Information Matters, Philippines: Transparency through Reporting
Capacity Building for Enhanced Reporting and Facilitation of International Mutual Learning through Peer-to-Peer Exchange

Training-Workshop on Uncertainty Analysis of GHG Data

Meranti Hotel, Quezon City, February 27-28, 2017

Climate Change Commission Philippines

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

On behalf of

Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety

of the Federal Republic of Germany

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ACRONYMS

AD	Activity Data
BMUB	German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety
BUR	Biennial Update Report
CCC	Climate Change Commission
DENR	Department of Environment and Natural Resources
DOE	Department of Energy
DOTr	Department of Transport
EF	Emission Factor
EMB	Environment Management Bureau
FMB	Forestry Management Bureau
GHG	Greenhouse Gasses
GHGI	Greenhouse Gas Inventory
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
ICA	International Consultation and Analysis
ICCT	International Council on Clean Transportation
IKI	International Climate Initiative
IM	Information Matters
INDC	Intended Nationally Determined Contribution
IPCC	International Panel for Climate Change
IPPU	Industrial Processes and other product use
KCA	Key Categories Analysis
LULUCF	Land use, land-use change and forestry
M&E	Monitoring and Evaluation
MA	Mitigation Action
MONRE	Ministry of Natural Resources and Environment of Viet Nam
MRV	Monitoring, Verification, Reporting
NC	National Communication
NDC	Nationally Determined Contributions
NICCDIES	National Integrated Climate Change Database and Information Exchange System
NIR	National Inventory Report - Viet Nam
NIS	National Inventory System - Viet Nam
PDF	Probability Density Function
PSA	Philippine Statistical Authority
RE	Renewable Energy
REDD	Reducing Emissions from Deforestation and Forest Degradation
UNFCCC	Unite Nations Framework Convention for Climate Change

EXECUTIVE SUMMARY

The Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) on behalf of the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB) has initiated the "Information Matters: Capacity Building for Enhanced Reporting and Facilitation of International Mutual Learning through Peer-to-Peer Exchange" Project (IM). IM phase I was completed in 2015 which aimed at strengthening in-country capacities for enhanced reporting (Biennial Update Report and National Communication) of climate relevant information to United Nations Framework Convention on Climate Change (UNFCCC) in four pilot countries (Chile, Dominican Republic, Ghana, Philippines). The Climate Change Commission serves as the focal government agency of the Information Matters Project in the Philippines. Now on it second phase, more support is provided to build on from the results of the first phase of the project, hence further strengthen climate information management and enhance the reporting capacity of the Philippines to UNFCCC. The current project phase also added four countries namely Columbia, Egypt, Georgia and Viet Nam as well as an Ad-hoc Facility.

As one of the capacity building activities under the Information Matters Project, a training-workshop on Uncertainty Analysis was conducted on February 27-28, 2017. The overall objective of the training-workshop aimed to provide the GHG Inventory Compiler and Data Suppliers from various sectors a comprehensive understanding of the concept of uncertainty estimates and use this information for the improvement of the National GHG Inventory and corresponding mitigation actions. The training-workshop was conceptualized as a result of the BUR Workshop conducted by the IM Project last February 2016. National GHG Inventories are only estimates of the true GHG emissions of a country. Uncertainty estimates of National GHG Inventories provide information to users of GHG data on the level of accuracy of the information presented in the inventory.

An uncertainty analysis also serves as a tool to prioritize national efforts towards GHG mitigation, by focusing on mitigating actions from sectors with robust emission estimates (low uncertainty) and provide further support to sectors where data sources need further improvement due to high uncertainties.

Key topics discussed were a) basic concept of uncertainty analysis, b) calculation of sector specific uncertainty based on IPCC 2006 guidelines and c) compilation of a quality assurance/quality control plan. Hands-on group working sessions helped to internalize and practice the theoretical input by the experts. Also, the experience of Viet Nam in preparing their first Biennial Update Report (BUR1) was shared by Dr. Nguyen Phuong Nam from the Department of Meteorology, Hydrology and Climate Change (DMHCC), a national focal agency on climate change under the Viet Nam Ministry of Natural Resources and Environment (MONRE).

40 representatives from national government agencies in charge of the Agriculture, Waste, Industry, Transport, Forestry and Energy (AWITFE) sectors participated in the training-workshop. It was also joined in by officials and staff from the Climate Change Commission (CCC) and GIZ and partners from Viet Nam. Technical expertise was provided by Dr. John Watterson and Ms. Ellie Kilroy of RICARDO-Energy and Environment (RICARDO-EE).

Below is a summary of key takeaways from the training-workshop.

1. Uncertainty estimation should be an integral element of the national GHG inventory compilation and those who collect the data are the best people to ask about the uncertainty related to their own data.
2. A functional QA/QC mechanism integrated in the National GHG Inventory System is necessary in assessing and managing the quality of inventory data while being collected.
3. A time-series of emission data for GHG emissions are vital to analyze trends and variations. Emission reductions due to mitigation actions that the Philippines implement could be reflected in the GHG inventory, and looking for signals of the change in sectoral emissions over time might reveal the impact of the mitigation activities. Hence, keeping track if the

country will be able to achieve its INDC targets by 2030.
4. Documentation of processes, methodologies, and assumptions should be embedded so it would be easy to reflect back or share lessons from the entire experience of uncertainty analysis.
5. Understanding key categories is essential in quality improvement of inventory as these are the focus in determining the estimates for the inventory.
6. Reducing uncertainty both at the national and sectoral level help in prioritizing inventory improvement.
7. Application of appropriate higher tier methodology is a main consideration to ensure that the inventory would respond in the context of the mitigation actions.

METHODOLOGY AND APPROACH

The facilitator used a combination of plenary presentation for discussion of concepts, key elements, and mechanisms and breakout sessions for application of acquired knowledge and skills. The outputs from the breakout sessions were then presented back in the plenary so resource persons and other participants would be able to raise comments and/or clarifications.

The entire training-workshop lasted for two days and at the end of the training-workshop, post-training evaluation and a post-training quiz were administered to test the training-workshops' efficiency, effectiveness, relevance to participating agencies as well as the level of the attainment of workshop objectives and to gauge how participants appreciated the shared knowledge and expertise, respectively.

PARTICIPANTS AND RESOURCE PERSONS

Representatives from national government agencies in charge of the Agriculture, Waste, Industry, Transport Forestry and Energy (AWIT-FE) sectors participated in the training-workshop. It was also joined by officials and staff from the Climate Change Commission and GIZ with participants from the Ministry of Natural Resources and Environment (MONRE) of Viet Nam, a Phase II participating country of the IM Project. The presence of Viet Nam in the training also served as a Peer-to-Peer Exchange Activity for the Phase II countries. Technical expertise were provided by Dr. John Watterson and Ms. Eleanor Kilroy of RICARDO-Energy and Environment (RICARDO-EE).

PRELIMINARIES

A quick introduction of participants was done, where representatives from each sector were acknowledged, followed by the welcome remarks from Ms. Sandee Recabar of the Climate Change Commission and knowledge baseline on uncertainty analysis and expectations check.

On behalf of the Climate Change Commission (CCC), ***Ms. Sandee Recabar, Acting Chief for Implementation Oversight Division*** welcomed the participants and representatives from the MONRE of Viet Nam. She mentioned that there were a number of capacity building activities under the Climate Change Commission for greenhouse gas (GHG) inventory in preparation for the role of agencies in the implementation of Executive Order 174 institutionalizing the national GHG inventory reporting and management system. In the course of such training-workshops and the conduct of actual GHG inventory, training on uncertainty analysis was requested by the line agencies to enhance their capacities in improving the quality of data. Hence, support was requested from GIZ under the Information Matters project. She hoped for a fruitful two-day session and encouraged everyone to take advantage of the presence of technical experts from RICARDO-EE.

Knowledge on Uncertainty Analysis and Expectations Check

The participants were asked to rate their knowledge on uncertainty analysis from zero (0) to ten (10), with 0 being the lowest and 10 being the highest. Each participant then posted their names on a round piece of paper to generate the probability distribution function of their level of knowledge on the topic, *see below graph*. Note that the mean and mode are both 3.

The same exercise was done prior to formally concluding the two-day session to determine the improvement in the level of knowledge of participants. The mean level of knowledge has increased from 3 to 5.6 while mode has improved from 3 to 6.

Aside from this, participants were asked to post their questions and expectations from the training-workshop.

Figure 1. Comparison of Pre and Post Training Rate of Knowledge on Uncertainty Analysis

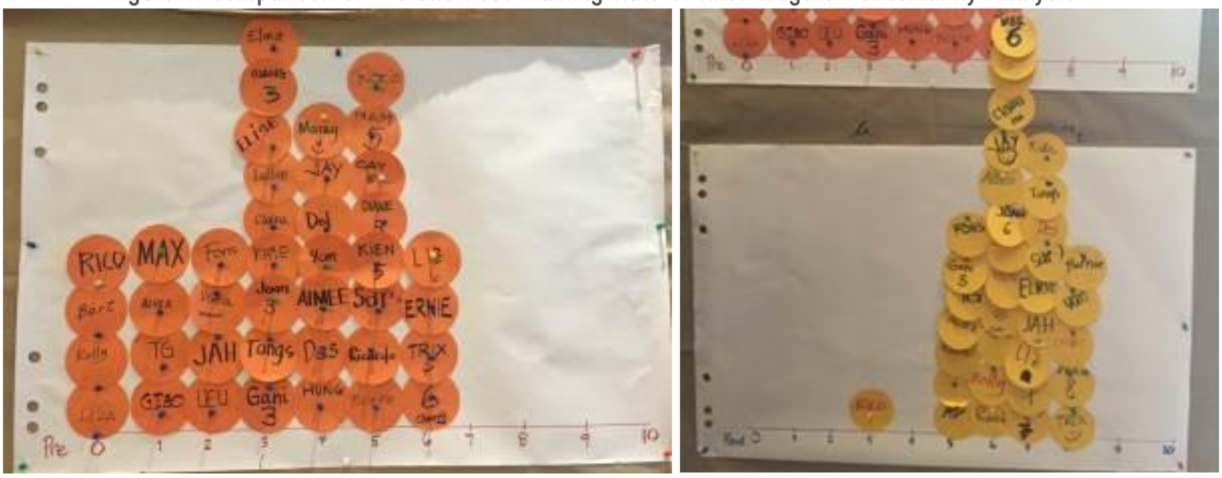

Table 1. Expectations from Participants

Questions and Expectations	
General Questions	• What is uncertainty measurement, in general? • What are the methods for estimating uncertainty from GHG data? • What methods are used to compute for uncertainties related to GHG emission? • What are the methods, style, and procedures to classify uncertain information? • How this kind of uncertainty is calculated or determined by making/establishing a device for its possibility to certainty? • What is the relevance of computing the level of uncertainty? • Step-by-step procedure in computing inventories
Sectoral Questions	• Clear step-by-step guide on how to do uncertainty analysis for the forestry sector of GHG inventories? • How uncertainty analysis be applied to transportation/measure GHG inventories in transport? • Measuring uncertainty in GHG emission for RE. • How can we apply uncertainty when we determine the minimum value of efficiency for a certain appliance? • What are the differences between the uncertainties of each sector among 5 sectors? • I hope that PSA and DA can start with actual GHG inventory calculation so we can practice uncertainty analysis
Quantifying Uncertainty	• Why do we need to calculate uncertainty analysis in GHG inventory? • Data and information needed/required in quantifying uncertainty • How to address uncertainty on data sets? • Data Availability and Accessibility? • How to establish an efficient data collection system? • How do we use the default values of IPCC for each analysis of uncertainty? • How do we analyze the uncertainty of activity data when AD does not have statistical values? • Quantifying and interpreting uncertainty assessment. • How to identify which results of a calculation are more uncertain? • How can level of uncertainty be measured? • Different levels of uncertainties have different weight factors, how to identify?
Measuring of Uncertainties	• How to assume the value of uncertainty if it does not exist? • How to minimize uncertainty in GHG emission estimates?

