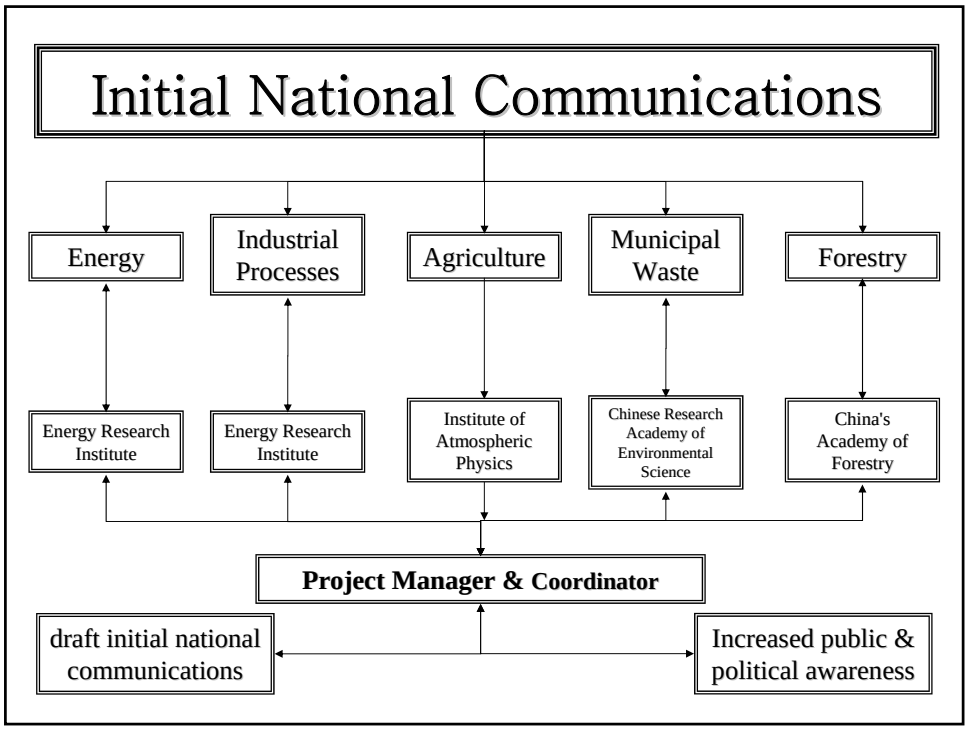
The project of **ECPINC** will enable China to fulfill its commitments under the United Nations Framework Convention on Climate Change (UNFCCC) to communicate to the Conference of Parties to the Convention:

- a national inventory of emissions and sinks of greenhouse gases;
- a general description of steps taken or envisaged by China to implement the Convention;
- any other information China considers relevant and suitable for inclusion in its Communication.

In addition, the project will enable China to strengthen and expand its activities for increasing public and political awareness and action related to climate change.

Immediate Objective

- Preparation of 1994 energy sector inventory
- Preparation of 1994 industrial processes inventory
- Preparation of 1994 agricultural sector inventory
- Preparation of 1994 forestry sector inventory
- Preparation of 1994 municipal waste sector inventory
- Drafting of initial national communication and incorporation into development strategy and processes
- Increased public and political awareness and action related to climate change



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Dr. Gao Qingxian

Preparation of 1994 energy sector inventory

Output 1:
- Estimate of GHG emissions from fossil fuel combustion

Output 2:
- Estimate of methane emissions from Chinese coal mining and post-mining activity

Output 3:
- Estimates for biomass activity level and emissions factors.

Output 4:
- Estimates of methane leaks and fugitive emissions from oil and natural gas systems

Output 5:
- Estimate of China's total methane emissions from energy activity in 1994

Output 6:
- Estimate of China's total GHG emissions from energy activity in 1994 and energy sector inventory

Preparation of 1994 industrial processes inventory

Output 1:
- Estimate of 1994 GHG emissions from cement production

Output 2:
- Estimate of 1994 GHG emissions from lime production

Output 3:
- Estimate of 1994 GHG emissions from iron and steel product

Output 4:
- Estimate of 1994 GHG emissions from calcium carbide production

Output 5:
- Estimate of 1994 GHG emissions from adipic acid production

Output 6:
- Estimate of China's total GHG emissions from industrial processes in 1994

Output 7:
- Capacity built through workshops and international training for improving methodology to prepare inventory

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Preparation of 1994 agricultural sector inventory

Output 1:
- Estimate of 1994 methane emissions from wetland rice fields

Output 2:
- Estimate of 1994 nitrous oxide emission from croplands

Output 3:
- Estimate of 1994 methane emissions from enteric fermentation

Output 4:
- Estimate of 1994 methane and nitrous oxide emission from animal waste management systems

Output 5:
- Workshop held for the agricultural section of the emissions inventory

Preparation of 1994 municipal waste sector inventory

Output 1:
- Several individuals trained to assist in activities below related to emissions from municipal solid waste and wastewater

Output 2:
- Capacity built through training in measurement and modeling techniques for developing a municipal solid waste and wastewater inventory

Output 3:
- Database of items relevant to emissions from municipal solid waste

Output 4:
- Estimation of lagged emissions from prior waste handling through the development of a model for this purpose

Output 5:
- Estimates of methane emissions from wastewater handling systems

Output 6:
- A 1994 inventory of methane emissions from municipal solid waste and wastewater in China

Drafting of initial national communication and incorporation into development strategy and processes

Output 1:
- A team qualified to draft initial national communications

Output 2:
- Adaptation options and other climate change issues considered and incorporated into the nation's sustainable development strategy

Output 3:
- Initial national communication drafted and approved

Increased public and political awareness and action related to climate change

Output 1:
- Awareness raising program

Output 2:
- Documentation, media, and workshop to promote awareness and understanding of climate change to a targeted audience through initial awareness raising program

Output 3:
- Report on national long-term strategies for improving public awareness of climate change issues

3 Introduction of Preparing for Inventory of Greenhouse Gas Emission from Municipal Waste Sector

- **The Reviews of the Previous Studies on CH_4 Emission Inventory**
- **The Uncertainty Analysis**
- **The Problems Encountered**

The Estimates of Global CH_4 Emissions from Different Waste Sources and Its Percentages

Sources	Emission Amount (Tg/yr)	Percentage of Total Emissions from Anthropogenic sources globally (%)	(Tg/yr)
SWDSs	20~70	5~20	
WWHs	30~40	8~11	Industrial: 26~40 Domestic: 2

IPCC, 1996

The Reviews of the Previous Studies on CH_4 Emission Inventory in China

1. **The problems and choices of Chinese greenhouse gases control: the sources and sinks of Chinese greenhouse gases in 1990 (WB & GEF)**
2. **National Research on Chinese Climatic Change (USA)**
3. **China's national Response Strategy for Global Climate Change (ADB)**
4. **Research on greenhouse gas emission and countermeasure in Beijing (Canada)**
5. **ALGAS (ADB)**

The Uncertainty Analysis

Project	The Problems and Choices Chinese GHGs Control	National Research on Chinese Climate Change	China's National Response Strategy for Global Climate Change	ALGAS
Foundation	GEF/WB	US Department of Energy	ADB	ADB
Base Year	1990	1990	1990	1990
Recommended Values (Mt CH_4)	0.792	2.5 (2.3 to 2.7)	1.3 (0.6 to 2.0)	0.899
Uncertainty (Mt CH_4)	0.6 to 2.7			

The Problems encountered during prepare inventory of GHGs Emission

1. **Population Statistics Data**
2. **Data on MSW Generation Rates in China**
3. **The Disposed Rate of MSW to SWDSs in China**
4. **Analysis Composition of MSW in China**
5. **The Degradable Organic Carbon (DOC) Content of Waste**
6. **Categories of Waste Disposal Sites**
7. **Other Default Values Recommended by IPCC**

Population Statistics data:

In revised 1996 IPCC Guidelines for National Greenhouse Gas Inventory:

For developed countries the population data is likely to be the total country population;

For developing countries and countries with economies in transition, the population data may be the total urban population only, because the rural population is assumed to dispose of waste in such a way that CH_4 emissions are extremely low.

But In China today there are more and more people lived in rural region go into urban areas to seek opportunities to work and live there. From our survey there are about 70 million people from rural worked in urban areas in recent 10 years.

Data on MSW Generation Rates in China:

In revised 1996 IPCC Guidelines for National Greenhouse Gas Inventory:

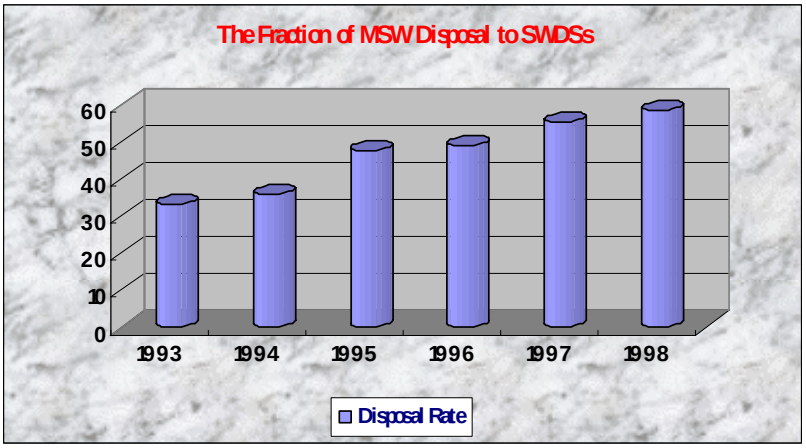
Total MSW can be calculated from Population (thousand persons) x Annual MSW generation rate (Gg/thousand persons/yr).

But In China, we have a Municipal Construction Statistic Year Book which have record of the carrying amount and disposal percentage of municipal waste. With the developing of urbanization, the number of cities increase.

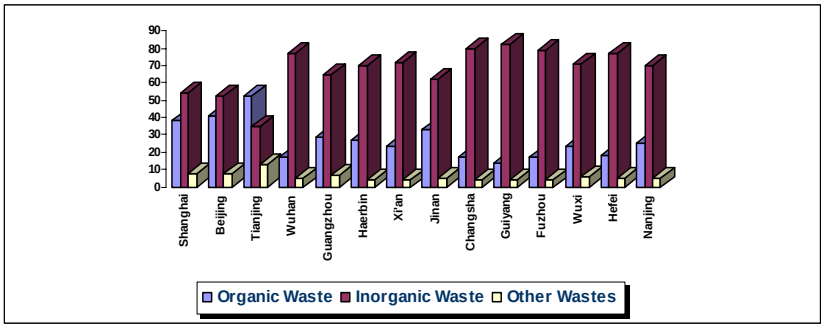
Due to the shortage of manage method, the carrying amount should be modified, through vast investigation on the carrying amount and disposal percentage, the experts group of China concluded that the carrying amount of municipal waste should be multiply a coefficient 0.76.

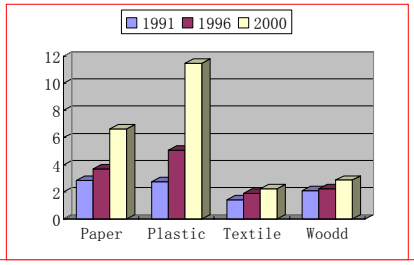
Considering the real situation of municipal waste collection, there are only 75% municipal waste are carried and **treated into** disposal sites.

During calculation, the different disposal rate in different region a considered.



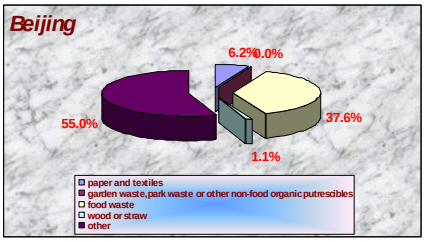
Analysis Composition of MSW in China:

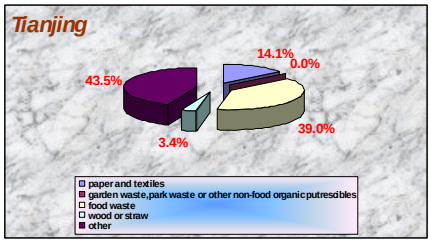




① Organic waste increase rapidly(~50%);
② Inorganic Waste decrease (~23.34%);
③ Recycle waste increase (~26.6%);
④ Combustible waste increase.

the weighted average of carbon content of various components of waste stream





Sample	Tianjing	Beijing	Average
Paper and Textiles	14.08	6.24	10.16
Food waste	39.02	37.63	38.33
Wood and straw	3.4	1.15	2.28
Others	43.5	54.99	49.25

components of waste stream	Organic Caron percentage (Weight)
Paper	26
Wood and straw	28
Textiles	30
Food waste	7

Fresh waste

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The Degradable Organic Carbon (DOC) Content of Waste:

In revised 1996 IPCC Guidelines for National Greenhouse Gas Inventory: **Per Cent DOC (by Weight) = 0.4A+0.17B+0.15C+0.30D**

Default DOC Values for Major Waste Streams	
Waste Streams	Per cent DOC (by Weight)
A: paper and textiles	40
B: garden waste, park waste or other non-food organic putrescibles	17
C: food waste	15
D: wood or straw	30

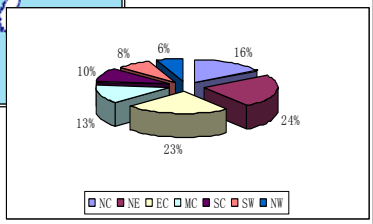
In our calculation,

Per Cent DOC (by Weight) =0.26(A)+0.28(B)+0.30(C)+0.07(D)

Where: A Paper ;
B **Wood and straw** ;
C **Textiles** ;
D **Food waste** 。

Categories of Waste Disposal Sites:

1. **NorthEast**
2. **NorthWest**
3. **North of China**
4. **East of China**
5. **South of China**
6. **SouthWest**
7. **Middle of China**



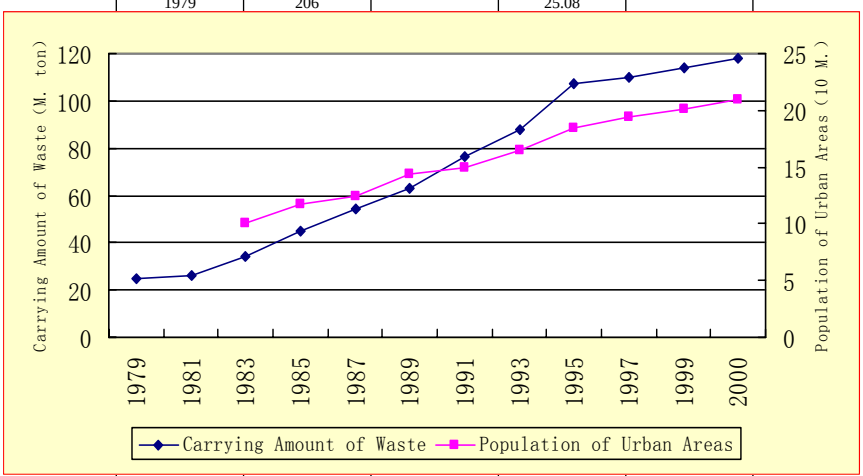
The Carrying Amount of Waste in 7 Regions of 1994

In different region, according the scope of the city, we classified the cities of China into 5 types:
Super City〔＞ 2 Million〕, there 14 super cities in China and we survey 10 cities of them and got the real data of them;
Large City〔1~2 Million〕, there 23 lager cities in China and we survey 15 cities of them and go to site investigation for 6 larger cities;
Big City〔0.5~1 Million〕, there 47 big cities in China and we survey 21 cities of them and go to site investigation for 6 big cities;
Medium City〔0.2~0.5 Million〕, there 159 big cities in China and we survey 39 cities of them and go to site investigation for 11 big cities;
Small City〔＜ 0.2 Million〕, there 425 small cities in China and we survey 52 cities of them and go to site investigation for 2 big cities;

Fro Region, To get investigation information of waste and its treatment from 47 cities in East region of China, 42 cities in North of China, 48 cities in WestMiddle region of China; To carry out site survey in 15 cities in east region, 10 cities in north region and 10 cities in westmiddle region.

The Statistic Chart of Municipal Waste during 1979~2000 of China

Year	Number of Cities	Population in Urban areas (10M)	Carrying Amount of Waste (M. ton)	Increase rate of Carrying Amount
1979	206		25.08	
1997	668	19.47	109.81	1.4%
1998	668	19.86	113.02	2.9%
1999	668	20.16	114.15	1.0%
2000	663	20.95	118.19	3.5%



Thanks!

Cambodia
Mr. Sum Thy

Technical Issues Related to the Preparation of the Cambodian GHG inventory: LULUCF

Workshop on Greenhouse Gas Inventories in Asia
13-14 November 2003, Phuket, Thailand

Presented by Thy SUM,
Chief of Climate Change Office,
Ministry of Environment, Phnom Penh, Cambodia.

Outlines

- Brief Introduction to the First Cambodian GHG Inventory
- GHG inventory for Land Use, Land Use Change and Forestry (LULUCF)
  - Why improve the GHG inventory in LULUCF?
  - Methodology for improving LULUCF activity data
  - Methodology for improving emission factors
  - Result of GHG inventory for LULUCF
- Conclusion and Recommendations

I. Brief Introduction to the First Cambodian GHG inventory (1)

- Base year: 1994
- Based on the Revised 1996 IPCC Guidelines
- Used IPCC Emission Factors
- Greenhouse gases (GHGs): carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O)
- Major sectors: Energy, Industrial Processes, Agriculture, Waste, and LUCF.

