# SEEA AGRICULTURE FORESTRY AND FISHERIES ( SEEA AFF ):
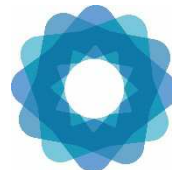
# AIR EMISSIONS, GHGs and Land Use/Land Cover: Relations between SEEA CF and the IPCC

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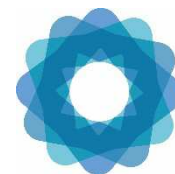Environmental
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# OUTLINE

- From SEEA CF to SEEA AFF Air Emissions Accounts

- Challenges and Opportunities of mapping land-based activities/GHG emissions between SEEA and IPCC/UNFCCC

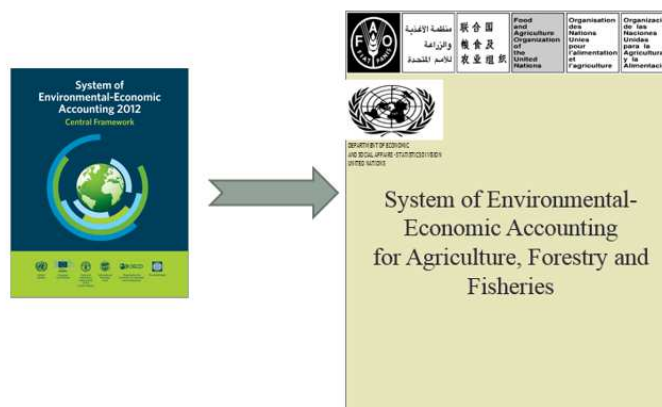- Results, Open Issues and Conclusion

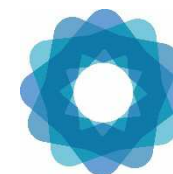Food and Agriculture Organization
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# From SEEA CF to SEEA AFF: Air Emissions Accounts

- SEEA AFF Air Emissions Accounts extend those in SEEA CF

- SEEA AFF Air Emissions Accounts include additional categories of land-based emissions/removals of GHG which are relevant to SEEA because directly associated with economic activities in Agriculture, Forestry and Fisheries
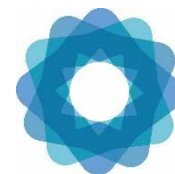
# From SEEA CF to SEEA AFF: Air Emissions Accounts

- SEEA AFF Air Emission Account is mapped onto the ISIC Section A, divisions

  o A01 *Crops and Livestock*
  o A02 *Forestry*
  o A03 *Fishing*

- SEEA AFF Air Emission Account can be mapped onto the Agriculture and Land Use, Land Use Change and Forestry reporting tables of the UN Framework Convention on Climate Change (UNFCCC) which follows the Guidelines of the Intergovernmental Panel on Climate Change (IPCC) for National GHG Inventories
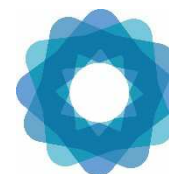
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# Air Emissions from SEEA CF to SEEA AFF

