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Proceedings of the 4th Workshop on Greenhouse Gas Inventories in Asia

14-15 February 2007, Jakarta, Indonesia

Center for Global Environmental Research

National Institute for Environmental Studies, Japan

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Foreword

The international community now recognizes increases in emissions of greenhouse gases (GHG) as the primary cause of climate change and its impacts. In this respect, GHG inventories, which provide information on these emissions and trends over time, play a critical role as a basis for decision makers to design and implement strategies to reduce emissions.

Parties to the UN Framework Convention on Climate Change (UNFCCC) which entered into force in March 1994 are required to develop and publish national GHG inventories. Almost all parties have submitted their first inventories in the initial national communications and are working on their second or subsequent communications.

The National Institute for Environmental Studies (NIES) has held the "Workshop on GHG Inventories in Asia" (WGIA) annually since November 2003 with the support of the Ministry of the Environment of Japan. The purpose of WGIA is to assist countries in Asia in developing and improving their inventories by promoting regional information exchange. The participants of this workshop have found that the information exchange that is made possible through WGIA and its resulting network has played a significant part in the enhancement of their inventories and their capacity to develop them.

The Center for Global Environmental Research (CGER) was established in 1990 at NIES to contribute to enhancing the scientific understanding of global environmental changes and to elucidate and provide solutions for environmental concerns. CGER has been actively working to achieve its goals by conducting global environmental research, providing the facilities to support research projects, and implementing global environmental monitoring.

This CGER reports serves as the proceedings for the 4th WGIA, which was held on February 14-15, 2007, in Jakarta, Indonesia with more than 50 experts in attendance. It is our hope that this report proves useful to all those who work in the field of GHG inventory development and other areas of climate change research, and that it contributes to the progress of inventory development in the region.

March 2007

Yasuhiro Sasano
Director
Center for Global Environmental Research
National Institute for Environmental Studies

Preface

The Workshop on Greenhouse Gas Inventories in Asia, or WGIA, was first organised in 2003 by the Ministry of the Environment and the National Institute for Environmental Studies in Japan in order to assist Asian countries in developing and improving their GHG inventories by promoting regional information exchange. We are pleased to report that with the addition of two countries to our group this year, Myanmar and Singapore, we now have a total of fourteen participating countries.

Networking between the participants is gaining strength. Through this network, the people who develop inventories in this region have been able to establish communication by e-mail in order to give and receive advice about the technical issues involved with the development of GHG inventories. This kind of result is exactly what we were hoping to achieve from the very first WGIA and we hope to continue to foster this kind of exchange in all future WGIA events.

Moreover, last summer, through the collaboration of the participants of WGIA, we were able to publish the first WGIA Activity Report. This publication serves to link our activities with those that are taking place at the regional and international levels and has received good reviews from relevant communities outside WGIA.

We believe that the WGIA meetings and networks serve an important role in the development of inventories in this region. We look forward to the continued participation of our member countries, and hope to be able to include a larger range of participants from various sectors in the future.

Dr. Shuzo Nishioka
Executive Director
National Institute for Environmental Studies (NIES)

Mr. Hiroshi Fujita
Climate Change Policy Division
Global Environment Bureau
Ministry of the Environment of Japan

ii

List of Acronyms and Abbreviations

AD	activity data
ALGAS	Asia Least-cost Greenhouse Gas Abatement Strategy
CGE	Consultative Group of Experts
CH_4	methane
CO_2	carbon dioxide
EF	emission factor
EFDB	Emission Factor Database
eq	equivalent
GHG	greenhouse gas
GIO	Greenhouse Gas Inventory Office of Japan
ICRAF	World Agroforestry Centre
IRRI	International Rice Research Institute
IPCC	Intergovernmental Panel on Climate Change
IPCC-NGGIP	IPCC National Greenhouse Gas Inventories Programme
LUCF	land-use change and forestry
LULUCF	land use, land-use change and forestry
MAI	mean annual increment of biomass of trees
MOEI	Ministry of Environment of the Republic of Indonesia
MOEJ	Ministry of the Environment of Japan
N	nitrogen
N_2O	nitrous oxide
NC	national communication
NIES	National Institute for Environmental Studies
QA	quality assurance
QC	quality control
UNFCCC	United Nations Framework Convention on Climate Change
WGIA	Workshop on Greenhouse Gas Inventories in Asia

Photos from the Workshop

Opening Speech

Dr. Shuzo Nishioka

Dr. Masnellyarti Hilman

Energy Working Group

Agriculture Working Group

Waste Working Group

Land-Use Change and Forestry Working Group

Closing Remarks

Mr. Dadang Hilman

Mr. Hiroshi Fujita

Contents

Part 1

Summaries

Executive Summary

The 4th Workshop on Greenhouse Gas (GHG) Inventories in Asia (WGIA) was held in Jakarta, Indonesia on February 14 and 15, 2007. It was organized by the Ministry of the Environment of Japan (MOEJ) and the National Institute for Environmental Studies (NIES) of Japan and hosted by the Ministry of the Environment of Indonesia (MOEI). The workshop was attended by representatives of twelve countries (Cambodia, Indonesia, Japan, Lao PDR, Malaysia, Mongolia, Myanmar, Philippines, Republic of Korea, Singapore, Thailand, and Vietnam) in addition to members of the UN Framework Convention on Climate Change (UNFCCC) Secretariat, the Technical Support Unit of the IPCC National Greenhouse Gas Inventories Programme (IPCC-NGGIP), and the World Agroforestry Centre. The objectives of this meeting were (1) to identify ideas or requests for future activities in the region, (2) to establish collaborative relationships between the participants, (3) to find out practical information that can be directly applied in GHG inventory development, and (4) to learn about the latest inventory-related information at global and regional levels.

In the first session, the participants heard reports from Myanmar and Singapore, two new member countries, as well as updates from Japan and Mongolia. Myanmar is now working on its initial national communication and is experiencing certain problems that could benefit from capacity building in this area. Singapore submitted their initial national communication in 2000 and will submit their second national communication in 2009. Japan reported that its total GHG emissions in 2005 showed an 8.1% increase from emissions in the base year and that means that Japan needs to reduce its emissions by 14.1% in total in order to achieve its six percent reduction commitment under the Kyoto Protocol. Mongolia introduced short- and long-term strategies which they developed to improve their GHG inventories.

The first session closed with a summary of the survey on interests and needs of member nations. The survey identified the following areas of concern and interest in the four sectors:

- Energy: collection of activity data, calorific values, and carbon emission factors of fuels
- Agriculture: rice cultivation and livestock characteristics
- Land use change and forestry (LUCF): mean annual increment of aboveground biomass
- Waste: wastewater flow and sources, solid waste stream and composition

In Session 2, the participants were divided into four sectoral working groups (energy, agriculture, land use change and forestry, and waste) in order to discuss the issues that were highlighted in the survey mentioned above.

Energy: Many countries are using IPCC default values in their calculations, and that seems to serve their needs at this time. Some countries are using Energy Balances as a basis for developing inventories for the energy sector. Countries that do not already have Energy Balances do not necessarily have to start developing them, but if they do already exist, they can be a useful starting point. Another key point was that due to the costs involved with implementing the inventories, it is necessary to find other uses for the data.

Agriculture: Only India and Japan possess disaggregated activity data on water regime of rice cultivated areas, while the others have only aggregated information. To improve the availability of activity data, the institutionalization of the national data collection system in the agriculture sector needs to be improved. A number of countries in the region still do not have their own country-specific emission factors for rice cultivation. A number of future topics for discussion were identified, including organic carbon in soil, N_2O emissions from N inputs, CH_4 and N_2O emissions from residue burning, feed type and composition and its relation to the CH_4 emissions from ruminants, and proper archiving of information regarding activity data and emission factors.

Land Use Change and Forestry: The group discussed methods for deriving mean annual increment of biomass of trees (MAI) and approaches to determining its uncertainty. The participants highlighted the fact that in Asia, although there exist methodologies for measuring MAI, and some have been put into practice in some countries, a critical concern is the uncertainty of the measured results. The group proposed that WGIA and its community play a role in linking relevant organisations and disseminating the outcomes of the workshops to a wider audience in order to increase awareness of the issues surrounding GHG inventory development in this sector.

Waste: The group discussed two themes: (1) wastewater treatment and discharge and (2) solid waste disposal on land. The reports from Indonesia, Japan, Lao PDR, Myanmar, Thailand, and Philippines identified four types of domestic wastewater flow in the region. In Asia, it is not common for domestic and industrial wastewater to be mixed for treatment. Comparison of solid waste streams among participating countries identified two types of recycling activities in the region: one is separation at source (e.g., at the home) and the other is material recovery at a recycling facility. The group highlighted the need to establish a database on the mass and composition of solid waste.

Session 3 dealt with the cross-cutting issues of Quality Control (QC) and Quality Assurance (QA). QC is performed by inventory personnel during the development of inventories and QA is performed on completed inventories by external evaluators following the implementation of QC procedures. QA/QC should be considered an integral part of the inventory process. Since there is a trade-off between QC requirements and timeliness/cost effectiveness, it is necessary to identify key areas on which to focus the QA/QC principles. The general discussion on QA/QC was followed by country reports from Mongolia and Japan.

The final session gave us a chance to hear from IPCC and UNFCCC representatives, summarize what we learned from the workshop, and discuss steps to improve GHG inventories in the region. Participants were informed of the differences between the Revised 1996 IPCC Guidelines and the 2006 Guidelines, with a note that the step between the two sets of guidelines is meant to be an evolutionary development. Participants were encouraged to make use of the latest version of UNFCCC software, especially because it offers non-Annex I Parties a way to archive their data, and to consult the GHG Inventory Experts Network.

During the final discussions, the participants discussed future activities that could be undertaken by the WGIA, including the development of a manual for inventory preparation in Asia, identifying possible regional projects, and linking to different organizations in order to enhance awareness. Participants also offered the idea of holding a workshop that involves policy makers from each country.

Three key concepts emerged from the discussions: (1) expertise, (2) dissemination of information, (3) and proposals for regional projects. The participants of WGIA should continue working together to improve GHG inventories in the region with these key concepts in mind.

Chairperson's Summary

Background

1. The 4th Workshop on Greenhouse Gas (GHG) Inventories in Asia (WGIA) was held in Jakarta, Indonesia on February 14 and 15, 2007. It was organized by the Ministry of the Environment of Japan (MOEJ) and the National Institute for Environmental Studies (NIES) of Japan and hosted by the Ministry of the Environment of Indonesia (MOEI).
2. The workshop was attended by representatives of twelve countries (Cambodia, Indonesia, Japan, Lao PDR, Malaysia, Mongolia, Myanmar, Philippines, Republic of Korea, Singapore, Thailand, and Vietnam) in addition to members of the UN Framework Convention on Climate Change (UNFCCC) Secretariat, the Technical Support Unit of the IPCC National Greenhouse Gas Inventories Programme (IPCC-NGGIP), and the World Agroforestry Centre (ICRAF).

Opening Session

3. The opening session of the workshop was chaired by Ms. Sulistyowati Hanafi, Assistant Deputy Minister for Climate Change Impact Control of MOEI. Participants heard welcoming remarks from Dr. Shuzo Nishioka (NIES), who outlined the history of the workshop, including the first WGIA which took place in 2003. With the addition of Myanmar and Singapore from this year, we now have a total of fourteen countries participating in the network of WGIA. The network is continuing to gain momentum through the contact that is being made between members outside of the workshop. As a direct result of this momentum, in the summer of 2006, we were able to publish the first WGIA Activity Report[1], which has been presented at a number of international meetings and will serve to assist our member countries as they work on their respective national communications.
4. Dr. Nishioka's remarks were followed by an address from the host country by Dr. Masnellyarti Hilman, Deputy Minister from Nature Conservation Enhancement and Environmental Destruction Control. Dr. Hilman mentioned that Indonesia has been very active in the field of GHG inventories, as it is currently preparing its second national communication. In addition, Indonesia is hosting this workshop and will host the Conference of the Parties to the UNFCCC (COP13) and the meeting of the Parties to the Kyoto Protocol (CMP3) later this year. The flooding that happened about one week before this workshop commenced served to underline the importance of climate change mitigation strategies and the inventories upon which such strategies can be based. The Indonesian team is working in close cooperation with their counterparts in Japan, and the country was very interested in working together to host the 4th WGIA, especially due to the potential for capacity building through the workshop. Dr. Hilman closed her speech by emphasizing the importance of local, regional, national, and international partnerships that can incorporate relevant expertise and stakeholders.
5. To close this session, Ms. Chisa Umemiya of the Greenhouse Gas Inventory Office of Japan (GIO) at NIES described the objectives of this workshop. She identified four areas that the participants should focus on during the following sessions:
   (1) identifying ideas or requests for future activities in the region,
   (2) establishing collaborative relationships between the participants,

[1] http://www-cger.nies.go.jp/publication/I067/I067.pdf

(3) finding out practical information that can be directly applied in GHG inventory development, and
(4) learning about the latest inventory-related information from global and regional levels.

Session 1: Updates on GHG Inventories in Asia

6. Session 1 was chaired by Mr. Kiyoto Tanabe of the Technical Support Unit of IPCC-NGGIP. In this session, we heard reports from Myanmar and Singapore, our two new member countries, as well as updates from Japan and Mongolia. The session closed with a summary of the survey on interests and needs of member nations.

- Mr. Ne Winn of the National Commission for Environmental Affairs reported that Myanmar participated in the "Asia Least-Cost Greenhouse Gas Abatement Strategy" (ALGAS), which included inventory development. They are now working on their initial national communication. They are experiencing problems including a lack of vulnerability/impact assessment and adaptation options, no national strategy and action plan, and the need for experts. The delegate underlined the need for capacity building in this area.
- For Singapore, Ms. Shu Yee Wong of the National Environment Agency reported that, as a highly industrialized, small city state with a high population, the country has unique issues in dealing with inventories. It is dependent on fossil fuels (99% fossil fuels, 1% renewables) and lacks natural resources. It has a 4-pronged national climate change strategy that includes public awareness, vulnerability and adaptation, mitigation, and competency building. The main mitigation strategies are energy efficiency and clean energy. They submitted their initial national communication in 2000 and will submit their second national communication in 2009.
- Mr. Hiroshi Fujita (MOEJ) reported that in Japan, MOEJ and GIO submit national GHG inventories to the UNFCCC in cooperation with relevant ministries and organizations. A 70-member committee checks the GHG emission estimation methods. In 2004, the total GHG emissions were about 1,355 million tons in CO_2 equivalents, which is a 7.4% increase from emissions in the base year under the Kyoto Protocol. As the total GHG emissions in 2005 showed an 8.1% increase over the base year, Japan needs to reduce its emissions by 14.1% in total in order to achieve its six percent reduction commitment under the Kyoto Protocol.
- Dr. Batimaa Punsalmaa of the Institute of Meteorology and Hydrology reported that Mongolia prepared its first GHG inventory in 1996, which was updated as a part of ALGAS in 1997, and again in 1998. Their initial communication was submitted in 2000 and they are now working on the second. Short and long term strategies have been developed to improve national GHG inventories. Their short-term strategy is to develop infrastructure by identifying data gaps, developing national procedures for collecting activity data, including the data in the statistical yearbook, and designing a database of activity data and emission factors. Their long-term strategy (2007-2010) focuses on bringing these concepts into practice by improving the database and developing national guidance.

7. Ms. Umemiya reported on the results of the preliminary survey on the interests and needs of WGIA member countries, which was conducted in October and November 2006 as part of the preparation for this workshop. The survey presented participants with a number of IPCC source/sink categories and asked them to select the levels (high, medium, low) of support needed for each of the categories. Areas that were identified as "high need"

could indicate problems with collecting activity data or setting country-specific values. Areas of "low need" may indicate that data and/or country-specific values already exist for that country. The survey identified the following areas of concern and interest in the four sectors:

- Energy: collection of activity data, calorific values, and carbon emission factors of fuels
- Agriculture: rice cultivation and livestock characteristics
- Land-use change and forestry (LUCF): mean annual increments of aboveground biomass
- Waste: wastewater flow and sources, solid waste stream and composition

Session 2: Sector-By-Sector GHG Inventory Development

8. In Session 2, the participants were divided into four sectoral working groups (energy, agriculture, land-use change and forestry, and waste) in order to discuss the issues that were highlighted in the survey mentioned above.

(a) Energy

- The energy working group session was chaired by Dr. Nishioka and reported on by Mr. Saleh Abdurrahman of the Ministry of Energy and Mineral Resources, Indonesia.
- The discussion started with reports from the participants on the issues surrounding the development of inventories in the energy sector for their respective countries. In general, it was found that many countries are using IPCC default values in their calculations, and that seems to serve their needs at this time. In some key instances where the energy sources and usage patterns are unique to the country, they may want to develop country-specific values, but the difference between the IPCC values and the country-specific values is not large in many cases, so it can be more cost-effective for certain countries to continue to use the IPCC values rather than spending a large amount of time and resources developing country-specific values. However, some countries that have already submitted one or two national communications might consider refining their results based on country-specific data.
- Some countries are using Energy Balances as a basis for developing inventories for the energy sector. Countries that do not already have Energy Balances do not necessarily have to start developing them, but if they do already exist, they can be a useful starting point. It is also important to try to find ways to collect the data for the inventories using, for example, estimates from supply side statistics.
- Another key point was that due to the costs involved with implementing the inventories, it is necessary to find other uses for the data. For some countries, it is difficult (i.e. too expensive) to ask for statistics to be prepared for the inventory alone. If the data can be used in other kinds of analyses, it will be easier to ask for it to be collected.
- The session closed with the suggestion that the countries in the energy section should come up with specific core activities to focus on before the 5th WGIA. For example, the group could study specific cases and see what can be done to improve upon them. The information exchange that takes place at WGIA is only the first step. It is important to set targets and work together to make improvements.

(b) Agriculture

- The agriculture working group session was chaired by Dr. Batimaa and reported on by Dr. Damasa Macandog of the University of the Philippines Los Banos.
- The agriculture group discussed the state of activity data and country-specific emission factors for rice cultivation in the region. One of the points that they discovered was that

only India and Japan possess disaggregated activity data on water regime of rice cultivated areas, while the others have only aggregated information. To improve the availability of activity data, the institutionalization of the national data collection system in the agriculture sector needs to be improved. Examples of research studies to develop country-specific emission factors by conducting field measurement in some countries were introduced, including those of the International Rice Research Institute (IRRI) and the National Institute for Agro-Environmental Sciences (NIAES) of Japan. However, a number of countries in the region still do not have their own country-specific emission factors for rice cultivation. These countries include Cambodia, Indonesia, Malaysia, and Vietnam. To help them develop their own country-specific emission factors, the group suggested that there was a need for more research and the use of the IPCC Emission Factor Database (EFDB)[2] and that data from neighboring countries with similar conditions and practices could be used.

- Data availability and improvement for CH_4 emissions from enteric fermentation was also discussed by the group and experiences were shared. The group identified that information on the number of heads of livestock is generally available, so that is what is used for estimation. The methodology that Japan uses to estimate country-specific emission factors from ruminants was introduced, but the group felt that while the methodology itself is quite useful, the cost for implementing this methodology was still too steep for most of the other nations.
- The group identified clear stages of development for the improvement of their activity data and emission factors in this sector. These stages are intended to help countries identify where they are in the spectrum of inventory development and where they might concentrate their energies on next.
- A number of future topics for discussion were identified, including organic carbon in soil, N_2O emissions from N inputs, CH_4 and N_2O emissions from residue burning, feed type and composition and its relation to the CH_4 emissions from ruminants, and proper archiving of information regarding activity data and emission factors.

During the discussion in the plenary session following the group report, a request arose to encourage countries to provide inputs for the IPCC EFDB and also to make better use of the database.

(c) Land-Use Change and Forestry

- The land-use change and forestry (LUCF) working group session was chaired by Dr. Rizaldi Boer of Bogor Agricultural University of Indonesia and reported on by Mr. Heng Chan Thoeun of the Ministry of Environment of Cambodia.
- The LUCF group discussed the following matters: (1) methods for deriving mean annual increment of biomass of trees (MAI), (2) approaches to determining uncertainty levels for the estimates of MAI and emissions and removals, (3) experiences in using the IPCC Good Practice Guidance for LULUCF (GPG for LULUCF)[3] (i.e., stock change approach), and (4) proposals for improving national capacity to enhance GHG inventories in this sector.
- The country reports presented by the group members from Cambodia, Indonesia, and Malaysia on the measurement of MAI and the estimation of its uncertainty showed that,

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[2] http://www.ipcc-nggip.iges.or.jp/EFDB/main.php

[3] http://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf.htm

although there are methodologies for measuring MAI, and some countries have already implemented them in order to develop their GHG inventories, the uncertainty of the results of the measurements has been a crucial concern for tropical countries in Asia. In tropical countries, MAI is different between natural and plantation forests, and among tree species. Also, the forests in these countries consist of a number of species and the countries contain a lot of natural and naturally-regenerated forests. As a result, the reliable estimation of MAI in tropical countries is a significant challenge compared to temperate and boreal zones. More research and support is therefore necessary for countries in the tropics. The expert report from ICRAF pointed out the difficulty in getting both accurate activity data and MAI. Whilst the broader land use categories are likely to reduce the uncertainty of activity data (i.e., land classification and area), obtaining reliable MAI under such broader categories seems not practically possible in a country like Indonesia where the ICRAF study was undertaken. Japan's experience in using the IPCC GPG for LULUCF taught us that the stock change method of the guidance provides good estimation results only when accurate forest inventory data are available. The choice of the method should be left to expert judgment.

- The group then considered proposals for WGIA and its community to undertake in the future to improve national capacity for inventory development in this sector. One proposal was to suggest that the WGIA play a role in facilitating connections with national, regional, and international organizations that play some part in the inventory process, regardless of whether they are involved in producing the inventories themselves (e.g. organizations that develop satellite image databases). Another proposal was to disseminate the outcomes and products of the workshops to the wider climate-change community so that more experts and countries will be aware of the useful information accumulated by the WGIA network.

After the report from the LUCF group, a point was raised at the plenary session that there is a need for a regional project on collecting data for the development of inventories in this sector. In response to this point, it was suggested that the needs of each country in the region be clearly identified in order to make such a regional project happen. In addition, some participants pointed out the difficulty that they were experiencing in following the IPCC GPG for LULUCF for uncertainty assessment. In response, it was suggested that the UNFCCC "User Manual"[4] and the CGE hands-on training materials on GHG inventories[5] would be helpful in this respect.

(d) Waste

- The waste working group session was chaired by Dr. Sirintornthep Towprayoon of King Mongkut's University Technology Thonburi in Thailand and reported on by Dr. Masato Yamada (NIES).
- The group mainly discussed two themes: (1) wastewater treatment and discharge and (2) solid waste disposal on land. Each participating country gave a report in order to assess the similarities and disparities of the management of wastes in each country and their relationship with GHG emission estimates.
- To initiate the discussion, the methodology outlined in the 2006 IPCC Guidelines for

[4] http://unfccc.int/files/essential_background/application/pdf/userman_nc.pdf

[5] http://unfccc.int/resource/cd_roms/na1/ghg_inventories/index.htm

National Greenhouse Gas Inventories[6] for estimating emissions from wastewater treatment was explained. The reports from Indonesia, Japan, Lao PDR, Myanmar, Thailand, and Philippines identified four types of domestic wastewater flow in the region: (1) untreated wastewater discharged to river/sea, (2) wastewater treated by septic tank and discharged to river/sea, (3) wastewater treated by septic tank via sewer collection and discharged to river/sea, and (4) wastewater treated by septic tank through sewer collection to central treatment plant before being discharged to river/sea. The industrial wastewater in the region is highly dependent on the nature of the industries in the area. In Asia, it is not common for domestic and industrial wastewater to be mixed for treatment. Comparison of solid waste streams among participating countries identified two types of recycling activities in the region: one is separation at source (e.g., at the home) and the other is material recovery at a recycling facility. The group highlighted the need to establish a database on the mass and composition of solid waste.

- With regard to the overall characteristics of the waste management situation in Asia, the group discovered that the situation differs considerably among large and small cities and rural areas in every country. In addition, it was found that, in Asia, recycling is important in the overall waste management flow and there is a need to collect and share more information on this topic.

Session 3: Cross-Cutting Issue- Quality Assurance and Quality Control (QA/QC)

9. Session 3 dealt with the cross-cutting issue of quality assurance and quality control (QA/QC). The session was chaired by Mr. Dominique Revet of the UNFCCC Secretariat.

- This session started with an overview of QA/QC principles by Mr. Tanabe. Quality Control (QC) is performed by inventory personnel during the development of inventories, whereas Quality Assurance (QA) is performed on completed inventories by external evaluators following the implementation of QC procedures. QA/QC should be considered an integral part of the inventory process. It serves to develop national GHG inventories which can be readily assessed in terms of quality and to drive the improvement of inventories. Countries that do not have the capacity to implement all parts of the QA/QC spectrum should consider using the minimum elements: defining roles and responsibilities and developing a QA/QC plan. Since there is a trade-off between QC requirements and timeliness/cost effectiveness, it is necessary to identify key areas on which to focus the QA/QC principles.
- Dr. Batimaa informed the group that Mongolia is currently using QA/QC to identify potential problems and make corrections to the inventories. They use it to check activity data, emissions factors, confirm the methodology and calculations, ensure completeness, provide documentation, and authenticate the report.
- Dr. Yukihiro Nojiri (GIO) explained that QA/QC principles are applied extensively to the GHG inventories in Japan. QC is undertaken by MOEJ, GIO, and related agencies and organizations. QA is done by a committee of 70 Japanese inventory experts organized into six subgroups. As an Annex I country, Japan is required to submit annual inventories. This means that they are working on the inventory for one year and the QA of the inventory for the previous year simultaneously. They have identified the need for

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[6] http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.htm

establishing a document archive system (e.g. similar to ISO) for the inventories.

Session 4: Toward Better GHG Inventory Development in Asia

10. Dr. Nishioka chaired the final session of the workshop, which gave us a chance to hear from IPCC and UNFCCC representatives, summarize what we learned from the workshop, and discuss steps to improve GHG inventories in the region.
11. Mr. Tanabe gave us a detailed description of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, including an overview of the differences between the Revised 1996 IPCC Guidelines and the 2006 Guidelines. He emphasized that the step between the two sets of guidelines is meant to be an evolutionary development. Key improvements include comprehensive coverage of emissions from CO_2 transport, injection and geological storage in the energy sector, new categories and new gases being included in the industrial processes and product use sector, the integration of agriculture and LULUCF sectors, and a revised methodology for CH_4 from landfills in the waste sector. It should be noted that the 2006 IPCC Guidelines have not yet been approved by the UNFCCC. Under the UNFCCC, Annex I Parties shall use the 1996 IPCC Guidelines and the Good Practice Guidance reports, and non-Annex I Parties should use the 1996 IPCC Guidelines and are encouraged to use the Good Practice Guidance reports. Nevertheless, the 2006 IPCC Guidelines may assist all Parties in fulfilling their inventory reporting requirements under the UNFCCC because individual methods in the 2006 IPCC Guidelines can be used in a consistent manner with the 1996 IPCC Guidelines and GPGs.
12. Mr. Tanabe's speech was followed by Mr. Revet who gave us an outline of current and future greenhouse gas inventory development in non-Annex I Parties. A total of 134 non-Annex I Parties have submitted their initial national communications, and three have submitted their second, including the Republic of Korea. It is now possible for non-Annex I Parties to submit a project proposal in advance of completing previous NCs. This is to allow for continuity in project financing. However, Parties must then submit their subsequent NC within four years of the disbursement of financial resources. It is possible to obtain a one-year extension, but this does not imply additional financial support. Mr. Revet encouraged the members of the workshop to make use of the latest version of UNFCCC software[7], especially because it offers non-Annex I Parties a way to archive their data, and to consult the GHG Inventory Experts Network[8]. The UNFCCC secretariat is interested in learning about the technical needs from the members of this region. It is also concerned with determining the effectiveness of CGE training materials and the inventory software.
13. Mr. Dadang Hilman of MOEI, rapporteur of the workshop, reported a summary of the key points from Sessions 1 to 3. During the final discussions, Ms. Umemiya outlined some suggestions that were offered during the workshop for future activities that could be undertaken by the WGIA, including developing a manual for inventory preparation in Asia, identifying needs to launch regional projects, and linking to different organizations in order to enhance awareness. Participants also expressed the idea of holding a workshop that involves policy makers from each country. It is expected that with the cooperation of policy makers in the region, inventory development would proceed more smoothly. Participants emphasized the need to increase the visibility of WGIA activities in the region, including targeting policy makers, as it is currently recognized only by

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7 http://unfccc.int/resource/cd_roms/na1/ghg_inventories/index.htm

8 http://www.ghgnetwork.org/

limited communities. One approach would be to disseminate the WGIA reports and publications to related experts in each country, including National Focal Points[9] under UNFCCC. Participants also agreed on the importance of the effective use of GHG inventory experts in the region, including those who participate in WGIA.

14. Participants discussed how to approach the possible implementation of a regional project on GHG inventory development. One suggestion was to first call for a number of relevant experts in a country to clearly identify gaps which would then become the basis for a regional project proposal. Each sectoral working group highlighted potential topics for such regional projects: e.g., organic carbon in soil, N_2O emissions from N inputs in the agriculture sector; MAI in the LUCF sector; and waste recycling in the waste sector. Another proposal made by participants was to initiate an international journal in which the outcomes of inventory-related research (e.g., development of country-specific emission factors) can be presented as there is currently no such research journal available.
15. Dr. Nishioka highlighted three key concepts that emerged from our discussions: (1) expertise, (2) dissemination of information, (3) and proposals for regional projects. He indicated that we should continue working together to improve GHG inventories in the region with these key concepts in mind. This new focus should lead the WGIA to a new phase in its development, in which we apply the information and experiences that we have shared thus far to progress to a more dynamic level of cooperation at the regional level.
16. The meeting was closed with final remarks from Mr. Hilman of MOEI and Mr. Fujita of MOEJ. Mr. Fujita expressed the interest and willingness of MOEJ to hold the 5th WGIA in 2008 and the participants expressed appreciation to their Indonesian hosts for their warm hospitality in Jakarta.

[9] http://maindb.unfccc.int/public/nfp.pl

Part 2

Reports from the Sectoral Working Groups

1 Energy Working Group

1 Introduction

There were 16 participants, with a mixture of people who were experts in the field and others who were here to learn more about the energy sector. Representatives from Indonesia, Japan, Korea, Lao, Myanmar, Singapore, Thailand, and Vietnam were present.

The objectives of the working group discussion were:

- To compare and discuss the collection of activity data in each country
- To compare and discuss the information of calorific values and carbon emission factors adopted by each country
- To learn existing practices of countries in Asia to estimate emissions more reliably

2 Results of the Discussion

2.1 Country Summaries

1 Indonesia

The Ministry of Energy and Mineral Resources publishes an energy balance table on a yearly basis. The data is obtained from energy producers and (large) consumers. The energy consumption from household, industry and transportation sectors is calculated using the intensity and activity data. Supply side data is used to measure greenhouse gas emissions especially carbon dioxide. This is done because the supply side data is more accurate and easier to obtain than demand/consumption data. Indonesia also uses the default IPCC emission factors. However, as Indonesian energy resources, including their calorific values, may vary from region to region, they are planning to develop their own emission factors.

2 Japan

Japan has a very long history of creating statistics for the energy sector as a part of its Energy Balance. The statistics are very detailed. This allows deep analysis, such as the situation in the transport sector where it has been noticed that emissions from trucks using diesel have decreased, while the number of cars has increased, with a resultant increase in emissions. In Japan, they have noticed a discrepancy between statistics that come from top-down sources and those that come from bottom-up sources, so they have worked to correct this gap. Japan gets 90 percent of its energy from external sources. Oil companies have to pay taxes on what they import, so records already exist about the supply. In Japan, various ministries produce their own data (METI supplies the Energy Balance, Ministry of Forestry gives stats for forestry), but the Ministry of the Environment is responsible for coordinating the inventories according to the Law Concerning the Promotion of Measures Concerning Global Warming. As an Annex I country, Japan is required to report its data annually, and this necessitates having an institutional structure in place for creating these reports. This results in a high level of coordination. Japan tends to use its own country-specific values and is capable of producing very detailed statistics in this sector. Japan had to create a national inventory as a part of its Kyoto Protocol commitments, so it has put a lot of time and energy into its inventory. Fortunately, there are very detailed statistics available for the energy sector, so this sector is not really causing concern in Japan right now.

3 Korea

Korea also imports 90% of its energy. In 2005, they took samples from various sectors to do bottom-up verification of activity data. Next year, they will focus on the transportation sector. Korea is still undergoing industrial restructuring, so it is important to refine the inventory now, while industries are in development. The Ministry of Commerce and Energy (equivalent to Japan's METI) has been given the authority to collect activity data from other ministries (e.g. forestry) and other government entities (e.g. Korean gas and oil entities), and to improve upon and publish the data. The process they use is quite similar to that of Japan. However, the Ministry of Commerce and Energy is the one that coordinates data collection, not the Ministry of the Environment (which supports data collection). Korea is shifting to cleaner, more efficient energy, so it has become necessary to develop country-specific values rather than to continue using IPCC defaults. There is government-industry collaboration to work towards developing these country-specific values. Korea has a good amount of first rate data to work with, so they are now working on quality control and quality assurance. They are refining their inventories by focusing on the development of country-specific values, ensuring that the calculations are up-to-date and that they reflect the current pace of technological development, and reporting their results back to industries. They have reached the point where they feel that they can help other countries that require assistance.

4 Lao

The system in Lao for collecting data is not yet adequate. Many improvements are needed. Lao is currently working on its second communication and making efforts to improve their data collection methods.

5 Myanmar

Myanmar participated in the "Asia Least-cost Greenhouse Gas Abatement Strategy" (ALGAS) from 1995 to 1998. ALGAS was a study of national GHG emissions for 12 Asian countries. They mostly use supply-side figures in their inventories.

6 Singapore

Singapore has the advantage of being small, so its inventories can be simplified in some ways. They are currently working on creating an Energy Balance and trying to close their data gaps. They use IPCC default values and have no plans to develop country-specific values at this time.

7 Thailand

Thailand uses top down calculations as a basis for their inventories rather than bottom-up. There is enough activity data available to make estimates. The Ministry of Energy is responsible for supplying and coordinating the data. In general, Thailand uses IPCC defaults for emission factors and, at this stage, compared to other sectors, the energy sector is a relatively low priority for developing country-specific values. Inventories are basically only used for national communications at this point.

8 Vietnam

There are some main energy indicators in the national statistics, but the data is not adequate. They are trying to use the data from the energy sector, but it is very difficult and has been taking a long time. They are currently working on their second communication and trying to update the data. The lack of activity data is causing problems. It is necessary to develop capacity for a national inventory group and policy-making.

2.2 Key Findings

Energy Balances can be used as a basis for developing inventories for the energy sector. However, countries that do not already have Energy Balances do not necessarily have to start developing them. It is more important to try to find ways to collect the data for the inventories using whatever means possible, for example, basing estimates on supply side statistics.

There are many categories, some of which are further differentiated into subcategories. Needs differ depending on the country, so this level of detail may not be necessary for every country. There should be a minimum set of broad categories for countries to focus on, especially when they are starting out. The categories can then be elaborated upon based on the needs of the country. These data from these categories can be used in the evaluation of countermeasures.

In order to gain support for inventory development in each country, it is important to recognize that the data used in the inventories can serve as valuable input for other analyses (CDM, assessment of mitigation strategies). _ It may be difficult (i.e. too expensive) to ask for statistics to be prepared only for the inventory. However, if the data can be used in other kinds of analyses, it will be easier to ask for it to be collected. It can also be used as feedback for the commercial sector so that industries can refine their emission strategies.

In Asian countries, which are experiencing rapid development, it is necessary to pay attention to new technologies that can enhance efficiency and decrease emissions. Certain industries should be examined on a regular basis (e.g. yearly, every five years) for new technologies that necessitate the recalculation of activity data and emission factors.

Many countries are using IPCC default values and that seems to serve their needs at this time. In some key instances where the energy sources and usage patterns are unique to the country, they may develop country-specific values. The difference between the IPCC values and the country-specific values is not large in many cases, so it can be more cost-effective for certain countries to continue to use the IPCC values rather than spending a large amount of time and resources developing country-specific values. However, countries that have already submitted one or two national communications may want to refine their results based on country-specific data. In addition, while it is natural to want to focus on finding ways to improve the accuracy of the estimates, it is also important to look for ways to gain institutional support for collecting and coordinating the data.

The session closed with the suggestion that the countries in the energy sector should come up with specific core activities to focus on in the energy sector before WGIA5. For example, the group could study specific cases and see what can be done to improve upon them. The information exchange that takes place at WGIA is only the first step. There is a need to set targets and work together to make improvements.

2 Agriculture Working Group

1 Objectives

The Agriculture Working Group Session focused on the following two categories:

- 4.C Rice Cultivation
- 4.A Enteric Fermentation

The Session discussed:

- Basic information on rice cultivation areas in each country and how the classification of those areas affects rice cultivation methane emissions (e.g., water regime, water regime prior to rice cultivation)
- Livestock characteristic in each country which affect methane emissions from enteric fermentation (e.g., weight, milk production)
- Existing practices of other countries to estimate emissions more reliably

2 Results of the Discussion

2.1 CH_4 Emissions from Rice Fields

1 Introduction

Rice ecosystems in the Asian region include upland rice, irrigated rice, rainfed rice and deep water rice ecosystems located at various positions in the landscape. A number of controlling factors affect the rate of CH_4 emissions from the various rice ecosystems. These factors include soil properties, temperature, cultural practices (water regime/drainage, fertilizer, seeding/transplanting, straw/residue management) and rice variety.

Cognizant of these varying factors, an Interregional Research Programme on Methane Emissions from Rice Fields was funded by the United Nations Development Program, Global Environmental Facility (UNDP/GEF GLO/91/G31) from 1993 to 1999. The program involved collaboration among international research organizations and national research institutes including the International Rice Research Institute, the Fraunhofer Institute for Atmospheric Environmental Research, and Agricultural Research Institutes of China, India, Indonesia, Philippines and Thailand.

Highlights of the results of this program showed that management practices can be modified to reduce CH_4 emissions without affecting rice yield:

- Intermittent drainage in irrigated systems reduces emissions and also saves water
- Improved crop residue management can reduce emissions
- Direct seeding results in less labor and water input and reduces methane emissions
- Plants grown under good nutritional conditions exhibit reduced methane emissions

2 Activity Data

With regard to the status of activity data for the calculation of CH_4 emissions from rice ecosystems, only 2 countries (India and Japan) reported the availability of disaggregated data for water regime management while the other countries (Cambodia, Philippines, Vietnam, Malaysia, Indonesia) reported the availability of only the aggregated data (Table 2.1). With regard to activity data on organic amendment, disaggregated data is not available for any country represented in the Agriculture Working Group. Only two countries (Japan and Malaysia) reported aggregated data while the rest of the countries reported that this activity data was unavailable (Table 2.1).

Table 2.1 Rice Ecosystem Activity Data Status

Activity data	Cambodia	India	Indonesia	Japan	Malaysia	Philippines	Vietnam
1) Water							
Aggregated	**X**		**X**		**X**	**X**	**X**
Disaggregated		**X**		**X**			
2) Organic Amendment							
Aggregated				**X**	**X**		
Disaggregated							
No data available	**X**	**X**	**X**			**X**	**X**

3 Emission Factors

Country-specific CH_4 emission factors are available for two countries (Japan and Philippines). There are many field measurements of CH_4 emissions from rice fields using the closed chamber method. Dr. Yagi of the National Institute for Agro-Environmental Sciences (NIAES), Japan analyzed 868 seasonal CH_4 emissions data from 103 study sites in the Asian region using a mixed linear model.

In the Philippines, the International Rice Research Institute measured CH_4 emissions from rainfed and irrigated rice fields and developed emission factors for these two rice ecosystems.

2.2 CH_4 Emissions from Enteric Fermentation

Activity Data for the number of heads of different ruminants are available from the National Statistics and Bureau of Animal Industry reports in all countries represented in the working group.

Dr. Enishi of Japan presented an analytical method to improve the determination of a CH_4 emission factor for ruminants based on Dry Matter Intake using Shibata’s equation. Dr. Enishi is also trying to develop and test simple measurement techniques to quantify CH_4 emissions from ruminants including the use of an open circuit respiration chamber, an in vitro gas production technique, a sulfur hexafluoride tracer technique and a semi-continuous system (Rusitec).

2.3 Further Improvements

Steps to improve activity data in the agriculture sector were identified as follows:

- Statistical Yearbooks
- Agricultural Statistics
- Seeking help for data gathering from National Ministries (Agriculture, Environment) and regional offices
- Experts’ opinions
- Documentation/Archiving (sources, comments)
- Sampling to obtain data

Steps to improve emission factors were identified as follows:

- Develop the technology needed to estimate CH_4 emission accurately from ruminants
- For countries without country-specific emission factors, use emission factor values from other countries with similar climatic conditions and cultural practices
- Consult the IPCC Emission Factor Database
- Modeling, equations (Shibata's equation)

Future directions for the improvement of GHG inventories in the agriculture sector will include:

- Organic C in soil
- N_2O emissions from N inputs (inorganic fertilizer, manure, crop residues)
- CH_4 and N_2O emissions from residue burning
- Feed type and feed composition vs. CH_4 emissions from ruminants
- Proper archiving of AD and EF (sources, notes, comments)
- Listing of activity data, emission factor, data gaps, institutionalization of data gathering, and compilation of activity data and emission factors for national GHG inventories

3 Land-Use Change and Forestry (LUCF) Working Group

1 Introduction

The LUCF Working Group session started with reports from four countries: Cambodia, Indonesia, Japan, and Malaysia. Following these reports, two experts presented the methodology from the IPCC Good Practice Guidance for Land Use, Land-Use Change, and Forestry (LULUCF) and discussed the uncertainty of C-stock estimates and its relation to sampling procedures. These presentations were made in order to help increase understanding of the issues and to develop possible strategies for developing better inventories. Finally, countries discussed ideas for developing and improving GHG inventories in the LUCF sector in Asia.

2 Objectives

The objectives of this discussion were:

- To compare and discuss the field measurement of and survey methods for mean annual increments (MAI) and the estimation of uncertainty
- To discuss existing practices for obtaining more reliable estimates of emissions and removals from the LUCF source/sink categories

The discussion covered four issues:

- Methods for deriving MAI
- Approaches to estimate the uncertainty of MAI
- The stock change methodology of the IPCC GPG for LULUCF
- Proposal for enhancing national capacity to improve GHG inventories in the LUCF sector

3 Results of the Discussion

3.1 Methods for Deriving MAI

- MAI can be derived from tree diameter increment data which are either reported by forest concession companies (e.g. Indonesia) or directly measured in the field. In addition, the difference in wood volume data between logged-over and virgin forests can be used for estimating MAI. Though these methodologies have been used to measure MAI in some countries in Asia, the critical concern with the results of estimated MAI is uncertainty.
- A case study in Cambodia showed how MAI, estimated from a field survey, could vary within the same national forest classification category, on which its first GHG inventories were based. The ecological condition of forests affects the values of MAI significantly; therefore, it is not appropriate if only national forest classification categories are taken into account.
- The analytical results of Indonesian inventory data highlighted the significant impact of the selection of MAI in certain forest categories, which are estimated to contribute to around 52% of total carbon removals in the country.
- Countries who have conducted regular forest inventories will have reliable estimates for the MAI. Full utilization of these forest inventory data and the MAI estimated from the data is desirable. In Malaysia, detailed forest inventories have been conducted every ten

years, therefore reliable estimation of MAI is possible.

3.2 Approaches to Estimating the Uncertainty of MAI

- The Monte Carlo analysis for uncertainty estimation requires a large number of data to be analysed in order to get objective results.
- A study by the World Agroforestry Centre showed that the uncertainty of activity data (i.e., land use classification and area) can be decreased if broad land use categories are adopted. However, if broad land use categories are selected, emission/removal factors (e.g., MAI) for such broad categories are needed. If obtaining reliable MAI in general is very difficult in tropical countries like Indonesia, getting good MAI under the broad categories would be a challenge.

3.3 The Stock Change Methodology of the IPCC GPG for LULUCF

- Japan's experience in using the carbon stock change approach revealed that this approach generates accurate results when detailed forest inventory data are used (e.g., what is available in Japan). Hence, if detailed forest inventory data are not available, the default approach (biomass increment) is recommended.
- Tropical forests consist of various types of forests under various management systems and climate types. As a result, the measurement of MAI becomes a significant challenge for tropical countries as compared to boreal and temperate zones where the structure of forests is relatively simple.

3.4 Proposal for Enhancing National Capacity to Improve GHG Inventories for the LUCF Sector

- The group concluded that although there are certain methodologies available for estimating MAI, the difficulty in getting reliable MAI is a critical concern for tropical countries in Asia, especially because the structure of tropical forests is more complex compared to boreal and temperate forests. Support for tropical countries to improve data availability and maintain datasets is needed.
- Participants discussed the difficulties they faced in getting access to information sources owned by different organisations. In order to improve data accessibility, it is necessary to have good coordination among all relevant organisations, including those which are directly and indirectly involved in inventory development. WGIA should play a role in facilitating such coordination in countries in Asia.
- WGIA should also make an effort to disseminate the work conducted by WGIA, including that of the LUCF group, as widely as possible, as this would help increase awareness among relevant personnel and organisations of the issues that are faced by countries and the resources that are currently in existence (e.g., pool of experts).

4 Waste Working Group

1 Overview

Discussion in the waste working group was focused on important activity data to improve GHG inventories; wastewater flow and solid waste streams in Asian countries. The discussion on wastewater began with Mr. Kiyoto Tanabe who reported on the 2006 IPCC Guidelines for National Greenhouse Gas Inventories on wastewater handling. Members from Lao PDR, Philippines, and Thailand reported on the situation of wastewater and solid waste in their countries. In addition members from Indonesia and Myanmar also shared experiences from their countries regarding these issues. Waste management in Japan, which was presented by Mr. Hiroshi Fujita, was used as a comparison case for Asian countries. As for solid waste, the presentations on recent study results on methane emission estimates by Ms. Sirintornthep Towprayoon and recent developments on Japan's inventories with regard to solid waste disposal by Mr. Masato Yamada were used to discuss GHG estimation for solid waste.

2 Results of the Discussion

2.1 Comparison of Wastewater Flow and GHG Emissions in Asia: Similarities and Differences

Refer to country reports during the break out group discussion, wastewater flow in Asian countries depends on the condition of the individual cities and countries. In general, wastewater flow can be classified into at least four categories as follows:

- *Untreated wastewater with final flow to river or sea*: No preliminary treatment of wastewater from households, effluent is not collected, final discharge to the river or sea
- *Septic tank with final flow to river or sea*: Domestic wastewater from toilets partly treated by septic tank, the rest is not collected, final discharge to the river or sea
- *Septic tank and sewer collection*: Domestic wastewater from toilets partly treated by septic tank, the rest is collected using sewer systems and discharged to the river or sea.
- *Septic tank and sewer collection discharge to central treatment plant*: Domestic wastewater from toilets partly treated by septic tank, the rest is collected using sewer systems and treated at a central treatment plant

Types of wastewater flow are dependent on several factors such as size of city, nature of society, type of septic tank, etc.

Uncollected and untreated industrial wastewater originates from small factories and is often discharged directly to reservoirs. The food industry, paper and pulp industry, chemical industry and textile industry produce wastewater flow with high organic compounds. Sludge treatment is not well documented. Mixing of domestic and industrial wastewater is not common in Asian countries. Very little information on methane correction factors (MCF) is available in most countries. However members agree that the 2006 IPCC Guidelines benefit Asian countries.

2.2 Comparison of Solid Waste Streams in Asia and GHG Emissions: Similarities and Differences

Solid waste streams can be identified mainly by the recycling activities:

- Separation at source (household): recyclable waste is separated and sold to communities and un-recyclable waste is collected. Almost every country has this category. Collected waste can be treated at a central plant or go directly to the landfill.
- Separation at site (Material Recycling Facility: MRF): In Asia, it is more common for recycling and sorting activities to be implemented by hand sorting or mechanical sorting at the central treatment plant before final disposal.

Accessibility to recycling data in many countries is possible. Common pre-treatment (waste reduction) technologies in Asian countries are composting and incineration. The main solid waste disposal technology is landfill. Waste streams in each country are also affected by local municipalities, laws, society, and education. However, waste composition in developing countries in Asia does not differ much among the countries.

The improvement of waste management generates co-benefits such as waste recycling and energy recovery, but the type and extent of the co-benefits depends on the country's situation.

