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Agenda Item 8

Greenhouse Gas emissions from Agriculture, Forestry and Land Use: FAOSTAT data analysis and tools in support of capacity development in member countries

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Abstract

The Food and Agriculture Organization of the United Nations (FAO) recently revised information on trends in global GHG emissions from agriculture, forestry and other land uses (AFOLU), and currently provides global, regional and country data updates of AFOLU emissions. According to FAO, the agriculture and land use emissions as a share of the total (including emissions from energy, transportation, industry, etc.) has declined continuously since 1990. This is because while agriculture emissions continue to increase annually, they are not growing as fast as emissions from fossil fuel use in other sectors. In addition, recent decades have seen an overall reduction in emissions from land use due to decreased deforestation, accompanied by a smaller increase in emissions from forest degradation. We present results globally and specifically for Asia and Pacific, and document, including with examples of ongoing activities, the possible uses of the FAOSTAT emissions database in support of capacity development in member countries to enhance their ability to assess their emissions and report them within the international climate change mechanisms, including in support of National Communications and Biennial Update Reports.

I. Introduction

The Food and Agriculture Organization of the United Nations (FAO) recently revised information on trends in global GHG emissions from agriculture, forestry and other land uses (AFOLU), and currently provides global, regional and country data updates of AFOLU emissions. According to FAO, the agriculture and land use emissions as a share of the total (including emissions from energy, transportation, industry, etc.) has declined continuously since 1990. This is because while agriculture emissions continue to increase annually, they are not growing as fast as emissions from fossil fuel use in other sectors. In addition, recent decades have seen an overall reduction in emissions from land use due to decreased deforestation, accompanied by a smaller increase in emissions from forest degradation. We present results globally and specifically for Asia and Pacific, and document, including with examples of ongoing activities, the possible uses of the FAOSTAT emissions database in support of capacity development in member countries to enhance their ability to assess their emissions and report them within the international climate change mechanisms, including in support of National Communications and Biennial Update Reports.

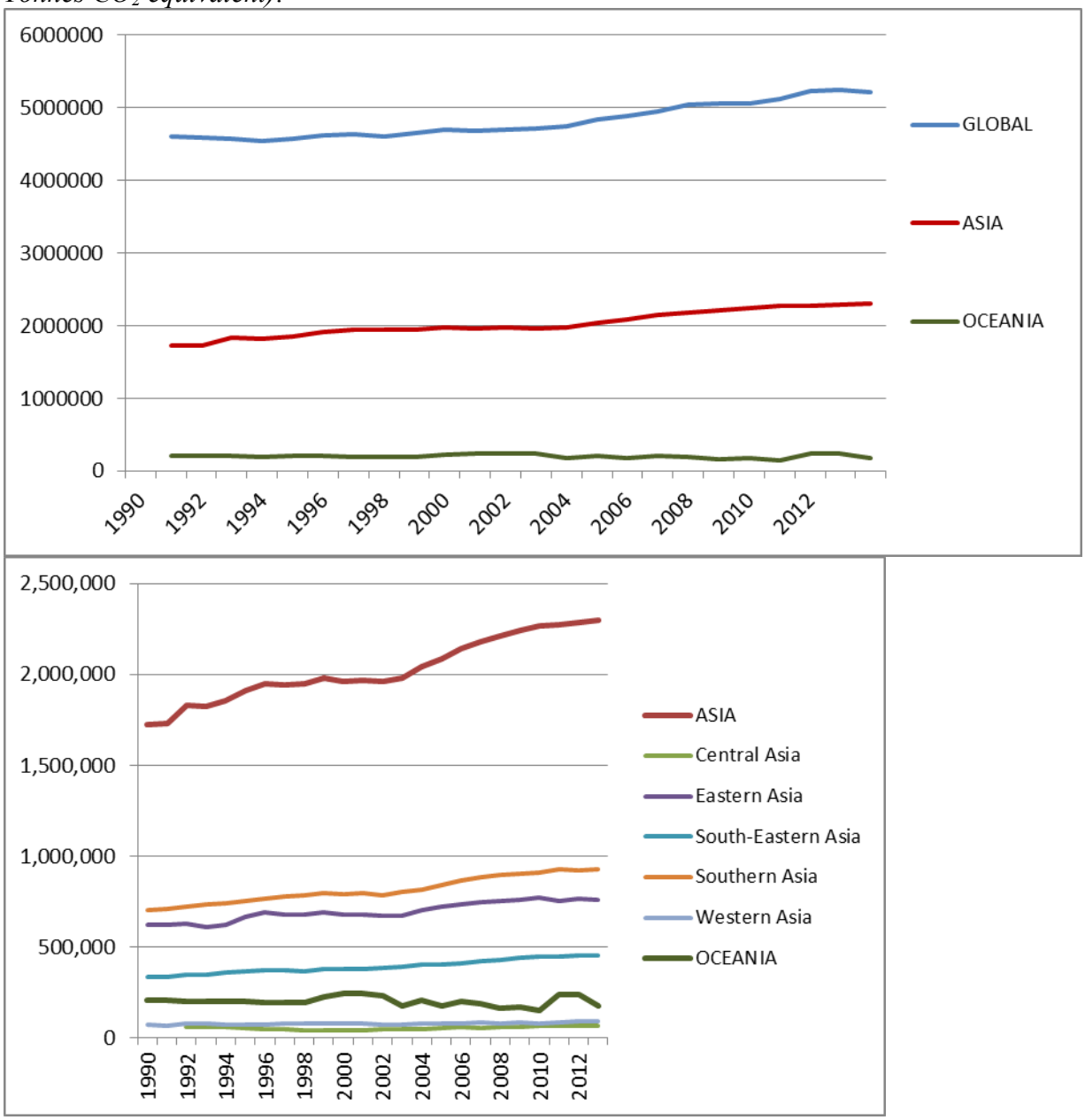
II. FAOSTAT Data: Emission Trends from agriculture, forestry and land use: Global and Asia and Pacific

