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Mapping IPCC greenhouse gas emissions categories to ISIC A in the SEEA AFF

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Abstract

Countries report their anthropogenic greenhouse gas (GHG) emissions as part of well-defined international reporting commitments under the UN Framework Convention on Climate Change (UNFCCC). Specifically, they report data collected and analysed following the international Guidelines for National Greenhouse Gas Inventories (NGHGI) of the Intergovernmental Panel on Climate Change (IPCC). The reporting commitments differentiate between developed and developing countries, referred to under the convention as Annex I (AI) and non-Annex I (NAI), respectively. All countries, including most OECD countries, report annually since 1992 and undergo stringent international review; NAI countries may report at multi-year intervals, notably within their National Communications (NC) or via Biennial Update Reports (BURs), and undergo limited review. For all countries, their NGHGIs represent the basis for so-called Monitoring, Reporting and Verification (MRV) processes, which are at the basis of enhanced transparency in reporting National Determined Contributions (NDCs) under the Paris Agreement.

The paper explores the linkages between UNFCCC reporting on GHG emissions from agriculture, forestry and land use, which are compiled following IPCC guidelines, and the relevant part of the Air Emissions physical flow accounts of the SEEA AFF (table 4.5)..

We use data from the FAOSTAT emissions database for agriculture and land use to pre-fill GHG emissions data in Table 4.5 for Central America, as an application example.

The paper aims at making available a first guidance tool for the implementation of table 4.5 of the SEEA AFF, in its latest version (the one presented at the 2016 LG meeting), to which we will refer, with a minor adjustment of terminology. The LG is expressly asked to express its opinion and to provide possible contributions to the further development of this work.

1. Introduction: Reporting emissions under the UN Framework Convention on Climate Change

The UN Framework Convention on Climate Change (UNFCCC) entered into force on 21 March 1994 with nearly-universal membership¹. The main objective of the Convention, as stated in its Article 2 is the “stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner”.

The parties to the convention have met annually from 1995 in Conferences of the Parties (COP) to assess progress in dealing with climate change. In 1997, during the COP 3, the Kyoto Protocol established legally binding obligations for developed countries to reduce their greenhouse gas emissions in the period 2008-2012. In this framework the 2010 Cancún agreements stated that increase in global average temperature should be limited to well below 2.0 °C above the pre-industrial level and pursuing efforts to limit increase even further to 1.5 °C temperature. In 2015, during the Cop 21, the Paris Agreement was adopted, governing emission reductions from 2020 onward through commitments of countries via so-called Nationally Determined Contributions.

All member countries submit national communications, which contain information on greenhouse gas emissions estimated following the Guidelines for National Greenhouse Gas Inventories (NGHGI) of the Intergovernmental Panel on Climate Change (IPCC), in respect of the principle of common but differentiated responsibilities and respective capabilities.²

Therefore the Monitoring Reporting and Verification (MRV)³ systems differ among Annex I (AI) and Non Annex I (NAI) parties.⁴ For the latter, the existing MRV framework

¹ The Convention was adopted at the United Nations Headquarters, New York on 9 May 1992. It was open for signature at Rio de Janeiro from 4 to 14 June 1992, and thereafter at the United Nations Headquarters, New York, from 20 June 1992 to 19 June 1993. By that date, the Convention had received 166 signatures. Currently, there are 197 Parties to the United Nations Framework Convention on Climate Change.

² UNFCCC Convention, Art 3.1 “The Parties should protect the climate system for the benefit of present and future generations of humankind, on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities. Accordingly, the developed country Parties should take the lead in combating climate change and the adverse effects thereof”. This also implies that tier level and reporting categories among Annex I and Non Annex I countries may differ.

³ The Principle of Measurement, Reporting and Verification (MRV) for both developed and developing country Parties was introduced by the Bali action plan adopted at COP 13 in 2007 and further elaborated through a number of subsequent COP decisions, resulting in a comprehensive MRV framework under the Convention.