2.3 Suggestions for Activities to Develop Improved Inventories, Including Potential Regional Cooperation

Many countries such as Thailand, Philippines, and Indonesia are now promoting waste recycling. Therefore, it is likely that waste composition in the future will change. The creation and maintenance of databases on mass and quality (composition) of waste would be very valuable. Such databases would be useful not only for improving GHG emission inventories but also for improving waste management in the future. Moreover, the application of technology that can produce energy, such as incineration, Refuse Derived Fuel (RDF), Waste to Energy, will be increased. Asian countries with advanced data on emission factors can step into using the Tier II methodology. However in case the technology changes, well defined activity data will be helpful for estimating emissions. Since the status of data acquisition is different among countries, guidelines on this issue would be useful for them.

Part 3

Presentations

Overview of WGIA4

WGIA Secretariat
Greenhouse Gas Inventory Office of Japan (GIO)
National Institute for Environmental Studies (NIES)
umemiya.chisa@nies.go.jp

Welcome Participants!

- 47 inventory-related government officials and researchers from 12 countries (including around 10 local participants from Indonesia)
- 3 representatives from international organisations
  - UNFCCC Secretariat
  - IPCC-NGGIP/TSU
  - World Agroforestry Centre

* The figures shown are as of Feb. 6, 2007.

Joint Hosting Organisations

- Ministry of the Environment of Japan
- National Institute for Environmental Studies
- Ministry of Environment of Indonesia (Local host)

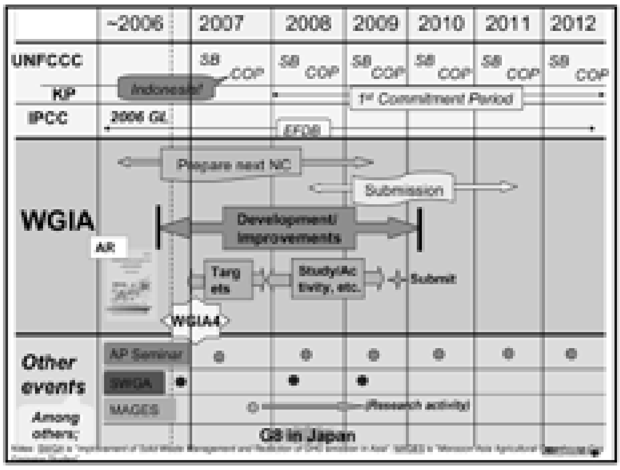


Diagram of workshop flow

Session I: Updates on GHG Inventories
- Country News

Session II: Sector-By-Sector Inventory Development
- Energy
- Agriculture
- Land-Use Change & Forestry
- Waste

Working Group Report from each group

Day 1

Session III: Quality Assurance & Quality Control
- Country/Expert Report

Session IV: Toward Better GHG Inventory Development in Asia
- Reports from the international organisations
- Overall discussion!

Day 2

Please try to find out about:

- ✓Ideas or requests for future activities in the region and your country, taking into account new inventories to be developed
- ✓Collaborative relationships between participants
- ✓Practical and useful information you can actually try to apply when you return home
- ✓Latest inventory-related information at the global and regional level

The Status of GHG Inventories Preparation in Myanmar.

Presented by

Ne Winn
National Commission for Environmental Affairs (NCEA)
14-2-2007

The status of Myanmar to prepare GHG inventories-

- The Government of Myanmar signed the United Nations Framework Convention on Climate Change (UNFCCC) on 11 June 1992 and ratified the convention on 25 November 1994.
- Also a party to several international and regional conventions and agreements relating to the environment, namely.
  - (i) Vienna Convention for the Protection of the Ozone Layer, 1985.
  - (ii) Montreal Protocol on Substances that Deplete the Ozone Layer, 1987.
  - (iii) London Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer, 1990.
  - (iv) United Nations Framework Convention on Climate Change 1992, and
  - (v) United Nations Convention to Conbat Desertification in those Countries Experiencing Serious Drought and lor Desertification, Particulary in Afria, Paris, 1994.

The ALGAS Project

- "Asia Least-cost Greenhouse Gas Abatement Strategy".
- a study by 12 Asian countries of national emissions of greenhouse gases (GHGs) in 1990.
- The Projections of GHGs emissions to 2020
- an analysis of GHGs abatement options in different economic sectors.
- also includes the formulation of national GHGs abatement strategies consistent with national development priorities.

- executed by ADB during 1995-1998 with funding of about $9.5 million from the GEF through the UNDP.
- Apart from Myanmar, the countries involved in the study are Bangladesh, People's Republic of China, India, Indonesia, Republic of Korea, Mongolia, Pakistan, Philippines, Thailand, Viet Nam and Democratic People's Republic of Korea (DPRK).

NTE undertook the country study

- with the active involvement of Governments through a designated national counterpart agency (NCA).
- drawn from different institutions of the country
- assisted in their tasks by a team of international technical experts (ITEs).
- involved a number of regional capacity building activities including training workshop on
- GHGs inventory preparation
- analysis of GHGs mitigation options
- empirical measurements of methane from rice paddies
- analytical modeling of the energy and forestry sectors
- preparation of project pre-feasibility report.

The outcomes of the ALGAS

- An assessment of energy, forestry and land-use change and agriculture sectors.
- formulation of a national least-cost GHGs abatement strategy
- a portfolio of least-cost GHGs abatement projects.
- a national GHGs action plan
- recommendations and future actions.

Situation on preparation of National Commuication under UNFCCC

- has yet to submit Myanmar Initial National Communication.
- undertaking the Project on Preparation on Preparation on Initial National Communication under the UNFCCC.

Linkages with past and ongoing climate change activities

- very limited activities on climate change
- based on the ALGAS project
- regularly participated in subsidiary Bodies meetings and the conference of Parties of the UNFCCC.

Project Management Team and National Study Team.

- A Project Management Team (PMT) and a National Study Team (NST) will be established under the auspices of the NCEA.
- A National Climate Change Committee (NCCC) to be chaired by the Sectary of NCEA will be established.

The NST will comprise six working groups dealing with

(i) GHG Inventory and Mitigation Options Analysis
(ii) Vulnerability and Adaptation Assessment.
(iii) Development and transfer of Environmentally Sound Technologies (ESTs)
(iv) Research and Systematic Observation
(v) Education, Training and Public Awareness.
(vi) Compilation of National Communication.

Previous activities under ALGAS.

- has undertaken a national GHG Inventory for Carbon dioxide, methane (CH4) and nitrous oxide (N_2O) for the base year 1990

Five source categories

- Energy [i.e, fuel combustion, energy industries, transport, commercial institution only (residential was not considered) and others].
- Industrial Processes
- Agriculture [i.e. enteric fermentation from domestic livestock; manure management and rice cultivation (CH_4) emission only], agricultural soils (N_2O emission only, prescribed burning of savannas and field burning of agricultural residues (CH_4 and N_2O emissions only)
- Land-Use change and forestry
- Waste (CH_4 emission only for solid waste disposal on land; wastewater treatment)

Gaps

The major gaps are

(i) CO2, CH4 and N2O data in the five source categories need to be updated and extended based on the COP8 Guidelines.
(ii) Lack of data or reliable data in certain source categories (e.g. methane emission from agricultural soils).
(iii) Lack of country - specific emission factors.
(iv) Uncertainties for sources and sinks were not estimated.
(v) Capacity-building in IPCC methodologies for GHG Inventory is still very much needed.

Proposed activities

- Carbon dioxide (CO_2), methane (CH4) and nitrous oxide (N_2O)
- Carbon monoxide (CO), nitrogen oxides (NOX) and non-methane volatile organic compounds (NMVOC), as well as sulphur dioxide (SO_2) will be undertaken for the year 2000.
- Five source categories.
- Energy (i.e. fuel combustion, energy industries; transport; commercial, residential; solid fuels).
- Industrial Processes.
- Agriculture (i.e. enteric fermentation from domestic livestock; manure management; rice cultivation, agricultural soils and field burning of agricultural residues).
- Land-Use Changes and Forestry.
- Waste.

Programmes containing measures to facilitate an Adequate Adaptation to Climate Change

- Previous activities.
- No previous studies on the vulnerability of Myanmar.
- Although eligible for funding for preparing NAPA.

Gaps

The Major gaps are-

(i) Lack of vulnerability assessment, including the integrated and quantitative vulnerability assessment.

(ii) Lack of cost-effective analysis of various adaptation options, including adaptation technologies.

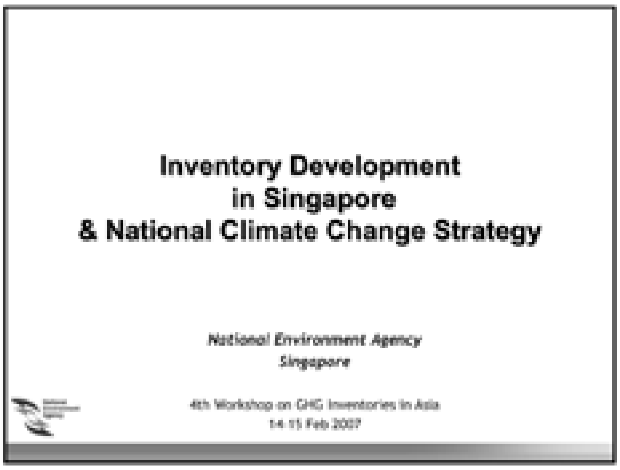
(iii) Lack of national strategy and action plan for adaptation to climate change and its related disaster prevention, preparedness and management

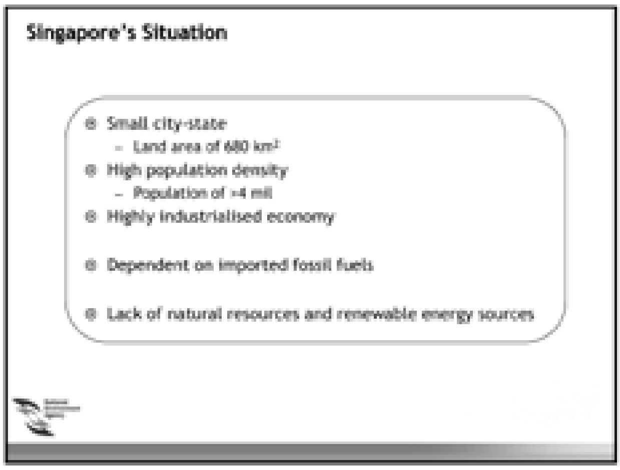
(iv) Lack of expertise in the field of vulnerability and adaptation (V&A) assessment integrated assessment.

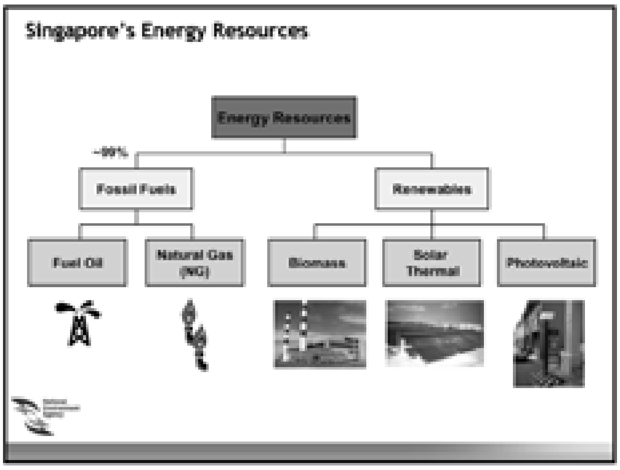
(v) Lack of assessment of the impacts of climate variability and extreme weather events on key socio-economic sectors.

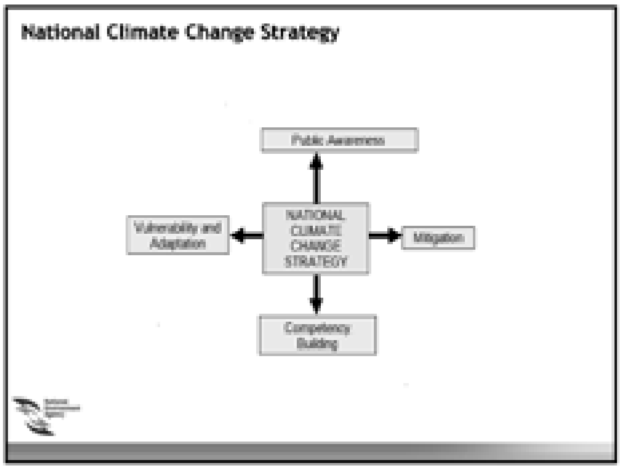
(vi) Capacity building is urgently needed in V & A assessment, including training on relevant methodologies.

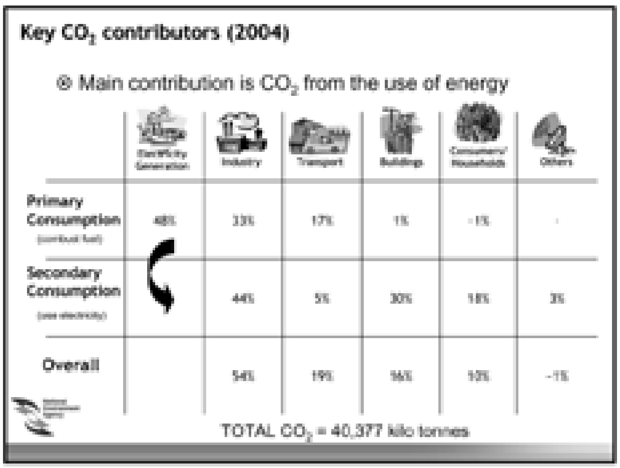
Thank You

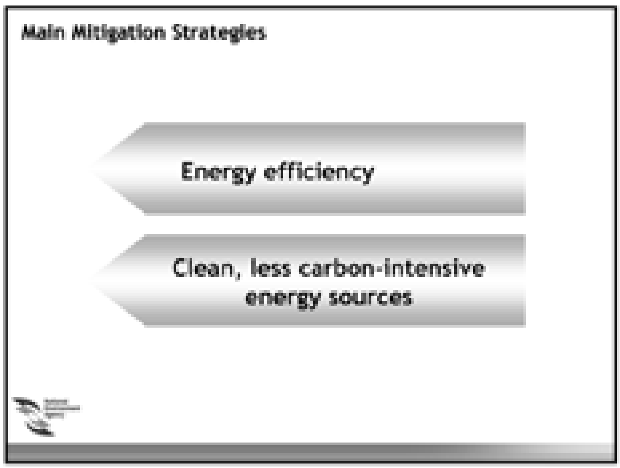

Inventory Development
in Singapore
& National Climate Change Strategy
National Environment Agency
Singapore
4th Workshop on GHG Inventories in Asia
14-15 Feb 2007


Singapore's Situation
Small city-state
– Land area of 680 km²
High population density
– Population of >4 mil
Highly industrialised economy
Dependent on imported fossil fuels
Lack of natural resources and renewable energy sources


Singapore's Energy Resources
Energy Resources
~99%
Fossil Fuels
Renewables
Fuel Oil
Natural Gas (NG)
Biomass
Solar Thermal
Photovoltaic


National Climate Change Strategy
Public Awareness
Vulnerability and Adaptation
NATIONAL CLIMATE CHANGE STRATEGY
Mitigation
Competency Building


Key CO2 contributors (2004)
Main contribution is CO2 from the use of energy
Electricity Generation
Industry
Transport
Buildings
Consumers/ Households
Others
Primary Consumption
48%
33%
17%
1%
~1%
Secondary Consumption
44%
5%
30%
18%
3%
Overall
54%
19%
16%
10%
~1%
TOTAL CO2 = 40,377 kilo tonnes


Main Mitigation Strategies
Energy efficiency
Clean, less carbon-intensive energy sources

Mitigation Efforts by Sector

Electricity Generation | Industry | Transport | Buildings | Consumer/Households

Improving Energy Efficiency in Electricity Generation

Electricity Generation

- New Energy Market introduced in Jan 2003
  - Promotes competition and expected to continue to drive improvements in generation efficiency
- Gencos switching to NG and adopting combined cycle generation technologies (CCGT)
- Cogeneration
  - 815 MW CCGT cogeneration plant
    - ⇒ ~30% energy savings and emissions reduction when compared to separate power and heat generation
  - Trigeneration and multigeneration have potential to further improve efficiency

Using Cleaner Fuels & Renewables

Electricity Generation

- Promoting cogeneration will increase the adoption of NG in industry
- Test-bedding and demonstration of innovative clean energy technologies will help Singapore become an early adopter when these technologies are commercially viable
  - Solar photovoltaics (PV)
  - Hydrogen fuel cells

Promoting Greater Energy Efficiency

Industry

- Energy Efficiency Improvement Assistance Scheme (EASe)
  Introduced in Apr 2005
  - $10 million incentive scheme
  - Fund limit - 50% of the cost of engaging ESCOs
  - Manufacturing companies and building owners/operators
- Energy Audit Scheme for large energy consumers
  - Launched in Jul 2002
  - Encourage very large emitters of CO_2 to improve their energy efficiency and energy management systems and practices
  - Measures implemented:
    - ⇒ Improvement of furnace efficiencies
    - ⇒ Optimisation of heat recovery, heat integration

Promoting Greater Energy Efficiency

Industry

- Accelerated Depreciation Allowance Scheme
  - Introduced in Jan 1996
  - Allows companies to depreciate qualifying capital equipment in one year instead of three

Replacement Equipment	Energy-saving Devices
Air-conditioning System	Solar Heating or Cooling System
Boiler	Solar Energy Collection System
Water Pumping System	Heat Recovery System
Washing or Dry-cleaning Machine System	Power Factor Controller
Refrigeration System	High Efficiency Electric Motor
Lift or Escalators	Variable Speed Drive Motor Control System
Instant Hot Water System	High Frequency Lighting System
	Computerised Energy Mgmt System

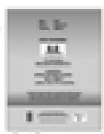
Promoting Energy Efficiency

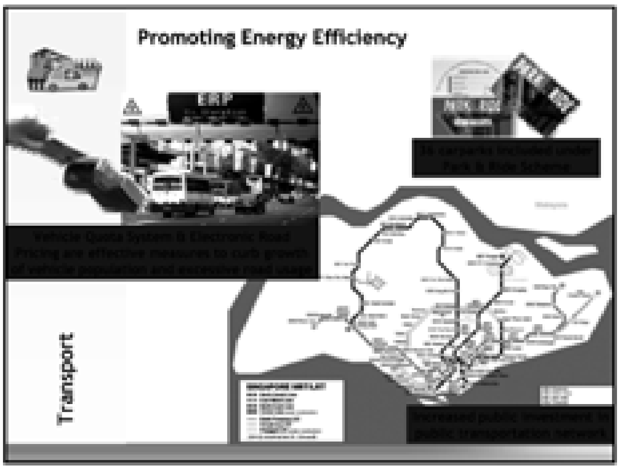
Transport

- Promote public transportation
- Promote green vehicles
  - Hybrid, fuel cell cars
  - Natural gas for taxis and buses

	MJ / passenger-km
Cars	1.5-2.0
Buses	0.9
MRT	0.2

- Green vehicle tax rebates
  - 40% of OMV for electric, hybrid, and CNG cars
  - 5% of OMV for CNG buses
  - Valid until 31 Dec 2007
- Fuel Economy Labelling Scheme
  - Launched in Jun 2003 on Green Transport Day
  - Green Transport Guide

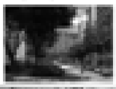

Fuel Economy Label



Buildings

Promoting Energy Efficiency

- Regulations and standards
  - BCA's Building Control Regulation for air-con bldgs (revised in Jan 2004)
    - Envelope Thermal Transfer Value (ETTV) and Roof TTV (RTTV)
    - Minimum efficiency requirements for air-con systems exceeding 30 kW
    - Maximum lighting power budget
  - Code of Practice 24 under SPRING Singapore's standards
    - Technical workgroup led by NEA
- Energy Efficiency Improvement Assistance Scheme (EASe)
- Energy conservation projects
  - Energy audit of common area services in 40 blocks of Aljunied Town Council
  - 14% - 18% potential energy savings uncovered
  - Results and recommendations were shared with Town Councils and HDB



Singapore's HDB Housing

Buildings

Public Sector to Lead

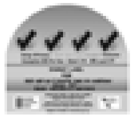
- Energy efficiency improvement of public sector buildings under Economy Drive initiative
  - 8 public agencies participating
  - Standard performance contracting documents developed
  - Two models: Shared savings & Guaranteed savings
- Energy Smart Building Labelling Scheme to raise awareness
  - Accord recognition for buildings with good energy performance, while maintaining a healthy and productive indoor environment

ES ENERGY SMART

Consumer/Households

Raising Awareness

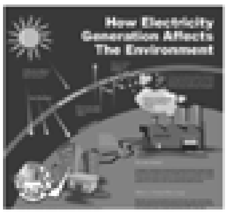
- Energy labelling of household appliances
  - Launched in Apr 2002
  - To-date, about 20% of air-cons and refrigerators in the market are energy labelled
  - Mandatory labelling to be introduced by mid-2007
- Green corners
  - Launched in Mar 2003
  - Showcase energy labelled products
  - 8 green corners island-wide
- Associate Green Corners
  - Launched in Jul 2005
  - At least 35% of displayed models are energy labelled
  - 17 associate green corners
- Energy efficiency display at HDB showflats



Consumer/Households

Raising Awareness

- Energy conservation talks for schools
- Energy conservation educational materials



Vulnerability and Adaptation

- As a low-lying island state in tropics, Singapore is vulnerable to climate change
- Areas of vulnerability include:
  - Coastal land loss and flooding
  - Water resource impacts
  - Higher energy demand and heat stress, higher ambient temperature
  - Rise in vector populations and impact on public health
- Study on the effects and impacts of climate change on Singapore is being commissioned

Competency Building

- Promote demonstration projects and R&D in low-carbon technology through Innovation for Environmental Sustainability (IES) Fund and joint research with tertiary institutions
  - E.g. solar, fuel-cells
- Govt agencies jointly promote sustainable energy industry and build competency to support local and regional CDM projects
  - E.g. ESCO services, solar industry, distributed power generation
  - E.g. carbon trading

Public Awareness

- Climate Change Awareness Programme (CCAP) aims to:
  - Raise awareness among households and motorists about climate change
  - Encourage the public to reduce GHG emissions through simple changes in lifestyles and habits that would reduce their energy consumption
- CCAP (focusing on consumers) launched on 22 Apr 2006
  - "Everyday Superhero"
  - www.everydaysuperhero.com.sg
- Habits for motorists was launched during Green Transport Week in Aug 2006

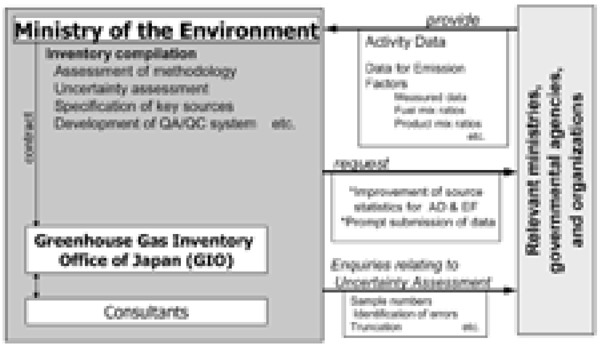
Thank you

Updates on GHG Inventories in Japan

Hiroshi Fujita
Climate Change Policy Division
Global Environment Bureau
Ministry of the Environment

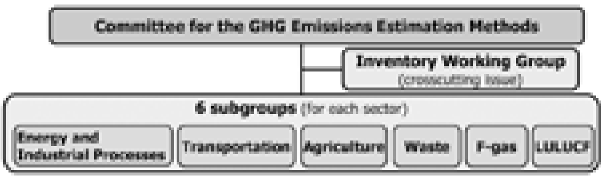
February 14, 2007
The 4th Workshop on GHG Inventories in Asia (WGIA4)

Current Institutional Arrangement



Current Institutional Arrangement

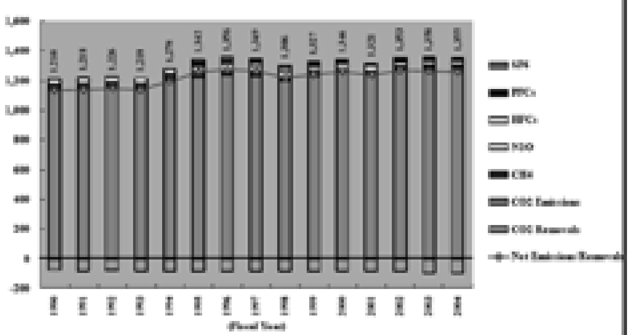
- "the Committee for the GHGs Emissions Estimation Methods", since 1999,
- Members: external experts, approximately 60
- The committee is in charge of methodological development of the inventory



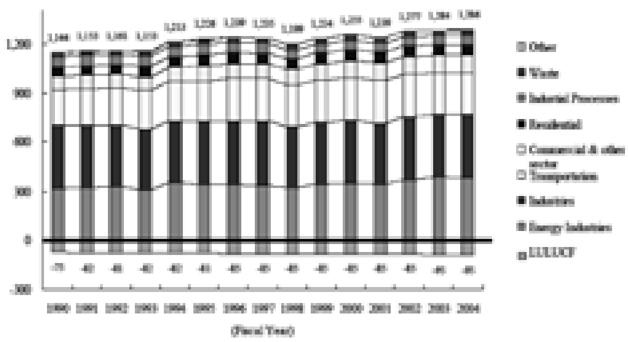
Report on Japan's Assigned Amount

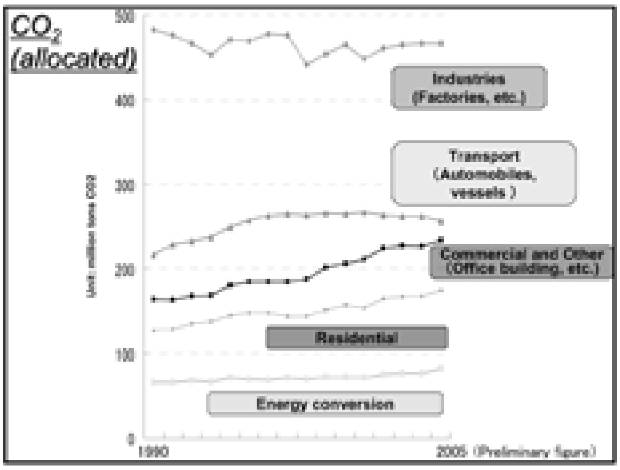
para.7	Part One	
para.7 (a)	I. Complete inventories of anthropogenic emissions by sources and removals by sinks of greenhouse gases not controlled by the Montreal Protocol for all years from 1990	(Part-1) page 1
para.7 (b)	II. Selected base year for HFC's, PFC's and SF6 in accordance with Article 3, paragraph 8	(Part-1) page 8
para.7 (c)	III. The agreement under Article 4	(Part-1) page 8
para.7 (d)	IV. Calculation of assigned amount pursuant to Article 3, paragraph 7 and 8	(Part-1) page 8
para.8	Part Two	
para.8 (a)	I. Calculation of its commitment period reserve in accordance with decision 11/CMP.1 (Article 17 of the Kyoto Protocol)	(Part-2) page 1
para.8 (b), (c), (d)	II. Activities under Article 3, paragraph 3 and 4 of the Kyoto Protocol	(Part-2) page 2
para.8 (e)	III. State of Development of a National System Based on Article 5, paragraph 1 of the Kyoto Protocol	(Part-2) page 6
para.8 (f)	IV. National Registry in accordance with Decision 13/CMP.1 Annex paragraph 8 (f)	(Part-2) page 29

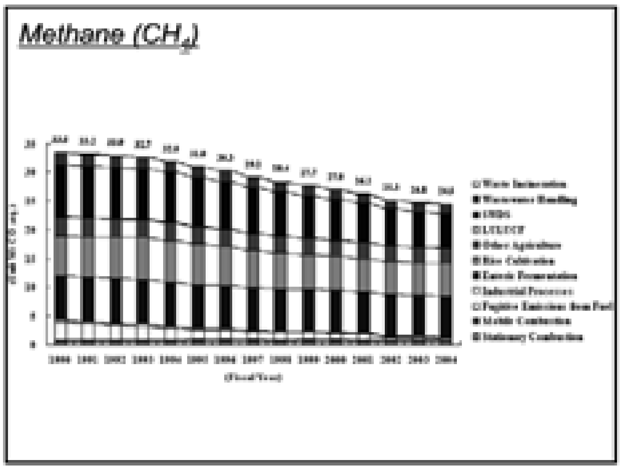
Trends in overall emissions and removals

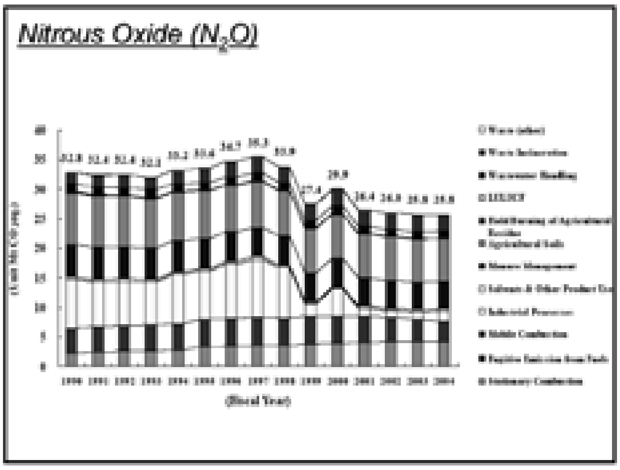


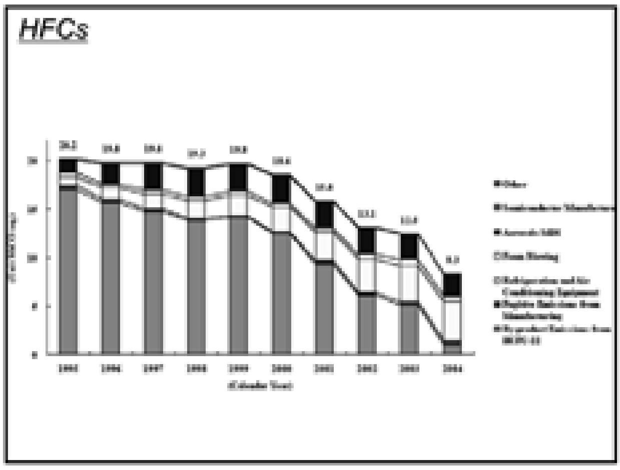
CO_2 (direct)

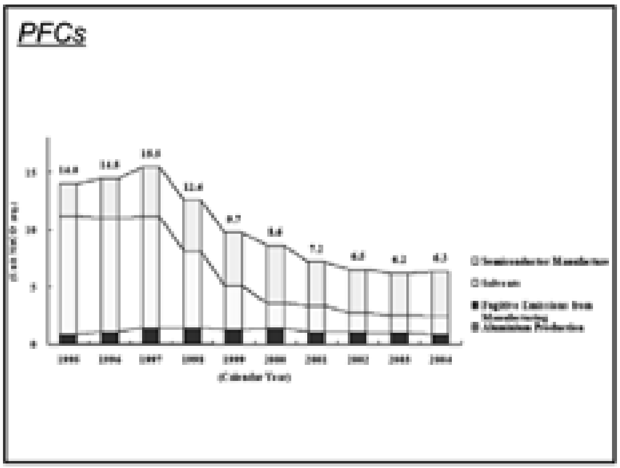


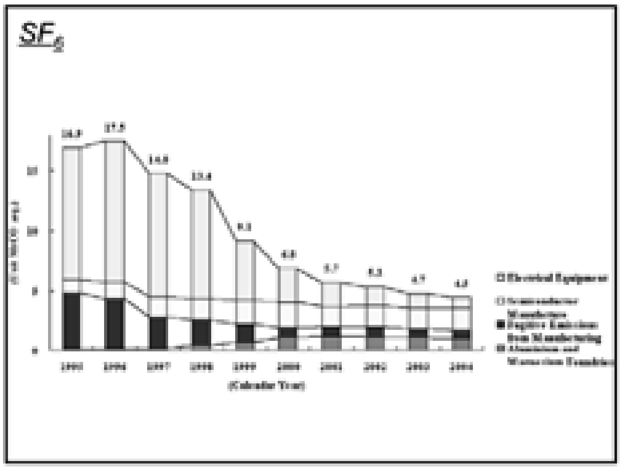

CO_2 (allocated)
Industries (Factories, etc.)
Transport (Automobiles, vessels)
Commercial and Other (Office building, etc.)
Residential
Energy conversion
500
400
300
200
100
0
1990
2005 (Preliminary figure)


Methane (CH_4)

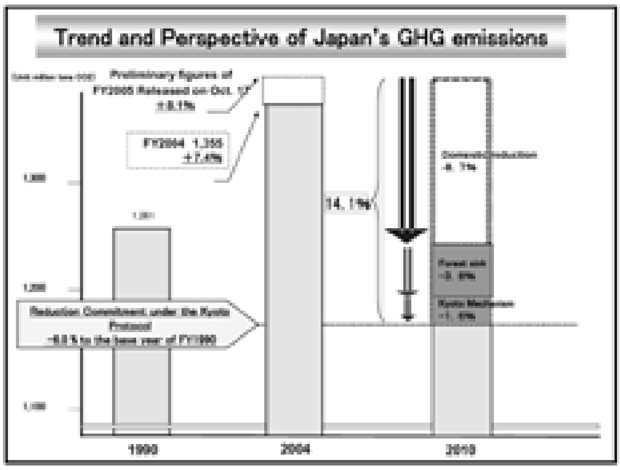

Nitrous Oxide (N_2O)


HFCs


PFCs


SF_6


The Aims of the Kyoto Target Achievement Plan
(Cabinet Decision on April 28, 2005)
1. Ensure achievement of 6% reduction commitment under the Protocol
2. Steady implementation of a continuous as well as long-term GHG emissions reduction on a global scale
21st Century is a century of the environment.
Climate change is a common issue to all human beings.
The government of Japan, as one of the most advanced countries across the globe in implementing measures on climate change, is aspired to take a leading role in the international community.


Trend and Perspective of Japan's GHG emissions
Preliminary figures of
FY2004
14. 1%
Forest sink
Reduction Commitment under the Kyoto Protocol
1990
2004
2010

The 4th Workshop on GHG Inventories in Asia (WGIA)
14-15 February 2007, Jakarta, Indonesia

SHORT- TERM AND LONG- TERM INVENTORY STRATEGIES OF MONGOLIA

Batimaa P. Institute of Meteorology and Hydrology

Contents

Introduction

- Mongolia has prepared its first greenhouse gases (GHG) inventory in 1996 for the base year 1990 under the US Country Studies Programme
- The inventory has been updated within the Asia Least-Cost Greenhouse Gas Abatement Strategy (ALGAS) in 1997.
- Initial National Communication (GEF/ UNEP), the GHG inventories were updated to 1998 with base year 1994.
- Capacity Building for Improving GHG Inventories

Introduction

The main goals of these strategies:

- to determine and prioritize the key needs for the preparation of the GHG emission inventories and
- to identify ways for improving methods and procedures for future inventories

Introduction

Barriers

- No standard data for inventory
- No system in data collection and checking
- No Institutional framework

Short term inventory strategy

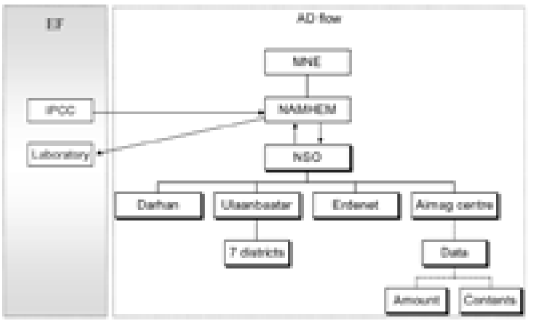
Data collection and archiving

- prepare a list of identified data gaps
- develop a national procedures of Activity data (AD) collection
- include necessary data for GHG inventories in Statistical Yearbook
- design of the database structure of national AD and Emission factors (EFs)
- establish National AD and EFs Database

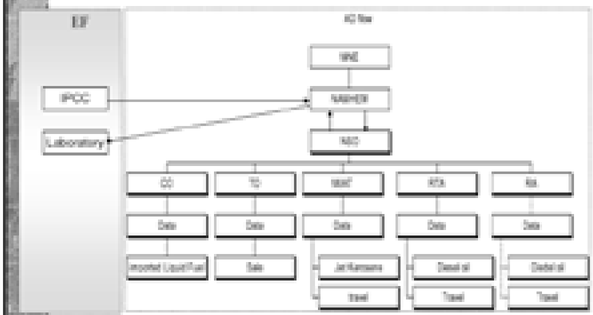
Data and EF assessment

No.	Sector	Activity data necessary for GHG inventory	Data source	Barriers in finding the data	How to overcome the barrier
	Waste				
	Landfills	Urban population	Statistical year book		
	Domestic wastewater	Urban population	Statistical year book		
	Commercial and industrial wastewater	Annual wastewater	[illegible]	[illegible]	[illegible]

Solid waste



Mobile



Short term inventory strategy

Improvement of Emission Factors

- develop a list of emission factors used in GHG inventories
- check reliability of EFs used
- prepare a list of local emission factors to be estimated in the specific local conditions
- estimate local EFs

Completeness

- identify missing sub -sectors and emission gases in the GHG inventories
- develop a work plan for national inventory by using IPCC Good practice Guidance

Short term inventory strategy

Methodological issues

- prepare national manual for preparation of national GHG inventories
- learn IPCC Good Practice and Uncertainty Management in National GHG Inventories

Inventory quality and uncertainty assessment

- prepare quality assurance and quality control (QA/ QC) plan in the development of national GHG inventories
- assess uncertainties

Reporting and Documentation

- create reporting and documentation system for national GHG inventory

Long Term strategy (2007- 2010)

Data

- **To improve the design of the database structure of national AD and EFs**
- **To develop a national guidance for updating national and/ or activity data of sectors**
- **To establish database of National AD and EFs**

Long Term strategy (2007- 2010)

Emission factors

- To check reliability of EFs used
- To check estimated local EFs

Long Term strategy (2007- 2010)

Completeness

- To conduct key source analysis of the GHG inventories
- To identify missing sub- sectors and activities in the GHG inventories
- To estimate emissions of missed gases

Long Term strategy (2007- 2010)

Institutional and procedural arrangements

- To establish a legal instrument on data issuing for GHG
- To establish an institutional structure for preparation of national GHG inventories
- To develop a capacity building program
- To establish a permanent center/ laboratory/ team of experts responsible for preparation of national GHG inventories

Long Term strategy (2007- 2010)

Inventory quality and uncertainty assessment

- To establish an official technical peer review process
- To conduct inventories QA/ QC

Long Term strategy (2007- 2010)

Reporting and Documentation

- To create inventory documentation system
- To complete documentation of activity data, EFs, methods
- To conduct trend analyses
- To conduct recalculations

Thank you

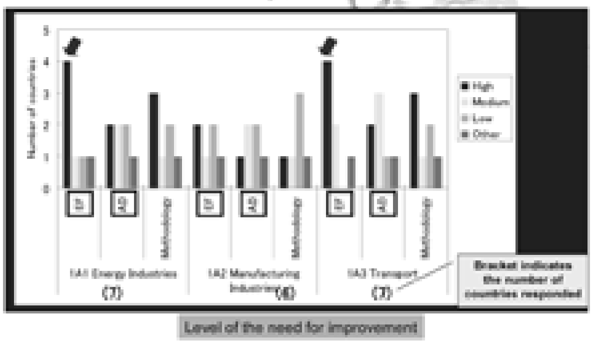
Results of the Preliminary Survey & Guidance for the Sectoral Working Group Session (Session II)

WGIA Secretariat
Greenhouse Gas Inventory Office of Japan (GIO)
National Institute for Environmental Studies (NIES)
umemiya.chisa@nies.go.jp

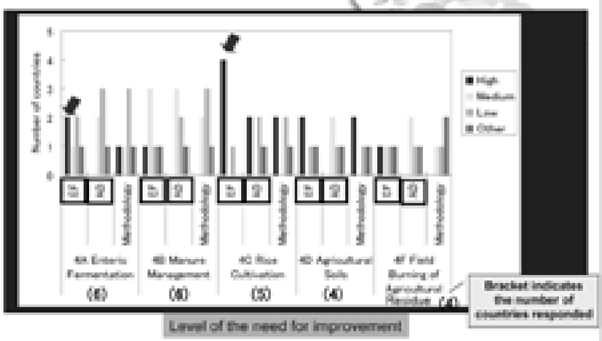
The WGIA4 Preliminary Survey conducted in Oct.-Nov. 2006

- ***Objective:***
  To identify the current situations and the levels of the need for improvement
- ***Survey Method:***
  Requested participants to select the levels of the need for each of IPCC source/sink categories as "High", "Medium", or "Low"

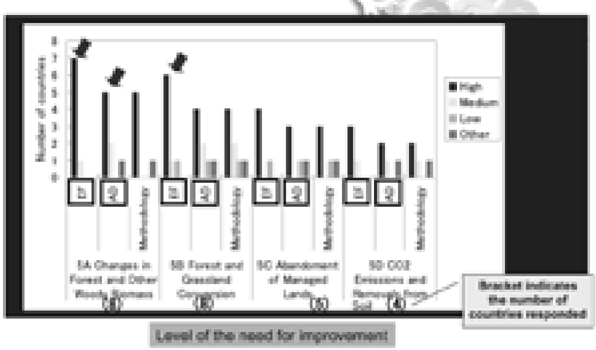
Energy Sector



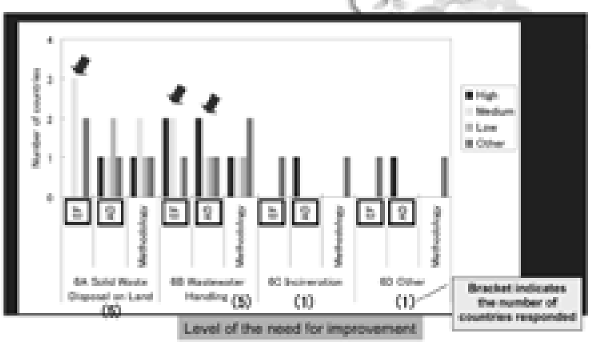
Agriculture Sector



LUCF Sector



Waste Sector

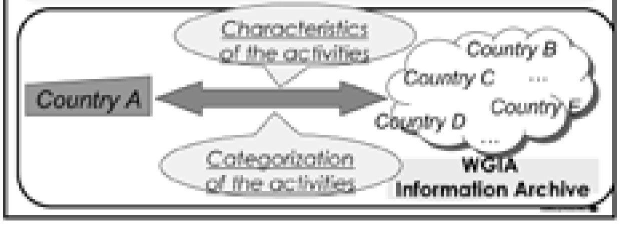


Guidance for the Next Session (1)

Approach:

Focusing on the significant categories identified, each WG will compare and discuss:

- **The characteristics of the activities** emitting/absorbing GHGs
- LUCF The measurement/survey methodology for obtaining **fundamental data** necessary for calculation



Guidance for the Next Session (2)

- Energy -	- Agriculture -	- LUCF -	- Waste -
➢Collection of AD ➢Calorific Values and Carbon EF of Fuels	➢Rice Cultivation Area ➢Livestock Characteristics	➢Mean Annual Increments of Aboveground Biomass	➢Wastewater Flow and Sources ➢Solid Waste Stream and Composition

- *Country-Specific EF*
- *Management of Activities and Data*
- *Model Methodology*
- *...*

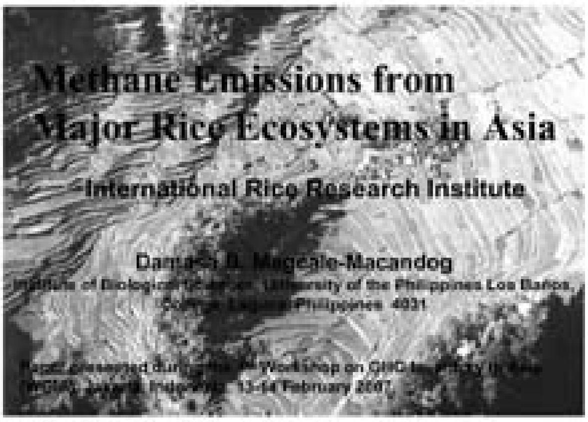
Points of Discussion!

- Comparison of the characteristics of an activity: Similar or different?
- Application of one country's method to the other(s)
- Necessary steps to be taken for improvements
- More and more...

We look forward to 10-min. presentations from each of the groups tomorrow!!

