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NATIONAL GREENHOUSE GAS INVENTORIES OF NON-ANNEX I PARTIES OF AFRICA: PRELIMINARY SYNTHESIS METHODOLOGICAL ISSUES

Working Paper

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I. INTRODUCTION

1. Articles 4.1 and 12.1 of the United Nations Framework Convention on Climate Change require all Parties to the Convention to communicate information to the Conference of the Parties (COP). This provision includes Parties that are not listed in Annex I to the Convention, referred to below as Parties. Article 12.5 specifies that each non-Annex I Party shall make its initial communication within three years of the entry into force of the Convention for that Party, or of the availability of financial resources in accordance with Article 4.3. Parties that are least developed countries may make their initial communication at their discretion.

2. This paper covers the information provided by five African Parties that submitted their initial communication by 1 May 2000 (Egypt, Lesotho, Mauritius, Senegal and Zimbabwe).

II. INVENTORIES OF ANTHROPOGENIC EMISSIONS AND REMOVALS OF GREENHOUSE GASES

3. Pursuant to Articles 4.1 (a) and 12.1 (a), all reporting Parties communicated a national inventory of anthropogenic emissions by sources and removal by sinks of greenhouse gases not controlled by the Montreal Protocol. This report covers inventory information from only 5 out of 48 African non-Annex I Parties, therefore, general conclusions on common patterns of the reporting of inventory data may not necessarily be applicable for all African non-Annex I Parties as a whole. The focus of this paper is on relevant methodological issues, to provide a general picture of how the data requirements have been addressed by the reporting Parties. The conclusions provided here may be useful for Parties that are currently in the process of preparing their initial national communication.

A. Main findings

4. Carbon dioxide (CO_2) emissions from the *energy* and *land-use change and forestry* sectors are the most important source of greenhouse gas emissions reported by Parties. *Land-use change and forestry* constitutes a net sink of CO_2 for all reporting Parties, with the exception of Lesotho[1]. Fuel combustion is the largest source of CO_2 emissions for all reporting Parties, except Lesotho and Senegal (where *forest and grassland conversion* in the *land-use change and forestry* sector is the largest source). Livestock is the largest source of methane (CH_4) emissions for all Parties, except Mauritius where *waste* is the largest. *Agricultural soils* is the largest source of nitrous oxide (N_2O) for all Parties, except Senegal where *forest and grassland conversion* is the largest.

5. All reporting Parties followed the IPCC Guidelines to estimate their inventories as requested by the UNFCCC guidelines, mostly using the default methods, and all of them except Egypt used the Revised 1996 IPCC Guidelines[2]. Egypt provided a national GHG inventory for 1990. Senegal and Lesotho provided it for 1994. Zimbabwe provided data for both 1990 and 1994. Mauritius reported its inventory for the year 1995.

[1] In this document, all assessments of GHG emissions and removals are based on the latest inventory, for those Parties which provided information for more than one year.
[2] In accordance with conclusions of the SBSTA at its fourth session (see document FCCC/SBSTA/1996/20).

6. The completeness of reporting in terms of major GHG gases (CO_2, CH_4 and N_2O) and IPCC sectors is similar as that of Annex I Parties. However, in the *land-use change and forestry* sector, the degree of completeness exceeded that of Annex I Parties. In the *industrial processes* sector, the degree of completeness relative to Annex I Parties was lower due to the different level of industrialisation.

7. All reporting Parties except Egypt provided data on GHG precursors. Egypt, Mauritius and Senegal reported emissions from bunker fuels while Egypt, Lesotho, Senegal and Zimbabwe provided aggregate GHG emissions estimates in terms of CO_2 equivalent. No Party reported HFC, PFC and SF_6 emissions. Mauritius and Zimbabwe provided information on the uncertainty of the estimates.

8. The two factors that appear to affect the quality of GHG inventories the most are:

(a) The availability and quality of activity data; and

(b) The updating of inventories on a continuous basis by stable national teams.

In the case of Senegal and Zimbabwe where inventories were updated, the completeness, transparency and quality improved in the new versions, suggesting the need to encourage the preparation of inventories on a continuous basis. The ability of Parties to improve and update their inventories appears to be related to the availability of financial and technical assistance. All reporting Parties received external support in preparing their GHG inventories.

9. All Parties reported on problems encountered when preparing their national inventories, mainly related to the availability or quality of activity data. Lesotho and Zimbabwe reported that the IPCC methodology to estimate GHG inventories were inadequate for some source categories or does not cover all sources in the *land-use change and forestry* sector. Senegal and Zimbabwe mentioned that some default coefficients were not appropriate for their national circumstances in this sector. In addition to reporting on problems, many Parties identified specific needs for the improvement of their inventories, and described their efforts to improve them.

10. Parties followed the UNFCCC guidelines in terms of completeness of the reporting of GHG sources categories. All Parties provided more comprehensive information than required by the guidelines. For example, all reported CH_4 emissions from *waste* and N_2O emissions from *agricultural soils*, all of them in a disaggregated way, as required by the IPCC Guidelines, although in the UNFCCC guidelines the reporting of these sources are not explicitly required.

11. All Parties presented their inventory using the IPCC summary table or a similar breakdown of information for the major GHG gases (CO_2, CH_4 and N_2O). Mauritius, Senegal and Zimbabwe submitted the worksheets according to the IPCC Guidelines. These worksheets provide information for replicating the inventories of Parties using default methods and, therefore, contribute to the transparency[3] of the inventories[4]. Egypt reported IPCC standard data

[3] Transparency in this document is understood as a measure of the extent to which the assumptions and methodologies used for an inventory are explained to facilitate replication and assessment of the inventory by users of the reported information. The provision of worksheets by some Parties enhanced the transparency of the inventories. IPCC worksheets provide basically the same inventory information as is included in the common reporting format which is used by Annex I Parties from the year 2000 onwards (FCCC/CP/1999/7).

tables. Lesotho, Mauritius and Zimbabwe provided CO_2 fuel combustion estimates obtained using both the IPCC reference and the sectoral approach, according to the IPCC Guidelines.

B. Methodological issues

12. The reporting of inventory data by Parties should follow the UNFCCC guidelines taking into account relevant SBSTA conclusions as presented in table 1. In almost all cases, Parties demonstrated consistency when following this guidance.