I. Brief Introduction to Cambodian GHG Inventory (2)

- Summary of 1994 Cambodian GHG emissions and uptakes

Sectors and Sinks	CO_2 uptake	Emissions				
		CO_2	CH_4	N_2O	NO_x	CO
ENERGY		1,272.08	24.13	0.33	16.69	456.56
INDUSTRIAL PROCESSES		49.85			0.01	0.03
AGRICULTURE			339.25	11.08	2.7	95.76
WASTE			6.77	0.42		
LAND USE CHANGE AND FORESTRY	64,850.23	45,214.27	74.77	0.51	18.58	654.2
TOTAL NAT'L GHG EMISSIONS/UPTAKE	64,850.23	46,536.20	444.92	12.35	37.98	1,206.55

III. GHG inventory for LULUCF:

Why improve the GHG inventory in LULUCF?

- Importance of LULUCF in contribution to National GHG inventory (79%)
- The previous estimation may accompany with high uncertainty, due to complexity of biological factors and lack of reliable data
- The new study is aiming at (1) development of local emission factors through field survey, (2) improvement of activity data, and (3) conducting uncertainty analysis

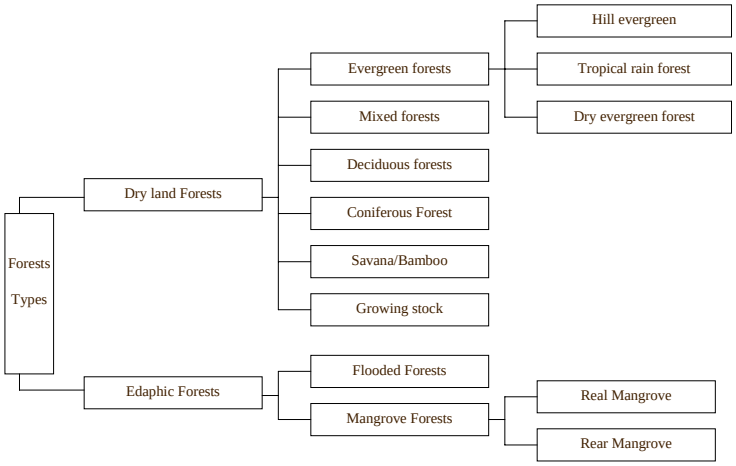
III. GHG inventory for LULUCF:

Methodology for improving LULUCF activity data (1)

- Activity data play an important role in the GHG estimation
- The improvement of activity data (land use and forest cover) was done through satellite image analysis
- Cambodia land use is divided into two categories (Wood land and non-wood land)
- These land categories are considered in the preparation of GHG inventory
- In 1998, the total Cambodian forest was about 10.5 Million hectare (58% of the total country land area)
- About 10 million hectare (96%) is dry land forests and 0.5 million hectare (4%) is edaphic forests

III. GHG inventory for LULUCF:
Methodology for improving LULUCF activity data (2)

Forest classification in Cambodia



III. GHG inventory for LULUCF:
Methodology for improving LULUCF activity data (3)

- Cambodian forest has been disturbed by human activities, such as logging, shifting cultivation, and conversion to agriculture
- The Forest Cover Assessment of the Department of Forestry and Wildlife was done up to district level
- However, the National GHG inventory for the First National Communication used the national level. For this new study, the estimate was done up to provincial level
- In addition, the previous GHG inventory was done without separation between disturbed and undisturbed forests.

III. GHG inventory for LULUCF:
Methodology for improving LULUCF activity data (4)

Forest area (1992-1996)

Forest type		Forest area (ha)	
		1992	1996
Evergreen	Undisturbed	723468	686672
	Disturbed	3835474	3817583
Mixed	Undisturbed	123108	119425
	Disturbed	1734581	1708532
Deciduous	Undisturbed	4857745	4773911
	Disturbed	447314	454915
Mangrove		77669	72835
Inundated		349475	335304
Forest regrowth		440939	379305
Plantation		86664	96783
Wood/strubland		2351735	2286613
Grassland		494968	503751
Mosaic cropping		314062	464233

III. GHG inventory for LULUCF:
Methodology for improving LULUCF activity data (5)

- Wood product in 1994 was estimated about 1.5 million m^3, excluded the illegal logging and these data were used for national GHG inventory
- The exclusion of illegal logging will probably mak the inventory underestimated.
- Therefore, for the new study, this data is taken into account.

III. GHG inventory for LULUCF:
Methodology for improving LULUCF activity data (6)

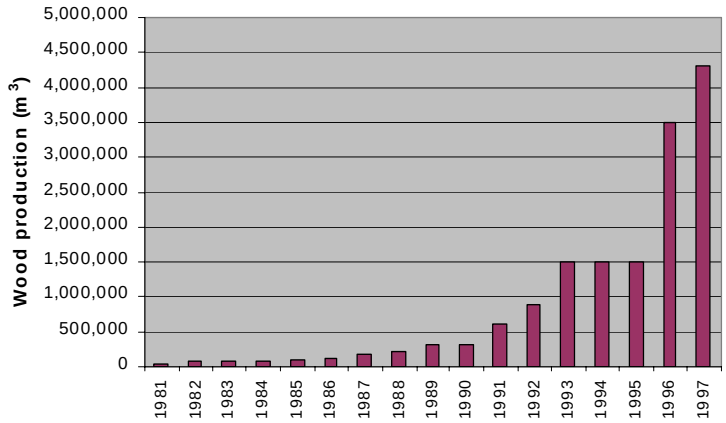


Figure 1: Wood production from 1981-1997

III. GHG inventory for LULUCF:
Methodology for improving emission factors (1)

- Studies on emission factors are very limited in Cambodia. These include aboveground biomass and mean annual biomass growth rate.
- In this study, the improvement of these data was carried out through literature review and field survey
- The survey was done in 7 sites (14 plots) in 4 different provinces. The size of sample plot is 200 m^2
- The ABOVEGROUND BIOMASS was estimated based on data on volume over bark (VOB), biomass expansion factor (BFF) and biomass density
- The MEAN ANNUAL INCREMENT was measured based on the measurement of diameter of tree in two different time.

III. GHG inventory for LULUCF: Methodology for improving emission factors (2)

Plot	Understorey[1] (1)	Necromas[2] (2)	Live tree biomass[2] (3)	Total AGB (1+2+3)
	t/ha			
A (Semi-evergreen)	7.0 (4.5)		66.62	74
B (Semi-evergreen)	7.1 (4.7)	19.77	89.92	117
C (Mangrove)	13.5 (3.2)	-	75.75	89
D (Mangrove)	-	-	198.34	198
E (Coniferous)	4.3 (1.2)	1.22	96.93	102
F (Coniferous)	3.1 (2.3)		54.18	57
G (Inundated forest)	6.9 (9.1)	3.44	28.72	39
H (Inundated forest)	6.6 (9.5)		53.64	60
I (Secondary forest)	6.2 (8.2)		35.12	41
J (Secondary forest)	4.4 (5.1)		48.51	53
K (Rubber)	3.3 (1.0)		84.52	88
L (Rubber)	3.0 (1.0)		109.57	113
M (Teak)	5.2 (2.7)	6.54	203.25	215
N (Teak)	6.2 (0.6)		148.07	154

Not: Values in the bracket is standard deviations and calculated from field survey, (2) estimated from diameter using allometric equation

III. GHG inventory for LULUCF: Methodology for improving emission factors (3)

Forest types	Initial NatCom	Estimated from Survey data	Other studies	Used in this study
Evergreen	295[1]		150[2]	200
Mixed (Semi evergreen)	370[1]	95	n.a	250
Deciduous	120[1]	n.a	n.a	100
Forest Regrowth	190[1]	47	32-230[3, 4]	120
Inundated	70[1]	50	15-342[4,5]	70
Mangrove	175	144	152-443[4]	150
Plantation	80	142	60-153[4]	100
Shrubland	70	n.a	~78[7]	70
Non-Forest/Agroforestry	n.a	n.a	30-207[6]	100
Wood-/Shrubland Evergreen	n.a	n.a	n.a	70
Wood-/Shrubland dry	n.a	n.a	n.a	50
Wood-/Shrubland Inundated	n.a	n.a	n.a	40
Mosaic of cropping<30%	n.a	n.a	~30[8]	30
Mosaic of cropping >30%	n.a	n.a	~100[8]	75
Grassland	n.a	n.a	2-7.6[5,9]	5

Source: [1]IPCC (1997); [2] FAO (1997); [3]Kiyono and Hastaniah (1997); [4]Wasrin *et al.*, (2000); [5]Utomo (1996); [6]Tomich et al. (1998); [7] Van Noordwijk *et al.*, (2000); [8]Murdiyarso & Wasrin (1996); [9]Palm et al., (1999); [10]Hairiah and Sitompul (2000). Note: ~ means around that value.

III. GHG inventory for LULUCF:
Methodology for improving emission factors (4)

Plot	Forest type	GRB (t/ha/year)	Plot	Forest type	GRB (t/ha/year)
A	Semi evergreeen	4.74	H	Inundated forest	-
B	Semi evergreeen	5.35	I	Secondary Forest	2.29
C	Mangrove	6.45	J	Secondary Forest	3.70
D	Mangrove	-	K	Rubber plantation	3.72
E	Coniferous	5.73	L	Rubber plantation	4.09
F	Coniferous	5.72	M	Tectona grandis	6.50
G	Inundated forest	-	N	Tectona grandis	6.55

Note: The estimates were the estimate of the biomass growth rate in the inventory year (2002).

III. GHG inventory for LULUCF:
Methodology for improving emission factors (5)

Forest types	Initial NatCom (t/ha/year)	Estimated from Survey data (t/ha/year)	Other studies (t/ha/year)	Used in this study (t/ha/year)
Evergreen	3.00[1]		0.30[7],	2.5
Mixed (Semi-evergreen)	4.20[2]	5.04	1.71-2.96[8]	3.0
Deciduous	3.60[2]	n.a	0.17[7]	2.0
Forest Regrowth	2.83[3]	2.99	1.3-2.7[9]	2.5
Inundated	2.98[3]	n.a	n.a	2.0
Mangrove	3.00[4]	6.45	n.a	3.0
Plantation (rubber)	*6.68*[5]	5.20	3.3-25[10]	6.7
Shrubland	1.00[4]	n.a	n.a	1.0
Non-Forest/Agroforestry	5.84[3]	n.a	n.a	6.0
Wood-/Shrubland Evergreen	n.a	n.a	n.a	1.0
Wood-/Shrubland dry	n.a	n.a	n.a	0.7
Wood-/Shrubland Inundated	n.a	n.a	n.a	0.5
Mosaic of cropping<30%	n.a	n.a	n.a	1.5
Mosaic of cropping >30%	n.a	n.a	n.a	0.5
Grassland	0.50[6]	n.a	n.a	0.2
Bamboo	1.50	n.a	n.a	n.a

Source: [1] IPCC (1997);[2] FAO (1997); [3] LEAP RWEDP (1997); [4] Lasco and Pulhin (1999); [5] Boer *et al.*, (2001);[6] UNDP-ESMAP (1992); [7]Ashwell (in Nophea, undated); [8]Logged over forest (Boer *et al.*, 2001); [9]Sutisna (1997), and [10]Askari (2000).

III. GHG inventory for LULUCF:
Result of GHG inventory (1)

⇨ GHG inventory for forestry sector in each province was estimated up to provincial level

⇨ Koh Kong Province is the highest CO2 emitter, while Mondol Kiri province is the highest C-sequestration

⇨ The error of estimate of CO2 emission is ranged between 1%22%, while the CO2 sequestration estimate ranges between 16%-38%

⇨ In term of CO2-eqv, more than half of Cambodian province were a net emitters

⇨ In comparison with the National GHG inventory reported in the National Communication, the improved inventory gave lower estimate.

III. GHG inventory for LULUCF:
Result of GHG inventory (2)

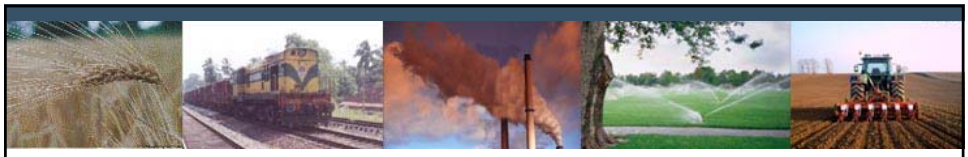
⇩ Comparison of 1994 GHG Inventory between National Communication and the Improved Inventory

	Removal (kt)	Emission (kt)				
	CO_2	CO_2	CH_4	CO	N_2O	NOx
Improved	-39,451.609	31,562.585	28.984	253.610	0.199	7.20
NatCom	-64,850.230	45,214.270	74.770	654.200	0.510	18.58
% Change of Natcom	39.2	30.2	61.2	61.2	60.9	61.

IV. Conclusion and recommendations

- The area of forests and area being converted and above ground biomass and annual growth rate of tree play the most important role that will determine greatly the accuracy of GHG inventory
- The improvement of the GHG inventory was made in 3 areas: forest area and rate of conversion, biomass growth rate, and level of analysis
- However, the aboveground biomass and biomass growth rate estimated from field survey will not represent the overall condition of Cambodia forest
- Further survey should be done for improving these factors.

India
Dr. Amit Garg

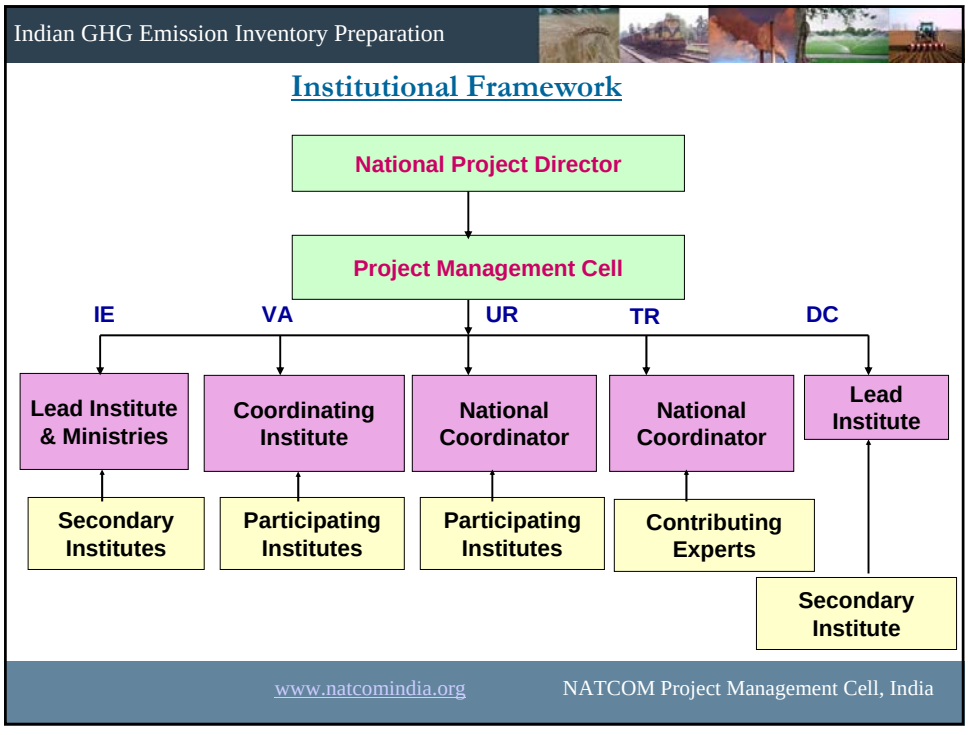


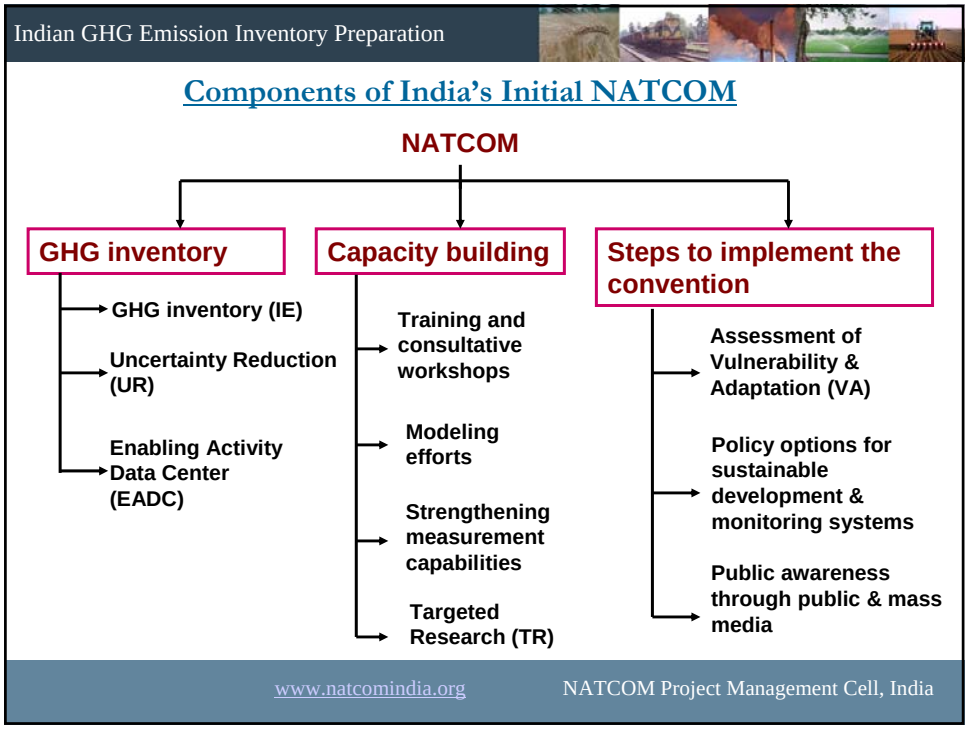
Methodologies for preparation of Inventories for India