Air emissions accounts in SEEA CF

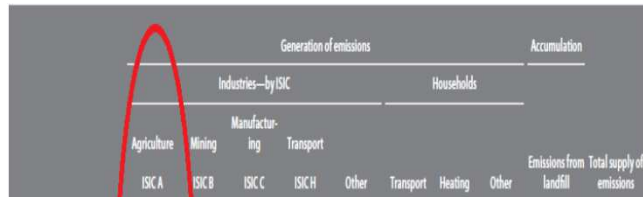| | Supply table for air emissions | | | | | | | | | | Use table for air emissions | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Generation of emissions | | | | | | | | | Accumulation | Flows to the environment | |
| | Industries—by ISIC | | | | | Households | | | | | | |
| Type of substance | Agriculture ISIC A | Mining ISIC B | Manufactur- ing ISIC C | Transport ISIC H | Other | Transport | Heating | Other | Emissions from landfill | Total supply of emissions | Emissions released to the environment | Total use of emissions |
| Carbon dioxide | 10 610.3 | 2 602.2 | 41 434.4 | 27 957.0 | 82 402.4 | 18 920.5 | 17 542.2 | 1 949.1 | 701.6 | 204 119.6 | 204 119.6 | 204 119.6 |
| Methane | 492.0 | 34.1 | 15.8 | 0.8 | 21.9 | 2.4 | 15.5 | 1.7 | 222.0 | 806.3 | 806.3 | 806.3 |
| Dinitrogen oxide | 23.7 | | 3.5 | 0.8 | 2.6 | 1.0 | 0.2 | 0.1 | 0.1 | 32.0 | 32.0 | 32.0 |
| Nitrous oxides | 69.4 | 6.0 | 37.9 | 259.5 | 89.0 | 38.0 | 12.1 | 1.3 | 0.3 | 513.6 | 513.6 | 513.6 |
| Hydrofluorocarbons | | | 0.3 | | 0.4 | | | | | 0.7 | 0.7 | 0.7 |
| Perfluorocarbons | | | | | | | | | | | | |
| Sulphur hexafluoride | | | | | | | | | | | | |
| Carbon monoxide | 41.0 | 2.5 | 123.8 | 46.2 | 66.2 | 329.1 | 51.2 | 5.7 | 1.1 | 666.9 | 666.9 | 666.9 |
| Non-methane volatile organic compounds | 5.2 | 6.5 | 40.0 | 16.4 | 27.2 | 34.5 | 29.4 | 3.2 | 0.9 | 163.3 | 163.3 | 163.3 |
| Sulphur dioxide | 2.7 | 0.4 | 28.0 | 62.4 | 8.1 | 0.4 | 0.4 | 0.1 | 0.0 | 102.5 | 102.5 | 102.5 |
| Ammonia | 107.9 | | 1.7 | 0.2 | 0.9 | 2.3 | 11.4 | 1.2 | 0.2 | 125.9 | 125.9 | 125.9 |
| Heavy metals | | | | | | | | | | | | |
| Persistent organic pollutants | | | | | | | | | | | | |
| Particulates (including PM10 and dust) | 7.0 | 0.1 | 8.5 | 9.3 | 4.4 | 6.0 | 2.8 | 0.5 | 0.0 | 38.5 | 38.5 | 38.5 |

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# Air Emissions from SEEA CF to SEEA AFF



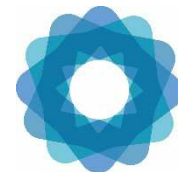**SEEA AFF Air Emissions Account**

# Challenges and Opportunities:
# SEEA and IPCC/UNFCCC Reporting

- The scope of both the SEEA and UNFCCC/IPCC is reporting of anthropogenic GHG emissions (emissions dependent on human activity): emissions from natural processes are not in scope
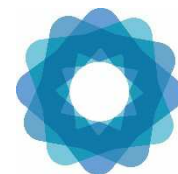