Methods and gases

13. All Parties followed the IPCC Guidelines to estimate their national GHG inventory, and four of them (Lesotho, Mauritius, Senegal and Zimbabwe) used the Revised 1996 IPCC Guidelines. Generally, Parties used IPCC default methods, but Senegal and Zimbabwe developed their own emission coefficients and methods in some specific sectors, mainly in the *land-use change and forestry* sector. All Parties presented emission estimates of the three main gases CO_2, CH_4 and N_2O on a gas by gas basis. Four Parties addressed the ozone precursors (CO, NO_x, and NMVOC) totally or partially. All Parties reported on CO_2 emissions by sources and removals by sinks from *land-use change and forestry*. Although not required by the UNFCCC guidelines, Egypt, Lesotho, Senegal and Zimbabwe provided estimates of aggregate GHG emissions in terms of CO_2 equivalent using the IPCC Global Warming Potential (GWP) values. Box 1 summarizes the status of reporting of inventory data by Parties.

Box 1. Status of reporting of inventory data

Party	Method used	Base Years	Reporting table[a]	Precursors: CO, NOx, NMVOC	HFCs, PFCs, SF_6	SO_2	Bunkers	CO_2 equivalent estimates
Egypt	IPCC	1990/91	IPCC Summary	-	-	-	X	X
Lesotho	IPCC, 1996	1994	IPCC Summary 7A	X	-	-	-	X[c]
Mauritius	IPCC,1996	1995	IPCC Summary	X	-	X	X	-
Senegal	IPCC, 1996	1994	IPCC Summary	CO, NOx only	-	-	X	X
Zimbabwe	IPCC, 1996	1994	IPCC Summary	CO, NOx only	-	-	-	X

[a] IPCC summary or similar breakdown of information for major greenhouse gasese (CO_2, CH_4 and N_2O)
[c] Lesotho did not used the latest GWP recommended by the IPCC.

14. The degree of completeness in reporting on IPCC sectors and sub-sectors is high, in accordance to both, table II of the UNFCCC guidelines and the IPCC summary table (see tables 2 and 3). Almost all Parties reported the most significant GHG emission source and sink categories, such as CO_2 emissions or removals from *fuel combustion*, *industrial processes* and *land-use change and forestry*, as appropriate, CH_4 emissions from *agriculture* and *waste*, and N_2O from *agricultural soils* and *fuel combustion*. The completeness of reporting of major GHG gases in different IPCC source categories is approximately the same as that of Annex I Parties as can be seen in table 3.

[4] It should be noted that many Annex I Parties used more complex national methods, which generally improves the quality of their inventories, but when they are not well documented in their communication, the information is less transparent.

15. No Party reported on fully fluorinated compounds[5], such as PFCs and SF_6, as encouraged by the UNFCCC guidelines. No Party reported emissions of HFCs which are not requested by the guidelines, but encouraged to be reported by SBSTA conclusions adopted later than the guidelines. The lack of reporting on these gases may be explained by the possible non-existence of such emissions or by the fact that these emissions are not estimated[6].

16. Estimates of emissions from *international aviation and marine bunker fuels* were reported by Egypt, Mauritius and Senegal. In conformity with the IPCC Guidelines, these emissions were reported separately from national totals.

17. The UNFCCC guidelines request Parties to make efforts to report the estimated range of uncertainty of their emission estimates, where appropriate. The reporting of uncertainties was limited, since only Mauritius and Zimbabwe complied with this request, the latter providing the information quantitatively, and the former qualitatively. Estimates from the *energy* sector were reported with high confidence levels, while for the LUCF sector were reported with medium confidence[7] (see table 4).

Reporting tables

18. All Parties reported their inventories consistently with the UNFCCC guidelines. All of them provided even more information than the minimum requested and used more comprehensive tabular formats than table II of those guidelines (see table 2). As all Parties followed the IPCC Guidelines for estimating their GHG emissions, they also generally, used the reporting formats of these guidelines: Egypt, Mauritius, Lesotho and Zimbabwe used the IPCC summary or provided a similar breakdown of information for the major GHG gases (CO_2, CH_4 and N_2O).

19. The use of the IPCC summary tables[8] provides for a more disaggregated reporting of inventory data than table II of the annex to the UNFCCC guidelines. Several individual GHG emissions from different IPCC source categories are not explicitly requested in this latter table, but may be included under "other". This is particularly the case for some significant source categories, such as *waste* and *agricultural soils*. They were explicitly reported by all Parties as it is presented in table 2.

20. The share of GHG emissions that are not requested to be reported or that are to be reported as "other" in a Party's total reported GHG emissions is sometimes substantial (see table 5). For the five reporting Parties, these shares ranged from 14 per cent (Egypt) to 32 per cent (Senegal) of the aggregated GHG emissions, expressed in terms of CO_2 equivalent, with an average of 22 per cent.

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[5] A fully fluorinated compound is one which contains atoms of fluorine (F) and only one other element (e.g. C, S, N). Thus, perfluorocarbons (PFCs), such as CF_4 and C_2F_6, and sulphur hexafluoride (SF_6) are fully fluorinated compounds, while hydrofluorocarbons (HFCs) are not.

[6] It has to be noted that the IPCC Guidelines did not provide methods for estimating emissions of these GHG until the version of 1996 that were available only from mid 1997.

[7] For confidence levels reported by Annex I Parties, see document FCCC/SBSTA/1998/7, table 14.

[8] It has to be noted that the IPCC software provide for automated reporting of IPCC summary tables. See Greenhouse Gas Inventory Software for the Workbook of the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories – Instruction Manual.

21. Mauritius, Senegal and Zimbabwe also provided IPCC worksheets (see table 6), which outline detailed calculations for the estimation of GHG emissions as well as numerical information on aggregate emission factors and activity data for inventories using IPCC default methods. The provision of these worksheets contributes substantially to the transparency of the inventories. Egypt provided the IPCC Standard Data Tables which also enhances transparency of reporting.