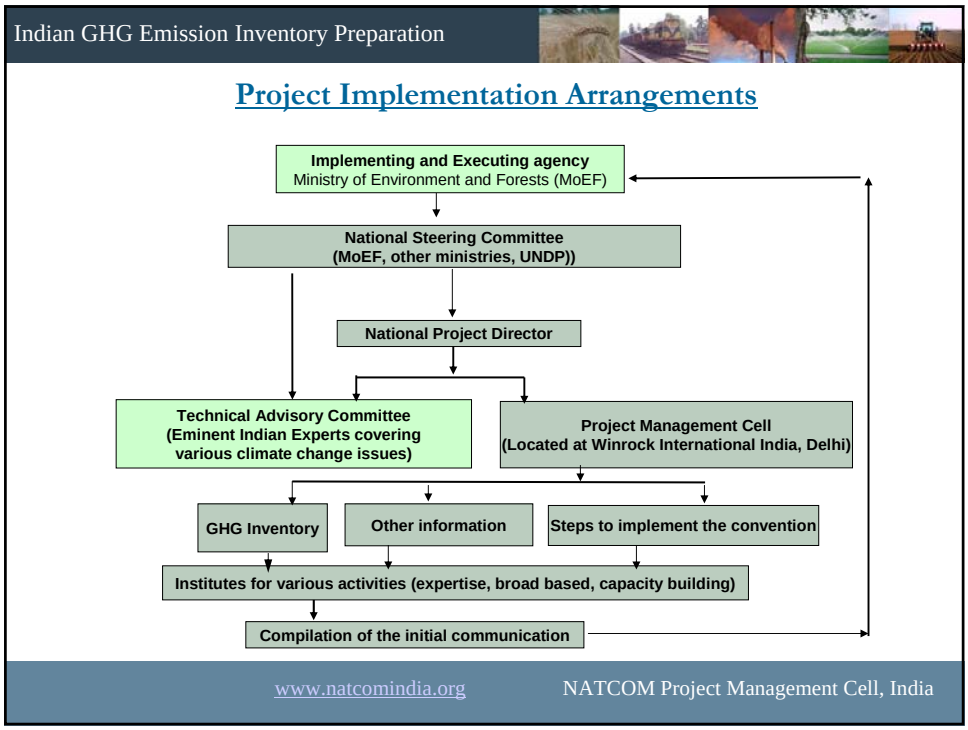
Amit Garg

Presentation for the
Workshop on GHG Inventories in Asia Region
Nov 13-14 2003, Phuket, Thailand

NATCOM Project Management Cell, India



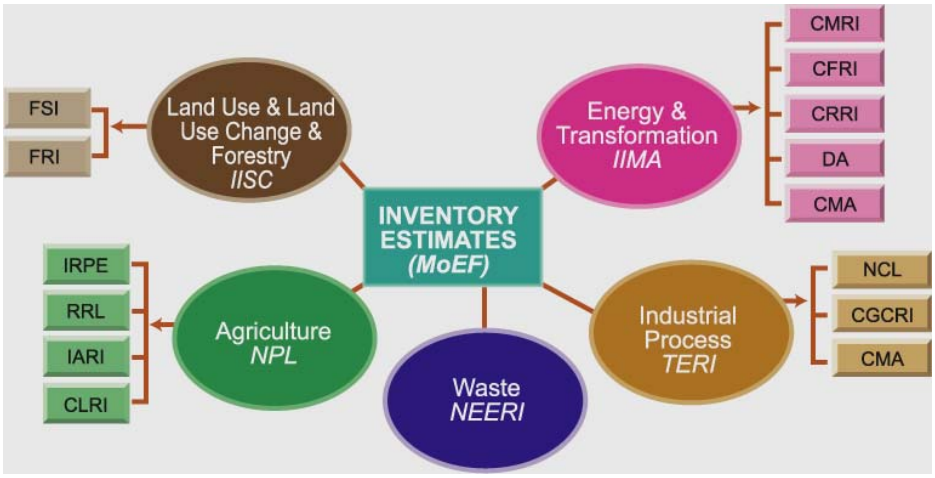

Indian GHG Emission Inventory Preparation
Components of India's Initial NATCOM
NATCOM
GHG inventory
GHG inventory (IE)
Uncertainty Reduction (UR)
Enabling Activity Data Center (EADC)
Capacity building
Training and consultative workshops
Modeling efforts
Strengthening measurement capabilities
Targeted Research (TR)
Steps to implement the convention
Assessment of Vulnerability & Adaptation (VA)
Policy options for sustainable development & monitoring systems
Public awareness through public & mass media
www.natcomindia.org
NATCOM Project Management Cell, India


Indian GHG Emission Inventory Preparation
Project Implementation Arrangements
Implementing and Executing agency
Ministry of Environment and Forests (MoEF)
National Steering Committee
(MoEF, other ministries, UNDP))
National Project Director
Technical Advisory Committee
(Eminent Indian Experts covering various climate change issues)
Project Management Cell
(Located at Winrock International India, Delhi)
GHG Inventory
Other information
Steps to implement the convention
Institutes for various activities (expertise, broad based, capacity building)
Compilation of the initial communication
www.natcomindia.org
NATCOM Project Management Cell, India

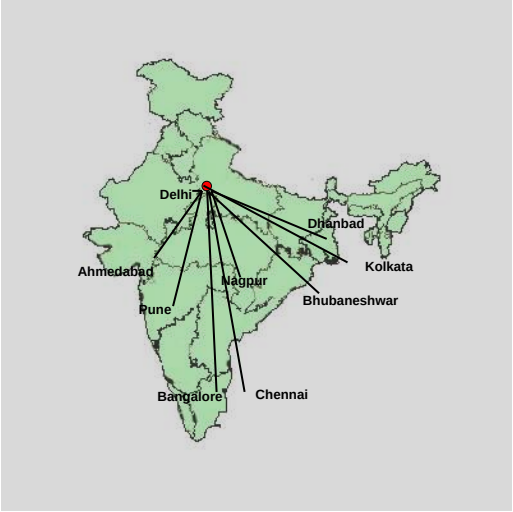
Approach to NATCOM Preparation

- Broad based participatory approach for
  - Development of comprehensive inventory of GHGs for 1994
  - Improve its reliability vis-a-vis reducing uncertainties of GHG emission coefficients in key source categories (IPCC guidelines and methodologies)
  - Vulnerability assessment and adaptation of various sectors to climate change
- Identification of key steps to implement the Convention
- Capacity Building and networking of Institutions through meetings, workshops (training, awareness and thematic) and publications

IE: Institutional Arrangement



IE: Geographical Institutional Distribution



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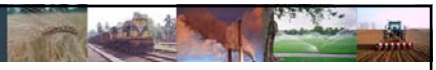

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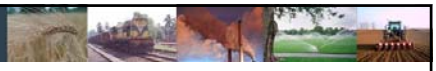
Indian GHG Emission Inventory Preparation



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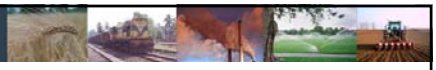

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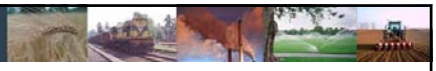

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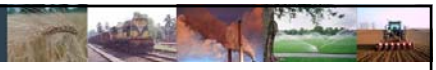

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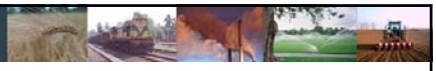

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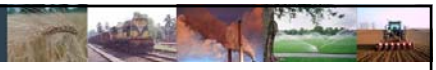
MoEF (1984-85), *Comprehensive Industry Document Series, Minimal National Standards, Straight Nitrogenous Fertilizer Industry.* Central Board for the Prevention and Control of Water Pollution, Ministry of Environment and Forests, Government of India, New Delhi, India.

Good Practice Guidelines

The Indian NATCOM has adopted Quality Control and Quality Assurance practices to the extent possible.

- **Data verification from alternate sources**
- **Going one level deeper**
- **Review by Indian experts not part of inventory preparation**
- **Inventory validation at three national workshops**



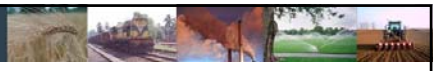
Uncertainty Reduction in Greenhouse Gas Emissions

Statistical Definition: An uncertainty is a parameter, associated with the result of measurement that characterises the dispersion of the values that could be reasonably attributed to the measured quantity (e.g. the sample variance or coefficient of variation).

Inventory definition: A general and imprecise term which refers to the lack of certainty (in inventory components) resulting from any causal factor such as unidentified sources and sinks, lack of transparency etc.

Source: IPCC Good Practice Guidelines

Indian GHG Emission Inventory Preparation



Uncertainty Reduction in Greenhouse Gas Emissions

- **Top down and bottom up estimates of national activity data have variations due to aggregation errors**
- **Existing activity data reporting formats are not meant for inventory reporting purposes**
- **IPCC default emission coefficients may not be representative of India specific coefficients**
- **Regional and sectoral variability exists in emission coefficients across a large country like India**
- **Wide technology diversity complicates estimation of India specific estimates (new and vintage technologies co-exist)**
- **Methodological issues**

Possible Reasons for Variation in Some Coefficients

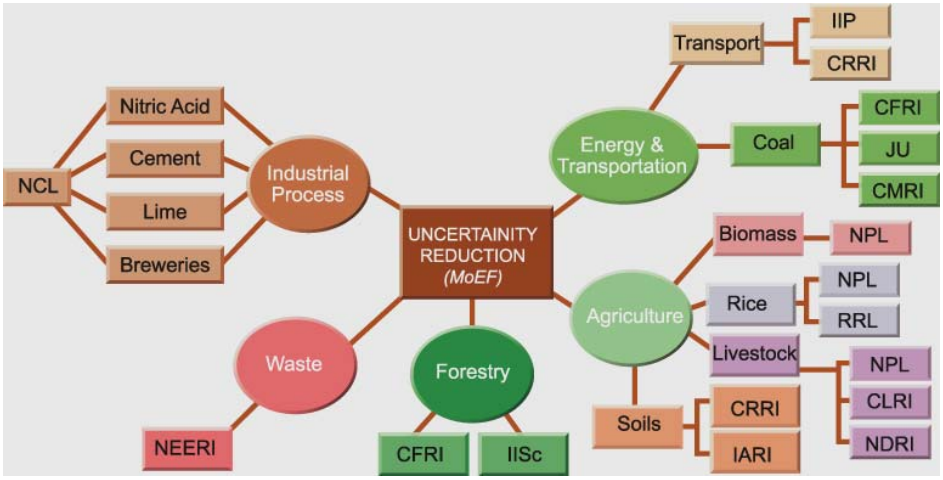
Coefficient type	Possible reasons for variation of Indian coefficients from IPCC default values
CH_4 from Municipal Solid Waste	Waste composition, waste collection levels and mechanisms, dump management, reduction technologies
CO_2 from coal combustion	Coal composition, boiler/ combustion efficiency, regional variations across the country, coal definition issues
Industrial process emissions	Technological variability in level and extent of control processes
CH_4 from enteric fermentation	Thinner cattle, not so rich feed type
CH_4 from rice paddy cultivation	Irrigation practices, fertilizer and soil types in India are not conducive to high CH_4 production

Uncertainties in Inventory Estimates

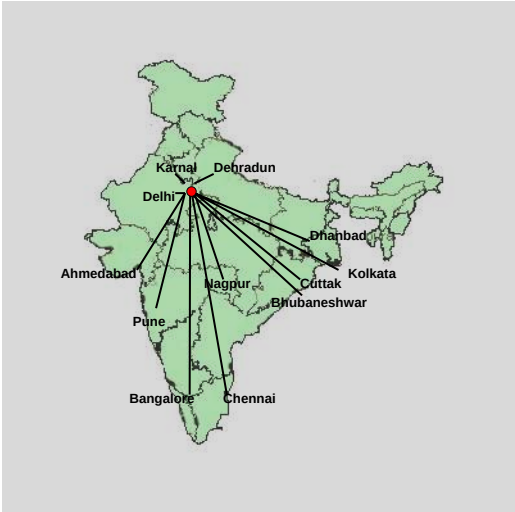
Uncertainties can be resolved through:

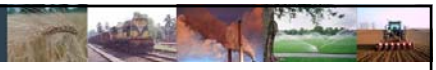
- Examination of Activity Data
- Development of Indigenous Emission Coefficients

UR: Institutional Arrangement



UR: Geographical Institutional Distribution





Key Source Categories: Energy & Transformation sector

Uncertainty in Activity data & emission coeff.

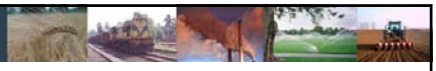
- **Road Transport**
  - **Car/ taxi**
  - **2W/3W**
  - **MCV/HCV**
  - **LCV**

Uncertainty in NCV & CO_2 emission coeff.

- **Coal Combustion**
  - **Coking coal**
  - **Non coking**
  - **Lignite**

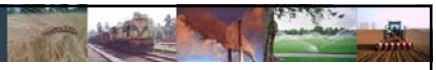
Uncertainty in CH_4 emission coeff.

- **Coal mining**
  - **During mining**
    - **Surface mining**
    - **Degree1**
    - **Degree2**
    - **Degree3**
  - **Post Mining**
    - **Surface mining**
    - **Degree 1**
    - **Degree 2**
    - **Degree 3**



Key Source Categories: Industrial Process sector

- **Cement production**
- **Lime production**
- **Lime stone and dolomite use**
- **Ammonia production**
- **Nitric acid production**



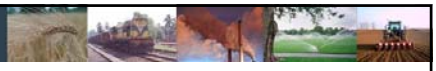
Key Source Categories: Agriculture sector

➢Rice Cultivation

- ❖Upland
- ❖Rain fed (Flood Prone)
- ❖Rain fed (Drought Prone)
- ❖Irrigated (Continuously Flooded)
- ❖Intermittently Flooded-Single Aeration
- ❖Intermittently Flooded-Multiple Aeration
- ❖Deep Water

➢Enteric Fermentation

- ❖Cattle
  - ▪Dairy
- ❖Non-Dairy
  - ▪Below 1yr
  - ▪1-3 yrs
  - ▪Others
- ❖Cross bred
  - ▪Dairy
- ❖Non-dairy
  - ▪Below 1yr
  - ▪1-3 yrs.
  - ▪Others
- ❖Buffalo
  - ▪Dairy
- ❖Non-Dairy
  - ▪Below 1yr.
  - ▪1-3 yrs.



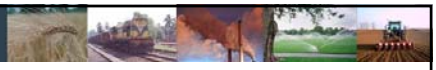
Key Source Categories: Agriculture sector (Contd.)

➢Manure Management

- ❖ Dairy Cattle
  - ▪Indigenous
  - ▪Cross bred
- ❖Non Dairy Cattle indigenous
  - ▪Below 1yr
  - ▪1 to 3 yrs
  - ▪Adults
- ❖Non Dairy Cattle Cross Bred
  - ▪Below 1yr
  - ▪1 to 2.5 yrs.
  - ▪Adults
  - ▪Dairy Buffaloes
- ❖Non Dairy Buffaloes
  - ▪Below 1 yr
  - ▪1 to 3 yrs.
  - ▪Adults

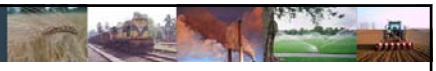
➢Crop Residue

- ❖ Residue to crop ratio
  - ▪Rice
  - ▪Wheat
  - ▪Maize
  - ▪Millet
  - ▪Jute
  - ▪Cotton
  - ▪Groundnut
  - ▪Sugarcane
  - ▪Rapeseed and Mustard



Key Source Categories: Agriculture sector (Contd.)