FAO provides emissions estimates for nearly 200 countries via the FAOSTAT Emissions database, which covers all AFOLU activities and their associated emissions, following IPCC 2006 Guidelines at Tier 1 and land approach 1 for the reference period 1961-2012 (agriculture) and 1990-2014 (forestry and other land uses). These estimates are based on activity data collected by FAO via statistical surveys. FAO provided this data to the Intergovernmental Panel on Climate Change Fifth Assessment Report (AR5, Working Group III), which assesses periodically the state of knowledge on climate change. FAOSTAT also includes emissions estimates from biomass fires, peatland drainage and fires based on geo-spatial information, as well as forest carbon stock changes based on national-level FAO Forest Resources Assessment (FRA) data. The EDGAR database is in additional used to cover all other emission sectors of a national economy (Energy, Transport, Industry, Buildings; source: EDGAR, 2013), and was used as a reference for estimating total anthropogenic emissions and to perform cross-sectoral synthesis.

Crop and Livestock
Trends in global AFOLU emissions from 1990-2010 are as follows: Decadal average agriculture emissions grew from 4.6 Gt CO_2 eq yr^{-1} (Gt: billion tonnes) in the 1990s, to 4.9 Gt CO_2 eq yr^{-1} in the 2000s, reaching 5.2 Gt CO_2 eq yr^{-1} in 2013 (Tubiello et al., 2015; see also an FAO infografix here: http://www.fao.org/assets/infographics/FAO-Infographic-GHG-en.pdf).

In contrast, decadal average forestry and other land use emissions declined, from a range of 5.7-6.8 Gt CO_2 eq yr^{-1} in the 1990s, to a range of 4.9-6.5 Gt CO_2 eq yr^{-1} in the 2000s, reaching 4.9 Gt CO_2 eq yr^{-1} in 2010. (Federici et al., 2015; see a FAO infografix here: http://www.fao.org/assets/infographics/FAO-Infographic-GHG-en.pdf)

Figure 1 –*Agriculture Emissions 1990-2012: Global and Asia and Pacific (Units are in 1000 Tonnes CO_2 equivalent).*