	• What is the first key point to start the uncertainty analysis when we have done before? • What is the difference between uncertainty and accuracy?
Reliability of Information	• Level of uncertainty for national GHGI. • Level of acceptance, reliability. • Is there an acceptable level of uncertainty in computing data? • Reliability/accuracy of gathered data. • How uncertain information become effective?
Baselines	• Reference base year/reference point of study
Time	• Timeline. • Timeliness of data
Beyond GHG Inventories	• Use uncertainty on daily life. • Practical application of uncertainty analysis. • How the lecture can be applied with work beyond GHG emissions?
Expectations	• In-depth understanding of the uncertainty analysis tool. • Learn and be familiar with the process of uncertainty analysis. • Learn techniques in measuring uncertainty. • Interactive and Comprehensive Discussion. • Learn a lot in this training

OVERVIEW OF INFORMATION MATTERS PROJECT: GLOBAL AND THE PHILIPPINES

Information Matters Project: A Global Overview

Ms. Rocio Lichte, GIZ Information Matters

Ms. Lichte presented an overview of the project and updates. Under the support of German Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB), the Information Matters project provides capacity-building and technical support to a number of selected partner countries to strengthen their in-country capacities for ambitious reporting under the United Nations Framework Convention on Climate Change (UNFCCC). It has a special focus on the preparation of Biennial Update Reports (BURs) and implementation of sustainable systems for measurement, reporting and verification (MRV). The project adopted a specific country-tailored approach, where the conceptualization underwent consultations with the partner countries, specific needs for the setup of MRV systems and the preparation of national greenhouse gas (GHG) emission inventories were identified, prioritized and addressed through tailored in-country capacity-building workshops and trainings.

The phase I of the project was in four pilot countries (Chile, Dominican Republic, Ghana, Philippines), while the second phase included four (4) additional countries: Columbia, Egypt, Georgia and Viet Nam as well as Ad-hoc Facility support to additional countries. Project activities include the following:

a. Identification of specific needs and priorities of the MRV systems and GHG monitoring in the partner countries;
b. Provision of tailored-made capacity-building trainings and backstopping as well as concepts for MRV institutionalization; and
c. Support the process through peer-to-peer exchange and generation of knowledge products.

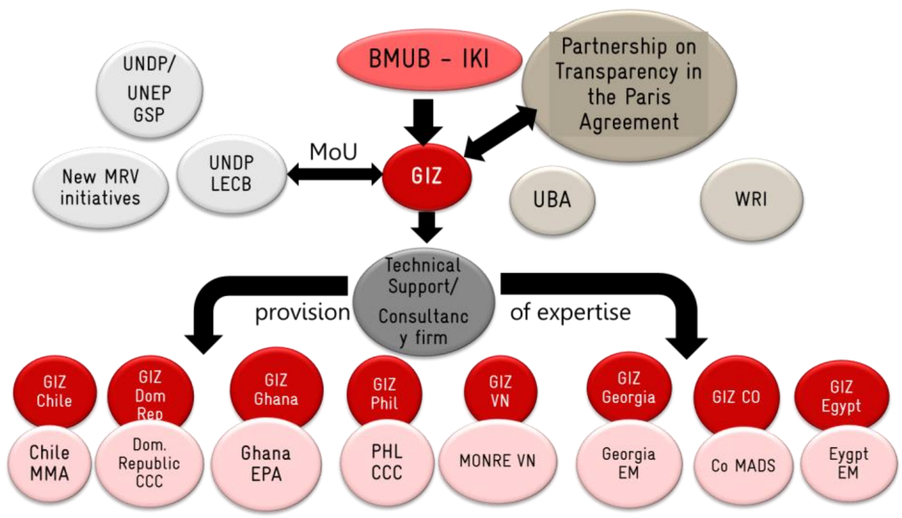

Figure 2. Project Framework

In 2015, the series of capacity building activities led to peer-to-peer exchanges between the IM partner countries. The discussion in these exchanges evolved around guidance on reporting and how the BUR and National Communication process can be streamlined to become more cost-effective in terms of translation of work for the government personnel from various sectors, awareness raising, and ensuring regular data provision.

Moreover, a number of knowledge products that incorporate experiences and lessons learned were and are still being developed and published under the project. For 2015-2016, published knowledge products include a) Stock Taking Tool, b) BUR Template, c)Practice Study on GHG Inventories in the Waste Sector, d) BUR Process Guidance Tool, and e) Preparing for the ICA Process: required efforts and capacities needed.

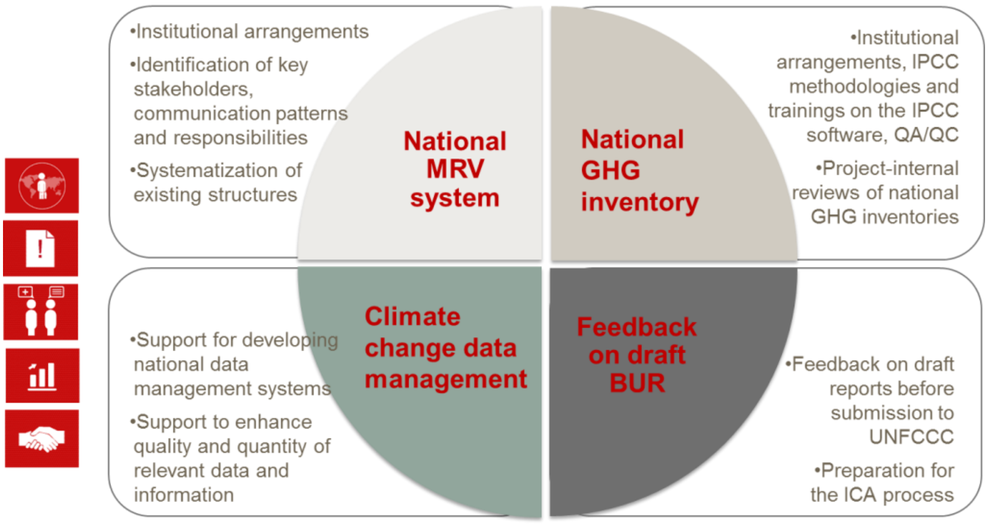

Figure 3. Components supported under IM Project

Table 2. Knowledge Products under IM Project

Knowledge Product	Objective	Method	Output
Stock Taking Tool	Assess the countries' current situation including strengths and gaps on MRV and overall mitigation landscape	Analytical tool that assists countries in identifying and prioritizing actions to develop national MRV systems	List of prioritized actions
BUR template	Assist countries in the preparation of transparent and ambitious BURs based on their national circumstances	Template providing a proposed structure/layout and guiding questions for information to be presented following (1) minimum requirements and (2) good practice/enhanced reporting	BUR in line with the UNFCCC requirements: - Updated template reviewed with inputs from UNFCCC, UNDP, UNEP, WRI and experience/feedback from countries - The template does not constitute an official UNFCCC document
BUR Process Guidance Tool	Assist countries in the overall process of preparing their BURs, undergoing the ICA process while enhancing their MRV systems	Interactive six step process defining main actions, identifying steps to be taken and allowing a rough time estimation for the overall process, depending on the countries´ circumstances	List of necessary steps to be taken including an estimation of the time required to implement those steps

Knowledge Product	Objective	Method	Output
Preparing for the ICA Process	Assist countries in preparing for and undergoing the International Consultation and Analysis (ICA) process	Identification of necessary preparatory steps at national level and of capacities needed	Guiding document with explanations and proposed preparatory activities
Practice Study on GHG Inventories in the Waste Sector	Assist countries in improving their GHG inventories in the waste sector	Good Practice study highlighting key issues to for developing GHG estimates in the waste sector and following the IPCC Guidelines	Technical information on elements to consider when developing GHG inventory estimates for the waste sector

Lastly, below are upcoming activities for 2017:

- For countries of phase I: Continued backstopping support until June 2017;
- Implementation of the project in phase II countries and support to few additional countries under the Ad-hoc Facility upon request;
- Peer-to-peer exchange for all 8 IM countries: 3-4 April, Dessau, Germany (followed by BUR Champions Workshop, 5-7 April, Berlin, organized under the Partnership on Transparency in the Paris Agreement); and
- UNFCCC SB 46 sessions in May: Get-together dinner for representatives of IM partner countries.

Updates on the Information Matters Project in the Philippines

Ms. Sandee Recabar, *Climate Change Commission*

The implementation of the Information Matters project is mainly intended to address key challenges in terms of the compilation of GHG inventories and to lessen dependence on the use of external consultants in developing main sections of climate reports to the UNFCCC, hence strengthening in-country capacity for enhanced reporting to the UNFCCC. The identification of capacity building activities under the IM project underwent numerous consultations with line agencies and relevant stakeholders guided by government directives and policies. As seen in the timeline below, the IM project kicked off in 2013 and has continuously provided support to the country in enhancing its reporting through implementation of tailored-fit capacity building activities.

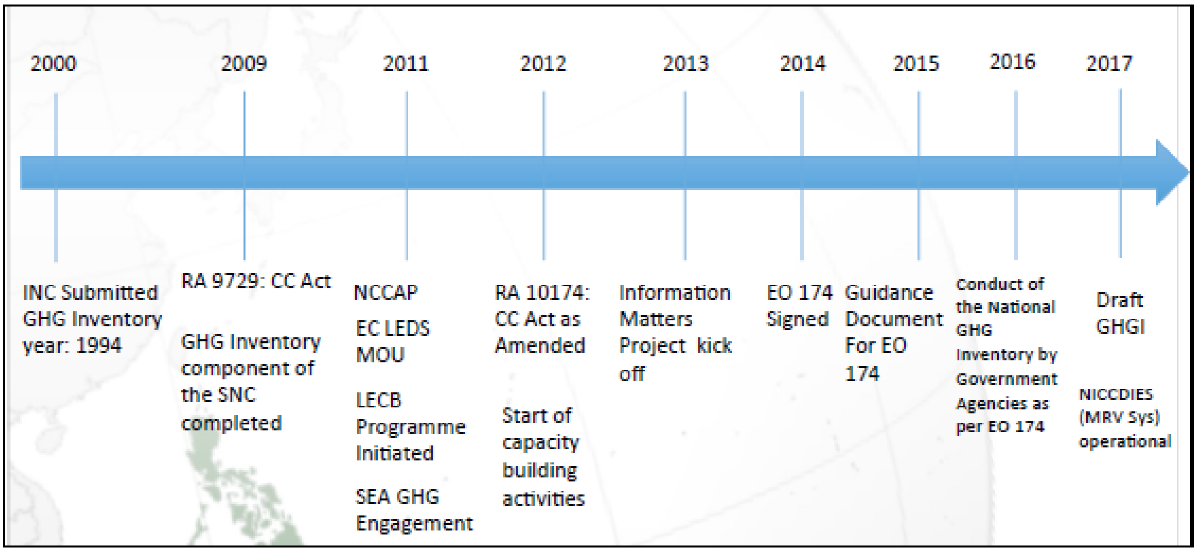

Figure 4. Timeline of Initiatives for GHG Inventory

The capacity building activities include training-workshops on domestic MRV architecture, development of baselines, climate relevant data management, Asia peer-to-peer exchange on GHG and non-GHG indicators and Biennial Update Report (BUR). The figure below demonstrates how the training-workshops are matched with the chapters of BUR development. In terms of policies, IM project also provided backstopping to the Climate Change Commission. These policies were put in place to address the BUR preparation.