22. In addition, Lesotho, Mauritius and Zimbabwe estimated their fuel combustion emissions using both the reference and the sectoral approach, as requested by the IPCC Guidelines (see table 6). This is a useful self-verification procedure which greatly improves the transparency of the inventories. The usefulness of applying both approaches would be enhanced if the identified differences were explained by Parties, although this is not explicitly required by the IPCC guidelines. For Zimbabwe the difference between the results obtained with the two approaches was large, but for the other two Parties was very little.[9]

23. Table II of the UNFCCC guidelines requests Parties to describe assumptions and methods, and the values of emission coefficients, where these differ from IPCC default methods and coefficients. This request allows for a more transparent reporting of inventory information by Parties. Most Parties used the default emission factors provided in the IPCC Guidelines. However, some Parties made an effort to develop national emission coefficients in order to better reflect their national circumstances, for example in the *land-use change and forestry* sector as reported by Senegal and Zimbabwe. The Parties that provided IPCC worksheets or standard data tables reported the values of the aggregated emission factors used enhancing the transparency of the inventory.

24. The source of the activity data used for the emission estimates of the different sectors and source categories was in some cases referenced by some Parties, even though this information is not explicitly requested by the UNFCCC guidelines. Generally, Parties indicated that activity data were obtained from national sources, such as national statistics provided by the respective ministries, municipalities and agencies, or from industrial facilities. In some cases, reference to international statistics was made, for example to statistics of the Food and Agriculture Organization of the United Nations (FAO) by Senegal and or statistics of the Southern African Development Community by Mauritius.

Methodological problems identified

25. The five reporting Parties explicitly identified problems in preparing their national inventories (see table 7). Most of the problems relate to the lack of activity data for estimation of emissions in some sectors or unavailability of activity data that suit the needs for reporting in line with the IPCC Guidelines. Lesotho and Zimbabwe reported problems related to limitations of the current IPCC methodology for estimation of emissions in some sectors, particularly *land-use change and forestry*.

26. In addition to the difficulties mentioned by Parties, other issues were also identified during the process of compiling the inventory information of the initial national communications:

[9] See document FCCC/SBSTA/1998/7, table 3.

(a) Different emission estimates for the same sector or source categories were indicated at different places of the communication;

(b) In some cases it was not clear whether certain source categories were not reported because they were not relevant for the country or had not been estimated for other reasons. Most Parties did not use appropriate notation keys as indicated in the IPCC Guidelines;

(c) Some Parties changed the format of the IPCC summary tables or did not include the precursors;

(d) In the *land-use change and forestry* sector, some inconsistencies were found in the reporting of estimates of biomass during a deforestation process, namely the fractions of biomass burned on site, burned off-site and left to decay. In addition, there was no clear indication as to the time-frame of the activity data used in some source categories, such as *forest and grassland conversion* and *abandonment of managed lands*; and

(e) CH_4 and N_2O emissions of biomass energy burning were not reported by most Parties. These emissions may be substantial for some countries.

Methodological problems encountered in the use of UNFCCC guidelines

27. The existence of the UNFCCC and the IPCC guidelines facilitated Parties to provide the best available data in their national GHG inventories. However, some common issues with the use of these latter guidelines[10] were identified:

(a) Table II of the annex to the UNFCCC guidelines does not facilitate disaggregated reporting of GHG emissions by sources and removals by sinks. This table does not not follow the disaggregation of the IPCC source-categories in most sectors, although it provides for reporting any kind of emissions and removals under "others". If Parties that use the IPCC Guidelines would like to report all GHG emissions and removals they estimated, they have to add several rows under "others" to the table II of the UNFCCC guidelines.

(b) The UNFCCC guidelines states that Parties should use the IPCC Guidelines for National Greenhouse Inventories as appropriate and to the extent possible, but not make specific reference to the Revised 1996 IPCC Guidelines that constitutes the most updated version of such guidelines. Decision 10/CP.2 was adopted by the COP before than such guidelines for national greenhouse gas inventories were available to Parties. However, four reporting Parties used the Revised 1996 Guidelines, as encouraged by conclusions of the SBSTA at its fourth session, especially those that prepared their national communication in a later stage.

(c) The UNFCCC guidelines encourage Parties to include in their national inventories information on fully fluorinated compounds, which cover PFC and SF_6 emissions[11]. The reporting of HFC emissions is not included in the UNFCCC guidelines[12] because they are not fully fluorinated compounds. However, it is expected a growth of HFC emissions because

[10] See decision 12/CP.4, paragraph 7(b).
[11] See footnote 8.
[12] It has to be noted that when the UNFCCC guidelines (decision 10/CP.2) were adopted, almost all non- Annex I Parties did not have emissions of HFCs. Later the fourth session of the SBSTA adopted conclusions encouraging Non-Annex I Parties to report emissions of HFCs., PFCs and SF_6. (FCCC/SBSTA/1996/20/paragraph 31).

these gases may be used as substitutes of the Ozone Depleting Substances to be phased out by the Montreal Protocol.

C. Issues related to the preparation of inventories

Institutional arrangements

28. A description of the existing institutional arrangements relevant to the preparation of national inventories on a continuing basis[13] was provided by Lesotho, Mauritius and Zimbabwe. In most cases, these arrangements consist of the establishment and operation of inter-institutional committees or agencies, or teams of national experts from different sectors, both from the public and the private sectors, and are usually co-ordinated by a leading national institution or ministry.

Improvements, needs and support received

29. Egypt, Mauritius and Zimbabwe identified areas for further improvement of inventory data (see table 7), which mainly address the problems mentioned in paragraph 25 above. Most reporting Parties mentioned the need for financial and technical assistance to improve their inventories. In addition, Mauritius and Zimbabwe draw attention to the importance of continuous collection of data and/or the establishment of databases appropriate to the requirements of IPCC reporting.

30. Parties made their own efforts to improve the quality of their emission estimates (see table 8). Senegal and Zimbabwe described the application of some national emission factors, national coefficients or methods that better suit their national circumstances. Some of these improvements introduced by Parties related also to the enhancement of the collection of activity data.

31. Significant improvements in the completeness, transparency and quality of the inventories were recognised in the inventories of Senegal and Zimbabwe which updated their previously submitted inventory data. Some problems identified in their initial inventory were overcome in the later inventory. This suggests that by preparing the GHG inventories on a continuing basis, the reporting and quality of inventory data can be improved.

