SPREP's Climate Change
and Integrated Coastal
Management Programme

Evaluation and Regional Synthesis of National Greenhouse Gas Inventories

Volume 1: General Assessment and Regional Synthesis

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Executive summary for policy makers

The Pacific Islands Climate Change Assistance Programme (PICCAP) is a three-year climate change enabling activity involving 10 Pacific Island Countries (PICs): Cook Islands, Federated States of Micronesia, Fiji, Kiribati, Marshall Islands, Nauru, Samoa, Solomon Islands, Tuvalu and Vanuatu. PICCAP is designed to assist PICs in meeting their reporting requirements under the United Nations Framework Convention on Climate Change (UNFCCC). The project is funded by the Global Environment Facility (GEF), implemented by the United Nations Development Programme (UNDP) and executed by the South Pacific Regional Environment Programme (SPREP).

To enable countries to fulfil their reporting requirements, PICCAP has been providing and facilitating technical assistance to national climate change teams and experts. This assistance has resulted in technical studies that will form the basis for their initial national communications to the Conference of the Parties (CoP) to the UNFCCC. National greenhouse gas (GHG) inventories are one of five activities that have been undertaken by national teams and experts. To ensure maximum value is gained from this work, the findings from each country need to be reviewed, evaluated and synthesised. The current regional assessment and synthesis is intended to complement and facilitate completion of the initial national communications.

In addition to fulfilling obligations under the Convention, the completion of these inventories is also of note for a number of important reasons:

- the completed inventories provide a comprehensive set of national data generated using international best practices;

- the data can be used in the preparation of national sustainable development strategies and for assessing the success of these strategies over time;

- the findings can be used to shape the positions taken in both national and international environmental policy discussions. In this respect it is especially helpful to be able to quantify both national and per capita emissions of GHG relative to totals and per capita values calculated on a global basis;

- the inventory results provide guidance for investment decisions by the private sector and by international, regional and bilateral donors. The newly acquired inventory data assist investors to determine where the greatest environmental benefits can be achieved; and

- by combining the data from the 10 inventories it is possible to prepare the first credible estimate of the anthropogenic GHG emissions for the Pacific Islands region.

The obvious and overall strength of the 10 national inventories is that they have been prepared using comparable methods that are in turn based on international best practices. The effort that has gone into compiling the GHG inventory data will be invaluable for estimating total and per capita emissions of GHG from individual countries and from the Pacific Islands region as a whole.

By way of introduction and background to the report, an historic overview of national GHG inventories undertaken by PICs is presented. This leads into a description of the national studies undertaken with support by PICCAP. The contributions made to our overall understanding of GHG sources and sinks are highlighted.

The recently completed inventories represent a significant advancement in terms of both our ability to undertake such studies and our level of understanding of the extent to which human activities in PICs contribute to changes in atmospheric composition. However, additional work is needed in order to address shortcomings in the methodologies, gaps in our knowledge, data constraints and remaining uncertainties.

A regionally focused synthesis of the results of the 10 national studies is provided. Significant variations in GHG emissions for the 10 PICs are documented, as are comparisons between PICs and countries outside the Pacific basin.

Annual CO_2 emissions from the energy sector range from 4.509 gigagrams (Gg) of carbon dioxide (CO_2)

for Tuvalu to 1196 Gg of CO_2 for Fiji. Per capita equivalent emissions range from 0.23 tonnes of CO_2 for Kiribati to 4.60 tonnes of CO_2 for Nauru. The range in per capita equivalent emissions is greater than those based on the equivalent CO_2 emissions from petroleum consumption.

Of the seven countries reporting methane emissions from solid waste disposal systems, the lowest reported annual emissions was for the Cook Islands (0.275 Gg of methane (CH_4) while the highest was for Fiji (3.4 GG of CH_4). The equivalent per capita emissions ranged between 0.274 kg of CH_4 for the Cook Islands and 42.865 kg of CH_4 per capita for Nauru.

Only four countries reported annual carbon release and uptake related to land use change and forestry activities. Fiji reported 2902 kilotonnes (kt) per annum of carbon uptake while the three other countries (Cook Islands, Samoa and Solomon Islands) reported values less than 73 kt of carbon uptake a year. The Solomon Islands inventory shows 2093 kt of carbon are released each year due to land use change and forestry, with the remaining three countries indicating 178 kt per annum, or less.

Three of the four countries indicated that CO_2 removals exceeded emissions due to land use change and forestry by as much as 9989 Gg of CO_2 per annum in the case of Fiji. The Solomon Islands reported that emissions exceeded removals by 7475.6 Gg of CO_2 per annum.

The small number of countries providing information on other emissions and removals does not allow useful comparisons to be made.

Available national data reveal a per capita equivalent emission of approximately 0.96 tonnes of CO_2 per year. On this basis, the total Pacific Island population of 7.1 million in 22 countries produces some 6.816 million tonnes (Mt) of CO_2 per year. In contrast, based on International Energy Agency data for 1996, global CO_2 emissions arising from fossil fuel combustion only are 22620.46 Mt of CO_2 per year, or 4.02 tonnes of CO_2 per capita per year.

Thus, on average, individual Pacific Islanders are responsible for producing approximately one quarter of the CO_2 emissions attributable to the average person worldwide. Expressed another way, the Pacific Islands region as a whole accounts for some 0.03% of the global emissions of CO_2 from fuel combustion despite having around 0.12% of the world's population.

By way of a further comparison, and relative to the global figures, the OECD countries are collectively responsible for nearly three times the per capita production of CO_2 through the burning of fossil fuels. In terms of total CO_2 emissions from fuel consumption, the 29 OECD countries account for just over 50% of the global total; yet these countries account for only about 20% of the world's population. The differences might be reduced somewhat if net emissions from biomass burning and land use changes were also included, but such refinement is not possible due to the current lack of comparable data.

The report goes on to explore the implications of the preceding findings for regional policies, including those dealing with technical, environmental and development issues. National and regional assessments of GHG emissions have identified areas where further capacity building is required. These include strengthening of technical abilities related to the inventory work itself, the need for enhancing the ability to meet the evolving requirements of the UNFCCC and the need to ensure that the inventory findings are reflected appropriately in national and regional policies and plans.

The report concludes with the identification of projects that would address many of the policy and capacity building implications that have been identified in the synthesis.

Acknowledgements

Appreciation is offered to all the named and unnamed individuals and organisations who contributed to the completion of the emissions inventories in the Cook Islands, the Federated States of Micronesia, Fiji, Kiribati, the Marshall Islands, Nauru, Samoa, the Solomon Islands, Tuvalu and Vanuatu.

List of abbreviations

CC:TRAIN	Climate Change Training
CoP	Conference of the Parties to the UNFCCC
GEF	Global Environment Facility
GHG	Greenhouse Gases
IPCC	Intergovernmental Panel on Climate Change
MPRII	Second Multipartite Review Meeting
OECD	Organisation of Economic Cooperation and Development
PAGII	Second PICCAP Advisory Group Meeting
PIC	Pacific Island Country
PICCAP	Pacific Island Climate Change Assistance Programme
SPREP	South Pacific Regional Environment Programme
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNITAR	United Nations Institute for Training and Research

1. Introduction

The Pacific Islands Climate Change Assistance Programme (PICCAP) is a three-year climate change enabling activity involving 10 Pacific Island Countries (PICs): Cook Islands, Federated States of Micronesia, Fiji, Kiribati, Marshall Islands, Nauru, Samoa, Solomon Islands, Tuvalu and Vanuatu. PICCAP is designed to assist PICs in meeting their reporting requirements under Articles 4 and 12 of the United Nations Framework Convention on Climate Change (UNFCCC). The project is funded by the Global Environment Facility (GEF), implemented by the United Nations Development Programme (UNDP) and executed by the South Pacific Regional Environment Programme (SPREP).

To enable countries to fulfil their reporting requirements under the UNFCCC, PICCAP has been providing and facilitating technical assistance to national climate change teams and experts. This assistance has allowed them to undertake technical studies that will form the basis for their initial national communications to the Conference of the Parties (CoP) to the UNFCCC. Expert advice, knowledge, skills and technical assistance has been provided through a series of training workshops and a University-based certificate training programme. In addition, in-country technical missions have been conducted by PICCAP and other regional partner institutions that work closely with the country teams and experts. These have helped ensure timely completion of the comprehensive technical studies.