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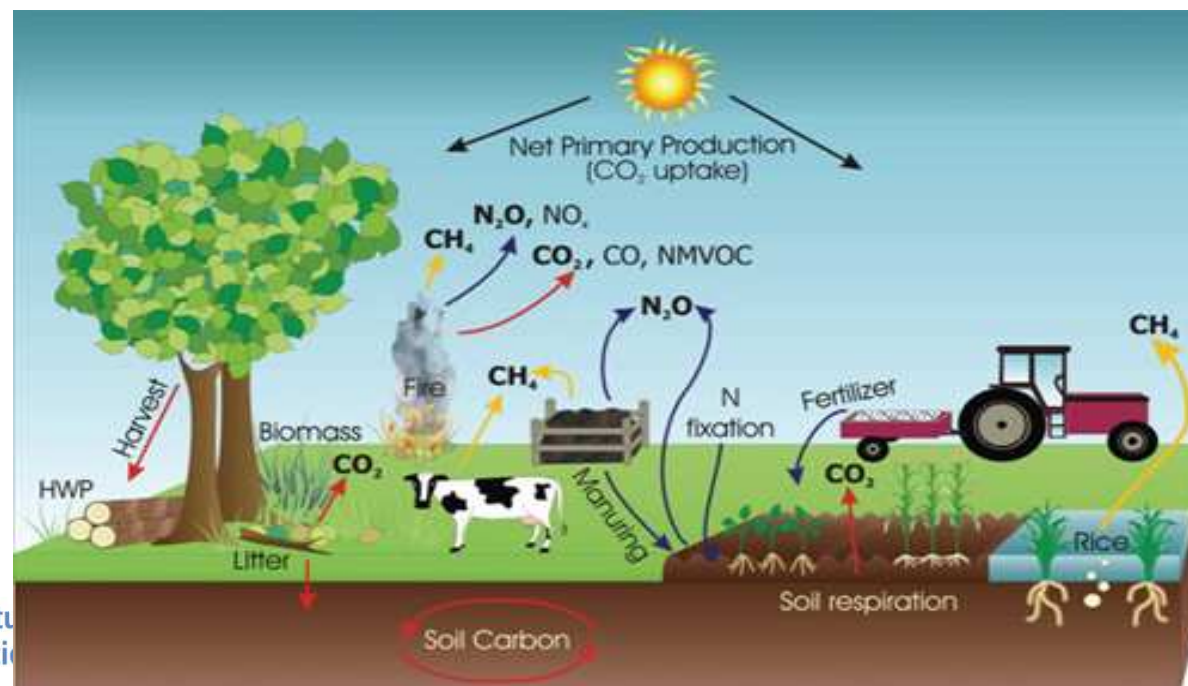
# Challenges and <u>Opportunities</u>:
# SEEA and IPCC/UNFCCC Reporting

- UNFCCC is an established process linked to International Climate Policy since 1992, with internationally approved technical guidelines for reporting (IPCC) since 1996

- Most countries have built-in legislation establishing UNFCCC focal points, institutional arrangements towards national GHG Inventories, including for agriculture and LULUCF

- Dozens of Countries (Annex I) report regularly at annual intervals, since 1992, with historical time series 1990-present
- Most developing countries report inventories, at increasingly frequent intervals—<u>with the ability to report at different Tiers</u>

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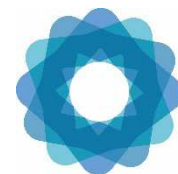Environmental
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# Challenges and Opportunities: SEEA and IPCC/UNFCCC Reporting

- Differences in system boundaries:
  - SEEA follows the **residence** principle
  - UNFCCC/IPCC follows the **territorial** principle


- Differences in underlying statistical classifications
  - The SEEA reports by economic activity **(ISIC).**
  - UNFCCC/IPCC reports with a focus on biophysical processes

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# Challenges and Opportunities: SEEA and IPCC/UNFCCC Reporting

- IPCC distinguishes between the Agriculture sector and the Land Use, Land Use Change and Forestry **(LULUCF)**

- In IPCC/UNFCC reporting system different GHG gases generated by the same economic activity may be reported separately under *Agriculture* (where only non- $CO_2$ gases are reported) and *LULUCF* (where mostly $CO_2$ gas is reported)

- IPCC/UNFCCC allows reporting of removals under LULUCF

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# Challenges and Opportunities: SEEA and IPCC/UNFCCC Reporting