32. The technical and financial support received by reporting non-Annex I Parties constituted a key element in the preparation of the national inventories. All Parties, received support from the GEF and its implementing agencies in the development and execution of enabling activities, which included the preparation of their national inventories in the context of their national communications[14]. Mauritius, Senegal and Zimbabwe received technical and financial assistance for preparing inventories through bilateral or multilateral channels before the preparation of their initial national communication. This fact also underlines the close relationship that exists between the quality of the inventories, their preparation on a continuous basis, and the provision for adequate resources and financial and technical support.

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[13] See decision 10/CP.2, annex, paragraph 4 (FCCC/1996/15/Add.1)

[14] Parties may wish to refer to document FCCC/SBI/2000/INF.7 which provides information on the status of preparation of initial national communications from non-Annex I Parties and the secretariat activities to facilitate the provision of technical and financial support, and to document FCCC/SBI/1999/INF.8 on information on GEF funding for the preparation of national communications.

D. Presentation of results

33. Tables A.1 to A.7 in the annex to this document summarise inventory data for CO_2, CH_4, N_2O, ozone precursors and international bunkers. The analysis provided in this section is based on 1994 inventory data where possible. In some instances, estimates have been converted into CO_2 equivalent estimates using 1995 IPCC global warming potentials, in order to facilitate comparison of inventory results. Such a presentation shows, for example, the relative contribution of the different greenhouse gases and the different sectors to a Party's total greenhouse gas emissions[15].

Emissions by sources and removal by sinks

34. All reporting Parties represent a net source of GHG emissions, with the exception of Zimbabwe, which is a net GHG sink, due to the relatively large CO_2 removals reported in the *land-use change and forestry* sector compared to emissions from all the sectors. Considering CO_2 only, Senegal and Zimbabwe also show a net removal of CO_2, by sinks from land-use change and forestry exceed total CO_2 emissions[16].

Aggregate GHG emissions expressed in terms of CO_2 equivalent[17]

35. Carbon dioxide was the primary GHG for all Parties. Methane was generally the second largest contributor to aggregate GHG emissions.

36. *Energy*, *agriculture* and *land-use change and forestry* sectors constituted the most important sources of GHG emissions for the reporting Parties. Removals by sinks from *land-use change and forestry* were large, offsetting GHG emissions from the sector for all reporting Parties except Lesotho. The *energy* sector as a whole was the largest source of GHG emissions for all Parties, except for Lesotho where *land-use change and forestry* came first. *Agriculture* was the second largest emitter sector for most Parties.

37. The level of emissions vary widely among reporting Parties. The total of aggregate GHG emissions expressed in CO_2 equivalent[18] of all African reporting Parties sum 157701 Gg, which represent 6.75 per cent of the total emissions of all 27 reporting Parties which have officially submitted their national communications. Three Parties (Lesotho, Mauritius and Senegal), have

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[15] It should be noted that 4 out of 5 Parties considered here used CO_2 equivalent estimates to assess the relative contribution of each individual greenhouse gas or sector to their aggregate GHG emissions.

[16] In view of the different role of *the land-use change and forestry* sector in the different Parties - in some, this sector offsets total emissions, while in others it is a large source of emissions – and the request by the IPCC Guidelines to provide net emissions or removals in the different source categories of this sector, the term "total CO_2 emissions" in this document denotes the sum of CO_2 emissions from all sectors except CO_2 emissions and removals *from land-use change and forestry*. This facilitates the presentation of the data in a consistent and comparable manner. Nevertheless, the magnitude of CO_2 *land-use change and forestry* emissions and removals is shown in relation to Parties' total CO_2 and aggregate GHG emissions.

[17] Aggregate GHG emission estimates given in this document represent the sum of total CO_2, CH_4 and N_2O emissions expressed in CO_2 equivalent, using IPCC 1995 GWP values. Total CO_2 emissions are calculated in line with the definition given in the previous footnote.

[18] Excluding *land-use change and forestry*.

emissions lower than 10000 Gg. In contrast, Egypt has aggregated emissions totalling over 116000 Gg, while the emissions from Zimbabwe represent more than 27000 Gg.

Emissions of main greenhouse gases (CO_2, CH_4 and N_2O)

Carbon dioxide

38. With the exception of Lesotho, the share of CO_2 from *fuel combustion* in the *energy* sector was the largest for the reporting Parties. It ranges from 86.4 (Zimbabwe) to 99.9 (Mauritius) per cent of total CO_2 emissions. Within the *fuel combustion* sector, *energy industry* was the largest source. *Transport* accounted for more than 30 per cent of *fuel combustion* CO_2 emissions for Mauritius and Senegal. CO_2 emissions from international bunker fuels were reported by three Parties[19] and were equivalent to between 0.03 (Senegal) and 32.5 per cent (Mauritius) of total CO_2 emissions[20]. The *land-use change and forestry* sector as a whole constituted a net sink of CO_2 for all Parties but Lesotho. For Lesotho, emissions from the *forest and grassland conversion* subsector exceeded the total removal by sinks. In the case of this country the largest emissions in the *land-use change and forestry* sector were from *changes in forest and other woody biomass stocks*. However, for four Parties[21], this subsector constituted the main removal by sinks. For Lesotho, removal by sinks from the subsector of *abandonment of managed lands* were larger than that from *changes in forest and other woody biomass stocks*.

Methane

39. Agriculture was the most significant source of CH_4 emissions for three of the reporting Parties[22] (from 50.6 to 80.7 per cent). *Waste* emissions were the most important CH_4 source for Mauritius (74 per cent). In the agricultural sector, *livestock* was the most important subsector for all reporting Parties.

Nitrous oxide

40. *Agriculture* was found the most important source of N_2O emissions for all reporting Parties, except Senegal and Zimbabwe, representing 18.5 and 24.8 per cent respectively. For Zimbabwe, *industrial processes* constituted the most important N_2O source, while for Senegal it was the *land-use change and forestry* sector.

[19] Egypt, Mauritius and Senegal.
[20] According to the UNFCCC and IPCC Guidelines, these emissions are not accounted for in national GHG emissions.
[21] Egypt, Mauritius, Senegal, and Zimbabwe.
[22] Lesotho, Senegal, and Zimbabwe.