⁴ Annex I (AI) Parties include the industrialized countries that were members of the OECD (Organisation for Economic Co-operation and Development) in 1992, plus countries with economies in transition, including the Russian Federation, the Baltic States, and several Central and Eastern European States, while Non-Annex

encompasses submitting National Communications (NCs) every four years and Biennial Reports and Biennial Update Reports (BRs and BURs) every two years, undergoing International Consultation and Analysis (ICA), setting up domestic MRV of domestically Supported Nationally Appropriate Mitigation Actions (NAMAs), and undertaking MRV of REDD-plus activities for the purpose of obtaining and receiving results-based incentives. Annex I Parties submit annual inventories consisting of the National Inventory Report (NIR) and Common Reporting Format (CRF). The NIRs documents and explains the information reported in the CRF tables relevant to all greenhouse gas (GHG) emissions and removals, implied emission factors and activity data.⁵

Annex I Parties annual national GHG inventories provide information on anthropogenic emissions and removals of GHGs from the Energy, Industrial processes, Solvents, Agriculture, Land Use, Land Use Change and Forestry (LULUCF), and Waste sectors, and for all years from the base year or period (usually 1990) to the most recent year. Moreover Annex I Parties that have ratified the Kyoto Protocol must include supplementary information demonstrate compliance with the Kyoto Protocol's commitments.

NCs from all Parties provide information on emissions and removals of greenhouse gases (GHGs); national circumstances; policies and measures; vulnerability assessment; financial resources and transfer of technology; education, training, and public awareness; and any other details of the activities a Party has undertaken to implement the Convention.

Biennial Reports (BRs) outline Annex I Parties' progress in achieving emission reductions and the provision of financial, technology, and capacity-building support to non-Annex I Parties, while BURs are used by non-Annex I countries to report similar information but with less stringent review processes

The information produced by countries through UNFCCC reporting is a useful source for SEEA Air Emissions Accounts ⁶

2. SEEA CF and SEEA AFF Air Emission Accounts

The SEEA CF defines air emissions as “gaseous and particulate substances released to the atmosphere by establishments and households as a result of production, consumption

I (NAI) Parties are mostly development countries. Certain groups of development countries are recognized by the Convention as being especially vulnerable to adverse impacts of climate change (e.g. countries with low-lying coastal areas and those prone to desertification and drought); 49 Parties classified by UN as least developed countries (LDCs) are given special consideration under the Convention: Parties are urged to take full account of the special situation of LDCs when considering funding and technology-transfer activities.

⁵ Detailed description of National Inventory Submissions, including National Inventory Report and Common Reporting Format may be found in the UNFCCC website at: http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/9492.php.

⁶ See also SEEA CF, *The relationship between air emissions accounts and other accounting frameworks*, p. 85 para 3.254- 3.255.

and accumulation processes”⁷. Generation of air emissions is recorded in table 3.7 Air Emissions account, *by resident economic unit* and *by type of substance*. For the purpose of accounting for emissions of carbon dioxide, the SEEA CF recommends that, where possible, carbon dioxide emissions resulting from the burning of fossil fuels should be distinguished from carbon dioxide emissions resulting from the burning of biomass. This allows for a comparison of the amount of fossil carbon added to the atmosphere in relation to the natural carbon cycle.

Resident economic units are (i) Industries and (ii) Households.

- (i) Industries are classified by ISIC, and namely are included: Agriculture (ISIC A), Mining (ISIC B), Manufacturing (ISIC C), Transport (ISIC H), and Other;
- (ii) Households are broken down by purposes: Transport, Heating and Other.

Type of substance includes greenhouse gases such as Carbon Dioxide (CO₂), Methane (CH₄), Nitrous Oxides (N₂O) as well as emissions of air pollutants such as Sulfur Dioxide (SO₂), Nitrogen Oxide (NO_x) and Particulates (PM₁₀).

Air emissions accounts provide data on greenhouse gas emissions and emissions of air pollutants that are fully consistent with the definitions, concepts and classifications of the System of National Accounts (SNA).

We focus herein on greenhouse gas emissions. To this end, GHG emissions recorded in the SEEA are distinct from those reported in national GHG inventories, which follow IPCC guidelines under the UNFCCC framework.

Main differences include system boundaries in the SEEA CF and in the IPCC (Residential vs Territorial) and the Classification (the SEEA following the ISIC classification, while the IPCC focusing on the underlying biophysical processes). As shown in section 3, these differences can be easily reconciled in the case of Agriculture.