WG Information

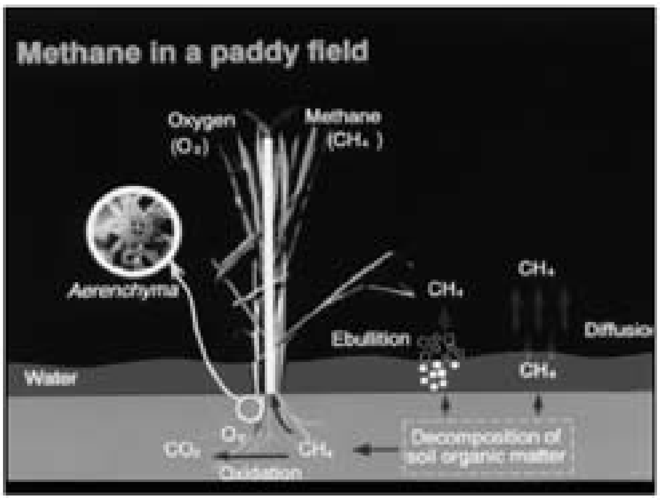
	Chair	Reporter	Meeting Room
Energy	Dr. Shuzo Nishioka	Mr. Saleh Abdurrahman	Diponegoro
Agriculture	Dr. Batimaa Punsalmaa	Dr. Damasa Macandog	Tanjung
LUCF	Dr. Rizaldi Boer	Mr. Heng Chan Thoeun	Teratai
Waste	Dr. Sirintornthep Towprayoon	Dr. Masato Yamada	Rasamala



Estimates of sources and sinks of atmospheric methane, (Tg CH_4 year^{-1})

Sources/sinks	IPCC Emission average
Natural	
Wetlands	115
Termites	20
Oceans, fresh waters	15
Others	15
Anthropogenic	
Fossil fuel (coal, gas produc/distribu)	100
Cattle	85
Rice paddies	60
Other soils	
Biomass burning	40
Landfills	40
Animal waste	25
Domestic sewage	25
Total identified sources	535
Total sinks	515
Atmospheric increase	37

Rice ecosystems

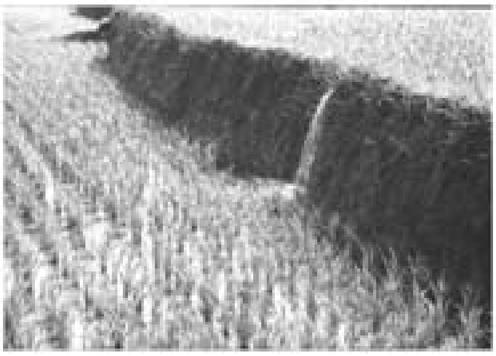


The Interregional Research Programme on Methane Emissions from Rice Fields

- International Rice Research Institute, Fraunhofer Institute for Atmospheric Environmental Research, Agricultural Research Institutes of China, India, Indonesia, Philippines and Thailand
- Funded by United Nations Development Program, Global Environmental Facility (UNDP/GEF GLO/91/G31)
- 1993-1999

Stations of the Interregional Program on Methane Emissions

Irrigated rice ecosystem



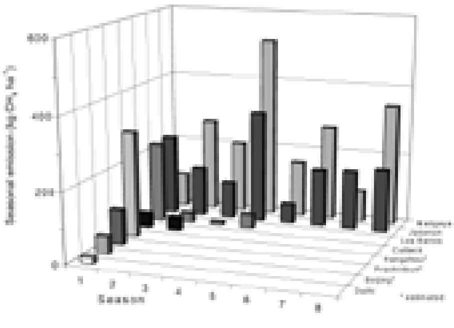
Irrigated rice: heavy water consumer

Methane emissions: field measuring system

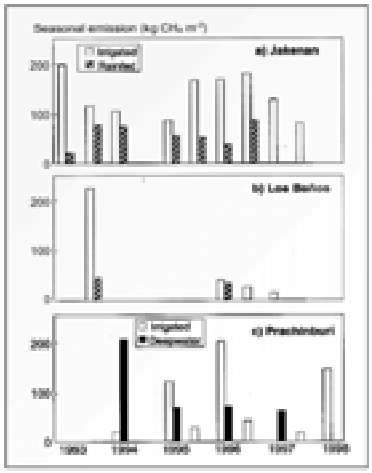
Methane emissions from rice fields: Controlling factors:

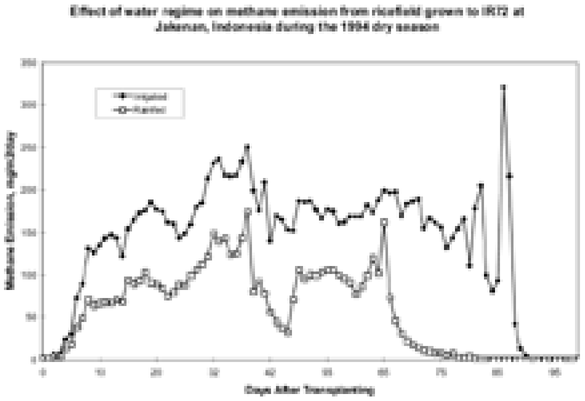
- Soil properties
- Temperature
- Cultural practices (water regime/drainage, fertilizer, seeding/transplanting, straw/residue management)
- Rice variety

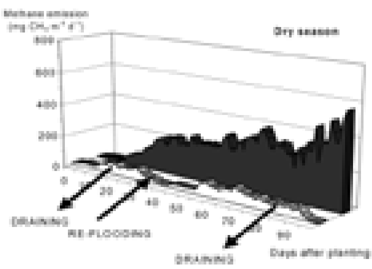
Seasonal CH_4 emissions from reference treatment **(continuous flooding, pure mineral fertilizer, cultivar IR72)**



Seasonal CH_4 emissions from irrigated and rainfed rice in Jakenan and Los Baños, and irrigated and deepwater rice in Prachinburi



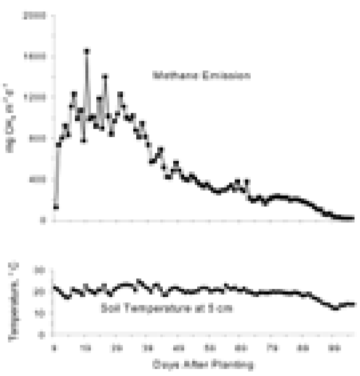




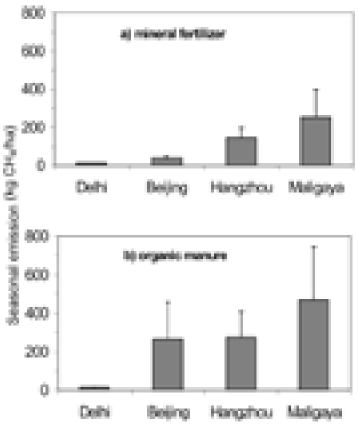
Methane emission rates in rainfed (white) and irrigated (maroon) rice , Los Baños, Philippines

Effect of temperature on methane emission

Beijing, China

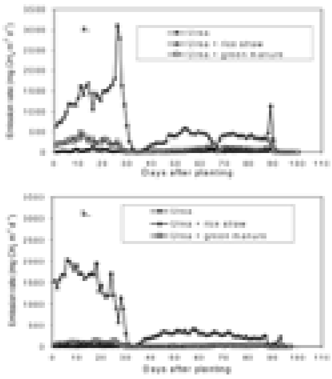


Site-specific CH_4 emissions in response to organic amendments

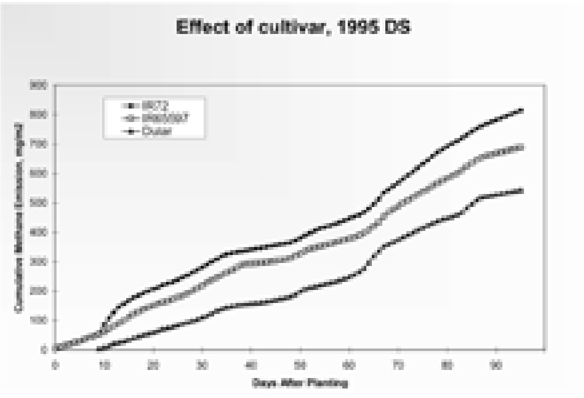


Methane emissions from urea, rice straw and organic manure

Los Baños Philippines

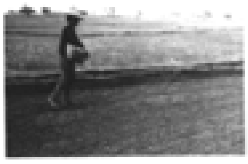


Conventional, improved high yielding, and new plant type

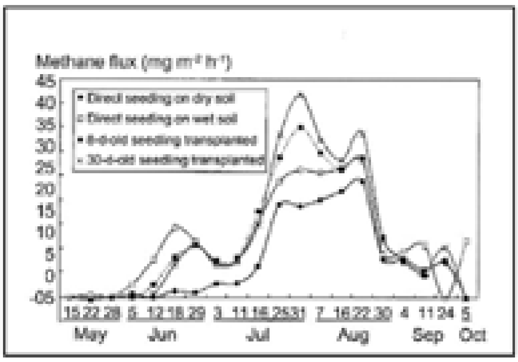


Transplanting

Direct (dry) seeding



Direct (wet) seeding



Variations in CH_4 emissions as affected by different cultural practices in Southeastern Korea

Harvesting rice

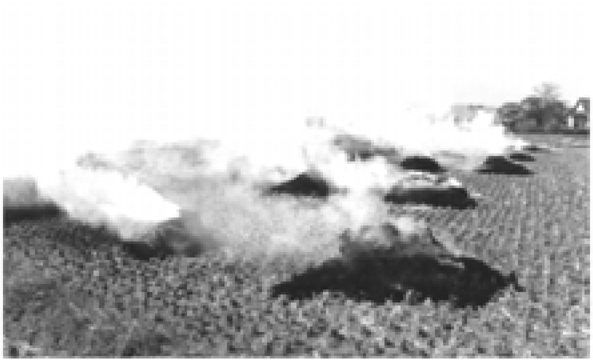
Residue management

- Eliminate straw burning
- Incorporate rice straw
  - o Maintain soil fertility in the long term
  - o Sustain increased yield
  - o Increase in organic C, N, available P, K and Si
  - o Yield advantage of straw incorporation over straw burning is 0.4 t ha^{-1} $season^{-1}$

Nutrient content of straw

Element	Content, %
• Nitrogen	0.6
• Phosphorus	0.1
• Sulfur	0.1
• Potassium	1.5
• Silica	5.0
• Carbon	40.0

Burning rice straw in China



Field burning of crop residues

Trace gases emitted

- Methane
- Carbon monoxide
- Non methane volatile organic compound
- Nitrous oxide
- Nitrogen oxides

Alternate residue management

Incorporation into the soil

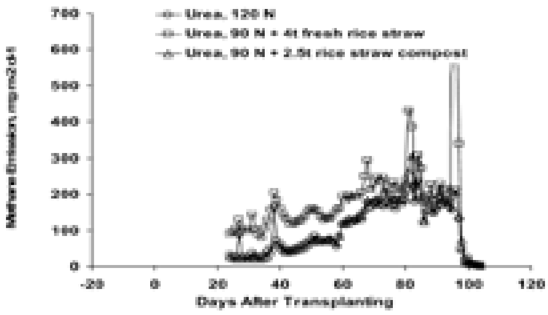
rice-rice system: incorporate previous residue soon after harvest

rice-upland crop: use straw as upland crop mulch

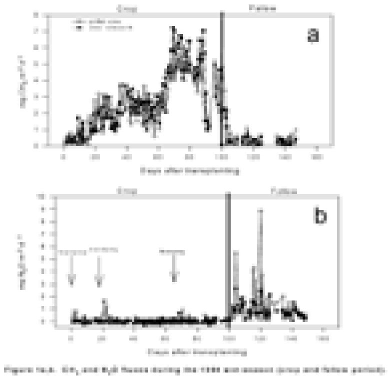
Straw incorporation

Composted rice straw from methane generator

Effect of straw management on methane emission
Maligaya, Philippines, 1997



Methane and nitrous oxide emissions



Rice production and methane emissions

Management practices can be modified to reduce emissions without affecting yield

- **Intermittent drainage in irrigated systems reduces emissions and also saves water**
- **Improved crop residue management can reduce emissions**
- **Direct seeding results in less labor and water input and reduce methane emissions**
- **Plants grown under good nutrition exhibit reduced methane emissions**

Rice production area ('000 hectares) in the Philippines by ecosystem (1983-93).

Year	Total	Irrigated	Rainfed
1983	3141	1688	1473
1984	3222	1755	1467
1985	3403	1838	1565
1986	3403	1878	1525
1987	3256	1852	1404
1988	3393	1956	1437
1989	3497	2064	1433
1990	3319	2010	1309
1991	3425	2060	1365
1992	3198	1980	1218
1993	3450	2017	1433
Mean	3337	1916	1421

Source: World Rice Statistics 1993-94. IRRI.

Methane emission factors from rice fields in the Philippines.

Ecosystem	Mean emission (mg/m^2/day) from Sites			Emission Factor (kg/ha/day)		% Decrease from IPCC
	Los Baños	Maligaya	Mean	Derived	IPCC default	
Irrigated	233.1	225.5	229.3	**2.3**	5.9	61
Rainfed	40.3		40.3	**0.4**	3.54	89

Global rice ecosystems, area and methane emissions

Ecosystem	Area (ha x 10^6)	Methane emission (kg ha^{-1})
Irrigated	79	21
Rainfed	36	10
Upland	19	0
Deepwater and tidal wetlands	12	16

Methane emission from rice fields:

Mitigation options in irrigated ecosystem

- Water management
- Management of organic amendments
- Alternate cultural practices
- Rice cultivar selection

Methane emission from rice fields:

Mitigation options in rainfed ecosystem

- Suitable water management
- Management of organic amendment
- Use of nitrification inhibitors

Methane emission from rice fields:

Mitigation options in deepwater ecosystem

- Proper straw management

Acknowledgment

- Mrs. Rhoda Lantin, retired Research Scientist of the International Rice Research Institute provided all the slides, materials and data for this presentation.

THANK YOU!

The 4th Workshop on GHG Inventories in Asia (WGIA4)
14-15 February 2007, Jakarta, Indonesia

Methane Emissions from Rice Cultivation:

Methodology of the 2006 IPCC Guidelines and Emission Factors in Japanese Inventory Estimation

Kazuyuki Yagi

National Institute for Agro-Environmental Sciences, Tsukuba

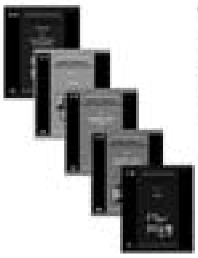
NIAES

Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (1996)

Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (2001)

http://www.ipcc.ch/

Revised 2006 IPCC Guidelines



Volume 1: Cross-Cutting Issues and Reporting Tables
Volume 2: Energy
Volume 3: Industrial Processes and Product Use
Volume 4: Agriculture, Forestry and Other Land Use (AFOLU)
Volume 5: Waste

Volume 4, Chapter 5.5
(p. 5-44 to -53)
Methane Emissions from Rice Cultivation

Has just published in the web-site:
http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.htm

2006 IPCC Guidelines
Methodology for CH_4 Emissions from Rice Cultivation

Basic Equations

Emissions (Gg/yr) = Σ_{ijk} (EF_{ijk} • t_{ijk} • A_{ijk} • 10^{-6}) Eq. (1)

EFi = EFc • SFw • SFp • SFo • SFs,r Eq. (2)

Here: EF_{ijk} = a daily emission factor for i, j, and k conditions, kg CH_4 ha^{-1} day^{-1}
t_{ijk} = cultivation period of rice for i, j, and k conditions, day
A_{ijk} = annual harvested area of rice for i, j, and k conditions, ha yr^{-1}
EFc = baseline emission factor, kg CH_4 ha^{-1} day^{-1}
SFw = scaling factor for water regime during the cultivation period
SFp = scaling factor for water regime in the pre-season
SFo = scaling factor for organic amendment applied
SFs,r = scaling factor for soil type, rice cultivar, etc., if available

2006 IPCC Guidelines
Methodology for CH_4 Emissions from Rice Cultivation

Baseline Emission Factor (EFc)

TABLE 5.11
DEFAULT CH_4 BASELINE EMISSION FACTOR ASSUMING NO FLOODING FOR LESS THAN 180 DAYS PRIOR TO RICE CULTIVATION, AND CONTINUOUSLY FLOODED DURING RICE CULTIVATION WITHOUT ORGANIC AMENDMENTS

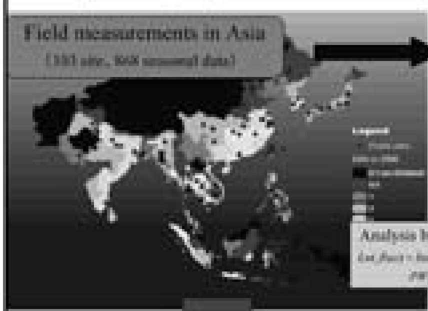
	Emission factor	Error range
CH_4 emission (kg CH_4 ha^{-1} d^{-1})	1.30	0.80-2.20

Source: Yan et al., 2005

A baseline emission factor for:
- no flooded fields for less than 180 days prior to rice cultivation
- Continuously flooded during the rice cultivation period
- without organic amendments

EFc in the 1996 Guidelines & 2000 GPG
= 200 kg ha^{-1} $season^{-1}$
- Without statistical analysis
- Regardless of the length of the cultivation period

CH_4 & N_2O Source Database for Rice Fields



Analysis by a mixed linear model

Publishing DB at web sites
- CH_4 from rice → JAMSTEC web
- N_2O from rice → NIAES web (under const.)

- Baseline emission factors
- Various scaling factors
- Uncertainty analysis

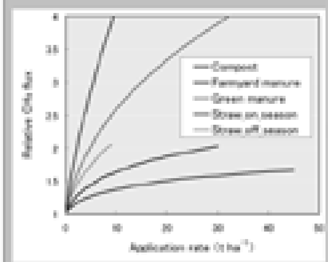
2006 IPCC Guidelines
Methodology for CH_4 Emissions from Rice Cultivation
Scaling Factors for Water Regime during the Cultivation Period (SFw)

Water Regime		Aggregated case		Disaggregated case	
		Scaling Factor (SF_w)	Error Range	Scaling Factor (SF_w)	Error Range
Upland		0	-	0	-
Irrigated	Continuously flooded	0.78	0.62-0.98	1	0.79-1.26
	Intermittently flooded - single aeration			0.60	0.46-0.80
	Intermittently flooded - multiple aeration			0.52	0.41-0.66
Rainfed and deep water	Regular rainfed	0.27	0.21-0.34	0.28	0.21-0.37
	Drought prone			0.25	0.18-0.36
	Deep water			0.31	ND

2006 IPCC Guidelines
Methodology for CH_4 Emissions from Rice Cultivation
Scaling Factors for Water Regime in the Pre-season (SFp)

Water regime prior to rice cultivation		Aggregated case		Disaggregated case	
		Scaling factor (SF_p)	Error range	Scaling factor (SF_p)	Error range
Non flooded pre-season <180 d		1.22	1.07-1.40	1	0.88-1.14
Non flooded pre-season >180 d				0.68	0.58-0.80
Flooded pre-season (>30 d)				1.90	1.65-2.18

2006 IPCC Guidelines
Methodology for CH_4 Emissions from Rice Cultivation
Scaling Factors for Organic Amendment applied (SFo)



Relationship between application rate of different organic amendment in fresh weight and CH_4 emissions

$$SFo = (1 + \Sigma_i ROA_i \cdot CFOA_i)^{0.59} \quad \text{Eq. (3)}$$

Here:
SFo = scaling factor for organic amendment
ROA_i = application rate of organic amendment i in fresh weight (t/ha)
CFOAi = conversion factor for organic amendment as shown in the following table

Organic amendment	Conversion factor (CFOA)	Error range
Straw incorporated shortly (<30 days) before cultivation	1	0.97-1.04
Straw incorporated long (>30 days) before cultivation	0.29	0.20-0.40
Compost	0.05	0.01-0.08
Farm yard manure	0.14	0.07-0.20
Green manure	0.50	0.30-0.60

2006 IPCC Guidelines
Methodology for CH_4 Emissions from Rice Cultivation

Major Revisions

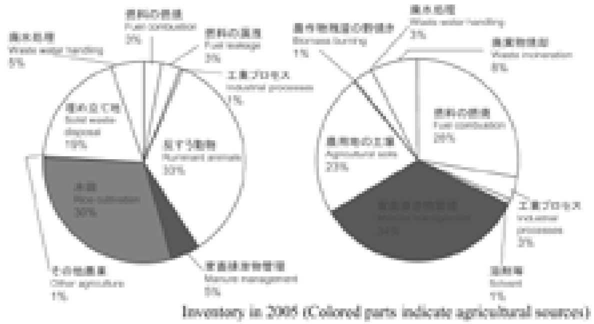
- Baseline emission factor (EFc) has revised to the daily rate, on the basis of statistical analysis of monitoring data
- New scaling factor for water regime in the pre-season (SFp) has incorporated
- Other scaling factors have revised on the basis of statistical analysis of monitoring data

2006 IPCC Guidelines
Methodology for CH_4 Emissions from Rice Cultivation

Implementation

- Reliable and universal emission and scaling factors, on the basis of statistical analysis of monitoring data, have provided.
- As a results, priority for developing country-specific factors became low.
- More importance to collect reliable activity data in each country for developing better emission inventory

National Inventory for Japan Anthropogenic Sources for CH_4 and N_2O



Inventory in 2005 (Colored parts indicate agricultural sources)

National Inventory for Japan
CH_4 Emissions from Rice Cultivation
Methodology

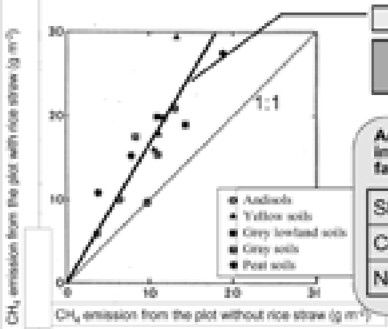
- Tier 2 methodology
- Country-specific emission factors for 5 soil types, which are based on seasonal field monitoring at 35 sites over the country during 1992-94
- Country-specific scaling factors for 3 organic amendment
- Water management was assumed to be homogeneous intermittent-irrigation for 98% of the rice fields

National Inventory for Japan
CH_4 Emissions from Rice Cultivation
Emission Factors

Type of soil	No. of data	Straw amendment	Various compost amendment	No-amendment	Proportion of area
		[gCH_4/m²/year]			%
Andosol	2	8.50	7.59	6.07	11.9
Yellow soil	4	21.4	14.6	11.7	9.4
Lowland soil	21	19.1	15.3	12.2	41.5
Gley soil	6	17.8	13.8	11.0	30.8
Peat soil	2	26.8	20.5	16.4	6.4

- Based on field monitoring campaign during 1992-1994 at 35 sites over Japan
- Measured by conventional water management with mid-season drainage followed by intermittent flooding

National Inventory for Japan
CH_4 Emissions from Rice Cultivation
Calculation for Organic Amendment Applied



SFo for straw: 1.68

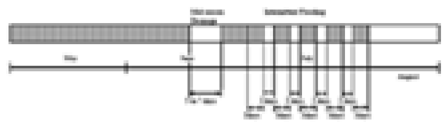
SFo for various compost: 1.25

Activity data based on interview with ca. 2,000 farmers by MAFF

Straw	60%
Compost	20%
No	20%

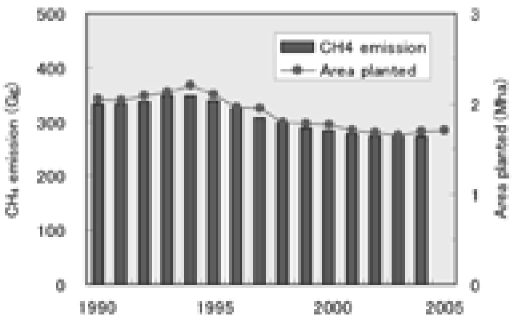
National Inventory for Japan
CH_4 Emissions from Rice Cultivation
Water Management Categorization

- Water management was assumed to be homogeneous intermittent-irrigation for 98% of the rice fields

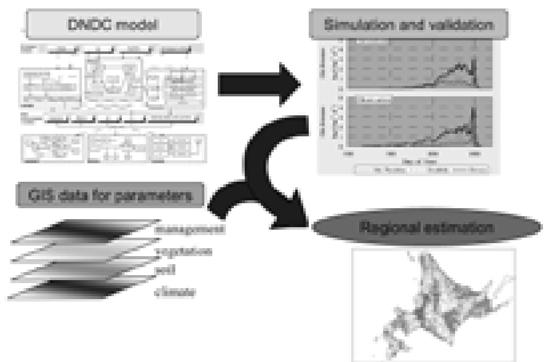


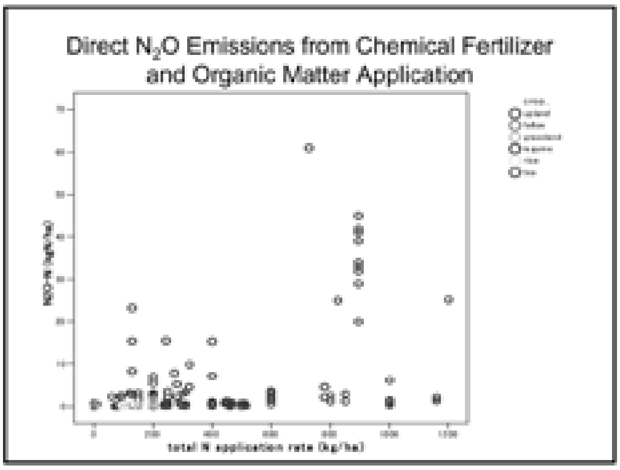
- A scaling factor of 1.77 is applied for continuous flooding fields which accounted for 2% of the area
- No consideration for water regime in the pre-season

National Inventory for Japan
CH_4 Emissions from Rice Cultivation
Trend of CH_4 Emission



Estimation of GHG Emissions by a Process-Based Model





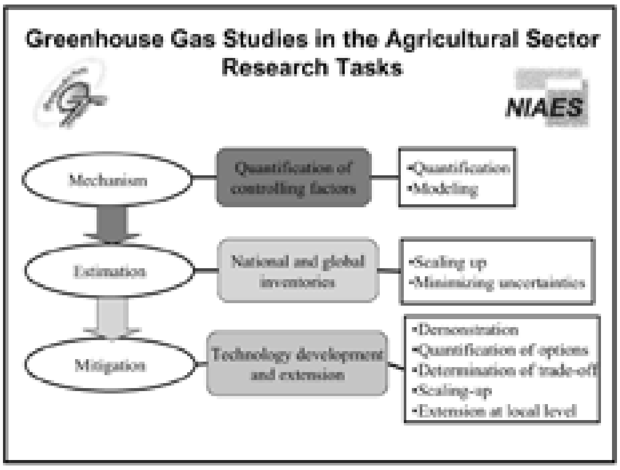
Emission Factors for N_2O from Rice

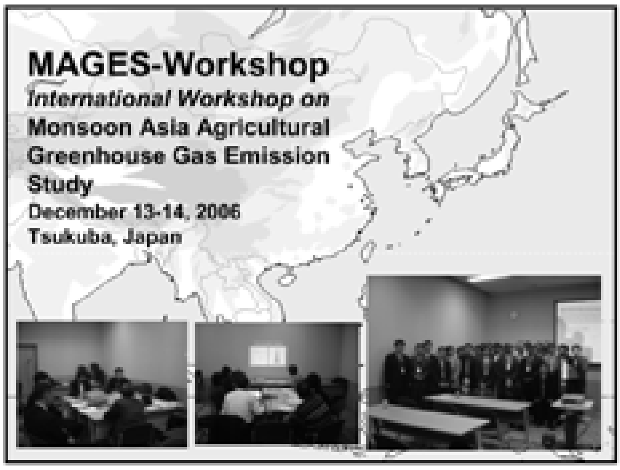
Direct N_2O: Mineral fertilizer/Animal manure
- Paddy rice: 0.31 % (from global data analysis)
- Tea: 2.9 % (from national data analysis)
- Other crops: 0.62 % (from national data analysis)

Direct N_2O: Crop residues/Legumes
- IPCC default values

Direct N_2O: Organic soils
- IPCC default values

Indirect N_2O
- Atmospheric deposition (IPCC default values)
- Leaching and run-off: 1.24 % (from global data analysis)





An International Research Project

MAGES

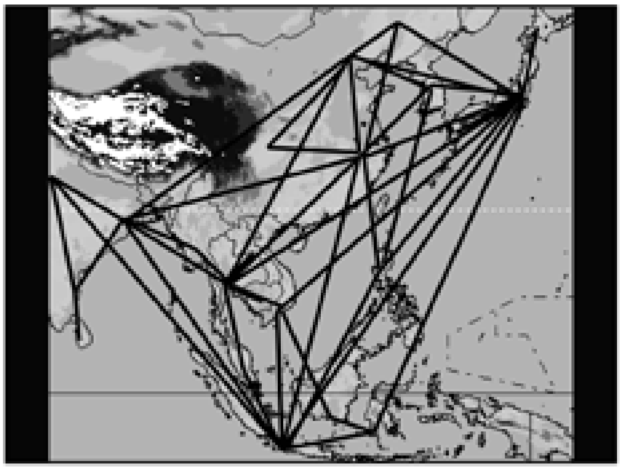
Monsoon Asia Agricultural Greenhouse Gas Emission Studies

Targets

- More accurate regional estimation of Agricultural GHG emissions
- Provide feasible mitigation options and their potentials
- Assess the influences of changing GHG emissions due to changes of management on regional land ecosystems and the atmosphere

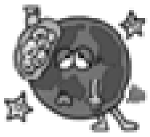
Plans in 2007

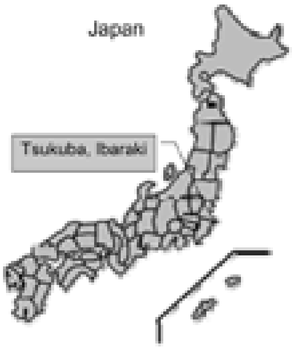
- MAGES web-site will be open soon.
- MAGES Research Plan will be completed by summer.
- Selected papers in 2006 Workshop will be published as a special section of Soil Sci. Plant Nutr.
- Next Workshop will be held in late 2007 or 2008.



Greenhouse gas emissions caused from Livestock in Japan

Osamu ENISHI
Livestock research team on global warming
National Institute of Livestock and Grassland Science
National Agriculture and Food Research Organization,
2 Ikenodai, Tsukuba, Ibaraki 305-0901, Japan
enishu@affrc.go.jp

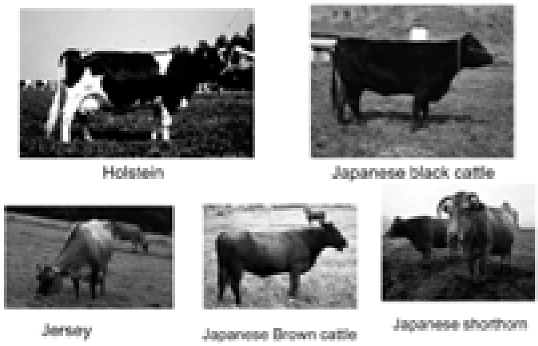




In this presentation.....

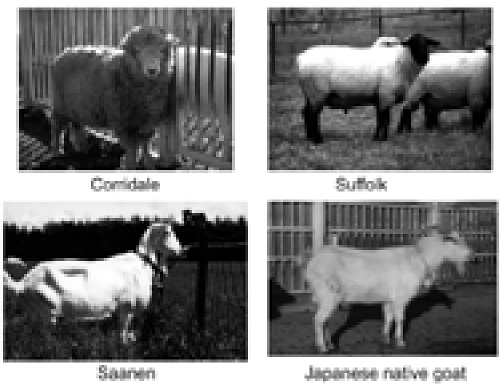
1. Animal production in Japan
2. Major source of GHG in this section
3. CH4 caused from ruminant
4. What research are need for next step ?

Main Livestock in Japan



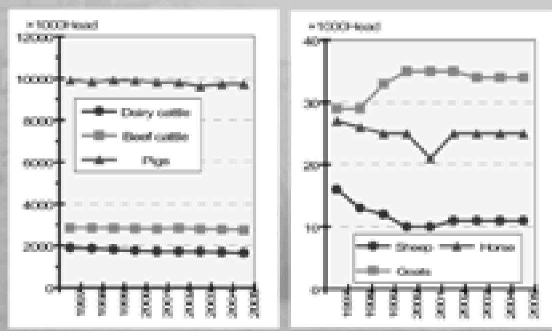
Holstein   Japanese black cattle
Jersey   Japanese Brown cattle   Japanese shorthorn

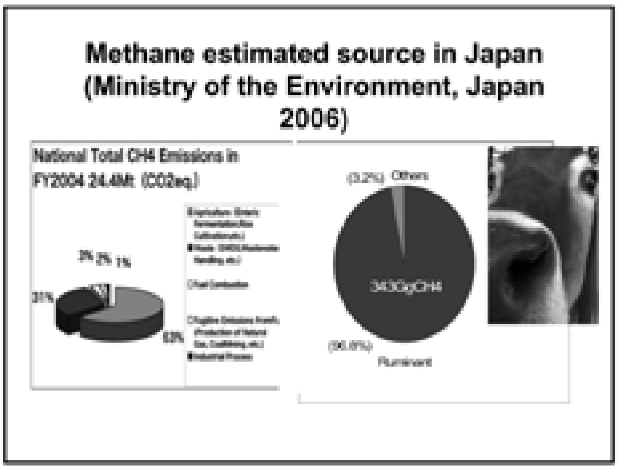
Minor livestock in Japan

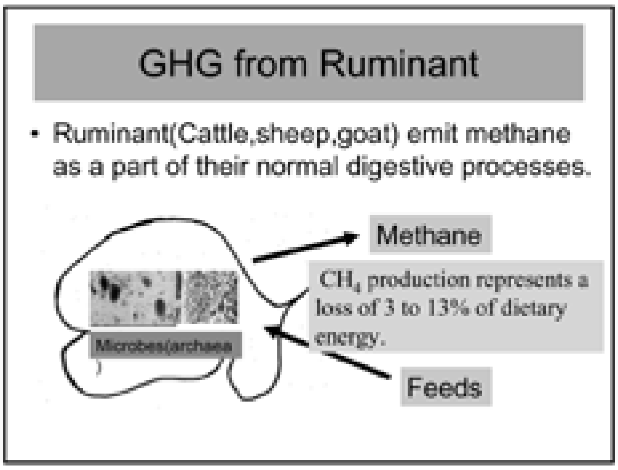


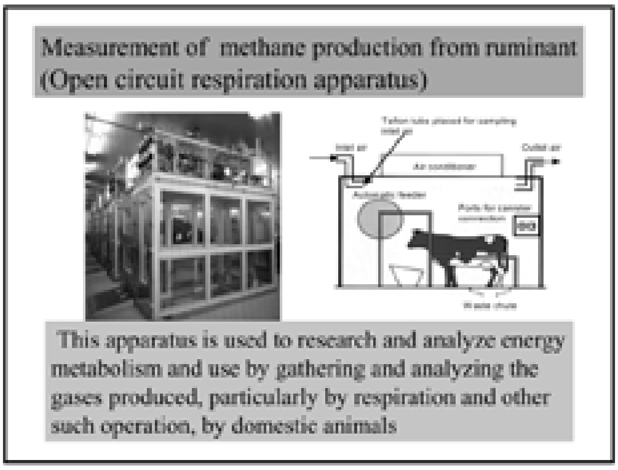
Corridale   Suffolk
Saanen   Japanese native goat

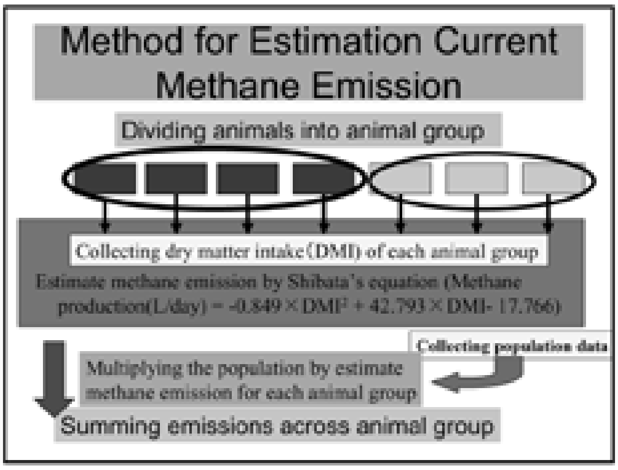
Livestock population in Japan

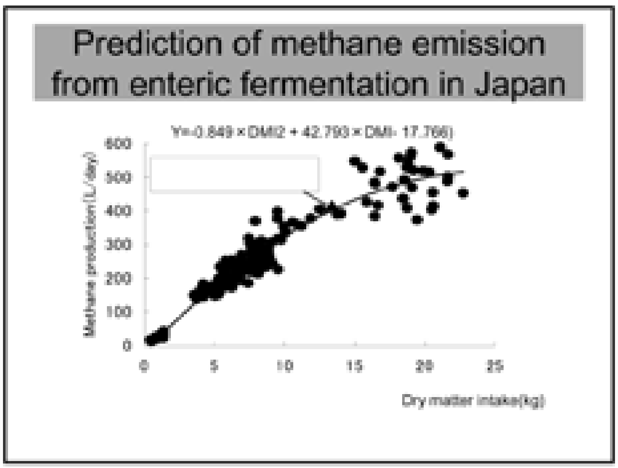


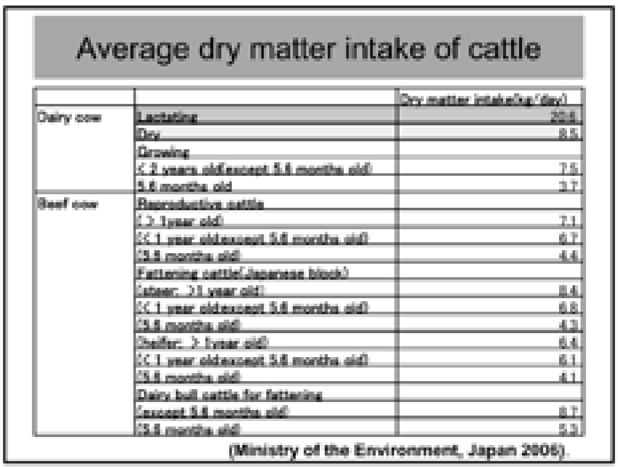











Average dry matter intake of cattle

		Dry matter intake(kg/day)
Dairy cow	Lactating	20.6
	Dry	8.5
	Growing	
	＜2 years old(except 5.6 months old)	7.5
	5.6 months old	3.7
Beef cow	Reproductive cattle	
	(＞1year old)	7.1
	(＜1 year old(except 5.6 months old)	6.7
	(5.6 months old)	4.4
	Fattening cattle(Japanese block)	
	(steer: ＞1 year old)	8.4
	(＜1 year old(except 5.6 months old)	6.8
	(5.6 months old)	4.3
	(heifer: ＞1year old)	8.4
	(＜1 year old(except 5.6 months old)	6.1
	(5.6 months old)	4.1
	Dairy bull cattle for fattening	
	(except 5.6 months old)	8.7
	(5.6 months old)	5.3

(Ministry of the Environment, Japan 2006).

CH_4 emissions from enteric fermentation ($kgCH_4$/year/head)

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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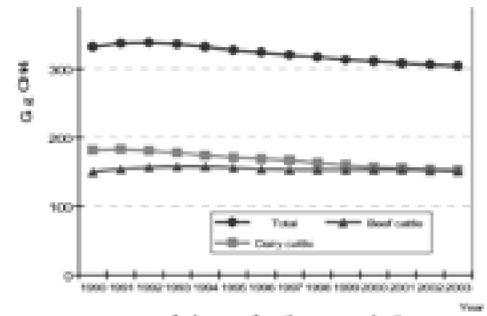


A change of methane production

Factors affecting methane emission from ruminant

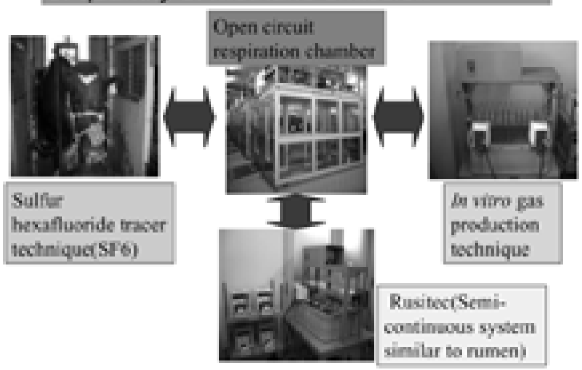
- Feed intake level
- Digestibility of feeds
- Feed processing
- Addition of lipid(unsaturated fatty acid) ,and so on

"Methane emission is influenced by many factors"

To take an accurate measurement of methane in various condition

It is need to develop simple measurement techniques of quantity of methane emission

A trial of simple measurement technique of quantity of methane emission



The research that we have to do

1. It is important to develop the technology needed to estimate CH4 emission accurately from ruminant and practically method to reduce the amounts of CH4.
2. Evaluation and a prediction of global warming impact on animal production.
3. We have to develop the feeding technology of livestock for warming.

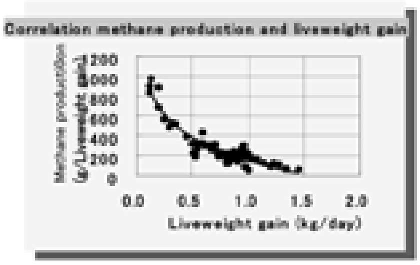
Future study

In vitro gas production technique(Menke's method) appears to have the capacity to determine the CH_4 production potential of ruminant diets. Further studies are needed to evaluate *in vitro* technique to reflect the treatment difference among the feed.

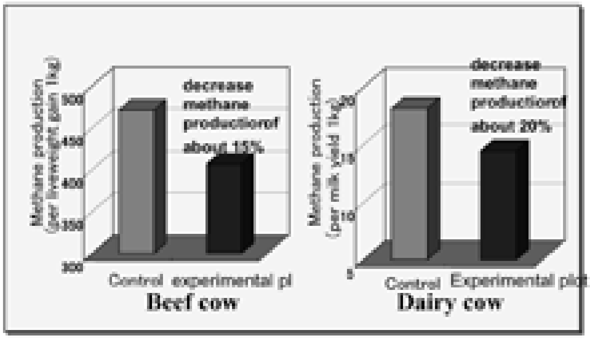
We found that condensed tannin(CT) compounds reduced the methane emissions from goat. Therefore, It is need to study about methane reduction using cattle

Factors affecting methane emission from ruminant

Improving animal productivity decreases methane emissions per unit of product.



Methane reduction by calcium fatty acid



Emission Reduction

- Unsaturated fatty acids
- Fat rich by-products
- Ionophore
- Removing ciliate protozoa from rumen

Country Report of Cambodia: Efforts to Estimate Country-Specific Mean Annual Biomass Increment and Its Uncertainty

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Presented at WGIA4
February 14-15, 2007, Jakarta, Indonesia

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Outline

- Overview
- Review of 1994 LUCF Inventories in NC1
- Methodology and Results of the Pilot Study
- Summary

Overview

- 3-year pilot study (completed in Mar. 2006) implemented jointly by MoEC and NIES with the financial assistance from the Asia-Pacific Network for Global Change Research CAPaBLE Programme
- Lack of country-specific MAI for the top key categories of the LUCF sector
- Conducted plot-based field measurement to estimate MAI of 3 major forest types
- Estimated the uncertainty of MAI for evaluation of the measurement
- Lessons learned

1994 Inventories in NC1

Percentage share of 3 main GHGs | Total CO_2 eq. emissions by sector

- Total national uptake is bigger than total emissions by around 5,000 Gg of CO_2-eq.

Source: MoEC (2002) Cambodia's Initial National Communication.

1994 Inventories in NC1

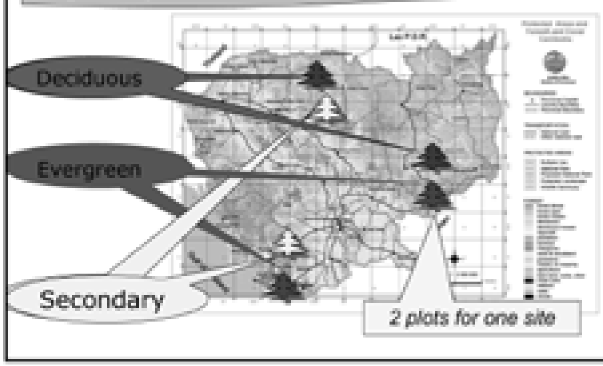
Results of Key Category Analysis

[redacted]

5A Changes in Forest / Woody Biomass	Forest - Deciduous	CO_2	-28,397.80	20.26%
5A Changes in Forest / Woody Biomass	Forest - Evergreen	CO_2	-22,148.50	15.69%
5B Forest & Grassland Conversion	Biomass-Decay- Forest - Secondary/Regrowth	CO_2	14,124.00	10.01%
5A Changes in Forest / Woody Biomass	Forest - Mixed&Coniferous	CO_2	-11,757.90	8.33%
5B Forest & Grassland Conversion	On-Site Burning - Forest - Secondary Regrowth	CO_2	10,165.20	7.20%
5A Changes in Forest / Woody Biomass	Roundwood Harvested	CO_2	8,271.94	5.86%
5B Forest & Grassland Conversion	Biomass-Decay- Forest - Deciduous	CO_2	4,154.33	2.94%
5A Changes in Forest / Woody Biomass	Shrubland	CO_2	-3,974.67	2.82%
5B Forest & Grassland Conversion	On-Site Burning- Forest - Deciduous	CO_2	2,991.12	2.12%
4A Enteric Fermentation	Non-dairy Cattle	CH_4	2,387.20	1.69%

Methodology

Step 1: Established sample plots in 3 major forest types designated by national forest definition



Methodology

Step 2: Conducted field measurement once a year for two years

Period	●Feb.-Apr. 2005 (1st time) ●Jan.-Feb. 2006 (2nd time) } 1 year gap
Number of sites & plots	2 separate sites for each forest type with 2 plots in one site
Size of plots (m)	●20*100 (bigger plots) ●5*40 (sub-plot within a bigger plot)
Items	Diameter (DBH), height, species of each tree
Reference	*Hairiah, K. et al. (2001) "Methods for sampling carbon stocks…" ICRAF.*

Notes: Living trees with more than 30cm in diameter were measured in bigger plots and those below were in sub-plots.

Methodology and Results

Step 3: Estimated aboveground biomass by applying a biomass regression equation

Biomass regression equation used:

$$Y = 42.69 - 12.800(D) + 1.242(D^2)$$

Where: D = DBH in cm

Reference: Brown, S. (1997) *"Estimating Biomass and Biomass Change of…"* FAO.

Step 4: Subtracted year 1 values from year 2 values to obtain annual increments

	EvF			DF			SF		
	t d.m./ha/yr								
	T=1	T=2	Difference	T=1	T=2	Difference	T=1	T=2	Difference
Living tree	388.39	397.15	8.76	269.50	275.23	5.73	154.66	160.33	5.66
Value in NC1	295		3.00	120		3.60	190		2.80

Methodology and Results

Step 5: Estimated uncertainty of the values following IPCC's method

Equation used:

$$\%\ \text{uncertainty} = 2\sigma / \mu * 100$$

Where: σ = standard deviation

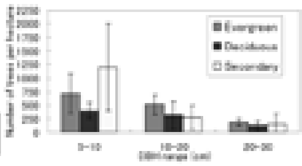
μ = the mean value

Reference: IPCC. (2003) *"GPG for LULUCF" IGES.*

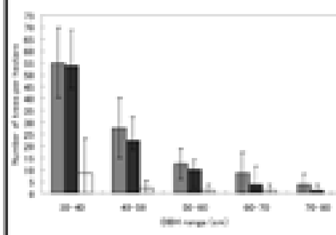
	Aboveground biomass in time 1 (t d.m./ha)	Uncertainty (%)
Evergreen	388.39	115
Deciduous	269.50	171
Secondary	154.66	267

} High!

Results



Average Number of Trees within Different DBH Ranges (cm)



Lesson learned

Variation of biomass stock in the same forest type is high across plots

The living condition of the forests is likely key rather than "forest definition"

Summary

- Efforts to develop country-specific MAI are encouraged as the categories are key
- AGB of forest is influenced mainly by the living condition and not necessarily by the national forest definition
- Nation-wide information of forests' living condition is desired

➡ •Is such a Map available or can be developed?
•How about the consistency with the activity data (i.e. forest area) used?

Thank You!

Estimating Mean Annual Increments of Aboveground Living Biomass and Uncertainty Analysis

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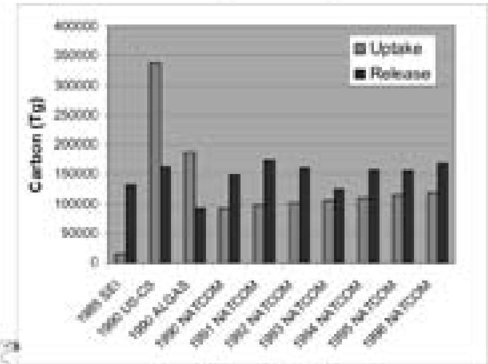
Department of Geophysics and Meteorology
Faculty of Mathematics and Natural Sciences
Bogor Agricultural University
WGIA4, 14-15 February 2007, Jakarta

Background

- All Parties to the UNFCCC are required to report national GHG inventories
- GHG inventory reports the estimate of GHG emission and uptake, therefore country should able to assess the long-term impacts of different land development and land-use management practices on GHG emissions and removals.
- Quality of activity data and emission factor from LULUCF is quite poor. In Indonesia, the estimates of carbon emission and uptake from this sector varied considerably from study to study due to change in assumption, activity data, emission factor and methodology.
- There is need to improve quality of activity data and emission factor as well as methodology

GHG Inventory: Forestry Sector



Data that need to be improved

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)	2.3
Biomass of each forest and vegetation type	2.3
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

Source: Murdiyarso (2002)

Approach to Estimate MAI

- Estimated from common available data such as
  - mean annual diameter increment collected by forest concession companies
  - yield table or wood volume data from plantation companies or from result of forest inventory conducted by the Ministry of Forestry etc.

Approaches to Estimate Above ground Biomass and MAI of logged over forests using diameter increment data

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)+D	(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	34.95	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	2.867	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	5.500	20.1	
			209.3			215.9	6.5

[1] Allometric equation for estimating volume of wood is V=0.0000777D[illegible], and [2] D=[illegible] (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}

Another approaches using wood volume data

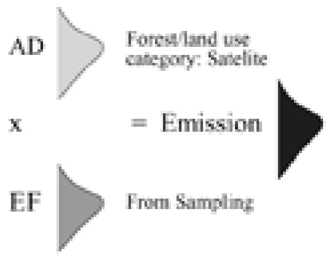
- MAI_{LoF}=((WV_{VF}–WV_{LoF})/Rotation)*WD*BEF
  - wood volume of virgin (WV_{VF}) and logged-over (WV_{LoF}) forests
  - WD wood density and BEF Biomass expansion factor (1.5 for natural forest: Ruhiyat, 1995)
- MAI = (SY * CF * BEF)/(Age of stand)
  - SY stand yield in m^3
  - CF correction factor: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

Forest Category	Forest types by function	Area (1000 ha)		Volume (m^3/ha) dbh 20cm+	
		Virgin Forest	Logged-over forest	Virgin Forest	Logged-over forest
Lowland forest	PF+Caf	18363,7	5966,2	165,4	66,9
	LPF+NCF	23012,5	16645,3	162,0	106,8
	CF	8211,7	4713,5	141,4	56,8
Swamp	PF+Caf	1777,4	1067,9	117,6	32,1
	LPF+NCF	4224,6	1540,4	152,8	93,8
	CF	3542,2	8090,0	100,6	47,0
Mangrove	PF+Caf	904,5	195,5	115,0	-
	LPF+NCF	446,6	609,4	103,4	2,4
	CF	624,6	508,4	84,6	19,2
Total	PF+Caf	21045,6	7229,8	159,2*	60,8*
	LPF+NCF	27684,3	20795,1	156,6*	99,8*
	CF	12378,5	14405,9	126,5*	53,2*
		Un-logged	Logged	Un-logged	Logged
Unproductive dry land	PF+Caf	2305,2	2343,6	89,8	15,6
	LPF+NCF	2295,1	4963,9	104,2	14,5
	CF	1376,9	4313,5	119,5	16,6
Unproductive wet land	PF+Caf	674,0	232,5	41,6	8,2
	LPF+NCF	469,7	754,4	80,7	22,4
	CF	395,4	1293,3	65,6	13,9
Agriculture	PF+Caf	753,6	1172,1	86,6	8,9
	LPF+NCF	796,0	1774,6	137,3	13,6
	CF	424,3	2933,6	91,1	14,0
Plantation	PF+Caf	-	-	-	-
	LPF+NCF	131,3	422,3	-	34,5
	CF	116,4	1087,1	-	19,6
Total	PF+Caf	3733,8	3746,2	80,2*	12,5*
	LPF+NCF	3696,5	7915,2	109,8*	32,2*
	CF	2497,2	8864,9	98,6*	14,6*

* The values are area weighted average. Source : Dephut (1996a).