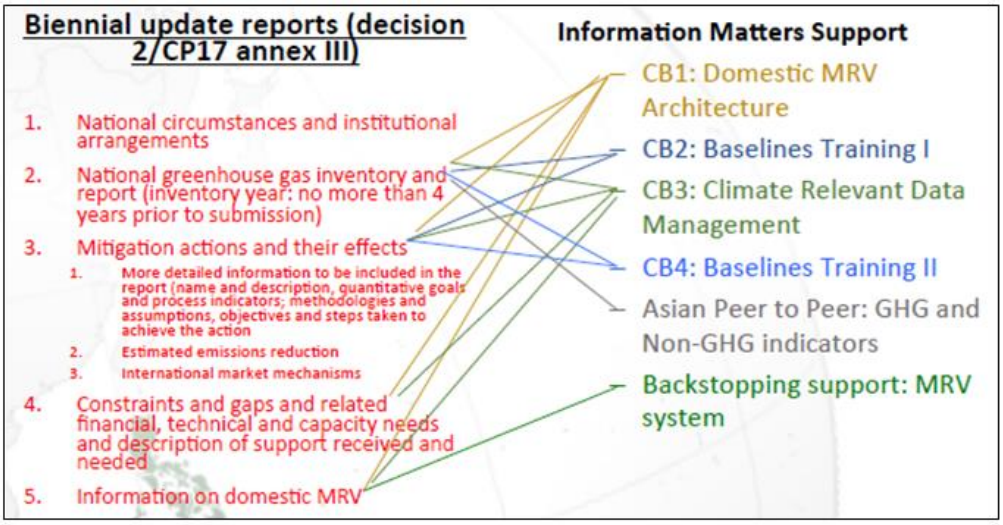

Figure 5. Matching of IM Capacity Building with BUR Chapters

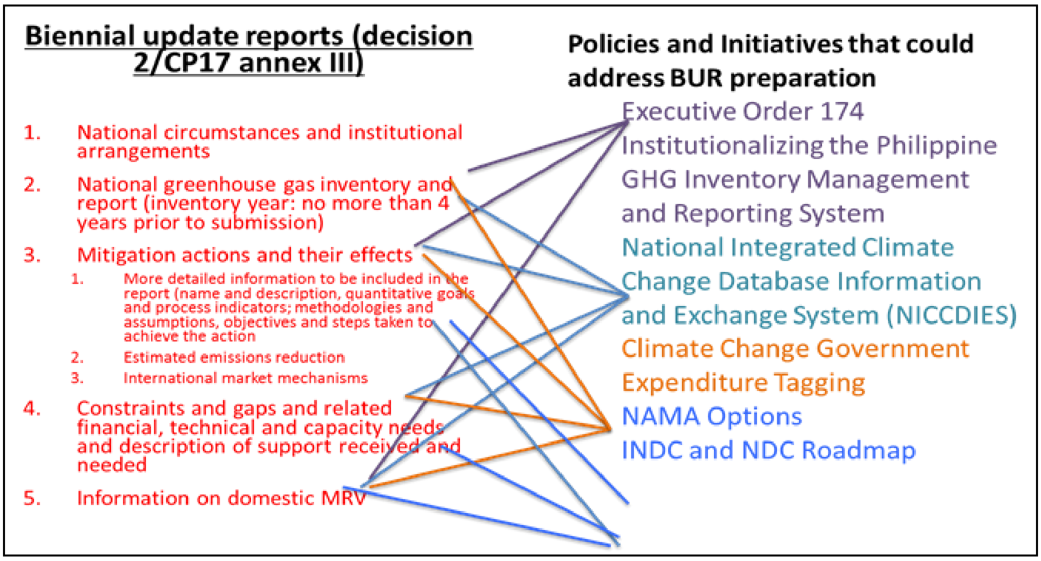

Figure 6. Policies to address BUR Preparation

PLENARY PRESENTATIONS: BASIC CONCEPT, CALCULATION OF UNCERTAINTY, AND QA/QC CONCEPT FOR GHG INVENTORY

Introduction to Uncertainty Analysis

Ms. Eleanor Kilroy, *RICARDO-EE*

Uncertainty is a lack of knowledge of the true value of a variable. It depends of the analyst's state of knowledge based on available data, underlying processes and methods of data collection. Uncertainty should be derived for the national level and the trend estimate, as well as for component parts of the inventory (e.g. emission factors and activity data). Hence, there are four key factors to estimating uncertainty:

a. Credibility: Inventories are estimates, which uncertainty analysis gives a clear statement of what we do and do not know;
b. Utility: Users of the inventory need to know how reliable the numbers are, especially if such data serve as input for policy or inventory improvement actions;
c. Requirement: Uncertainty analysis is a requirement of all good practice inventories; and
d. Scientific: All scientific analysis should include an uncertainty assessment.

In addition, uncertainty is used for validating the accuracy of the estimates and helps to prioritize efforts in improving the inventory. The key source category is one that should be prioritized within the national inventory system because its estimate has a significant influence on a country's total inventory of direct greenhouse gases in terms of the absolute level of emissions, the trend in emissions or both.

In calculating uncertainty, basic concepts can be found below:

- Accuracy: Agreement between true value and measured/calculated/ estimated value;
- Precision: Agreement among repeated measurements of the same variable;
- Systematic error (or bias): Lack of accuracy;
- Random error: Random variation above or below the mean value;
- Probability Density Function (PDF): Range and relative likelihood of possible values;
- 95% confidence interval: Range that encloses the true value.

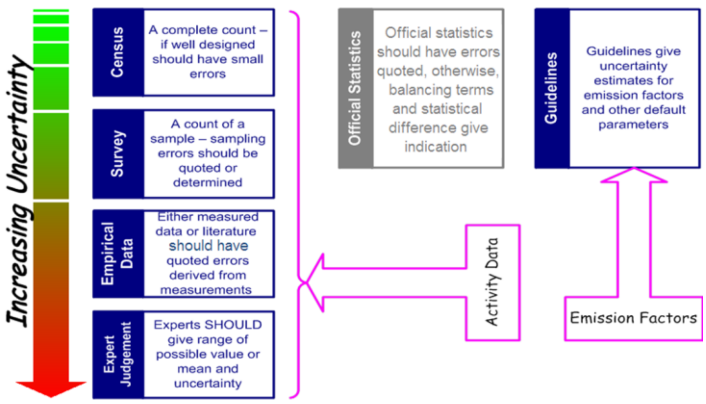

Figure 7. Uncertainty Analysis Elements

While there are numerous causes of uncertainty such as the lack of completeness, missing data, and statistical random errors, the calculation can be improved by considering the following:

- The choice of methodology may not accurately reflect the actual emissions. Thus, good practice requires that biases be reduced as much as possible. Guidelines used in the inventory aim to be as unbiased and as complete as possible.
- Measured values have errors and emission factors may not be truly representative.
- Implement good QA/QC process to minimize calculation errors.

Activity data is often collected and published regularly by national statistical agencies, which may have initially assessed the associated uncertainties as part of its data collection procedures. However, it should be noted that uncertainty of the data should be collected as part of data acquisition. In UK for instance, collection of data for GHG inventory always requires an estimate of uncertainty from source data and its corresponding QA/QC system information. Hence, carrying out an uncertainty analysis should be an integral part of the inventory compilation process and not just an "add on" at the end of the process.

Expert judgment is always required in collecting information. Seeking expert judgment at technical and statistical levels aims to address issues related to the choice of methodologies, parameter values and uncertainty ranges, most appropriate activity data and emissions data. The text box on the right details the standard protocol in eliciting expert judgment.

•***Motivating***: Establish a rapport with the expert, describe the context, and explain the most commonly occurring biases.
•***Structuring***: Clearly define the quantities for which judgements are to be sought (e.g., resulting emissions or removals should be for typical conditions averaged over a one-year period).
•***Conditioning***: Work with the expert to identify and record all relevant data, models, and theory relating to the formulation of the judgements.
•***Encoding***: Request and quantify the expert's judgement. May differ but should include uncertainty information.
•***Verification***: Analyze and feedback concluded regarding their judgement. Is what has been encoded really what the expert meant?

In terms of gathering uncertainties in emission factors, the IPCC 2006 guidelines outline information about uncertainties. This could be found in a general chapter in Volume 1: General guidance and reporting, Chapter 3. While a section on "Uncertainty Assessment" is established for each sectoral methodology.

To combine uncertainties the following equation is used:

Equation 1. Combining uncertainties

EQUATION 3.1
COMBINING UNCERTAINTIES – APPROACH 1 – MULTIPLICATION

$$U_{total} = \sqrt{U_1^2 + U_2^2 + \ldots + U_n^2}$$

Where:

U_{total} = the percentage uncertainty in the product of the quantities (half the 95 percent confidence interval divided by the total and expressed as a percentage);

U_i = the percentage uncertainties associated with each of the quantities.

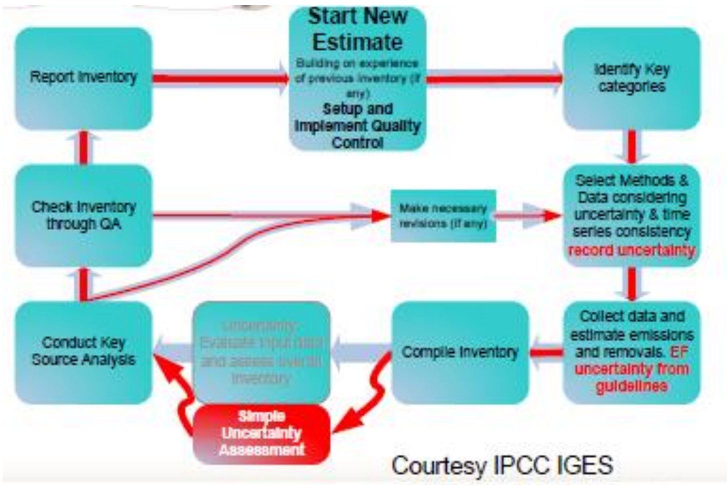

Figure 8. Estimating Uncertainty Flowchart

There are two approaches in combining uncertainties: the first approach is "error propagation" while the second approach is to estimate by simulation, i.e. Monte Carlo method.

While in reducing uncertainty, the following suggestions can be considered:

- Priority should be given to sources of data to the inventory that have the most impact on the overall uncertainty;
- The uncertainty estimates can be used to improve the usefulness of the key category analysis (KCA);
- Improve assumptions and methods by identifying and making improvements to ensure assumptions and methods reflect real-world values as closely as possible, as well as avoiding over-simplification of assumptions;
- Improve measured values (use more precise measurement techniques) and ensure appropriate emission factors are used;
- Implement good QA/QC processes to minimize calculation errors and prevent bias;
- Document sources of uncertainty that have not been quantified to ensure these are addressed in future;
- Implement checks to limit errors in calculations;
- Identify areas for improvement in data collection and/or methodologies; and
- Moving towards higher tier methodologies typically reduces uncertainty.

In conclusion,

- Producing high quality emission and removal estimates based on recommended "good practice" is paramount.
- The level of effort in conducting an uncertainty analysis is small in comparison with the efforts on estimating the GHG inventory.
- Data collection activities should consider data uncertainties:
  - This will ensure that the best data is collected and ensures good practice estimates.
  - As you collect data you should assess their "quality".
  - At its simplest, a well-planned uncertainty assessment should only take a few extra hours.

Prior to moving to the next topic, Dr. Watterson and Ms. Kilroy simulated the standard protocol in seeking expert's advice. Dr. Watterson took note that stating the relevance and motivating the expert is very important in getting the needed information. The session ended with a five-point quiz.

Quantifying Uncertainty

Dr. John Watterson, RICARDO-EE

Dr. Watterson mentioned that uncertainty is clustered by levels that are related to other categories and linked to trends among time series data collected over the years. Uncertainty can be expressed either as quantitative data or qualitative information related to the data. The use of uncertainty in GHG inventories should ensure that estimates are accurate in the sense that they are systematically neither an overestimation nor an underestimation of the true emissions or removals and that uncertainties are reduced so far as practicable. Also, an uncertainty analysis should be seen, first and foremost, as a means to help prioritize national efforts to reduce the uncertainty of inventories in the future, and guide decisions on methodological choice. Uncertainty is used for validating the accuracy of the estimates and help to prioritize efforts in improving the inventory.

He gave some simple examples of estimating uncertainties, taking note of two simple steps. First is the combination of emission factor, activity data and other estimation parameter ranges by categories and greenhouse gases. The second step contains the estimation of overall uncertainty in national emissions and the trend in national emissions between the base year and the current year. Cross-reference to the IPCC 2006 guidelines was emphasized.

Using the motor gasoline data of the Philippines published under the Second National Communication to the UNFCCC (http://unfccc.int/resource/docs/natc/phlnc2.pdf), Dr. Watterson guided the participants in combining data to estimate overall uncertainty following the equations from the IPCC 2006 guidelines.

Step 1: Calculation of Emission

Equation 2. GHG Emission Calculation

$$GHG\ emission = AD \times EF$$

The activity data for motor gasoline used in the Philippines in 2014 was 3,043 kilo tonnes, with an assumption of 5% uncertainty (as a 95% CI) based on expert judgment. This is a typical assumption of GHG inventories of other countries. Given that the data is expressed in mass, it needs to be converted to energy units using the IPCC default calorific value of 44.3TJ/Gg (NCV basis), where 1 Gg is equivalent to 1 kilo tonne. Hence, 3,043 k tonnes x 44.3 TJ/Gg = 134,805 TJ.