TABLES

Table 1. Paragraphs of UNFCCC guidelines and SBSTA conclusions relevant to the reporting of inventory data

UNFCCC guidelines (decision 10/CP.2, annex)	
Paragraph 8	The Guidelines for the National Greenhouse Gas Inventories and Technical Guidelines for Assessing Climate Change Impacts and Adaptation or the simplified default methodologies adopted by the Intergovernmental Panel on Climate Change (IPCC) should be used by non-Annex I Parties, as appropriate and to the extent possible, in the fulfilment of their commitments under the Convention.
Paragraph 9	Information should be provided on the following greenhouse gases: carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O), to the extent the Party's capacities permit. In addition, Parties are encouraged to include in their national inventories the fully-fluorinated compounds, as appropriate. Other greenhouse gases included in the IPCC methodology may be included at the discretion of the Parties. Emissions from bunker fuels should be reported separately from national emission.
Paragraph 10	Parties should strive to present the best available data in a table (see table II below), to the extent their capacities permit, and try to identify the areas where the data may be further improved in future communications through national capacity building.
Paragraph 14	Non-Annex I Parties should provide the best available data in their inventory. To this end such data should be provided for the year 1994. Alternatively, non-Annex I Parties may provide such data for the year 1990.
SBSTA conclusions: The SBSTA, at its fourth session, recalled decision 10/CP.2, and encouraged: (a) non-Annex I Parties to apply the Revised 1996 IPCC Guidelines, as appropriate and to the extent possible, in communicating their national greenhouse gas inventories (FCC/SBSTA/1996/20, paragraph 30(b)); (b) Parties to report actual emissions of HFCs, PFCs and SF_6, given that these better reflect the real releases to the atmosphere and encouraged Parties which are not in a position to report actual figures to report potential emissions (FCCC/SBSTA/1996/20, paragraph 31).	

Table 2. Completeness of reporting according to table II of the UNFCCC guidelines
(to be provided later)

Greenhouse Gas Source and Sink Categories	CO_2		CH_4		N_2O	
	Total	%	Total	%	Total	%
Total (Net) National Emission (Gigagram per year)	5	100	5	100	5	100
1. All Energy	5	100	5	100	5	100
Fuel Combustion	5	100	5	100	5	100
Energy and transformation industries	3	60	3	60	3	60
Industry	4	80	3	60	3	60
Transport	4	80	4	80	3	60
Commercial-institutional	4	80	3	60	3	60
Residential	4	80	4	80	3	60
Other (please specify)	3	60	2	40	2	40
Biomass burned for energy	2	40	2	40	2	40
Fugitive Fuel Emission			3	60		
Oil and natural gas systems			2	40		
Coal mining			1	20		
2. Industrial Processes	4	80	1	20	3	60
3. Agriculture			5	100		
Enteric Fermentation			5	100		
Rice Cultivation			2	40		
Savanna Burning			3	60	2	40
Others (please specify)			4	80	4	80
Manure management			4	80		
Agricultural soils					3	60
Field burning of agricultural residues			3	60	3	60
Other						
4. Land-Use Change and Forestry	5	100	1	20	1	20
Changes in Forest and other woody biomass stock	5	100				
Forest and Grassland Conversion	3	60	1	20	1	20
Abandonment of Managed Lands	1	20				
5. Other Sources as appropriate and to the extent possible (please specify)	2	40	5	100		
CO_2 emissions and removals from soils	1	20				
Other (land-use change and forestry)	1	20				
Waste			5	100		
Solid waste disposal on land			5	100		
Waste water handling			4	80		
Waste incineration						
Other (waste)						
International bunkers	3	60				

Notes:

Sectors and source categories that are not requested to be reported or that are to be reported as "other" in table II of the UNFCCC guidelines are given in shaded cells.

Table 3. Completeness of reporting according to the IPCC Guidelines *(to be provided later)*

GHG source category	CO_2		CH_4		N_2O	
	Reporting Parties	% of total	Reporting Parties	% of total	Reporting Parties	% of total
I.A. Fuel combustion	**5**	**100** *(100)*	**5**	**100** *(100)*	**5**	**100** *(100)*
1. Energy industries	3	60 *(91)*	3	60 *(79)*	3	60 *(82)*
2. Manufacturing industries and construction	**4**	**80** *(91)*	3	60 *(82)*	3	60 *(74)*
3. Transport	**4**	**80** *(94)*	**4**	**80** *(91)*	3	60 *(85)*
4. Small combustion	3	60 *(94)*	3	60 *(85)*	3	60 *(76)*
5. Other	**4**	**80** *(68)*	3	60 *(41)*	3	60 *(32)*
6. Biomass burning	3	60 *(32)*	2	40 *(29)*	3	60 *(18)*
I.B. Fugitive fuel emissions	-	- *(53)*	3	60 *(88)*	-	- *(9)*
1. Solid fuels	-	- *(15)*	2	40 *(71)*	-	- *(-)*
2. Oil and natural gas	-	- *(47)*	1	20 *(82)*	-	- *(9)*
II. Industrial processes	**4**	**80** *(100)*	1	20 *(53)*	3	60 *(79)*
A. Mineral products	3	60 *(68)*	-	- *(-)*	-	- *(-)*
B. Chemical industry	1	20 *(32)*	1	20 *(24)*	2	40 *(50)*
C. Metal production	2	40 *(50)*	1	20 *(18)*	-	- *(3)*
D. Other production	1	20 *(32)*	1	20 *(3)*	1	20 *(3)*
III. Solvent use	-	- *(21)*	-	- *(-)*	-	- *(26)*
IV. Agriculture	-	. *(12)*	**5**	**100** *(100)*	3	60 *(100)*
A. Enteric fermentation	-	-	**5**	**100** *(97)*	-	- *(-)*
B. Manure management	-	-	**4**	**80** *(91)*	-	- *(15)*
C. Rice cultivation	-	-	2	40 *(35)*	-	- *(9)*
D. Agricultural soils	-	- *(12)*	-	- *(21)*	3	60 *(85)*
E. Prescribed burning of savannas	-	-	3	60 *(3)*	2	40 *(3)*
F. Field burning of agricultural residues	-	. *(-)*	3	60 *(38)*	3	60 *(24)*
G. Other	-	-	-	- *(-)*	-	- *(-)*
V. Land-use change and forestry	**5**	**100** *(91)*	2	40 *(44)*	2	40 *(41)*
A. Changes in forest and other woody biomass stock	**5**	**100** *(88)*	-	- *(3)*	-	- *(6)*
B. Forest and grassland conversion	**4**	**80** *(32)*	2	40 *(26)*	2	40 *(15)*
C. Abandonment of managed lands	1	20 *(7)*	-	- *(-)*	-	- *(-)*
D. CO_2 emissions and removals from soils	1	20 *(9)*	-	- *(-)*	-	- *(-)*
E. Other	1	20 *(15)*	-	- *(15)*	-	- *(15)*
VI. Waste	-	- *(41)*	**5**	**100** *(97)*	-	- *(53)*
A. Solid waste disposal on land	-	- *(15)*	**5**	**100** *(97)*	-	- *(-)*
B. Waste-water handling	-	- *(3)*	**4**	**80** *(74)*	-	- *(24)*
C. Waste incineration	-	. *(32)*	-	- *(35)*	-	- *(41)*
D. Other	-	-	-	- *(6)*	-	- *(-)*
VII. Other	-	- *(3)*	-	-	-	- *(-)*
International bunker	3	60 *(71)*	-	- *(35)*	-	- *(35)*