National greenhouse gas (GHG) inventories are one of five activities undertaken by national teams and experts. To ensure that maximum value can be gained from this work, the findings of the national studies require review, evaluation and synthesis. At the second PICCAP Advisory Group Meeting (PAGII) held in Auckland, New Zealand, and the second Multipartite Review Meeting (MPRII) held in Apia, Samoa, it was agreed that National GHG Inventories be reviewed and a regional synthesis of GHG inventories be produced by a regional consultant working in close collaboration with the PICCAP Scientific/Technical Adviser. The regional assessment and synthesis is intended to complement and facilitate completion of the initial national communications.

1.1 Terms of reference

The regional consultant will work with the PICCAP Scientific/Technical Adviser to review the National GHG Inventories and produce a regional synthesis for inclusion in the initial National Communication to be submitted to the CoP of the UNFCCC. In preparing the National GHG Inventory Report, the consultant will use the format and guidance provided by *Decision CP.2/10 on Non-Annex I National Communications* and the *Greenhouse Gas Inventory Reporting Instructions (Volume I) of the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.*

(1) The consultant will use the National GHG Inventory and, in close consultation with PICCAP Scientific/Technical Adviser, undertake the following tasks:

   (a) describe, review and evaluate all National GHG Inventories;

   (b) identify gaps, data constraints, methodological problems and uncertainties;

   (c) provide a regional synthesis of the information contained in the National GHG Inventories;

   (d) identify and highlight regional policy implications particularly in relation to (i) national priorities and issues, (ii) energy use and future demand, and (iii) any other relevant policy issues;

   (e) identify and provide options for capacity building needs in relation to future inventory work and the UNFCCC process; and

   (f) identify possible projects.

(2) By way of the PICCAP Scientific/Technical Adviser, the consultant should draw on the expertise, experiences and knowledge of the National GHG Inventory experts, country team members and the national coordinators,

and consult as widely as possible in preparing a regional synthesis of the GHG inventories.

(3) Upon completion of the draft regional synthesis the consultant must present the findings at an appropriate regional meeting/ conference, as determined by PICCAP/SPREP management.

(4) The Regional Synthesis Report should include an Executive Summary for Policy Makers.

1.2 Approach and methods

Before a regional synthesis of the national inventory findings could be undertaken it was necessary to assess the quality of the individual studies through a validation process. The assessment was aided by the development of a checklist, which identified numerous impediments to the completion of the reports to adequate standards.

The general findings of this technical assessment and validation are presented in Section 3 of this report. The more detailed findings are presented in Volume 2.

The regional synthesis was undertaken by compiling and interpreting the comparable statistics for all 10 countries (or fewer if information was not provided by all). In some instances the data for the 10 countries were extrapolated in order to estimate the collective and individual contributions Pacific Islanders are making to greenhouse gas emissions, relative to other regions and the globe as a whole.

Finally, the findings were used to guide a discussion that addressed implications for policy and for capacity building activities at both national and regional levels and to identify gaps, constraints and issues for further elaboration and development in future inventories.

1.3 Outline of report

Section 2 provides an historic overview of National GHG Inventories undertaken by PICs. This leads into a description of the national studies undertaken with support by PICCAP. The contributions made to our overall understanding of GHG sources and sinks will be highlighted.

The recently completed inventories represent a significant advancement in terms of both our ability to undertake such studies and our level of understanding of the extent to which human activities in PICs contribute to changes in atmospheric composition. These accomplishments will be described in Section 3, as will the need for additional work to address shortcomings in the methodologies, gaps in our knowledge, data constraints and remaining uncertainties. More detailed information is provided in Volume 2.

Section 4 provides a regionally focused synthesis of the results of the 10 national studies. Variations in emissions for the 10 PICS are documented, as are comparisons between PICs and countries outside the Pacific basin.

Section 5 explores the implications of the preceding findings for regional policies, including those dealing with technical, environmental and development issues.

The national and regional assessments of GHG emissions have identified areas where further capacity building is required. As described in Section 6, these include strengthening technical abilities related to the inventory work itself, the need for enhancing the ability to meet the evolving requirements of the UNFCCC and the need to ensure that the inventory findings are reflected appropriately in national and regional policies and plans.

The report concludes with the identification of projects that would address many of the policy and capacity building implications that have been identified in the synthesis.

2. Review of National GHG Inventories

2.1 Previous studies

Under the US Country Studies Programme, the Federated States of Micronesia, Fiji, Kiribati and the Marshall Islands have completed an initial inventory using 1990 and 1994 as reference years. Under the auspices of PICCAP, these countries agreed to repeat their inventories for 1994. Kumar (1999) includes a summary of the achievements, constraints and experiences these countries gained from the US Country Studies Programme.

2.2 Studies supported by PICCAP

PICCAP has supported the preparation of National GHG Inventories for all 10 of its participating countries. A summary of the activities undertaken by PICCAP in support of the studies can be found in Kumar (1999). These initiatives include a one-week training course attended by at least two people from each of the participating countries. The aim of the workshop was to introduce participants to the Intergovernmental Panel on Climate Change (IPCC) and Organisation for Economic Cooperation and Development (OECD) methodology for reporting on GHG inventories as required by the UNFCCC and to adapt this methodology for use in the individual countries involved in PICCAP. The workshop made use of training materials that were developed by the United Nations Institute for Training and Research (UNITAR) as part of its climate change training programme (CC:TRAIN).

2.3 Accomplishments

The ultimate objective of the UNFCCC is the stabilisation of GHG concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. As part of accomplishing this goal, the Convention also calls for Parties to commit themselves to the following:

- develop, update periodically, publish and make available to the CoP their national inventories of anthropogenic emissions by sources, and removals by sinks, of all GHG not controlled by the Montreal Protocol; and
- to use comparable methodologies for inventories of GHG emissions and removals, to be agreed upon by the CoP.

To give effect to these commitments, the 10 countries participating in PICCAP have prepared and submitted their national inventories of GHG emissions and removals by sinks, in accordance with the Revised IPCC Guidelines (IPCC, 1997). For most countries[1] this is the first National GHG Inventory to be prepared. The findings will be incorporated in the national communications to the CoP.

In addition to fulfilling obligations under the Convention, the completion of these inventories is also of note for a number of important reasons. Firstly, the completed inventories provide a comprehensive set of national data generated using international best practices. These data can be used in the preparation of national sustainable development strategies and for assessing the success of these strategies over time. Secondly, the findings can be used to shape the positions taken in both national and international environmental policy discussions. In this respect it is especially helpful to be able to quantify both national and per capita emissions of greenhouse gases, relative to totals and per capita values calculated on a global basis. Thirdly, the inventory results provide guidance for investment decisions by the private sector and by international, regional and bilateral donors. The newly acquired inventory data assist investors to determine where the greatest environmental benefits can be achieved. Fourthly, by combining the data from the 10 inventories it is possible to prepare the first credible estimate of the anthropogenic GHG emissions for the Pacific Islands region.

[1] The exceptions are the Federated States of Micronesia, Fiji, Kiribati and the Marshall Islands.

3. Evaluation of the inventories

3.1 Introduction

To facilitate the evaluation reported in this section, a checklist of desirable attributes of a national inventory report was developed. The checklist was based on the reporting instructions in IPCC (1997) and the findings of an expert group meeting on methods for the assessment of inventory quality (IPCC, 1998). A summary of the findings using the checklist is presented in Table 3.1. More detailed information is presented in Volume 2 of this report.

It is intended that the detailed information in Volume 2 be used for three purposes:

(1) to highlight where improvements can be made in the completeness and usefulness of the current inventories;

(2) to provide guidance as to how future inventories can be enhanced in terms of both the methods used and the information that is produced; and

(3) to identify areas for future inventory work so that a higher level of transparency, consistency and comparability can be achieved.

This is the first attempt by most countries to produce a GHG inventory by their own trained nationals. The level of achievement to date is therefore commendable. Many strengths can be identified. The shortcomings are noted in order to enhance the quality of future inventories and related work.