Emission factor on one hand is 69,300 kg CO_2 / TJ (NCV basis), where the range of uncertainties (as 95 Confidence Intervals, or 95 % CI is) is 67,500 (95 CI) for lower limit and 73,000 (95 CI) for upper limit. These values need to be converted to percentage (%) uncertainties using the equation (l-c)/c for lower limit and (u-c/c) for upper limit, where c is the mean, l is lower limit and u is upper limit. Range of percentage (%) uncertainties is calculated as follows:

Table 3. Range of Percentage (%) Uncertainty

Parameter	Value	Uncertainty (%)
l (lower)	67 500	- 2.6%
u (upper)	73 000	+ 5.3%
c (mean)	69 300	-

Note that the percentage (%) uncertainties are not identical which means that the uncertainties are asymmetric. Although this provides a slight problem in having only one (1) percentage, the average of the two (2) values can be taken out to come up with single percentage (%) uncertainty. Another option is to take a "conservative approach" and use the higher of the percentage (%) uncertainties which means that the uncertainty is not underestimated.

For the purpose of the exercise, the higher of the percentages has been taken, to assume that the uncertainty is + 5.3%

Thus, following the first equation, the emission was calculated as follows:

Emission = 134,805 TJ x 69 300 kg CO2 / TJ (NCV basis)
= 9,341,986,500 kg CO2 or **9.34 MT**

In terms of verifying the calculation, comparing the estimates of another source like the National Communication of another country that contains the GHG inventory for motor gasoline can be an option.

Step 2: Uncertainty Calculation

The uncertainty associated with quantity of used gasoline is assumed at 5.0%, while uncertainty associated with the emission factor for gasoline (the carbon emission factor) is calculated at 5.3%.

Hence, using the equation 3.1 and 3.2 Volume 1 Chapter 3 of IPCC 2006, the combined percentage (%) uncertainty is calculated at 7.3% (9.34 MT CO2 +/- 7.3 %).

The greenhouse gas inventory is principally the sum of products of emission factors, activity data and other estimation parameters.

Equation 3. IPCC Equation 3.1

EQUATION 3.1
COMBINING UNCERTAINTIES – APPROACH 1 – MULTIPLICATION

$$U_{total} = \sqrt{U_1^2 + U_2^2 + \ldots + U_n^2}$$

Where:

U_{total} = the percentage uncertainty in the product of the quantities (half the 95 percent confidence interval divided by the total and expressed as a percentage);

U_i = the percentage uncertainties associated with each of the quantities.

.

Equation 4. IPCC Equation 3.2

EQUATION 3.2
COMBINING UNCERTAINTIES – APPROACH 1 – ADDITION AND SUBTRACTION

$$U_{total} = \frac{\sqrt{(U_1 \bullet x_1)^2 + (U_2 \bullet x_2)^2 + \ldots + (U_n \bullet x_n)^2}}{|x_1 + x_2 + \ldots + x_n|}$$

Where:

U_{total} = the percentage uncertainty in the sum of the quantities (half the 95 percent confidence interval divided by the total (i.e., mean) and expressed as a percentage). This term 'uncertainty' is thus based upon the 95 percent confidence interval;

x_i and U_i = the uncertain quantities and the percentage uncertainties associated with them, respectively.

Therefore, Equations 3.1 and 3.2 in the IPCC 2006 guidelines (Volume 1 Chapter 3) can be used repeatedly to estimate the uncertainty of the total inventory. In practice, uncertainties found in inventory categories vary from a few percent to orders of magnitude, and may be correlated. This is not consistent with the assumptions of Equations 3.1 and 3.2 that the variables are uncorrelated, and with the assumption of Equation 3.2 that the coefficient of variation is less than about 30%, but under these circumstances, Equations 3.1 and 3.2 may still be used to obtain an approximate result.

Another example is on agriculture, specifically for CH4 emissions from enteric fermentation in two (2) types of livestock. The overall uncertainty using the calculation is estimated at 33%.

Thus, comparing data of agriculture and energy sector, agriculture sector has bigger uncertainty given that the estimation of methane from enteric fermentation is quite complicated.

In terms of uncertainty in the trend of data over time, Dr. Watterson stressed the importance of time-series data to derive the variations since the mitigation actions that the Philippines implement will be reflected in the GHG inventory, and looking for signs of changes in sectoral emissions over time might reveal the impact of determined mitigation activities

Figure 9. Illustration of Trend in Emission

Conceptually, there are two types of sensitivities – *type sensitivity* arises from uncertainties that affect emissions or removals in the base year and the current year equally, while *type B sensitivity* arises from uncertainties that affect emissions or removals in the current year only. Once the uncertainty introduced into the national inventory by Type A and Type B sensitivities have been calculated, it can be summed up using the error propagation equation (Equation 3.1) to give the overall uncertainty in the trend. Note that the IPCC provided a worksheet to help in such calculation.

However, in cases when uncertainty cannot be quantified, it can still be assessed qualitatively by using ordinal values such as high, medium, low or the use of a scale (scale from 1 to 5). This simple approach will still provide a relative estimate of uncertainty between categories and help prioritize the development of the inventory.

Lastly, linking uncertainty analysis to the key category analysis will help in prioritizing GHG inventory improvement and move towards higher tier GHG methodologies

Discussion Highlights

Below are key inputs from the open plenary:

- For ranges of uncertainties, it is recommended to use the higher value, while for range of emission factor; the mid value should be used.
- If uncertainty is to be qualified as high, medium, and low, consistency of using such qualification with agreed value for high, medium, and low across sectors is crucial in calculating relatively correct uncertainty. Otherwise, calculation could be wrong.
- Key category analysis is not compulsory under the IPCC but a good practice to improve quality of inventory. Sensitivity may be useful especially for complicated GHGI (since there can be varying levels of sensitivity) but lesser important than KCA.

Quality Assurance/Quality Control and Verification

Ms. Eleanor Kilroy, *RICARDO-EE*

Ms. Kilroy stressed that efforts in GHG inventory compilation should be guided by the overarching IPCC indicators of quality, specifically transparency, accuracy, completeness, consistency, and comparability (TACCC).

- Transparency. There is sufficient and clear documentation that such individuals or groups other than the inventory compilers can understand how the inventory was compiled and can assure that it meets the good practice requirements for national greenhouse gas emissions inventories.
- Accuracy. The national greenhouse gas inventory contains neither over- nor under-estimates so far as can be judged. This means trying to identify and remove bias from the inventory estimates
- Completeness. Estimates of emissions/removals are reported for all relevant categories of sources and sinks, and gases. Where estimates or other documentation is missing these should be clearly documented together with a justification for exclusion.
- Consistency. Inventory annual trends, as far as possible, should be calculated using the same method and data-sources in all years and should aim to reflect the real annual fluctuations in emissions or removals and not be subject to changes resulting from methodological differences.
- Comparability. The national greenhouse gas inventory is reported in a way that allows it to be compared with national greenhouse gas inventories for other countries. This comparability should be reflected in appropriate choice of key categories and in the use of the reporting guidance and tables and use of the classification and definition of categories of emissions and removals.

Thus, there are four key requirements of a GHG inventory system.

- Development of an inventory compilation, reporting and development plan covering QA/QC, timing, deliverables and stakeholder involvement;
- Good quality and consistent management to underpin the work;
- Introducing a functional QA/QC system; and
- Approaches to improve the quality of the inventory such as Key Category Analysis (KCA) and estimating and reducing uncertainty (of emissions/removals).

From the four key requirements, Ms. Kilroy focused on the QA/QC and verification and cited the experience of the United Kingdom in building its GHG inventory system, where QA/QC and verification is a fundamental part of the system.

Based on IPCC guidelines, quality control is a system of routine technical activities to assess and maintain the quality of the inventory while being compiled. Quality assurance is a planned system of review procedures conducted by personnel not directly involved in the inventory compilation/development process (preferably by independent third parties). Verification is the 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. Such method is external to the inventory and applies independent data, including comparisons with inventory estimates made by other bodies or through alternative methods, which in return may compliment both QA and QC.

With these requirements in building the GHG inventory system, a team with clear roles and responsibilities should be set up. Such team may be composed of the sectors and GHG experts, with good management and governance. For instance, UK has a National Inventory System that considers time-series, prioritized development and reduction of uncertainty. The system is being supported by a national team, led by a national steering committee with support from RICARDO-EE and other partners. The team meets twice a year to discuss the inventory and develop a priority development plan to further improve its GHG inventory.

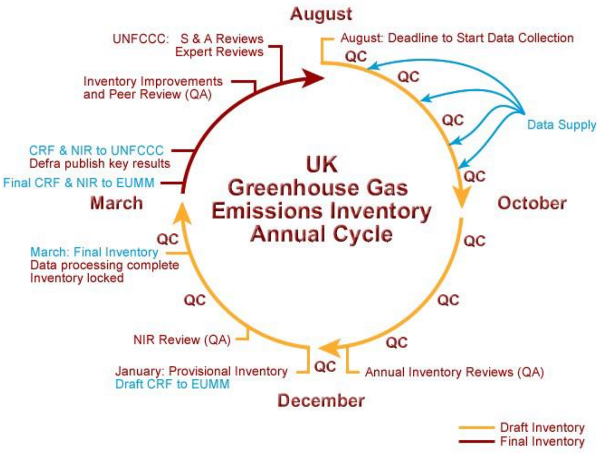

Figure 10. UK National GHG Inventory Cycle

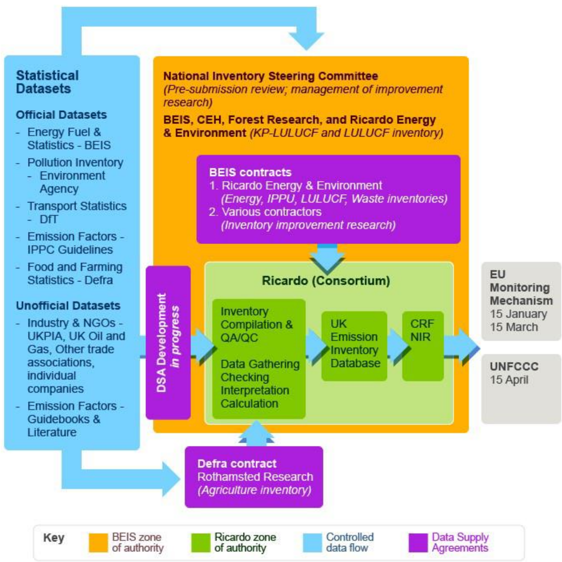

Figure 11. UK National GHG Inventory Team

While the Philippines, work with a national database for an organized data collection on climate change mitigation particularly on GHG Inventory, Mitigation Actions, LEDs, and MRV system called NICCDIES. The CCC is designated as the overall coordinator, while line agencies are designated as lead to their respective sectors (i.e. DOE for Energy, DENR-FMB for Forestry, DENR-EMB for Industry and Waste, DA and PSA for Agriculture, DOTr for Transport).

Moreover, it should be noted that documentation, archiving and reporting is important once the inventory system becomes functional. All information related to the planning, preparation, and management of inventory activities need to be recorded and QA/QC procedures should be documented. These are important information to enable continuous improvement of inventory estimates. Lastly, a summary of implemented QA/QC activities and key findings as a supplement to each country's national inventory should be regularly reported.

In terms of resources, lack of or limited resources for GHG inventory compilation is quite challenging but should not become a hindrance in continuing the work of inventory compilation. Ms. Kilroy provided advice in addressing such challenges:

- Identify roughly 15-20 categories and concentrate resources on them (Key Category Analysis) since such accounts for 95% of emissions;
- For other sources use "Tier 1" methods;
- Focus efforts on collecting activity data;
- Use defaults for emission factors (fuels in particular) but consider higher tier methods, if the inventory is to respond to mitigation activities (e.g. in agriculture); and
- Look for and use national statistics that are institutionally established. Cooperate in collecting new data and verify with international data sources (IEA, FAO, ICAO etc.).

Thus, in summary:
- Inventories need to be credible to both national and international audiences: they need to be of high quality.
- Apply IPPC methodologies.
- Keep in mind the principles of quality: "TACCC".
- QA/QC and verification activities should be integral parts of the inventory process.
- Seek to achieve the balance of QC requirements for timeliness & cost effectiveness.
- Initial planning and good management is essential.
- Limited resources/funds are not a barrier to GHG inventory compilation.