Notes:

- IPCC sectors or source categories reported by 80 per cent or more of the reporting non-Annex I Parties are given in bold. The values given in italics and in parentheses indicate the percentage of reporting by Annex I Parties, for purposes of comparison. These values are taken from document FCCC/SBSTA/1998/7, table 18.

- Sources reported as not occurring (NO) were considered as reported in this table. Sources reported as NE (not estimated) or NA (not applicable) were not considered as reported.

[a] *Nauru treated all aviation fuel as international bunkers.*

[b] *Vanuatu only reported fuels for aircraft.*

Table 4. Confidence level [a] of emission estimates

Gas and source	Mauritius	Zimbabwe
CO_2		
Fuel combustion	H	95
Industrial processes	H	
Land-use change and forestry	M	80-90
CH_4		
Fuel combustion	H	
Fugitive fuel emissions		
Livestock	M	
Other agriculture		
Waste	M	80-90
N_2O		
Fuel combustion	H	
Chemical industry	M	
Agricultural soils	M	

[a] The secretariat uses the term "confidence levels" in compiling data provided by Parties using different terms: uncertainties, error range, accuracy, etc. Confidence levels are given in per cent. For Parties that reported on uncertainties qualitatively, the following codes were used: High (H); medium (M); low (L).

Table 5. Share of IPCC source categories not requested by the UNFCCC guidelines in total emissions [a]

Party	CO_2 [b]	CH_4	N_2O	Aggregate
	%	%	%	%
Egypt	0	31	92	14
Lesotho	0	31	100	28
Mauritius	0	86	98	15
Senegal	9	48	87	32
Zimbabwe	14	15	95	23

[a] This table only refer to the information provided in the latest national GHG inventories submitted by the Parties.

[b] Does not include emissions/removals from the Land-use Change and Forestry sector for presentation purposes. However, Lesotho reported emissions/removals from the category "CO_2 emissions and removals from soil".

Table 6. Status of reporting using the IPCC reporting framework

Party	IPCC sectoral information							Comparison with reference approach (CO_2 fuel combustion) [a] Difference (%)	
	Sectoral reports	Worksheets [b]					Standard data tables		
		E	IP	A	LUCF	W			
Egypt	-	-	-	-	-	-	E, IP, LUCF, W	X	-
Lesotho	X	-	-	-	-	-	-	X	-0.16
Mauritius	X	1-1, 1-2, 1-3, 1-4, 1-5	2-2, 2-7, 2-13	4-1, 4-5	5-1	6-1	-	X	0
Senegal	-	1-1, 1-3, 1-5	2-1	4-1 (CH_4), 4-2, 4-3, 4-4	5-1, 5-2, 5-3	6-1, 6-2, 6-3	-	-	-
Zimbabwe	-	1-1, 1-3, 1-4	2-1	4-1(CH_4), 4-3 (modified). 4-4	5-1, 5-2, 5-3	6-1, 6-2	-	X	25

Notes:

The following abbreviations have been used:

E: Energy **A:** Agriculture **W:** Waste
IP: Industrial processes **LUCF:** Land-use change and forestry

[a] Comparison of CO_2 emission estimates from *fuel combustion* with those obtained using the IPCC reference approach. Differences as a percentage relative to the estimates obtained with the sectoral approach, which are set at 100 per cent in this table. For Lesotho, Mauritius, and Zimbabwe, the difference given in this column was calculated by the secretariat based on the numerical data provided in the communications.

[b] In some cases, the numeration of worksheets refers to the Revised 1996 IPCC Guidelines, while in others, numeration refers to the 1995 version of those guidelines. A few Parties also added worksheets which are not part of the IPCC Guidelines.

Table 7. Problems encountered and areas for further improvement by Parties in the preparation of GHG emission inventories

Party	Problems/Areas			Comments
	Activity data	Emission factors	Methods	
Egypt	X			There is a high degree of uncertainty in LUCF, mainly due to the lack of reliable data / *Inclusion of more GHGs than the 3 main ones (CO_2, CH_4, N_2O).* *Improve reliability and availability of data in land-use change and forestry sector.* *Include industrial waste water.*
Lesotho	X		X	IPCC Guidelines do not include the rampant overgrazing, the expansion of croplands into marginal grasslands, and the encroachment of settlements onto croplands and rangelands; the emissions caused by sanitation from the rural and peri-urban areas. Weakness of statistics in the energy sector, and need to make projections from older surveys. Formidable data problem faced in the waste sector.
Mauritius	X			Solvent use; waste (land disposal) / *Improved statistics to allow for better data gathering for periodic GHG inventories; need to obtain the data at a higher disaggregation level.* *Need to centralise all climate change related data .*
Senegal	X			Feedstock in the energy sector. Livestock (different methods for gathering of activity data in 1991 and 1994).
Zimbabwe	X		X	Bunkers, industrial processes, explosives used in mining operations (N_2O), livestock, agricultural soils, savannah burning, abandonment of managed lands and other land-use change and forestry source categories, waste (unaccounted dumps) / *Importance of reliable databases to meet the IPCC/UNFCCC requirements, including building of GHG databases for future national communications.* *Reviewing, updating and systematic dissemination of climate change data.* *Quantitative research into sectoral GHG emissions.* *Need to improve GHG inventory methods.*

Note: Problems encountered by Parties are written in regular font, while the areas for further improvement reported by Parties appear in italic.