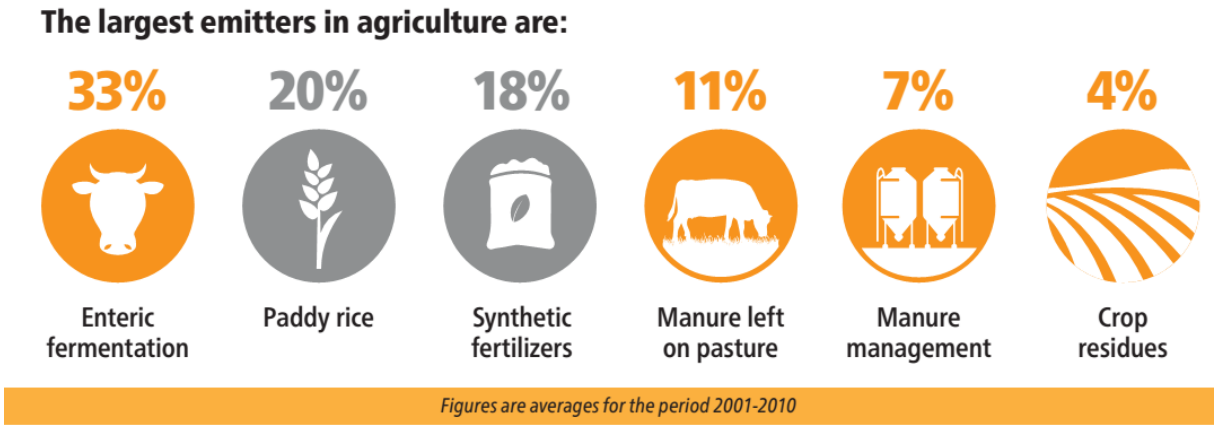
Source: FAOSTAT, 2016

In the Asia Pacific region, emissions from agriculture represent 46% of the world total. Decadal average agriculture emissions grew from slightly over 2 Gt CO_2 eq yr^{-1} (Gt: billion tonnes) in the 1990s, to 2.2 Gt CO_2 eq yr^{-1} in the 2000s, reaching nearly 2.5 Gt CO_2 eq yr^{-1} in 2013. The increase in agriculture emissions was significantly higher than the global average in Asia (on average 9% compared to 6% on a global scale) between the two most recent decades, whereas the emissions from Oceania during the same period was limited to 1% increase.

Furthermore as shown in Fig. 1, Southern and Eastern Asia have the highest share of emissions. See also an FAO infografix here: http://www.fao.org/assets/infographics/NEW-ASIA-FAO-Infographic-GHG-en.pdf .

Globally, within the crop and livestock sector, the top agriculture emissions sectors were Enteric Fermentation (40%), followed by Manure left on pasture (16%), Synthetic fertilizers (15%), and Paddy Rice (10%). A similar pattern is found in Asia but in this case the share of agriculture emissions from paddy rice doubles the global average (20%). Emissions from synthetic fertilizers is also higher (18%) than global average.

Figure 2 –*Main sources of agriculture emissions, average 1990-2010 for Asia Pacific*



Source: FAOSTAT, 2016

Forest and Land Use

While emissions from crop and livestock production increased since 1990 at both global and regional level (in Asia and Pacific), global decadal average forestry and other land use emissions declined.