<u>Discussion Highlights</u>

- <u>On importance of having a QA/QC system for national or sectoral levels</u>. In the UK, the steering committee oversees the quality, while RICARDO EE provides the technical expertise. However, sectors are required to conduct their own checks or apply their respective QC based on their specific circumstances. For instance forestry has a different approach in checking their data from the agriculture sector. Hence, there is an oversight, sector specific and common team support the entire process.

- On the essential elements that would qualify the QA/QC procedures. There is an ISO standard for GHG inventories but its content is not the same as the IPCC guidelines. IPCC has a checklist on QA/QC, which the country may use to verify its compliance.

- On the specific threshold for uncertainty which can be considered as acceptable value. In the Philippines, the uncertainty for total net emission for CO_2 inventory is about 10% while other gases may have a different or even higher uncertainty. However, this does not affect the level of confidence of the inventory. Analysis using spreadsheets would provide the confidence on the trend, because the same method is being used each year and the uncertainty in the trend of emissions over time can be quite small even if the uncertainty for a specific year is larger. Thus, it should be noted that while uncertainty for carbon dioxide can be quite accurate compared to non-CO_2 emissions, it does not reduce the credibility in the inventory and or affect the overall quality of the inventory. There are three steps to remember a) understand key categories, b) prioritize improvement, and c) aim to reduce uncertainty at the national and sectoral level.

- On the experience of UK in developing the GHG Inventory System. The UK can provide guidance given its experience in reporting as an Annex I country. In fact, examples and guidance based on UK experience can be provided to Viet Nam and the Philippines, in terms of their current efforts on GHG inventory. Relatively, creating an inventory is straightforward since the IPCC 2006 guidelines provide the information and compliance software (for free).

- On key considerations for developing QA/QC for mitigation actions. In the UK, the estimation for mitigation actions is normally done against the baselines. An annual report is submitted to the Parliament that sets out the summary work to be done by the Climate Change Committee to ensure that the UK is counselling. This is called Carbon Budget Report, which outlines the estimates for CO_2 reduction for mitigation actions or if such inventory responded given that calculation was done independently. Note that the inventory may respond differently, for instance when emission reduction is applied in agriculture sector, the method that was originally used may simply not allow the accounting of change, hence the method to be applied may have to be a higher tier to be able to respond to the mitigation actions. Energy efficiency could be a different case, as it responds automatically, for example, compared to 10 years ago, the current lighting type (LED) needs less electricity and less fuel, hence the inventory will respond automatically (fuel x carbon). Therefore, application of appropriate methodology needs to be taken into account if such mitigation action should appear in the inventory.

Preparation of First Biennial Report: Viet Nam's Experience

Dr. Nguyen Phuong Nam, *DMHCC-MONRE, Viet Nam*

Viet Nam ratified the UNFCCC in 1994 and Kyoto Protocol in 2002. The Ministry of Natural Resources and Environment (MONRE) is the National Focal Point of Viet Nam for implementation of the UNFCCC and the Kyoto Protocol (KP), specifically the Department of Meteorology, Hydrology and Climate Change (DMHCC) is responsible for:

- Organizing and coordinating the implementation of UNFCCC and KP modalities, guidelines and procedures;
- Standing Office for the National Steering Committee of the UNFCCC and the KP;
- Designated National Authority for the Clean Development Mechanism;
- Focal point for communication with the UNFCCC Secretariat and the Intergovernmental Panel on Climate Change (IPCC).

Viet Nam submitted the Initial National Communication (NC1), the NC2 and the Initial Biennial Update Report (BUR1) to the UNFCCC Secretariat in 2003, 2010 and 2014, respectively. It is one of the countries that submitted the first Biennial Update Report before the December 2014 deadline of the UNFCCC – a result of concerted efforts from the government, private sector, and development partners such as the Japan International Cooperation Agency (JICA). In fact, BUR1 preparation was integrated in the national policy and budget of the central government.

In the experience of Viet Nam, developing the content of the BUR is not as complicated as the NCs since there are only four (4) chapters to fill in and two (2) references to include. The first chapter outlines the current national circumstance of the country and its sustainable development strategy, and institutional arrangement for the development of BUR. It was also noted that since Viet Nam is categorized as middle-income country, it has been receiving lesser ODA support compared before, hence for future reporting, the government needs to include budget for NCs' and BURs' preparations.

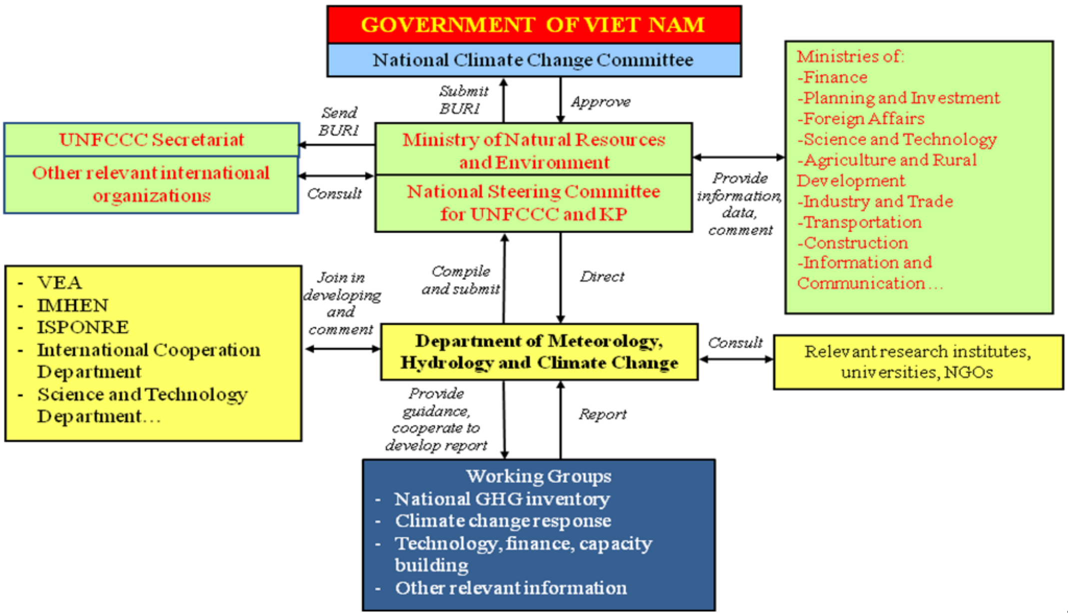

Figure 12. Institutional Arrangement for the First BUR Development in Viet Nam

Chapter 2 tackles the results of the 2010 GHG inventory and how it was implemented in terms of institutional arrangement, the specific methodology used, and QA/QC. It also outlines the GHG emission projection for 2020 and 2030.

The inventory adopted the methodologies outlined in the Revised 1996 IPCC Guidelines for National GHG Inventories (IPCC, 1996), IPCC Good Practice Guidance and Uncertainty Management in National GHG Inventories (IPCC, 2000), and the IPCC Good Practice Guidance for Land Use, Land Use Change and Forestry (IPCC, 2003). Activity data were collected from the General Statistics Office (GSO) under Ministry of Planning and Investment (MPI) and other related ministries and stakeholders, steered and facilitated by DMHCC –MONRE. DMHCC-MONRE also coordinates the QC/QC plan for the GHG inventory with support from sector agencies for direct implementation of QA/QC processes for tier 1 and tier 2 methodologies. External experts are also hired to independently assess the results of the inventories.

The National Inventory Reports (NIRs) of 2005 and 2010 have identified 95 categories, excluding LULUCF and 117 categories including LULUCF and provided recommendations responding to sectors in the improvement of GHG inventories. Emission factors in the IPCC guidelines were used as default for the sectors except for rice cultivation, where country-specific EFs were used.

The 2010 GHG Inventory of Viet Nam showed that the energy sector has the highest contribution to GHG emissions accounting 53% of the total GHG emission. Out of 266 million tonnes (Mt) of CO_2, 141.1 Mt belong to the energy sector – the total emission do not include the LULUCF sector as it contributed to CO_2 net removals (-20.4 Mt). The calculation of removals only started during the submission of the BUR1. The country is targeting to increase the removals from -19.2 Mt of CO_2 to -45.3 Mt by 2030.

Table 4. Viet Nam's 2010 GHG Inventory

Sector	CO_2	CH_4	N_2O	Total	Percentage (%)
Energy	124.8	16.0	0.4	141.1	53.05
Industrial Processes	21.2	-	-	21.2	7.97
Agriculture	-	57.9	30.4	88.3	33.20
LULUCF	-20.3	1.0	0.1	-19.2	
Waste	0.07	13.4	1.8	15.4	5.78
Total Emissions (excluding LULUCF)	146.0	87.3	32.7	266.0	100.00
Total Emissions (including LULUCF)	125.7	88.3	32.8	246.8	

With the experience of the country in preparing the GHG inventory for the BUR1, the National Inventory System (NIS) was approved by the Prime Minister through the Decision No. 2359/QD-TTg in December 2015. The decision provided the legal foundation for the responsibilities of the ministries and stakeholders in the NIS. Also, the decision has nine (9) annexes that provide formal technical information for activity data collection of line ministries and stakeholders involved in the NIS, including 48 spreadsheets with approximately 5000 single activity data for the five (5) sectors.

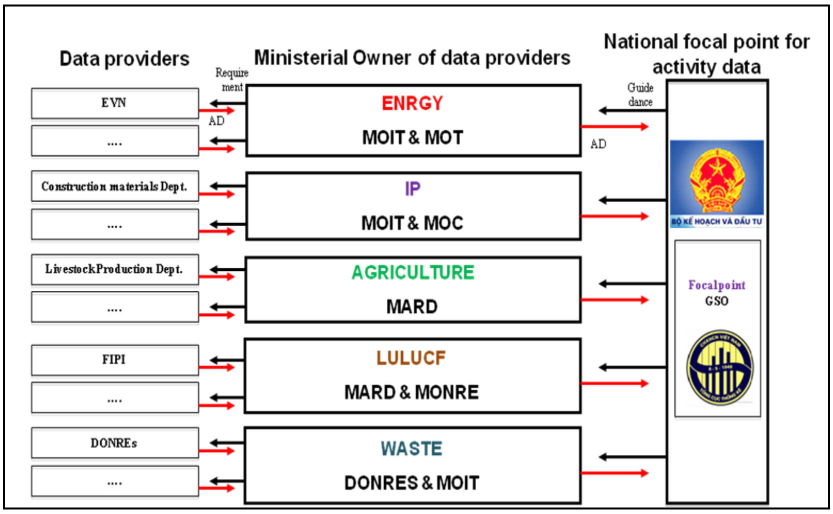

Figure 13. Requirements for Activity Data

Key challenges in GHG Inventory compilation for the preparation of the BUR:

- After less than a year from the NIS approval, GSO-MPI has only collected activity data (AD) from 5/5 ministries and 39/63 cities/provinces for the preparations of the BUR2 (year 2013) and NC3 (year 2014);
- The official AD for the 2013 GHG Inventory are available with 60% of the 5000 single AD;
- Some AD is inadequate, there is a lack of a specific database to implement the inventory (i.e. LULUCF sector);
- Implementation of the GHG inventory is not comprehensive;
- Most of the EFs used for GHG inventory are IPCC's default values;
- QA/QC is insufficient due to a lack of specific guidelines;
- No plan and activities for uncertainty analysis and recalculation is in place;
- Domestic financial resources and availability of local experts for the national GHG inventory are limited;
- Most of the national GHG inventories (i.e. BUR, NC3) were still conducted primarily under programs and projects funded by international aid agencies (i.e. UNEP).

Discussion Highlights

- On calculation of GHG emissions and removals: Prior to its third national communication, carbon sinks emission removals were not reported. It was only in 2010 that the GHG removals by sinks were calculated given the limitation in the activity data for estimates and emission factors from the previous GHG inventory years. Hence, only GHG emissions were calculated for the first and second national communications, while current and project removals were already included in the first BUR.

- On key categories covered under IPPU: There are only two key categories for the industry sector, the *first category* is cement due to a major production in Viet Nam and the *second* is on the production of construction materials.

- On calculation for other gases: Hydrofluorocarbons, Perfluorocarbons and Sulfur Hexafluoride gases were not yet calculated due to limited activity data and the country only focused on the key gases (CO_2, CH_4 and N_2O) under the Revised 1996 IPCC Guidelines for National GHG Inventories as recommended by UNFCCC for Non-Annex I countries.