By using WD of 0.65 t m-3 and BEF of 1.5, the mean annual increment of logged-over forest in Indonesia ranged from 1.71 to 2.96 tB ha-1 yr-1.

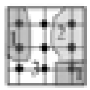
Uncertainty Analysis Using Monte Carlo Simulation



Approach to estimate uncertainty when the total area of an inventory region is generally known (Source IPCC-GPG2000):

Table 5.3.1 provides an example of this procedure. The standard error of an area estimate is obtained as $A\sqrt{p_i(1-p_i)/(n-1)}$, where p_i is the proportion of points in the particular land-use class, A the known total area, and n the total number of sample points.[4] The 95% confidence interval for A_i, the estimated area of land use class i, will be given approximately by ±2 times the standard error.

TABLE 5.3.1
EXAMPLE OF AREA ESTIMATION VIA PROPORTIONS

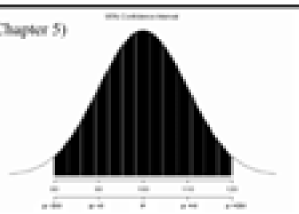
Sampling procedure	Estimation of proportions	Estimated areas of land use classes	Standard error
	$p_i = n_i / n$	$A_i = p_i \cdot A$	$s(A_i)$
	p_1 = 3/9 ≅ 0.333	A_1 = 300 ha	$s(A_1)$= 150.0 ha 50%
	p_2 = 2/9 ≅ 0.222	A_2 = 200 ha	$s(A_2)$= 132.2 ha 66%
	p_3 = 4/9 ≅ 0.444	A_3 = 400 ha	$s(A_3)$= 158.1 ha 40%
	Sum = 1.0	Total = 900 ha	

n_i = number of points located in land-use class i
n = total number of points

Increase number of samples →

Total Area	900 ha			Error	Uncertainty
	ni		pi		
n1	5	p1	0.26	93 ha	30.4 %
n2	5	p2	0.26	93 ha	30.4 %
n3	9	p3	0.47	106 ha	24.8 %
n	19		1.00		

Source: IPCC-GPG (Chapter 5)



In the GPG 2000, the percentage uncertainty is defined as:

$$\% \text{ uncertainty} = \frac{\frac{1}{2}(95\% \text{ Confidence Interval width})}{\mu} \times 100$$

For this example:

$$\% \text{ uncertainty} = \frac{\frac{1}{2}(40)}{\mu} \times 100 = \frac{20}{\mu} \times 100 = \frac{20}{100} \times 100 = 20\%$$

Where:

σ = standard deviation

$\sigma = \sqrt{\text{variance}} = 10$

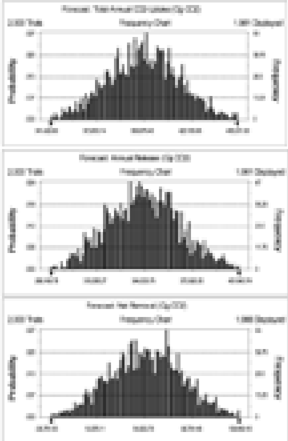
μ = the mean of the distribution.

Note that this uncertainty is twice the relative standard error (in %), a commonly used statistical estimate of relative uncertainty.

			Bil C	U=(CxD)
Forest Land	Forest Plantation (Incl.	Tectona grandis	2,124.63	1.26
		Pinus merkusii	1,350.52	0.06
		Swietenia spp.	239.76	0.06
		Paraserianthes falcataria	68.58	0.06
		Rasilla	380.29	0.23
	Timber Estate (Outside	Acacia spp.	16,835.42	10.35
		Paraserianthes falcataria	5,461.42	3.25
		Gmelina	594.62	0.36
	Reforestation	Pinus merkusii	470.12	0.58
		Tectona grandis	99.80	0.06
		Acacia spp.	726.67	0.44
		Eucalyptus spp.	175.92	0.11
		Others	1,420.38	0.55
	Other Forests	Production Forest	16,505.20	10.09
		Conversion Forest	10,882.52	6.88
		Protection + Conservation Forest	10,047.43	6.07
		Others*	25,777.58	16.76
Non Forest land	Afforestation	Pinus spp.	2,776.87	1.68
		Acacia spp.	8,589.72	5.31
		Eucalyptus spp.	3,576.62	2.17
		Paraserianthes falcataria	7,266.72	4.59
		Others	867.77	0.54
	Estate	Hevea Brasilliensis	17,671.24	10.76
		Coconut	27,029.72	16.52
		Oil Palm	5,456.64	2.29
		Others	2,493.80	1.45
			165,697.99	

Assumed uncertainty levels are 20% for AD and EF

Similar for F&G Conversion, i.e. Converted area, biomass before and after conversion

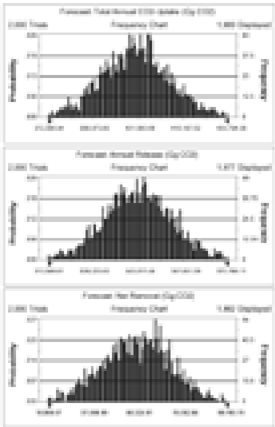


Uncertainty for AD and EF: 20%

Mean = 400,653 Gg CO_2
SDev = 22,606 Gg CO_2
Uncertainty 11.2%

Mean = 343,664 Gg CO_2
SDev = 22,357 Gg CO_2
Uncertainty 13.2%

Mean = 59,989 Gg CO_2
SDev = 32,250 Gg CO_2
Uncertainty 107%



Uncertainty for AD and EF: 10%

Mean = 400,653 Gg CO_2
SDev = 11,089 Gg CO_2
Uncertainty 5.5 %

Mean = 343,664 Gg CO_2
SDev = 11,531 Gg CO_2
Uncertainty 6.7%

Mean = 59,989 Gg CO_2
SDev = 15,844 Gg CO_2
Uncertainty 52%

Level of uncertainty would depend 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)

Future Works

- Assessing the impact of changing resolution of satelite image on:
  - area estimates
  - above gound 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
- Development of more effective and efficient procedures for estimating AD and EF

Green House Gas Inventory in Malaysia

Presentation for the WGA 4

Jakarta 13-14 February 2007

By Samsudin Musa

Forest Research Institute Malaysia

Malaysia: National Communication

- National Initial National Communication 1994
- Second National Communication 2000 – on-going

Second National Communication

- FRIM appointed leading LULUCF sector – March 2004
- Working closely with several relevant departments
  - Ministry of Natural Resources & Environment (NRE)
  - Forest Department: Peninsular Malaysia, Sabah & Sarawak.
  - Department of Agriculture (DOA)
  - Universiti Putra Malaysia (UPM)
  - Malaysian Palm Oil Board (MPOB)
  - Malaysian Rubber Board

Forestry in Malaysia

- Forest sector is an important economic sector
- Contributed about US$5.7 billion in 2005
- Major income earner for some State Governments
- About 60% of land covered by natural tropical forest
- Malaysia recognise the protective role of forest – environment, climate, soil, water, biodiversity, etc.
- Conserving and Managing forest on sustainable basis accorded a high priority

Forest Lands in Malaysia

- Forested lands in Malaysia categorised:
  - Permanent Reserved Forests
  - National/State Parks, Wildlife Sanc. Etc
  - Stateland Forests
- Permanent Reserved Forest categorised
  - Production Forest
  - Protection Forest

Malaysia: Distribution and Extent of Major Forest Type, 2000 (Million Hectares)

Region	Inland	Swamp	Mangrove	Others	Total Forested Land
Peninsular Malaysia	5.500	0.200	0.100	0.100	5.900
Sabah	3.810	0.120	0.340	0.340	4.420
Sarawak	8.640	1.040	0.130	0.130	9.840
Total	17.950	1.360	0.670	0.284	20.160

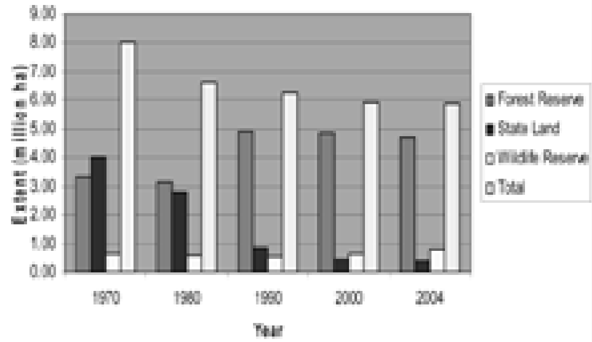
Source: FDPM, FD Sabah & Sarawak

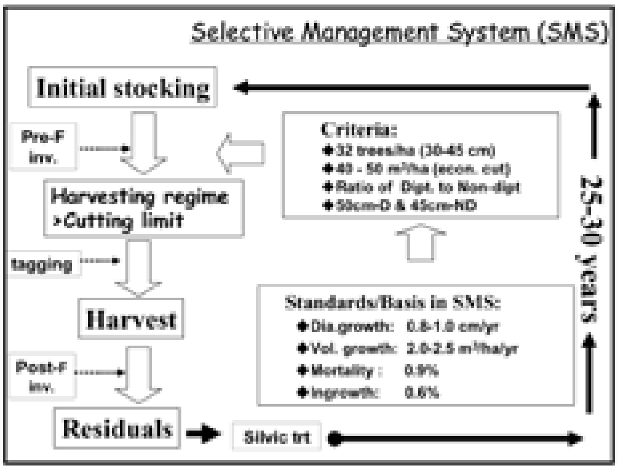
Malaysia: Forested Area By Region, 2000 & 2004 (Million Hectares)

Region	2000	2004
Peninsular Malaysia	5.94	5.90
Sabah	4.42	4.38
Sarawak	9.84	9.24
Total	20.20	19.52

Source: FDPM, FD-Sabah & Sarawak

Changes in Forested Area (Pen. M'sia)





Net Changes in CO_2 in forest and other woody Biomass stocks

	Annual Carbon Release (Kt C)	Net Annual Carbon Intake (kt C)	Annual CO2 Removals (Gg CO_2)
Pen. Malaysia	4,765	32,744	120,061
Sarawak	17,728	31,684	116,174
Sabah	**3,218**	**18,272**	**66,996**
Total	**25,711**	**82,699**	**303,231**

Improvements Since the last presentation

- Key categories
  - Only managed forest is considered
  - Totally protected area not included
- Forest Conversion
  - Real 10-year average used
  - Based on FD annual reports
- Current and future work
  - country specific increment data
  - Soil data

Data Accuracy

- Malaysia has relatively good estimates on forest extent
  - Based on periodic national inventories
  - Accepted sampling procedures and analysis
- Growth data for carbon – still using many default IPCC values
  - Plans to improve further using local growth estimates

Estimate of Extent- Inventories

- Macro Level
  National Forest Inventory
  - ten year intervals
  - cluster plot
  - 95% confidence level
  - < 1% sampling intensity
- Operational Level
  Pre-F & Post-F Inventory
  - areas open for logging
  - systematic line plot
  - 10% at 95% confidence level
- Differ in terms of sampling design, information collected & frequency

The National Forest Inventory has the followings objectives:

- To determine the extent location of forest areas by forest types;
- to assess changes in forest resources with respect to distribution, composition, forest stocking, forest stand and total tree volume according to its quality and productivity;
- to determine the standing volume of forest areas in accordance with the forest type stratification;
- to estimate the net and gross standing volumes of specific diameter classes according to species groups/types and areas with potentials for exploitation; and
- to determine the location and assess both the quality and quantity of rattan, bamboo, palm and pandanus.

NFI method

PHASE 1

The use of satellite imagery (LANDSAT TM) for the establishment of a fixed grid of monitoring points over the entire forest area

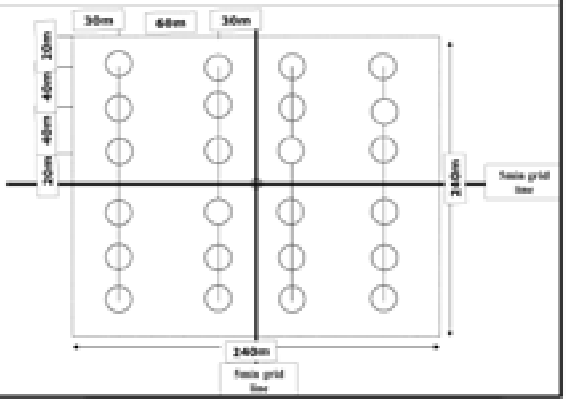
PHASE 2

The establishment of GIS to described in detail forest situation at these grid points

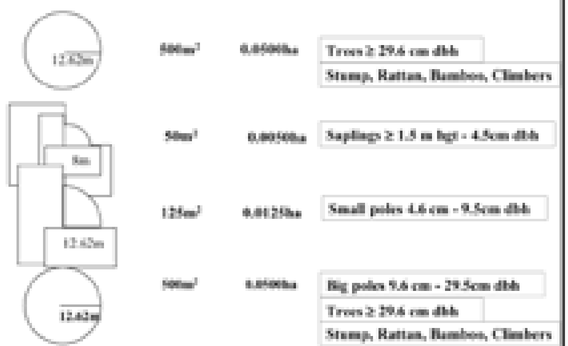
PHASE 3

Field sampling of all forest type on a random selected number of grid points according to predetermined accuracy standards

Layout of the National Forest Inventory Plot



Layout of the National Forest Inventory Plot



Minimum Sample Inventory Unit

Forest type/ Strata	Strata Code	Estimated CV (%)*	SE (%)	Min. sample unit
Superior Nat. For.	11	30	15	20
Good Nat. For.	12	30	15	20
Moderate Nat. For.	13	30	15	20
Poor Nat. For.	14	55	-	15
Logged For. 11-20 yrs.	23	45	15	35
Logged For. 21-30 yrs.	24	40	10	65
Logged For. 31+ yrs.	25	35	10	50
TOTAL				225

* 95% probability level

Biomass Increments

- Under National Communication estimates of forest extent, stocking (volume and density estimates) and species composition is reliable based periodical inventory –country specific data
- However, above ground biomass increments and carbon stocks are still based on default factors by IPCC

19

Forest Type	Forest Categories	Area of Forest/Biomass Stocks	Annual Growth Rate	Annual Biomass Increment
		(kha)	(t dm/ha)	(kt dm)
Inland	*Virgin Forest Good*	837.03	5.9	4,938.48
	Virgin Forest Moderate	723.31	5.9	4,267.55
	Logged-over 1-10 yrs (exclude enrichment planting)	563.13	9.16	5,158.31
	Logged-over 11-20 yrs	1,014.56	6.93	7,030.89
	Logged-over 21-30 yrs	705.94	4.61	3,254.36
	Logged-over 31/above yrs	620.32	4.17	2,586.73
Peat swamp	*Virgin Peat Swamp Forest*	100.56	2.22	223.23
	Logged-over Peat Swamp Forest	138.196	11.11	1,535.36
Mangrove		87.021	12.47	1,085.15

Mean Annual Increments

Plans to use more country specific increment data

- Mean Annual Volume Increments has been determined under SMS to be between 2.0-2.5 m^3/ha/yr
- Mean diameter increments 0.8-1.0 cm/yr
- Based on studies by Forestry Department and FAO in 1970's
- Current new data on MAI available from growth studies

21

Growth and Yield Studies

- Many PSP's have been established over the years for various objectives, have different plot layouts and measurement protocol
- Currently 13 growth studies located in different parts of the country being used for estimating increments
- 5 plot layouts and some differences in measurements protocols
- Studies generally indicate and volume and diameter increments are lower than that estimated under current management practice (SMS)

22

Location of Growth and Yield Plots in Pen. Malaysia

Biomass estimation

Estimation of forest biomass was carried out using allometric relationships obtained in this forest during IBP. This section summarizes the previous work on allometric relations in Plot 1 of the Forest Reserve (Kato *et al.* 1978). The height (*H*) of a given tree can be estimated from its d.b.h. (*D*) by the following formula:

$$\frac{1}{H} = \frac{1}{2.0D} + \frac{1}{61} \quad [\text{m, cm}] \qquad (1)$$

From the values of *D* and *H*, the dry mass of stem, branches, and leaves of the tree are estimated as:

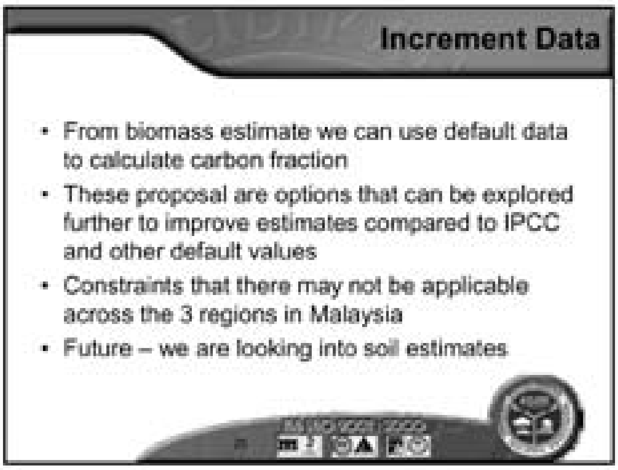
$$M_s = 0.0313(D^2H)^{0.9733}, \quad [\text{kg}, 10^{-4}\text{m}^3] \qquad (2)$$

$$M_B = 0.136 M_s^{1.070}, \quad [\text{kg, kg}] \qquad (3)$$

and

$$\frac{1}{M_L} = \frac{1}{0.124 M_s^{0.794}} + \frac{1}{125}, \quad [\text{kg, kg}] \qquad (4)$$

where M_s, M_B and M_L, respectively, denote the dry mass of stem, branches and leaves. The constants in equations 1–4 were determined using the whole range of tree diameters from samples taking no regard of species in Plot 1 (Kato *et al.* 1978), so that these relations are applied across species. The sampling method is detailed in Kato *et al.* (1978). The total above-ground biomass (TAGB) was computed by summing the above-ground biomass of individual trees ($M_s + M_B + M_L$; Fig. 1) for ≥5 cm d.b.h.


Increment Data
• From biomass estimate we can use default data to calculate carbon fraction
• These proposal are options that can be explored further to improve estimates compared to IPCC and other default values
• Constraints that there may not be applicable across the 3 regions in Malaysia
• Future – we are looking into soil estimates


Thank you
Terima Kasih

Evaluation Procedure for Carbon Stock Changes in Japanese Forest Sectors

Masahiro Amano
Waseda University

Forest land remaining forest land

- 1995 Report adopted <u>IPCC Default Method</u>
  ΔCFFLB = (ΔCFFG − ΔCFFL)

  ΔCFFLB = annual change in carbon stocks in living biomass
  ΔCFFG = annual increase in carbon stocks due to biomass growth
  ΔCFFL = annual decrease in carbon stocks due to biomass loss,

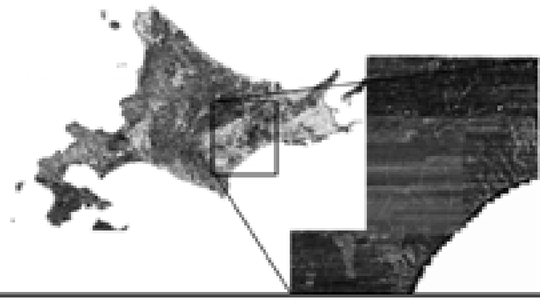
Forest land remaining forest land

- 2005 Report adopted <u>Stock Change Method</u>
  ΔCFFLB = (C t2 – C t1) / (t2 – t1)

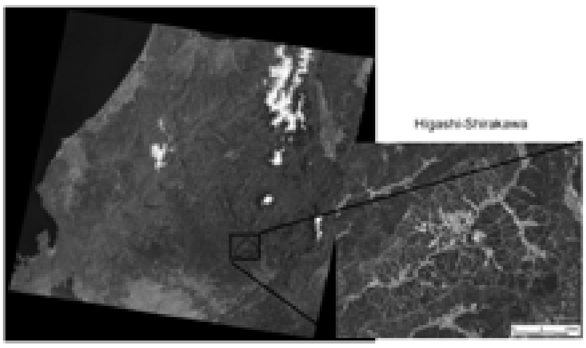
  ΔCFFLB = annual change in carbon stocks in living biomass
  C t2 = total carbon in biomass calculated at time t2
  C t1 = total carbon in biomass calculated at time t1

Japanese Inventory System focuses on Kyoto Protocol

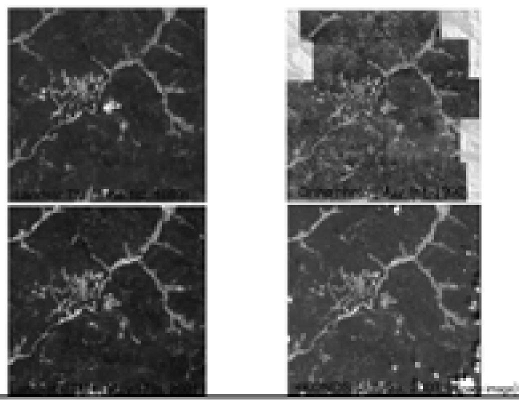
Monitoring ARD
Preparation of orthophotos around 1990 to define forest area in 1989/12/31



Location of an ARD test area by RS



Images used in ARD monitoring test case



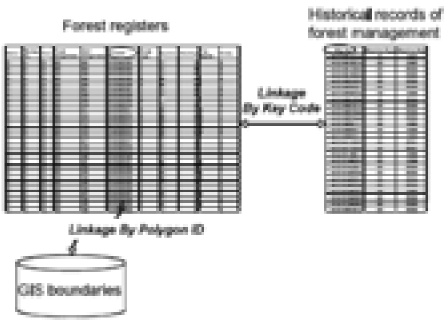
Identification of FM lands

- Narrow and broad interpretation of the definition of FM
  - (LULUCF GPG)… *A party could interpret the definition of forest management in terms of specified forest management practices, such as fire suppression, harvesting or thinning, undertaken since 1990. Alternatively, a country could interpret the definition of forest management in terms of a broad classification of land subject to a system of forest management practices, without the requirement that a specified forest management practice has occurred on each land.*

Forest Inventory Data 1

- Forest registers
  - Attribute information
    - Area, Species, Age, DBH, Volume, Ownership
  - Number of Compartment and Sub-compartment of all private and national forests
    - Compartments: 370,000 records
    - Sub-compartments: 31,000,000 records
  - Renewal every five years
  - Linkage to boundaries in forest maps

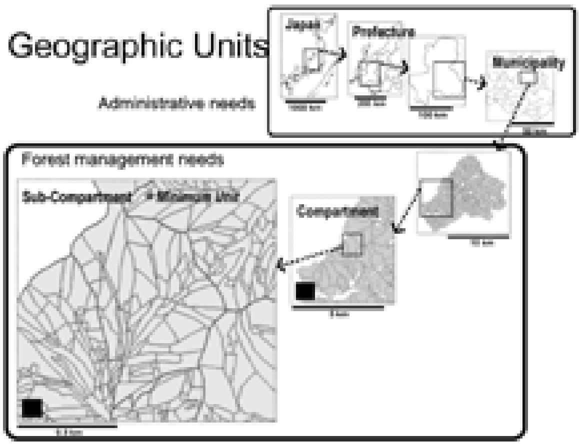
Forest Registers Database

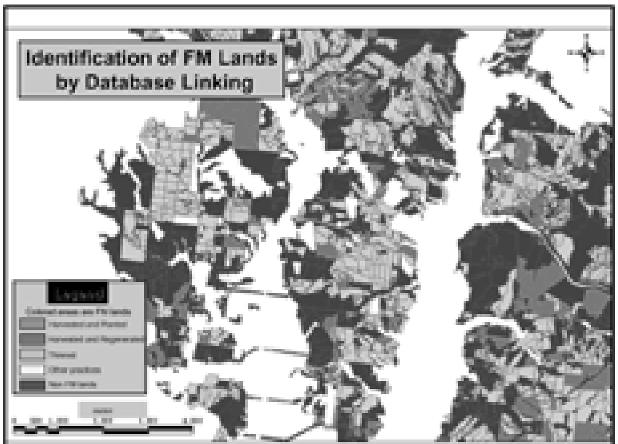


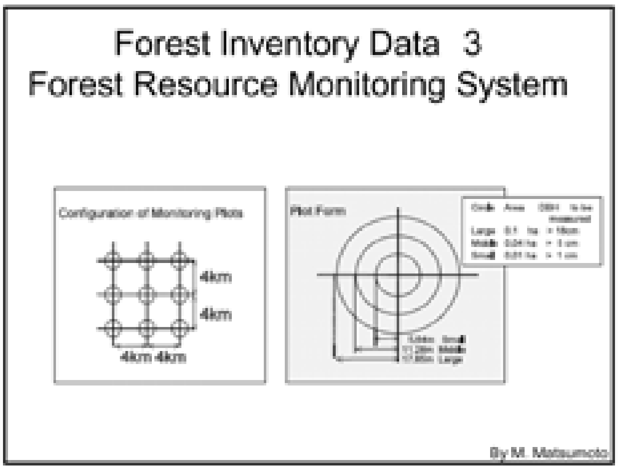
Forest Inventory Data 2

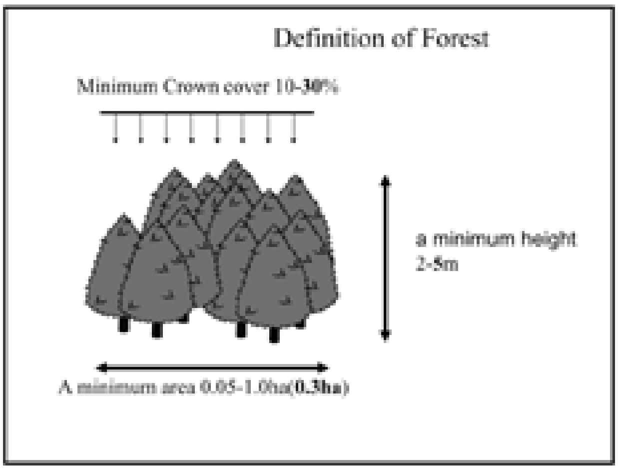
- Forest maps
  - 1/5000 scale maps
  - Boundaries of forest compartments and sub-compartments
  - Around 40% of the boundaries were digitized for GIS so far

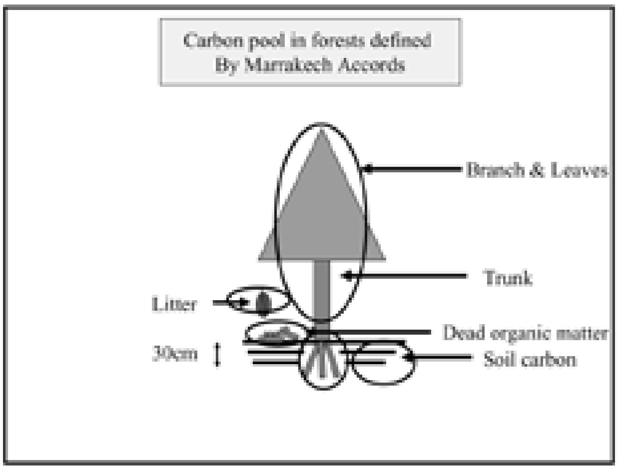
Geographic Units











Collection of data
(above ground biomass)

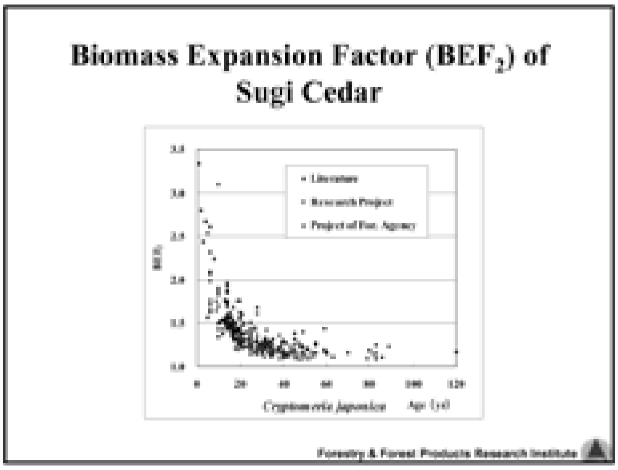
Tree species	Previous Literature	Research Project ①	Project by Forest Agency ②	③	④	Total
Cryptomeria japonica	214	11	68	25	17	335
Chamaecyparis obtusa	82	8		16	39	145
Pinus densiflora	135	0		4	3	142
Larix kaempferi	49	9		8	7	73
Abies sachalinensis	30	2		2	5	39
Picea jezoensis	0	3			3	6
Picea glehnii	1	4		2	5	12
Other conifers	1	1		1	3	6
Broadleaf	171				15	186
Total	683	38	68	58	97	944

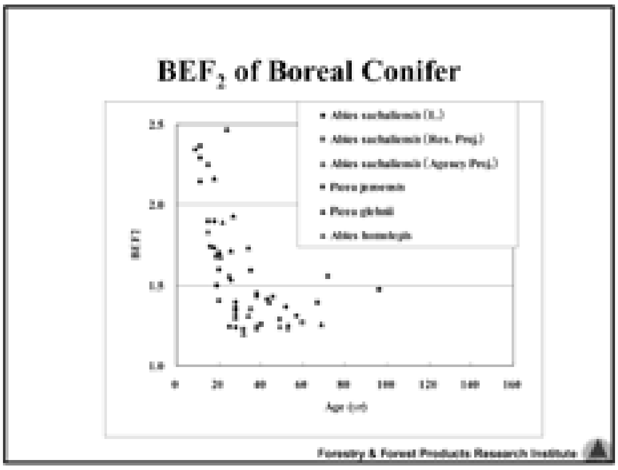
①Study on Transparent and Verifiable Method of Evaluating Carbon Sinks(FY2001-2003)
②Project on evaluate to effect of thinning for forest sink(FY1999-2000)
③Project on development for measurement system of forest sink(FY2001-2002)
④Project on organization development for measurement and Use of forest sink(FY2003-2006)

➢We are measuring 73 plots in which 28 plots are measuring additionally below ground biomass in 2004.

➢We will repeat same plan to measure in 2005 and 2006.

Forestry & Forest Products Research Institute



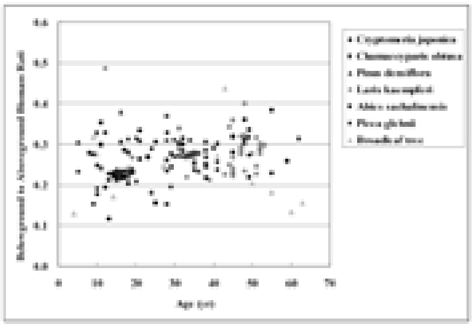


Biomass Expansion Factors of Some Typical Species in Japan

Stand Age	Tree Species	Previous Literature			by added data of research project FY2001–2003			Tentative value by added data of forest agency project FY1999–2003		
		Number of	Mean	Conf. RSE	Number of	Mean	Conf. RSE	Number of	Mean	Conf. RSE
≦20	Cryptomeria japonica	111	1,61	±0,07 4,3%	—	—	—	142	1,58	±0,06 3,8%
	Abies sachalinensis	14	1,85	±0,17 9,0%	—	—	—	15	1,85	±0,16 8,4%
	All of broadleaf	47	1,39	±0,07 4,9%	—	—	—	48	1,40	±0,07 4,9%
≧21	Cryptomeria japonica	105	1,25	±0,02 1,6%	116	1,24	±0,02 1,6%	163	1,23	±0,01 1,2%
	Abies sachalinensis	16	1,36	±0,05 3,9%	18	1,35	±0,05 3,7%	24	1,35	±0,05 3,7%
	All of broadleaf	124	1,28	±0,02 1,9%	—	—	—	138	1,27	±0,02 1,6%

By T. Iehara

Belowground to Aboveground Biomass Ratio (Root-Shoot Ratio,R)

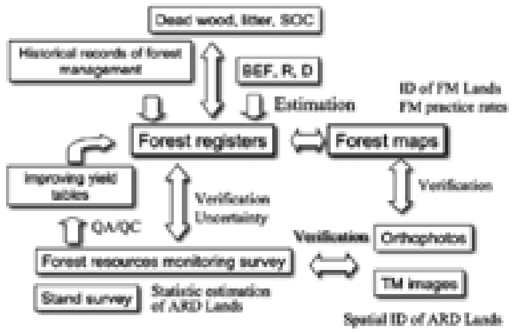


Forestry & Forest Products Research Institute

Belowground to Aboveground Biomass Ratio of Some Typical Species in Japan

Stand Age	Tree Species	Previous Literature		
		Number of	Mean	Conf. RSE
≦20	Cryptomeria japonica	37	0,23	±0,01 5,9%
	Abies sachalinensis	5	0,26	±0,05 21,1%
	All of broadleaf	4	0,22	±0,09 38,7%
≧21	Cryptomeria japonica	35	0,28	±0,01 4,8%
	Abies sachalinensis	2	0,15	±0,10 66,2%
	All of broadleaf	8	0,24	±0,07 28,0%

Forest GHG Accounting System



By M. Matsumoto

Methodology in IPCC's GPG-LULUCF

Masahiro Amano
Waseda University

Method 1 (also called the **default method**) requires the biomass carbon loss to be subtracted from the biomass carbon increment for the reporting year (Equation 3.2.2).

EQUATION 3.2.2
ANNUAL CHANGE IN CARBON STOCKS IN LIVING BIOMASS
IN FOREST LAND REMAINING FOREST LAND (DEFAULT METHOD)

$$\Delta C_{FF_{LB}} = (\Delta C_{FF_G} - \Delta C_{FF_L})$$

Where:

$\Delta C_{FF_{LB}}$ = annual change in carbon stocks in living biomass (includes above- and belowground biomass) in forest land remaining forest land, tonnes C yr^{-1}

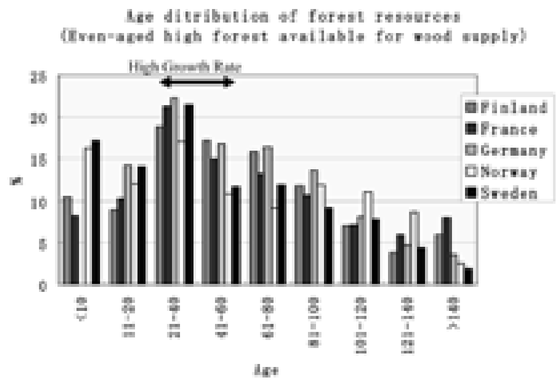
ΔC_{FF_G} = annual increase in carbon stocks due to biomass growth, tonnes C yr^{-1}

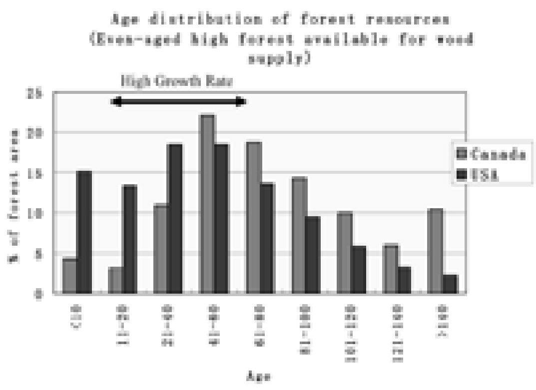
ΔC_{FF_L} = annual decrease in carbon stocks due to biomass loss, tonnes C yr^{-1}

Revised 1996 IPCC Guide lines for National Greenhouse Gas Inventories, Reference Manual, Chapter 5: Land-use Change &Forestry

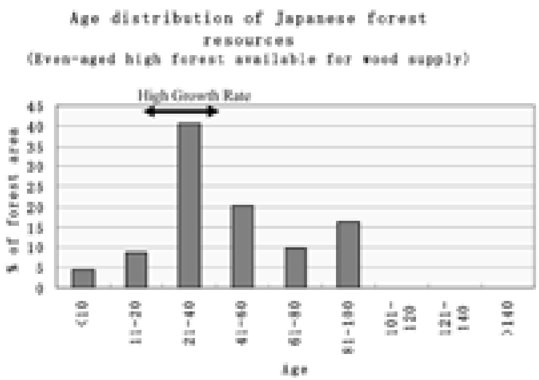
- page 5.17
- Changes in forest and other woody biomass stocks may be either a source or a sink for carbon dioxide for a given year and country or region. The simplest way to determine which, is by comparing the annual biomass growth versus annual harvest, including the decay of forest products and slash left during harvest. Decay of biomass damaged or killed during logging results in short-term release of CO2. For the purposes of the basic calculations, the recommended default assumption is that all carbon removed in wood and other biomass from forests is oxidised in the year of removal. This is clearly not strictly accurate in the case of some forest products, but is considered a legitimate, conservative assumption for initial calculations. Box 5 provides some further discussion of this issue.

[illegible]

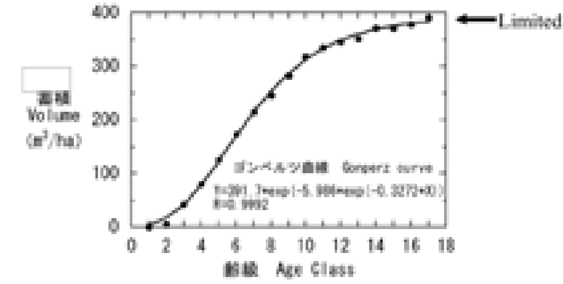




Source: TBFRA2000



Growth Pattern of Forests



Method 2 (also called the stock change method) requires biomass carbon stock inventories for a given forest area at two points in time. Biomass change is the difference between the biomass at time t_2 and time t_1, divided by the number of years between the inventories (Equation 3.2.3).

EQUATION 3.2.3
ANNUAL CHANGE IN CARBON STOCKS IN LIVING BIOMASS
IN FOREST LAND REMAINING FOREST LAND (STOCK CHANGE METHOD)

$$\Delta C_{FF_{LB}} = (C_{t_2} - C_{t_1}) / (t_2 - t_1)$$

and

$$C = [V \bullet D \bullet BEF_2] \bullet (1 + R) \bullet CF$$

Where:

$\Delta C_{FF_{LB}}$ = annual change in carbon stocks in living biomass (includes above- and belowground biomass) in forest land remaining forest land, tonnes C yr^{-1}

C_{t_2} = total carbon in biomass calculated at time t_2, tonnes C

C_{t_1} = total carbon in biomass calculated at time t_1, tonnes C

V = merchantable volume, $m^3\ ha^{-1}$

D = basic wood density, tonnes d.m. m^{-3} merchantable volume

BEF_2 = biomass expansion factor for conversion of merchantable volume to aboveground tree biomass, dimensionless.

R = root-to-shoot ratio, dimensionless

CF = carbon fraction of dry matter (default = 0.5), tonnes C (tonne d.m.)$^{-1}$

EQUATION 3.2.4
ANNUAL INCREASE IN CARBON STOCKS DUE TO BIOMASS INCREMENT
IN FOREST LAND REMAINING FOREST LAND

$$\Delta C_{FF_G} = \Sigma_{ij} (A_{ij} \bullet G_{TOTAL_{ij}}) \bullet CF$$

Where:

ΔC_{FF_G} = annual increase in carbon stocks due to biomass increment in forest land remaining forest land by forest type and climatic zone, tonnes C yr^{-1}

A_{ij} = area of forest land remaining forest land, by forest type (i = 1 to c) and climatic zone (j = 1 to m), ha

$G_{TOTAL_{ij}}$ = average annual increment rate in total biomass in units of dry matter, by forest type (i = 1 to c) and climatic zone (j = 1 to m), tonnes d.m. $ha^{-1}\ yr^{-1}$

CF = carbon fraction of dry matter (default = 0.5), tonnes C (tonne d.m.)$^{-1}$

EQUATION 3.2.6
ANNUAL DECREASE IN CARBON STOCKS DUE TO BIOMASS LOSS
IN FOREST LAND REMAINING FOREST LAND

$$\Delta C_{FF_L} = L_{fellings} + L_{fuelwood} + L_{other\ losses}$$

Where:

ΔC_{FF_L} = annual decrease in carbon stocks due to biomass loss in forest land remaining forest land, tonnes C yr^{-1}

$L_{fellings}$ = annual carbon loss due to commercial fellings, tonnes C yr^{-1} (See Equation 3.2.7)

$L_{fuelwood}$ = annual carbon loss due to fuelwood gathering, tonnes C yr^{-1} (See Equation 3.2.8)

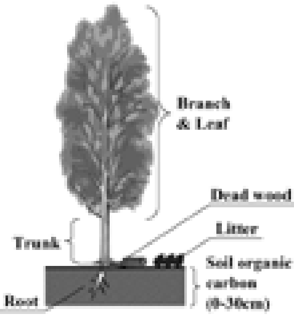
$L_{other\ losses}$ = annual other losses of carbon, tonnes C yr^{-1} (See Equation 3.2.9)

Default method <<<>>> Stock change method

IPCC GPG-LULUCF

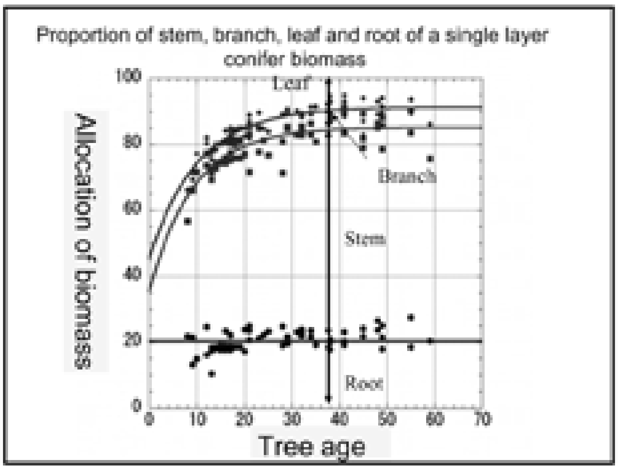
- In general the stock change method will provide good results relatively where very accurate forest inventories are carried out.
- The stock change method has a risk of the inventory error.
- Under some conditions incremental data may give better results.
- The choice of using default or stock change method at the appropriate tier level will therefore be a matter for expert judgment, taking the national inventory systems and forest properties into account.

Carbon pools defined by IPCC



Carbon pools		Method for measurement	Feasibility (Cost)
Above ground biomass	Branch & Leaf	Use of parameter	○
	Trunk	Direct measurement	◎
Below ground biomass	Root	Sampling survey & model	△
Dead wood		Sampling survey & model	△
Litter		Sampling survey & model	△
Soil organic carbon		Sampling survey & model	△

COP9 decision paper
- Projects participants shall account for all changes in the following carbon pools: above-ground biomass, below-ground biomass, litter, dead wood, and soil organic carbon.
- Projects participants may choose not to account for a given pool in a commitment period, if transparent and verifiable information is provided that the pool is not a source.



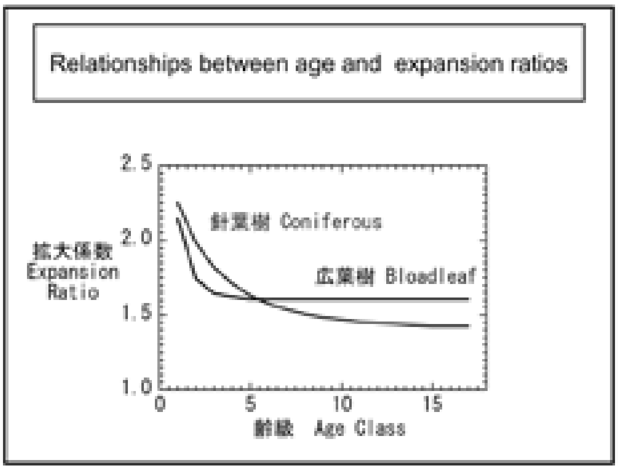


TABLE 3A.1.2
ABOVEGROUND BIOMASS STOCK IN NATURALLY REGENERATED FORESTS BY BROAD CATEGORY (tonnes dry matter/ha)
(To be used for Bw in Equation 3.2.9, for $L_{conversion}$ in Equation 3.3.8 in Cropland section and for $L_{conversion}$ in Equation 3.4.13. in Grassland section, etc. Not to be applied for C_L or C_L in Forest section Equation 3.2.5)

Tropical Forests [1]

	Wet	Moist with Short Dry Season	Moist with Long Dry Season	Dry	Montane Moist	Montane Dry
Africa	310 (131 - 513)	260 (159 – 433)	123 (120 - 130)	72 (16 - 195)	191	40
Asia & Oceania						
Continental	275 (123 - 683)	182 (10 – 562)	127 (100 - 155)	60	222 (81 - 310)	50
Insular	348 (280 - 520)	290	160	70	362 (330 - 505)	50
America	347 (118 - 860)	217 (212 - 278)	212 (202 - 406)	78 (45 - 90)	234 (48 - 348)	60

TABLE 3A.1.5
AVERAGE ANNUAL INCREMENT IN ABOVEGROUND BIOMASS IN NATURAL REGENERATION BY BROAD CATEGORY
(tonnes dry matter/ha/year)
(To be used for G_W in Equation 3.2.5)

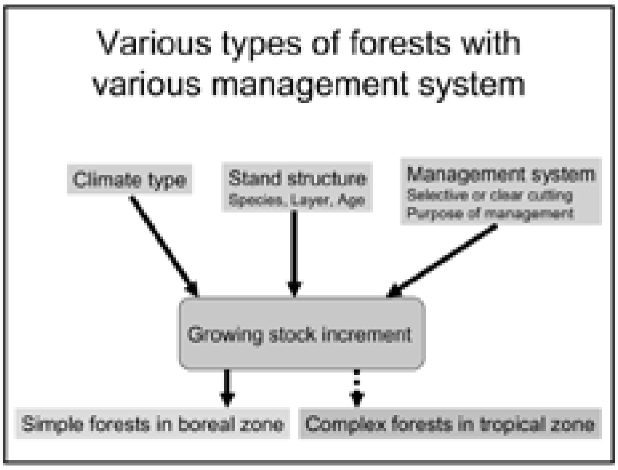
Tropical and Sub-Tropical Forests

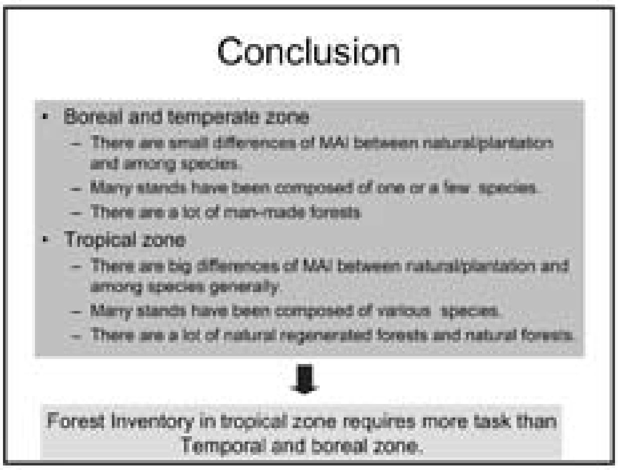
Age Class	Wet	Moist with Short Dry Season	Moist with Long Dry Season	Dry	Montane Moist	Montane Dry
Asia & Oceania						
Continental						
≤20 years	7.0 (3.0 – 11.0)	9.0	6.0	5.0	5.0	1.0
>20 years	2.2 (1.3 – 3.0)	2.0	1.5	1.5 (1.0 – 2.2)	1.0	0.5
Insular						
≤20 years	13.0	11.0	7.0	2.0	12.0	3.0
>20 years	3.4	3.0	2.0	1.0	3.0	1.0

Table 3A.1.6
ANNUAL AVERAGE ABOVEGROUND BIOMASS INCREMENT IN PLANTATIONS BY BROAD CATEGORY
(tonnes dry matter/ha/year)
(To be used for G_{TW} in Equation 3.2.5
In case of missing values it is preferred to use stemwood volume increment data I_V from Table 3A.1.7)

Tropical and sub-tropical Forests

	Age Class	Wet	Moist with Short Dry Season	Moist with Long Dry Season	Dry	Montane Moist	Montane Dry
		R >2000	2000>R>1000		R<1000	R>1000	R<1000
Asia							
Eucalyptus spp	All	5.0 (3.6-8.0)	8.0	15.0 (5.0-25.0)	-	3.1	-
other species	-	5.2 (2.4-8.0)	7.8 (2.0-13.5)	7.1 (1.6-12.8)	6.45 (1.2-11.7)	5.0 (1.3-10.0)	-




Conclusion
• Boreal and temperate zone
– There are small differences of MAI between natural/plantation and among species.
– Many stands have been composed of one or a few species.
– There are a lot of man-made forests
• Tropical zone
– There are big differences of MAI between natural/plantation and among species generally.
– Many stands have been composed of various species.
– There are a lot of natural regenerated forests and natural forests.
Forest Inventory in tropical zone requires more task than Temporal and boreal zone.