| DOMAIN | CATEGORY | | GAS reported | Data source |
|---|---|---|---|---|
| Agriculture | | Enteric Fermentation | $CH_4$ | FAOSTAT |
| | | Manure Management | $CH_4$, $N_2O$ | FAOSTAT |
| | | Rice Cultivation | $CH_4$ | FAOSTAT |
| | Agricultural soils | Synthetic Fertilizers | $N_2O$ | FAOSTAT |
| | | Manure applied to soils | $N_2O$ | FAOSTAT |
| | | Manure left on pasture | $N_2O$ | FAOSTAT |
| | | Crop residues | $N_2O$ | FAOSTAT |
| | | Cultivated organic soils | $N_2O$ | HWSD, GLC2000 |
| | | Burning - Savanna | $CH_4$, $N_2O$ | GFED4, JRC, FRA-GEZ |
| | | Burning – Crop residues | $CH_4$, $N_2O$ | FAOSTAT |

| DOMAIN | CATEGORY | GAS reported | Data source |
|---|---|---|---|
| LULUCF | Forest land | $CO_2$ | FRA |
| | Cropland | $CO_2$ | HWSD, GLC2000 |
| | Grassland | $CO_2$ | HWSD, GLC2000 |
| | Burning Biomass | $CH_4$, $N_2O$, $CO_2$ | GFED4, HWSD |
| | Wetlands | $CO_2$ | |
| | Settlements | $CO_2$ | |
| | Other land | $CO_2$ | |

# Results : ISIC A01



**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 Cutivation**
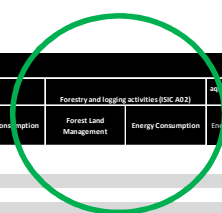
**Drainage and Cultivation of Organic Soils**  **Other Cropland and Grassland Activities**  **Fuel Combustion**

# Results : ISIC A02



Forestry and logging activities (ISIC A02)

Forest Land Management | Fuel Combustion

# Results: ISIC A03

# Results: Emissions by Gas and Products

| Type of Substance |
| --- |
| **Greenhouse Gases** |
| Carbon Dioxide |
| Methane |
| Nitrous oxide |
| |
| *Total GHG in CO2eq* |
| |
| Other Air Pollutants |
| Dinitrogen oxide |
| Hydrofluorocarbons |
| Perfluorocarbons |
| Sulphur hexafluoride |
| Carbon monoxide |
| Non-methane volatile organic compounds |
| Sulphur dioxide |
| Ammonia |
| Heavy metals |
| Persistent organic pollutants |
| Particulates (including PM10 and dust) |
| |
| **GHG: CO2eq by Product** |
| **Crops Primary** |
| Cereals |
| Pulses |
| Fodder Crops |
| Other crops |
| **Livestock** |
| Cattle and Buffaloes |
| Sheep and Goats |
| Pigs |
| Other livestock |
| **Gross Fixed Capital Formation in Land** |
| Land Transformation |
| Land Conversion |

**AGRICULTURE FORESTRY AND FISHING ACTIVITIES (ISIC A)**

Crop and animal production, hunting and related service activities (ISIC A01)

| Type of substance | Manure Applied to Soil | Crop Residues | Burning Crop Residues | Syntetic Fertilizers | Cultivation of Organic Soil | Rice Cultivation | Manure Management | Manure left on Pasture | Enteric Fermentation | Other Cropland and Grassland Management | Energy Co... |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Greenhouse Gases** | | | | | | | | | | | |
| Carbon Dioxide | | | | | | | | | | | |
| Methane | | | | | | | | | | | |
| Nitrous oxide | | | | | | | | | | | |
| | | | | | | | | | | | |
| *Total GHG in CO2eq* | | | | | | | | | | | |
| | | | | | | | | | | | |
| Other Air Pollutants | | | | | | | | | | | |
| Dinitrogen oxide | | | | | | | | | | | |
| Hydrofluorocarbons | | | | | | | | | | | |
| Perfluorocarbons | | | | | | | | | | | |
| Sulphur hexafluoride | | | | | | | | | | | |
| Carbon monoxide | | | | | | | | | | | |
| Non-methane volatile organic compounds | | | | | | | | | | | |
| Sulphur dioxide | | | | | | | | | | | |
| Ammonia | | | | | | | | | | | |
| Heavy metals | | | | | | | | | | | |
| Persistent organic pollutants | | | | | | | | | | | |
| Particulates (including PM10 and dust) | | | | | | | | | | | |
| | | | | | | | | | | | |
| **GHG: CO2eq by Product** | | | | | | | | | | | |
| **Crops Primary** | | | | | | | | | | | |
| Cereals | | | | | | | | | | | |
| Pulses | | | | | | | | | | | |
| Fodder Crops | | | | | | | | | | | |
| Other crops | | | | | | | | | | | |
| **Livestock** | | | | | | | | | | | |
| Cattle and Buffaloes | | | | | | | | | | | |
| Sheep and Goats | | | | | | | | | | | |
| Pigs | | | | | | | | | | | |
| Other livestock | | | | | | | | | | | |