Table 8. Actions taken by Parties in order to improve the quality of their emissions estimates

Party	Use of country-specific methods or models	Comparison of estimates obtained using national and IPCC default methods	Use of national and/or regional emission factors
Lesotho			Energy: calorific values were sourced from the 1991 Southern African Development Community (SADC) statistics.
Senegal			Country-specific coefficients have been used for: biomass (*energy*), agricultural waste burning, some land-use change and forestry sources.
Zimbabwe	Industrial processes: (except cement production) Balanced chemical equations of the resources transformation processes; actual measurements at the fertilizer plant. Savanna burning: Method involves modelling the processes of modelling the accumulation of combustible matter in relation to patterns in specified areas. Satellite-derived estimates used to calculate amount of biomass burnt.		Use of own emission and conversion factors for some land-use change and forestry source categories. Waste water: fraction of waste water treated anaerobically .

Annex

INVENTORY – TABLES, 1990 AND 1994

General notes

1. Numerical data on inventories of GHG emissions and removals as well as on projections are included in the tables below. The inventory tables contain information provided by the six non-Annex I Parties from Latin America and the Caribbean that officially submitted inventory data in their initial national communications, updates to those communications or national GHG inventory only, as in the case of Paraguay.

2. The inventory tables (A.1 to A.8) provide information for both 1990 and 1994, as reported by the Parties, in a consistent and comparable manner for individual non-Annex I Parties, although varying in the degree of coverage in various tables. This is due to differences in the coverage of years and sectors in the national communications.

3. The tables provide inventory data on a gas-by-gas basis for CO2, CH4, N2O, and include information on international bunkers. Information on land-use change and forestry is both included in CO2 and aggregate estimates and presented separately from other CO2 estimates, in order to facilitate a consistent and comparable presentation of the data. To present aggregate greenhouse gas emissions in a comparable manner the secretariat has used IPCC 1995 global warming potentials (GWPs), based on the effects of GHG over a 100-year time horizon, to present information in CO2 equivalent.

4. Figures may differ from those reported in the national communications as a result of rounding during data input and processing, corrections of typographical and calculation errors or omissions, and the presentation (for consistency and comparability) of subtotals and totals not provided in the national communication. Some differences are also due to the fact that, in striving to ensure consistency and comparability, the secretariat has had to convert some of the estimates reported so that they concur with the format of the current IPCC Guidelines for the reporting of greenhouse gas emissions. The footnotes and notes to the tables should be treated as an integral part of the tables.

List of tables

Explanatory notes

Blanks in the tables signify an absence of quantitative information. The secretariat has chosen to leave the spaces blank in order not to complicate the reading of the tables. The figure "zero" appears in the table only when reported as such by Parties. Categories of sources of GHG emissions or their sinks corresponding to the IPCC Guidelines nomenclature are given in italics. Details and percentages in tables and figures do not necessarily add to totals, due to rounding.

The following chemical symbols and abbreviations have been used:

CH4	methane
CO	carbon monoxide
CO2	carbon dioxide
HFCs	hydrofluorocarbons
N2O	nitrous oxide
NOx	nitrogen oxides
NMVOCs	non-methane volatile organic compounds
PFCs	perfluorocarbons
SF6	sulphur hexafluoride
SO2	sulphur dioxide

The following units of weight have been used: Gg gigagram (10^9 grams)

The following other abbreviations have been used:

GHG	greenhouse gas
GWP	global warming potential
LUCF	land-use change and forestry

Table A.1: Anthropogenic CO_2 emissions and removals by source/sink category, 1990 and 1994 (Gigagrams and percentage of total by Party)

		Fuel combustion [a]		Industrial processes		Other [b]		Total (excluding LUCF) [c]	Land-use change and forestry [d]	Total (including LUCF) [e]	Percentage of LUCF in total CO_2 [f]
	1990	**(Gg)**	**%**	**(Gg)**	**%**	**(Gg)**	**%**	**(Gg)**	**(Gg)**	**(Gg)**	**%**
Egypt		74 682	88.4	9 777	11.6			84 459	-9 900	74 559	-11.7
Zimbabwe		16 750									
Total		91 432		9 777		0		84 459	-9 900	74 559	
	1994										
Lesotho		636	100.0					636	1 261	1 897	198.2
Senegal		3 660	91.4	346	8.6			4 006	-6 576	-2 570	-164.2
Zimbabwe		14 772	86.4	2 316	13.6			17 088	-62 269	-45 181	-364.4
Total		19 068		2 662		0		21 730	-67 584	-45 854	
	1995										
Mauritius		1 737	99.9	2	0.1			1 738	- 221	1 517	-12.7

a Aggregate emissions of CO_2, CH_4 and N_2O in terms of CO_2 equivalent using 1995 IPCC global warming potentials.
b Includes *waste* and non-CO_2 (CH_4 and N_2O) *land-use change and forestry* emissions.
c Sum of aggregate GHG emissions (CO_2, CH_4 and N_2O in CO_2 equivalent) from all sectors, excluding CO_2 *land-use change and forestry* emission/removals. This total is set at 100 per cent in this table.
d Total net CO_2 emissions or removals from *land-use change and forestry*.
e Sum of aggregate GHG emission (CO_2, CH_4 and N_2O in CO_2 equivalent) from all sectors, including CO_2 *land-use change and forestry* emissions/removals.
f Percentage increase or decrease in aggregate GHG emissions with the inclusion of *land-use change and forestry*.