3.2 Strengths

The obvious and overall strength of the 10 national inventories is that they have been prepared using comparable methods that are in turn based on international best practices (IPCC, 1997). The effort that has gone into compiling the GHG inventory data for 10 Pacific Island countries will be invaluable for estimating total and per capita emissions of GHG from individual countries and from the Pacific Islands region as a whole. Preliminary estimates of these values will be provided in Section 4.

Table 3.1 shows that all countries used the IPCC Reference Approach to determine CO_2 emissions from energy sources. All countries used the IPCC source/sink categories, where appropriate, and provided information as to how data were aggregated to the level of these categories. Countries used the source/sink categories of IPCC when there were sufficient data. For example, some countries did not consider emissions related to industrial processes and solvents and other product use because the activities were either absent or no methodology was developed by IPCC for these source/sink categories.

Most countries have used the same base year (1994), as required by Decision 10/CP.2 of the CoP, thereby facilitating inter-country comparisons and aggregation of data to the regional level. However, in one instance 1991 was used as the base year, and for another country data were provided for all four years from 1994 to 1997, inclusive.

In all but one case the emission factors were consistent with the units used but, as will be elaborated later, default emission factors were always applied.

Further benefits of the consistent approach to preparing GHG emissions inventories will be apparent in Section 4, and in the ability to develop regionally-based response options for mitigation (Section 5).

As stated, one country reported emissions data for four years from 1994 to 1997. Over the period CO_2 emissions increased by 13.6% (3.4% per year) while CO_2 removals increased by 7.2% over the same period. The bulk of the increased emissions occurred in the Land Use Change and Forestry category. While the findings are for only one country, they do illustrate the benefits of repeated assessments using comparable and consistent methods.

Sectoral report tables	Number of countries providing some level of information	Number of countries providing no information	Unclear or partial	Not applicable
Energy	5	5	0	0
Industrial processes	0	10	0	0
Solvent and other product use	0	10	0	0
Agriculture	3	7	0	0
Land-use change and forestry	3	7	0	0
Waste	4	6	0	0
Summary report	6	4	0	0
Short summary report	5	5	0	0
Overview table	2	8	0	0
Use of standard units	7	3	0	0
Use of IPCC source/sink categories with description of differences	8	0	2	0
Details of base year(s)	7	0	3	0
Information on emissions using reference approach	10	0	0	0
Information on uncertainties	3	7	0	0
Information on verification	0	10	0	0
Documentation allowing reproducible approach	2	8	0	0
Checking results against other methods	0	10	0	0
Evidence of double counting of emissions	0	2	8	0
Consistency of emission factors with units used	8	1	1	0
Use of default emission factors	9	0	1	0
Sectoral approach data provided—compared to reference approach	2	5	3	0
Explanation of any differences	1	4	0	5
Inventory report provided	7	3	0	0
Description of differences from IPCC default methods	1	9	0	0
Description of estimation methods	3	7	0	0
Description of major assumptions not included in worksheets	3	7	0	0
References to data sources	6	4	0	0
Innovations in data sources, methods etc.	1	9	0	0
Description of difficulties in developing and reporting the inventory	7	3	0	0
Data constraints	7	3	0	0
Resources limitations	7	3	0	0

Table 3.1: Number of countries providing GHG inventory information

3.3 Gaps

Table 3.1, and the more detailed information in Volume 2, reveals that there are many, but understandable, shortcomings in the inventories. These fall into three broad categories, and will be discussed in turn.

3.3.1 Gaps in coverage

The IPCC GHG inventory has six main categories: Energy, Industrial Processes, Solvent and Other Product Use, Agriculture, Land Use Change and Forestry, and Waste. Currently no methods are provided for determination of emissions related to solvent and other product use.

Table 3.2 shows that of the five remaining categories only energy is reasonably well reported. Additional details are provided in Volume 2.

The information provided for each category tends to reflect two major factors: the importance of the activities represented by the module, relative to the collective economic activity and the availability of information on which the reporting is based. The energy sector is of critical importance to all Pacific Island countries and the information on which an emissions inventory is based is relatively accessible, at least in so far as the Reference or Top-Down Approach is concerned.

The low reporting for the other categories is a reflection of both the relative insignificance of the activities related to that module (industrial processes are noteworthy in this respect) and the lack of the relevant activity data (for example, absence of data on forest and grassland conversion and abandonment).

The lack of relevant activity data is an issue that will be taken up in Section 6.

At another level, coverage within the respective categories is also highly variable. Examples of gaps in the energy category (the most reported category) include the inability to separate international bunkers from the national fuel consumption data and the lack of information on consumption of biomass fuels. As noted previously, only two countries also used the sectoral approach for determining CO_2 emissions from energy sources.

Given the relative importance of CO_2 removals by Pacific Island countries (see Section 4), it is regrettable that only three countries provided even partial data on land use change and forestry. However, these three countries did provide data on total carbon uptake, and hence have contributed to our understanding of the relative importance of GHG sources and sinks for Pacific Island countries (see Section 4).

3.3.2 Gaps in understanding

The gaps in understanding that are revealed in the inventory reports have major implications for not only the quality and usefulness of the current inventories, but also for the training, which must be undertaken if future inventories are to address shortcomings in our contemporary knowledge and understanding.

As a result of the work of IPCC and cooperating agencies, the inventory process is now highly systematised. The software and worksheets that are provided mean that there are fewer instances where individual judgement is required. However, there are still many requirements for personal knowledge and understanding, especially with respect to the following:

- overcoming information deficiencies or absences;
- harmonising the activity data with the IPCC source, sink and other categories;
- recognising differences from default methods;
- awareness and use of assumptions not explicit in the IPCC methodology;
- ensuring consistency in units, conversion factors and in emission factors;

Category	Some information provided	No information provided
Energy	7	3
Industrial processes	2	8
Agriculture	3	7
Land use change and forestry	3	7
Waste	4	6

Table 3.2: Number of countries providing information related to the five IPCC categories

- use of country-relevant emission factors;
- avoiding double counting of energy sources that contribute to emissions;
- quality assurance;
- improvement of information sources and methods;
- characterising uncertainties;
- reporting and interpreting findings; and
- developing recommendations and policy options;

While seven countries provided a written report to complement the tabulated data, regrettably few included material that allows an assessment of the level of understanding related to the requirements listed above. This, in itself, suggests that those undertaking the inventories have not recognised fully the need for transparency, consistency and comparability in the inventory process.

Where countries provided the information, it is apparent that harmonising the activity data with the IPCC source, sink and other categories is a major challenge. This not unexpected finding is likely to apply to other countries that failed to report on the procedures used, but without explicit information it is impossible to know what assumptions were made when the activity data was interpreted in the context of the IPCC categories. At both the regional and country level more effort needs to be made to ensure that the activity data is referenced to the IPCC categories in an appropriate and consistent manner.

The failure of three countries to adopt consistent units, conversion factors and emission factors resulted in serious errors in the estimated GHG emissions. These were of such magnitude that they were readily recognised; however, it raises concern that further, less obvious errors may persist.

All countries used default emission factors and few raised concerns as to their applicability. Country-relevant emission factors have been recognised as a priority (SPREP 1999), but understanding is needed in order to make decisions as to when and under what circumstances they should be used. Although IPCC (1997) notes the necessity to ensure that emissions from a given activity are not included in several source categories, there is no recognition in the reports of this important requirement. The same comment applies to the more general requirement of quality assurance.

In a small number of reports, suggestions were made in relation to improving information sources and methods, but in general there seemed to be an acceptance of the status quo and of generic methods rather than ones which would yield higher quality estimates given the country specific circumstances.

Similarly, a small number of reports made a concerted effort to characterise the uncertainties in the estimated sources and sinks, but in the main the issue of uncertainty was not discussed. In such cases there is a risk that those users who are not well-informed on the national inventory will fail to recognise the limitations inherent in the information, with the possibility that inappropriate, if not unwarranted, decisions and actions will result.

One national report noted that the most important CO_2 removal mechanism for most Pacific Island countries is the uptake of CO_2 by planktonic marine plants. Many of these countries have over 10,000 times as much ocean as land. Instructions for dealing with ocean areas as a removal mechanism were not provided in the guidelines. It was recommended that specifications to address this sink category be added to the IPCC guidelines in the future. However, to do so would shift the focus from anthropogenic to natural processes.