Estimating the uncertainty of C stock estimates:

its implication for sampling procedures

Betha Lusiana, Meine van Noordwijk,
Subekti Rahayu and Andree Ekadinata

World Agroforestry Centre

The 4th Workshop on GHG Inventories in Asia, Jakarta - Indonesia
February 14 - 15, 2007

The IPCC Good Practice Guideline (2004) sets requirements to assess uncertainty of the national GHG inventories including for Land Use, Land Use Change and Forestry (LULUCF) sector.

Table 1. Estimated uncertainty values for CO_2

Source category	Emission Factor U_E	Activity Data U_A	Overall uncertainty U_T
Energy	7%	7%	10%
Industrial Processes	7%	7%	10%
Land Use Change and Forestry	33%	50%	60%

Source: *Revised 1996 IPCC Guidelines for National GHG Inventories: Reporting Instruction*

With the LULUCF sector responsible for about 20% of global emissions, the uncertainty in this term is unacceptably high...

Relationships between the errors in 'emission factor' and 'activity data'?

In estimating net C emissions due to land cover change
- 'emission factor': difference in C stock of the previous and new land cover type (the difference between two C stock estimates),
- 'activity data': the area where changes occurred.

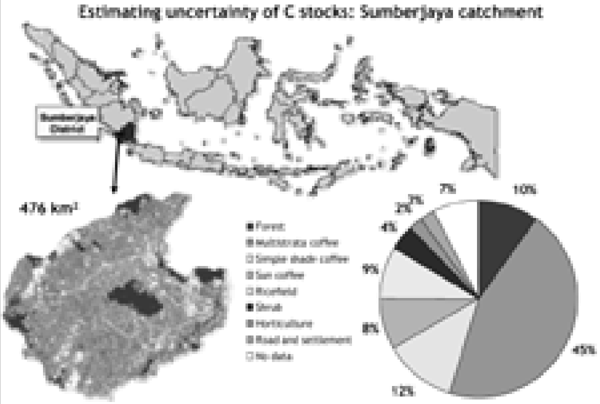
If the land cover classification is very coarse (forest ⇔ non-forest),
- the uncertainty in 'emission factor' will be large,
- 'activity data' are relatively easy to obtain.

If the land cover classification includes many nuances,
- the 'emission factors' will be well-defined,
- 'activity data' will have high uncertainty due to misclassification of points

Is there an intermediate ground of 'optimal' land cover classification with minimal uncertainty in net C emissions?

AN EXAMPLE

Estimating uncertainty of C stocks: Sumberjaya catchment



Land use classification based on Landsat image 2002 (Ekadinata, 2006)

Uncertainty: Activity factor

Table 2. Classification error matrix

Classified Land Use	Reference Land Use: Forest	Multi-strata coffee	Simple shade coffee	Sun coffee	Rice field	Shrub	Horti-cul-ture	Others	Total
Forest	45					2			47
Multistrata coffee		92	36		3	2			133
Simple shade coffee		42	50	7	1				100
Sun coffee	1		1	25		1			28
Rice field		1	4	2	49		1	2	59
Shrub	4	1		1		31			37
Horticulture			1		1		17		19
Others				1	1			23	25
Total	50	136	92	36	55	36	18	25	448

Source: *Ekadinata (2002)*

Uncertainty: Activity factor

Table 3. Estimated error in land use classification

Land Use	Estimated error in land use classification
Forest	10%
Multistrata coffee	32%
Simple shade coffee	46%
Sun coffee	31%
Ricefield	11%
Horticulture	60%
Shrub	14%
ALL	26%

Based on 448 groundtruth points

Uncertainty: Emission factor

Carbon stock estimates and its error

Land Use	Carbon stock estimate (Mg ha⁻¹)	Standard deviation	Mean standard error e_E
Forest	232.0	133.5	29.1
Multistrata coffee	44.8	34.0	7.2
Simple shade coffee	23.5	12.0	2.9
Sun coffee	16.3	20.8	4.0
Rice field	3.0	1.4	0.6
Horticulture	1.9	1.2	0.5
Shrub	82.0	84.3	2.0

Source: based on 110 sample plots from ASB (1998) and Berlian (2002)

Uncertainty: Activity factor

What happened to the error
If we make the land use category coarser?

<table>
<tr><th></th><th>Forest</th><th>Multi-strata coffee</th><th>Simple shade coffee</th><th>Sun coffee</th><th>Shrub</th><th>Rice field</th><th>Horti-culture</th></tr>
<tr><td rowspan="7">Estimated error in classi-fication</td><td rowspan="7">0.10</td><td>0.32</td><td>0.46</td><td rowspan="3">0.31</td><td rowspan="3">0.6</td><td>0.11</td><td>0.14</td></tr>
<tr><td colspan="2">AF coffee</td><td colspan="2">Agriculture</td></tr>
<tr><td colspan="2">0.04</td><td colspan="2">0.07</td></tr>
<tr><td colspan="4">Tree based (+shrub)</td><td colspan="2">Agriculture</td></tr>
<tr><td colspan="4">0.04</td><td>0.07</td><td></td></tr>
<tr><td colspan="6">Non-forest</td></tr>
<tr><td colspan="6">0.02</td></tr>
</table>

Calculation is based on agglomeration of the original land use categ

The error substantially decreased

Uncertainty: Emission factor

What happened to the error
If we make the land use category coarser?

<table>
<tr><th></th><th>Forest</th><th>Multi-strata coffee</th><th>Simple shade coffee</th><th>Sun coffee</th><th>Shrub</th><th>Rice field</th><th>Horti-culture</th></tr>
<tr><td rowspan="7">Mean standard error e_E</td><td rowspan="7">29.1</td><td>7.2</td><td>2.9</td><td rowspan="3">4.0</td><td rowspan="3">2.0</td><td>0.5</td><td>0.6</td></tr>
<tr><td colspan="2">AF coffee</td><td colspan="2">Agriculture</td></tr>
<tr><td colspan="2">4.6</td><td colspan="2">0.4</td></tr>
<tr><td colspan="4">Tree based (+shrub)</td><td colspan="2">Agriculture</td></tr>
<tr><td colspan="4">3.1</td><td colspan="2">0.4</td></tr>
<tr><td colspan="6">Non-forest</td></tr>
<tr><td colspan="6">2.9</td></tr>
</table>

Calculation is based on agglomeration of the original land use ca

The error slightly decreased

Estimating landscape carbon stocks: combining both errors

Land Use	Area (km²)	Plot level C-stock estimates (Mg ha⁻¹)	Landscape level C-stock estimates (Gt ha⁻¹)	Incorporating classification error: Plot C-stock estimate (Mg ha⁻¹)	Incorporating classification error: Landscape C-stock estimate (Gt ha⁻¹)	Δ Estimates (Gt ha⁻¹)
Forest	47.8	232.0	1.11	225.6	1.08	0.03
Multi-strata coffee	212.7	44.8	0.95	38.7	0.82	0.13
Simple shade coffee	57.1	23.5	0.13	31.7	0.18	0.05
Sun coffee	39.4	16.3	0.06	20.6	0.1	0.04
Rice field	41.1	3.0	0.01	5.4	0.02	0.01
Horti-culture	10.7	1.9	0.002	3.1	0.003	0.001
Shrub	19.6	82.0	0.16	95.4	0.19	0.03
Others	11.9					
TOTAL	475.7		2.44		2.4	0.04

What happened if we make the land use category coarser?

<table>
<tr><th></th><th>Forest</th><th>Multi-strata coffee</th><th>Simple shade coffee</th><th>Sun coffee</th><th>Shrub</th><th>Rice field</th><th>Horti-culture</th><th>Total</th></tr>
<tr><td rowspan="7">Δ Landscape Level Estimates (Gt ha⁻¹)</td><td rowspan="7">0.03</td><td>0.13</td><td>0.05</td><td rowspan="3">0.04</td><td rowspan="3">0.03</td><td>0.01</td><td>0.001</td><td>0.04</td></tr>
<tr><td colspan="2">AF coffee</td><td colspan="2">Agriculture</td><td></td></tr>
<tr><td colspan="2">0.02</td><td colspan="2">0.01</td><td>0.03</td></tr>
<tr><td colspan="4">Tree based (+shrub)</td><td colspan="2">Agriculture</td><td></td></tr>
<tr><td colspan="4">0.09</td><td colspan="2">0.02</td><td>0.07</td></tr>
<tr><td colspan="6">Non-forest</td><td></td></tr>
<tr><td colspan="6">0.09</td><td>0.05</td></tr>
</table>

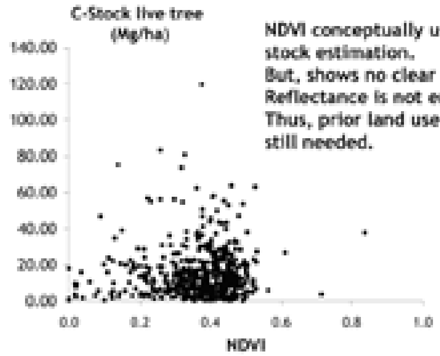
Calculation is ba... of the original land use category

No significant differences

Results from example

- In this particular case, no tradeoff of error:
  → Optimal land use categories in this case 5 (Forest, AF coffee, Sun (mono) coffee, agriculture, bush)
- More sample plots for C stock should be taken for land use category with higher variation → FOREST
- More points for ground truth should be taken for land use category with higher uncertainty → SUN COFFEE

Is there an 'optimal' land cover classification?



NDVI conceptually useful for C-stock estimation.
But, shows no clear relationship.
Reflectance is not enough.
Thus, prior land use categories is still needed.

Next steps: estimating uncertainty in carbon stock changes

- To estimate C-stock changes, similar approach can be used.
  $U_A = U_{A\text{-}year1} + U_{A\text{-}year2}$
  $U_E = U_{E\text{-}year1} + U_{E\text{-}year2}$
- For efficiency, Year-1 C-stock estimates can still be used in Year-2. Thus efforts can be focused on reducing classification error ('Activity' data)
- To reduce geo-referenced error and increase the ability in detecting spatial changes, sample plots for C-stock should not be taken in edges

Next steps: estimating uncertainty in carbon stock changes

- Broad land use categories are desirable to reduce classification error. Eg. Forest, Tree-based, non tree-based, non-vegetation, settlement
  Nevertheless, C-stocks sample plots should be in finer categories structured in a hierarchy that allows grouping into the broad categories used in image classification

Disclaimer: This is an early version of the calculation.
For more infomation. please contact Betha Lusiana (b.lusiana@cgiar.org)

INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE
NATIONAL GREENHOUSE GAS INVENTORIES PROGRAMME
WMO UNEP

How to estimate emissions from Wastewater Handling

Kiyoto Tanabe
Technical Support Unit,
IPCC NGGIP

The 4th Workshop on GHG Inventories in Asia (WGIA)
14-15 February 2007, Jakarta, Indonesia

Reporting Categories

1996 Guidelines (Vol.3) Chapter 6, Sections 6.3, 6.4
GPG2000 Chapter 5, Section 5.2

1996 Guidelines + GPG2000
- 6B: Wastewater Handling
  - 6B1: Industrial Wastewater
  - 6B2: Domestic and Commercial Wastewater
  - 6B3: Other

Essentially the same!

2006 Guidelines Volume 5, Chapter 6

2006 Guidelines
- 4D: Wastewater Treatment and Discharge
  - 4D1: Domestic Wastewater Treatment and Discharge
  - 4D2: Industrial Wastewater Treatment and Discharge
- 4E: Other

Methods for emission estimation

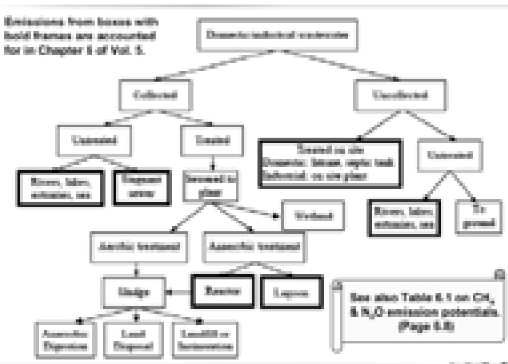
- Under the UNCCC, Non-Annex I Parties should use 1996GLs, and are encouraged to apply GPG2000.
- However, for this category, the 2006GLs can be used to estimate emissions, because the methods are essentially the same as, and better than, the 1996GLs.
  - ✓ Reasonably simplified (e.g., distinction between wastewater and sludge has been removed [following GPG2000])
  - ✓ Wider coverage (e.g., CH_4 from uncollected wastewater)
  - ✓ Up-to-date information and data available
- Therefore, let's see 2006GLs methods here.
- Attention!!
  - ✓ Spreadsheets in the UNFCCC Inventory Software are not entirely compatible with 2006GLs calc procedure.
  - ✓ Worksheets in Vol.5 can be used instead.

Overview of this category

- Gases to be estimated and reported
  - ✓ CH_4 and N_2O
  - ✓ CO_2 emissions are not considered because these are of biogenic origin
- Sources by type
  - ✓ Domestic (including commercial) wastewater / Industrial wastewater
  - ✓ Collected / Uncollected
  - ✓ Treated / Untreated

Wastewater treatment system and discharge pathways

Emissions from boxes with bold frames are accounted for in Chapter 6 of Vol. 5.



See also Table 6.1 on CH_4 & N_2O emission potentials. (Page 6.8)

Important factors for CH_4 production

- Wastewater and sludge can produce CH_4 if it degrades anaerobically.
- CH_4 production depends primarily on
  - ✓ Quantity of degradable organic material
    - BOD (BOD_5) for domestic wastewater
    - COD (by dichromate method) for industrial wastewater
  - ✓ Temperature
    - Below 15 °C, significant production is unlikely
  - ✓ Type of treatment system
    - Degree to which the system is anaerobic - MCF

Estimation of CH_4 emissions

- Three tiers according to data availability
  - ✓ Tier 1: Default values for EFs and activity parameters
  - ✓ Tier 2: Same method as Tier 1 with country-specific EFs and activity parameters
  - ✓ Tier 3: Advanced country-specific method (based on plant-specific data from large wastewater treatment facilities)
- Determine the tier to use following the decision trees
- If this is a key category, Tier 2 or 3 should be used.

CH_4 from domestic wastewater treatment and discharge (Tiers 1 & 2)

- Step 1: Estimate total organically degradable carbon in wastewater (TOW) [kg BOD/yr]

$$TOW = P \times BOD \times 0.001 \times I \times 365$$

P = country population [person]
BOD = per capita BOD [g/person/day]
I = correction factor for additional industrial BOD discharged into sewers [fraction]

- Step 2: Obtain emission factors (EF_j) [kg CH_4/kg BOD]
  - ✓ Select the pathways and systems
  - ✓ Obtain EFs for each pathway or system (j)

$$EF_j = B_o \times MCF_j$$

B_o = maximum CH_4 producing capacity [kg CH_4/kg BOD]
MCF_j = methane correction factor [fraction]

CH_4 from domestic wastewater treatment and discharge (Tiers 1 & 2)

- Step 3: Calculate emissions from TOW and EF_j, and adjust for possible sludge removal and/or CH_4 recovery

CH_4 emissions [kg CH_4/yr]

$$= [\sum_{i,j} (U_i \times T_{i,j} \times EF_j)] \times (TOW - S) - R$$

U_i = fraction of population in income group (i) [fraction]
$T_{i,j}$ = degree of utilisation of treatment/discharge pathway or system (j) for each income group (i) [fraction]
$\sum_i (U_i \times T_{i,j})$ = fraction of WW treated in the system (j)
(Ensure $\sum_{i,j} (U_i \times T_{i,j}) = 1$!!)

S = organic component removed as sludge [kg BOD/yr]
R = amount of CH_4 recovered [kg CH_4/yr]

- Default values for S and R = 0

CH_4 from domestic wastewater treatment and discharge (Tiers 1 & 2)

TABLE 6.5
EXAMPLE OF THE APPLICATION OF DEFAULT VALUES FOR DEGREES OF TREATMENT UTILIZATION (T) BY INCOME GROUP

Treatment or discharge system or pathway		T (%)	Notes
Urban high-income	To sea	10	No CH_4
	To aerobic plant	20	Add industrial component
	To septic systems	10	Uncollected
Urban low-income	To sea	10	Collected
	To pit latrines	15	Uncollected
Rural	To rivers, lakes, sea	15	
	To pit latrines	15	Uncollected
	To septic tanks	5	
Total		100%	Must add up to 100 %

Reference: ... and Liles (1999)

$U_i \times T_{i,j}$

Income group (i) | Pathway or system (j)

CH_4 from industrial wastewater treatment and discharge (Tiers 1 & 2)

- Step 1: Estimate total organically degradable carbon in wastewater for industrial sector (i) (TOW_i) [kg COD/yr]
  - ✓ First, identify major industrial sectors with large potentials for CH_4 emissions. (e.g., pulp & paper, food & drink, etc.)

$$TOW_i = P_i \times W_i \times COD_i$$

P_i = total industrial product for industrial sector (i) [t/yr]
W_i = wastewater generated in industrial sector (i) [m^3/t-product]
COD_i = chemical oxygen demand (industrial organic component in wastewater generated in industrial sector (i) [kg COD/m^3]

- Step 2: Obtain emission factors (EF_i) [kg CH_4/kg COD]

$EF_i = B_o \times MCF_i$ (similarly to dom. WW)

CH_4 from industrial wastewater treatment and discharge (Tiers 1 & 2)

- Step 3: Calculate emissions from TOW_i and EF_i, and adjust for possible sludge removal and/or CH_4 recovery

CH_4 emissions [kg CH_4/yr]

$$= \sum_i [(TOW_i - S_i) \times EF_i - R_i]$$

S_i = organic component removed as sludge in industrial sector (i) [kg COD/yr]
R_i = amount of CH_4 recovered in industrial sector (i) [kg CH_4/yr]

- Default values for S_i and R_i = 0

Issues on sludge

- CH_4 emissions from sludge sent to landfills, incinerated or used in agriculture should not be included in this category.
- The amount of organic component removed as sludge ("S" in the equations) should be equal to the sum of:
  - ✓ amount of sludge disposed at SWDS
  - ✓ amount of sludge applied to agricultural land
  - ✓ amount of sludge incinerated or used elsewhere
- Wastewater and sludge that is applied on agricultural land should be considered in Agriculture (or AFOLU) Sector.

Estimation of N_2O emissions

- N_2O emissions can occur as:
  - ✓ direct emissions from treatment plants; or
  - ✓ indirect emissions from wastewater after disposal of effluent into waterways, lakes or the sea
- Typically, direct emissions are much smaller than indirect emissions.
  - ✓ Except for countries that predominantly have advanced centralized wastewater treatment plants with nitrification and denitrification steps
- Industrial sources are believed to be insignificant.
- Only one tier for indirect emissions from domestic wastewater:
  - ✓ No higher tiers, no decision tree
  - ✓ Industrial wastewater co-discharged with domestic wastewater into the sewer system is included

N_2O from domestic wastewater treatment effluent (indirect emissions)

- Step 1: Estimate total nitrogen in the effluent ($N_{EFFLUENT}$) [kg N/yr]

$$N_{EFFLUENT} = (P \times Protein \times F_{NPR} \times F_{NON\text{-}CON} \times F_{IND\text{-}COM}) - N_{SLUDGE}$$

P = human population [person]
Protein = annual per capita protein consumption [kg/person/yr]
F_{NPR} = fraction of nitrogen in protein [kg N/kg protein] (default = 0.16)
$F_{NON\text{-}CON}$ = fraction for non-consumed protein added to the wastewater [fraction]
$F_{IND\text{-}COM}$ = fraction for industrial and commercial co-discharged protein into the sewer system [fraction]
N_{SLUDGE} = nitrogen removed with sludge [kg N/yr]

N_2O from domestic wastewater treatment effluent (indirect emissions)

- Step 2: Calculate emissions by multiplying an emission factor to $N_{EFFLUENT}$

$$N_2O \text{ emissions [kg } N_2O\text{/yr]} = N_{EFFLUENT} \times EF_{EFFLUENT} \times 44/28$$

$EF_{EFFLUENT}$ = emission factor for N2O emissions from wastewater effluent discharged into aquatic environments [kg N_2O-N/kg N]
(Default value is 0.005 (0.0005-0.25) [kg N_2O-N/kg N].
= Consistent with the EF for indirect N_2O in AFOLU.)

44/28 = factor for conversion of kg N_2O-N into kg N_2O

For more details…

- Default values for EFs and other various parameters can be found in Chapter 6 of Vol.5 of 2006GLs.
- Worksheets – See Annex 1 of Vol.5.
- Any questions?

SOLID WASTE DISPOSAL on LAND in INDONESIA

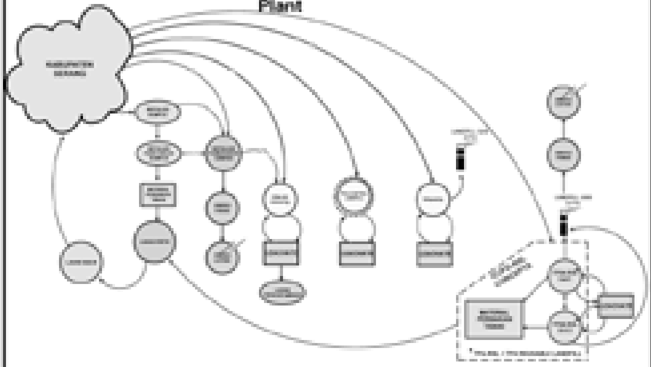
The 4th Workshop on Greenhouse Gas (GHG) Inventories in ASIA

by

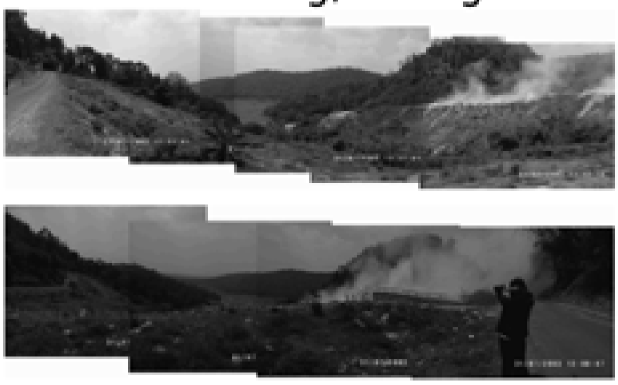
HB Henky Sutanto – BPPT – Indonesia

Jakarta, 14-15 February 2007

2FD.Reusable Sanitary Landfill means 2 place of LandfillGas to Energy Plant & Means also 2 Anaerobic Composting Plant



FD-OD Cilowong, Serang 2004



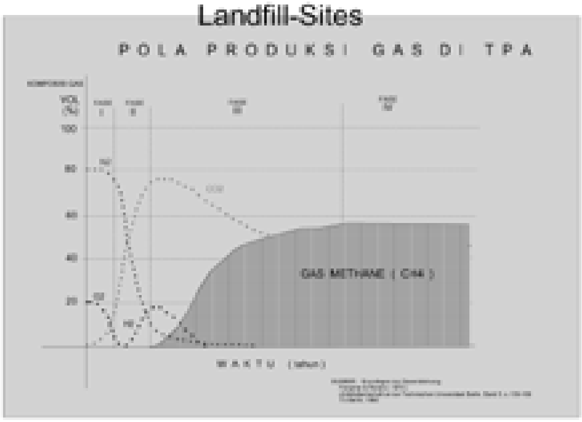
THE MAIN PROBLEMS

460 Location of Final Disposal-Open Dumping in Indonesia

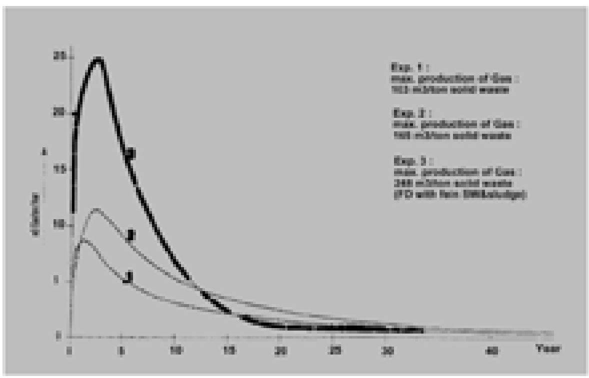
460 unit Emitter of Green House Gas (CH4 & CO2)

21 x CO2 = CH4 (Landfill Gas & GreenHouseGas)

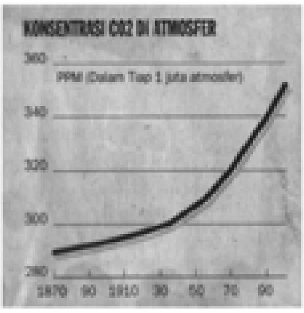
Time Frame of Production of CH4-Gas in SW-Landfill-Sites

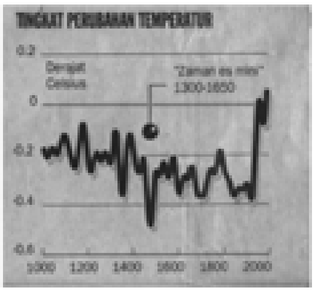


Timeframe & Amount of LFG-Production from SW-Landfill

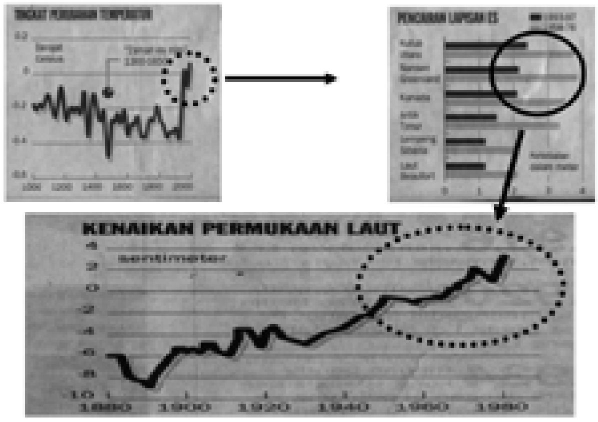


Global Warming as an effect of Green House Gas (CO_2,CH_4) Emission





Global Warming & Possible Future Disasters



ANOTHER PROBLEMS

- **How to fulfill the MDG-Targets & to eradicate :**
  - Poverty
  - Illiteracy
  - Hunger
  - Unsafe & unsustainable water supply
  - Disease
  - Urban & environmental degradation
- **Energy supply shortages**
- ***Sustainability of available Airspace for the Solid Waste -Temporary & -Final Disposal.***

SOLID WASTE STREAM, FROM GENERATION TO DISPOSAL
The Growth of Solid Waste Generation/person/year (tpy)

			Y	1971	1980	1990	2000	2010	2020
	Prog-CODE			Tpy/capita	Tpy/capita	Tpy/capita	Tpy/capita	Tpy/capita	Tpy/capita
Sumatra	HMSMPC			0,026	0,191	0,189	0,225	0,209	0,182
Jawa	HMJVPC			**0,029**	**0,199**	**0,240**	**0,338**	**0,361**	**0,358**
Kalimantan	HMKLPC			0,031	0,224	0,271	0,381	0,407	0,403
Sulawesi	HMSLPC			0,031	0,224	0,271	0,381	0,407	0,403
Nusa Tenggara	HMNTPC			0,053	0,372	0,496	0,780	0,945	1,079
Maluku-Irian	HMMIPC			0,039	0,230	0,326	0,555	0,750	1,009
INDONESIA	HMPCRI			0,031	0,195	0,236	0,332	0,354	0,350

SOLID WASTE STREAM, FROM GENERATION TO DISPOSAL
ThePrediction of Growth of Urban Population in Indonesia

			Y	1971	1980	1990	2000	2010	2020
	Prog-CODE			Million person	Million person	Million person	Million person	Million person	Million person
Sumatra	EWSM			3,6	5,5	7,5	9,6	11,7	13,8
Jawa	EWJV			**16,6**	**22,9**	**30,0**	**37,0**	**44,1**	**51,1**
Kalimantan	EWKL			0,9	1,4	2,1	2,7	3,4	4,0
Sulawesi	EWSL			1,0	1,7	2,2	2,8	3,4	3,9
Nusa Tenggara	EWNT			0,6	1,0	1,3	1,7	2,0	2,3
Maluku-Irian	EWMI			0,3	0,4	0,5	0,7	0,8	1,0
INDONESIA	EWRI			23,1	32,8	43,7	54,5	65,3	76,2

SOLID WASTE STREAM, FROM GENERATION TO DISPOSAL
ThePrediction of Growth of Household in Indonesia

			Y	1971	1980	1990	2000	2010	2020
	Prog-CODE			X1.000 unit	X1.000 unit	X1.000 unit	X1.000 unit	X1.000 unit	X1.000 unit
Sumatra	HAHASM			684	1.054	1.541	2.091	2.717	3.354
Jawa	HAHAJV			**3.344**	**4.984**	**6.969**	**9.027**	**11.010**	**12.770**
Kalimantan	HAHAKL			166	283	444	636	845	1.007
Sulawesi	HAHASL			207	306	455	637	844	987
Nusa Tenggara	HAHANT			114	176	271	393	488	587
Maluku-Irian	HAHAMI			42	68	106	154	202	250
INDONESIA	HAHARI			4.558	6.872	9.786	12.938	16.105	18.954

SOLID WASTE STREAM, FROM GENERATION TO DISPOSAL
ThePrediction of Solid Waste Production Growth in Indonesia

			Y	1971	1980	1990	2000	2010	2020
	Prog-CODE			Million Ton/year	Million Ton/year	Million Ton/year	Million Ton/year	Million Ton/year	Million Ton/year
Sumatra	[illegible]			0,10	1,05	1,43	2,17	2,44	2,51
Java	[illegible]			**0,48**	**4,57**	**7,20**	**12,53**	**15,92**	**18,29**
Kalimantan	[illegible]			0,03	0,32	0,57	1,04	1,38	1,62
Sulawesi	[illegible]			0,03	0,37	0,60	1,07	1,37	1,59
Nusa Tenggara	[illegible]			0,03	0,35	0,65	1,29	1,89	2,53
Maluku-Irian	[illegible]			0,01	0,09	0,18	0,39	0,63	1,01
INDONESIA	[illegible]			0,70	1,80	3,80	7,00	10,80	14,80
INDONESIA	[illegible]			1,70	5,30	19,00	36,40	56,30	76,70

Sources of Solid Wastes & Volume (m3/day) in Bandung – West Java Province

Nr.	Source	Volume(m3)	
1	**Housing Area**	**3.978**	
2	Market	613	
3	Street	449	
4	Industry	787	
5	Commercial	312	
6	Public Facility	561	

Source: KLH-Asdep Urusan Limbah Domestik, maret 2005

Composition of Solid Wastes & Volume (m3/day) in Magetan – East Java Province

Nr.	Art of Waste	Volume(m3)	(%)
1	**Organic Materials**	**93,18**	
2	Paper	3,87	
3	Plastics	3,97	
4	Metal	1,54	
5	Glass/Porcelain	0,52	
6	Natural Rubber	0,63	
7	Textile	1,72	
8	Others	1,84	

Source: KLH-Asdep Urusan Limbah Domestik, maret 2005

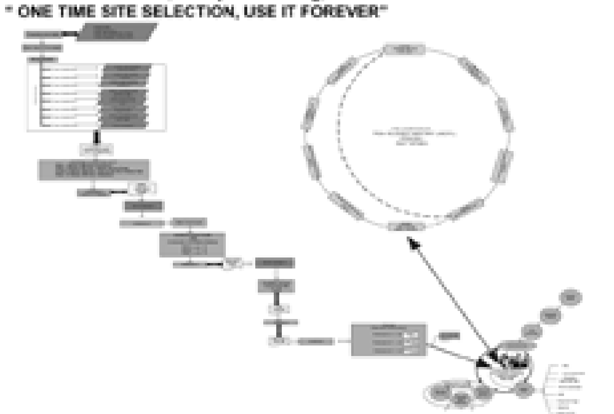
POSSIBLE SOLUTIONS

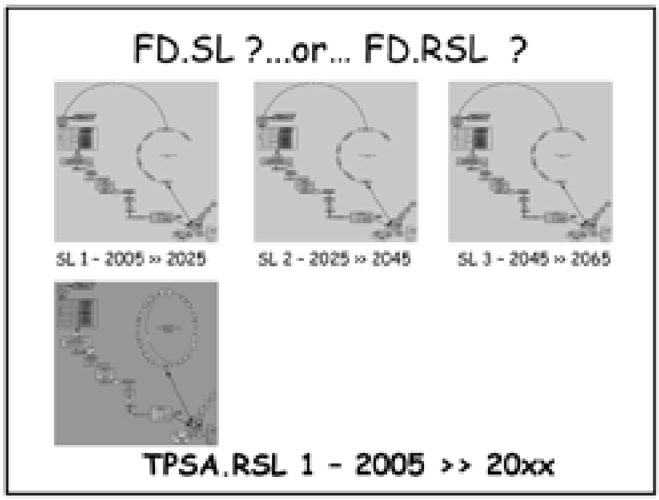
- CH4-Recovery from existing SW-Final Disposal.Open Dumping
- Landfill-Mining after CH4-Recovery activity
- Use of LM-Compost for erosion control activity
- Plantation of Jatropha-Curcas in terraced area
- Use the Jatropha-Tree as a hedge in the rural area
- Jatropha-Seed processing for Non-Edible BioDiesel Oil (Liquid)
- Conversion of SWFD, from existing FD.Open Dumping to FD.RSL I
- Development of 2nd. FD.RSL in New Locations
- Integrate two FD Locations in the IC-2FD.RSL spatial concept.
- CH4 Gas Recovery in every FD.REUSABLE SANITARY LANDFILL (Gas)
- Landfill-Mining in FD.RSL after CH4-Recovery activity, preparation works before the next filling cycle (Reuse of FD.Reusable Sanitary Landfill)

SW-Final Disposal, a spatial problems

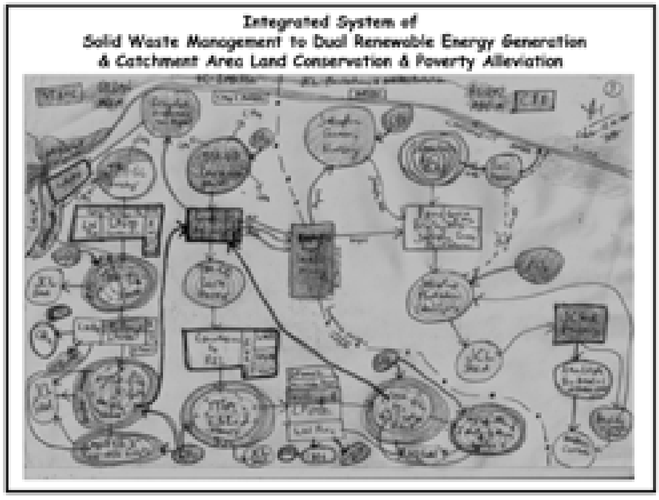
		SCENARIO I	SCENARIO II	SCENARIO III
Heavy Equipment		Cat-D8	Cat-D9 / Cat-LC 816C	Cat-LC 826B
Standard Space/ FD-RSL Module BPPT	Ha.	23,61	18,85	13,51
INDONESIA 2000	Ha	5.360	4.280	3.070
INDONESIA 2010	Ha	6.470	5.170	3.705
INDONESIA 2020	Ha	7.560	6.032	4.325

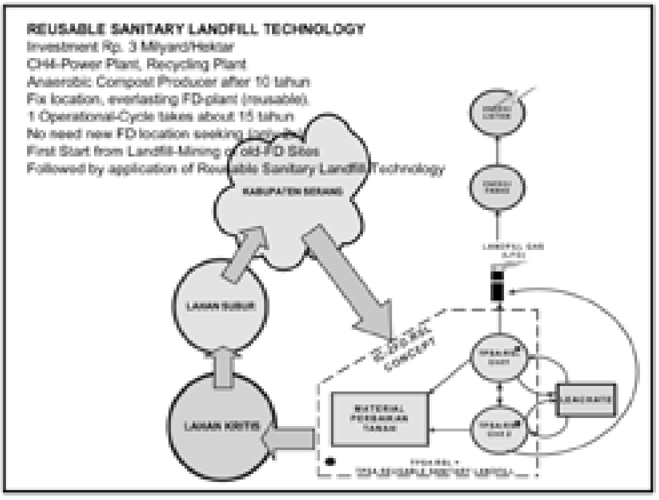
METHODOLOGY OF SITE_SELECTION FOR SWFD-REUSABLE SANITARY LAND
DEVELOPED DURING THE WORLD-BANK PROJECT
WJEMP-SERANG 3-1, Kabupaten Serang, Provinsi Banten 2003
" ONE TIME SITE SELECTION, USE IT FOREVER"

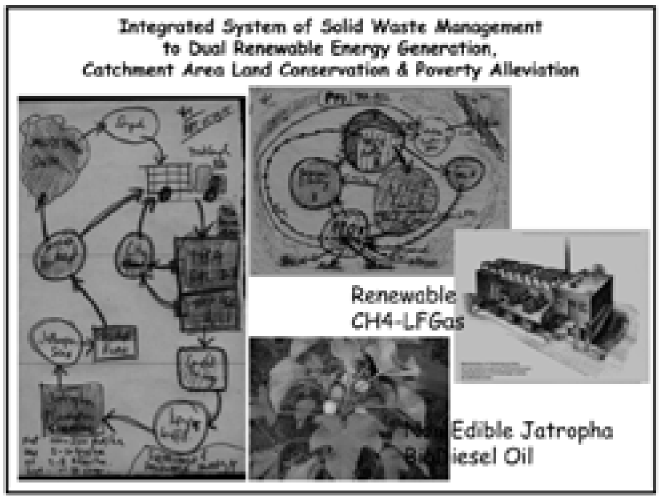


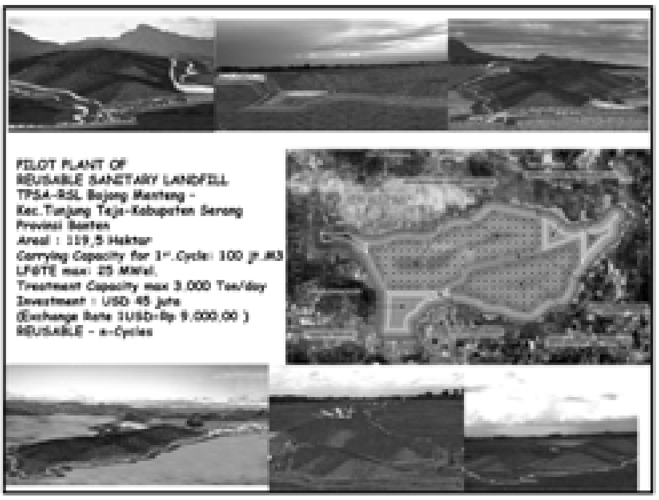

FD.SL ?...or... FD.RSL ?
SL 1 - 2005 >> 2025
SL 2 - 2025 >> 2045
SL 3 - 2045 >> 2065
TPSA.RSL 1 - 2005 >> 20xx


REUSABLE SANITARY LANDFILL, LANDFILL MINING COMPOST, SOIL CONSERVATION AND JATROPHA CURCAS L. PLANTATION
An
Automotive Non Edible Bio-Diesel Oil
(ANE-BDO)
& CH4-Landfillgas
sustainable producer

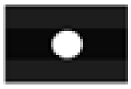

Integrated System of Solid Waste Management to Dual Renewable Energy Generation & Catchment Area Land Conservation & Poverty Alleviation


REUSABLE SANITARY LANDFILL TECHNOLOGY
Investment Rp. 3 Milyard/Hektar
CH4-Power Plant, Recycling Plant
Anaerobic Compost Producer after 10 tahun
Fix location, everlasting FD-plant (reusable).
1 Operational-Cycle takes about 15 tahun
No need new FD location seeking
First Start from Landfill-Mining of old-FD Sites
Followed by application of Reusable Sanitary Landfill Technology
KABUPATEN SERANG
LAHAN SUBUR
LAHAN KRITIS
MATERIAL PERBAIKAN TANAH
LEACHATE


Integrated System of Solid Waste Management to Dual Renewable Energy Generation, Catchment Area Land Conservation & Poverty Alleviation
Renewable CH4-LFGas
Non Edible Jatropha Bio Diesel Oil


PILOT PLANT OF
REUSABLE SANITARY LANDFILL
TPSA-RSL Bojong Menteng -
Kec. Tunjung Teja-Kabupaten Serang
Provinsi Banten
Areal : 119,5 Hektar
Carrying Capacity for 1st.Cycle: 100 jt.M3
LFGTE max: 25 MWel.
Treatment Capacity max 3.000 Ton/day
Investment : USD 45 juta
(Exchange Rate 1USD=Rp 9.000,00)
REUSABLE - n-Cycles

Lao People's Democratic republic
Peace Independence Democracy Unity Prosperity



Country Report on
Waste Working Group Session at WGIA 4
14 - 15 Feb 2007, Jakarta, INDONESIA.
By
Khamphone KEODALAVONG
Deputy Chief of Industrial Environment Division
Department of Industry (MIC).

1

Country Profile

Lao People's Democratic republic (Lao PDR)

- Landlocked Country in South East Asia.
- Total area: 236,800 km^2.
- Population 5.9 million (2005).
- Population Density 24 people per square meter.
- Population growth of 2.5%.
- Ethnicity: 3 MainGroups, such as 70% Lao Lum, 10% Lao Theung, and 10% LaoSoung
- Borders: Cambodia, China, Myanmar, Thailand and Vietnam
- Capital: Vientiane.
- Official Language: Lao(English and French is also widely used).
- Climate: Rainy and Dry seasons(Each last 6 months).

Strengthening solid waste management

Government Policy:

- Promote the integration and development national policy, strategy, legislation and framework
- Increase institutional capacity in planning and monitoring and management
- Improve human resources and building awareness of government staff and publics
- Increase the coordination between line agencies
- Seeking technical cooperation and fund Establishing network and database system

3

Applicable Laws

- Environment Protection Law-1999.
- The Land Law - 1997
- Industrial Manufacturing Law-1999
- Decree of the Council of Minister on the Management of the City and Public Places, 1991
- The Minister's Agreement on the Rules and Regulation for Town Planing, 1996
- Prime Minister's Decree on the Organization of Urban Development and Administration Authorities, 1997
- Industrial Wastewater Discharge Regulations, 1994.

4

Ministries Concerned to Environmental (Wastewater and Solid Waste) Management such as :

- ❑**Ministry of Agriculture and Forestry(MAF).**
- ❑**Ministry of Health(MH).**
- ❑**Ministry of Communication, Transportation; Post and Construction (MCTPC).**
- ❑ **Science Technology and Environment Agency (STEA)**
- ❑**Ministry of Electricity and Mine**
- ❑**Ministry of Industry and Commerce (MIC).**

5

Number of Industrial Manufacturing Sector

The statistic show in 1994 to 2004:

- In 1994 : 5,946 units.
- In 2000 : 21,000 units.
- In 2004 : 26.200 units.

6

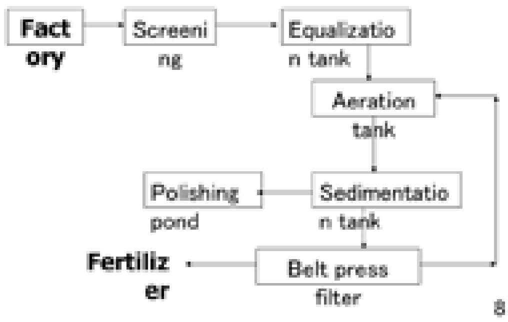
Capital and Industrial Wastewater

- Every industries sould be wastewater treatment system before discharge to river.
- Total of industrial wastewater in Vientiane capital in 2002 about 8,224,000 m^3/y
- Composition (sources) of wastewater

Sources	Mass	% Share
Pulp and paper manufacturing	201,932	2.46
Meat processing	116,640	1.42
Alcohol, beer production	461,209	5.60
Textiles	7,444,221	90.52
Total	8,224,000	100 %

7

Industrial Wastewater Flow



8

Capital and Industrial Waste

- Only 5 major town has was collection systems
- Disposal Method:
  - Disposal at the land field sites
  - Burning in open areas
  - Dumping on selected spots or water body
- Waste Production in urban areas 0.75 kg per capita per day.

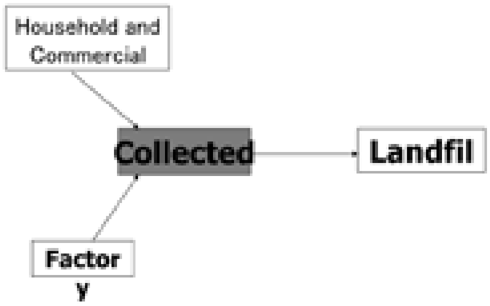
Composition of Solid Waste:

- Organic Material (Compost) - 60 %
- Reuse waste (Glass,can...) - 10-15 %
- Recycle Waste (Plastic , Paper, Steel...) - 10-15 %
- Hazardous Waste - 10 %

(Urban and Commercial Waste has the same composition)

9

Capital and Industrial Waste Flow



10

Case Study on Solid Waste in Vientiane Capital (2002)

- In Vientine capital has 9 districts
- The Population is 636,493 belong to 108,083 families
- The among of solid waste about 400-500 tone/day
- Solid waste collection and disposal ability to Landfill is about 50% from 4 districts and amount 120-130 tone/day and the rest 50% has been separated for recycling: Paper, Bottles, Metal, Iron, Plastic and etc

Key Issues and Barriers

- Lack of capacity in planning and management
- In sufficient technical knowledge, fund and equipment
- Low awareness of public on the impact of solid waste

11

The Pupils and waste economic in the future

At the present many primary and lower secondary schools in Vientiane municipality have the waste bank mean that: Teachers in every school urged their students bring the waste that could recycle especially the paper, the waste papers and others… to sell at their school. 30% of the profit is put into the fund of school administration and 70% of the rest if used in capital to by waste from pupils.

Now a day comprise of four Schools that involved the project and in the future will have 15 Schools.

12

With good methodology positive impact are as followed:

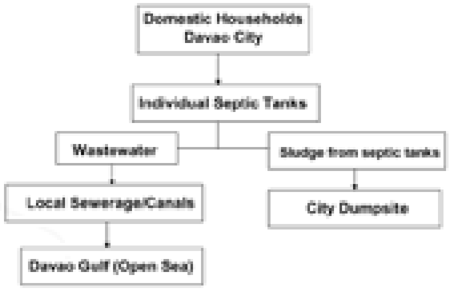
- The pupils learn about the value of the waste.
- The pupils learn about making income for the, decreased their parents' payment.
- Country will be cleaned.
- The pupils will spend with great economy because they know they find it hard to earn money.

13

WASTEWATER HANDLING

Reported by:
RAQUEL FERRAZ VILLANUEVA
PHILIPPINES

WASTEWATER FLOW FOR DOMESTIC WASTEWATER

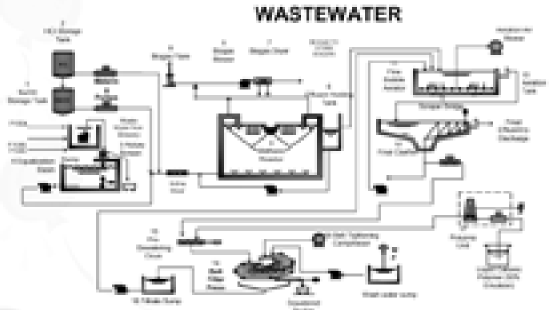


COMPOSITION/SOURCES OF DOMESTIC WASTEWATER

Domestic Wastewater is composed of:

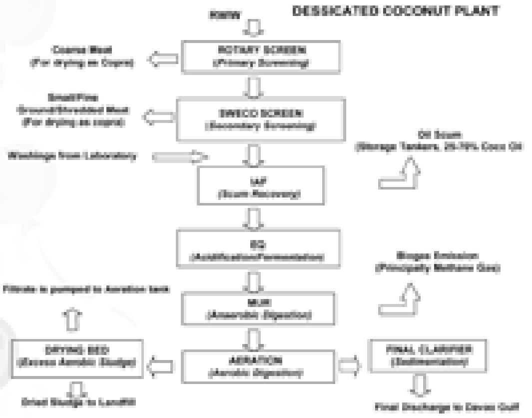
- Human Waste
- Urine
- Water from Washings
- Water from Bathing

WASTEWATER FLOW FOR INDUSTRIAL WASTEWATER



BEER MANUFACTURING PLANT

WASTEWATER FLOW FOR INDUSTRIAL WASTEWATER



COMPOSITION/SOURCES OF INDUSTRIAL WASTEWATER

For Beer Manufacturing: Weight in Kgs./year = 3,456 kgs./yr.