- **Soils**
  - **EF1(fraction of N input kg N2O-N/kg N)**
  - **EF2(organic soil)kg N2O-N ha/yr**
  - **EF4 (Nitrogen deposition)kg N2O-N/kg NH3-N and Nox-N emitted**
  - **EF5(leached/run-off N from fertilizer and manure)kg N2O-N/kg N leaching/run-off**
  - **Frac.GASF (gas loss through volatilization from inorganic fertilizer)kg NH3-N + Nox-N/kg of synthetic fertlizer N applied**
  - **Frac.GASM (gas loss through volatilization from manure) kg NH3-N + Nox-N/kg of N excreted by livestock**
  - **Frac.leach (Leaching loss of N from applied fertilizer and manure) kg N/kg fertilizer or manure N**



Key Source Categories: Land Use, Land Use Change & Forestry

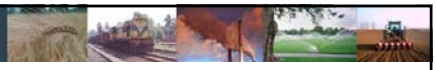
- **Changes in forest and other woody biomass**
- **Annual forest and grass land conversion**
- **Abandonment of managed lands**
- **CO_2 emission or uptake from soils**

Key Source Categories: Waste

➢**Municipal Solid Waste : Okhla**

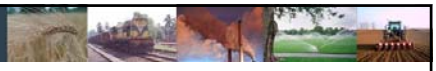
Uncertainty Reduction: Emission Coefficients Measurements

•Coal	CO_2
•Power and Steel(Coal)	CO_2
•Road transport	CO_2, N_2O
•Biomass burning	CH_4, N_2O
•Cement, Nitric acid, Lime	CO_2, N_2O, CH_4
• Enteric fermentation in animals	CH_4
•Manure management	CH_4, N_2O
•Rice paddy cultivation	CH_4
•Soils	N_2O
•Municipal Solid Waste	CH_4



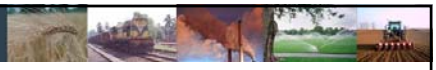
Emission Coefficient: Research Methodologies

Sector/ Source	Methodology
Road transport	Emission coefficient determined by exhaust gases sampling through constant volume methodology. Vehicles are tested using Chassis dynamometer assembly. CO_2 and CO - using non-dispersive infrared absorption type CO_2 analyser; HC - using Flame Ionization detector type analyser; NOx – using chemiluminescent (CLA) type analyser
Calorific values of Indian coals	Assessment of NCV and GCV of various Indian coals such as Coking, Bituminous and Lignite based on their moisture, carbon and hydrogen contents
Coal mining	CH_4 emission measurements using Haldane Mine Air Analysis Apparatus and gas chromatographs. Chamber method used for the first time in India for open cast mine measurements



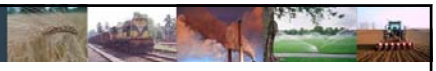
Research Methodologies (Contd.)

Sector/ Source	Methodology
Coal combustion in power plants	CO_2 Emission factor estimates through primary data collection on fuel feed rate, quality parameters, sampling of coal, fly and bottom ash and Direct measurement of gases at different stack heights. Analysis using gas chromatographs with standard gas samples. Suspended Particulate Matter - The Whatman glass fibre filter paper Respirable Suspended Particulate Matter - The Whatman glass fibre filter paper Sulphur Dioxide – Sodium Tetrachloromercurate method Nitrogen Dioxide – Sodium Hydroxide method Ambient CO_2 and Photosynthesis rate – Portable Photosynthesis System Leaf Area – Leaf Area Meter
Coal combustion in steel plants	CO_2 Emission factor estimated through primary data collection on quantity and type of fuel consumption, quantity of reducing agents, carbon in ore, pig iron and steel, production of pig iron and steel along with direct measurement of flue gas. Analysis using gas chromatographs with standard gas samples.



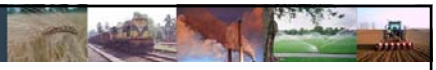
Research Methodologies (Contd.)

Sector/ Source	Methodology
Coal Combustion in cement plants	CO_2 Emission factor estimates through primary data collection on raw material consumption, its composition, content of clinker and CaO, limestone content, cement kiln dust and direct measurement of gases for Dry, Semi-Dry and Wet Technologies. Analysis using gas chromatographs with standard gas samples.



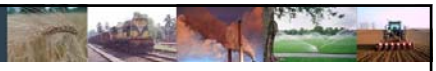
Research Methodologies: Industrial Processes

Sector/ Source	Methodology
Nitric acid production	Analysis of N_2O samples using Portable Infra Red gas analyzer collected from Selective catalytic reduction (SCR), at feed to SCR, at feed to Non-SCR, and from Non-SCR at stack levels.
Lime production	Based on lime production data and standard IPCC methodology
Cement production	CO_2 emission coefficient derived from the analysis of CaO and MgO in raw material, clinker, and finished cement samples. Analysis is carried out by atomic absorption spectrophotometer (AAS)



Research Methodologies: Agriculture

Sector/ Source	Methodology
Rice cultivation	Collection of CH_4 samples at different types of fields with different water regimes, amendments, cultivars for the entire one year. Analysis using gas chromatographs with standard gas samples.
Biomass combustion	Measurement of emission factors through collection of gases for different samples of bio mass Analysis using gas chromatographs with standard gas samples.
Enteric fermentation	Determination of emission factor of CH_4 through Measurement of CH_4 due to enteric fermentation in dairy cows Estimate of CH_4 emission factors using activity data on feed intake, feed energy, etc.



Research Methodology: LULUCF

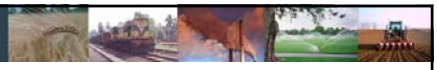
Based on literature survey and appropriate for Indian plantation types

Research Methodologies: Waste

Sector/ Source	Methodology
Municipal Solid Waste	**Actual CH_4 measurement at one landfill site in Delhi**
	Estimation of Waste water generated per category of industry; maximum methane production capacity and methane emission factor per kg of COD

Workshops conducted

- Workshop on Good Practices in Inventory Development (Nov 27-30, 2001), New Delhi
- Seminar on Reducing Uncertainties in Inventory Estimates (November 28, 2001), New Delhi
- Workshop on Inventory Development (December 3-5, 2001), Ahmedabad
- National Communication Workshop on LULUCF Scoping (February 7-8, 2002), Bangalore
- Finalization of Emission Coefficients (March 4-5, 2003), New Delhi
- Finalization of GHG Emission Inventories (March 27, 2003), New Delhi
- Finalization of GHG Emission Inventories from Agriculture sector (April 2, 2003), Delhi
- Finalization of GHG inventory in LULUCF Sector (May 6-7, 2003), Dehradun



Conclusions

- **Activity Data**
  - **Robustness**
  - **Uncertainty Reduction**
  - **Depth**
  - **Completeness**
- **Emission Factors**
  - **Some key source categories**
  - **Sampling plan**
  - **Calibration**
  - **Reproducibility**

Development of National GHG Inventory: INDONESIA

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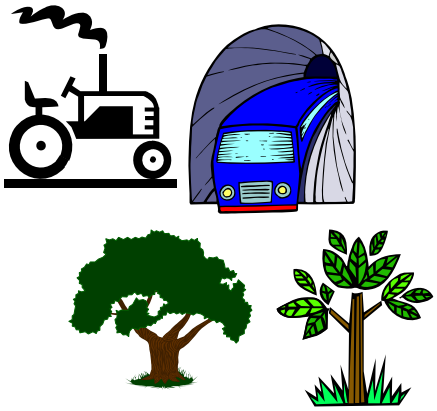
Outline of Presentation

- Overview
- National System for Developing National GHG Inventory
- Effort to improve the inventory
- Global program for improving GHG inventory

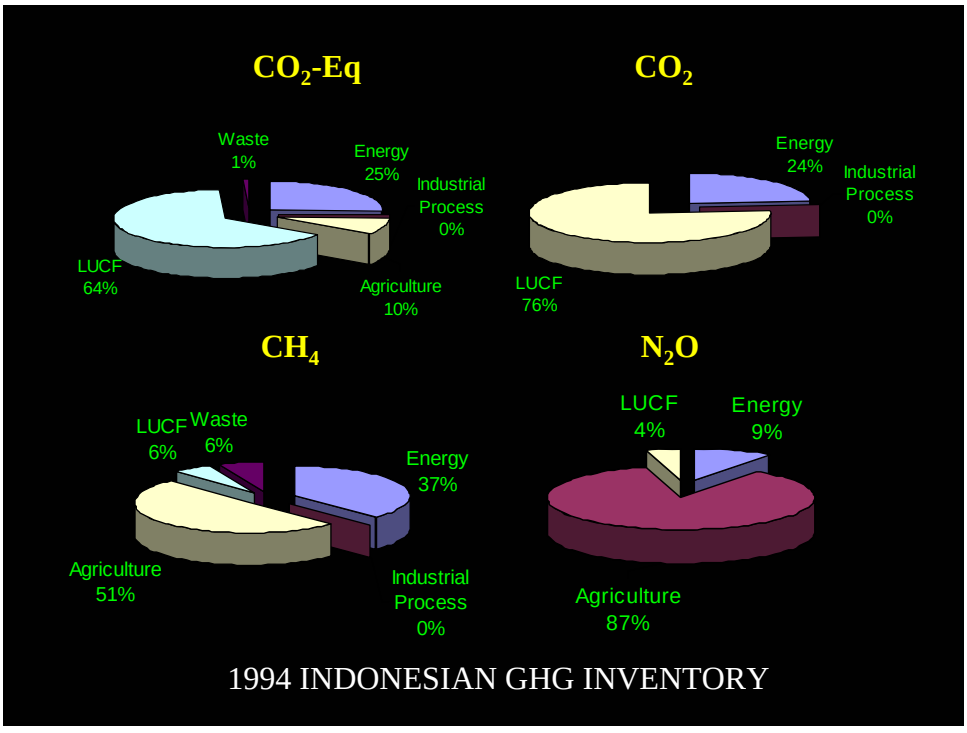


National GHG Inventory

- **Each non-Annex I Party shall communicate to the COP a national inventory of anthropogenic emissions by sources and removals by sinks of all GHGs not controlled by the Montreal Protocol, to the extent its capacities permit (Article 4.1a and Article 12 .1a)**
- **Non-Annex I Parties shall estimate national GHG inventories for the year 1994 for the initial national communication or alternatively may provide data for the year 1990. For the second national communication, non-Annex I Parties shall estimate national GHG inventories for the year 2000. The LDC Parties could estimate their national GHG inventories for years at their discretion.**

National GHG Inventory

- **Non-Annex I Parties <u>should</u> <u>use</u> the *Revised 1996 IPCC Guidelines* for national GHG Inventories.**
- **Parties <u>may</u> <u>use</u> different methods (*tiers*) included in the Guidelines, giving priority to those methods which are believed to produce the most accurate estimates, depending on national circumstances and availability of data. As encouraged by the IPCC Guidelines, Parties can also use national methodologies where they consider these to be better able to reflect their national situation, provided that these methodologies are consistent, transparent and well documented.**

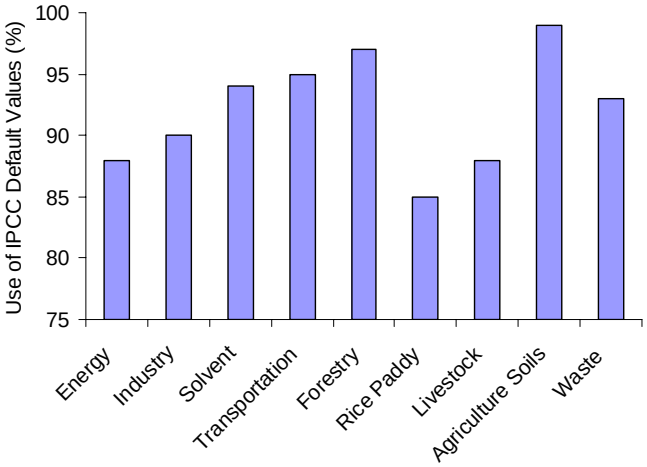


1994 INDONESIAN GHG INVENTORY

Problems

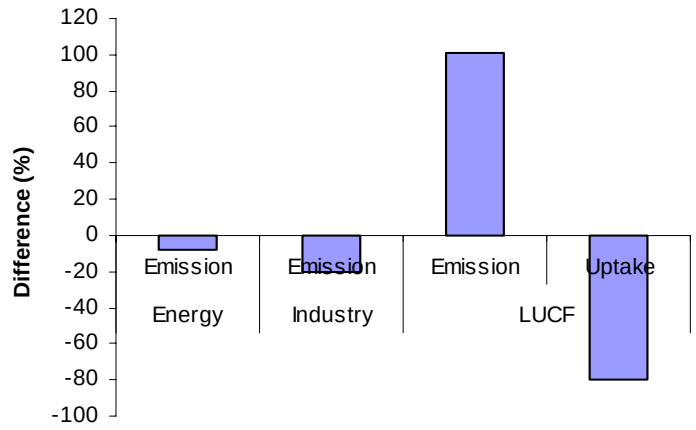
- National system for developing GHG inventory has not been well developed.
  - No effective and efficient system for managing activity data of related sectors for the development of the inventory
  - No system for checking the reliability of the inventory
  - Most of emission factors used are IPCC default values. However, data on these are becoming more available especially for some sectors (e.g. agriculture-rice paddy and LUCF)
- The certainty level of the estimates for most sectors were considered low, in particular LUCF.

The use of IPCC Default Values in Developing the 1994 GHG Inventory

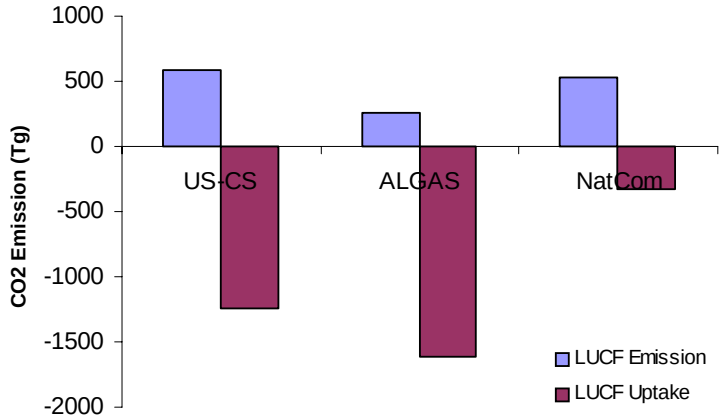


Most of local values were based on expert Judgments

The Difference of CO2 emission estimate between ALGAS and NatCom Report

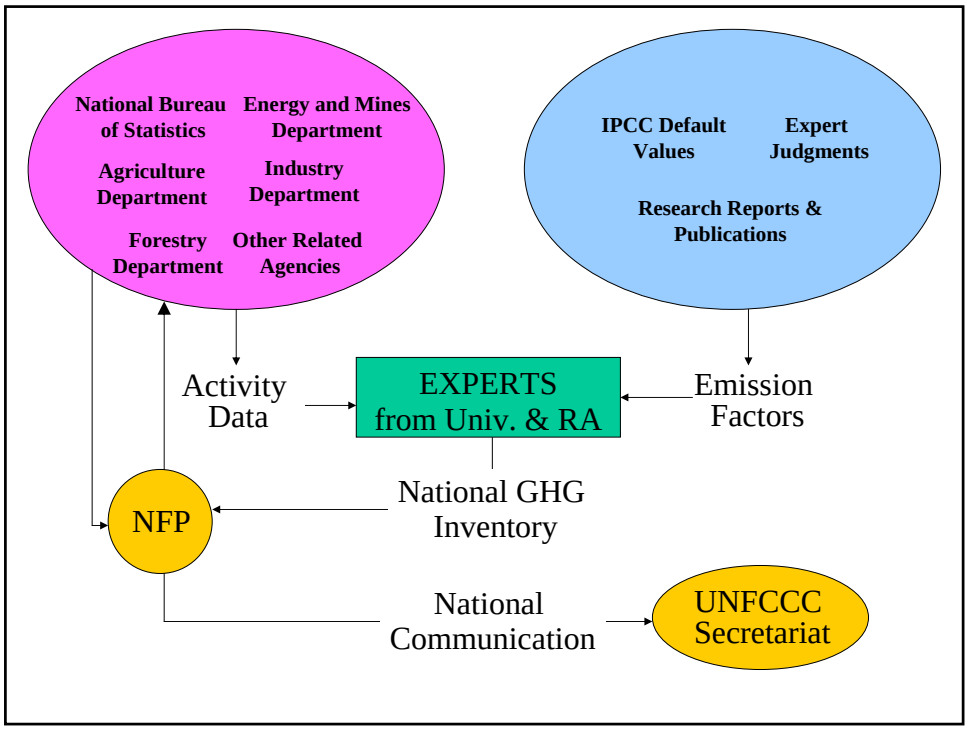


CO2 emission estimate from LUCF from three studies



Indonesia
Dr. Rizaldi Boer

National System



EFFORTS TO IMPROVE THE INVENTORY

- ENERGY SECTOR
- INDUSTRIAL SECTOR
- AGRICULTURE SECTOR
  - Rice Paddy
  - Livestock
  - Agriculture Soils
- FORESTRY SECTOR
- WASTE

ENERGY AND INDUSTRIAL SECTOR

- Level of certainty of the activity data from energy and industrial sector are considered as high in comparison to non-energy sectors, as most data published in the National Statistics of these sectors were from private companies which have good data management system.
- Efforts to develop local emission factors for these sectors are not recorded as well as for waste

AGRICULTURE SECTOR

Improvement of Emission Factors

- Methane for Rice Paddy:
  - Ample research activities on mineral soils conducted by Research Agencies in collaboration with IRI
  - Limited number of research activities on organic soils (Bogor Agricultural University, JSPS-Hokkaido University and Univ of Gottingen-Germany). Indonesia has about 22 millions ha of peat land and will be used for agriculture development.