However, it should be noted that the IPCC guidelines are designed to estimate and report on national inventories of *anthropogenic* greenhouse gas emissions and removals, i.e. emissions and removals that are a direct result of human activities, or are the result of natural processes that have been affected by human activities (IPCC, 1997). Thus the above recommendation is inconsistent with IPCC policy.

As understanding and experience increases one could reasonably expect to see significant improvements in reporting and interpreting findings and the subsequent development of recommendations and policy options.

3.3.3 Gaps in reporting

As noted in Table 3.1, seven of the 10 countries provided some form of inventory report. Given that for most countries this is the first such national report ever prepared, the quality of the reports is commendable.

As noted by the IPCC, national inventory reports should provide minimum information to enable the results to be reconstructed, and to justify the choice of methodology and data used. Thus documentation should contain enough information to explain differences between national methods and data, and the IPCC default methods and assumptions. Reasons for the differences should be explained and

sources of emission factors and other national data should also be clearly cited. Minimum requirements include emission factors, activity data and a list of references documenting any differences from IPCC recommendations (IPCC, 1997).

Most countries used the IPCC default methods, though in some cases this must be assumed as it was not directly stated in the reports. However, even when all default methods are used there is still a need to aggregate activity data in a way that conforms as closely as possible to the IPCC source and sink categories. As noted above, assumptions must be made when harmonising the activity data with the source and sink categories, but only three countries provided even minimal information on the procedures that were followed.

Six countries provided some information on the sources of activity and other data used in the inventory. Even in these instances, more explicit details would be needed in order to meet the IPCC reporting standards. Only one country described innovations in data sources and methodology.

The majority of the national reports did refer to difficulties in developing and reporting the inventory. The comments made are reflected in Section 3.4 and 3.5 and in the recommendations in Section 8 of this report.

3.4 Data constraints

The majority of countries that submitted a written report noted significant difficulties related to acquiring the requisite data. The principal issues were whether or not the desired data actually existed and, if so, whether it was accessible, in a timely manner and in a form that permitted its use for the inventory.

One national report stated the key issues in very clear terms: *acquisition of accurate data is definitely the hardest part of the inventory... the lack and poor data quality reflects limited resources and capabilities so it must be emphasised from this exercise that future inventories will be improved only if an effort is made now to improve data management resources and skills.*

Other pertinent comments made in the reports include:

- 'either there was no precise information available or records have not been updated';
- 'understanding the guideline manual... has been time consuming and... by the time the text was understood we sometimes learn that the data collected was not the correct one';
- 'no data were available... like burning of grassland and abandonment of managed lands';
- 'the Customs Department have lost the 1991 data from their computer database';
- 'no data is available on which areas have recently been logged and replanted and this sink can therefore not be estimated';
- 'data from emissions based upon fuel sold to ships or aircraft engaged in international transport have been included in the national totals, as the data for these activities could not be isolated';
- 'it was difficult to determine what portion of fuel was for "international" use in a nation of small land area but 1.2 million square kilometres of ocean area';
- 'agricultural and land use data is based primarily on subjective estimates or not estimated—currently... has no system of agricultural surveys';
- 'no estimates for land use and forest change are available at he present time';
- 'no estimation of SO_2 emissions was made in this inventory. Without the appropriate information about the petroleum products imported into the country the risk of achieving an extremely low level of confidence associated with SO_2 emissions was seen to be too high if estimation procedures were to be applied';
- 'a dominant feature in the residential sector... in the past decade is the growing use of lawn mowers, both the four-stroke and two-stroke engines. Again no mechanism is in place to monitor the amount of fossil fuel used this way';
- 'notwithstanding the great effort by the Agriculture Department in collecting information, very little is known about rural agriculture';
- 'most crop residues are non-combustible—these are usually left to decompose at the plantation sites. However, as there is no information about the quantities of these items they have been excluded from the inventory';
- 'due to the limited information on land use practices, there is much uncertainty associated with emissions from Land Use Change and Forestry. Reducing this uncertainty depends very much on the Forestry Division in soliciting the required information for future GHG inventories';

- 'for the National Team for Climate Change to come up with a more realistic emission and removal estimate for greenhouse gases there is a need to have access to data of acceptable standard. In addition, the team still requires assistance and collaboration from all sectors involved in greenhouse gas emissions and removals. Hence the need for an integrated system with comprehensible and user friendly mechanisms that allow closer cooperation between the team and the various sectors of the community';

- 'availability of the requested data seems to be the greatest problem of this inventory';

- 'management problems such as poor filing system, poor recording system, change of resources etc. within each respected organisation also contribute to the delay of this inventory';

- 'some organisations take total disregard of this inventory and pretend to be busy';

- 'the accuracy and reliability of the data provided depend entirely on the genuineness and good will effort of each respected organisation';

- 'main constraints faced in this study were the lack of readily available data and the time frame of the inventory which was very short (July to November, 1998)';

- 'due to time constraints the experts were not able to collect all the possible data for the different sectors from the outer islands';

- 'we have not calculated all the emissions for all the different sectors due to lack of readily available data';

- 'the emissions of CO_2 and other non-CO_2 greenhouse gases produced from industrial sources are not reported due to the time restriction and some difficulties encountered in the process of data collection, some of which are listed below:

    - few statistical data for 1994 provided by the Department of Trade and Industry on the total quantities of alcohol and soft drinks produced in the country are questionable,

    - the feedback we received from the various government and private sectors involved in food processing and other products is very poor,

    - we found that most of the information that we requested from them did not exist,

    - some of the private companies are reluctant to release their statistical data information requested'; and

- 'we have no statistics available on fuel wood consumption, burning of cleared forest, forest and grassland conversion and abandonment of managed lands into their prior natural and grassland conditions'.

One country team conducted a questionnaire to obtain information on the use of fuel wood. This was deemed necessary due to the absence of formal records of this fuel type, despite its apparent significance in the local economy. Although the IPCC guidelines specifically require that CO_2 emissions from biomass or fuel wood burning be excluded from national totals, the inventory team noted that the results of the survey showed a high usage of these fuels, particularly in the rural communities where large quantities of fuel wood are used for cooking and for drying crops such as copra, cocoa and peanuts. Thus CO_2 emissions will be large in a relative sense.

One report noted that frequent changes in management create difficulties in accessing data; changes in management often mean changes in the methods of record keeping and often records prior to the change are burnt or otherwise destroyed.

Another perspective on data availability makes some interesting points. Given that it was the first GHG inventory conducted in the country, the term 'greenhouse' met with considerable resistance, and there was 'bad impression and uncertainty' with respect to how the inventory might affect businesses and organisations being asked to provide data. Organisations were apprehensive about the ways in which the inventory might impact on them, and therefore were unwilling to provide information in case it could be used against them.

At least one country was unsuccessful in obtaining activity and associated data for land areas leased to a foreign government for military use. The GHG emissions were thought to be of major importance relative to those from the remainder of the country. The suggestion was made that the GHG emissions for such land areas be included in the inventory of the country leasing the land.

One country noted problems in changing the inventory base line from 1990 to 1994. The report noted that 'such [a] period is quite a distant (sic) backward hence most selected organisations require [a] substantial amount of time to locate old files or record[s], thus delaying respond (sic)'.

Lack of access to suitable transport was highlighted as an impediment to obtaining the necessary data:

'transport is a must because collection of data requires a lot of moving around in search of relevant data'.

In summary, the lack of ready access to the accurate data in a form that is consistent with inventory requirements is a major impediment to the successful implementation of the inventory. These problems are more apparent and significant when the inventory is conducted for the first time; however, many will not reduce for subsequent inventories unless concerted efforts are made to remedy or mitigate them. Possible strategies will be discussed in Section 7.

It is pertinent to note that an expert group meeting on methods for the assessment of GHG inventory quality (IPCC, 1998) recommended that IPCC develop 'codes of good practice' to improve the availability of underlying data for inventories. The recommendations will be explored in more detail in Section 7.

3.5 Resource limitations

A typical comment can be found in the report for Samoa, where attention is drawn to a recent survey conducted by the Government of Samoa. The survey revealed that technical data required by the IPCC guidelines is very limited due to the limited resources for data management, the lack of skills, or both. Many of the comments and observations documented in Section 3.4 are pertinent to the current discussion. Thus, most of the data gaps identified in that section are traceable to resource limitations, including inadequacies in data collection and management procedures and systems, and shortages of people to participate in the formal processes of completing the inventory.