Moreover, as pointed out in the “SEEA Air Emissions Accounts: from Central Framework to Agriculture, Forestry and Fisheries”⁸ development of SEEA AFF-specific Air Emission Accounts now allows to use UNFCCC reporting rules in order to include, consistently within the SEEA framework, the full range of land-based emissions and removals that are directly associated with ISIC A activities.

⁷ SEEA CF, 3.6.3 Accounting for air emissions, p.81, para 3.233

⁸ The “SEEA Air Emissions Accounts: from Central Framework to Agriculture, Forestry and Fisheries” was prepared by FAO and presented at the Eleventh Meeting of the UN Committee of Experts on Environmental-Economic Accounting, New York, 22-24 June 2016, and is available on line at : https://unstats.un.org/unsd/envaccounting/ceea/meetings/eleventh_meeting/BK-11-3c-5.pdf

3. SEEA CF and UNFCCC/IPCC System Boundaries and Classification

As discussed at the UNCEEA in 2016, the SEEA CF system boundary is based on the 2008 System of National Accounts (SNA) and follows the *residence principle* (i.e.: the scope is to report the emissions of national economic activities, regardless of where these activities occur.)

The air emission statistics compiled under UNFCCC/IPCC within National GHG Inventories follow, by contrast, the *territorial principle* (i.e.: scope is to report the emissions generated within the national territory, regardless of who is causing the emissions). It is worth noting that, at regional and global level, as well as at national level for most countries, the only differences in applying either of these principles are in reporting of emissions from international shipping and transport. These emissions are a very minor component of GHG emissions at global, regional and for most countries, national level.⁹

The air emissions accounts of the SEEA CF and those of the IPCC/UNFCCC differ also, as mentioned in section 2, in their underlying statistical classifications. Specifically, the SEEA/SNA follows the International Standard Industrial Classification of All Economic Activities (ISIC) and thus considers Agriculture, Forestry and Fishing as one economic activity (ISIC Section A), with its three divisions: Crop and Livestock (A01), Forestry (A02), and Fishing (A03).¹⁰ In terms of air emissions, these industries comprise emissions stemming from processes, transport and stationary emissions, including energy use.

By contrast, UNFCCC/IPCC does not apply ISIC. It rather distinguishes between the Agriculture sector on the one hand, and the Land Use, Land Use Change and Forestry (LULUCF) sector on the other. More attention is given to the underlying biophysical processes and specific GHG gases than on the underlying economic activity. As a result, often different GHG gases generated by the same economic activity may be reported separately under Agriculture (where only non- CO₂ gases are reported) and LULUCF (where mostly CO₂ gas is reported).

4. The SEEA AFF Air Emission accounts: allocating emissions from Agriculture and LULUCF through ISIC compliant economic activities

The SEEA AFF Physical flow air emissions account records emissions and removals that are the direct result of activities under ISIC A, Divisions 01 (Crop and Animal Production), 02 (Forestry and Logging) and 03 (Fishing and Aquaculture). Emissions linked to these

⁹ For a detailed analysis of System boundaries in the SEEA and in The IPCC/UNFCCC see: "SEEA Air Emissions Accounts: from Central Framework to Agriculture, Forestry and Fisheries", section 2. System boundaries, p.2

¹⁰ ISIC Rev.4 has been officially released on 11 August 2008. This latest version is available on-line at: <https://unstats.un.org/unsd/cr/registry/isic-4.asp>

economic activities are those arising from land management, related to crop cultivation and livestock rearing, and including practices such as tillage or drainage of organic soil. This is in line with SEEA CF, para 3.241.¹¹ These emissions are those reported following IPCC guidelines, as non-CO₂ gases in Agriculture, and as CO₂ under LULUCF.

ISIC A01 includes emissions from land clearing for crop and pasture production. Under UNFCCC reporting these are instead reported in LULUCF—forest land converted to other uses. .

ISIC A 02 includes emissions linked to forestry and forest land management, including degradation. Under UNFCCC reporting these are reported in LULUCF—forest land remaining forest land. ISIC A 01 and ISIC02 include also emissions from biomass fires.