Some of Research Results

Means and standard deviation of CH_4 and CO_2 emissions rates from rice field in inland, transitional and coastal peat soils of Central Kalimantan (mg m^{-2} h^{-1})

Gases	Age of crops	Berengbengkel (inland)		Sampit (transitional)		Samuda (coastal)	
		Mean	Stdev	Mean	Stdev	Mean	Stdev
CH_4	0 WAP	6.38	0.32	6.20	0.61	6.14	0.23
	4 WAP	7.38	0.51	6.77	0.11	6.90	0.57
CO_2	0 WAP	66.61	0.87	61.98	3.74	60.49	3.57
	4 WAP	74.60	3.48	72.82	4.32	76.96	4.63

AGRICULTURE SECTOR

Improvement of Emission Factors

- Methane for livestock
  - Limited number of research activities on developing methane EF from Rumen. Small number of research activities is on going at IPB (Bogor Agricultural University)

AGRICULTURE SECTOR

Improvement of Emission Factors

- N_2O from Agriculture Soils
  - Limited number of research activities on developing N_2O EF from agriculture soils. (Agriculture Research Agencies, Impact Centre for Southeast Asia)

FORESTRY SECTOR

Priority data domains	Importance
Converted forest area per forest type	*3*
Growth rate of forest and vegetation types (including plantations)	*3*
Forest typology (biomass-based, floristic, ecology, climatic, administrative)	*3*
Wood harvest (legal + illegal, half-life time by use)	*2.5*
Biomass of each forest and vegetation type	*2.5*
Root biomass per vegetation / land use land cover type	2.2
Wood to biomass expansion factor, allometrics	2.2
Abandoned land: area + growth rate (increment)	1.7
Soil C stock (including organic soils + LU impacts)	1.1
On-site (in situ) burning	0.5

FORESTRY SECTOR

Approaches to Estimate MAI, Abovegroud Biomass

Diameter class (D in cm)	Mean number of stems/ha	Volume of stem (V in m^3)[1]	Total Volume of stem (m^3/ha)	Diameter after growing (Dg in cm)[2]	Volume of stem after growing (V in m^3)[1]	Total Volume of stem (m^3/ha)	Volume increment (m^3 ha^{-1} yr^{-1})[3]
(1)	(2)	(3)	(4)=(2)x(3)	(5)=(1)+*Di*	(6)	(7)=(2)x(6)	(8)=(7)-(4)
14.50	249.4	0.087	21.8	14.82	0.093	23.1	
24.50	104.1	0.347	36.1	24.91	0.362	37.7	
34.50	50.2	0.852	42.8	34.93	0.880	44.2	
44.50	22.2	1.662	36.9	44.92	1.704	37.8	
54.50	10.4	2.831	29.4	54.90	2.887	29.9	
64.50	5.2	4.407	22.7	64.92	4.484	23.1	
70.00	3.6	5.464	19.7	70.47	5.560	20.1	
			209.3			215.9	**6.5**

[1]Allometric equation for estimating volume of wood is $V=0.00007771D^{2.267}$, and
[2]$Di=0.000006D^3 - 0.0008D^2 + 0.0335D - 0.0178$ (R^2=48%). [3]Using BEF of 1.5 (Ruhiyat, 1995) and wood density of 0.6, the mean annual biomass increment of logged-over forest was about 5.9 t ha^{-1} yr^{-1}

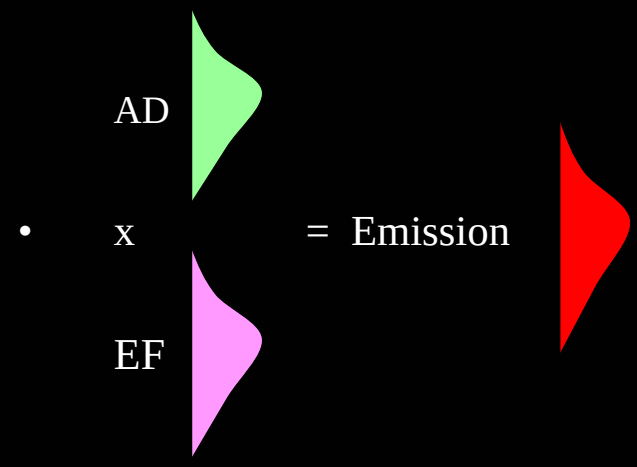
FORESTRY SECTOR

Another approaches

- $MAI_{LoF}=((WV_{VF}–WV_{LoF})/Rotation)*WD*BEF$
  - wood volume of virgin (WV_{VF}) and logged-over (WV_{LoF}) forests
  - WD wood density and BEF Biomass expansion factor (1.5 for natural forest: Ruhiyat, 1995)
- MAI = (SY * CF * BEF)/(Age of stand)
  - SY stand yield in m^3
  - CF correction factor: ratio between stand yield table and observed data collected through forest inventory
- Allometric equations: To estimate volume of wood (database) and total biomass

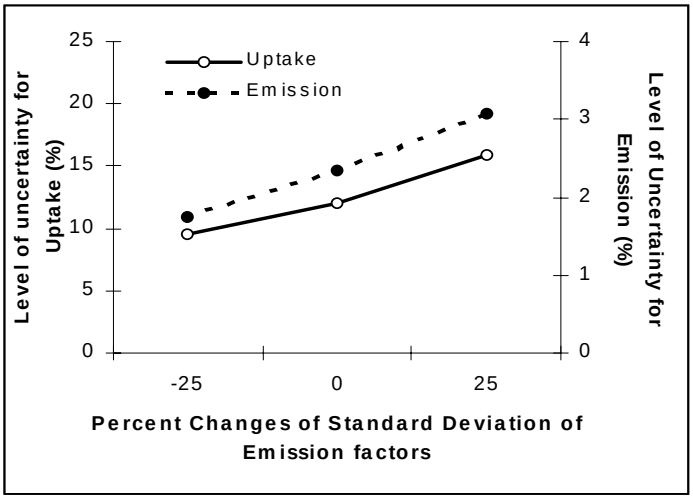
FORESTRY SECTOR

Uncertainty Analysis: Jambi case in 1992



FORESTRY SECTOR

Impact of Changing Standard Deviation of MAI on level of Uncertainty



FORESTRY SECTOR

Level of uncertainty depending on

- the complexity of LULUCF (number of land use categories)
- size of area under study
- resolution of images ~ area estimates of LULUCF
- method of averaging MAI, Biomass density (non-weigthed or weigthed mean)

FORESTRY SECTOR

Future Works

- Assessing the impact of changing resolution of satelite image on:
  - area estimates
  - above ground biomass estimates ~ allometric equations, expansion factor (rules: as simple as possible)
  - Level of uncertainty of C-emission and C-uptake estimates ~ cost effectiveness
- Development of model for estimating MAI from available information such as LQI (soil+climate information) ~ e.g. Patterson Index
- Development of more effective and efficient procedures for estimating AD and EF

GLOBAL PROGRAM

UNDP-GEF Enabling Activity: Regional Proposal for Improving GHG Inventory (Pending ?)

- Giving greater attention to procedures for *selecting* and *prioritising* emission factors and other appropriate data required for the inventory;
- Placing more emphasis for *identifying* and *testing cost-effective methods* for data collecting appropriate to national circumstances;
- Giving priority to *publishing* research on emission factors so that the results can be validated and contribute to the IPCC process;
- Considering ways of *establishing* and *strengthening* national institutional arrangements for archiving and updating national inventories;
- Strengthening *data sharing* and information exchange of regional data through workshops and regional centres;
- Developing an *integrated training package* that considers all aspects of data collection, including incentives for their collection, data management and other procedural matters related to data quality.

PDF Component Activities:

- Phase I
- Assessment of current information taken from inventories of initial National Communications and data gathered through the Support Programme
  - Development of a procedure for selecting and prioritizing emission factors and data to be improved from among different sectors
  - Assessment of cost of different methods of data collection and management
  - Development of consensus for the elements of a common approaches for implementation such as reducing uncertainty and common bias, procedure for selecting and prioritizing data for collection etc.
- Phase II
  - Testing and revising the common approach before implementation

Global Program

- ***Component 1: Emission factors and appropriate data gathering.*** Criteria under the common approach :
  - magnitude and contribution of GHG emissions and removals for a given source or sink at the national level;
  - the sensitivity of the calculation estimates to the proposed data, including an assessment of the extent to which the uncertainty of the estimate will be improved through more accurate emission factors and other data;
  - the relevance of the source/sink and the sector of the inventory to meet national priorities;
  - the feasibility of implementing abatement measures, including technology transfer, for a given sector;
  - the availability of low-cost data collection methods, including standard or internationally-accepted methods.

Global Program

- ***Component 2: Strengthen national arrangements for archiving, updating and managing of greenhouse gas inventories****. Specific Activities for this component:*
  - *archiving* of relevant national data (i.e., activity data, emission factors, conversion factors) for several years;
  - *identifying* data sources and national experts that have been involved in inventory preparation in a national database;
  - *periodic updating* of inventories in a cost-efficient manner;
  - *comparing* inventories across years in order to identify trends in emissions and removals;
  - *documenting* the selection process of national activity data, emission factors, and other conversion factors used in inventory preparation process;
  - *documenting* methodologies and assumptions used; and
  - *validating* conversion of units and other data.

Global Program

- ***Component 3: Training for the implementation of good practices for preparing national inventories and dissemination of the underlying data.*** There are three main activities in this component
  - Those which address scientific methodology, such as the IPCC Guidelines and Good Practices;
  - Disseminate data under Component 1
  - Relate to institutional structures and data management under Component 2
- ***Key features of national data arrangements include***:
  - A flexible system taking into account national circumstances as well as the requirements of UNFCCC and IPCC guidelines.
  - National experts would be responsible for the information entered into the national data system. Records of any changes to the system would be registered.

Korea
Dr. Seungdo Kim

CH_4 Emission from Korean Landfills: Application of Tier 1

Seungdo Kim
Associate Professor
Dept. of Env. System Eng.
Hallym University

HALLYM UNIVERSITY
Pyrolysis Research Laboratory

Research Necessities for GHG inventories in Korea

- Generation Rate of GHG in Korea :
  11^{th} highest in the world
  - ✓ Collection of reliable emission data of GHG
    - Necessity for developing reliable estimation methods of GHG from various emission sources
- CH_4 emission from Landfill
  - ✓ Difficulty in estimating CH_4 emission correctly because of temporal variation of landfill conditions

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Recent Works regarding CH_4 Emission from Landfill in Korea

- Estimation of Korean specific emission factor and key parameters for Tier 1
- Modification of Tier 2 method to reflect the Korean Landfill situations
  - ✓Estimation of methane generation constant for Korean Landfill MSW (Municipal Solid Wastes)

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Questions to be answered

- Are the emission results accurate?
- What is the accuracy level to be used as national emission data?

↓

What does make it difficult to estimate the emission rate of CH_4 from landfill?

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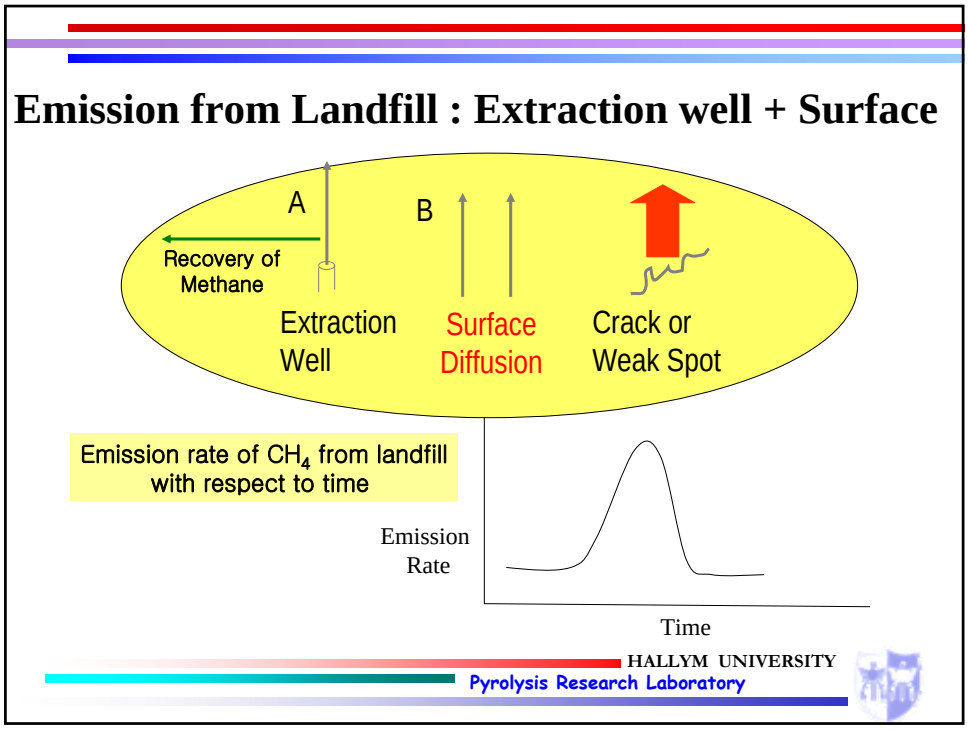
Emission from Landfill : Extraction well + Surface
A
B
Recovery of Methane
Extraction Well
Surface Diffusion
Crack or Weak Spot
Emission rate of CH_4 from landfill with respect to time
Emission Rate
Time
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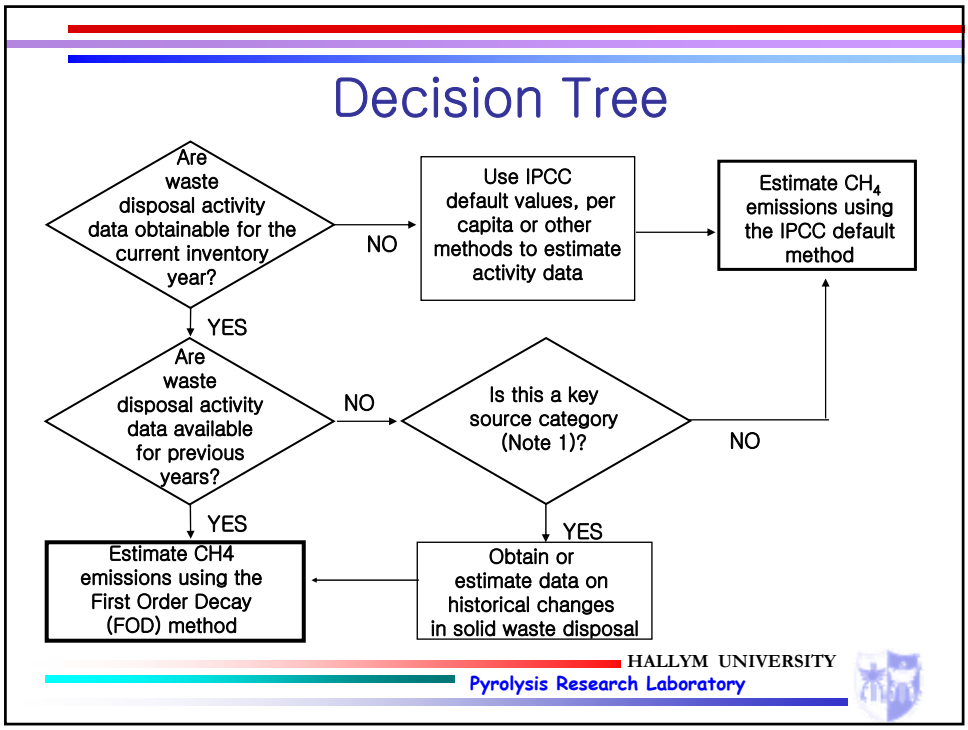
Decision Tree
Are waste disposal activity data obtainable for the current inventory year?
NO
Use IPCC default values, per capita or other methods to estimate activity data
Estimate CH_4 emissions using the IPCC default method
YES
Are waste disposal activity data available for previous years?
NO
Is this a key source category (Note 1)?
NO
YES
YES
Estimate CH4 emissions using the First Order Decay (FOD) method
Obtain or estimate data on historical changes in solid waste disposal
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Default Method : Tier 1

- Assumption
  - ✓MSW landfilled in a year would be converted completely into CH_4 which would be emitted from the landfill in the same year
- Limitation to application
  - ✓Only applicable for landfills demonstrating constant quality and quantity of MSW with respect to time

Estimation Equation for Tier 1

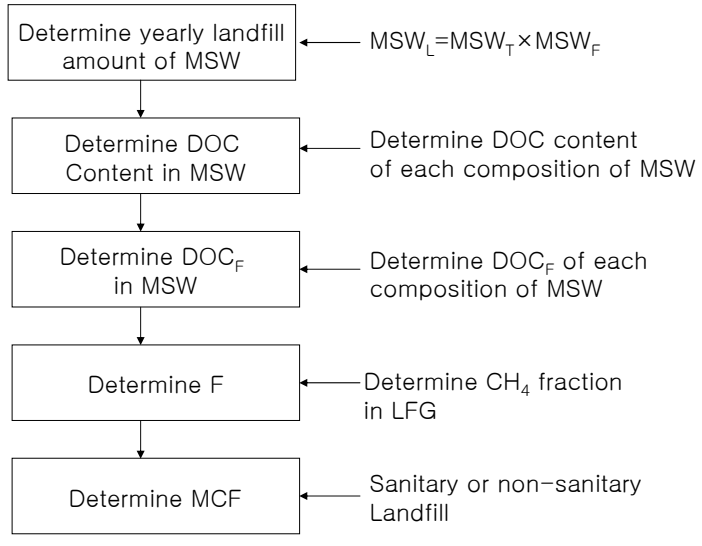
$$CH_4 = (MSW_T \times MSW_F \times L_0 - R) \times (1 - OX)$$