BREAKOUT SESSION: SECTORAL EXERCISES ON UNCERTAINTY CALCULATION AND QA/QC PLANNING

Exercise 1: Simple Uncertainty Calculation

The participants were grouped according to their sector representation and asked to calculate a simple uncertainty exercise. From the calculations presented below, Dr. Watterson emphasized the importance of crossing the units out in order to determine the final unit needed and being extra careful in using carbon and carbon dioxide so as not to misread the calculation.

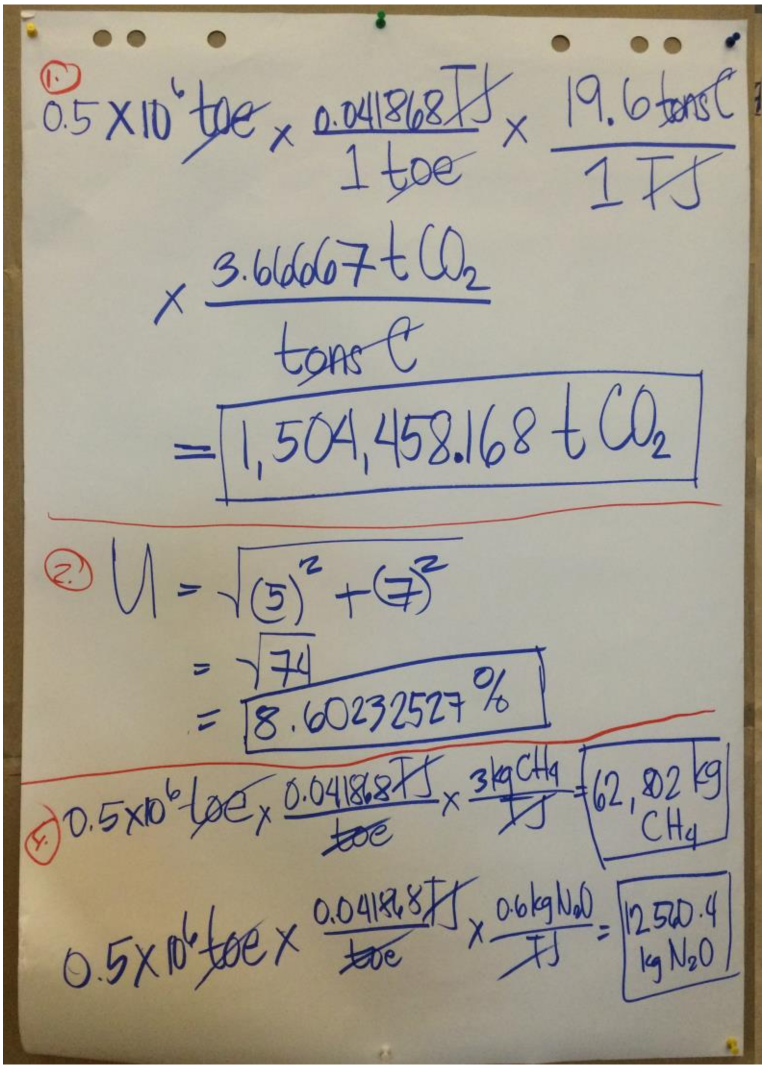

Figure 14. Simple Uncertainty Calculation

Exercise 2: Sectoral Uncertainty Analysis

The same AWITFE groupings were applied while CCC representatives divided themselves among the sectoral groups. The groups were asked to work on the exercise provided to them, following specific questions indicated in the worksheet to calculate uncertainties for their own sectors (see annex 4 for the sample worksheet*)*. The results were then presented back to the plenary for further discussion. Figures below illustrate the calculations of the groups, following some comments from Dr. Watterson.

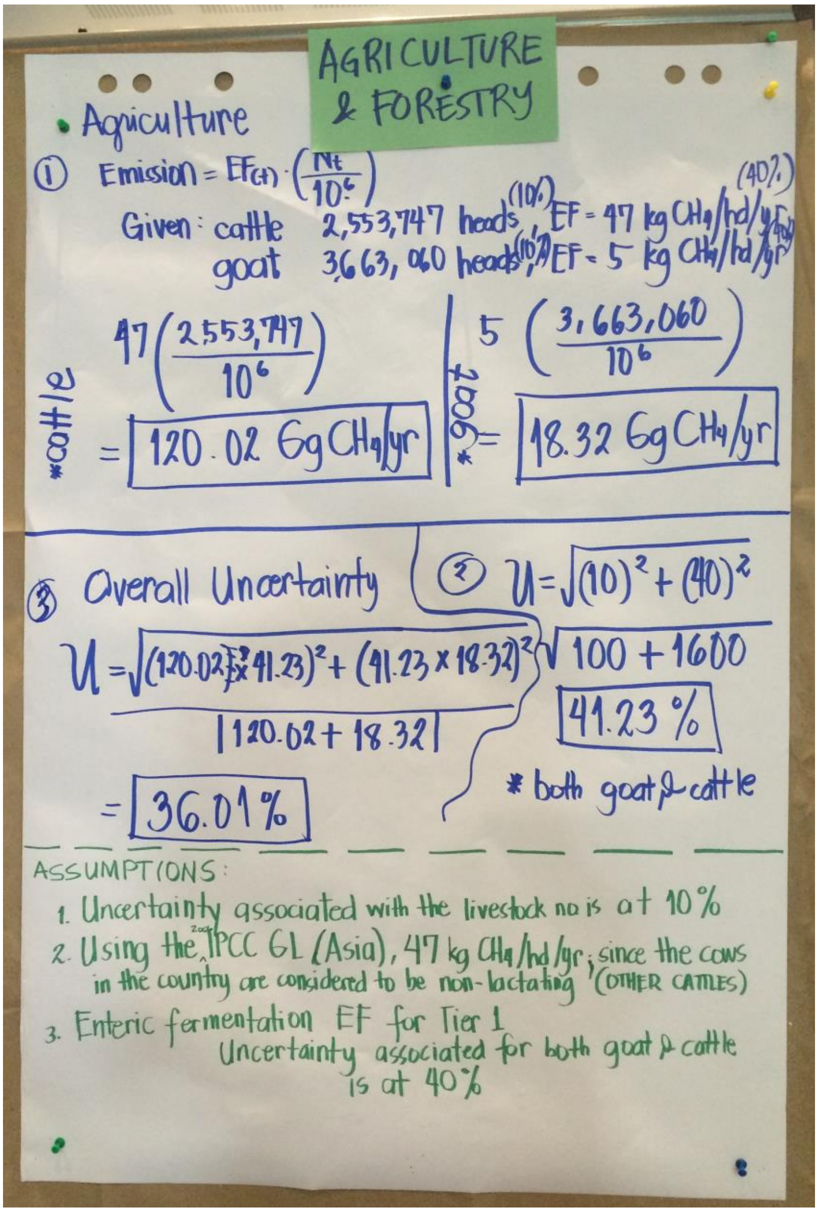

Figure 15. Sectoral Uncertainty Calculation (Agriculture and Forestry - Philippines Group)

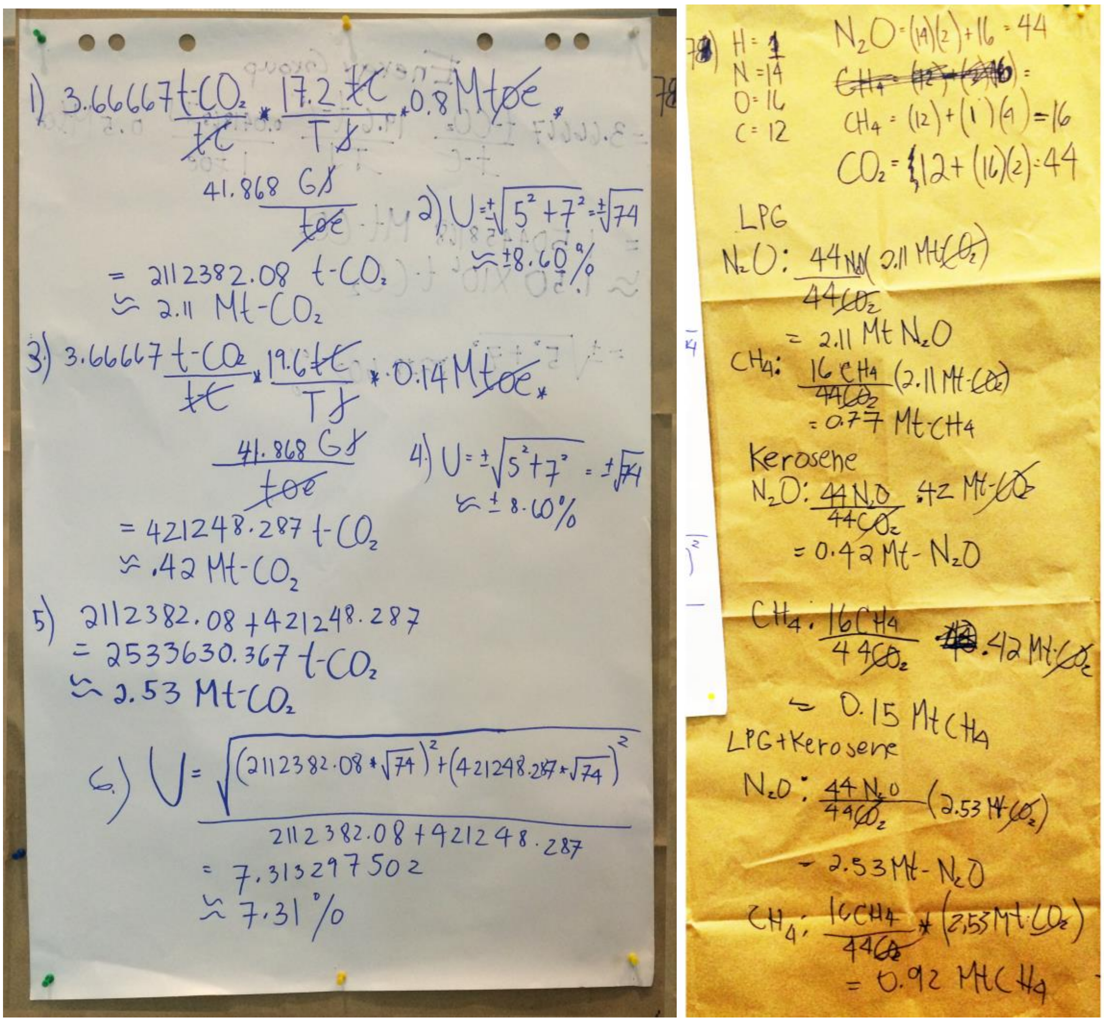

Figure 16. Sectoral Uncertainty Calculation (Energy - Philippines Group)

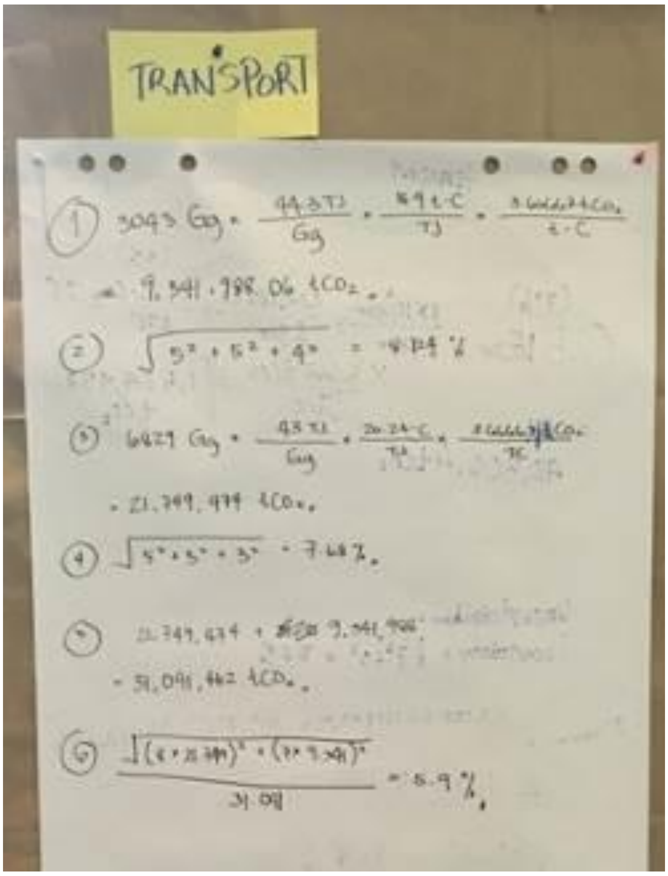

Figure 17. Sectoral Uncertainty Calculation (Transport - Philippines Group)