However, the results of the inaugural inventories, and even those for countries with more experience, provide ample evidence that, in addition, training is required for those who have formal responsibility for implementing and completing the inventory. The gaps in understanding that were documented in Section 3.3 are, in themselves, evidence of this need for enhanced expertise and experience.

It should be possible to complete an inventory of GHG emissions and sinks if the appropriate software is provided and access to a certain amount of data is available. Indeed, many countries have achieved this level of success, merely by a largely uncritical use of the software and the available data. However, even with a cursory understanding of the complexities of the inventory process it is clear that major challenges will inevitably arise when assembling the activity data, selecting emission factors and making assumptions and choices. Frequently, critical assessment and expert judgement are required. Meeting the inventory requirements is not merely a matter of completing forms (or a spreadsheet) in an uncritical manner, and assuming that all data are internally and mutually consistent.

It is also important that this inventory is not just a 'one-off' exercise; it must be repeated at appropriate time intervals, using consistent data and methods. The compilation of an accurate, reliable inventory of GHG emissions and sinks is a complex and continuous activity because it requires the pooling of multidisciplinary skills in fields such as the natural sciences, engineering, economics, sociology, management and commerce. Thus there is a need for the ongoing participation of a team of in-country experts who accumulate expertise and experience through their continued involvement. There is also an implicit commitment of continued financial support and to the provision of the necessary information. Therefore institutional, legal, political and financial systems must be capable of providing continued support to the inventory process.

The 10 countries have demonstrated a willingness and commitment to meet their obligations to the Convention. Through their initial efforts they have also identified many of the challenges and the shortcomings in the procedures, and in their ability to follow them.

There is now an urgent need to ensure that the numerous resource needs (human, financial, information and so on) are addressed in a timely manner. In this way there will be a marked improvement in the quality of the next and subsequent inventories. This will enhance their usefulness, not only for assessing the efficacy of current national policies and international agreements, but also for guiding development planning at the national level and strengthening environmental agreements internationally.

4. Regional synthesis of the national findings

4.1 Introduction

There are three intended outcomes from this regional synthesis of the 10 National GHG Inventories:

- a compilation of comparable and internally consistent data on GHG emissions and removals for the 10 Pacific Island countries;
- comparisons between individual Pacific Island countries, between these countries and those outside the region, using information calculated on both a national and per capita basis; and
- aggregation of the data for the 10 Pacific Island countries for comparison with estimates of global emissions and removals of GHGs.

Despite problems and constraints with the quality and completeness of the information provided in the initial inventories, a synthesis of the available data will be undertaken. The results are reported in the following sections. For the reasons stated above and in Volume 2, these must be regarded as preliminary.

The available data for selected GHG emissions and removals have been scaled against country populations and land area, respectively. In this way, regionally averaged per capita rates of the anthropogenic emissions of GHG are estimated. Similarly, regionally averaged rates of removals have been calculated on a per land area basis.

These derived data will be used for three purposes:

- to assess relative rates of emissions and removal, on a country-by-country basis;
- to compare regional estimates of per capita emissions and removals per unit land area with comparable global values; and
- to determine the relative contribution of the Pacific Islands region to the global emissions and removals of GHG.

For the synthesis, broad categories of emissions and removals are used. This is consistent with the intent of a regional synthesis.

4.2 Comparison of national GHG emissions and removals

Table 4.1 presents summary data on population and CO_2 and CH_4 emissions for given sectors of the reporting countries. Where necessary the reported data have been adjusted, as described in Volume 2.

Annual CO_2 emissions from the energy sector range from 4.509 Gg of CO_2 for Tuvalu to 1196 Gg of CO_2 for Fiji. Per capita equivalent emissions range from 0.23 tonnes of CO_2 for Kiribati to 4.60 tonnes of CO_2 for Nauru. The range in per capita equivalent emissions is greater than those based on the equivalent CO_2 emissions from petroleum consumption, as provided in Johnston (1995). In that case the per capita emissions ranged between 0.12 for Kiribati and 1.51 for Palau. While the data are not strictly comparable (the petroleum consumption data are for 1990 and under the IPCC guidelines not all the petroleum consumed contributes to national GHG emissions), one would expect some congruence. The relationships will be explored later in this section.

Of the seven countries reporting methane emissions from solid waste disposal systems, the lowest reported annual emissions was for the Cook Islands (0.275 Gg of CH_4) while the highest was for Fiji (3.4 GG of CH_4). The equivalent per capita emissions ranged between 0.274 kg of CH_4 for the Cook Islands and 42.865 kg of CH_4 per capita for Nauru.

Only four countries reported annual carbon release and uptake related to land use change and forestry activities. Fiji reported 2902 kt per annum of carbon uptake while the three other countries (Cook Islands, Samoa and Solomon Islands) reported values less than 73 kt of carbon uptake a year. The Solomon Islands inventory shows 2093 kt of carbon are released each year due to land use change and forestry, with the remaining three countries indicating 178 kt per annum, or less.

Three of the four countries indicated that CO_2 removals exceeded emissions due to land use change and forestry, by as much as 9,989 Gg of CO_2 per annum in the case of Fiji. The Solomon Islands reported that emissions exceeded removals by 7475.6 Gg of CO_2 per annum.

Unfortunately the small number of countries providing information on other emissions and removals does not allow useful comparisons to be made.

4.3 Regional estimates of per capita emissions, and comparison with global values

Due to the dominance of the energy sector in the GHG emissions of Pacific Island countries, the following analysis will derive regional estimates of per capita emissions from the energy sector and compare these with global values.

Figure 4.1 presents the estimated total CO_2 emissions from the energy sector, based on the original and adjusted data.

- Two critical points arise from Figure 4.1B: there is a *relatively* large country-to-country variation in per capita emissions of CO_2 from the energy sector; and

- a single data point (for Fiji) will have a major influence on any estimate of average per capita

Country	Population (000s)[2]	CO_2 emissions from energy sector (Gg of CO_2)[3]	CO_2 emissions per capita for the energy sector (tonnes of CO_2 per capita)[3]	1990 petroleum consumption expressed as equivalent CO_2 emissions (Gg of CO_2)[4]	Methane from solid waste disposal systems (Gg of CH_4)	Per capita methane emissions from solid waste disposal systems (kg of CH_4 per capita)	Total carbon uptake increment for land use change and forestry (kt C)	Annual carbon release for land use change and forestry (kt C)	Net annual CO_2 emission (-) or removal (+) for land use change and forestry (Gg CO_2)
Cook Islands	46.8	32.401	0.69	43.5	0.0128	0.274	42.120	N/A	154.4
Federated States of Micronesia	105.5	235.9	2.24	155.9	N/A	N/A	N/A	N/A	N/A
Fiji	772.7	1196	1.55	996.9	3.4	4.400	2902	177.62	9989
Kiribati	77.7	18.56	0.23	32.6	0.4252	5.475	N/A	N/A	N/A
Marshall Islands	43.4	158	3.64	90.6	0.61598	14.193	N/A	N/A	N/A
Nauru	9.919	45.621	4.60	N/A	0.42518	42.865	N/A	N/A	N/A
Palau	17.2	N/A	N/A	83.4	N/A	N/A	N/A	N/A	
Papua New Guinea	3608	N/A	N/A	2494	N/A	N/A	N/A	N/A	N/A
Samoa	161.298	102.386	0.64	112.4	1.1461	7.105	72.76	50.40	81.97
Solomon Islands	285.176	294.513	1.03	155.9	0.63236	2.217	54.0	2092.8	-7475.6
Tonga	97.8	N/A	N/A	72.5	N/A	N/A	N/A	N/A	N/A
Tuvalu	9.043	4.509	0.50	7.25	N/A	N/A	N/A	N/A	N/A
Vanuatu	142.419	56.7078	0.40	83.4	N/A	N/A	N/A	N/A	N/A

Note: CO_2 = carbon dioxide; CH_4 = methane; Gg = Gigagrams; Kt/C = Kilotonnes of carbon. N/A denotes data was not available at the time of this synthesis.

Table 4.1: Summary data on population and CO_2 and CH_4 emissions for given sectors.