MSW_T = Total MSW generated (Gg/yr)
MSW_F = Fraction of MSW disposed at Landfills
L_0 = Methane generation potential (Gg CH_4/Gg waste)
$L_0 = MCF \times DOC \times DOC_F \times F \times 16/12$
MCF = Methane Correction Factor (fraction)
DOC = Degradable organic carbon (fraction)
DOC_F = Fraction DOC dissimilated
F = Fraction by volume of CH_4 in landfill gas
R = Recovered CH_4 (Gg/year)
OX = Oxidation factor (fraction)

<Key Parameters of Tier 1>

(1) Landfilled amount of MSW : MSW_L
(2) DOC
(3) DOC_F
(4) MCF
(5) R
(6) OX

Flow diagram for estimation of L_0



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Properness of Key Parameters used in the Tier 1 calculations

- MSW_L (Landfilled amount in a specific year)
  - ✓ Using yearly reports of National Generation and Treatment Statistics of solid wastes reported by the MOE of Korea
- DOC (Degradable Organic Carbon)
  - ✓ Development of Korean specific DOC estimation equation

$$DOC(\%) = 0.114 \times FW + 0.320 \times PA + 0.366 \times WO + 0.571 \times RU + 0.061 \times SL + 0.114 \times AN + 0.285 \times OT$$

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- DOC_F (Fraction DOC Dissimilated)
  - ✓ Default value suggested by IPCC : 0.5~0.6
    - Using the average value : 0.55
  - ✓ Comparison with other results
    - EPA : 0.584
    - Metropolitan landfill in Korea : 0.596
- MCF (Methane Correction Factor)
  - ✓ IPCC suggested default values
    - Sanitary landfill : 1.0
    - Non-sanitary landfill : 0.4~0.8
  - ✓ Using 1.0
    - Most landfills recently constructed in Korea are sanitary landfills

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- R (Recovery Ratio of Methane)
  - ✓ Difficulty in estimating the recovery ratio
  - ✓ Using 13% which was reported by a previous study
  - ✓ Necessity to estimate the accurate R
    - Extensive research would be required
- OX (Oxidation Factor)
  - ✓ IPCC default value
    - Sanitary : 0.1
    - Non-sanitary : 0.0
  - ✓ Using 0.1

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Generation and Emission of CH_4 from Korean landfills (1990~2000)

Year	DOC(%)	L_0 (ton CH_4/ ton waste)	Generation rate of CH_4 (ton/yr)	Emission rate of CH_4 (ton/yr)	TCE
1990	12.70	0.04657	1,427,269	1,117,450	6,399,940
1991	13.26	0.04862	1,598,714	1,251,679	7,168,710
1992	11.40	0.04180	1,328,532	1,040,146	5,957,202
1993	9.65	0.03538	1,473,674	1,153,782	6,608,025
1994	9.58	0.03513	978,054	765,747	4,385,641
1995	9.05	0.03318	754,556	590,764	3,383,465
1996	9.15	0.03355	855,382	669,703	3,835,574
1997	8.22	0.03014	814,805	637,934	3,653,622
1998	9.13	0.03348	744,693	583,041	3,339,236
1999	10.10	0.03703	711,649	557,170	3,191,067
2000	9.16	0.03359	622,927	487,752	2,793,489

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Conclusions

- Key parameters for Tier 1 were estimated to accommodate the characteristics of MSW landfilled in Korea
  - ✓Korean Specific Emission Factor is determined for Tier 1
    - Need to estimate DOC_F and R
- According to the Tier 1, the emission rate of CH_4 from Korean landfills in 2000 was 2,793,489 TCE, which represented more than 70% in total GHG emission from waste sectors

- Modified FOD (Tier 2) method is under development in order to reflect the landfill conditions in Korea
  - ✓Within 2~3 years, the emission of CH_4 from Korean landfills would be estimated by means of the Tier 2 method.

Lao Republic
Mr. Syamphone Sengchandala

GHG Inventory in ASIA Region
13-14/11/2003, Phuket Thailand

The First Experience GHG Inventory Preparation in Lao PDR

By: Syamphone SENGCHANDALA
Science Technology and Environment Agency, Prime Minister's Office

Outline presentation

- Background Information
- GHG Inventory
- GHG Mitigation Option
- Factors affected the achievement of results
- Next Step.

Lao Republic
Mr. Syamphone Sengchandala

Background Information

- Lao PDR Ratified the UNFCCC on 4 April 1995 and Ratify Kyoto Protocol in 6 February 2003.
- The Science Technology and Environment Agency (STEA) is assigned by the Government as a National Authority for coordinating and implementing UNFCCC and Designated National Authority (DNA) for CDM
- Established National Greenhouse Gas Inventory Committee (NGIC) and Technical Working Group(TWG).
- Lao PDR has carried out two main projects:
  - National GHG Inventory Project supported by UNDP-GEF, since July 1997 and completed in 2000.
  - Climate Change Enabling Activity (additional financing for capacity building in priority area) supported by UNDP-GEF since January 2001and will finalizing soon.

GHG Inventory

Based Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventory were studied in 4 Sectors (Based year 1990 data) as below:

1. Energy sector:
   - Fossil fuel consumption
   - Traditional biomass burned for energy
2. Agriculture sector:
   - Enteric fermentation
   - Manure management
   - Rice cultivation

GHG Inventory [Cont.]

3. Forestry sector:

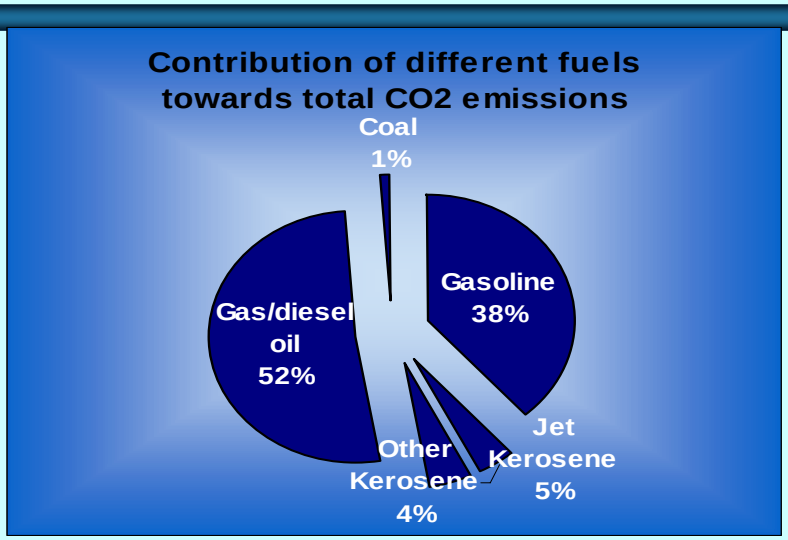
- Change in forest and woody biomass
- Forest conversion: Aboveground CO_2 released from on-site burning
- Forest conversion: Aboveground CO_2 released from off-site burning
- Aboveground CO_2 release from decay

4. Waste:

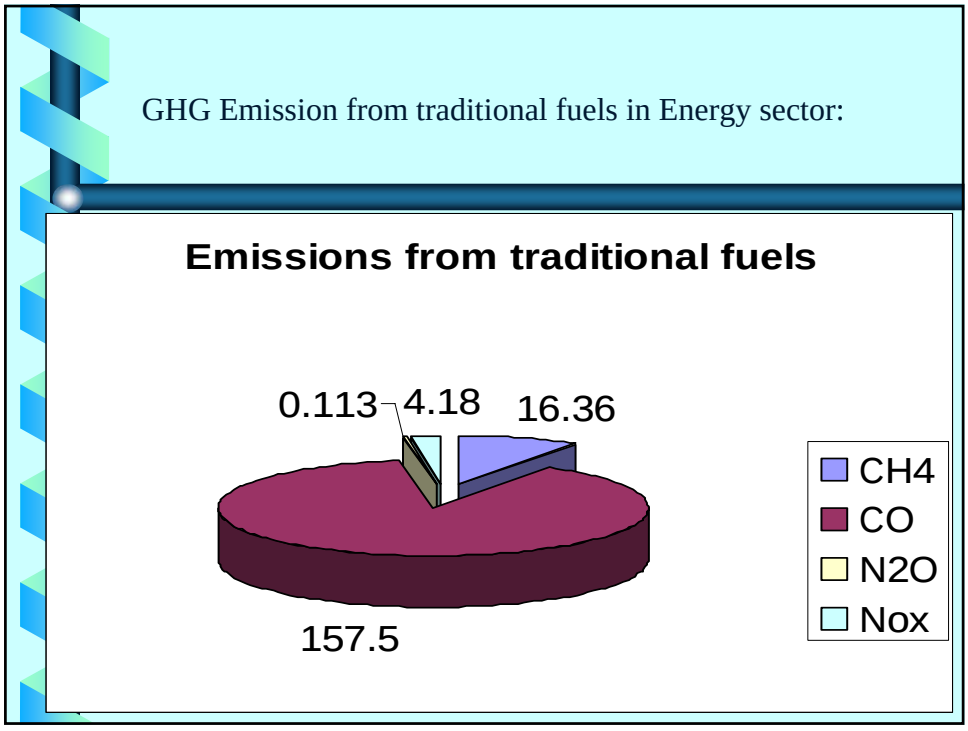
- Landfills

- Lao PDR is a net emitter

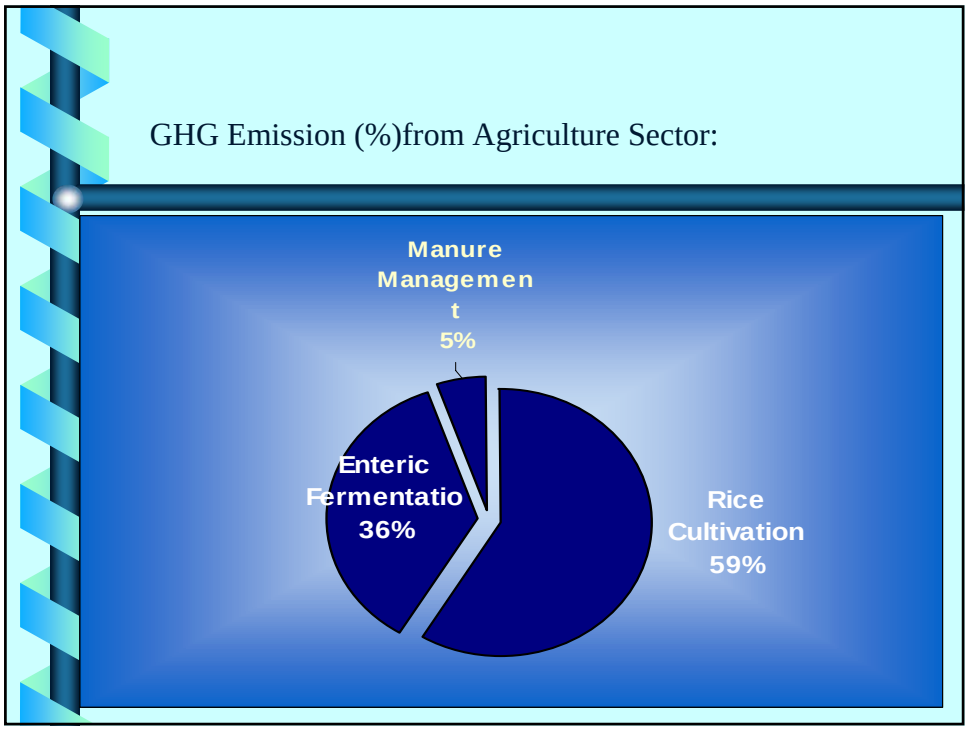
GHG Emission (%) from fossil fuel consumption in Energy sector:



GHG Emission from traditional fuels in Energy sector:



GHG Emission (%)from Agriculture Sector:



GHG Mitigation Option

- Energy sector:
  - Energy conservation and improvement in energy efficiency through upgradation currently employed technologies.
  - Introduction of the advanced technologies that are more efficient or based on renewable energy source.
  - Structural change within the consumer sectors.
  - Promotion of the use of renewable energy such as small-scale hydropower development and electricity generation by wind, solar, thermal energy and biogas.
  - In the transportation sector, the options governed by objective of the reducing congestion and local air pollution. The major options are use of 4- stroke engine to replace 2- stroke and expansion of public transportation service.

GHG Mitigation Option [cont.]

- Agriculture sector:
  - The options possible in the agriculture sector are as below:
    1. Multiple Aeration Technique or MAT
    2. Strategic supplement to feed through MUB (multi-nutrient urea block)
    3. Biogas digesters to capture CH_4 for energy use.
- Forest sector:
  - Increase the total forest area in the country.
  - Reforestation of regarded forest land, afforestation programm and delineation of the national protected.

GHG Mitigation Option [cont.]

- Waste:
  - Promote public to reduce, reuse and recycle of solid waste.
  - Use three principal methods to dispose of solid waste as municipal landfills, open burning and dumping.
  - Encourage the treatment of waste water before releasing out.

Factors affected the achievement of results:

- Lack of Local Expertise
- Lack of realistic data
- Lack of country-specific or regional-specific emission factor
- Lack of activity data required to estimate GHG emissions

Next Step

- Preparation Second National Communication on Climate Change.
- Preparation National Action Plan of Action (NAPA) on Climate Change.
- Increase public awareness activities on climate change
- Implement a GHG mitigation plan

Thank you

Mongolia
Dr. Batima Punsalmaa

Workshop of GHG Inventories in Asia Region

Mongolia's GHG inventory

13-14 Phuket, Thailand

Batima P. Institute of Meteorology and Hydrology

UNFCCC and Kyoto protocol

The Government of Mongolia signed the UNFCCC on **June 12, 1992** at the Rio Conference and the Great Khural (Parliament) of Mongolia ratified it **on September 30, 1993.**

The Government of Mongolia ratified/accessed the Kyotk Protocol on **15 December 1999**.

Main gases

- The GHG inventory includes emissions of carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), nitrogen oxides (NO_x) and carbon monoxide (CO) for the base year 1994.
- Emissions of other greenhouse gases, such as NMVOCs and PFCs, have not been included in the inventory.

Sectors

- Energy,
- Industrial Processes,
- Agriculture,
- Land Use Change and Forestry, and
- Waste.

Data

- In most instances the main obstacle was the lack of reliable data for the calculations
- Only general activity data, such as
  - fuel consumption,
  - cement production,
  - domestic animal population,
  - area of cultivated land

Institutions

- National Agency for Meteorology, Hydrology and Environment Monitoring
- Institute of Meteorology and Hydrology
- Mongolian National University
- Energy Conservation CO.Ltd
- Ulaanbaatar City Governor's Office

Methodologies

- IPCC Guidelines for National GHG Inventories (IPCC, 1995) and the Revised 1996 Guidelines (IPCC, 1997);
- IPCC default EF
- Some modification

Inventory

- Mongolia prepared its first greenhouse gases (GHG) inventory in 1996 for the base year 1990 under the US Country Studies Programme
- Updated within the Asia Least-Cost Greenhouse Gas Abatement Strategy (ALGAS),
- As part of the enabling activities of preparation of the Initial National Communication (GEF/UNEP), the GHG inventories were updated to 1998 with base year 1994.

Modification

Category	Subcategory	Modified items
Energy	Fuel Combustion	-classification of fuel type -conversion factors for conversion from kilotonne to Terajoule for solid fuel -oxidized carbon fraction for solid fuel burning
	Traditional Biomass Fuel Combustion	- international bunker data (added) -traditional biomass fuel accounting (added)
Industrial processes	lime production (added)	
Agriculture	Livestock	- enteric fermentation emission factors
Land Use Change and Forestry	Changes in Forests and Other Woody Biomass Stocks	-area of forest/biomass stock -biomass expansion conversion ratio -annual growth rate
Grassland Conversion		-emissions from lands used by mines (added)
Waste	Landfills	-fraction of solid waste landfilled -fraction of carbon in biogas which is released as methane

Modification

- “0.92” for the fraction of oxidized carbon for solid fuels
- “0.6 t dm/ha” for annual growth rate of logged forests and “0.2 t dm/ha” for planted forests

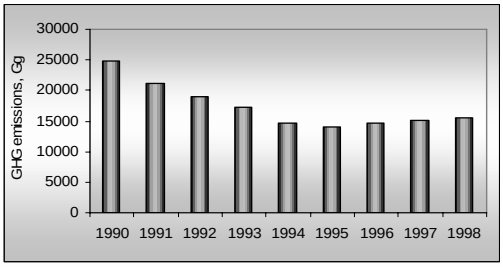
Mongolia INC

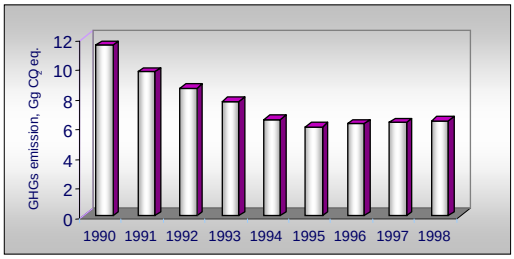
- Mongolia's Initial National Communication was reviewed by the National Communication Support Programme, the UNEP Collaborating Centre on Energy and Environment

GHG emissions

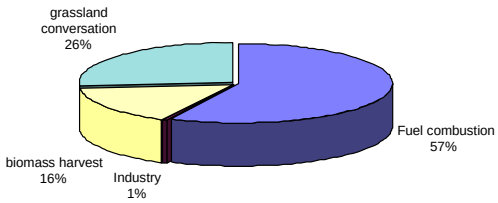
- Fossil fuel combustion is the largest source of CO_2 emissions in Mongolia, accounting for about 60% of all emissions. The second largest source is from the conversion of grasslands for cultivation (20-27%). Emissions from industrial processes account for less than 1% of all emissions. Total emissions of CO_2 in Mongolia reached 9,064 Gg in the base year 1994, representing a decrease of 10,072 Gg from 1990 emission levels. CO_2 emissions have been increasing since 1996, reaching 8,729 Gg in 1998. The removals are increasing constantly. The removal in 1990 was 9.9% of total emissions; it increased to 39.4% and 44.7% in 1994 and 1998, respectively.