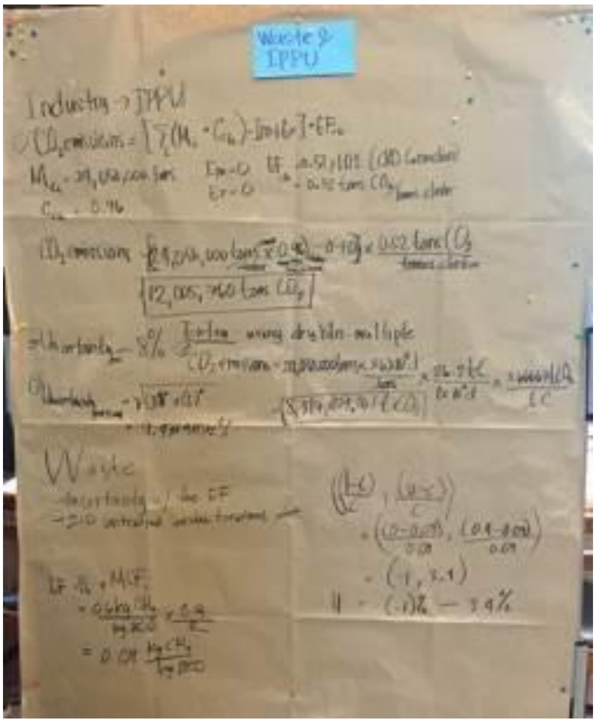

Figure 18. Sectoral Uncertainty Calculation (Waste & IPPU - Philippines Group)

Year	Consumption (TOE)	Weight (GJ)	Weight (TJ)	Uncertainty (%) of AD	EF (t-C/TJ)	EF CH4 KgCH4/TJ)	EF N20 KgN2O/TJ)	Uncertainty (%) of EF	CO2 Emision (t-C)	CO2 (t-CO2)	CH4 (kg-CH4)	N2O (kg-N2O)	Uncertainty (%) of Emission	Total Emission (t-CO2eq)
kereose	140000.0	5861.5	5861520.	7.0	19.6	2.0	0.6	5.0	114885792.	421248.3	43.0	0.000015	8.6	421249
LPG	800000.0	33494.4	33494400	7.0	17.2	2.0	0.6	5.0	576103680.	2112382.1	245.6	0.000015	8.6	2112387
TOTAL										2533630.4			7.3	

Figure 19. Sectoral Uncertainty Calculation (Energy -Viet Nam Group)

From the presented calculations, feedback/comments were provided by Dr. Watterson:

- The table in the chapter on uncertainty of the IPCC 2006 guidelines can be used for a more complicated calculation.
- Refer to IPCC guidelines for applicable emission factors, if country specific data is not available.
- A time-series inventory is useful in providing a trend analysis.
- Document all assumptions and information from experts.
- Watch out for units used for the calculations, i.e. metric ton vs megaton.
- Apply QA/QC as good practice to check the computation.

Exercise 3: Development of QA/QC Plan

The groups were asked to develop a QA/QC plan to improve the quality of the GHG emission estimates for their respective sectors. The following questions were provided to guide the groups in their discussion.

- What are the key categories to tackle in your sector?
- How might you be able to use the uncertainty analysis to develop an improvement plan?
- How could you build on development work that has already been done, and which is planned in the future?
- Where might there be quality problems, and how could these be overcome?

Table 5. QA/QC Plan of each Sector

Sector	Key Categories	Actions	Improvement Plan	Building on Development Work
Transport	• Road • Air • Water	• Development of tools for data collection • Generation of country-specific emission factors • Improvement of activity data collection (bottom-top approach) • Generation of fuel economy • Development of QC/AC Plan • Centralized database of public/private transport vehicles (air, water, land) • Strengthen agency/organizational linkages	• VA will inform which key categories should be prioritized in the improvement plan	• Conduct regular assessment of methodologies used

Sector	Key Categories	Actions	Improvement Plan	Building on Development Work
Waste	• Solid Waste Disposal Sites • Rate of Open Burning Act	• Consider options for obtaining century specific factors • Review of latest WACS results • Compare direct measurements against estimates and document significant discrepancies • Convene FGD to determine all available data and data sources • Compare WACS data across similar sets		
IPPU	Metal (steel billets)	• Regional data collection • ODS substitute – measure actual usage		
	Cement	• Clinker production data • Regional data collection • Check with alternative data (sales, import/export)		
Energy	• Electricity Generation • Energy Industries	• Assessment of the quality and completeness of current data • Application of information, communication technology (ICT) for standard reporting format • Capacity building • Engage stakeholders through workshops on data requirements • Legal framework (Enercon Law)		
Forestry	Reforestation	• More accurate reporting and mapping of NGP planting sites • Continuous validation and monitoring (Executive Order 26 and 193) • Use of LAWIN for biodiversity monitoring • Enhance capacities of forest guards/extension officers		
	Forest Protection	• Monitoring and reporting every 6 months (EO 23: NGP) • NFSMS (ITTO Timber tracking) • Help improve accuracy of forest cover maps generated by the national mapping		

Sector	Key Categories	Actions	Improvement Plan	Building on Development Work
		agency • Supply accurate location of forest areas that may be used to validate and improve accuracy of forest cover in national land cover maps • Enhance capacities of forest guards/extension officers		
Agriculture	• Rice production • Livestock and Poultry Production • Manure Management • Land use	• Address identified data gaps through conduct of special/scientific studies to generate required information • Improve data collection on agricultural statistics to capture other data gaps • Engage the department of Agriculture (DA) in GHG inventory related activities • Conduct experts group meeting/FGDs as possible sources of data		
Viet Nam (Agriculture)	• Rice cultivation (.50%)-Irrigated • Manure management Enteric Fermentation (>20%) • Buffalo • Cattle	• Improve quality • Develop country-specific emission factor • Apply Tier 2 • QC for agriculture: data collection and documentation • Country-specific emission factors updated for irrigated • IPCC 2006 guideline methodology application		

CLOSING REMARKS

On behalf of the Climate Change Commission (CCC), ***Ms. Mary Descery Joy Bongcac*** thanked everyone for the active participation. She mentioned that CCC will soon start the inventory process to finalize the inventory for 2010. She also reminded the participants that a consultant for NICCDIES will be visiting respective agencies for the finalization of the template for data collection and sharing. Finally, she thanked GIZ for organizing the training-workshop and RICARDO-EE for sharing their technical expertise on uncertainty analysis.

Dr. John Watterson thanked the participants and GIZ for inviting RICARDO-EE. He hoped agencies would put into practice the learning/lessons gained from the workshop.

Ms. Rocio Lichte from GIZ expressed gratitude for the participation of agencies. She is certain that the training-workshop would have an impact in the work of the relevant agencies in GHG inventory. She also emphasized that additional questions can be sent via email to the IM Project Team who will gladly respond.

POST-TRAINING TEST SCORES

A 15-item post-training test was developed by the trainers to gauge the level of understanding of the participants on the basic elements of uncertainty analysis. The highest possible score obtainable was 35.

The graph below shows the frequency distribution of scores garnered by the participants. A total of 32 participants took the test. The highest score registered was 31 while the lowest was 23. The lowest score obtained represents 66% of the total possible correct answers.

The group's average, median, and mode were 27. Standard deviation was 2.58 based on total population.

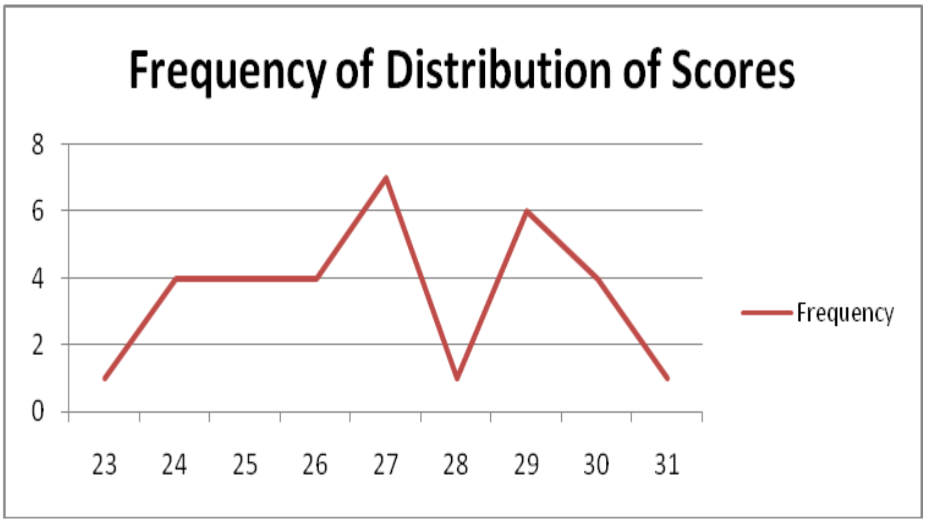

Figure 20. Frequency of Distribution of Post-Test Scores

POST-TRAINING EVALUATION RESULT

The participants were requested to evaluate the training-workshop by rating five (5) criteria; preparation and course delivery, facilitation, speakers, general satisfaction, and venue. The evaluation indicated six (6) ratings; strongly agree (5); agree (4); neither agrees nor disagree (3); disagree (2); strongly disagree (1); and no answer (0). In general, participants showed much interest on the training-workshop given that majority of the participants' general satisfaction was rated "4". The respondents have agreed that workshop objectives were met with a weighted average of 4.25.[1] Figure 16 below demonstrates the result for the evaluation criteria, while the next table details additional comments from the post-training evaluation. Note that one (1) out of the 32 participants who responded to the evaluation was not able to rate the second set of questions at the back of the form.

Figure 21. Evaluation Result for Each Criterion

[1] Each evaluation score is assigned with weight to determine the relative importance of each quantity on the average. Thus, the following is the assigned weight for each score: strongly agree (5)=2, agree (4)=1, neutral (3)=0, disagree (2)=-1, and strongly disagree (1)=-2

Specific comments were:

Questions	Comments
What will you do differently in your work/practice setting as a result of this workshop?	• Pay more attention to QC/QA processes, especially the routine checking and documentation. • Considering to analyze the uncertainty of Viet Nam GHG inventory • Convene the inventory team and discuss/share the experiences we had. • Develop plan of action • Be mindful of the possible sources of uncertainty in the inventory. • Apply all the necessary methods and approach relative to uncertainty calculation • Be more cautious when it comes to calculations. • Review of all existing information. • Take more notes • Setting up of information/data, create a system to easily view and calculate the emission in different gases. • Use the results of the workshop to some of the office works, especially database and share the things I learned to my officemates • Share the knowledge • Application of knowledge learned • Draft an echo report for the officemates/team • Minimize the uncertainty of collected data
What aspects of the workshop could be improved	• The workshop should have more practice exercises • Congratulations for countries because we need the learning by doing with real data and country context • More time for workshops • Provision of handouts/presentation materials for better attention during lecture • Visual presentation • None, because the facilitator and speakers provided directions clearly and comprehensively. • Close guidance in exercises • The venue could be on a much accessible location
Other Remarks	• Thank you very much! • No chicken • Unclean plates, utensils, glasses • Ok, informative • Great speakers and topics • Superb content and expert speakers • Thanks for a fun learning experience

ANNEXES

1. Program Agenda and Concept Note

In-country Training-Workshop on Uncertainty Analysis of National GHG Inventories

February 27-28, 2017 * Meranti Hotel, Quezon City

CONCEPT NOTE

Overview

Uncertainty estimates are an essential element of a complete inventory of greenhouse gas emission and removals. An uncertainty assessment is good practice in national greenhouse gas inventory development. Awareness of uncertainty parameters and results provides inventory compilers with insight when evaluating suitable data during the data collection and compilation phases [1].

As part of its national communications (NC), the Philippines had submitted GHG emission estimates based on the following national inventories:

a) The National Communication for 2000 using the emission estimates of the a National GHG inventory with 1994 as Base Year; and
b) The more recent NC submitted in 2014, using emission estimates of the National GHG inventory with 2000 as Base Year.