[2] From SPREP (1999)

[3] Data are from the national GHG emissions inventories, adjusted as noted in Volume 2.

[4] Based on Johnston (1995)

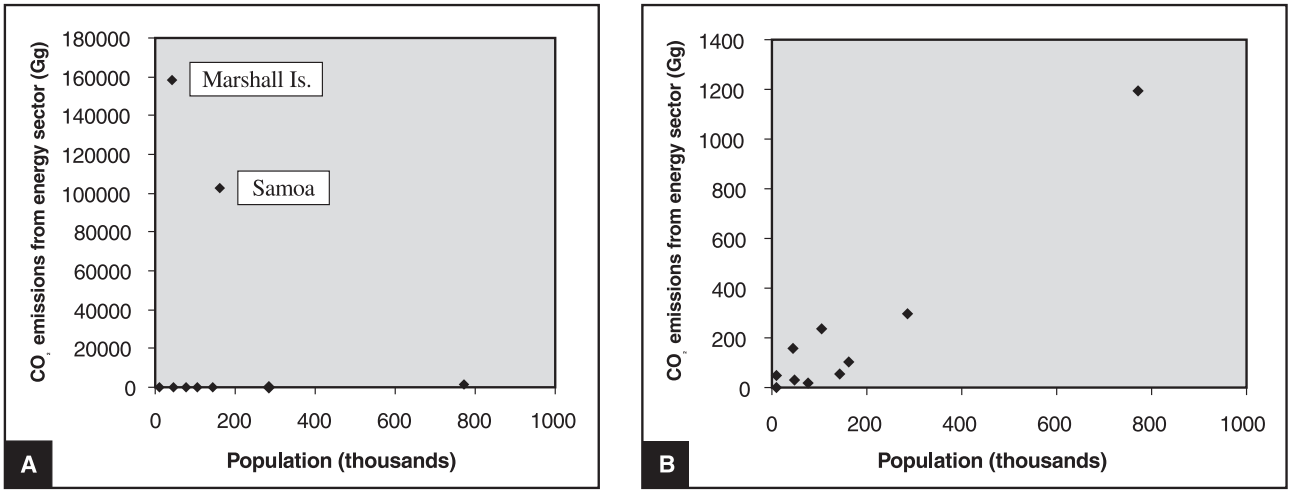

Figure 4.1: CO_2 emissions from the energy sector of individual countries, with respect to their national populations.

A. *Data as given in the national inventory reports – the anomalously high data points are for Marshall Islands and Samoa.*

B. *As for A, but the two anomalously high values for Marshall Islands and Samoa are assumed to be in GT rather than the reported units of TJ.*

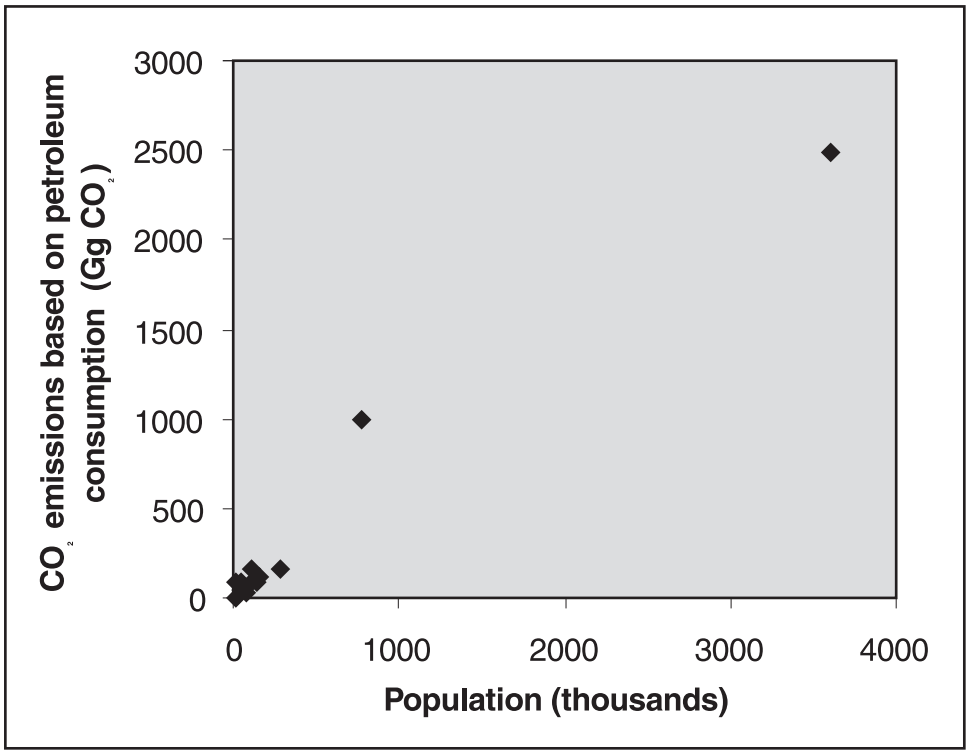

Figure 4.2: National petroleum consumption, expressed as equivalent CO_2 emissions, and national population. Data as listed in Table 4.1.

equivalent emissions for the Pacific Islands region as a whole.

The former point reflects reality—population is far from perfect as an indicator of energy consumption, and hence CO_2 emissions. In order to further investigate the second point, CO_2 emissions were estimated using the 1990 petroleum consumption data for 12 Pacific Island countries, as reported by Johnston (1995). Figure 4.2 compares petroleum consumption by country (expressed as equivalent CO_2 emissions) and national population. The data are presented in Table 4.1.

The advantage of using these data is that they cover 12 Pacific Island countries (as opposed to 10 for the PICCAP emissions inventory) and include a second larger country (Papua New Guinea). The disadvantage is that the data are not directly comparable with those used to construct Figure 4.1. As noted in Section 3.2, energy sources are not limited to petroleum. The data are for 1990 rather than 1994. Furthermore, in reality not all the petroleum consumed is counted as emissions against the energy sector (e.g. international bunkers).

Despite these shortcomings, the pattern of data points in Figure 4.2 is similar to that in Figure 4.1B. It is clear that per capita values are substantially higher for Fiji than for Papua New Guinea, suggesting that the data point for Fiji in Figure 4.1B may somewhat distort any estimate of average per capita emissions for the Pacific region as a whole. This is confirmed by considering the results of regression analyses as reported in Table 4.2.

It is clear from Table 4.2 and Figure 4.2 that, at least for estimates of CO_2 emissions based on petroleum consumption, the data for Papua New Guinea is more consistent with those for the smaller countries than is that for Fiji. Moreover, as shown in Figure 3.1, of the four countries that reported both reference and sectoral estimates of CO_2 emissions from the energy sector, Fiji was the only one that showed significant over-estimates by the reference method. This implies that fuel consumption data alone may also over estimate emissions, more than might be the case for other countries.

Until additional data can be provided to improve the certainty of the relationship shown in Figure 4.1B, and based on the results shown in Table 4.2, a slope of 0.96 will be assumed to best describe the relationship between population and CO_2 emissions from the energy sector. This implies a weighted average equivalent emission 0.96 tonnes of CO_2 per capita—a range of 0.23 to 4.60 was reported in Section 4.2.

Based on a total Pacific Island population of 7.1 million (SPREP, 1999) and the per capita equivalent emission of 0.96 tonnes of CO_2 per year, the entire population produces some 6.816 million tonnes (Mt) CO_2 per year (Table 4.3).

Global CO_2 emissions arising from fossil fuel combustion only are reported to be 22620.46 Mt of CO_2 per year, or 4.02 tonnes of CO_2 per capita per year for 1996 (IEA, 1998).

Dependent variable	Independent variable	Countries included	Slope	Correlation coefficient
CO_2 emissions from energy sector	Population	PICCAP countries	1.43	0.93
As above	As above	As above excluding Fiji	0.96	0.46
Petroleum consumption as equivalent CO_2 emissions	As above	Countries in Table 4.1	0.72	0.96
As above	As above	As above excluding Papua New Guinea	1.16	0.92
As above	As above	Countries in Table 4.1 excluding Fiji	0.69	0.99
As above	As above	Countries in Table 4.1 excluding Papua New Guinea and Fiji	0.68	0.15

Table 4.2: Results of regression analyses relating population to CO_2 emissions

Thus, on average, individual Pacific Islanders are responsible for producing approximately one quarter of the CO_2 emissions attributable to the average person worldwide. The Pacific Islands region as a whole account for some 0.03% of the global emissions of CO_2 from fuel combustion. This is despite having around 0.12% of the world's population.