- Domestic Wastewater - 10%
- Wash Water from equipments, tanks, etc. - 30%
- Process Wastewater - 60%

For Dessicated Coconut Manufacturing:
Weight in kgs./yr. = 2,468 kgs./yr

- Domestic Wastewater = 4.5%
- Wash Water from equipments = 4.5%
- Process Wastewater = 72%
- Wash water from the floor = 19%

SOLID WASTE DISPOSAL ON LAND

Reported by:

RAQUEL FERRAZ VILLANUEVA

PHILIPPINES

SOLID WASTE COMPOSITION OF THE MUNICIPALITY OF STO. TOMAS, DAVAO DEL NORTE

BACKGROUND PROFILE:

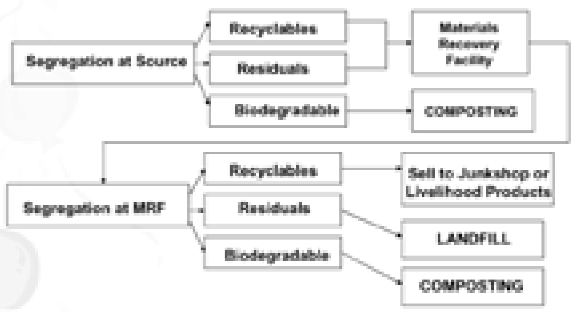
The Municipality of Sto. Tomas in Davao del Norte was created on August 14, 1959 thr0ugh Executive Order No. 352. It has a land area of 32,041 hectares composed of 19 barangays with a total population of 84,367 with a total households of 16,810.

Solid Waste Management in the municipality started in 1994 as The Clean and Green Program, upto 2004. In order that this program will succeed two (2) Municipal Ordinances and three (3) Resolutions were passed by the municipal council.

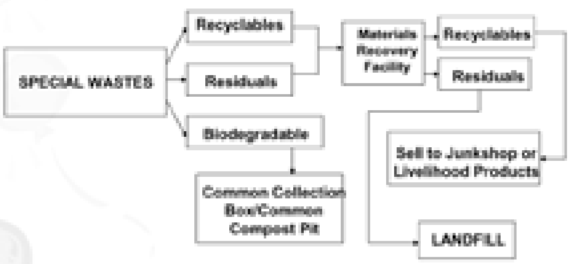
A Solid Waste Management Board was organized to oversee the effective solid waste management of their municipality.

This municipality is one of the model sites being assisted by the Environmental Management Bureau, DENR in Region XI and is a recipient of several awards because of its successful implementation of its solid waste disposal.

SOLID WASTE STREAM FROM GENERATION TO DISPOSAL



SOLID WASTE STREAM FROM GENERATION TO DISPOSAL



SOLID WASTE COMPOSITION/SOURCES

Residual (Non-Biodegradable)

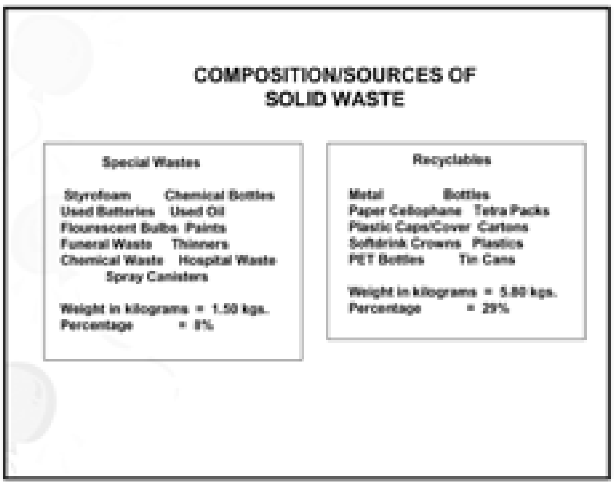
Tin Foil	Shells
Rubber Tires	Plastic Wrappers
Broken Ceramics	Rubber Bands
Broken Bottles	Twine
Broken Glasses	Cups
Cigarette Filters	Toothpaste Tubes
Hair	Shampoo Sachets
Straws	Sanitary Napkin
Diapers	

Weight in kilograms = 2.30 kgs.
Percentage = 12%

Biodegradable

Food Leftovers	Leaves
Vegetable Peelings	
Flowers	
Roots of Plants	Egg Shells
Banana Stalk	Paper
Kitchen Waste	Barbeque
Animal Waste	Sticks

Weight in kilograms = 10.40 kgs.
Percentage = 52%


COMPOSITION/SOURCES OF
SOLID WASTE
Special Wastes
Styrofoam Chemical Bottles
Used Batteries Used Oil
Flourescent Bulbs Paints
Funeral Waste Thinners
Chemical Waste Hospital Waste
Spray Canisters
Weight in kilograms = 1.50 kgs.
Percentage = 8%
Recyclables
Metal Bottles
Paper Cellophane Tetra Packs
Plastic Caps/Cover Cartons
Softdrink Crowns Plastics
PET Bottles Tin Cans
Weight in kilograms = 5.80 kgs.
Percentage = 29%


Thank You!

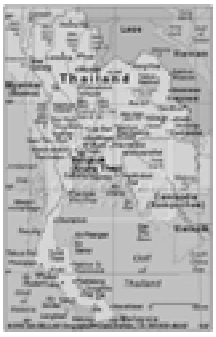
Wastewater flow and solid waste stream in Thailand

Sirintornthep Towprayoon

Joint Graduate School of Energy and Environment,
King Mongkut's University of Technology Thonburi

JGSEE

Presented at **The 4th Workshop on GHG Inventories in Asia (WGIA4)** 14-15 February 2007, Jakarta, Indonesia



General description of Thailand

Location : latitude 5°40" N to 20°30"N
longitude 97°70" E to 105°45" E

Area: 513,114.6 square kilometers
27 % remain under forest

Climate: wet and dry seasons
annual mean temperature 27° C

Population : approx. 64 Million

Wastewater Flow

- Location of Source
  - Metropolitans
  - Municipalities
  - Cities
- Type of Source
  - Household
  - Building
  - Restaurant
  - Industry
  - Agricultural farm
- Activity data
  - Wastewater generation rate
  - Amount of wastewater
  - BOD per head

Domestic Wastewater

Domestic Wastewater Generation

Region	Wastewater generation (l/capita/day)					
	1993	1997	2002	2007	2012	2027
Central	160-214	165-242	170-288	176-342	183-406	189-482
North	183	200	225	252	282	316
Northeast	200-253	216-263	239-277	264-291	291-306	318-322
South	171	195	204	226	249	275

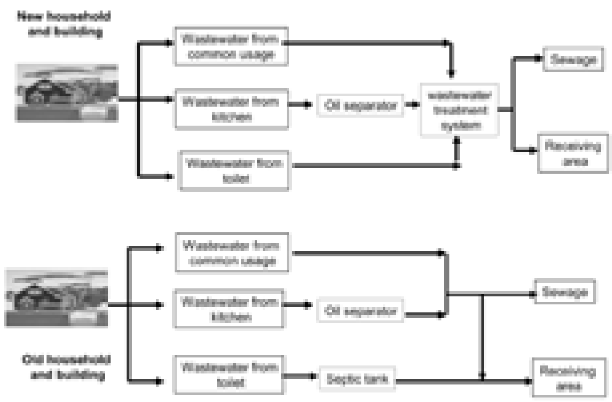
Source : OEPP 1995

Domestic Wastewater

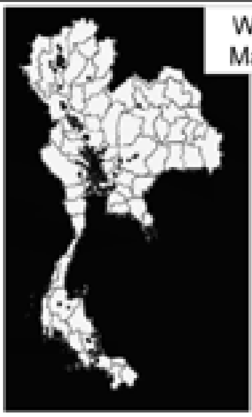
Region	(gm BOD/capita/day)				
	1997	2002	2007	2012	2017
Central	30	34	36	38	40
North	30	34	36	38	40
Northeast	35	40	43	47	50
South	35	38	42	46	50

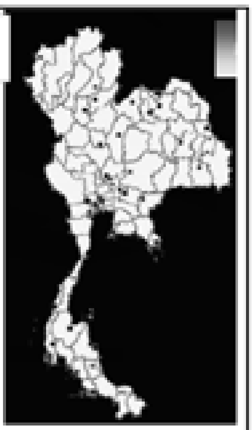
Source : OEPP 1995

On site Wastewater Treatment



Wastewater Management





Small community : Cluster treatment plant to reduce sewage collection

Dense population area, tourist Province and in area with poor Water quality : Central treatment plant

Domestic Wastewater Treatment in Bangkok

Ongoing Wastewater Treatment Projects Status in 2002

Wastewater Treatment Project	Service Area (km²)	Capacity (m³/day)	Status
1. Si Phraya	2.7	30,000	Operation
2. Rattanakosin	4.1	40,000	Operation
3. BMA-1	37.0	350,000	Under construction
4. Chongnonsi	28.5	200,000	Operation
5. Nong Khaem-Phasicharoen	44.0	157,000	Construction Completed,
Ratburana	42.0	65,000	Operation Test
6. BMA-4	33.4	150,000	Under construction
Total	191.7	992,000	

Source : Department of Drainage and Sewerage, BMA, 2002

Listing of the Future Wastewater Treatment Project

Wastewater Treatment Project	Service Area (km²)	Capacity (m³/day)	Status
1. Thonburi	51	520,000	Preparation for the Feasibility Study
2. Phrakanong - Klong Toei	71	480,000	Completion of Feasibility Study
3. Nong Bon	55	125,000	Listed in the 5th BMD Plan
Total	177	1,125,000	

Source : Department of Drainage and Sewerage, BMA, 2001

Wastewater Central Treatment Plant in Thailand

Location	Number of Plants	Status of treatment plants				Capacity (m3/day)
		Under operation	Under Repair	Under Construction	Delay construction	
Bangkok	7	7	-	-	-	992,000
Central region	21	15	5	-	1	812,100
Eastern region	15	11	3	1	-	293,900
Northern region	17	9	5	3	-	236,088
Northeastern region	18	9	3	6	-	277,082
Southern region	17	8	4	5	-	358,320
TOTAL	95	59	20	15	-	2,969,490

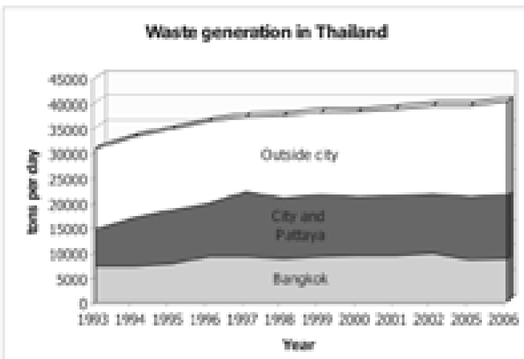
As of 2006 Data from BMA

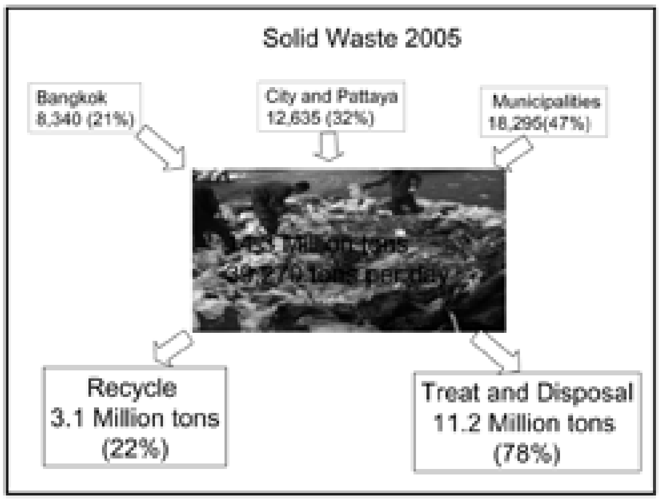
Solid Waste Stream

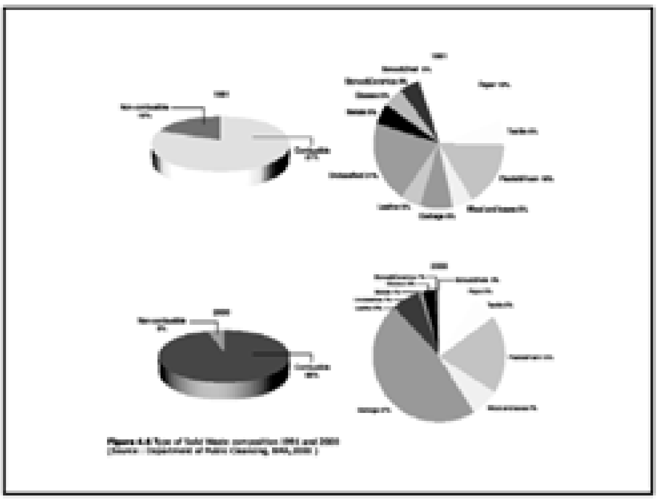
- Waste generation rate
- Waste composition
- Waste recycle

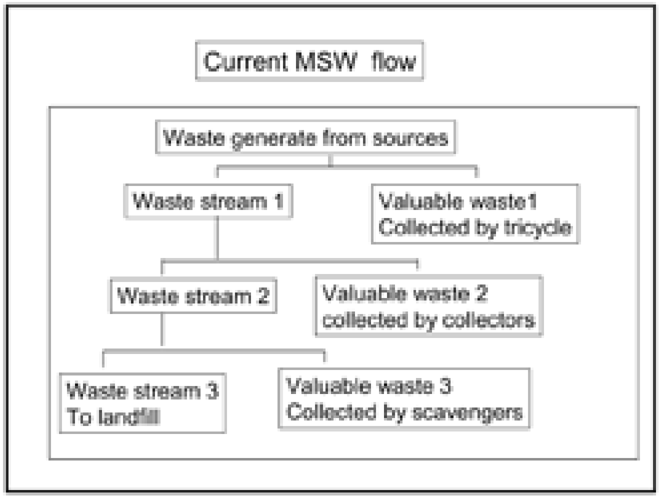
Waste generation and waste generation rate

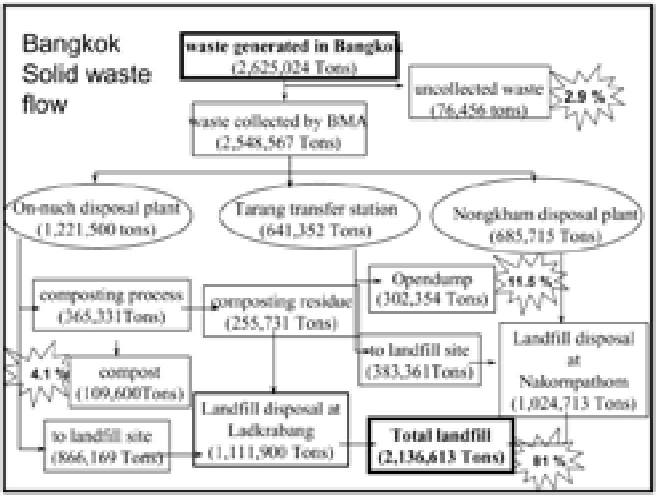
Area	Population	Waste generation (tons/day)	Waste generation rate (kg/cap/day)
1 Bangkok	5,844,607	9,350	1.6
2. City and Pattaya	12,203,425	14,661	1.2
2.1 Central- Western region	3,585,595	4,650	1.3
2.2 Northen region	2,264,406	2,825	1.25
2.3 North-east region	3,239,281	3,134	0.97
2.4 Eastern region	1,246,151	1,901	1.53
2.4 Southern region	1,867,992	2,151	1.15
3. Outside City	44,871,653	17,930	0.4
	63,655,458	**41,941**	**0.66**

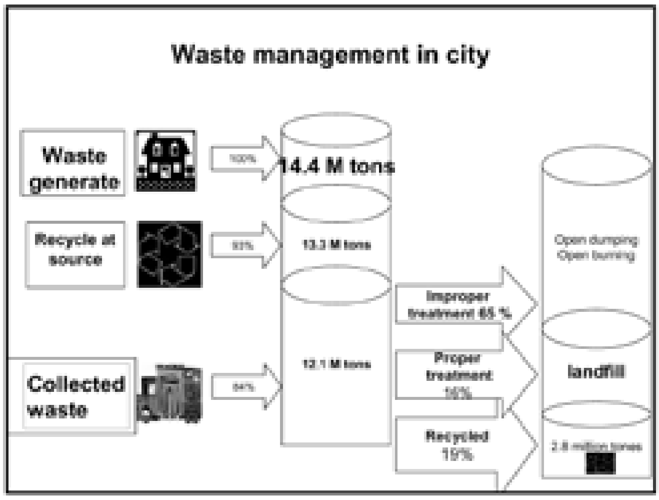


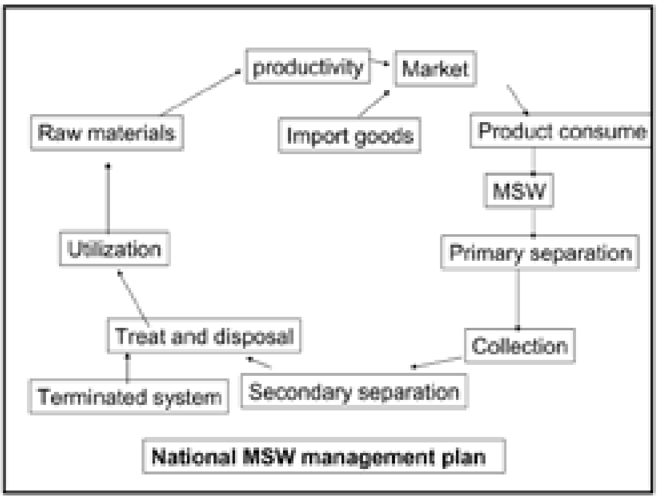

Solid Waste 2005
Bangkok
8,340 (21%)
City and Pattaya
12,635 (32%)
Municipalities
18,295(47%)
Recycle
3.1 Million tons
(22%)
Treat and Disposal
11.2 Million tons
(78%)



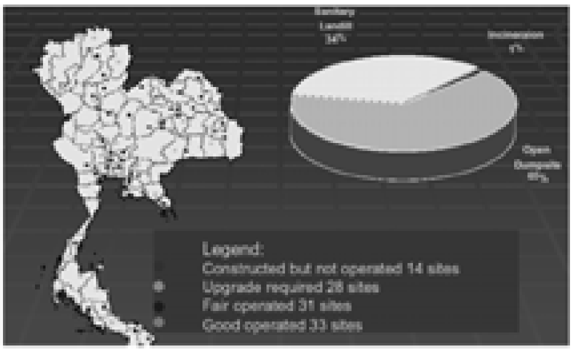

Current MSW flow
Waste generate from sources
Waste stream 1
Valuable waste1
Collected by tricycle
Waste stream 2
Valuable waste 2
collected by collectors
Waste stream 3
To landfill
Valuable waste 3
Collected by scavengers


Bangkok
Solid waste
flow
waste generated in Bangkok
(2,625,024 Tons)
uncollected waste
(76,456 tons)
2.9 %
waste collected by BMA
(2,548,567 Tons)
On-nuch disposal plant
(1,221,500 tons)
Tarang transfer station
(641,352 Tons)
Nongkham disposal plant
(685,715 Tons)
composting process
(365,331Tons)
composting residue
(255,731 Tons)
Opendump
(302,354 Tons)
11.8 %
4.1 %
compost
(109,600Tons)
to landfill site
(383,361Tons)
Landfill disposal
at
Nakornpathom
(1,024,713 Tons)
Landfill disposal at
Ladkrabang
(1,111,900 Tons)
to landfill site
(866,169 Tons)
Total landfill
(2,136,613 Tons)
81 %


Waste management in city
Waste
generate
14.4 M tons
Recycle at
source
Collected
waste
Open dumping
Open burning
Improper
treatment 65 %
Proper
treatment
landfill
Recycled
19%


productivity
Market
Raw materials
Import goods
Product consume
MSW
Utilization
Primary separation
Treat and disposal
Collection
Terminated system
Secondary separation
National MSW management plan

Solid waste treatment in Thailand 2003



Treatment Technology

- Bangkok :
  - Landfill at Kampangsan, Rachadhewa,
- City and Pattaya :
  - Sanitary landfill 104 sites,
  - Incinerators 3 sites,
  - Combined technology 10 sites

Waste to Energy

- Incineration :
  - Phuket 2.5 MW
- Landfill :
  - Kampangsan 870 kW
  - Rachadhewa 935 kW
- Anaerobic Digestion :
  - Rayong 625 kW
  - Chonburi 1MW

Thank you for your attention
And
Sawasdee Ka

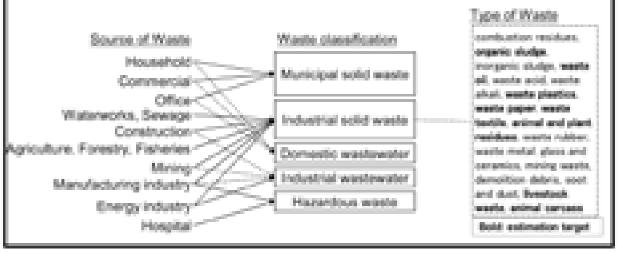
Country Report of Japan
Management of Wastewater

Hiroshi Fujita
Climate Change Policy Division
Global Environment Bureau
Ministry of the Environment

February 14, 2007
Waste Working Group Session
The 4th Workshop on GHG Inventories in Asia (WGIA4)

Waste in Japan

- Waste are classified into "municipal waste" and "industrial waste," in according to Japanese regulations.
- Industrial waste is categorized twenty types of waste from business activities, provided for exclusively under the Waste Management Law.
- Municipal waste is other waste to be treated by municipalities and is classified into "municipal solid waste," such as garbage from households, and "human excrement".
- Wastewater and solid waste are treated separately.



Water Pollution Control Law

Water Quality Conservation Law

Factory Wastewater Regulation Law

These laws (1958) were limited to those situations in which damage from water quality degradation had already occurred, and did not proactively prevent degradation of water quality. Consequently, the laws were unable to provide sufficient coverage with regard to environmental conservation.

The Ashio Copper Mine at the time of the poisoning incident
(Source: Mainichi Newspaper web site)

Water Pollution Control Law (1970)

1. Measures to overcome "catch-up" administrative attitude
- Shift from specified-area regulation to national regulation
- Uniform wastewater standards + more stringent prefectural effluent standards
2. Regulations tightened to ensure strict compliance with standards
- Direct penalties for violations
3. Unification of the legal system in principle

Sewerage Law

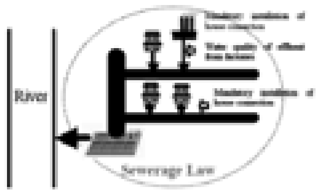
- Under the Sewerage Law enacted in 1901, local government is to conduct sewage works but budgetary measures were lacking. For this reason, although local governments began sewage works, they were faced by financial difficulties.

- Although construction of sewers and treatment facilities was implemented by local government, house connection and conversion to flush toilets for households were left to residents. When sewage works were started, such financial burdens held back the development of house connection and flush toilets.

- When hazardous wastewater is discharged from factories into the sewerage system, it could damage sewerage facilities and harm treatment capacity of treatment facilities.

- The installation, maintenance and management of individual treatment tanks were completely left to residents.

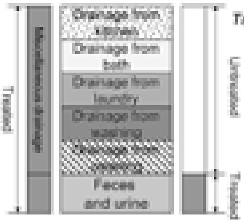
The Sewerage Law was revised in 1958 to provide a legal basis for the collection of user fee for local government, make the installation of house connection and the conversion to flush toilets mandatory, also regulate the water quality of effluent from factories and other facilities into the sewerage system.



Johkasou Law

Gappei shori johkasou

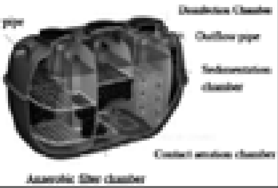
- Both miscellaneous drainage and feces and urine are treated
- Only gappei-shori johkaso has been permitted to be newly established after April in 2001.



Tandoku shori johkasou

- Only feces and urine are treated

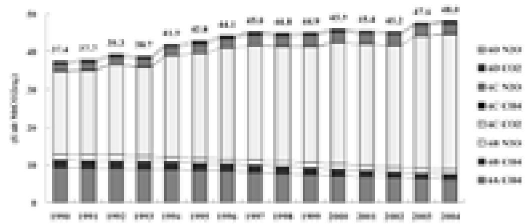
In 1983, the Johkasou Law was established to regulate the manufacture, establishment, inspection, and cleaning of individual treatment tank. Also, in 1994, regulations established localities as the basic regulating body for the installation and management of Johkasou.



Subject of Estimation

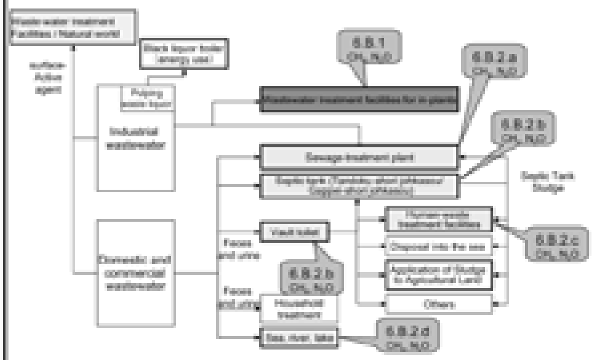
- 6.A Solid Waste Disposal on Land
  - 6.A.1 Controlled Landfill Sites
  - 6.A.3 Other Controlled Landfill Sites
- 6.B Wastewater Handling
  - 6.B.1 Industrial Wastewater
  - 6.B.2 Domestic/commercial wastewater
- 6.C Waste Incineration
  - Incineration
  - Used as raw materials or fuels
- 6.D Other
  - Decomposition of Petroleum-Derived Surfactants

Emissions estimate and trends

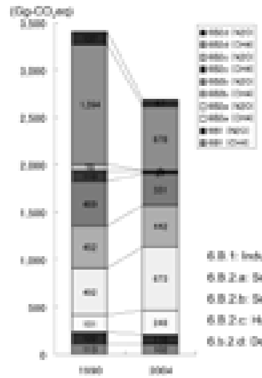


- Emissions from the waste in FY2004 increased by 28.7% compared to FY1990, represented 2.8% of total GHGs emissions in FY2004.
- The main reason for emission increasing is due to an increment of incinerated waste. Though the total amount of waste has been almost stable.

Management flow of Wastewater



6.B Wastewater handling



- CH_4 and N_2O emissions from '6.B Wastewater handling in 2004FY was 2,686 Gg CO_2eq, which have decreased by 21.2% since 1990FY.

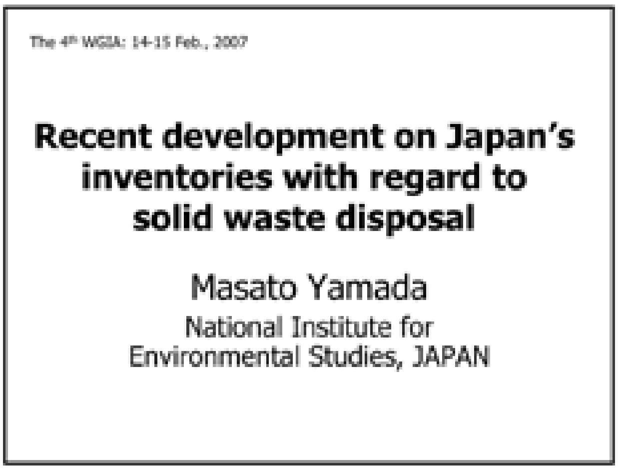
6.B.1: Industrial Wastewater

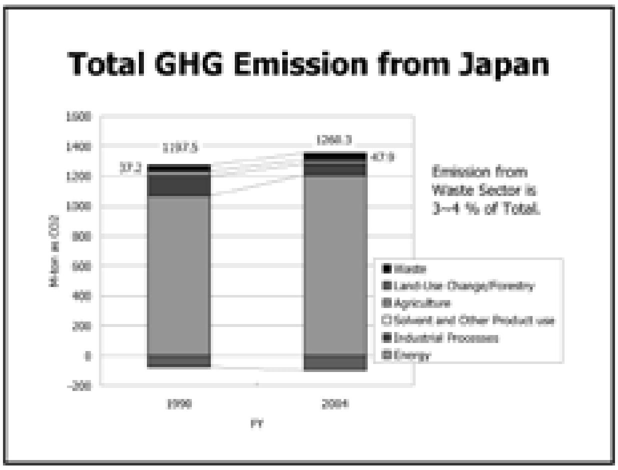
6.B.2.a: Sewage Treatment Plant

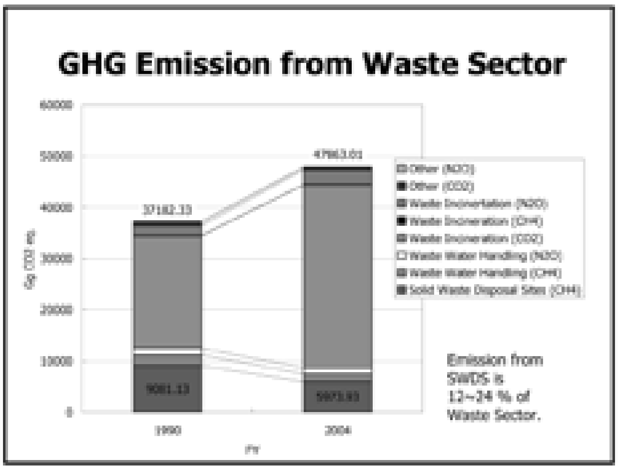
6.B.2.b: Septic tank and vault toilet

6.B.2.c: Human-Waste Treatment Plant

6.b.2.d: Decomposition of untreated waste water discharged

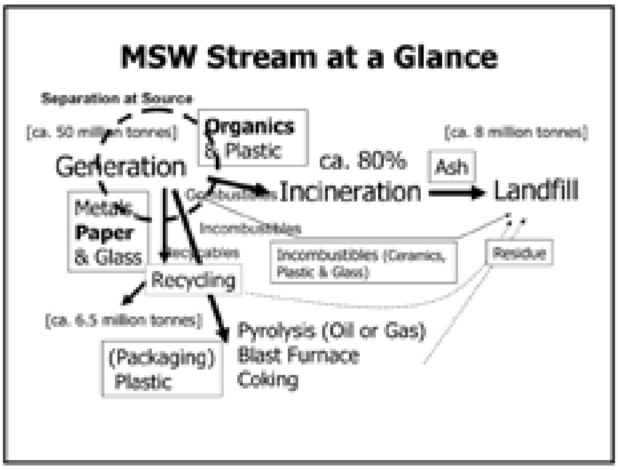

The 4th WGIA: 14-15 Feb., 2007
Recent development on Japan's inventories with regard to solid waste disposal
Masato Yamada
National Institute for Environmental Studies, JAPAN


Total GHG Emission from Japan
1600
1400
1200
1000
800
600
400
200
0
-200
Mt-ton as CO2
1197.5
37.2
1260.3
47.9
1990
2004
FY
Emission from Waste Sector is 3~4 % of Total.
Waste
Land-Use Change/Forestry
Agriculture
Solvent and Other Product use
Industrial Processes
Energy

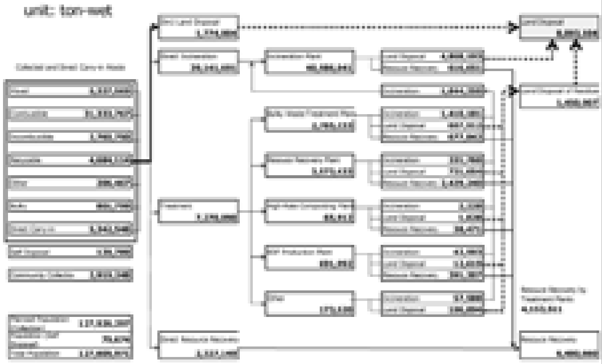

GHG Emission from Waste Sector
60000
50000
40000
30000
20000
10000
0
Gg CO2 eq.
37182.33
47863.01
9081.13
5973.93
1990
2004
FY
Other (N2O)
Other (CO2)
Waste Incineration (N2O)
Waste Incineration (CH4)
Waste Incineration (CO2)
Waste Water Handling (N2O)
Waste Water Handling (CH4)
Solid Waste Disposal Sites (CH4)
Emission from SWDS is 12~24 % of Waste Sector.


Brief History of Waste Management in Japan
Edo Period
Before War
After War
Urbanization & Concentration of Population
Drinking Water Pollution caused by Waste
Assignment of Disposal Site
Assignment of Waste Handler
Beginning of International Trade
Out Break of Cholera
Improvement of Collection & Beginning of Incineration
Development of Water Supply
Fall of Organic Manure Demand
Out Break of Dysentery
Collection & Treatment of Night Soil
Development of Sewage System
Economic Growth & Pollution
Environmental Pollution caused by Incineration and Land Disposal
Current Law
Separation at Source
Exhaust Gas Treatment
Semi-Aerobic Landfill
Distinction of MSW and ISW
Assignment of Hazardous Waste
Oil Shock
Rise of Resource Price
Resource Recovery by Local Government
Rise of Cost for Recycling and Destruction of Market
?
Issues on Dioxins
Advanced Incineration Technology
Mass-Consumption
Restriction of Landfill Capacity
Sound Material Cycle Society (Application of Recycling Technology)
Issues on Global Environment
Improvement of Resource Recovery
GHG emission from landfill sites has been drastically reduced by "Separation at Source", "Intermediate Treatment (Incineration)" and "Semi-Aerobic Landfill", which were originally introduced for improvement of public health and environment.

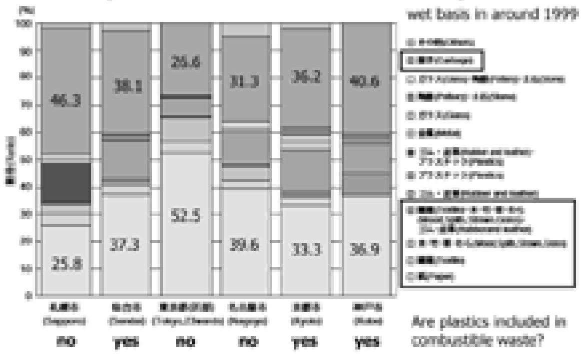

Waste in Japan
✓ Waste are classified into "municipal waste" and "industrial waste," in keeping with Japanese regulations.
✓ Industrial waste contains 20 types of waste from business activities, provided for exclusively under the Waste Management Law.
✓ Household E-waste and end-of-life vehicles are separately treated and recycled by producers.
✓ Municipal waste is other waste to be treated by municipalities and is classified into "municipal solid waste," such as garbage from households, and "human excrement (and sludge from johkasou)".
✓ Wastewater and solid waste are treated separately.
Source of Waste
Household
Commercial
Office
Waterworks, Sewage
Construction
Agriculture, Forestry, Fisheries
Mining
Manufacturing industry
Energy industry
Hospital
Waste classification
Municipal solid waste
Industrial solid waste
Domestic wastewater
Industrial wastewater
Hazardous waste
Household E-waste
End-of-life vehicles
combustion residues, organic sludge, inorganic sludge, waste oil, waste acid, waste alkali, waste plastics, waste paper, waste wood, waste textile, animal and plant residues, waste rubber, waste metal, glass and ceramics, mining waste, demolition debris, soot and dust, livestock waste, animal carcass
refrigerator, washing machine, air conditioner, television


MSW Stream at a Glance
Separation at Source
[ca. 50 million tonnes]
Generation
Organics & Plastic
ca. 80%
Incineration
Ash
Landfill
[ca. 8 million tonnes]
Metals
Paper
& Glass
Combustibles
Incombustibles
Recyclables
Recycling
Incombustibles (Ceramics, Plastic & Glass)
Residue
[ca. 6.5 million tonnes]
(Packaging) Plastic
Pyrolysis (Oil or Gas)
Blast Furnace
Coking

MSW Stream (FY2004)



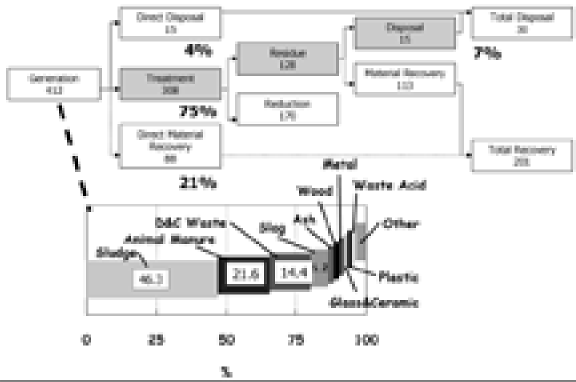
Composition of MSW (for combustible waste)



MSW Statistics

- ✓ Data is obtained by measurement of every load. Municipalities, who are responsible to disposal, measure waste, recovered materials and its treated residues at the gate of plants and disposal sites.
- ✓ This statistical survey is yearly.
- ✓ The national government request for this data to prefectures.
- ✓ Waste composition data is not demanded for national statistics. However, municipalities occasionally estimate this for operation of plants and planning of waste management.

Industrial Waste Stream (FY2004)



Industrial Waste Statistics

- ✓ Data is obtained by the sample method. Prefectures send questionnaires to generators who are responsible to disposal.
- ✓ This statistical survey is usually quinquennial. Timings of survey are different for prefectures.
- ✓ The national government request for summery of this data to prefectures.
- ✓ Betweenness is interpolated using generation units of 66 industrial sectors, which denominators are economic drivers, such as shipment value, number of employees, headage, etc.
- ✓ More detail mass flow of industrial waste streams is complemented by additional inquiry surveys and statistics from industries.

Sub Categories for SWDS

Category	Item		Mode	CH4	CO2	N2O
Municipal Solid Waste	Food (Garbage)		Anaerobic	O	O	
			Semiaerobic	O	O	
	Paper		Anaerobic	O	O	
			Semiaerobic	O	O	
	Wood		Anaerobic	O	O	
			Semiaerobic	O	O	
	Textile (made by Natural Fiber)		Anaerobic	O	O	
			Semiaerobic	O	O	
	Sludge	Night Soil Treatment and Johkasou	Anaerobic	O	O	
			Semiaerobic	O	O	
Industrial Solid Waste	Food		Anaerobic	O	O	
	Paper			O	O	
	Wood			O	O	
	Textile	made by Natural		O	O	
	Sludge	Sewage Treatment		O	O	
		Water Supply		O	O	
		Manufacture		O	O	
		Cattle Manure		O	O	
Other	Illegal Dumping		Anaerobic	O	O	
	Composting		Composting	O		O

Method for Estimation

- First Order Decay (FOD) Model with Domestic Parameters (Tier. 3)

$$E = \{\Sigma(EF_{i,j} \times A_{i,j}) - R\} \times (1 - OX)$$

E: CH4 Emission from managed disposal sites (kg-CH4)
$EF_{i,j}$: Emission factor of degradable waste, i disposed to site with structure, j without incineration (kg-CH4/t)
$A_{i,j}$: Degraded waste of degradable waste, i degradable waste disposed to site with structure, j without incineration in a inventory year (t-dry)
R: CH4 recovery (t)
OX: Fraction of CH4 oxidation in cover soil (-)

Emission Factor

- EF=[Carbon Content] x [Fraction of Gasification] x [Methane Correction Factor] x [CH4 Fraction in Landfill Gas]
  - Carbon Content
  - Fraction of Gasification (DOC_f): 50%
  - MCF: anaerobic=1.0, semi-aerobic=0.5
  - CH4 Fraction: 50%

Item		%-dry
Food (Garbage)		43.4
Paper		40.9
Wood		45.0
Textile		45.2
Sludge	Sewage	40.0
	Night Soil Treatment and Johkasou	40.0
	Water Supply	7.5
	Manufacture	45.0
	Cattle Manure	40.0

Carbon Content

Set by the 9 types of waste

- Kitchen garbage, Waste paper, Waste Woods
  - Data sources: Result of analyses for MSW conducted by 5 cities in Japan
  - Set by averaging all data between1990-2004
  - MSW data have been used for also ISW
- Waste natural fiber textile
  - Data sources: Carbon content of each natural fiber products data and domestic demand of each fiber
  - Set by averaging of carbon content in each year from 1990 to 2004
- Sewage sludge
  - Use the upper limit of default value presented in GPG2000 on ground of Japan's domestic research results
- Human waste sludge, Livestock waste
  - Use the sewage sludge's value in consideration with properties of waste
- Waterworks sludge
  - Intermediate results of measurements at several water purification plants in Japan has been used
- Organic sludge from manufacturing industries
  - Use papermaking industry's value in view of data limitation
  - Paper sludge is the main organic sludge under papermaking industry and the carbon content were calculated by the cellulose's carbon content

Landfill Types in Japan

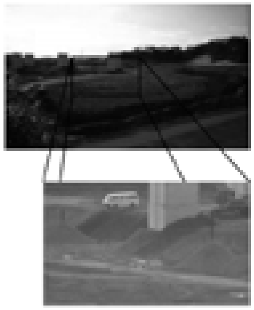
Emissions from SWDS have been calculated under two types of landfill; semi-aerobic landfill and anaerobic landfill.

■Semi-aerobic landfill

Regarding as semi-aerobic those sites which have leachate treatment facilities and subsurface containment structures.

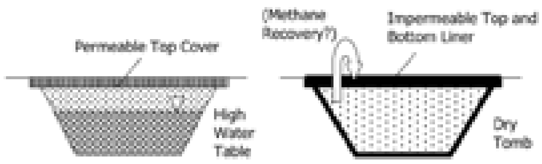
■Anaerobic landfill

Disposal sites where landfilling started before the 1977 joint order, and all coastal and inland water landfills are treated as anaerobic disposal sites.



Landfill types in IPCC GL

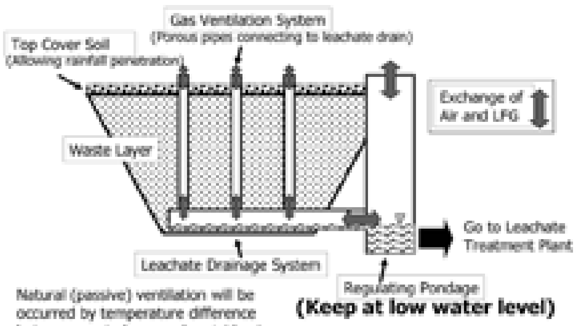
The "managed" landfill in Guidelines is classified to the "anaerobic landfill".



Traditional Sanitary Landfill   Western Landfill

Emission of polluted leachate will be extend over a long period of time.

Semi-Aerobic Landfill

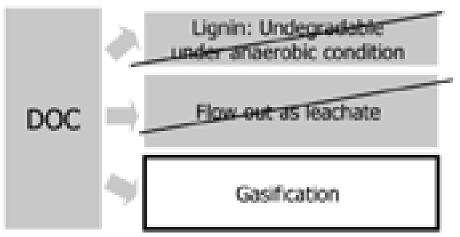


Natural (passive) ventilation will be occurred by temperature difference between waste layer and outside air.

(Keep at low water level)

Aerobic decomposition of waste can improve quality of leachate and LFG emission.

Fraction of DOC that can decompose



Generally the amounts of DOC lost with the leachate are low (less than 1%) and can be neglected in the calculations. (2006 IPCC Guideline)

Is this explanation realistic in Asian Countries?

Activity

$$W_i(T) = W_i(T-1) \times e^{-k} + w_i(T)$$

$$A_i(T) = W_i(T-1) \times (1 - e^{-k})$$

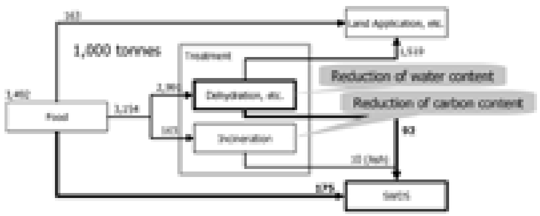
$$k = \ln(2) / H$$

$A_i(T)$: Degraded waste, i in a inventory year, T
$W_i(T)$: Remained waste, i at disposal site in a inventory year, T
$w_i(T)$: Disposed waste, i in a inventory year, T
k: Degradation rate (1/yr)
H: Half life of waste, i

w_i=[Degradable waste disposed] x
[Fraction of waste disposed to site with different structures] x
[Fraction of dry matter in waste, i]

Activity

- Degradable waste disposed
  - Accounting amount of disposal waste other than flowing stream with incineration



Activity

- Fraction of dry matter in waste

Item			Dry matter content %
Food			25
	Pre-Treated		30
Paper	MSW		80
	ISW		85
Textile (Natural)	MSW		80
	ISW		85
Sludge	Sewage Treatment		specific for each plant
	Night Soil Treatment and Jokasou	Direct Disposal	15
		Pre-Treated	30
	Water Supply		original data is dry basis
	Cattle Manure	Direct Disposal	16.9
		Pre-Treated	30
	Manifacture	Food Processing	77
		Chemical	57
		Pulp and Paper	closed

Activity

- Fraction of waste disposed to site with different structures

Category	Structure	%-wet		
		1977	1990	2004
MSW	anaerobic	100	64.2	45.3
	semi-aerobic	0	25.8	54.6
ISW	anaerobic	100	100	100

- Half Life
  - Food: 3 years, Paper: 7 years, Textile (natural): 7 years, Wood: 36 years, Sludge: 3.6 years (default)
- Delay Time
  - 6 month

Activity

- Activity for Emission from managed SWDS

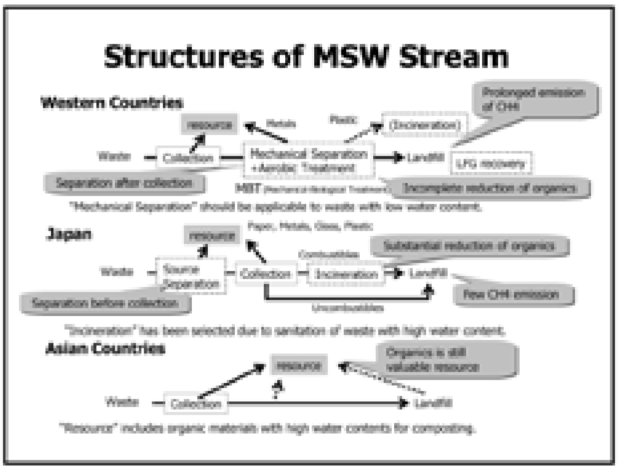
Item		Degraded waste in a inventory year: 1,000 tonnes/year			
		1990	1995	2000	2004
Food		517	511	444	335
Paper		1246	1175	995	840
Textile (natural)		73	65	56	47
Wood		344	377	373	359
Sludge	Sewage Treatment	297	277	223	198
	Night Soil Treatment and Jokasou	51	52	52	50
	Water Supply	192	185	157	130
	Manifacture	363	292	182	133
	Animal Manure	251	240	208	232
Total		3336	3175	2682	2285

Other

- CH_4 Recovery
  - For one site

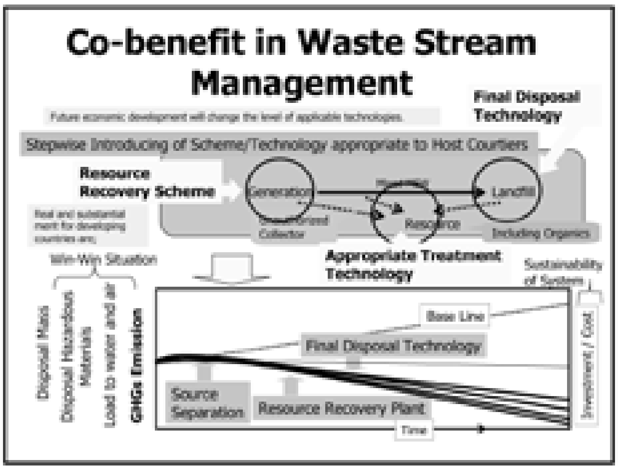
	unit	1990	1995	2004
LFG Usage	km3N	1985	2375	1561
CH4 Conc.	%	53.3	42.2	40.0
CH4 Usage	km3N	1059	1003	624
	GgCH4	0.76	0.72	0.45

- Fraction of CH4 oxidation in cover soil
  - 0



Issues on Estimation of MSW stream

- ✓ Waste mass data on authorized management stream can be estimated from account (monetary) data.
  - ✓ Uncertainty will be depended on conversion from truck road to weight.
  - ✓ Installation of treatment and resource recovery facilities before disposal will improve quality of SWDS and waste statistics.
- ✓ 3R activities including unauthorized resource recovery can significantly be change mass and composition of MSW.
  - ✓ "How to estimate the unauthorized stream" is important research issue.
  - ✓ "How to incorporate unauthorized activity to waste management" is important political issue.
- ✓ Better waste management will lead to better estimation and environment.