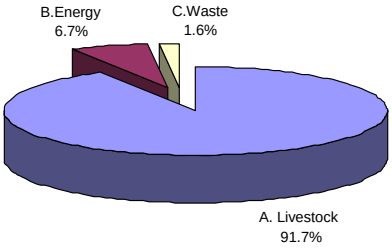
GHG emissions





CO_2 and CH_4 emissions by sector for 1994





Mongolia
Dr. Batima Punsalmaa

Problems and Gaps

Availability of Information:
- No standard data for inventory and mitigation study except statistical data

Human resources:
- No incentives to keep trained national experts
- No permanent coordination that could provide the continuity of the study on climate change

Methodologies and tools
- Could not develop country specific emission factor

Financial constraints:
- GEF

Recommendations

- More training at international level
- Provide possibility to involve experts that have been participated in previous NC
- Establish regional or sub-regional center for GHG inventory and data base
- Establish information exchange network on climate change
- Improve mechanism to implement specific needs identified in the NCs

GHG Inventory in the Philippines

Damasa B. Magcale-Macandog

Institute of Biological Science
University of the Philippines Los Baños

Agriculture
National Data

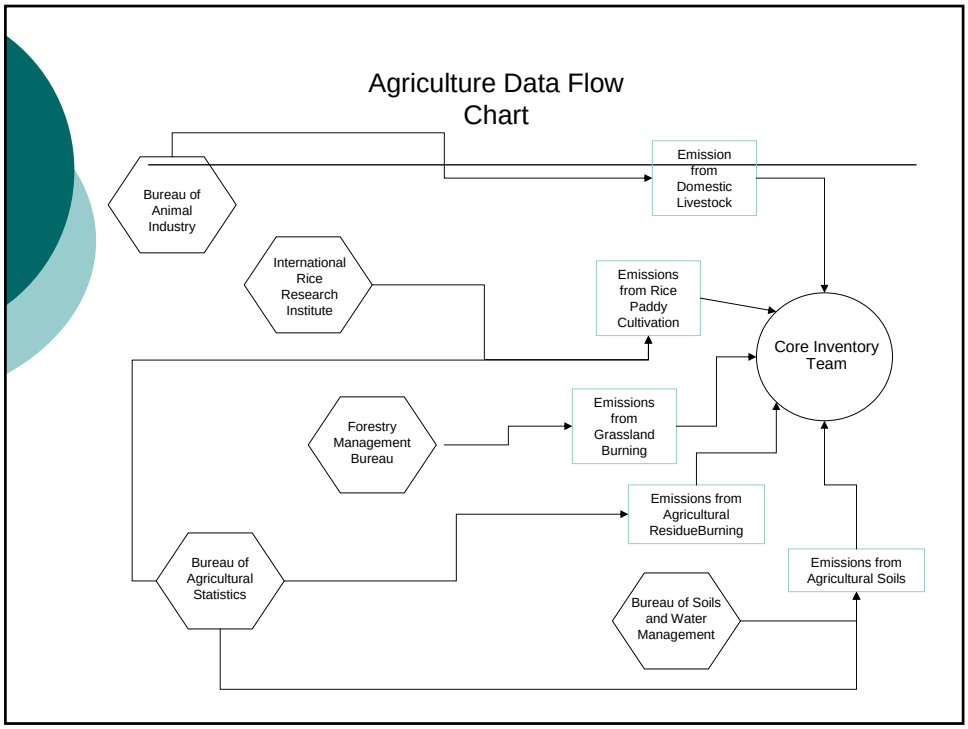
- Population of Domestic Livestock
- Percentage of manure treated in different animal waste management systems
- Harvested area of rice - irrigated and rainfed types
- Total area of grassland burned annually
- Bureau of Agricultural Statistics, Dept. of Agriculture
- Bureau of Animal Industry, Dept. of Agriculture
- Bureau of Agricultural Statistics, Dept. of Agriculture
- Reforestation Division of Forestry Management Bureau, Dept. of Environment and Natural Resources

Agriculture
National Data

Aboveground biomass density	local studies
Annual major crop production (corn, rice, etc.)	Bureau of Agricultural Statistics, Dept. of Agriculture
Production statistics for nitrogen-fixing crops – dry pulses and soybeans	Bureau of Agricultural Statistics, Dept. of Agriculture)
Area of cultivated organic soils (ha of histosols)	Bureau of Soil and Water Management

Agriculture
International Data

Ratio of dairy cattle to cattle population	FAO
Number of cropping seasons per year	developed by IRRI
methane emission factor integrated over cropping season in g/m2	developed by IRRI



Energy
National Data

- Apparent fuel consumption
- Number of motor vehicles registered by type of vehicle and fuel used
- Overall Energy Balance Sheet, Dept. of Energy
- Land Transportation Office

Energy (National Data): Fugitive Emissions

- Coal production – mining
- Coal Division, Dept. of Energy
- Gas
- Consumption data in PJ units
- data available *as electricity generated MWhr*

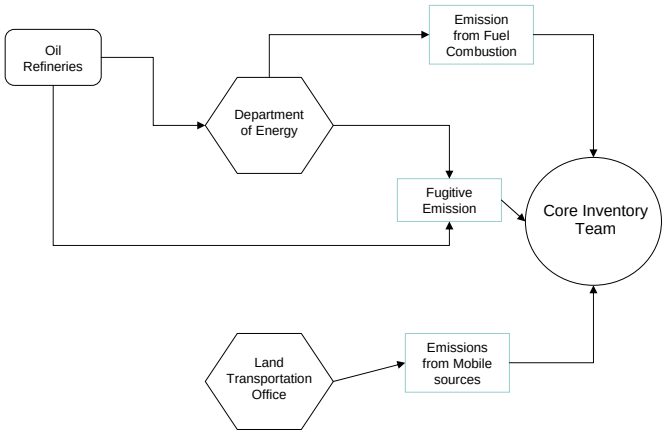
Energy (National Data): Fugitive Emissions

- Oil refining
- crude refinery and catalytic cracker throughput and type of storage
- private oil companies
- Crude oil production statistics
- Oil and Gas Division, Dept. of Energy
- Amount of oil transported
- data collected from a private contractor

Energy
International Data

- Default IPCC emission factors for most computations

Energy Data Flow Chart

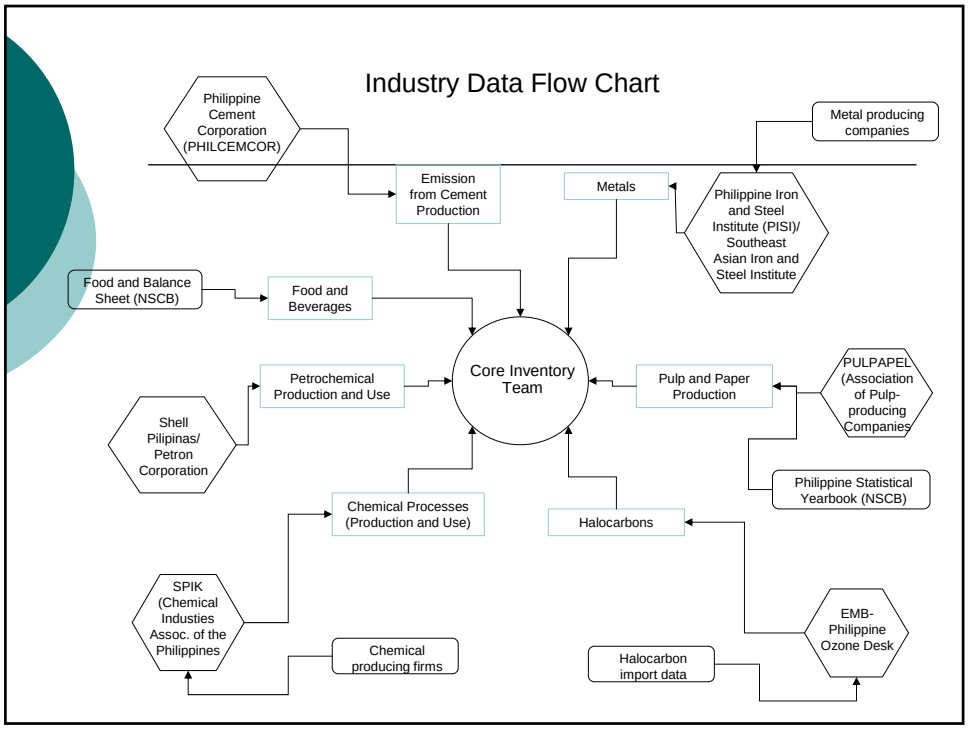


Industry
National Data

- Food Balance Sheet
  - released by the National Statistics Coordination Board
- Import data on halocarbons
  - from the Philippine Ozone Desk of the DENR)
- Other references:
  - Data released by industry associations
  - *Philippine Statistical Yearbook, Philippine Yearbook, Annual Economic Indicators*

Industry
International Data

- Default IPCC emissions factors for most computations
- Additional data on food and alcoholic beverages production
  - Food and Agriculture Organization food balance sheet
- Additional information for halocarbons
  - UNEP Ozone Action website
- Annual rated capacity for pulp
  - FAO forestry database



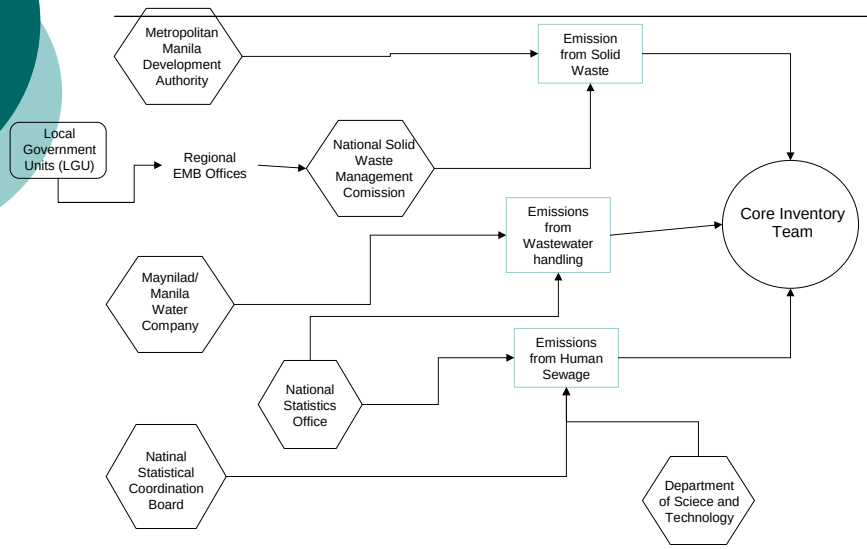
Waste
National Data

- Degradable organic component indicators
  - (kg BOD/1,000 persons/year)
- Fraction of domestic/commercial organic compound removed as sludge
  - (*Fs,dom*)
- Local values for fraction of wastewater or sludge treated by the handling systems
  - (*W* or *S*)
- *Industrial Efficiency and Pollution Control/Environmental Management Strategy*
  - prepared by UNDP-World Bank, 1992, for Metro Manila

Waste
International Data

- DOC values for different waste components
- COD/BOD ratio to compute industrial wastewater emissions

Waste Data Flow Chart



Data Gaps

Data Gaps
Agriculture

- Ratio of residue to crop product
- Synthetic nitrogen fertilizer consumption data

Data Gaps
Energy

- Consumption data for biomass fuels (wood/woodwaste, charcoal and other biomass wastes) – Energy Balance sheet of the DOE only covered the Industrial subsector. The inventory also used the UNDP-ESMAP and HECS data of DOE. The residential data was available.
- Gas production data from the Oil and Gas Division of DOE.

Data Gaps
Energy

- Statistics on leakage of gas and venting and flaring data locations unknown
- Number of motor vehicles registered by type and kilometers traveled and fuel consumed per vehicle type

Data Gaps
Industry

- Itemized chemical production data (only aggregate data provided)
- Production data from smaller pulp producing firms
- Itemized production data of specified types of alcoholic beverages
- Production data of alcoholic beverages

Data Gaps
Industry

- Production data of ferroalloys according to base metals used
- NMVOC, CO, NOx, SO2 emissions from manufacturing processes not registered with SPIK (Chemical Industries Association of the Philippines)
- Actual emissions from the use of halocarbons and SF6 (currently, only potential emis-sions estimated)
- Activity data for products containing HFC-134a

Data Gaps
Waste

- Municipal solid waste per capita generation rate for most rural areas
- Philippine industrial wastewater COD loads
- Sludge treatment

Data Gaps
Waste

- Efficiency of solid waste collection outside Metro Manila
- Wastewater and wastewater handling systems (especially for areas outside Metro Manila)
- Amount of CH4 recovered or flared from industrial wastewater

GHG Inventory Sectoral Issues and Concerns

- Problems/Issues/ Concerns
- Recommendations

Energy

- No country specific data; specifically No local emission factors
- Institutionalization of the Overall Energy Balance (OEB) Sheet
- Study local fuel types: composition of fuels and develop local emission factors.
- OEB adapted in such a way that it will contain all the information necessary for the computation of GHG emissions in the energy sector.

Energy

- Data readily available from DOE but are highly variable due to continuous updates in fuel consumption and allocations.
- Link data in the OEB with the GHG emissions calculations to reflect instantaneously any changes resulting from the new set of values.

Energy

- Incomplete database on household consumption of biomass fuels such as wood/woodwaste, charcoal, agriwaste and other biomass/waste.
- Institutionalize/regularize surveys and studies on household fuel consumption – not only biomass fuels, but all other con-ventional and nonconventional fuel types.

Energy

- Major data gaps in the transportation sub-sector prevent a more accurate GHG emission computation:
  - Type and technology of registered vehi-cles: VTEC, fuel injection, etc.
  - Number of kilometers traveled per year
  - Year and make of car.
- Institutionalize a complete and comprehensive registration process con-taining all the necessary and important information for each registered vehicle in every LTO registration branch.

Energy

- Institutionalization of data flow and information systems within DOE
- Develop structured linkages within the DOE specifically with the Demand Analysis and Planning Division (DAPD), main data center of the department, and the Environment Division which computes and projects national CO_2 emissions from the energy sector.

Industry

- Availability of data, this being highly dependent on what industrial firms, estates, or associations choose to provide for regulatory purposes (especially to the DENR or EMB or any such regulatory body as well as any indirectly related purpose)
- More reliable data sources: DTI and PEZA-- non regulatory bodies which issue annual permits
- UNDP may also be another repository data

Industry

- Reliability of data
  - Involve NGO's like the Philippine Business for Environment (PBE) which are pro-active in the environment awareness circles.
  - Involve industrial associations, e.g., PISI, SPIK, PHILCEMCOR, PHINMA, etc. to increase cooperation within sectors.

Industry

- Reliability of data
- Institutionalize inventory methodologies within DTI, NSCB, and EMB all of which already have most of the requisite data available.
- Possibly create local emission factors for highly emissive sectors like cement, iron and steel.

Agriculture

- Deficiency of country-specific factors and data.
- Default factors not representative of country's actual situation.
- Generate local statistics by conducting researches and surveys to be conducted by the involved agencies such as BAS, BAI, IRRI, PhilRice, etc.

Agriculture

- Institutionalization of data flow and information system within BAS, DA
- Establish a statistical framework and a database information system for the inventory.

Agriculture
Domestic Livestock

- Current data on distribution of animal manure among animal wastes management systems are estimates only.
- Ascertain ACTUAL distribution of animal manure among the animal wastes management systems.

Agriculture
Prescribed Burning of Savanna

- Lack country-specific statistics (biomass density of savanna, fraction of exposed biomass that is burned, etc.) necessary for the estimation of emissions.
- Do research and study. Lead agency: DA/FMB

Agriculture
Burning of Agricultural Residues

- Lack country-specific statistics
- Conduct research/survey on cultural practices of local farmers in order to generate data regarding crop residues

Agriculture
Agricultural Soils Management

- No country-specific data and factors
- Do research and study. Lead agency: DA/FMB

Waste
Solid Waste

- Need for a more comprehensive dataset
- Data for other regions (besides the NCR) – data may be acquired from the LGU's
- Provisions for categorizing waste disposal by economic class, region, etc. to see the impact of these specific categories.