However, information related to the uncertainty of GHG emission estimates is yet to be identified based on the needs specified in the Second National Communication. The Quality Assurance (QA) and Quality Control (QC) processes, procedures and management systems related to the compilation of GHG data at the national level is still not yet established. The IPCC Guidelines request Parties to make efforts to report the estimated range of uncertainty in their emission estimates to ensure the overall quality of GHG inventory reports.

National GHG Inventories are only estimates of the true or actual GHG emissions of a country. Uncertainty estimates of National GHG Inventories provide guidance to users of GHG data of the level of accuracy of the GHG information.

An uncertainty analysis can also become a tool to prioritize national efforts towards GHG mitigation efforts, by focusing on mitigating actions from sectors with robust emission estimates (low uncertainty) and provide further support to sectors where data sources needs further improvement due to high uncertainties.

Global and National Framework

In an effort to significantly contribute to global mitigation efforts, it was decided at the sixteenth session of the Conference of the Parties (COP 16) of the UNFCCC that developing countries should submit biennial update reports (BURs) to communicate their national efforts. The BURs shares information on greenhouse gas inventories (GHGI).

The Philippines is expected to submit its first Biennial Update Report (BUR) as a Non-Annex I Party. The Seventeenth Conference of Parties (COP 17) adopted the "UNFCCC biennial update reporting guidelines for Parties not included in Annex I to the Convention", which are contained in annex III to decision 2/CP.17. BURs for non-Annex I parties will undergo and international verification process through an international consultation and analysis.

Accurate, consistent and internationally comparable data on GHG emissions is essential to take the most appropriate action to mitigate climate change. Communicating relevant information on the most effective ways to reduce emissions to adapt to the adverse effects of climate change also contributes towards global sustainable development[2]

Situation in the Philippines

In preparation for the submission of its first BUR, the Philippines has identified in its Second National Communication the gap related to the QA/QC of its National GHG Inventory. To ensure the quality of the National GHG Inventory, uncertainty estimates from Sectoral Data Sources needs to be determined. However, the Philippines needs the support to develop its own capability in improving the quality of its national GHG inventory and enable local sectors to institutionalize Uncertainty Analysis and QA/QC of sectoral GHG inventory.

Uncertainty analysis is a potential tool to allow the targeting of specific areas within the GHG inventory for enhanced data collection. This will enable a user to rank in order the importance of different emission sources in terms of their overall contribution to the emission inventory and its overall uncertainty range[3]

Objectives

The overall objective of the workshop is to provide the GHG Inventory Compiler and Data Suppliers from various sectors a comprehensive understanding of the concept of uncertainty estimates and use this information for the improvement of the National GHG Inventory

Specific objectives of the workshop are as follows:

a) Review the methodology for estimating uncertainty from GHG data;
b) Calculate Uncertainty Estimates for Sectoral Data;
c) Use the GHG Uncertainty Estimates in establishing a QA/QC Program for specific GHG Data Sources;

[2] http://unfccc.int/national_reports/nonannex_i_natcom/reporting_on_climate_change/items/8722.php
[3] http://www.ipieca.org/publication/addressing-uncertainty-oil-and-natural-gas-industry-greenhouse-gas-inventories-technical

d) Provide an introduction to basic GHG verification process among sectors prior to data consolidation;

Resource Persons

The main speakers for the training-workshop are Dr. John Watterson and Ms. Eleanor Kilroy from Ricardo Energy and Environment through GIZ Global IM project

Proposed Agenda

Time	Topics	Trainer/ Speaker
DAY 1 27Feb2017		
8:30-9:00	Registration of Participants	IM Project/CCC
9:00-9:30	Opening - Prayer and national anthem - Welcome remarks	Representative from CCC
09:30-10:15	Overview of the Project	GIZ IM Project Representative Representative from CCC
10:15-10:30	AM Snack	
10:30 – 11:00	Overview of workshop Board of expectations/worries	Ricardo EE (with input from participants)
11:00-12:00	Uncertainty Analysis - Overview of uncertainty analysis - Key concepts and terminology - Basis for uncertainty analysis - Causes of uncertainty - Reducing uncertainty - *Uncertainty Analysis Quiz*	Ricardo EE
12:00-13:00	Lunch Break	
13:00-13:30	Answers and discussion of Uncertainty Analysis Quiz	
13:30 -15:00	Quantifying Uncertainty - Methods - Data and information required - Combining uncertainty	Ricardo EE
15:00-15:15	PM Break	
15:15-16:15	Calculation of simple uncertainty estimates – everybody - Q+A	Ricardo EE
16:15-16:30	Plenary discussion / wrap up of the day	Ricardo EE (with input from participants)
16:30	End of Day 1	
DAY 2 28Feb2017		

Time	Topics	Trainer/ Speaker
8:30-9:00	Registration of Participants	
9:00-9:15	Recap of Day 1	
9:15-10:15	Calculation of Uncertainty Estimates of Sector-Specific GHG Data - Group exercises in estimating uncertainty from Agriculture, Waste, Industry, Transport, Forestry and Energy Sectors	Ricardo EE Facilitated by CCC and Sector Representatives
10:15-10:30	AM Break	
10:30-11:15	Continuation of sector-specific Uncertainty Estimates exercise	Ricardo EE Facilitated by CCC and Sector Representatives
11:15-12:00	Presentation of Sector Outputs - Uncertainty Estimates of Sectoral GHG Data	Ricardo EE Facilitated by CCC and Sector Representatives
12:00-13:00	Lunch	
13:00-14:15	Introduction to the management of GHG Inventory Quality (QA/QC and Verification) and brief introduction on GHG verification	Ricardo EE
14:15-14:30	PM Break	
14:30-15:45	Development of sector QA/QC Plans based on uncertainty estimates	Ricardo EE Facilitated by CCC and Sector Representatives
15:45-16:30	Workshop Wrap-up and evaluation of Board of Worries Final Quiz Closing Remarks	Facilitator CCC Representative
16:30	End of Day 2	

2. Group Exercises

2.1 Simple Uncertainty Calculation

Calculate

1. The CO2 emissions from the domestic use of Kerosene in 2000
2. The uncertainties associated with the domestic use of Kerosene in 2000

Extra questions if you have time

3. How could you check your calculations?
4. Calculate the N2O and CH4 emissions from the use of kerosene

4.2. Sectoral Uncertainty Calculation

Calculate

1. The CO2 emissions from the domestic use of LPG in 2010
2. The uncertainties associated with the domestic use of LPG in 2010
3. The CO2 emissions from the domestic use of Kerosene in 2010
4. The CO2 emissions associated with the domestic use of Kerosene in 2010
5. The combined CO2 emissions from LPG and Kerosene use in 2010
6. The combined estimate of uncertainty from LPG and Kerosene use in 2010

Extra questions if you have time

8 How could you check your calculations?

7 Calculate the N2O and CH4 emissions from the use of these fuels

Data Sources:

GHG Inventory Manual.pdf

TABLE 1. CARBON EMISSION FACTORS AND IPCC EQUIVALENT OF FUELS IN THE OEB ILLUSTRATIVE ONLY

Fuel Classification (from OEB Sheet)	IPCC Equivalent	Emission Factor (t-C/TJ)	Uncertainty (95% CI)
Asphalt	Bitumen	22	
Avgas	Other Oil	20	
Biomass	Solid Biomass	29.9	
Coal	Sub-bituminous coal	26.2	
Crude Oil	Crude Oil	20	
Diesel	Gas/Diesel Oil	20.2	5
Fuel Oil	Residual Fuel Oil	21.1	
Gasoline	Gasoline	18.9	5
Jet Fuel	Jet Kerosene	19.5	
Kerosene	Other Kerosene	19.6	5
LPG	LPG	17.2	5
Lubes	Lubricants	20	
Naptha	Naptha	20	
Natural Gas	Natural Gas	15.3	
Other PP4	Other Oil	20	

http://www.doe.gov.ph/power-and-electrification/national-grid-emission-factor-ngef

NATIONAL GRID EMISSION FACTOR (NGEF)

Parameter	t-CO_2/MWh
Operating Margin Emission Factor	0.6032

http://www.doe.gov.ph/doe_files/pdf/01_Energy_Situationer/2012-2030-PEP.pdf

Extracted from graph - Residential Energy Demand, By Fuel / Mtoe ILLUSTRATIVE ONLY

Units are Mtoe (mega tonnes oil equivalent)

Year	LPG	Kerosene	Biomass	Electricity	Total	Uncertainty (95% CI)
2000	0.9	0.5	5.4	1.2	8	7
2001	0.9	0.46	5.18	1.2	7.74	7
2002	0.9	0.43	4.97	1.27	7.57	7
2003	0.8	0.39	4.75	1.33	7.27	7
2004	0.9	0.35	4.53	1.4	7.18	7
2005	0.8	0.25	4.32	1.4	6.77	7
2006	0.77	0.23	4.1	1.43	6.53	7
2007	0.73	0.21	3.97	1.45	6.36	7
2008	0.7	0.19	3.83	1.48	6.2	7
2009	0.8	0.16	3.7	1.5	6.16	7
2010	0.8	0.14	3.6	1.6	6.14	7
2011	0.8	0.12	3.5	1.65	6.07	7
2012	0.8	0.1	3.2	1.7	5.8	7
2013	0.85	0.1	2.93	1.73	5.61	7
2014	0.91	0.09	2.67	1.77	5.44	7
2015	0.96	0.09	2.4	1.8	5.25	7
2016	1.01	0.09	2.2	1.8	5.1	7
2017	1.06	0.08	2	1.88	5.02	7
2018	1.12	0.08	1.8	1.95	4.95	7
2019	1.17	0.08	1.6	2.03	4.88	7
2020	1.22	0.07	1.4	2.1	4.79	7
2021	1.28	0.07	1.28	2.22	4.85	7
2022	1.33	0.07	1.16	2.34	4.9	7
2023	1.38	0.06	1.04	2.46	4.94	7
2024	1.43	0.06	0.92	2.58	4.99	7
2025	1.49	0.06	0.8	2.7	5.05	7
2026	1.54	0.05	0.72	2.88	5.19	7
2027	1.59	0.05	0.65	3.05	5.34	7
2028	1.64	0.05	0.57	3.23	5.49	7
2029	1.7	0.04	0.5	3.4	5.64	7
2030	1.75	0.04	0.42	3.58	5.79	7

5. Post-Training Evaluation Result (Tabulation)

Questions	5 (Strongly Agree)	4 (Agree)	3 (Neither Agree nor Disagree)	2 (Disagree)	1 (Strongly Disagree)	0 (No Answer)	Total	Weighted Average
PREPARATION AND COURSE DELIVERY								
Invitation stated the goals	8	21	1	0	0	2	32	3.97
WS content was organized & easy to follow.	10	22	0	0	0	0	32	4.31
Sufficient opportunity for interactive participation	14	17	1	0	0	0	32	4.41
Materials distributed were pertinent and pitched at the right level.	4	22	6	0	0	0	32	3.94
Sufficient time to cover all proposed activities	8	24	0	0	0	0	32	4.25
FACILITATOR/MODERATOR								
Proper Guidance from the Moderator	11	21	0	0	0	0	32	4.34
Facilitator(s) was/were well prepared for the workshop	12	20	0	0	0	0	32	4.38
Comprehensive and Clear instructions and directions	10	22	0	0	0	0	32	4.31
Facilitator(s) encouraged active participation and ownership to expected outputs	12	20	0	0	0	0	32	4.38
SPEAKERS: Clear, Concise and Effective Presentation								
John Watterson	17	15	0	0	0	0	32	4.53
Eleanor Kilroy	11	20	1	0	0	0	32	4.31
GENERAL SATISFACTION								
Objectives were met	9	22	1	0	0	0	32	4.25
Learned a lot of new concepts and tools	10	22	0	0	0	0	32	4.31
Satisfied with my increased understanding of the topic	13	17	1	0	0	0	31	4.39

Definitely help me make a difference in the way I do my job	10	20	1	0	0	0	31	4.29
Sharing of information with other colleagues	12	19	0	0	0	0	31	4.39
FACILITY								
Training venue and related facilities provided a comfortable setting.	7	21	2	1	0	0	31	4.10
Location for the training was accessible and convenient for me.	8	17	6	0	0	0	31	4.06
Refreshments and food provided were of good quality.	9	17	4	1	0	0	31	4.10
Tools and equipment during the sessions worked well.	11	17	3	0	0	0	31	4.26

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