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# Conclusions

- SEEA AFF provides an expanded Table for Air Emissions Accounts, providing necessary additional details to reporting from activities within ISIC A01-03, with possibility to report by gas and product

- In doing so, it provides a (hopefully useful) mapping between IPCC/UNFCCC categories unto SEEA categories

- SEEA AFF allows in principle to also report carbon removals from land management and land use change—possible linkages to EEA
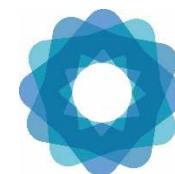
# Thank You

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# Challenges and Opportunities: SEEA CF

- **Land is a unique environmental asset, that delineates the space in which economic activities and environmental processes take place and within environmental assets and economic assets are located**

- Land is central to environmental and economic accounting and is in the scope of the SEEA CF and SEEA AFF

- Beyond assessment of ownership and tenure: e.g. of relevance to SEEA AFF, intensity of crop and livestock production and associated GHG emissions and mitigating options; afforestation and deforestation

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# LAND COVER AND LAND USE

For environmental accounting purposes, including land-based air emissions, there are two primary aspect of land:

I.   **Land use** reflects both (a) the activities undertaken and (b) the institutional arrangements put in place for a given area for the purposes of economic production, or the maintenance and restoration of environmental functions.

II.  **Land cover** refers to the observed physical and biological cover of the Earth's surface and includes natural vegetation and abiotic (non-living) surfaces.

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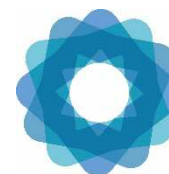
# SEEA AFF Land Use

**SEEA CF Land Use Classification**

| | | |
|---|---|---|
| 1 | Land | |
| 1.1 | Agriculture | |
| 1.2 | Forestry | |
| 1.3 | Land used for aquaculture | |
| 1.4 | Use of built-up and related areas | |
| 1.5 | Land used for maintenance and restoration of environmental functions | |
| 1.6 | Other uses of land n.e.c. | |
| 1.7 | Land not in use | |
| 2 | Inland waters | |
| 2.1 | Inland waters used for aquaculture or holding facilities | |
| 2.2 | Inland waters used for maintenance and restoration of environmental functions | |
| 2.3 | Other uses of inland waters n.e.c. | |
| 2.4 | Inland waters not in use | |

| Land use classes | |
|---|---|
| | Land used for agriculture |
| Land | Arable Land |
| | Permanent Crop |
| | Arable land and permanent crop (tot) |
| | Permanent meadows and pasture (cultivated) |
| | Permanent meadows and pasture (naturally growing) |
| | Permanent meadows and pastures (tot) |
| | Total |

**SEEA AFF Land Use Classification**

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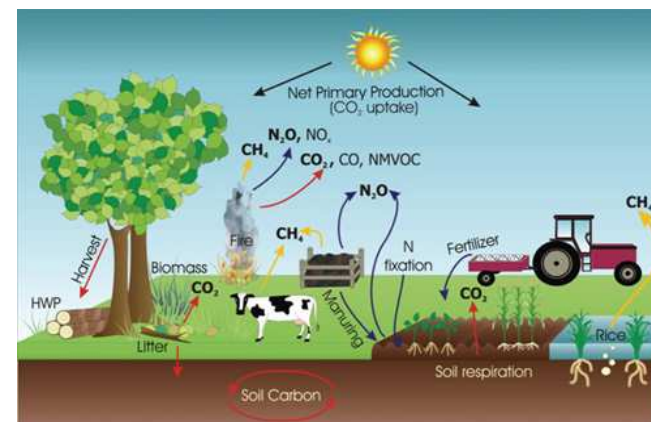
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# FAOSTAT Emissions Database:
# A reference Tier 1 Exercise