By way of further comparison, OECD countries as a whole are responsible for nearly three times the per capita production of CO_2 through the burning of fossil fuels. In terms of total CO_2 emissions from fuel consumption, these 29 OECD countries account for just over 50% of the global total, despite having around 20% of the world's population.

These findings are the result of the first attempt to estimate CO_2 emissions by the energy sector in the Pacific Islands region, using internally consistent and comparable data. They show the small contributions Pacific Islanders make to global emissions, both individually and collectively. The policy implications of these and other findings of this report are discussed in the following section.

It may be possible to undertake similar analyses for methane from solid waste disposal systems, and possibly for CO_2 removals and emissions from land use change and forestry, but at present it is unclear if the methodology used above (and the available data) would support such an approach.

	Population (million)	**CO_2 equivalent emissions per capita** (t CO_2)	**CO_2 equivalent total emissions** (Mt of CO_2)
Pacific Island region[5]	7.1	0.96	6.816
World[6]	5624.44	4.02	22620.46

Table 4.3: Pacific Island and global estimates of CO_2 equivalent emissions and emission factors for fuel combustion

[5] Based on data from SPREP (1999) and from this report

[6] Based on IEA (1998).

5. Regional policy implications

5.1 Implications for technical policies and plans

The technical issues which must be addressed have already been identified in Volume 2 of this Report and were captured by the statement made in one of the national reports:

> *'acquisition of accurate data is definitely the hardest part of the inventory... the lack [of data] and poor data quality reflects limited resources and capabilities so it must be emphasised from this exercise that future inventories will be improved only if an effort is made now to improve data management resources and skills'.*

Another country also identified numerous problems and constraints influencing preparation of the inventory and went on the make a series of suggestions and recommendations. These are all worthy of consideration by regional and international organisations:

- 'Any future inventory that involves [the] gathering of confidential data as such must be weighed accordingly before deciding the due date (due to delays in gaining approvals for access to the data). [The] aims and objectives of the inventory must be clearly defined and by all means brought to public awareness at large so that sources for the data are fully aware and thus feel secure to provide relevant data. Public awareness should be geared towards building confidence and trust amongst each organisation.'

- 'Any new project as such require[s] strong backing from governments. This is because often new project[s] dealing with confidential information bring about mixed reaction[s], confusion, uncertainty and above all suspicion. Wherever possible respective governments should assist by all possible means.'

- 'Collection of data is something that requires a lot of moving around. Data do not come by itself (sic). Therefore it is recommended that [the] responsible organisation must consider mobility should it undertake [a] similar or related inventory.'

- 'It was discovered during this inventory that quite a number of the selected organisation[s] and even those prominent organisation[s] do not keep proper records or do not have proper format[s] to keep records. It is hereby suggested that [the] Statistic Division of the Ministry of Finance should develop a standard recording system whereby each respective organisation should comply accordingly. This would be very helpful to any future inventory. Every technical ministry must be involved in the establishment of such standard recording systems.'

- 'By all means and wherever possible, those responsible to undertake (sic) such an inventory should have some **teeth to bite**. On that regard, the legislation or Acts of Parliament which empower the Statistics Division to collect data should also be used for [this] inventory, which is equally important and of national interest. This should enable those engaged [in] the program to go in person and collect relevant data accordingly, otherwise questionnaire[s] must be given ample time for the management of each selected source and those engaged in the programme to develop mutual understanding.'

A third country made some pertinent comments and suggestions on technical constraints:

> 'one of the major barriers that need to be removed is the lack of educational and public awareness on climate change. In order to improve the quality of inventory for future reporting,... [the Government] must try to develop more means of educational and public awareness by making use of the resources that are available. By doing this, we can be able to get the message right across to the key sectors or personnel and even right down to the end-users and involve them to carry out the work. This, I believe will eliminate a lot of constraints and difficulties arising during our future inventory on data collection.'

The report went on to recommend the following:

- more attention should be paid by the National Government to obtaining the required political

support that would encourage the public and private sectors to develop mechanisms that will strengthen the momentum and capacity that is built and established under PICCAP to ensure the continuity of the project once the PICCAP funding comes to an end;

- more training of local consultants for GHG inventory is necessary. This is to increase in-country capacity for carrying out these duties and therefore ensuring sustainability for PICCAP national communication reporting;

- having committed ourselves to this project, it is a need for the Government to be clarified on the issue of climate change and more importantly on activities to be implemented under mitigation and adaptation options.

From another perspective (IPCC, 1998), codes of good practice have been recommended as a way of improving the availability of underlying data for inventories. These codes would be intended to help countries prepare national inventories, develop emission factors and conduct direct emissions measurements. They would be based on internationally accepted procedures. Moreover, they could be applied to obtain data in regions such as the Pacific, where no or little data exists, and to extending the existing global databases on activity data and emissions factors.

An IPCC expert group meeting (IPCC, 1998) has also recommended that further reference approaches also be developed, in addition to that which already exists for the energy sector. The present report has shown (Fig. 3.1) how the use of both procedures can act as a verification procedure, in this case for CO_2 emissions from the energy sector. Reference approaches for other sectors could also be used for verification.

5.2 Implications for development policies and plans

Section 2.3 gives a number of reasons why completion of a National GHG Inventory is in the best interest of a developing country. One reason is that the results of such inventories provide a comprehensive set of national data that can be used in the preparation of national sustainable development strategies and for assessing the success of these strategies over time. The relevance of the inventory to the development, implementation and review of national sustainable development strategies is direct and readily apparent. For example, the inventory can assist countries to recognise opportunities to increase the efficiency of existing energy supply systems and to consider opportunities for substituting less costly fuels. Such applications are one focus of the discussion in Sections 5.3 and 5.4.

Another focus is the use of information gained via the inventory to guide the positions taken in regional and international discussions, negotiations and cooperative programmes related to environmental protection and other aspects of sustainable development. This will be the focus of the discussion in Section 5.5.

Ellis (1999) has evaluated a wide range of measures that could reduce GHG emissions by Pacific Island countries and has defined a set of criteria to select measures that might be included in a regional programme of GHG mitigation. Of necessity, his analysis was based on carbon emissions inferred from national data on petroleum consumption (Johnston, 1995). Using these data, he estimated that in 1990 emissions of carbon (or of CO_2) by Pacific Island countries represented about 0.02% of total world emissions. The 1994 estimate reported above (Section 4), which is based on the 10 national inventories but extrapolated to include all Pacific Island countries, was 0.03%. The difference is insignificant, as are the differences in per capita emissions. Johnston (1999) questions the comparability of the regional and global data used by Ellis. With the availability of inventory data prepared using international standardised best practices, many of these concerns can now be laid to rest.

Regardless of any remaining inconsistencies, the message is clear and incontrovertible—Pacific Island countries and their inhabitants are minor players when it comes to GHG emissions, either as a region or on a per capita basis.

However, this does not mean that Pacific Island countries can or should sit back and rest on the reputation of being minor emitters of greenhouse gases. As the following sections indicate, Pacific Island countries have many good reasons for taking concerted action now that they have more substantive information on which to base their actions.

5.3 National issues, priorities and plans

Pacific Island countries are 'minor' emitters, in both a relative and absolute sense. Thus any steps they take to reduce their emissions will have a negligible effect on atmospheric composition. However, other quite distinctive reasons may well give rise to the same decisions to reduce emissions.

Economic factors may, for example, drive the decision to increase the efficiency of existing energy

supply systems and to consider opportunities for substituting less costly fuels. The information available as a result of the GHG inventory will help determine the cost effectiveness of the various options (see Section 5.4) and, in turn, guide decision making related to investment and other initiatives.