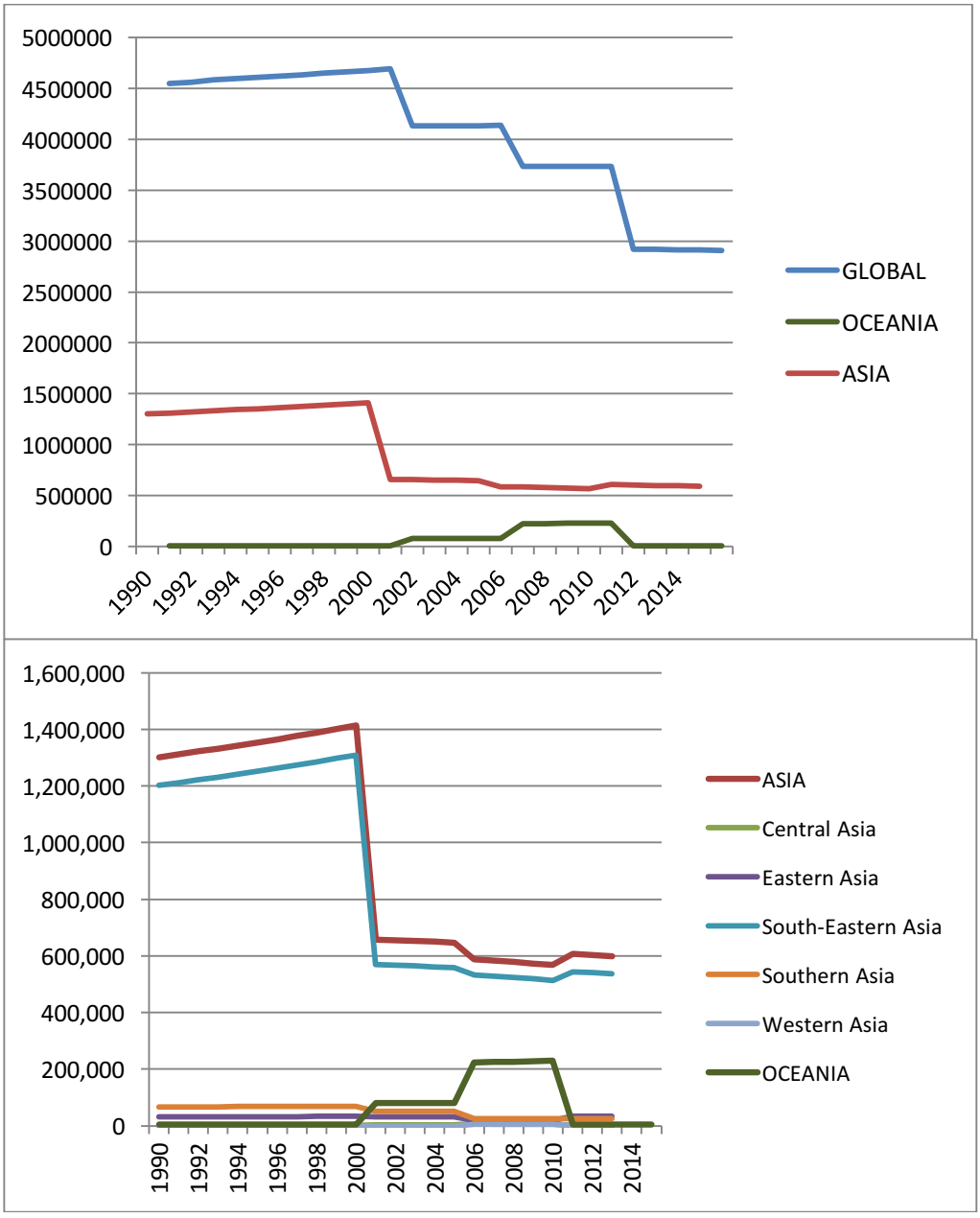
Deforestation

Global carbon emissions from deforestation decreased significantly, from 4.6 Gt CO_2 eq yr^{-1} (Gt: billion tonnes) in the 1990s, to 4.1 Gt CO_2 eq yr^{-1} in the 2000s, and only totaling 2.8 Gt CO_2 eq yr^{-1} in 2013 (FAOSTAT 2016). This represented a 12% decrease over the most recent two decades, with a further 30% drop, mainly due to trends in Brazil, in the last few years since 2010.

In Asia and Pacific, deforestation and related emissions also decreased significantly, from over 1.3 Gt CO_2 eq yr^{-1} (Gt: billion tonnes) in the 1990s, to 0.8 Gt CO_2 eq yr^{-1} in the 2000s, and with a further decrease to 0.6 Gt CO_2 eq yr^{-1} in the period 2010-2015 (FAOSTAT 2016). This represented a 39% decrease over the most recent two decades, including a further 24% drop in the last few years since 2010.

Sub-regionally, the largest reduction in deforestation form 1990 to 2013 was recorded in Eastern Asia and Pacific (-25%), while deforestation actually increased in Middle Asia and Pacific (+6%). As a result, while deforestation was larger in Eastern Asia and Pacific than in Middle Asia and Pacific in the 1990s (almost 420 and 320 Mt CO_2 eq yr^{-1}, respectively; Mt: million tonnes), byt 2013 Middle Asia and Pacific became the largest source of deforestation, greater than Eastern Asia and Pacific (336 and 320 Mt CO_2 eq yr^{-1}, respectively). The third sub-region in importance for deforestation was Western Asia and Pacific, where deforestation rates have remained constant since 1990s at about 270 Mt CO_2 eq yr^{-1}.

Figure 3 –*Deforestation Emissions 1990-2010: Global and Asia and Pacific (Units are in 1000 Tonnes CO_2 equivalent).*



Forest Emissions and Removals

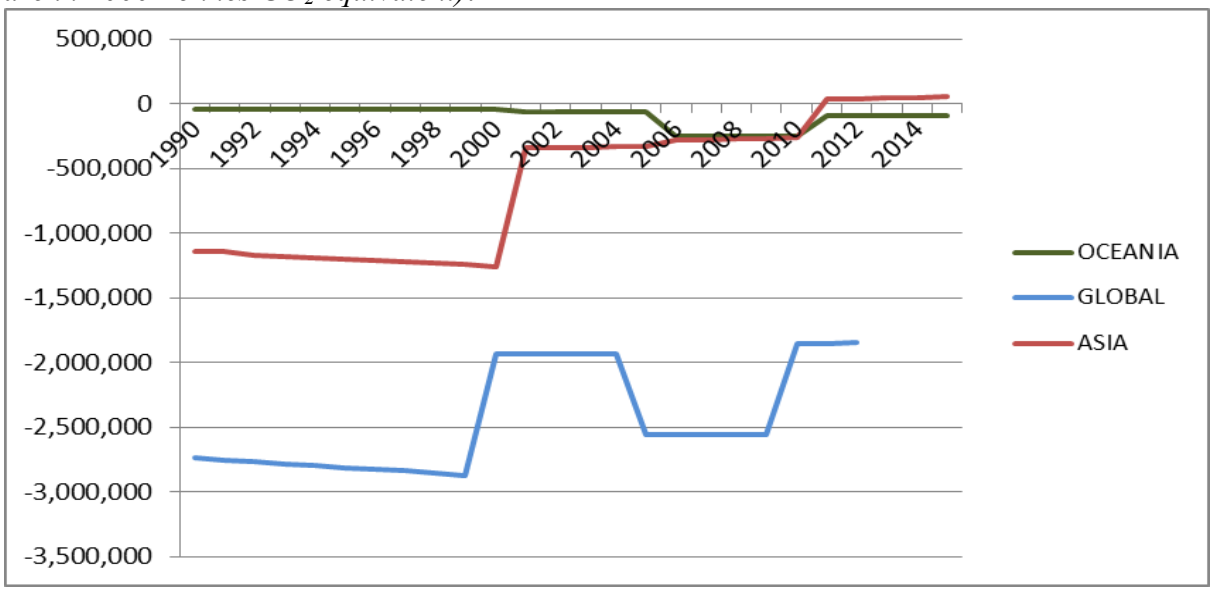
Remaining forests (those not being deforested but undergoing growth and cut cycles, including degradation) acted as a carbon sink globally, albeit decreasing in strength, from -2.7 Gt CO_2 eq yr^{-1} (Gt: billion tonnes) in the 1990s, to -2.7 Gt CO_2 eq yr^{-1} in the 2000s, and -1.9 Gt CO_2 eq yr^{-1} in the period 2010-2015 (FAOSTAT 2016). This represented a 18% decrease in forest sink strength over the most recent two decades, with a further 14% drop in the last few years since 2010.