¹¹ SEEA CF para 3.241, p. 114: “The nature of air emissions means that it is quite possible for air emissions released in one country to be carried through the atmosphere into the territory of another country. While these flows may be of considerable interest in understanding the state and quality of the atmosphere of a national environment, they are out of scope of air emission accounts, as they occur within the environment”

Crop and animal production, hunting and related service activities (ISIC A01)										
Syntetic Fertilizers	Manure Applied to Soil	Burning Biomass	Crop Residues left on soils	Manure left on Pasture	Enteric Fermentation	Manure Management	Rice Cultivation	Cultivation of Organic Soils	Other Cropland and Grassland Activities	Fuel Combustion

Forestry and logging (ISIC A02)		Fishing and aquaculture (ISIC A03)	
Forest Land Management	Fuel Combustion	Fuel Combustion	Other

The relationship between ISIC and IPCC categories are shown in **Figure 1** above.

5. Pre-filling SEEA AFF physical flow air emissions account with FAOSTAT emissions statistics

SEEA AFF table 4.5, Physical flow account for air emissions may be compiled using the FAOSTAT Emissions database.¹² For this exercise we use information on ISIC A activities for the year 2014 for Central America.

As from figure 1 above, activities in ISIC A01, *Crop and animal production, hunting and related service activities*, were associated to emissions in the following IPCC categories:

- Enteric Fermentation;
- Manure Management;
- Rice Cultivation,
- Synthetic Fertilizer,
- Manure Applied to soil
- Manure Left on Pasture
- Crop Residues
- Cultivation of Organic Soils
- Burning- Savanna
- Burning – Crop Residues
- Energy

Activities in ISIC A 02, *Forestry and Logging*, were associated to the following IPCC emissions categories:

- Forest land

¹² FAOSTAT Database (<http://www.fao.org/faostat/en/#home>) contains emissions estimates for Agriculture (times series refer to 1961-2014) and LULUCF (times series refer to 1990-2015) for 185 countries. Estimates are computed using the 2006 IPCC Guidelines (www.ipcc-nggip.iges.or.jp/public/mtdocs/pdfiles/1411_FAO-IPCC-IFAD_Rome_AFOLU.pdf.)

- Energy

Activities in ISIC A03, *Fishing and aquaculture*, were associated only to the fisheries component of the FAOSTAT emissions from energy. With these simple rules the SEEA AFF Ari emissions account table can be easily compiled using FAOSTAT data. Results for Central America (defined through the FAOSTAT aggregate list) are described below.

	Crop and animal production, hunting and related service activities (ISIC A01)										
	Syntetic Fertilizers	Manure Applied to Soil	Burning Biomass	Crop Residues left on soils	Manure left on Pasture	Enteric Fermentation	Manure Management	Rice Cultivation	Drainage and Cultivation of Organic Soils	Other Cropland and Grassland Activities	Fuel Combustion
Type of Substance											
Carbon dioxide (CO ₂)			146.25								14,663.23
Methane (CH ₄)		4,878.76	490.32			63,791.51	2,181.78	230.64			296.6497
Nitrous oxide, (N ₂ O)	11,736.04		204.76	2,596.85	27,211.28				217.47	1,918.76	1141.3146
Total GHG in CO₂eq	11,736.04	4,878.76	841.34	2,596.85	27,211.28	63,791.51	2,181.78	230.64	217.47	1,918.76	16,101.20

Figure 1 ISIC A (01) categories and IPCC Processes for Central America, 2014. Source: FAOSTAT

	Forestry and logging (ISIC A02)		Total Supply & Use
	Forest Land	Net Forest Conversion	
Type of Substance			
Carbon dioxide (CO ₂)	-38694.544	79475.175	55,590.1149
Methane (CH ₄)			71,869.66
Nitrous oxide, (N ₂ O)			45,026.47
Total GHG in CO₂eq	-38694.544	79475.175	172,486.25

Figure 2 ISIC A (02,) Categories and IPCC Processes (2)

Fig. 2 and 3 show the impact of ISIC 01 activities on Total ISIC Activities, being responsible of 76% of total GHG emissions in Central America, 2014 (Fig. 4)