Political factors may also influence the decision to reduce emissions through improved efficiencies and/or use of fuels that produce emissions with a lower global warming potential. For example, the credibility of a country, or the region as a whole, will be enhanced if there is a demonstrated willingness to act in concert with other countries rather than pleading special circumstances. The efforts of minor emitters of GHG in the Pacific Islands region to reduce GHG emissions would act as a moral imperative and provide impetus for other countries to take some domestic action in reducing their overall emissions. Moral considerations may, in themselves, lead to a decision to reduce emissions. The atmosphere is part of the global commons; thus a country may well decide to act as a good global citizen and reduce its emissions, no matter how small the inventory data show those emissions to be.

The available data (see Table 4.1) also reveal that some Pacific Island countries (notably those with larger volcanic islands as opposed to a predominance of small atolls) have the potential for large GHG removals through appropriate land and forest management practices. Forests have the potential to provide GHG mitigation through the use of the wood as a cooking and industrial fuel and through increases in the standing biomass. Hence the re-establishment of forests is an effective mitigation measure, while a mature forest with stable biomass is neutral in terms of emissions and removals. On the other hand, forests that are being harvested, cleared for agriculture or damaged by fire are net emitters of greenhouse gases.

Continued use of fuel wood, rather than a shift to electricity or fossil fuels for cooking and water heating, is advantageous from a mitigation perspective. As Ellis (1999) notes, rural people in particular should therefore be encouraged to maintain adequate supplies of fuelwood.

The inventory data, as it becomes increasingly available, should provide an opportunity to quantify the extent to which landuse changes, forestry and use of traditional fuels in Pacific Island countries are contributing to net increases or decreases in atmospheric GHG concentrations. Though the magnitude of the resulting changes will inevitably be small from a global perspective, the findings may well be instrumental in setting policies and implementing plans that achieve larger reductions in global net emissions.

Baseline and subsequent inventories are fundamental to being able to track the benefits and costs of mitigation strategies that have been implemented.

5.4 Energy use and demand

Mitigation measures related to energy can be subdivided into demand side and supply side options.

The former include improved efficiencies and fuel substitutions in the transport and industrial sectors, labelling schemes, improved designs of energy-consuming consumer goods and education and awareness programmes. Such measures can be more targeted and more accurately costed if the information provided by a National GHG Inventory is available to decision makers and planners.

Supply side options include increased efficiencies and fuel substitution in existing energy systems. Again the feasibility, costs and benefits of such options are more readily assessed if reliable and comprehensive GHG inventory data are at hand.

5.5 Other policy implications

As noted in Section 5.2, the findings arising from analysis of the inventory data at either national or regional level can be influential with respect to foreign policy and intergovernmental negotiations. Armed with credible and comprehensive information on national and regional GHG emissions, especially in relation to those of the OECD and other countries, representatives of Pacific Island countries will now be able to substantiate their claims that Pacific islanders are 'innocent victims' of global warming. The inventory data will provide a sound basis for Pacific Island governments to identify their priorities for foreign assistance and investments related to sustainable development in general, and mitigation in particular.

6. Capacity building implications

In order to maximise their value, GHG emissions inventories must be repeated, and the quality of the information and methods continually improved. Section 3 and Volume 2 highlight a number of factors that impede the successful undertaking and reporting of emissions inventories in Pacific Island countries.

In summary, the impediments include inadequate information acquisition and management systems, limitations on resources (financial, technical and human), institutional shortcomings, inadequacies in the methodologies and a deficiency in the level of governmental and private sector commitment to addressing the negative implications of global warming. Thus increasing the capacity of Pacific Island countries to be more active and fruitful partners in addressing climate change issues requires a comprehensive effort across a variety of fronts.

The analysis conducted in the present study suggests that the priority areas relate to ensuring that the necessary information is readily available and there is the required expertise to process and analyse it. A close second would be improved methodologies and changing government and private sector priorities and practices to ensure climate change response strategies are integrated into national development planning.

6.1 Future inventory work

Future inventories will have value only if they are conducted by individuals who have the expertise to apply and adapt the internationally approved inventory methods. The key criteria for inventory quality are completeness, consistency, transparency and comparability (IPCC, 1997). The inventories studied in this report fall short of the expected standards, across all criteria. This is to be expected since most countries are undertaking the inventories for the first time. However, in order to make maximum use of the information acquired through the present inventory process, and to ensure that future inventories are comparable yet improved, it is important that expertise continue to be built in-country. This will not only ensure that there are people who can undertake the detailed data processing required by the methodology, but also that there are individuals who are capable and committed to acquiring and supplying the necessary information. Furthermore, each country should have available individuals who are able to interpret the findings of the inventory and ensure they are reflected in national policies, plans, decisions and in international negotiations.

Improved information acquisition and management systems are also required. These need to be an integral part of the national information gathering procedures, operating under that authority and in a way that ensures consistency and completeness in the records.

6.2 UNFCCC process

The findings of the national GHG emissions inventories should be incorporated in national communications and reflected in the national implementation strategies. This is the means by which the international community can be made aware of the extent to which human activities are modifying atmospheric composition (and hence radiative forcing), and the nature of national responses to the threat of climate change.

Developing countries may also have a moral, if not legal responsibility to reduce their GHG emissions and enhance removals. There will be many reasons why it is appropriate to demonstrate the effectiveness of these strategies.

However, in order to participate in these activities and achieve the desired outcomes, countries must have the necessary expertise and other resources. There must also be the political will and the institutional support for undertaking the steps to achieve compliance with the Convention and international best practices.

Non-Annex I Parties continue to identify a lack of experts and trained personnel as one of the main problems and constraints in the process for preparation of initial national communications. Availability of data, including emission factors for greenhouse gases and the activity data and other information necessary to apply such factors, was

frequently cited as another reason for delay. The Convention Secretariat has noted this slow progress towards completion and submission of national communications. This is despite the efforts being made by the Global Environment Facility (GEF), and its implementing agencies, to facilitate the process.

Initiatives such as PICCAP and the support programmes, which include CC:TRAIN, are instrumental in ensuring that Pacific Island countries develop increased capacity to meet not only their obligations under the UNFCCC, but also ensure that climate change response strategies are main-streamed in the national development planning process.

7. Possible projects related to greenhouse gas inventories

A number of possible projects discussed and presented here have arisen from the preceding evaluation and synthesis. The intention is not to repeat suggestions included in the Mitigation Analysis Report by Ellis (1999). His proposals address broader issues for mitigation. The proposals presented here highlight specific issues that need to be addressed and activities that need to be continued, improved and sustained at the country and institutional levels. This will allow continued improvement of the GHG inventory process and its integration into sustainable development processes.

- *Development of PIC-specific emission factors for all source/sink categories.* The default values used at present do not necessarily reflect the conditions from which activity data is established. Using such values exacerbates the problems associated with uncertainties, quality assurance and other methodological problems.

- *Strengthening of institutions/agencies responsible for maintaining and managing activity, inventory and related data*. The task of collecting and storing data should be shared among various agencies with respect to source/sink categories.

- *Target public awareness of the implications arising from the GHG inventories and links with national sustainable development.* This is vital to the strengthening of efforts in this area. Support and political will is required from policy makers, the government and from the private sector for further inventory work.

- *Identification, building and strengthening the capacity of national institutions, agencies and individuals/personnel to undertake GHG inventories*. This is a critical component for the continual improvement and sustainability of the inventory process over the long term.

8. Conclusions and recommendations

Through PICCAP and other initiatives at the regional and national level, considerable progress has been made in the ability to conduct and report on national inventories of GHG emissions and removals that meet needs at the national, regional and international levels.

The 10 countries that have participated in this programme now have available to them quantitative information on anthropogenic sources and sinks of GHGs. Equally importantly, there is now an estimate of the regional contribution to emissions that cause undesirable changes in the atmospheric composition.

The available data indicate that, collectively and individually, Pacific Islanders are making minimal contributions to greenhouse gas emissions relative to other regions and the globe as a whole. At the same time, some Pacific Island countries are likely to be removing measurable quantities of GHGs from the atmosphere, through changes in land use and through forestry activities.

While considerable progress has been made, the inventories completed to date have many shortcomings. These result from such problems as inadequate information acquisition and management systems, limitations on resources (financial, technical and human), institutional shortcomings, inadequacies in the methodologies and a deficiency in the level of governmental and private sector commitment to addressing the negative implications of global warming. There is a need for these impediments to be addressed so that more can be gained from the present inventory and future inventories perform better when judged against the criteria of completeness, consistency, transparency and comparability.

9. References

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