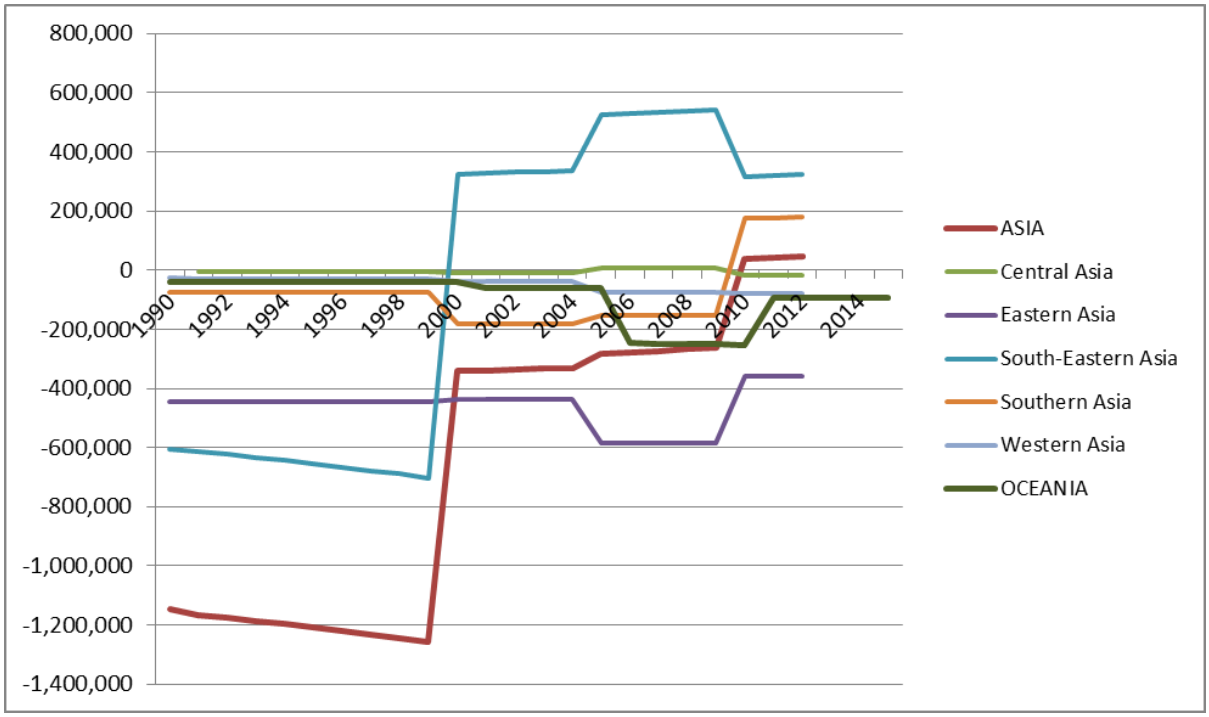
The sink strength actually increase in Oceania during between the period 1990 to the late 2000s to decrease then of 9% in the most recent years. The reduction was instead particularly important in Asia where the strength of the forest to act as carbon sink decreased from -1.1 Gt

CO_2 eq yr^{-1} in 1990s to -0.4 Gt CO_2 eq yr^{-1} in the 2000s to reach -0.06 Gt CO_2 eq yr^{-1} in the most recent years since 2010.

Likewise in the Asia and Pacific, the strength in the forest sink decrease significantly. A reduction of 56% was recorded in the 1990s (from -1.2 Gt CO_2 eq yr^{-1} to -0.5 Gt CO_2 eq yr^{-1} in the 2000s), and with a further decrease to -0.1 Gt CO_2 eq yr^{-1} in the recent years since 2010 (FAOSTAT 2016), which corresponded to 76% *decrease* in sink strength.
All sub-regions because a forest sink in recent years, and especially in the period after 2005. The largest forest sink was recorded in Middle and Eastern Asia and Pacific (-90 and -70 Mt CO_2 eq yr^{-1} respectively, in 2013), followed by Southern, Western and Northern Asia and Pacific at about -70 Mt CO_2 eq yr^{-1} each in 2013. The third sub-region in importance for deforestation was Western Asia and Pacific, where deforestation rates have remained constant since 1990s at about 270 Mt CO_2 eq yr^{-1}.