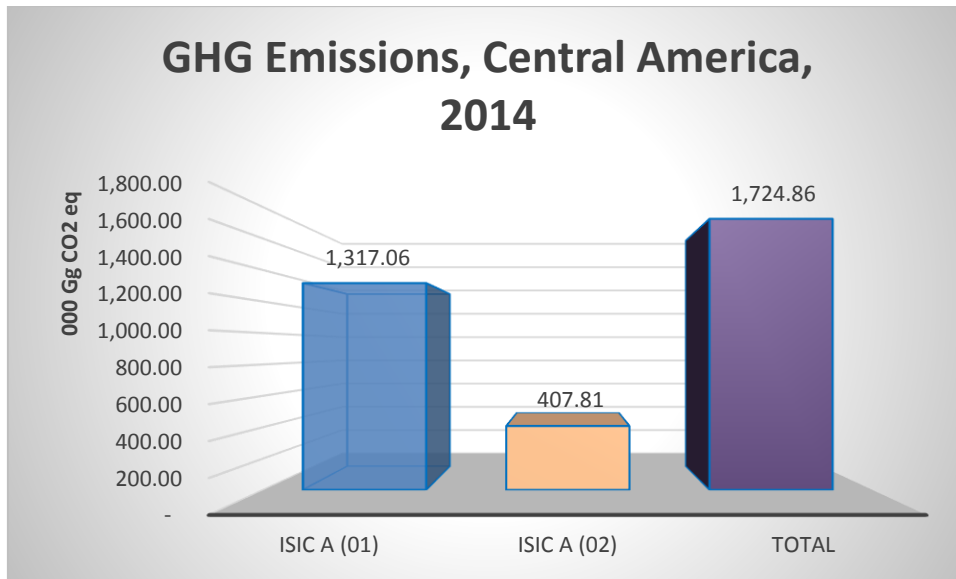


Figure 3 Distribution of GHG emissions among ISIC sectors in Central America, 2014

Also, the contribution of single GHG gases can be decomposed via the SEEA AFF table, resulting in 55,590.1149 CO₂, 71,869.66 CH₄ and 45,026.47 N₂O for Central America, year 2014.

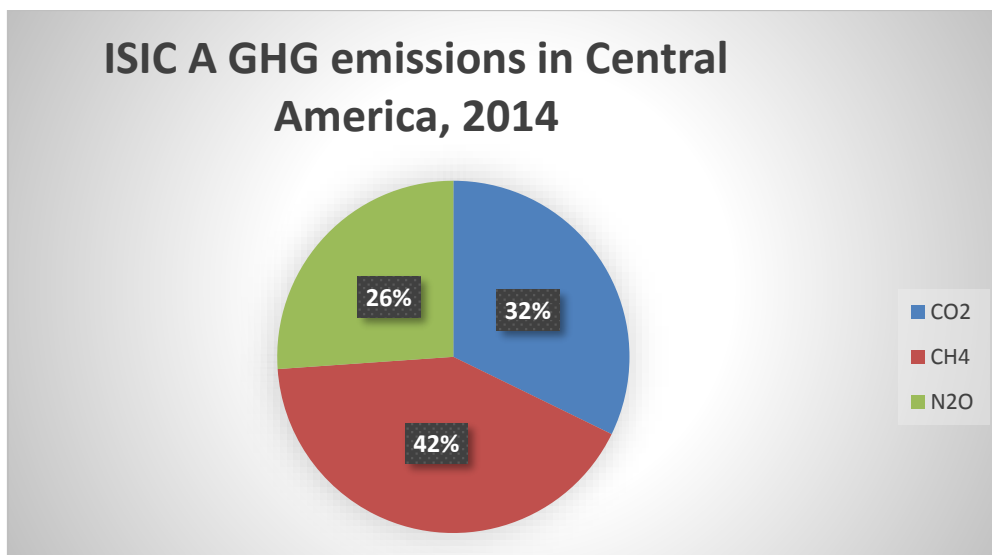


Figure 4 ISIC A GHG emissions in Central America, 2014

6. Conclusions

SEEA and the UNFCCC reporting systems play, each in its own specific field, an extremely important role. Integrating these two frameworks the SEEA AFF allows the reporting of IPCC gases and processes under ISIC economic activities.