Table A.2: Anthropogenic CO_2 emissions from fuel combustion, 1990 and 1994
(Gigagrams and percentage of total by Party)

	Energy industries		Industry		Transport		Small combustion [a]		Other [b]		Total
1990	**(Gg)**	**%**	**(Gg)**	**%**	**(Gg)**	**%**	**(Gg)**	**%**	**(Gg)**	**%**	**(Gg)**
Egypt	25 120	33.6	21 342	28.6	18 189	24.4	10 029	13.4			74 682
Zimbabwe											16 750
Total	25 120		21 342		18 189		10 029		0		91 432
1994											
Lesotho			28	4.4	221	34.7	383	60.2	5	0.8	636
Senegal			1 623	44.3	1 233	33.7	804	22.0			3 660
Zimbabwe	7 028	47.6	2 397	16.2	1 851	12.5	3 496	23.7			14 772
Total	7 028		4 048		3 305		4 682		5		19 068
1995											
Mauritius	656	37.7	278	16.0	645	37.1	148	8.5	10	0.6	1 737

a Includes emissions from the source/sink categories: *commercial/institutional*, *residential* and *agricultural/forestry/fishing*.
b Includes emission from all other non-specified *fuel combustion* except from the combustion of *biomass*.

Table A.3. Anthropogenic CO_2 emissions and removals[a] from land-use change and forestry by subcategories, 1990 and 1994 (Gigagrams and percentage of total flux from land-use change and forestry[b])

	Changes in forest and other woody biomass stock		Forest and Grassland conversion		Abandon-ment of managed lands		Other		Total net emissions or removals
1990	**(Gg)**	**%**	**(Gg)**	**%**	**(Gg)**	**%**	**(Gg)**	**%**	**(Gg)**
Egypt	-9 900	100.0							-9 900
Zimbabwe									
Total	-9 900		0		0		0		-9 900
1994									
Lesotho	- 289	3.9	1 630	19.6	-2 750	41.2	2 670	67.9	1 261
Senegal	-25 820	57.3	19 245	74.5					-6 576
Zimbabwe	-64 769	96.3	2 500	3.9					-62 269
Total	-90 878		23 375		-2 750		2 670		-67 584
1995									
Mauritius	- 221	100.0							- 221

a Negative values in Gg denote removal of CO_2. Positive values denote a net source of emissions.

b The given percentages represent the proportion of emissions and removal of this category in relation to the sum of the absolute values of the net emission in each category. For example, the percentage figure for changes in forest and other woody biomass stocks for Argentina is 15458/(15458 + 9646 + 29079) * 100=28.5.

Table A.4. Anthropogenic CH_4 emissions by source category, 1990 and 1994 (Gigagrams and percentage of total by Party)

	Energy				Agriculture						Waste		Other [c]		Total
	Fugitive fuel		Fuel combustion		Livestock [a]		Rice cultivation		Other [b]						
1990	**(Gg)**	**%**	**(Gg)**	**%**	**(Gg)**	**%**	**(Gg)**	**%**	**(Gg)**	**%**	**(Gg)**	**%**	**(Gg)**	**%**	**(Gg)**
Egypt	148	14.3	58	5.6	347	33.7	190	18.5	7	0.7	271	26.3	9	0.9	1 029
Zimbabwe [d]			97	100.0											97
Total	6 314		569		6 919		751		26		2 623		715		20 801
1994															
Lesotho			8	16.5	37	80.3			0	0.4	1	2.7			46
Senegal [e]	0	0.1	5	1.9	138	49.8			2	0.8	106	38.3	25	9.0	277
Zimbabwe	13	3.7	64	17.8	187	52.0			50	13.9	25	7.0	20	5.7	360
Total	5 166		631		6 865		3 075		105		2 621		680		19 215
1995															
Mauritius			1	11.1	1	14.8					3	74.0			5

a Includes source/sink categories: *enteric fermentation* and *manure management*.
b Includes source/sink categories: *prescribed burning of savannas, field burning of agricultural residues and other*.
c Includes source/sink categories*: industrial processes* and *land-use change and forestry*.
d The Party also reported a total energy CH_4 emission estimate for 1990 (97 Gg).
e The Party indicated that emissions from *rice cultivation* were negligible.

Table A.5. Anthropogenic N_2O emissions by source category, 1990 and 1994 (Gigagrams and percentage of total by Party)

	Energy				Industrial processes		Agriculture		Other [b]		Total
	Transport		Other [a]								
	1990 (Gg)	%	(Gg)	%	(Gg)	%	(Gg)	%	(Gg)	%	(Gg)
Egypt	8.87	26.1	2.15	6.3	1.00	2.9	21.00	61.8			34.00
Zimbabwe [c]			1.12	100.0							1.12
Total	8.87		3.27		1.00		21.00		0.00		35.12
	1994										
Lesotho			0.10	14.5			0.50	72.5	0.09	13.0	0.69
Senegal			0.03	12.9			0.05	18.5	0.17	68.5	0.25
Zimbabwe	0.56	5.8	0.62	6.4	6.05	62.8	2.39	24.8	0.01	0.1	9.63
Total	0.56		0.75		6.05		2.94		0.27		10.57
	1995										
Mauritius	0.005	0.7	0.04	4.8	0.28	38.4	0.40	55.4			0.73

a Includes *fugitive fuel emissions* and *fuel combustion* emissions other than *transport*.
b Includes *land-use change and forestry* and *waste*.
c The Party reported a total energy N_2O emission estimate for 1990 (1.1 Gg).

Table A.6. Anthropogenic emissions of precursor gases, 1990 and 1994 (Gigagrams)

	CO	NOx	NMVOC
1990	**(Gg)**	**(Gg)**	**(Gg)**
Zimbabwe	496		
Total	496	0	0
1994			
Lesotho	144	5	18
Senegal	311	9	
Zimbabwe	1 946	77	
Total	2 401	92	18
1995			
Mauritius [a]	67	10	15

a The Party also reported an SO_2 estimate (13 Gg).

Table A.7. Anthropogenic CO_2 emissions from international bunkers, 1990 and 1994 (Gigagrams)

1990	**(Gg)**
Egypt	7,184
Total	7,184
1994	**(Gg)**
Senegal	3.116
Total	3.116
1995	**(Gg)**
Mauritius	670

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