Figure 4 –*Emission/Removals from forests 1990-2010: Global and Asia and Pacific (Units are in 1000 Tonnes CO_2 equivalent)*.

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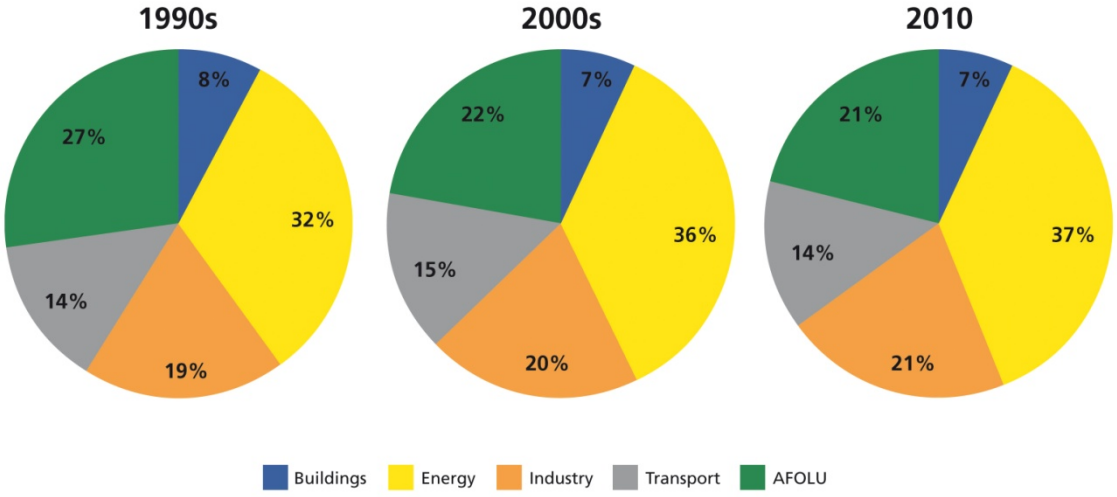
Eastern Asia
South-Eastern Asia
Southern Asia
Western Asia
OCEANIA

III. New Indicators: Shares of emissions to total economy

The data described above represent currently available data in FAOSTAT (except the 2013 which is a preliminary figure), subject to automatic update every year.
This section illustrates new data for inclusion into the *agri-environmental* sub-domain of the FAOSTAT database, focusing on indicators in support of country analysis other than emission assessment for reporting to the climate convention, but rather in support of wider indicators towards Sustainable Development Goals and SEEA Agriculture processes (see companion paper on SEEA Agriculture, APCAS 26). The new data indicate that the share of emissions from agriculture and land use to the total emissions in a country, region or globally.

Globally, the share decreased from 29% in the 1990s, to 24% in the 2000s, to 21% in 2010. Furthermore, prior to 2005 emissions from deforestation and other land use activities were significantly larger than those from crop and livestock production. By 2010, agriculture was the larger component, contributing 11% of total emissions, compared to deforestation and land use (10%). Deforestation was responsible for only 8% of total anthropogenic emissions in 2010, compared to 12% in the 1990s.