Country Report of Thailand: Evolution of SWDS methane emission estimate

Sirintornthep Towprayoon

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

JGSEE

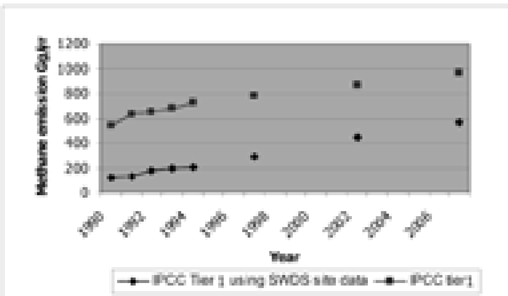
Presented at The 4th Workshop on GHG Inventories in Asia (WGIA4) 14-15 February 2007, Jakarta, Indonesia

Content

- Historical record of GHG emission from SWDS
- Improving of activity data
- Improving of emission factor
- Study of k value

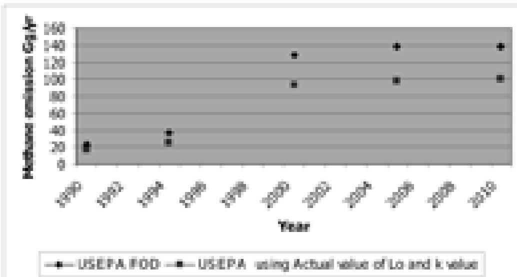
Comparison of methane emission from SWDS using IPCC tier 1

Report in Algas Project and first NC



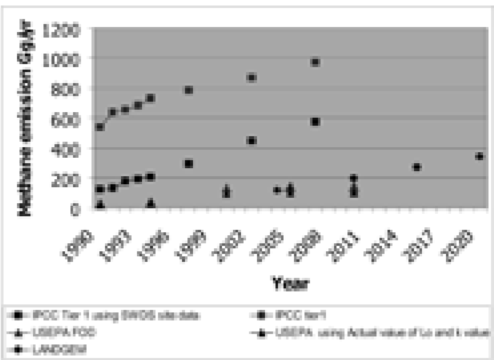
Towprayoon 1995

Methane emission from SWDS using USEPA model

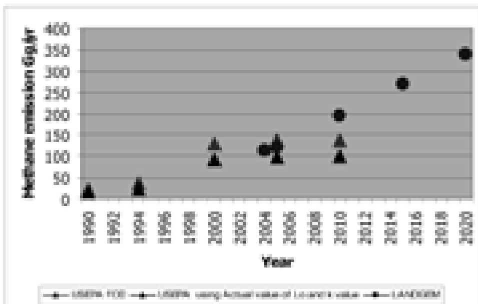


Masniyoom and Towprayoon 1996

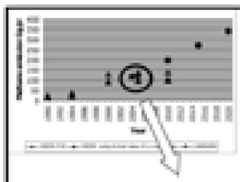
Comparison of Methane emission from SWDS using Tier 1 and FOD method



Emission from FOD method



1 Masniyoom and Towprayoon 1996, 2 Kornboonraksa et al 2004

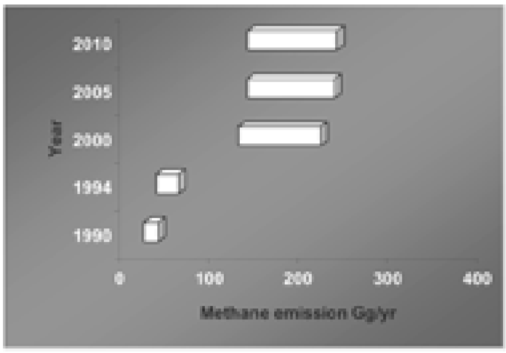


Comparison of Methane emission from SWDS Using FOD method with local value (Gg/yr)

Method	2004	2005
US EPA with default value [1]		138.5
USEPA with local Lo and k value [1]		97.3
Land GEM [1]	114.3	
FOD with value from field measurement (close flux chamber) [2]	103,1	
IPCC method (Tier 1) [2]	366.0	

1 Masniyoom and Towprayoon 1996, 2 Komboonraksa et al 2004

Range of different emission



Improving activity data acquisitions

- More data details are studied and collected
- Increase numbers of landfill sites and basic data achieved
- Waste generation and waste generation rates are more precise at sub-district level
- More accuracy estimation is expected

Location of waste disposal site in Thailand

cHART ET AL

Waste generation and waste generation rate

Area	Population	Waste generation (tons/day)	Waste generation rate (kg/cap/day)
1 Bangkok	5,844,607	9,350	1.6
2. City and Pattaya	12,203,425	14,661	1.2
2.1 Central- Western region	3,585,595	4,650	1.3
2.2 Northen region	2,264,406	2,825	1.25
2.3 North-east region	3,239,281	3,134	0.97
2.4 Eastern region	1,246,151	1,901	1.53
2.4 Southern region	1,867,992	2,151	1.15
3. Outside City	44,871,653	17,930	0.4
	63,655,458	**41,941**	**0.66**

Improving Emission Factor

- Waste composition has been investigated and archived as database at sub-district level
- DOC by each site is available
- Study of k value has been done
- More accuracy estimation is expected

Province | Sub-district | Waste composition

จังหวัด	ชื่อเทศบาล	องค์ประกอบของขยะมูลฝอย (ร้อยละโดยน้ำหนัก)									
		เศษอาหาร	กระดาษ	พลาสติก	แก้ว	โลหะ	ยาง/หนัง	ผ้า	ไม้/ใบไม้	หิน/กระเบื้อง	อื่นๆ
อุดรธานี	24. [illegible]		-	-	-	-	-	-	-	-	-
	25. [illegible]	5.00	16.00	15.00	3.00	10.00	2.00	2.00	43.00	3.00	1.00
	26. [illegible]	25.00	5.00	15.00	20.00	5.00	5.00	5.00	10.00	5.00	5.00
	27. [illegible]	28.00	16.00	20.00	7.00	3.00	2.00	2.00	15.00	2.00	1.00
	28. [illegible]	0.00	10.00	20.00	3.00	2.00	5.00	10.00	50.00	0.00	0.00
	29. [illegible]	10.00	3.00	5.00	2.00	5.00	4.00	1.00	50.00	10.00	10.00
	30. [illegible]	50.00	10.00	5.00	5.00	3.00	2.00	5.00	15.00	0.00	5.00
เฉลี่ย		24.89	14.81	15.07	6.83	4.17	2.86	3.11	19.64	2.81	6.02

Average

Waste Composition database

Fraction of DOC represented in Bangkok and other provinces

Component	Bangkok Metropolitan		Other Province	
	Percent of each component	Percent of DOC in MSW*	Percent of each component	Percent of DOC in MSW*
Paper	16.5	6.6	13.57	5.43
Food	13.5	2.04	45.34	6.8
Cloth	4.6	1.84	1.54	0.62
Wood&Yard Waste	6	1.8	5.03	1.51
Other non organic component	59.4	-	34.52	-
Total	100	**12.28**	100	**14.36**

Fraction of DOC from various landfill site

Site	Food	Paper	Textile	Green waste	Plastic	Bone	Rubber	Metal	Glass	Rock & Ceramic	DOC
Pattaya	39.99	14.06	3.54	4.6	15.95		3.17	3.55	9.1	3.03	0.148
Cha-Am	63.8	5.62	2.12	12.81	8.36		0.22	1.41	1.56	0	0.168
Nakornpathom	37.37	14.74	11.48	9.6	22.11	2.57	1.1	0	0.34	0	0.190
Hua-Hin	48.36	31.77	0.97	0.18	17.12	1.23	0.02	0.35	0	0	0.213
Nontaburi	41.97	18.67	0.52	1.14	31.75		0.79	0.32	1.33	1.51	0.154
Klongsuan	55	15		10	15				5		0.176
Rayong	48.73	18.03	0.41	0.1	17.27		0.1	0.88	10.51		0.156
Samutprakan	54.97	19.63	5.24	9.16	10.47			0.52			0.213
Lamchbang	39	19.33	13.84	3.43	14.66		1.63	2.43	1.54	1.84	0.206
Mabtapud	44	17.45	4.65	4.1	15.61		0.6	1.41	7.81	1.47	0.172
Nakornsawan	75.79	4.87	0.41	0.3	13.17		0.28	0.36	0.81		0.154
Pathumthani	69	6.46	2.73		13.95		0.36	0.75	5.53		0.154

DOC range from 0.148-0.213

Study of K value

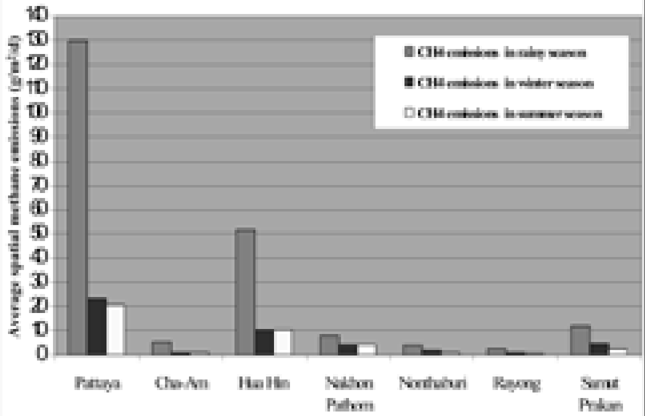
- Seasonal variation
- Type of landfill
- Age of landfill

Seasonal variation

Site	Open Year	Site Age (yr)	Landfilling Condition	Average spatial methane emissions (g/m²/d)				Methane emission	k (yr⁻¹)
				Rainy	Winter	Summer	All		
Pattaya	2002	4	Managed - Deep	129.8	23.4	20.69	75.92	1,485.75	0.073
Mabtapud	2001	5	Managed - Deep	104.47	16.67	20.79	61.45	153.01	0.016
Cha-Am	2000	6	Managed - Shallow	5.41	1.00	0.99	3.22	56.08	0.018
Laemchabang	1999	7	Managed - Deep	135.73	22.99	24.90	79.84	2,074.87	0.21
Pathumtani	1998	8	Managed - Deep	16.07	2.87	2.60	9.46	154.57	0.0034
Nakornprathom	1997	9	Unmanaged - Deep	7.89	4.17	3.06	5.96	166.52	0.0034
Hua-Hin	1996	10	Managed - Deep	17.79	10.31	10.18	14.02	548.31	0.063
Nontaburi	1985	21	Unmanaged - Deep	3.94	1.64	0.77	2.57	43.26	0.0002
Klongsuan	1993	13	Unmanaged - Shallow	N.D.	N.D.	N.D.	N.D.	N.D.	-
Rayong	2001	5	Unmanaged - Shallow	2.44	1.00	0.55	1.61	20.65	0.007
Samutprakan 1	1999	7	Unmanaged - Deep	12.21	4.42	2.59	7.91	73.89	0.0069
[illegible]	[illegible]	14	Unmanaged - Shallow	N.D.	N.D.	N.D.	N.D.	N.D.	-

Methane Emission in Rainy Season = 2.83 * (Methane Emission in Winter Season + Summer Season)

Seasonal variation of methane emissions

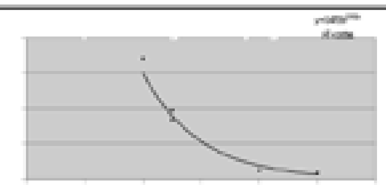


K value by type of Landfill

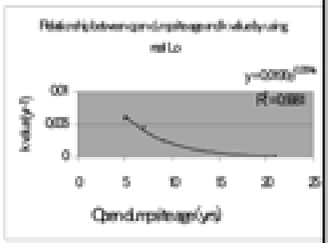
Type of landfill	Site	Open year	Age (yr)	Average landfilling tpd	MCF	DOC	Lo	k
Managed - Deep	Pattaya	2002	3	239.63	1	0.1487	106.96	0.073
	Hua-Hin	1996	9	45.51	1	0.2136	153.59	0.063
	Lamchabung	1999	6	120.30	1	0.2067	148.64	0.21
	Mabtaput	2001	4	40.00	1	0.1724	124.00	0.016
	Rachathewa	2000	5	3,500.00	1		107.3	0.182
Managed - Shallow	Cha-Am	2000	5	26.36	1	0.1682	120.90	0.018
Unmanaged - Deep	Nakornprathom	1997	8	180.30	0.8	0.1900	109.31	0.0034
	Nontaburi	1985	20	850.30	0.8	0.1541	88.64	0.002
	Samutprakan 1	1999	6	80.00	0.8	0.2135	122.85	0.0069
Unmanaged-Shallow	Klongeuan	1993	12	3.50	0.4	0.1760	50.63	ND
	Rayong	2001	4	49.11	0.4	0.1568	45.11	0.007

Manage-Deep 0.016-0.21 Managed-shallow 0.018

Unmanaged ND – 0.007



K value and site age



Thank you for your attention
And
Sawasdee Ka

Session II
GHG Inventory Report by Sector

Energy Sector

Participants

- 16 participants, 8 countries
- mixture of people who were experts in the field and others who were here to learn more about the energy sector

- Mr. Saleh Abdurrahman (Indonesia), Ms. Lilih Handayaningrum (Indonesia), Mr. Haneda Sri Mulyanto (Indonesia), Dr. Agus Nurrohim (Indonesia), Mr. Amin Suwanto (Indonesia)
- Dr. Shuzo Nishioka (Japan), Dr. Yukihiro Nojiri (Japan)
- Mr. Young Yoon Kim (Korea), Mr. Yong Gi Lim (Korea), Mr. Dongheon Yoo (Korea), Mr. Chan-Gyu Kim (Korea)
- Mr. Immala Inthaboualy (Lao)
- Mr. Thein Tun (Myanmar)
- Ms. Shu Yee Wong (Singapore)
- Dr. Vute Wangwacharakul (Thailand)
- Dr. Huy Phung Bui (Vietnam)

Key Points

- Find other uses for the data so it is easier to ask for it to be produced
- Pay attention to new technologies and adapt calculations accordingly
- Decide whether to use IPCC defaults or develop country-specific values based on need
- Need to determine targets for WGIA5

Indonesia

- uses a combination of reported figures and calculated figures
- for energy sector, tends to use supply side figures as there is more accurate data available for the supply side than for the consumption side
- fuel is subsidized rather than taxed, so not easy to use government records in the calculations
- generally makes rough estimates from their Energy Balance

Japan

- uses country-specific values, capable of producing very detailed statistics in this sector
- very long history of creating statistics for the energy sector as a part of its Energy Balance
- various ministries produce their own data (METI supplies the Energy Balance, Ministry of Forestry gives stats for forestry), but Ministry of the Environment is responsible for coordinating the inventories
- required to report its data annually which necessitates having an institutional structure in place for creating these reports – results in a high level of coordination
- this sector is not really a target for future development as it is already mature

Korea

- still undergoing industrial restructuring, so important to refine the inventory now, while in development stage
- Ministry of Commerce and Industry (equivalent to Japan's METI) collect activity data from other ministries (e.g. forestry) and other government entities (e.g. Korean gas and oil entities), and improve upon and publish the data.
- shifting to cleaner, more efficient energy, so need to develop country-specific values – government-industry collaboration working towards developing these values
- now working on quality control and quality assurance
- refining their inventories by focusing on the development of country-specific values, ensuring that the calculations are up-to-date and that they reflect the current pace of technological development, and reporting their results back to industries

Lao

- system for collecting data is not yet adequate
- many improvements needed
- currently working on its second communication and working on improving data collection methods

Myanmar

- participated in the "Asia Least-cost Greenhouse Gas Abatement Strategy" (ALGAS) from 1995 to 1998
- ALGAS was a study of national GHG emissions for 12 Asian countries
- mostly use supply-side figures in their inventories

Singapore

- has the advantage of being small, so its inventories can be simplified in some ways
- currently working on creating an Energy Balance and trying to close their data gaps.
- uses IPCC default values and has no plans to develop country-specific values at this time

Thailand

- uses top down calculations as a basis rather than bottom-up
- enough activity data available to make estimates
- Ministry of Energy is responsible for supplying and coordinating the data
- uses IPCC defaults for emission factors
- at this stage, compared to other sectors, the energy sector is relatively low priority for developing country-specific values
- inventories are basically only used for national communications at this point

Vietnam

- some main energy indicators in the national statistics, but the data is not adequate
- trying to use the data in the energy sector, but it is very difficult and has been taking a long time
- currently working on their second communication and trying to update the data
- lack of activity data is causing problems
- need to develop capacity for a national inventory group and policy-making

Key Point: Find Other Uses

- it is difficult (i.e. too expensive) to ask for statistics to be prepared only for the inventory
- if the data can be used in other kinds of analyses, it will be easier to ask for it to be collected
- it can also be fed back to the commercial sector so that companies can refine their emission strategies

Key Point: New Technologies

- in Asian countries, which are experiencing rapid development, it is necessary to pay attention to new technologies that can enhance efficiency and decrease emissions
- certain industries should be examined on a regular basis (e.g. yearly, every five years) for new technologies that necessitate the recalculation of emission factors

Key Point: IPCC vs. Country-Specific

- some countries that have already submitted one or two national communications may want to refine their results based on country-specific values
- difference between the IPCC values and the country-specific values is not large in many cases, so it can be more cost-effective for certain countries to continue to use the IPCC values rather than spending a large amount of time and resources developing country-specific values

Key Point: Target for Next WGIA

- come up with specific core activities to focus on in the energy sector before WGIA5
- study specific cases and see what can be done to improve upon them
- information exchange that takes place at WGIA is only the first step
- need to set targets and work together to make improvements

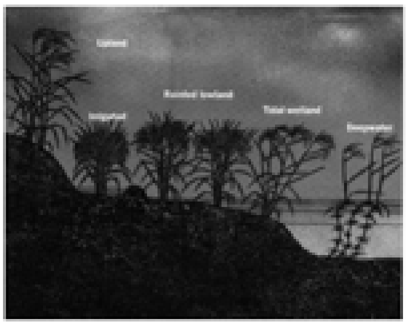
AGRICULTURE WG REPORT

Report presented during the 4th WGIA, 15 February 2007, Jakarta, Indonesia

Agriculture WG

- Chair – Dr. Batimaa Punsalmaa (Mongolia)
- Reporter – Dr. Damasa Macandog (Philippines)
- Members:
  - Mr. Dominique Revet (UNFCCC)
  - Dr. Osamu Enishi (Japan)
  - Dr. Kazuyuki Yagi (Japan)
  - Dr. Nguyen Khac Tich (Vietnam)
  - Mr. Shuhaimen Ismail (Malaysia)
  - Dr. Mohamad Z. Abdul Ghani (Malaysia)
  - Mr. Muslihudin (Indonesia)
  - Mr. Chan Thou Chea (Cambodia)

CH_4 emissions from rice ecosystems

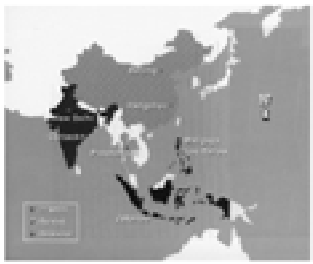


Methane emissions from rice fields: Controlling factors:

- **Soil properties**
- **Temperature**
- **Cultural practices (water regime/drainage, fertilizer, seeding/transplanting, straw/residue management)**
- **Rice variety**

The Interregional Research Programme on Methane Emissions from Rice Fields

- International Rice Research Institute, Fraunhofer Institute for Atmospheric Environmental Research, Agricultural Research Institutes of China, India, Indonesia, Philippines and Thailand
- Funded by United Nations Development Program, Global Environmental Facility (UNDP/GEF GLO/91/G31)
- 1993-1999



Rice production and methane emissions

Management practices can be modified to reduce emissions without affecting yield

- **Intermittent drainage in irrigated systems reduces emissions and also saves water**
- **Improved crop residue management can reduce emissions**
- **Direct seeding results in less labor and water input and reduce methane emissions**
- **Plants grown under good nutrition exhibit reduced methane emissions**

Approach

- Closed chamber method

Countries with data from this approach:

IRRI project – Philippines, Indonesia, Thailand, China, India

Japan

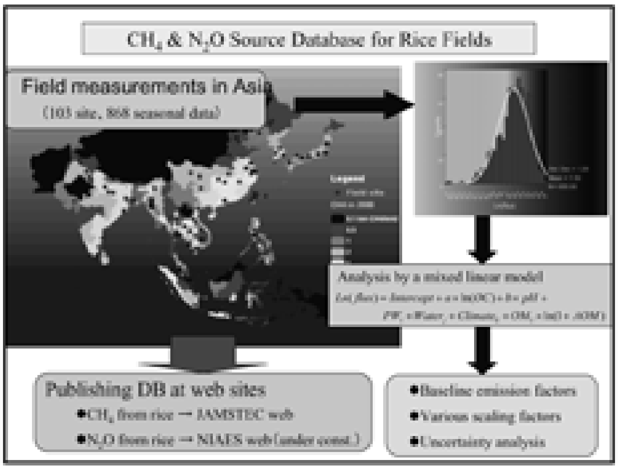
Countries without data: Malaysia, Cambodia, Vietnam

Rice Ecosystem Activity Data Status

Activity Data	Cam	India	Indon	Japan	Malay	Mongol	Phil	Viet
Water regime								
a. Aggregated	▲		▲		▲	▲	▲	▲
b. Disaggregated		▲		▲				
Organic Amendment								
a. Aggregated				▲	▲			
b. Disaggregated								
c. No available data	▲	▲	▲			▲	▲	▲

COUNTRY SPECIFIC CH_4 EF FROM RICE ECOSYSTEMS

- **With country-specific EF:**
  - Japan
  - Philippines
- **Without country-specific EF:**
  - Indonesia
  - Malaysia
  - Cambodia
  - Vietnam



National Inventory for Japan CH_4 Emissions from Rice Cultivation

Emission Factors

Type of soil	No. of data	Straw amendment	Various compost amendment	No-amendment	Proportion of area
			[$gCH_4/m^2/year$]		%
Andosoil	2	8.50	7.59	6.07	11.9
Yellow soil	4	21.4	14.6	11.7	9.4
Lowland soil	21	19.1	15.3	12.2	41.5
Gley soil	6	17.8	13.8	11.0	30.8
Peat soil	2	26.8	20.5	16.4	6.4

- Based on field monitoring campaign during 1992-1994 at 35 sites over Japan
- Measured by conventional water management with mid-season drainage followed by intermittent flooding

Methane emission factors from rice fields in the Philippines.

Ecosystem	Mean emission ($mg/m^2/day$) from Sites			Emission Factor (kg/ha/day)		% Decrease from IPCC
	Los Baños	Maligaya	Mean	Derived	IPCC default (T=27 °C)	
Irrigated	233.1	225.5	229.3	**2.3**	5.9	61
Rainfed	40.3		40.3	**0.4**	3.54	89

2006 IPCC Guidelines Methodology for CH_4 Emissions from Rice Cultivation

Baseline Emission Factor (EFc)

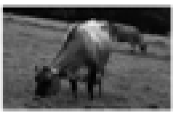
[illegible]	Emission factor	Error range
CH_4 emission ($kg\ CH_4\ ha^{-1}\ d^{-1}$)	1.30	0.80-2.20

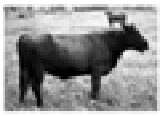
A baseline emission factor for:
- no flooded fields for less than 180 days prior to rice cultivation
- Continuously flooded during the rice cultivation period
- without organic amendments

EFc in the 1996 Guidelines & 2000 GPG
= 200 $kg\ ha^{-1}\ season^{-1}$
- Without statistical analysis
- Regardless of the length of the cultivation period

CH_4 Emission from Enteric Fermentation

- Activity Data on Number of heads of different ruminants
- – available for all countries
- - National Statistics data
- - Bureau of Animal Industry





Method for Estimation Current Methane Emission

Dividing animals into animal group

Collecting dry matter intake(DMI) of each animal group

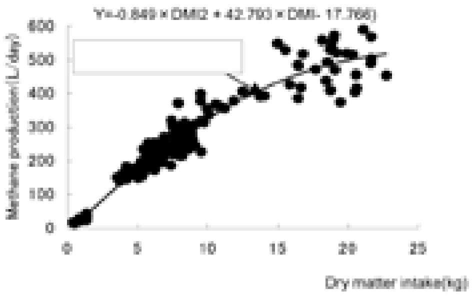
Estimate methane emission by Shibata's equation (Methane production(L/day) = $-0.849 \times DMI^2 + 42.793 \times DMI - 17.766$)

Collecting population data

Multiplying the population by estimate methane emission for each animal group

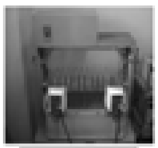
Summing emissions across animal group

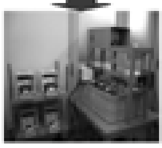
Prediction of methane emission from enteric fermentation in Japan



A trial of simple measurement technique of quantity of methane emission

Open circuit respiration chamber





Sulfur hexafluoride tracer technique(SF6)

In vitro gas production technique

Rusitec(Semi-continuous system similar to rumen)

Steps for Improvements of Activity Data in Agriculture:

- Statistical Yearbooks
- Agricultural Statistics
- Seek help for data gathering from National Ministries (Agriculture, Environment) and regional offices
- Experts' opinion
- Documentation/Archiving (sources, comments)
- Sampling to obtain data

Steps for Improvements of EF

- Develop a technology needed to estimate CH_4 emission accurately from ruminants
- For countries without country-specific EF, use EF values from other countries with similar climatic conditions and cultural practices
- Consult the EFDB
- Modeling, equations (Shibata's eqn)

Future directions

- Organic C in soil
- N_2O emissions from N inputs (inorganic fertilizer, manure, crop residues)
- CH_4 and N_2O emissions from residue burning
- Feed type and feed composition vs CH_4 emissions from ruminants
- Proper archiving of AD and EF (sources, notes, comments)
- Listing of AD, EF, data gaps, institutionalization of data gathering and compilation of AD and EF for national GHG inventories

THANK YOU!

Summary from LUCF Working Group

Chair: Rizaldi Boer
Reporter: Heng Chan Thoeun
Member: Chisa Umemiya, Samsudin Musa, Masahiro Amano, Betha Lusiana, Dadang Hilman ...

Key Issues

- Methods for deriving Mean Annual Increment
- Approaches to estimate the uncertainty of the estimates
- Experiences in using IPCC-GPG Guidance for LULUCF (Stock Change Approach)
- Proposals for Improving National Capacity to improve National GHG Inventory for LUCF sector

Methods for deriving MAI

- Indonesia presented a number of approaches to estimate MAI
  - Natural Forest (Logged-over forest) using Reported Tree Diameter Increment Data collected by Forest Concession Companies
  - Plantation Forest using Wood Volume Data
- The selection of MAI for a certain forest categories has huge impact of the estimate of carbon removal. Level of certainty for the MAI for such forest categories is very crucial to increase the reliability the estimates. The key forest categories (of the 26 land use/forest categories) for Indonesia were production forest, conversion forest, rubber plantation and coconut/palm oil plantation. These four forest categories contributed to about 52% of total carbon removal of the country

Methods for deriving MAI

- Cambodia experience from field measurement study on MAI, ecological condition of forests affect very much on the MAI. However, such information is not taken into account in making Cambodia 1994 inventory as inventories were developed based on "national forest classification only
- Malaysia has conducted good forest inventories four times (every 10 years) and the results are a good basis for improving the National GHG Inventory for LUCF sector. However, such resources have not been used by the National Inventory Team.

Approaches to estimate the uncertainty of the Estimates

- Indonesia presented two cases in assessing the uncertainty of the GHG Inventory for LUCF:
  - Monte Carlo simulation is found to be a good approach however this approach may lead to a greater uncertainty if the availability of the data is limited (e.g. Monte Carlo simulation requires information on standard deviations of the AD and EF where these values are readily available). Malaysia could be benefit from using this approach as it has better database of the AD and EF from its forest inventory.

Approaches to estimate the uncertainty of the Estimates

- ICRAF demonstrated the relationship between simplifying land use/forest categories (AD) and overall uncertainty of the Carbon stock estimates
  - **Broad land use categories are desirable to reduce classification error (eg. Forest, Tree-based, non tree-based, non-vegetation, settlement), however, there is a need to have C-stock samples in finer categories structured in a hierarchy that allows grouping into the broad categories used in image classification (to ensure that the combined land use/forest categories have slight different in C-Stock)**

Experiences in using IPCC-GPG Guidance for LULUCF (Stock Change Approach)

- Japan has applied Carbon Stock Approach (IPCC-GPG for LULUCF) in developing its GHG Inventory. Some important findings
  - The stock change method will provide good results if very accurate forest inventories are available, otherwise default method is recommended
- The choice of using default or stock change method at the appropriate tier level will therefore be a matter for expert judgment.

Experiences in using IPCC-GPG Guidance for LULUCF (Stock Change Approach)

- The challenges for tropical countries are
  - There are big differences of MAI between natural/plantation and among species,
  - Many stands composed of various species, and
  - There are a lot of natural regenerated forests and natural forests
- Single approach may not provide good inventory in tropical zone and tropical countries will need more works to do related to the above issues
- In the context of NATCOM, can developing countries uses combination of the two approaches as appropriate?

Proposals for Improving National Capacity to improve National GHG Inventory for LUCF sector

- The WGIA should play role in facilitating the countries to
  - develop link and collaboration with other national, regional, International organizations to improve their inventories (e.g. opening access to satellite image database owned by the organizations
- NIES may need to focus on disseminating works that have been done by the WGIA and how the countries can make use of these group to contribute to the process of the development of National GHG Inventories (e.g. developing list of targeted stakeholders/sectors that should receive the publications/articles produced by the NIES and the Group etc

Proposals for Improving National Capacity to improve National GHG Inventory for LUCF sector

- For tropical countries, more supports are needed to improve their GHG inventories for LUCF sector

The 4th WGIA: 14-15 Feb., 2007@Jakarta, Indonesia

Report on WG: Waste

Chair: Dr. Sirintornthep Towprayoon
Reporter: Dr. Masato Yamada
Participants: Mr. HB. Henky Sutanto, Ms. Upik Sitti Aslia, Mr. Hiroshi Fujita, Mr. Khamphone Keodalavong, Mr. Ne Winn, Ms. Raquel Ferraz Villanueva and Mr. Kiyoto Tanabe

7 countries/organization and 9 participants

Theme one: Wastewater treatment and discharge

Presentations

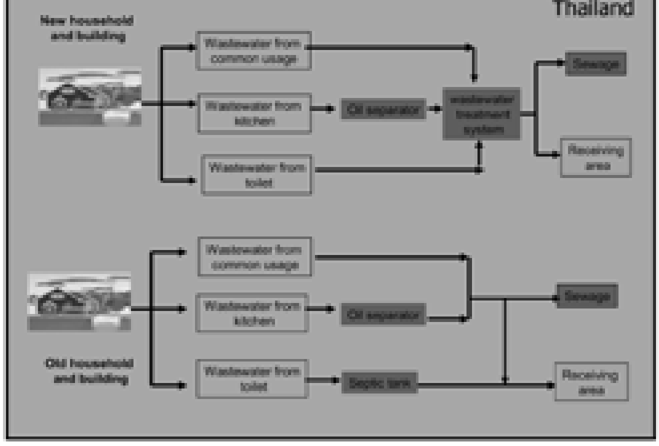
- Methodology in IPCC's Guidelines by Mr. Kiyoto Tanabe
- Country Report: Philippines by Ms. Raquel Ferraz Villanueva
- Country Report: Lao PDR by Mr. Khamphone Keodalavong
- Country Report: Indonesia by Mr. HB. Henky Sutanto and Ms. Upik Sitti Aslia
- Country Report: Myanmar by Mr. Ne Winn
- Country Report: Thailand by Dr. Sirintornthep Towprayoon
- Country Reports: Japan by Mr. Hiroshi Fujita

Discussion (1): Comparision of wastewater flow in Asia

- **Domestic WW flow**
  - **There are 4 types of flow in Asia**
    - **Untreated to river/sea**
    - **Septic tank to river/sea**
    - **Septic tank via sewer collection to river/sea**
    - **Septic tank through sewer collection to central treatment plant and discharging to river/sea**
  - **These flows are depend on type of septic tank**
  - The flowchart in 2006 guideline is not enough for Asian Countries.

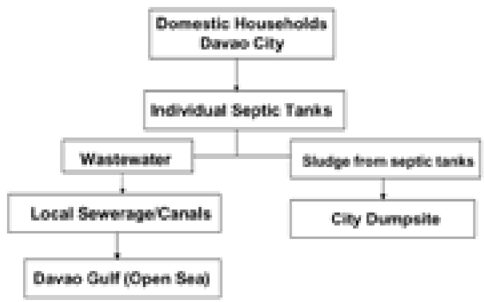
On site Wastewater Treatment

Thailand



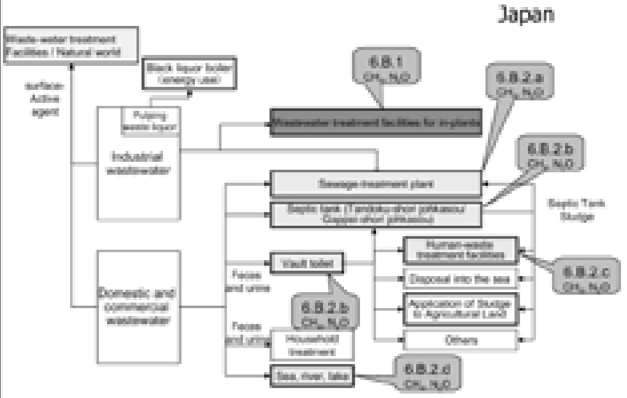
WASTEWATER FLOW FOR DOMESTIC WASTEWATER

Philippines



Management flow of Wastewater

Japan



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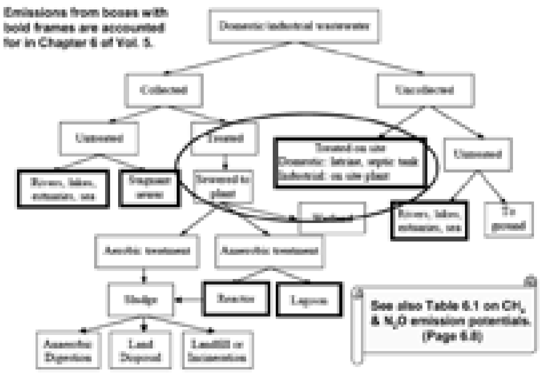
    - Septic tank through sewer collection to central treatment plant and discharging to river/sea
  - These flows are depend on type of septic tank
  - **The flowchart in 2006 guideline is not enough for Asian Countries.**

Wastewater treatment system and discharge pathways

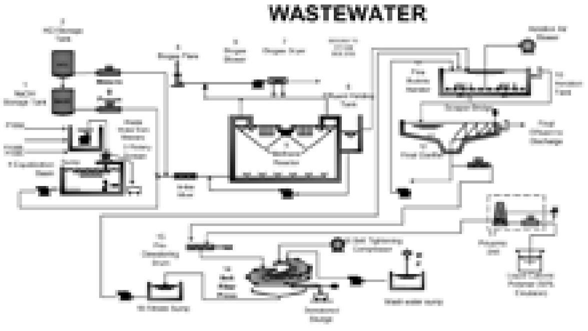
IPCC



Discussion (2): Comparision of wastewater flow in Asia

- **Industrial WW flow**
  - **should depend on type of industry**
    - **Uncollected & untreated: small factory**
    - **Organics is mainly contained in WW from Food, Pulp and paper, Chemical, Textile... industries**
    - **Make attention to fate of sludge.**

WASTEWATER FLOW FOR INDUSTRIAL WASTEWATER

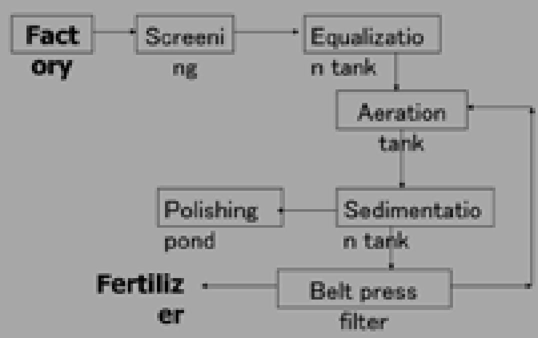


BEER MANUFACTURING PLANT

Philippines

Industrial Wastewater Flow

Lao PDR



Discussion (3): Other Issues

- **Mixing of Domestic and Industrial WW**
  - **is not common in Asian Countries.**
- **EF**
  - **MCF: less information in Asian countries.**
  - **We can use 2006 guideline data if they fit to Asian countries.**

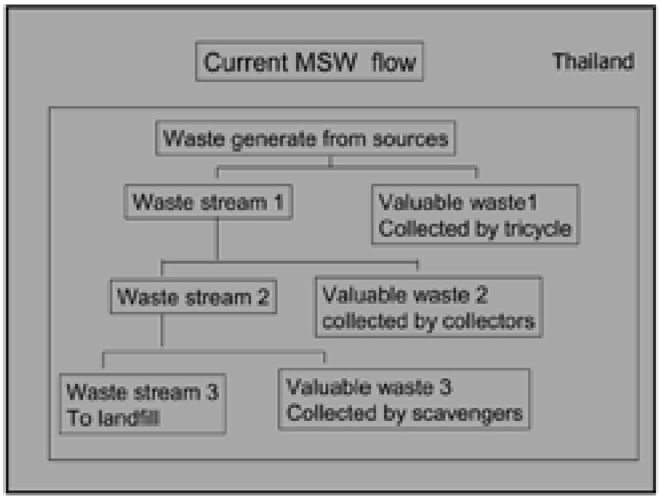
Theme two: Solid waste disposal on land

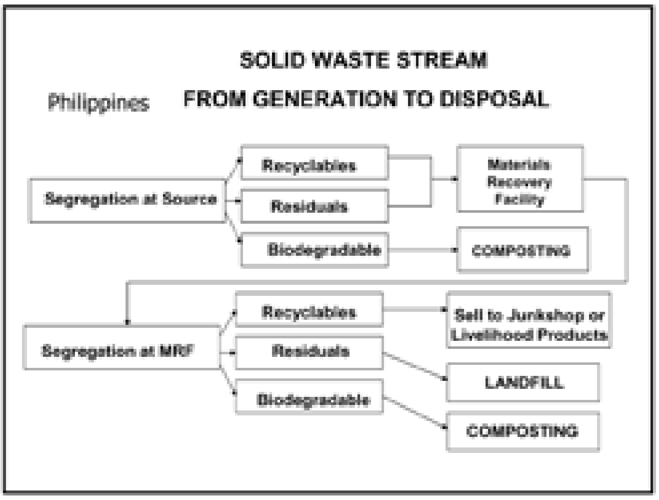
Presentations

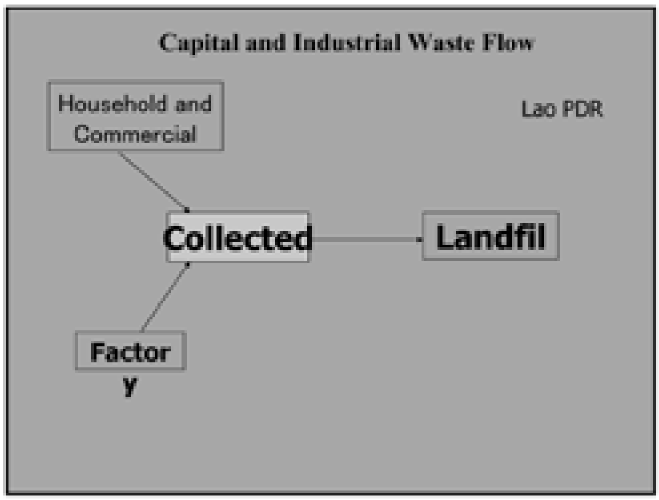
- Country Reports: Lao PDR by Mr. Khamphone Keodalavong
- Country Reports: Indonesia by Mr. HB. Henky Sutanto
- Country Reports: Philippines by Ms. Raquel Ferraz Villanueva
- Country Reports: Thailand by Dr. Sirintornthep Towprayoon
- Country Reports: Japan by Dr. Masato Yamada

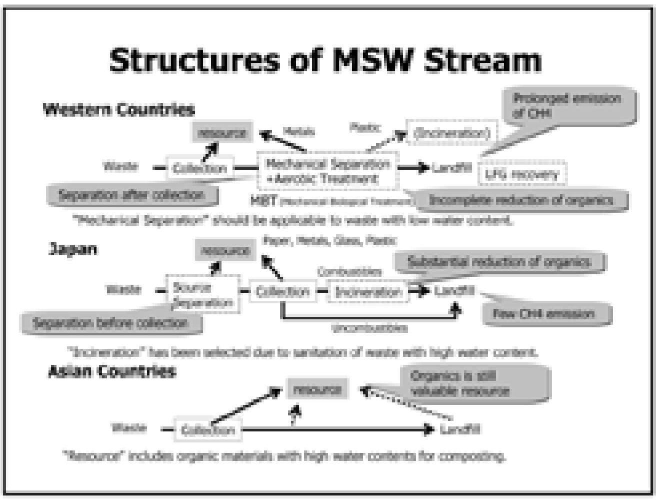
Discussion (4): Comparison of Solid Waste Stream in Asia

- **2 Waste recycling activities**
  - **Separation at Source (or House): almost every countries for valuables**
  - **Material Recovery Facility: some countries (Philippines, Thailand)**
- **Access to data on recycling is possible.**
- **Pre-treatment (or waste reduction) technologies in Asian countries are composting and incineration.**
- **Waste stream of each countries is also affected from policy of local municipality, law, society...**









Discussion (5): Comparison of Solid Waste Stream in Asia and Others

- **Database on mass and quality (or composition) of waste and its continuity is important.**
  - **This can be also used for future improvement of management with incineration, RDF, Waste to Energy or so on...**
  - **Composition will be change due to growing recycling activities.**
  - **Data acquisition is important. Guideline could be helpful.**
- Main co-benefit in improvement of waste management such as waste recycling and energy recovery depends on country's situation.

Philippines

SOLID WASTE COMPOSITION/SOURCES

Residual (Non-Biodegradable)

Tin Foil	Shells
Rubber Tires	Plastic Wrappers
Broken Ceramics	Rubber Bands
Broken Bottles	Twine
Broken Glasses	Cups
Cigarette Filters	Toothpaste Tubes
Hair	Shampoo Sachets
Straws	Sanitary Napkin
Diapers	

Weight in kilograms = 2.30 kgs.
Percentage = 12%

Biodegradable

Food Leftovers	Leaves
Vegetable Peelings	
Flowers	
Roots of Plants	Egg Shells
Banana Stalk	Paper
Kitchen Waste	Barbeque
Animal Waste	Sticks

Weight in kilograms = 10.40 kgs.
Percentage = 52%

Capital and Industrial Waste

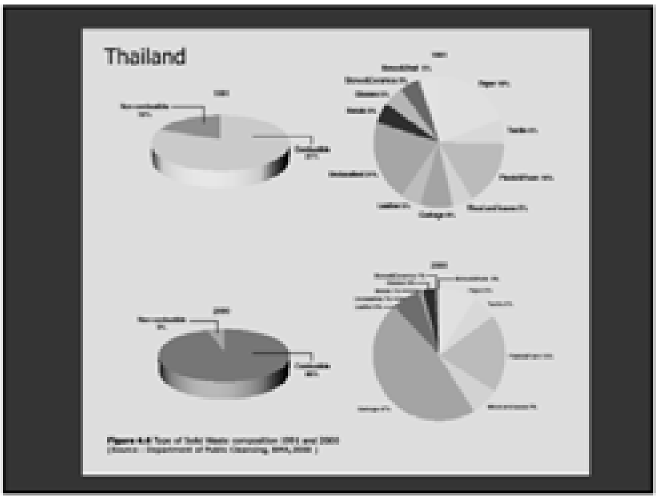
Lao PDR

- Only 5 major town has was collection systems
- Disposal Method:
  - Disposal at the land field sites
  - Burning in open areas
  - Dumping on selected spots or water body
- Waste Production in urban areas 0.75 kg per capita per day.

Composition of Solid Waste:

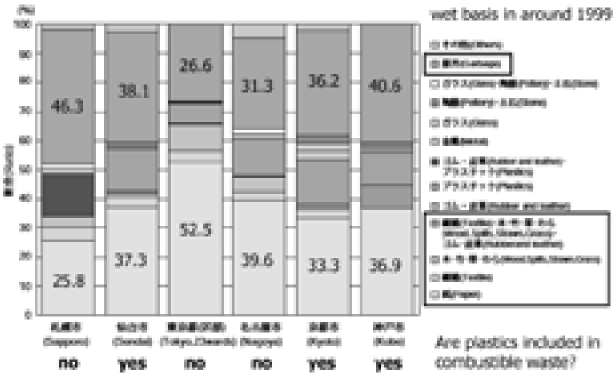
- Organic Material (Compost) - 60 %
- Reuse waste (Glass,can...) - 10-15 %
- Recycle Waste (Plastic , Paper, Steel...) - 10-15 %
- Hazardous Waste - 10 %

(Urban and Commercial Waste has the same composition)



Japan

Composition of MSW (for combustible waste)



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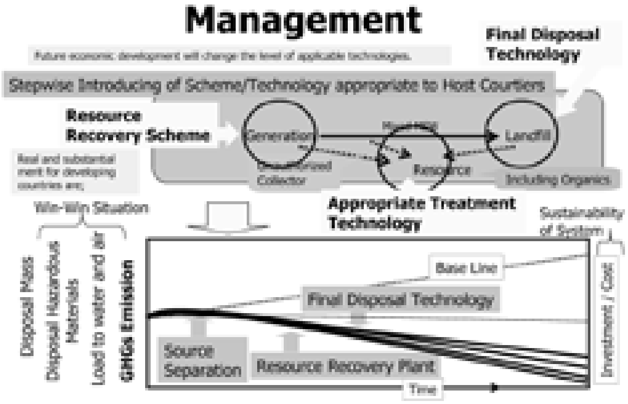
  - Data acquisition is important. Guideline could be helpful.
- **Main co-benefit in improvement of waste management such as waste recycling and energy recovery depends on country's situation.**

Co-benefit in Waste Stream Management



Thank you for your attention

INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE
NATIONAL GREENHOUSE GAS INVENTORIES PROGRAMME
WMO UNEP

Quality Assurance/Quality Control and Verification

Kiyoto Tanabe
Technical Support Unit,
IPCC NGGIP

The 4th Workshop on GHG Inventories in Asia (WGIA)
14-15 February 2007, Jakarta, Indonesia

Outline

- Aims
- Definition (from 2006 IPCC Guidelines)
- Practical considerations
- Major elements

QA/QC and Verification – Why?

- QA/QC and verification procedures serve:
  - ✓ to develop national GHG inventories that can be readily assessed in terms of quality
  - ✓ to drive inventory improvement
- A QA/QC and verification system contributes to improvement of national GHG inventory
  - Transparency
  - Consistency
  - Comparability
  - Completeness
  - Accuracy

What is "Quality Control"?

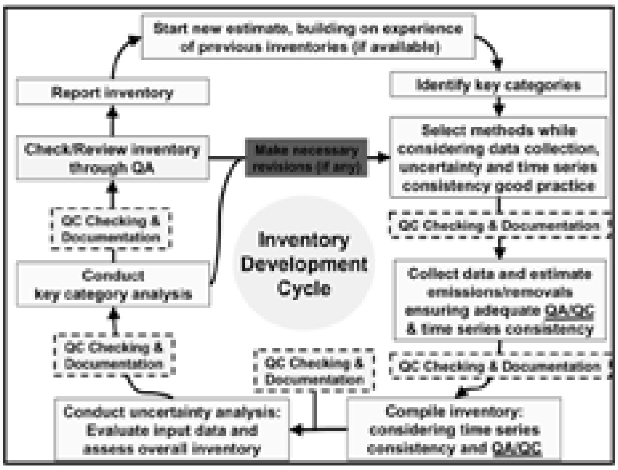
- System of routine technical activities to assess and maintain the quality of the inventory as it is being compiled
- Performed by personnel compiling the inventory
- QC system is designed to:
  - ✓ Provide routine and consistent checks to ensure data integrity, correctness, and completeness
  - ✓ Identify and address errors and omissions
  - ✓ Document and archive inventory material and record all QC activities

What is "Quality Assurance"?