& geo-reference data

**+**

IPCC 2006 Guidelines

**=**

# SEEA CF Land Cover

SEEA AFF adopts the SEAA CF land cover classification

| | Category |
|---|---|
| 1 | Artificial surfaces (including urban and associated areas) |
| 2 | Herbaceous crops |
| 3 | Woody crops |
| 4 | Multiple or layered crops |
| 5 | Grassland |
| 6 | Tree-covered areas |
| 7 | Mangroves |
| 8 | Shrub-covered areas |
| 9 | Shrubs and/or herbaceous vegetation, aquatic or regularly flooded |
| 10 | Sparsely natural vegetated areas |
| 11 | Terrestrial barren land |
| 12 | Permanent snow and glaciers |
| 13 | Inland water bodies |
| 14 | Coastal water bodies and intertidal areas |

# PHYSICAL ASSET FOR LAND COVER

## Method:

1. Sources of Global Land Cover datasets (spatial resolution; temporal depth): **MODIS land cover products** (2001 – 2012) 500m;
2. Extracting **country aggregates** for each available year;
3. Mapping land cover classifications: **translating** land cover legend to SEEA land cover classes) with LCCS/LCML;
4. for multiple dates (*circa* **2003**; *circa* **2009**);

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**1)** http://glcf.umd.edu/data/lc/



**2001 – 2012**

**2)**
Applying **FAO GAUL** (Global Administrative Unit Layer)
to extract country aggregates (area covered in each country
by each land cover classes in the original dataset)

**3) LCCS** is a system to develop land cover classifications; applicable to all scales and means;

Classes are defined by a unique combination of **classifiers**;

A first dichotomous phase (**Vegetated; Abiotic surface**)
.. and then a **Modular Hierarchical Phase**:

✓ Natural/Cultivated
✓ Main life form (Woody; Herbaceous; Lichens/Mosses):
✓ Cover : Closed / Open / Closed to Open
✓ Height
✓ Other attributes**:** Spatial distribution/macropatterns; Leaf Type; Leaf phenology

| | IGBP_MODIS | Mapping | SEEA class name |
|---|---|---|---|
| 0 | Water | 13 | Water bodies |
| 1 | Evergreen Needleleaf forest | 6 | Tree Covered Area |
| 2 | Evergreen Broadleaf forest | 6 | Tree Covered Area |
| 3 | Deciduous Needleleaf forest | 6 | Tree Covered Area |
| 4 | Deciduous Broadleaf forest | 6 | Tree Covered Area |
| 5 | Mixed forest | 6 | Tree Covered Area |
| 6 | Closed shrublands | 8 | Shrubs Covered Area |
| 7 | Open shrublands | 8 | Shrubs Covered Area |
| 8 | Woody savannas | 6 | Tree Covered Area |
| 9 | Savannas | 6 | Tree Covered Area |
| 10 | Grasslands | 5 | Grassland |
| 11 | Permanent wetlands | 7 – 9 | |
| 12 | Croplands | 2 – 3 – 4 | Cropland |
| 13 | Urban and built up lands | 1 | Artificial surfaces |
| 14 | Cropland/Natural vegetation mosaic | 2 – 3 – 4 // 6 – 8 – 5 | Cropland // Natural vegetation ? |
| 15 | Snow and ice | 12 | Snow and glaciers |
| 16 | Barren or sparsely vegetated | 10 – 11 | |