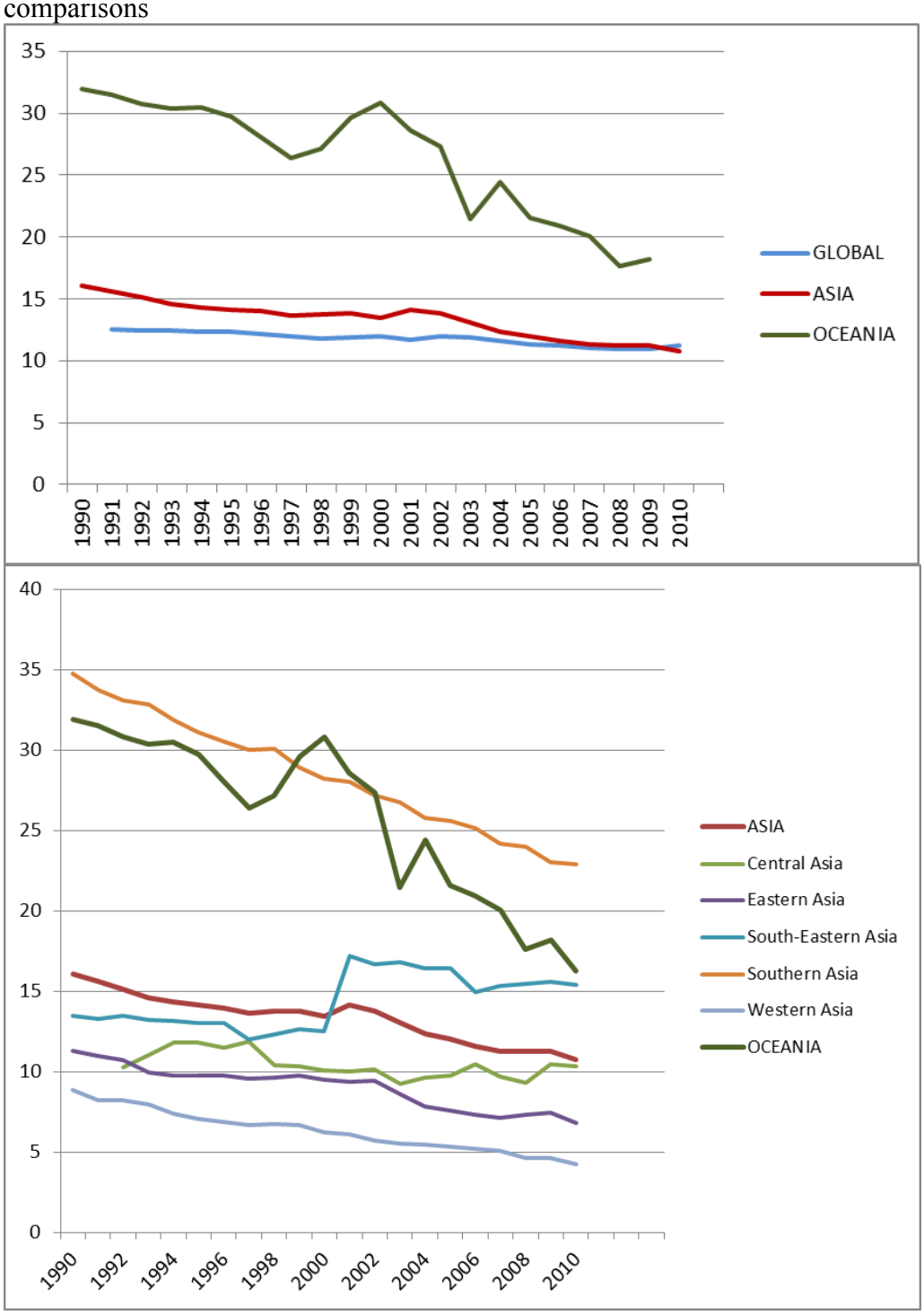
Figure 6 – *Shares of Anthropogenic Emissions, Global*



Source: Tubiello et al (2015) and FAOSTAT Test Site, 2015

Similarly to the global trend, the share of agriculture emissions decreased in Asia and Pacific. In Asia and Pacific, the share of agriculture was about 22% in the 1990s and decreases to less than 18% in the 2000s and further decreased to 13% in 2010 (FAOSTAT test site, 2016). The reduction was lower in Asia in the the most recent years (-14%) while more significant in Oceania (-30%). Central Asia was the only sub-region to record an increase (albeit limited to 5%) in the share of emissions from agriculture in the recent years.

Figure 7 – *Shares of agriculture to anthropogenic Emissions, Global and Asia and Pacific* comparisons