Waste
Domestic/Commercial Wastewater Treatment

- Need to acquire sludge data.
- Need to acquire new/accurate data regarding wastewater treatment plants and volume of wastewater treated and processed; treatment efficiency, for all regions
- More comprehensive data on sludge. May be quantified by the local sewers Maynilad Waters, LWUA

Waste
Domestic/Commercial Wastewater Treatment

- Data on wastewater: no local BOD levels.
- Untreated wastewater
- Scientific and experimental determination of local BOD levels.
- Study effects of untreated waste water – no methane generated in this case but the repercussions arising from non-treatment are not known.

Waste
Industrial Wastewater

No readily available data regarding industrial wastewater except for 1992 IEPC

- Data coverage is not entire nation
- Data are in BOD and not COD – thus need for proper conversion

1. Conduct regular survey/study on national wastewater treatment systems. (DENR/DTI)
- Scientific study for COD levels in WW treatment systems.

LAND USE CHANGE AND FORESTRY

- Significant variability among existing data (e.g. Lasco, Franscisco, ESMAP, etc.)

- Conduct actual field studies
- Validate default data

LAND USE CHANGE AND FORESTRY

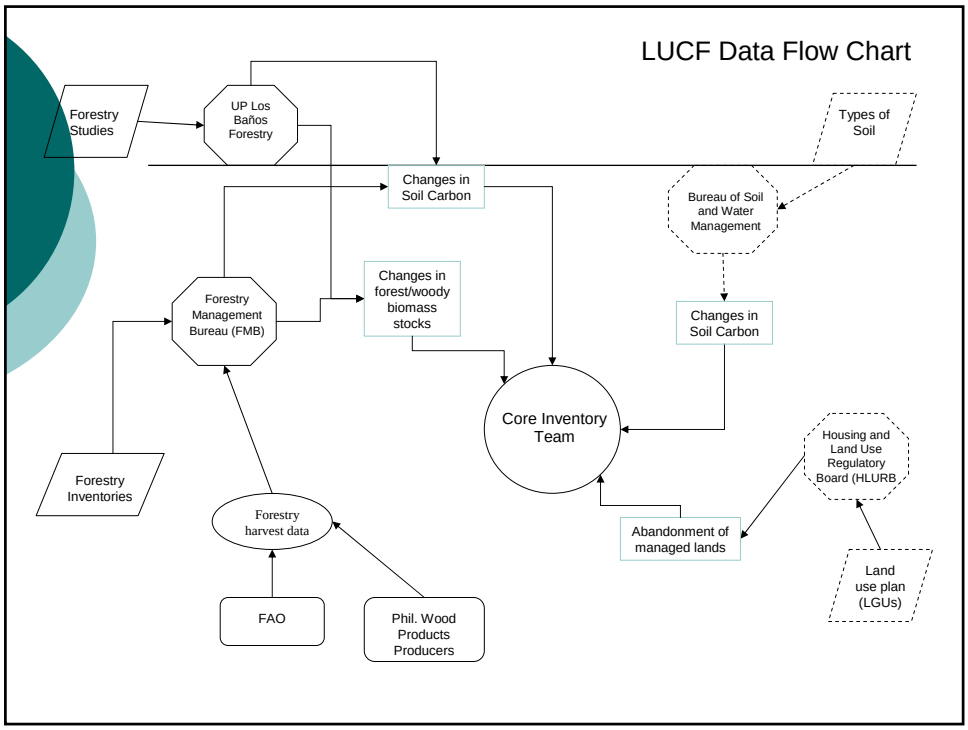
- Lack of country specific data (data gaps) – IPCC default values used
- Unreliable data on forest area and eventual fates of woody biomass after land conversion
- Conduct actual field studies
- Determine carbon sequestration values
- Determine actual forest area and conversion by reliable party using precise methods – key government institution: FMB

LAND USE CHANGE AND FORESTRY

- Need to enhance capability and credibility of some government agencies involved in collecting relevant forest data.
- Need to systematize scheme for data collection
- Coordination between relevant agencies such as FMB and NAMRIA regarding LUCF data collection
- Review and update existing information management structures in DENR and other groups involved in LUCF issues

LAND USE CHANGE AND FORESTRY

- Limited resources available on carbon sequestration studies
- Data on soil carbon and abandoned lands
- Determine carbon sequestration rates for Philippine woody biomass
- Formulate strategies to generate funds for carbon sequestration studies
- Begin reconstruction of soil carbon resources and data gathering on aban-doned lands



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Vietnam
Mr. Hoang Manh Hoa

The Workshop of GHG Inventories in Asia Region, 13-14 November 2003, Phuket, Thailand

Results of 1994 National GHG Inventory in Viet Nam and GHG emission projection

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Contents

A. Background

- Viet Nam is located in South East Asia
- The land area occupies 330,900 km^2
- The sea water territory under sovereignty and jurisdiction is more than 1 million km^2
- The coastline of 3,260 km covers the East and the South
- Viet Nam has a system of coast 3000 big and small islands with total area of more than 1600 km^2

A. Background (Cont.)

- The forest areas are 9.3 million ha
- The agricultural lands are 7.37 million ha
- The population of Viet Nam in 1994 was 70.8 million with average annual growth rate of 1.6%
- Viet Nam is an agricultural country with 70-80% of the population living in rural areas
- GDP (1994): 1.53 billion USD
- GDP per capita (1994): 215 USD
- The average annual GDP growth rate was 8.2% during 1991-1995

A. Background (Cont.)

- Sectoral Contribution to GDP:
  - ✓ Industry: 29.6%
  - ✓ Services: 41.7%
  - ✓ Agriculture, Forestry, Fishing: 28.7%

B. 1994 National GHG Inventory

- 1994 National GHG Inventory was implemented by the Hydro-Meteorological Service (HMS), nowadays Ministry of Natural Resources and Environment of Viet Nam (MONRE)
- 1994 National GHG Inventory covers three major GHGs:
  - Carbon dioxide (CO_2)
  - Methane (CH_4)
  - Nitrous oxide (N_2O)
- 1994 National GHG Inventory includes GHG emission projection from main sources

B. 1994 National GHG Inventory (Cont.)

- 1994 National GHG Inventory was carried out for five main sources of emission:
  - Energy
  - Industrial Processes
  - Forestry and land use change
  - Agriculture
  - Waste

The Methodology of Inventory follows the guidance of the IPCC revised version 1996

The data source was collected and processed from the General Statistical Office and other related Agencies of Viet Nam.

B. 1994 National GHG Inventory (Cont.)

1. Energy :

   GHGs emissions from energy sector including transportation are emissions from burning of fossil fuel (coal, oil, gases) for energy activities while fugitive emissions are from mining. GHGs emissions depend on characteristics and amount of fuel.

B. 1994 National GHG Inventory (Cont.)

- GHG emissions from fuel combustion:

  - In 1994, Viet Nam produced 6.2 million tons of coal, 7.1 million tons of oil. All crude oil is exported.Coal is partly exported, partly goes to meet domestic needs. Firewood remains an important fuel source in the Viet Nam energy structure. It occupies 56% total domestic fuel consumption.

  - GHG emissions by fuel combustion in 1994 were estimated at 21.580 million tons of $C0_2$; 120.509 thousand tons of CH_4 and 1.756 thousand tons of N_20.

  - $C0_2$ is mainly emitted by coal and oil combustion, meanwhile CH_4 and N_20 from biomass burning.

  The total GHG emissions by fuel combustion are 24.655 million tons of $C0_2$ equivalent

B. 1994 National GHG Inventory (Cont.)

- GHG fugitive emission:

In Viet Nam, GHG fugitive emission is mainly generated by coal, oil and gas exploitation and transportation.

- CH_4 fugitive emission from coal exploitation in 1994 was 39.749 thousand tons.

- CH_4 fugitive emission from oil and gas exploitation in 1994 was 7.015 thousand tons.

The total CH_4 fugitive emission from coal, oil and gas exploitation in 1994 was 46.764 thousand tons.

- GHG emission from energy sector activities :

The total emission from energy sector activities (electricity generation, industry and construction, transport, services/commerce, household, agriculture, forestry and fishery...) was 25.637 million tons of CO_2 equivalent

B. 1994 National GHG Inventory (Cont.)

2. Industrial processes:

GHGs emissions from various types of industrial processes are non-energy use related emissions. These emissions are related to physical and chemical transforms of materials, in which GHGs such as CO_2, CH_4, N_20 and other gases are released. The methodology for estimation of emission from various industrial processes is based on the amount of gases emitted from a product unit (emission coefficient) and amount of used material

- Industrial processes and industrial products were manufactured or used in Viet Nam in 1994 relating to the emissions of CO_2, CH_4, NO_x, NMVOC, CO and SO_2
- The total CO_2 emission from industrial processes was 3.807 million tons, mainly from construction material manufacturing (cement production occupied 2.677 million tons; lime baking 651 thousand tons) and steel rolling 475 thousand tons.
- SO_2 emission was about 1.6 million tons, mainly from cement production.

B. 1994 National GHG Inventory (Cont.)

3. Forestry and land use change:

+Estimation of CO_2 emission and sequestration in this sector was focused on the following activities:

- Change in forest area and woody biomass stocks in natural and planning forests.
- Forestry and grassland conversion, forest exploitation.
- Forest natural renovation in abandoned farmland.

+ Estimation of GHG emissions / up takes:

- CO_2 sequestration by forest biomass growth: in 1994, Viet Nam had 8.252 million ha of natural forest, 1.049 million ha of planning forest and 9.778 million ha classified as forestland without forest. The total planning trees in 1994 are 350 million. CO_2 being sequestered by forest is 39.272 million tons.

B. 1994 National GHG Inventory (Cont.)

+ CO_2 emission from forest and grassland conversion: in 1994,there were 338, 000 ha of land use change, in which 40,600 ha under evergreen forest.

GHGs emissions from these activities were estimated as below:

- CO_2 : 56.72 million tons
- CH_4 : 0.18 million tons
- N_2O : 0.00124 million tons
- CO : 1. 57 million tons
- NO_x : 0.0447 million tons

B. 1994 National GHG Inventory (Cont.)

CO_2 sequestration by natural regeneration in abandoned farmland.

The natural regeneration of forest in abandoned farmland or degraded forest for the period of about 20 years is 820,000 ha. Estimated CO_2 absorbed amount is 11.05 million tons.

+ CO_2 emission in the Inventory year by soil from previous land use change and management.

Estimated CO_2 emission amount is 8.824 million tons.

The total GHGs emitted into the atmosphere by forest and land use change in 1994 are 19.38 million tons of CO_2 equivalent.

B. 1994 National GHG Inventory (Cont.)

4. Agriculture:

+ Livestock :

CH_4 emission from livestock sector is 465.565 thousand tons, 336.585 thousand tons of which is from enteric fermentation and 128.980 thousand tons from manure management.

+ Rice cultivation:

The total rice cultivated area in 1994 is 6.599 million ha, more than 60% of which under constantly flooded irrigation, the rest is not constantly irrigated and mostly relies on rainfall.

The total CH_4 emission from wetland rice field is 1559.7 thousand tons among which , 873.8 thousand tons in the North and 685.9 thousand tons in the South of Viet Nam

B. 1994 National GHG Inventory (Cont.)

+Prescribed burning of savanna:

- The main emission source in this sub-sector is savanna prescribed burning due to slash and burn farming practices of the mountainous ethnic minorities.
- The total emissions in this sub-sector are 15.91 thousand tons of CH_4 , 417.5 thousand tons CO, 0.20 thousand tons N_20 and 7.11 thousand tons NO_x

+Field burning of agricultural residues.

The emissions in this sub-sector are as follows: 51.72 thousand tons CH_4 , 1086.07 thousand tons CO, 1.19 thousand tons N_2O and 43.17 thousand tons NO_x

B. 1994 National GHG Inventory (Cont.)

+ Agricultural soil:

The total emission in this sub-sector is 26.02 thousand tons N_2O, including:

- N_2O emitted directly from soil: 16.63 thousand tons
- N_2O emitted directly from animals : 0.004 thousand tons
- Indirectly N_2O emission :9.39 thousand tons

The total GHG emissions from agricultural sector are 52.45 million tons of CO_2 equivalent

B. 1994 National GHG Inventory (Cont.)

5. Waste sector:

+ Municipal solid waste.

Estimated CH_4 emission from waste is 66.298 thousand tons, mainly from big cities.

+ CH_4 emission from domestic and commercial waste water is 1.027 thousand tons

+CH_4 emission from industrial waste water processing is 0.79 thousand tons

+ N_2O emission from human is 3.66 thousand tons.

The total GHGs emissions in waste sector are 68.115 thousand tons CH_4, 3.66 thousand tons N_2O equal to 2565.015 thousand tons of CO_2 equivalent

B. 1994 National GHG Inventory (Cont.)

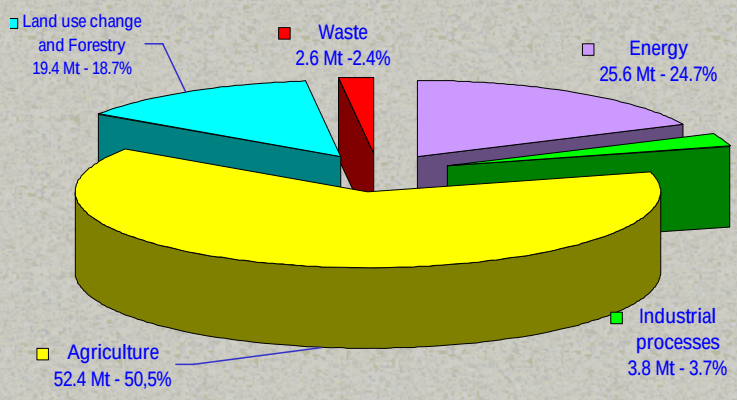
In conclusion:

- The total GHG emissions in 1994 in Viet Nam were 103.839 million tons of CO_2 equivalent and 1.4 tons CO_2 equivalent per capita.
- GHG emissions from energy sector was 25.637 million tons of CO_2 equivalent, accounted for 24.7% of total national emissions; forestry and land use change: 19.380 million tons of CO_2 equivalent, accounted for 18.7 %; agricultural sector : 52.450 million tons of CO_2 equivalent, accounted for 50.5 %; industrial processes and waste sector : 3.807 and 2.565 million tons of CO_2 equivalent , accounted for 3.7 % and 2.4 % respectively (table 1 and figure 1)

Table 1 : Results of 1994 National GHG Inventory in Viet Nam

Emission sector	*CO_2 equivalent (million ton)*	%
Energy	25.637	24.7
Industrial Processes	3.807	3.7
Agriculture	52.450	50.5
Forestry and Land Use Change	19.380	18.7
Waste	2.565	2.4
Total emissions	103.839	100

Figure 1: Results of 1994 National GHG Inventory in Viet Nam



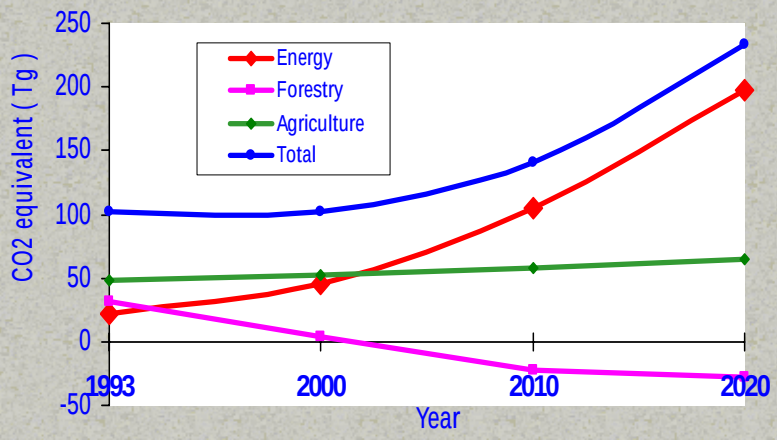
C. GHG emission projection in Viet Nam

- In the future, the major emission sectors will be energy, agriculture, forestry and land use change
- GHG emissions in the period of 2000-2020 will be increased mainly causing by the fossil fuel consumption to meet energy demand in the country. Thus, in the future, energy sector will be a main GHG emission source in Viet Nam
- Emissions from the energy sector are projected in 2010 to 105 million tons of CO_2 equivalent and in 2020 to 197 million tons of CO_2 equivalent, it is about 8 time higher than 1994 emission level
- In agriculture sector, GHG emissions in CO_2 equivalent will reach from 52.4 million tons in 1994 to 57.2 million tons in 2010 and 64.7 million tons in 2020

C. GHG emission projection in Viet Nam (Cont.)

- In forestry and land use change sector, the amount of CO_2 is projected to decline from 19.4 million tons in 1994 to 4.2 million tons in 2000 and the net sequestration of 21.7 million tons in 2010 and 28.4 million tons in 2020
- Generally, GHGs emissions from the three main sectors in Viet Nam were projected at more than 140 million tons and 233 million tons of CO_2 equivalent in 2010 and 2020 respectively (figure 2).

Figure 2: GHG Emission Projection in Vietnam



D. Priorities of future research areas

- ✓ Developing and evaluating potential and feasible GHG mitigation options
- ✓ Researching on assessment of climate change impacts and developing measures to cope with and adapt to climate change based on scenario in the region.
- ✓ Developing a realistic portfolio of potential AIJ/CDM projects in Viet Nam
- ✓ Developing a strategy and action plan and appropriate institutional capacity to exploit opportunities presented by AIJ/CDM to achieve sustainable socio-economic development of the country and to contribute to global GHG emission reduction.

Thank you very much for your attention

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