- Planned system of review procedures conducted by personnel not directly involved in the inventory compilation/development process (preferably by independent third parties)
- Performed upon a completed inventory following the implementation of QC procedures
  - ✓ Verify that measurable objectives were met
  - ✓ Ensure that the inventory represents the best possible estimates given the current state of scientific knowledge and data availability
  - ✓ Support the effectiveness of the QC programme

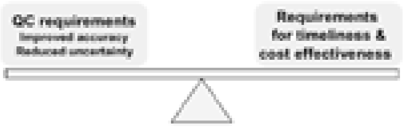
What is "Verification"?

- Collection of activities and procedures conducted during the planning and development, or after completion of an inventory that can help to establish its reliability for the intended applications of the inventory
- Methods that are external to the inventory and apply independent data, including comparisons with inventory estimates made by other bodies or through alternative methods
- May be constituents of both QA and QC



Practical Considerations

- Seek to achieve the balance of both requirements



- Also seek to enable continuous improvement of inventory estimates
- Try to identify where to focus more intensive analysis and review

Major Elements

- Participation of an inventory compiler who is also responsible for coordinating QA/QC and verification activities and definition of roles/responsibilities within the inventory
- A QA/QC plan
- General QC procedures that apply to all inventory categories
- Category-specific QC procedures
- QA and review procedures
- QA/QC system interaction with uncertainty analyses
- Verification activities
- Reporting, documentation, and archiving procedures

Roles and Responsibilities

- The inventory compiler should:
  - ✓Be responsible for coordinating the institutional and procedural arrangements for inventory activities.
  - ✓Define specific responsibilities and procedures for the planning, preparation, and management of inventory activities.

QA/QC Plan

- Fundamental element of the system
- Should include a scheduled time frame for the QA/QC activities
- A key component – List of data quality objectives (measurable)
- Important to accommodate procedural changes and a feedback of experience
  - ✓The periodic review and revision of the QA/QC plan is an important element to drive the continued inventory improvement.

General QC Procedures

- Generic quality checks applicable to all source and sink categories, related to:
  - ✓Calculations
  - ✓Data processing
  - ✓Completeness
  - ✓Documentation
- Automated checks are encouraged where possible – to effectively check large quantities of input data

Category-specific QC Procedures

- Complements general QC procedures
- Directed at specific types of data used in the methods for individual source or sink categories
- Applied on a case-by-case basis focusing on:
  - ✓key categories
  - ✓categories where significant methodological and data revisions have taken place

QA Procedures

- Activities outside the actual inventory compilation, performed preferably by third party reviewers who are independent from the inventory compiler
  - ✓Expert peer review
  - ✓Audits
- Priority should be given to:
  - ✓key categories
  - ✓categories where significant methodological and data revisions have taken place

QA/QC and Uncertainty Estimates

- Provide valuable feedback to each other on critical components of the inventory estimates and data sources that:
  - ✓Contribute to both the uncertainty level and inventory quality
  - ✓Should therefore be a primary focus of inventory improvement efforts
- Uncertainty analysis can provide insights into:
  - ✓Weaknesses in the Estimate
  - ✓Sensitivity of the estimate to different variables
  - ✓The greatest contributors to uncertainty

Verification

- Activities to provide information for countries to improve their inventories
  - ✓Comparisons of national estimates
    - Applying different tier methods
    - Comparisons with independently compiled estimates
    - Comparisons of intensity indicators between countries
  - ✓Comparisons with atmospheric measurements

Documentation, Archiving and Reporting

- Document and archive all information relating to the planning, preparation, and management of inventory activities
  - ✓Records of QA/QC procedures are important information to enable continuous improvement to inventory estimates.
- Report a summary of implemented QA/QC activities and key findings as a supplement to each country's national inventory

The 4th Workshop on GHG Inventories in Asia (WGIA)
14-15 February 2007, Jakarta, Indonesia

Quality Assurance/Quality Control

Batimaa P. Institute of Meteorology and Hydrology

Objectives

Why we need the internal and external quality assurance/control ?

- to identify potential problems and make corrections where possible
- to perform GHG inventory with good quality
  - Internal
  - External

Internal assurance/control

- Organizations and implementing units that responsible for GHG national inventory will set up working group consisted from the professional organizations and experts to check accuracy and quality of NIR
- The working group will take quality control according to **approved guidelines**

Steps

- Check AD
- Check EF
- Check Methodology
- Check calculations
- Check the completeness
- Check documentation and archiving
- Check the report

Accuracy and completeness of AD

- Check the reliability of data sources
- All AD from each source have to be checked and compared with ones of previous inventory.
- AD checked against data sources
- Any changes from the previous inventory have to be checked whether the changes adjusted appropriately

Accuracy and completeness of EF

- To check reliability of EFs used
- To check estimated CS EFs

Methodology

- Check any changes in methodology

Estimation/calculation

- Identify any mistakes in calculation
- Check the recalculations

Completeness

- Check whether all sectors are included
- Check whether all gases are estimated

Documentation and archiving

Whether documentation and archiving was done according to the National Manual

External assurance/control

External assurance/control will be carried out by a third party that did not involve in inventory preparation

External assurance/control

Public Administrative organizations responsible for the implementation of the UNFCCC will set up a working group to take the external control/assurance.

External assurance/control

- Check and evaluate how the internal QA
- Compare the National inventory with other country`s inventory
- Recommendation for improvement

Thank you

Greenhouse gas Inventory Office of Japan

Quality Assurance & Quality Control in Japan

Jakarta, Indonesia
4th Workshop on GHG Inventories in Asia
February 14, 2007

Yukihiro NOJIRI
Manager Greenhouse Gas Inventory Office of Japan (GIO)
Center for Global Environmental Research (CGER)
National Institute for Environmental Studies (NIES)

Outline

Japan's QA/QC procedures has installed to each step of the inventory preparation and development

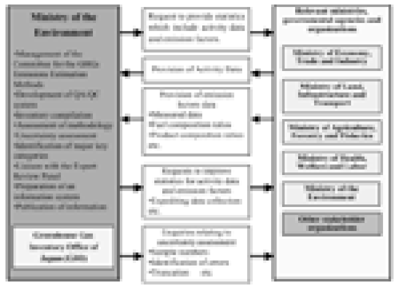
- Inventory Planning
- Inventory Preparation including QA/QC
- Inventory Management
- Further Improvement

Greenhouse gas Inventory Office of Japan

Greenhouse gas Inventory Office of Japan

1. Inventory Planning

1-2. Institutional Arrangement for the Preparation of the GHG Inventories



➢Based on ***the Law Concerning the Promotion of Measures to Cope with Global Warming***

Greenhouse gas Inventory Office of Japan

1-3. Quality Assurance/Quality Control Plan

➢Current QA/QC plan was established 2nd February 2006 which is included in the report of the Estimation Method Committee *(only in Japanese)*.

➢Summary of the QA/QC plan is indicated in the Initial Report.

- ➢QC: conducted by the MOE (including GIO and consultants), as well as by other related agencies and organizations
- ➢QA: conducted by Japanese experts within the Committee for the Greenhouse Gases Emissions Estimation Methods

Greenhouse gas Inventory Office of Japan

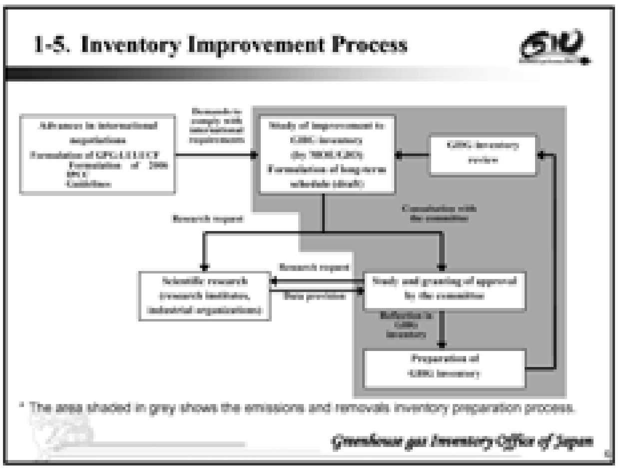
1-4. Official Consideration and Approval

➢In the case that changes in the estimate are made, study is carried out in the Committee for the Greenhouse Gas Emissions Estimation Methods.

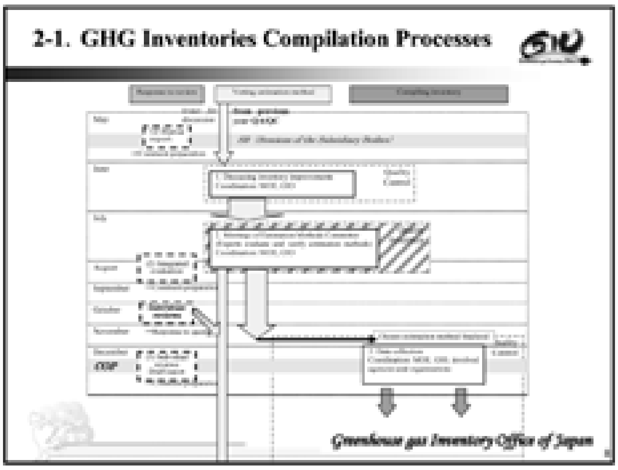
➢The prepared GHG inventories are circulated with electrical basis such as CD-ROM among the related ministries and after they have all confirmed and approved them.

➢If necessary, a report is also made to the Global Warming Prevention Headquarters.

Greenhouse gas Inventory Office of Japan


1-5. Inventory Improvement Process
Advances in international negotiations
Study of improvement to GHG inventory
GHG inventory review
Consultation with the committee
Research request
Scientific research (research institutes, industrial organizations)
Research request
Data provision
Study and granting of approval by the committee
Preparation of GHG inventory
* The area shaded in grey shows the emissions and removals inventory preparation process.
Greenhouse gas Inventory Office of Japan


Greenhouse gas Inventory Office of Japan
2. Inventory Preparation including QA/QC

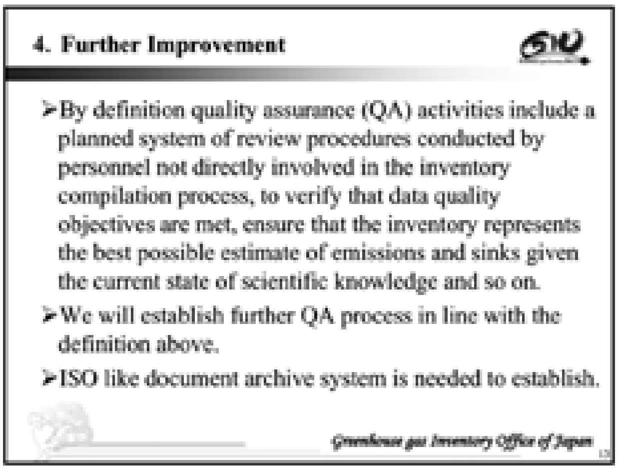

2-1. GHG Inventories Compilation Processes
Greenhouse gas Inventory Office of Japan

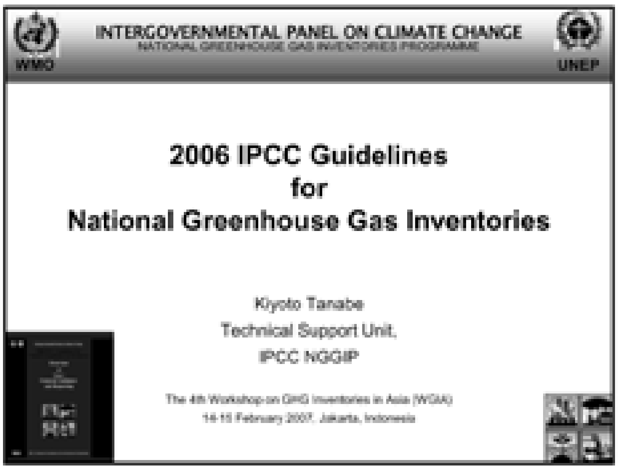

2-2. GHG Inventories Compilation Processes (cont.)
to the next year QA/QC
Greenhouse gas Inventory Office of Japan


Greenhouse gas Inventory Office of Japan
3. Inventory Management


3. Inventory Management
➢Historical data on GHG inventories are archived in Electric Basis in GHG Inventory Office of Japan (GIO).
➢MOE, GIO and relevant ministries and organization have been responding to review processes and have been providing archived information.
Greenhouse gas Inventory Office of Japan


Greenhouse gas Inventory Office of Japan
4. Further Improvement


4. Further Improvement
➢By definition quality assurance (QA) activities include a planned system of review procedures conducted by personnel not directly involved in the inventory compilation process, to verify that data quality objectives are met, ensure that the inventory represents the best possible estimate of emissions and sinks given the current state of scientific knowledge and so on.
➢We will establish further QA process in line with the definition above.
➢ISO like document archive system is needed to establish.
Greenhouse gas Inventory Office of Japan


INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE
NATIONAL GREENHOUSE GAS INVENTORIES PROGRAMME
WMO
UNEP
2006 IPCC Guidelines
for
National Greenhouse Gas Inventories
Kiyoto Tanabe
Technical Support Unit,
IPCC NGGIP
The 4th Workshop on GHG Inventories in Asia (WGIA)
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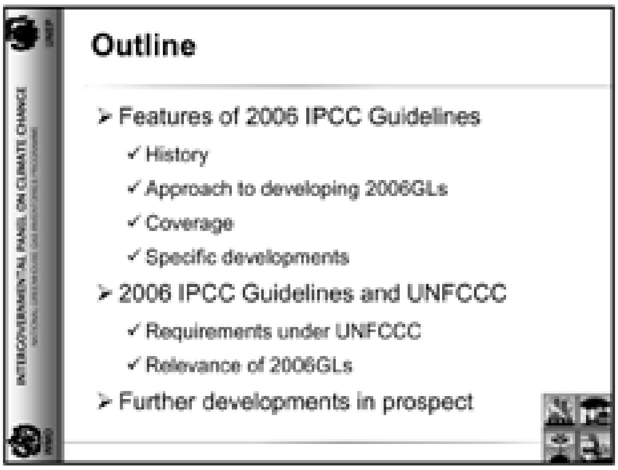
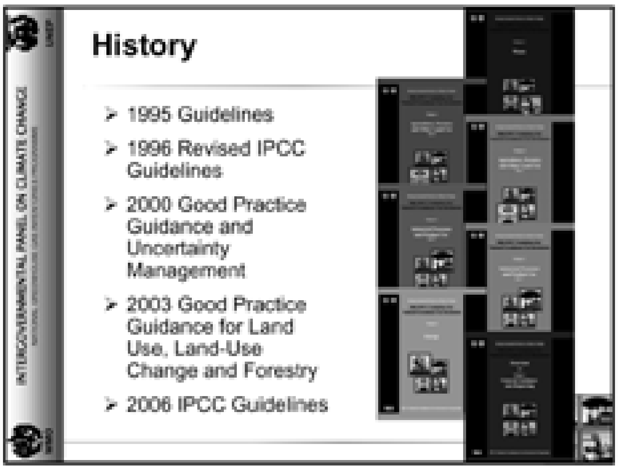
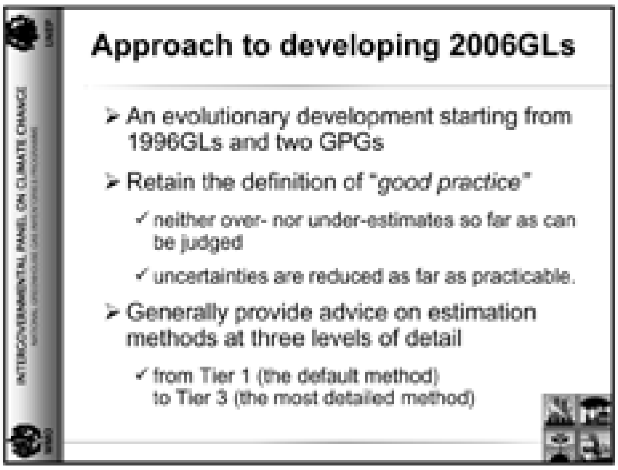
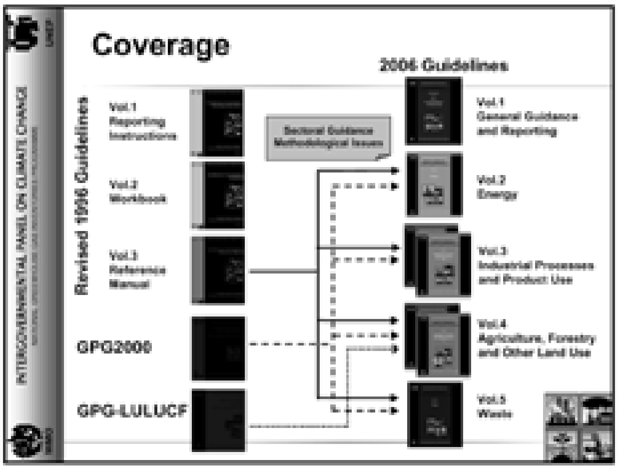
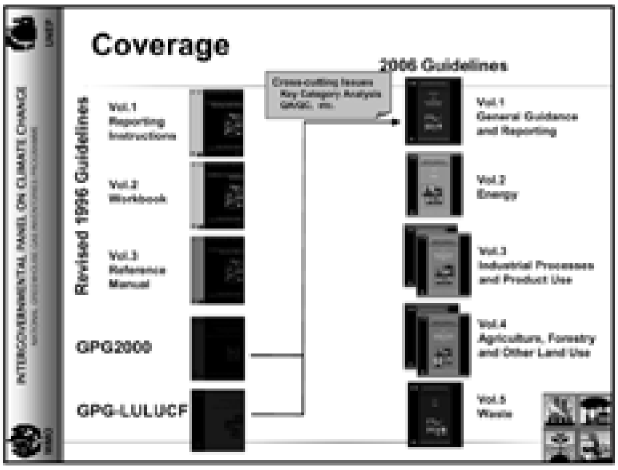
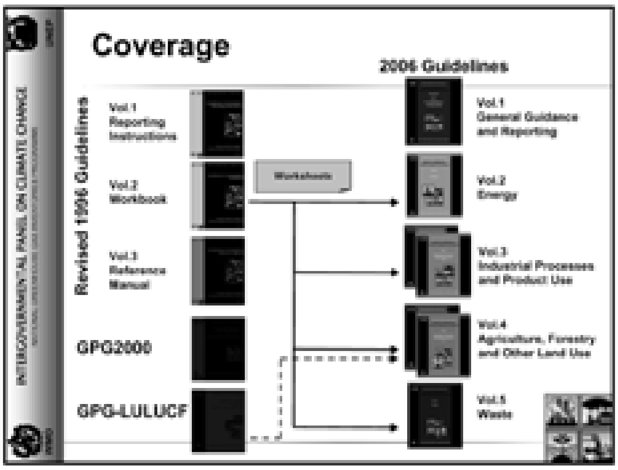

Outline
➢ Features of 2006 IPCC Guidelines
✓ History
✓ Approach to developing 2006GLs
✓ Coverage
✓ Specific developments
➢ 2006 IPCC Guidelines and UNFCCC
✓ Requirements under UNFCCC
✓ Relevance of 2006GLs
➢ Further developments in prospect
INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE

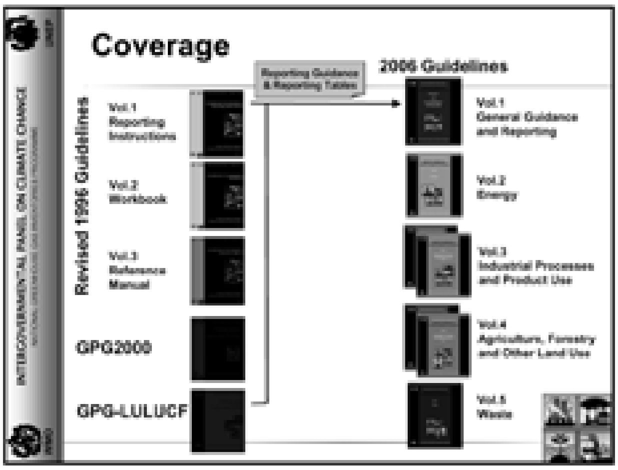

History
➢ 1995 Guidelines
➢ 1996 Revised IPCC Guidelines
➢ 2000 Good Practice Guidance and Uncertainty Management
➢ 2003 Good Practice Guidance for Land Use, Land-Use Change and Forestry
➢ 2006 IPCC Guidelines
INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE

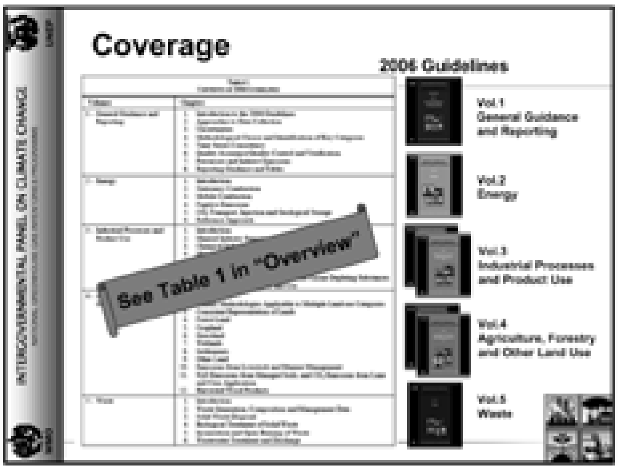

Approach to developing 2006GLs
➢ An evolutionary development starting from 1996GLs and two GPGs
➢ Retain the definition of "good practice"
✓ neither over- nor under-estimates so far as can be judged
✓ uncertainties are reduced as far as practicable.
➢ Generally provide advice on estimation methods at three levels of detail
✓ from Tier 1 (the default method) to Tier 3 (the most detailed method)
INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE

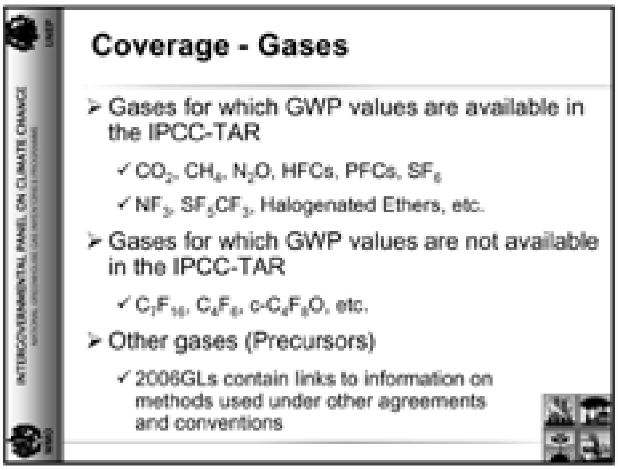

Coverage
2006 Guidelines
Revised 1996 Guidelines
Vol.1 Reporting Instructions
Vol.2 Workbook
Vol.3 Reference Manual
GPG2000
GPG-LULUCF
Sectoral Guidance Methodological Issues
Vol.1 General Guidance and Reporting
Vol.2 Energy
Vol.3 Industrial Processes and Product Use
Vol.4 Agriculture, Forestry and Other Land Use
Vol.5 Waste

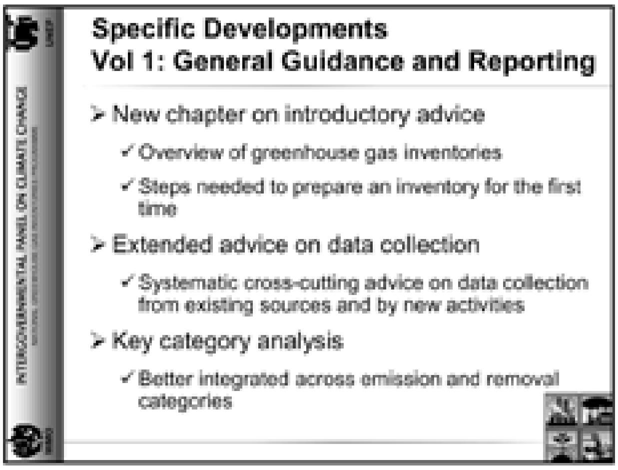

Coverage
2006 Guidelines
Revised 1996 Guidelines
Vol.1 Reporting Instructions
Vol.2 Workbook
Vol.3 Reference Manual
GPG2000
GPG-LULUCF
Cross-cutting Issues
Key Category Analysis
QA/QC, etc.
Vol.1 General Guidance and Reporting
Vol.2 Energy
Vol.3 Industrial Processes and Product Use
Vol.4 Agriculture, Forestry and Other Land Use
Vol.5 Waste

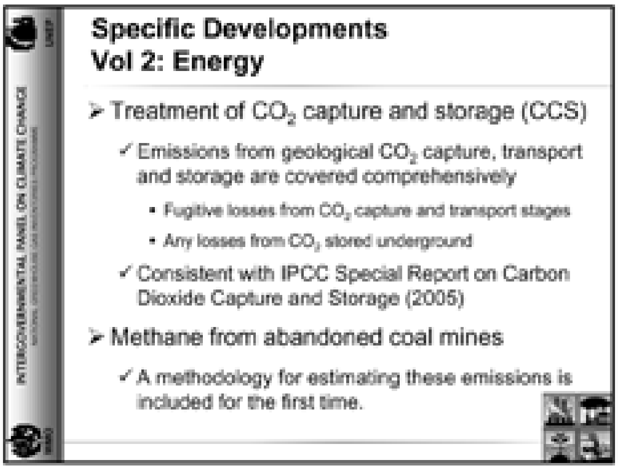

Coverage
2006 Guidelines
Revised 1996 Guidelines
Vol.1 Reporting Instructions
Vol.2 Workbook
Vol.3 Reference Manual
GPG2000
GPG-LULUCF
Worksheets
Vol.1 General Guidance and Reporting
Vol.2 Energy
Vol.3 Industrial Processes and Product Use
Vol.4 Agriculture, Forestry and Other Land Use
Vol.5 Waste


Coverage
Reporting Guidance & Reporting Tables
2006 Guidelines
Revised 1996 Guidelines
Vol.1 Reporting Instructions
Vol.2 Workbook
Vol.3 Reference Manual
GPG2000
GPG-LULUCF
Vol.1 General Guidance and Reporting
Vol.2 Energy
Vol.3 Industrial Processes and Product Use
Vol.4 Agriculture, Forestry and Other Land Use
Vol.5 Waste


Coverage
2006 Guidelines
See Table 1 in "Overview"
Vol.1 General Guidance and Reporting
Vol.2 Energy
Vol.3 Industrial Processes and Product Use
Vol.4 Agriculture, Forestry and Other Land Use
Vol.5 Waste


Coverage - Gases
➢ Gases for which GWP values are available in the IPCC-TAR
✓ CO_2, CH_4, N_2O, HFCs, PFCs, SF_6
✓ NF_3, SF_5CF_3, Halogenated Ethers, etc.
➢ Gases for which GWP values are not available in the IPCC-TAR
✓ C_7F_{16}, C_4F_6, c-C_4F_8O, etc.
➢ Other gases (Precursors)
✓ 2006GLs contain links to information on methods used under other agreements and conventions


Specific Developments
Vol 1: General Guidance and Reporting
➢ New chapter on introductory advice
✓ Overview of greenhouse gas inventories
✓ Steps needed to prepare an inventory for the first time
➢ Extended advice on data collection
✓ Systematic cross-cutting advice on data collection from existing sources and by new activities
➢ Key category analysis
✓ Better integrated across emission and removal categories


Specific Developments
Vol 2: Energy
➢ Treatment of CO_2 capture and storage (CCS)
✓ Emissions from geological CO_2 capture, transport and storage are covered comprehensively
• Fugitive losses from CO_2 capture and transport stages
• Any losses from CO_2 stored underground
✓ Consistent with IPCC Special Report on Carbon Dioxide Capture and Storage (2005)
➢ Methane from abandoned coal mines
✓ A methodology for estimating these emissions is included for the first time.

Specific Developments Vol 3: IPPU

- New categories and new gases
  - ✓ Expanded to include more manufacturing sectors and product uses (e.g., Production of TiO_2, petrochemicals, LCD)
  - ✓ Additional GHGs identified in the IPCC TAR (e.g., NF_3, SF_5CF_3)
- Non-Energy Uses of Fossil Fuels
  - ✓ Improved guidance on demarcation with the Energy Sector
- Actual emissions of F-gases as Tier 1
  - ✓ Potential emissions - no longer considered appropriate
  - ✓ New Tier 1 - Actual emission estimation based on default activity data where better data are not available.

Specific Developments Vol 4: AFOLU

- Integration between Agriculture and LULUCF
- Managed land as a proxy for identifying anthropogenic emissions and removals
- Consolidation of previously optional categories
  - ✓ Emissions and removals from all fires on managed land
  - ✓ CO_2 emissions and removals associated with terrestrial carbon stocks in settlements and managed wetlands
- Approach-neutral methods to include HWP
- "Appendix" - Basis for future methodological development
  - ✓ e.g., CH_4 emissions from managed flooded lands

Specific Developments Vol 5: Waste

- Revised methodology for CH_4 from landfills
  - ✓ New Tier 1 method - a simple first order decay model
  - ✓ Option to use data available from the UN and other sources
  - ✓ Regional and country-specific defaults on waste generation, composition and management
- Carbon accumulation in landfills
  - ✓ Relevant for the estimation of HWP in AFOLU
- Biological treatment and open burning of waste
  - ✓ To ensure a more complete coverage of sources

Specific Developments Relevant to all volumes

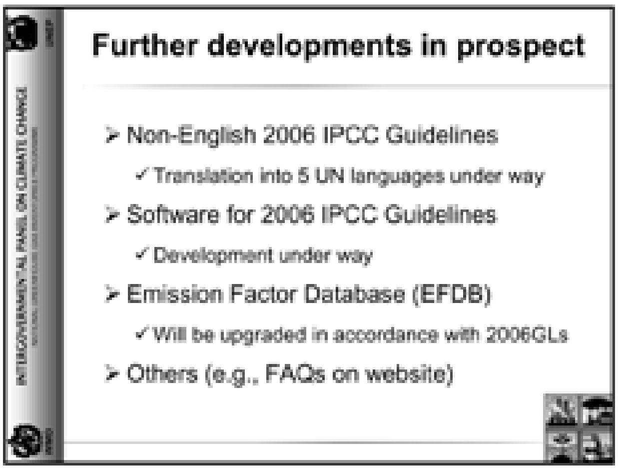
- CO_2 resulting from emissions of other gases
  - ✓ 2006GLs estimate carbon emissions in terms of the species which are emitted
  - ✓ CO_2 from atmospheric oxidation of non-CO_2 species can be estimated additionally, if necessary
- Treatment of nitrogen (N) deposition
  - ✓ Formerly only agricultural sources were covered
  - ✓ 2006GLs cover all significant sources of N deposition, including agriculture, industrial and combustion sources
- Relationship to entity- or project level estimates
  - ✓ Methods for national inventories can also be relevant for estimating actual emissions or removals at the entity or project level.

Requirements under UNFCCC

- 1996 Guidelines (+GPGs)
  - ✓ Annex I Parties "shall" use 1996GLs and GPGs
  - ✓ Non-Annex I Parties:
    - "should" use 1996GLs [Dec 17/CP.8]
    - "are encouraged to" use GPGs [Dec 13/CP.9]
- 2006 Guidelines
  - ✓ Not yet approved by UNFCCC for use as a whole
  - ✓ Nevertheless, 2006GLs may assist Parties in fulfilling their inventory reporting requirements under the UNFCCC

Relevance of 2006 IPCC Guidelines

- Individual methods in 2006GLs can be used within the 1996/UNFCCC reporting guidelines
  - ✓ "... Users are encouraged to go beyond these minimum default methods where possible, ..." (1996GLs Vol.1 Overview)
  - ✓ Remember!! The 2006GLs are:
    - An **evolutionary** development
    - Authors' best methodologies available (accepted by IPCC)
    - For the use of all countries
- For example...
  - ✓ New or revised default EF data for Fuel Combustion
  - ✓ Tier 1 methods to calculate actual emissions of F-gases
  - ✓ Tier 1 FOD method to estimate CH_4 from SWDSs


Further developments in prospect
➢ Non-English 2006 IPCC Guidelines
✓ Translation into 5 UN languages under way
➢ Software for 2006 IPCC Guidelines
✓ Development under way
➢ Emission Factor Database (EFDB)
✓ Will be upgraded in accordance with 2006GLs
➢ Others (e.g., FAQs on website)
INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE

Current and Future Greenhouse Gas Inventory Development in non-Annex I Parties

Dominique Revet
DRevet@unfccc.int

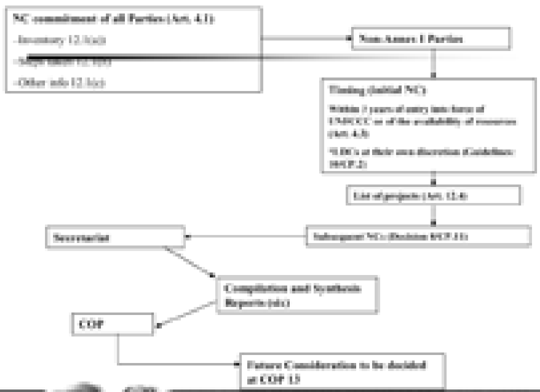
National Communications - Status

- **Total number of submitted national communications from non-Annex I Parties**
  - **Initial** national communications: **134** (as at 8 January 2007)
  - **Second** national communications: **3** (as at 27 March 2006)
  - **Third** national communications: **1** (as at 11 November 2006)
- **10 most recent submissions**
  - Sierra Leone (8 January 2007)
  - United Arab Emirates (UAE) 2 January 2007
  - Mexico (11 November 2006)
  - Mozambique (2 June 2006)
  - Fiji (18 May 2006)
  - Suriname (27 March 2006)
  - Guinea-Bissau (1 December 2005)
  - Saudi Arabia (29 November 2005)
  - Venezuela (13 October 2005)
  - Rwanda (8 September 2005)

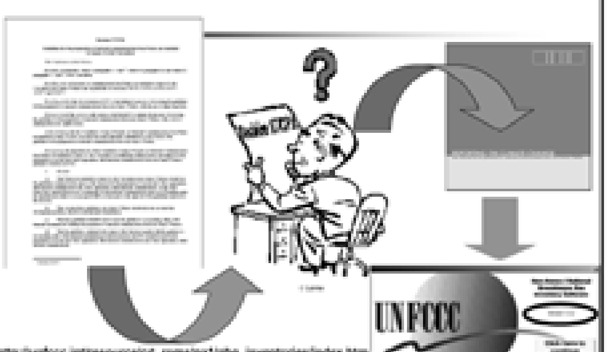
National Communications – Web Page

http://unfccc.int/national_reports/non-annex_i_natcom/items/2979.php

National Communications Process



Decision 17/CP.8

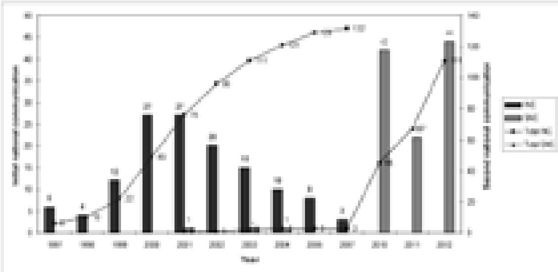


http://unfccc.int/resource/cd_roms/na1/ghg_inventories/index.htm

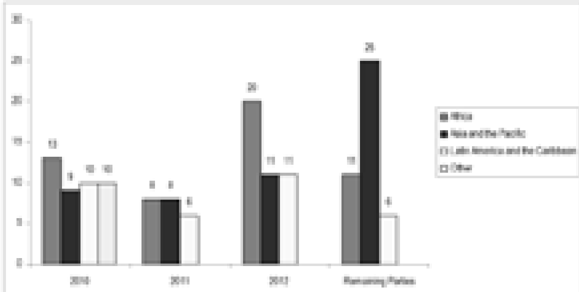
Decision 8/CP.11

- Invites NAIP to prepare **project proposals**, **even in advance** of substantially completing their previous NCs, in order to avoid a lack of **continuity** in project financing
- Decides that NAIP **should** apply for the financing of their subsequent NCs at any time **between 3 to 5 years** of the initial disbursement of funds for the actual preparation of their previous NCs
- Shall make all efforts to **submit** their 2nd NC (or when appropriate 3rd) **within 4 years** of the disbursement of financial resources
- May use an **extension** of **up to 1 year** (after having informed the secretariat), but this shall not imply additional financial resources

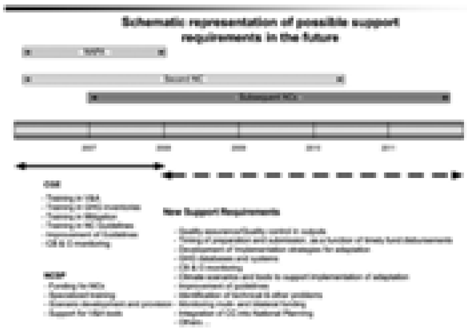
Status of submission of Initial (INCs) and Second National Communications (SNCs) projected submissions of SNC



Projected Regional Distribution of Second National Communications (2010-2012)



Important Opportunities in Preparing Second National Communication



Useful Tools for NAI GHG Inventories

- **UNFCCC Software**

http://unfccc.int/resource/cd_roms/na1/ghg_inventories/index.htm

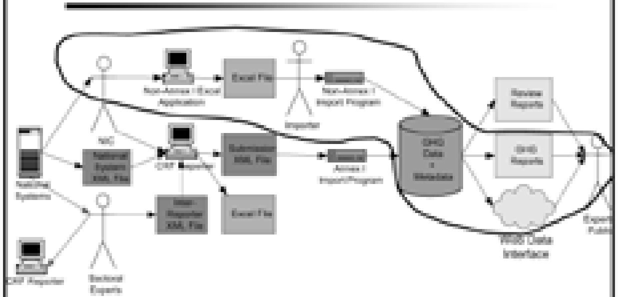
- **CAALU** (Central American Agriculture and Land Use)

Stephen Ogle, Colorado State University, ogle@nrel.colostate.edu

- **GHG Inventory Experts Network** (NCSP funded)

http://www.ghgnetwork.org/

The Integrated GHG database makes it possible to generate thousands of analysis reports + the expected future public access to the GHG data



The Evolving Role of National Communications

- **Timely** submission of second round of national communication for use by all Parties in assessing the status of climate change issues
- Informing the **CGE** on **technical needs** of the region – where are the technical gaps? (new mandate to be discussed at COP 13)
- Providing the UNFCCC secretariat any comments or suggestions on the CGE training materials and the secretariat's inventory software secretariat@unfccc.int

Report on Sessions I to III

Mr. Dadang Hilman

Session 1: Myanmar

- Introduced experience of working under ALGAS project
- Has just started working on preparing initial national communication
- Gaps: lack of vulnerability assessment, lack of analysis of adaptation options, lack of national strategy and action plan, lack of expertise, lack of impact assessment, need capacity building

Session 1: Singapore

- 4-pronged national climate change strategy
- Main contribution is CO_2 from energy
- Main mitigation strategy: energy efficiency, clean energy
- Will submit second national communication in 2009

Session 1: Japan

- introduced current institutional arrangement for annual inventory submissions
- Introduced latest trends of GHG emissions
  - total GHG emissions in 2005 showed 8.1% increase over base year, so have to reduce emissions by 14.1%

Session 1: Mongolia

- Short-term strategy: develop infrastructure by identifying data gaps, developing national procedures for collecting activity data, including data in statistical yearbook, designing database of AD and EF
- Long-term strategy (2007-2010): focus on bringing it into practice by improving database, developing national guidance

Session 1: WGIA Survey

- Purpose: understand the current situation and identify areas for improvement
- Results
  - areas of "high" need may indicate problems with collecting activity data, country-specific values, categories
  - Areas of "low" need may indicate that data and/or country-specific values already exist[

Session 1: WGIA Survey

- Energy: collection of AD, calorific values and carbon EF of fuels
- Agriculture: rice cultivation and livestock characteristics
- LUCF: mean annual increments of aboveground biomass
- Waste: wastewater flow and sources, solid waste stream and composition

Session 2: Energy

- Find other uses for the data
- Pay attention to new technologies
- Decide whether to use IPCC defaults or develop country-specific values
- Need to determine target for WGIA5

Session 2: Agriculture

- Improvement of availability of disaggregated Activity Data through institutionalization of data collection
- Improvement of EF through research or EF from EFDB or data from other countries with similar environmental conditions and cultural practices
- Proper documentation and archiving of AD and EF used in the national GHG inventories

Session 2: LUCF

- Methods for deriving reliable Mean Annual Increment are a challenge for many tropical countries in Asia
- Uncertainty of estimates involves various factors, therefore needs to be assessed carefully (e.g. Expert judgment in deciding which assessment methodology to be taken)
- Need WGIA to facilitate the development of linkages and collaboration between different organisations

Session 2: Waste

- 4 types of domestic wastewater flow with/without septic tank exist in Asia
- Recycling activates are important for the solid waste stream in Asia
- Establishment of database on mass and quality of waste and its continuity is important

Session 3: QA/QC

- Quality Control (QC) – performed by inventory personnel during development of inventories
- Quality Assurance (QA) – performed by external evaluators after development of inventories
- INTEGRAL PART of inventory process
  - Leads to continuous improvement of inventories, facilitates comparison of estimates, comparison with other countries
  - Not obligatory, but very useful tool
- Minimal Elements
  - Define roles and responsibilities
  - Develop QC/QA plan
- Trade-off between QC requirements and timeliness/cost effectiveness
  - Identify key areas to focus QA/QC on

Session 3: QA/QC in Mongolia

- Use QA/QC to identify potential problems and make corrections
- Check
  - AD
  - EF
  - Methodology
  - Calculations
  - Completeness
  - Documentation
  - Report

Session 3: QA/QC in Japan

- QC – by MOE, GIO, related agencies, organizations
- QA – by committee of 70 Japanese inventory experts with 6 subgroups
- Mandatory yearly inventories – working on inventory of one year and QA of previous year simultaneously
- Archive historical data every year
- Necessary to establish document archive system (e.g. similar to ISO)

Part 4

Annex

Annex 1: Agenda

Day 1, Wednesday 14th February		
8:30~9:00		**Participant Registration**
9:00~10:00	**Opening Session** *Chair: Ms. Sulistyowati Hanafi*	
9:00~9:05	Dr. Shuzo Nishioka	Welcome Address
9:05~9:10	Ms. Masnellyarti Hilman	Welcome Speech from Host Country
9:10~9:30	All	Introduction of Participants
9:30~9:45	Ms. Chisa Umemiya	Overview of WGIA4
9:45~10:00	All	Questions
10:00~10:15		***Tea Break***
10:15~11:50	**Session I: Updates on GHG inventories in Asia** *Chair: Mr. Kiyoto Tanabe*	
		Country News
10:15~10:30	Mr. Ne Winn	The Status of GHG Inventories Preparation in Myanmar
10:30~10:45	Ms. Wong Shu Yee	Inventory Development in Singapore and National Climate Change Strategy
10:45~11:00	Mr. Hiroshi Fujita	Updates on GHG Inventories in Japan
11:00~11:15	Dr. Batimaa Punsalmaa	Development of Short-Term and Long-Term Inventory Strategies of Mongolia
11:15~11:30	Ms. Chisa Umemiya	Results of the Preliminary Survey and Guidance for the Sectoral Working Group Session (Session II)
11:30~11:50	All	Questions and discussions
		(Group Photo)
12:00~		***Lunch Time***
	Session II: Sector-By-Sector GHG Inventory Development	
13:30~18:00	**WG: Energy** *Chair: Dr. Shuzo Nishioka, Reporter: Mr. Saleh Abdurrahman*	
	All	- Comparison of Collection of Activity Data
	All	- Comparison of Calorific Values and Carbon Emission Factors
	All	- Country Report
	All	- Summary and Preparation of WG Presentation
13:30~18:00	**WG: Agriculture** *Chair: Dr. Batimaa Punsalmaa, Reporter: Dr. Damasa M. Macandog*	
		"Rice Cultivation"
	All	- Comparison of Basic Information of Rice

		Cultivation Area
		- Country Report
	Dr. Damasa M. Macandog	Methane Emissions from Major Rice Ecosystem in Asia
	Dr. Kazuyuki Yagi	Methodology of the 2006 IPCC Guidelines and EFs in Japanese Inventory Estimation
		"Enteric Fermentation"
	All	- Comparison of Livestock Characteristics
		- Country Report
	Dr. Osamu Enishi	Greenhouse Gas Emissions Caused From Livestock in Japan
	All	- Summary and Preparation of WG Presentation
13:30~18:00	**WG: Land Use Change and Forestry (LUCF)** *Chair: Dr. Rizaldi Boer, Reporter: Mr. Heng Chan Thoeun*	
		- Comparison of Measurement/Survey Methodology of Mean Annual Increments
	Ms. Chisa Umemiya	Cambodia's Experience
	Dr. Rizaldi Boer	Indonesia's Experience
	Mr. Samsudin Musa	Malaysia's Experience
	Dr. Masahiro Amano	Japan's Experience
		- Model Measurement/Survey Methodology
	Dr. Masahiro Amano	Methodology in IPCC's GPG-LULUCF
	Ms. Betha Lusiana, ICRAF	Estimating the Uncertainty of C Stock Estimates: Its Implication For Sampling Procedures
	All	- Summary and Preparation of WG Presentation
13:30~18:00	**WG: Waste** *Chair: Dr. Sirintornthep Towprayoon, Reporter: Dr. Masato Yamada*	
		"Wastewater Handling"
	Mr. Kiyoto Tanabe, IPCC-NGGIP/TSU	How To Estimate Emissions From Wastewater Handling
	All	- Comparison of Wastewater Flow and Its Sources Indonesia (by Mr. HB. Henky Sutanto) Lao PDR (by Mr. Immala Inthaboualy) Philippines (by Ms. Raquel Ferraz Villanueva) Thailand (by Dr. Sirintornthep Towprayoon)
	Mr. Hiroshi Fujita	Management of Wastewater in Japan
		"Solid Waste Disposal on Land"
	All	- Comparison of Solid Waste Stream and Its Composition
	Dr. Masato Yamada	Recent Development on Japan's Inventories with regard to Solid Waste Disposal

	Dr. Sirintornthep Towprayoon	Evaluation of SWDS Methane Emission Estimate
	All	- Summary and Preparation of WG Presentation
19:00~		***Reception hosted by the organisers***

Day 2, Thursday 15th February		
9:00~10:40	**Session II (Continued)** *Chair: Mr. Dominique Revet, UNFCCC secretariat*	
		Working Group Presentation
9:00~9:20	Mr. Saleh Abdurrahman	Energy
9:20~9:40	Dr. Damasa M. Macandog	Agriculture
9:40~10:00	Mr. Heng Chan Thoeun	Land-Use Change and Forestry (LUCF)
10:00~10:20	Dr. Masato Yamada	Waste
10:20~10:40	All	Questions and discussions
10:40~10:55		***Tea Break***
10:55~12:10	**Session III: Cross-Cutting Issue- Quality Assurance and Quality Control (QA/QC)** *Chair: Mr. Dominique Revet*	
10:55~11:15	Mr. Kiyoto Tanabe	Quality Assurance/Quality Control and Verification
		Country Report
11:15~11:35	Dr. Batimaa Punsalmaa	Quality Assurance/Quality Control in Mongolia
11:35~11:55	Dr. Yukihiro Nojiri	Quality Assurance/Quality Control in Japan
11:55~12:10	All	Questions and discussions
12:10~		***Lunch Time***
14:00~16:00	**Session IV: Toward Better GHG Inventory Development in Asia** *Chair: Dr. Shuzo Nishioka*	
14:00~14:20	Mr. Kiyoto Tanabe	2006 IPCC Guidelines for National Greenhouse Gas Inventories
14:20~14:40	Mr. Dominique Revet	Current and Future GHG Inventory Development in non-Annex I Parties
14:40~14:50	Mr. Dadang Hilman	Report on Session I to III, by Rapporteur
14:50~15:50	All	Overall Discussion and Wrap-up - Regional cooperation for future GHG inventory development - Proposals and suggestion for next activities of WGIA
15:50~15:55	Mr. Dadang Hilman	Closing Remark
15:55~16:00	Mr. Hiroshi Fujita	Closing Remark

Annex 2: List of Participants

Sectors are indicated in bold following the participants' names.

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