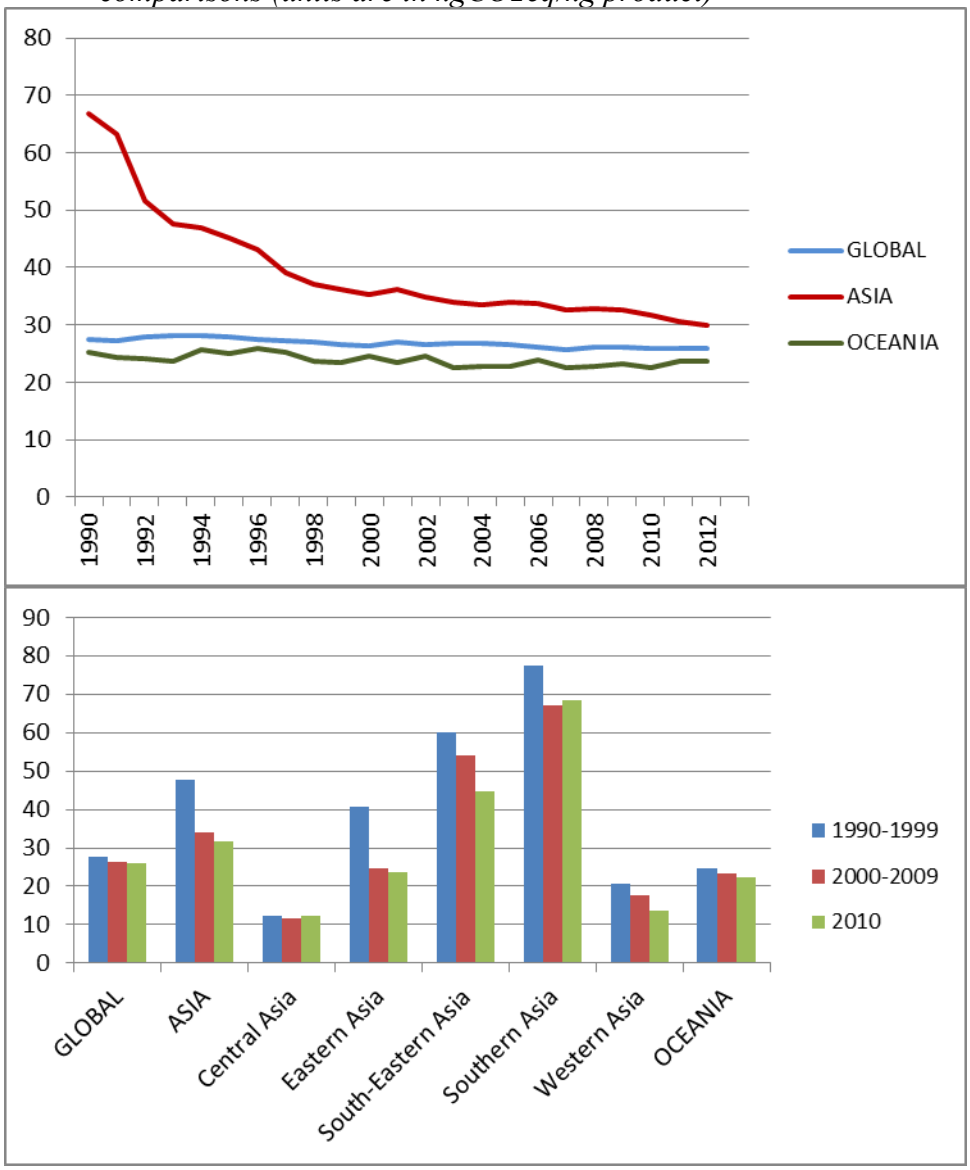


Source: Tubiello et al (2015) and FAOSTAT Test Site, 2016

IV. New Indicators: Carbon intensity of Commodities

This section illustrates new data for inclusion into the *agri-environmental* sub-domain of the FAOSTAT database, focusing on indicators in support of country analysis other than emission assessment for reporting to the climate convention, but rather in support of wider indicators towards Sustainable Development Goals and SEEA Agriculture processes (see companion paper on SEEA Agriculture, APCAS 26).
The new data indicate that the intensity of greenhouse gas emissions of various agriculture commodity products in a country, region or globally.

Figure 8 – *Carbon intensity of cattle meat production, Global and Asia and Pacific comparisons (units are in kgCO2eq/kg product)*



Source: FAOSTAT Test Site, 2015

We provide herein an example of the many commodities currently implemented in test site, which comprise meat and milk products by animal type, cereal and rice.

As Fig. 8 indicates, global GHG intensities for cattle meat decreased over time over the period 1990-2012, from 27.5 to 26.4 kg CO2eq/kg meat in the 1990s and 2000s respectively, to 25.9 in 2012. At regional level, the FAOSTAT indicator analysis shows that Asia and Pacific GHG intensities of meat similarly decreased but were higher than global averages ranging from 36.1 to 28.6 kg CO2eq/kg meat in the 1990s and 2000s respectively, to reach 27 in 2012. During these decades the emissions intensity was always higher than the global average in Oceania (it reached 22.4 kg CO2eq/kg in 2012) compared to Asia. However, the progress towards reduced intensity of cattle meat were more significant in Asia (from 47.6 to 34 CO2eq/kg between the 1990s and the 2000s) to a further reduction to 31.6 CO2eq/kg in 2012. This is likely due to the intensification in the livestock sector observed during the past years in the countries of the region.

V. Capacity Development in Support of member countries

Current efforts by FAO in the area of greenhouse gas emissions and associated agri-environmental indicators in FAOSTAT have led to the compilation of new data in support of member countries to monitor, assess and report critical information for analysis and policy making. Within this context, the ongoing efforts are fully consistent with and can significantly support the Global Strategy and SEEA development goals. In particular, FAOSTAT is expanded to include an assessment of GHG emissions from agriculture and land use, in close collaboration with IPCC guidelines and UNFCCC requirements. A work programme is in place, and increasingly integrated into the SEEA Agriculture implementation strategy, with a focus on improvement of the data collection process, country capacity development, country case studies. Such activities support the creation of detailed technical guidance for potential appropriate national mitigation actions (NAMA) in developing countries and especially LDCs, including support for their reporting needs within the UN Framework Convention on Climate Change (UNFCCC), such as the new requirements to submit Biennial Update Reports (BURs), with emissions information. The development of a data warehouse for FAOSTAT and other FAO databases is ongoing and will lead to easier integration and use of the agri-environmental data held at FAO, with integration towards implementation of relevant agri-environmental indicators.

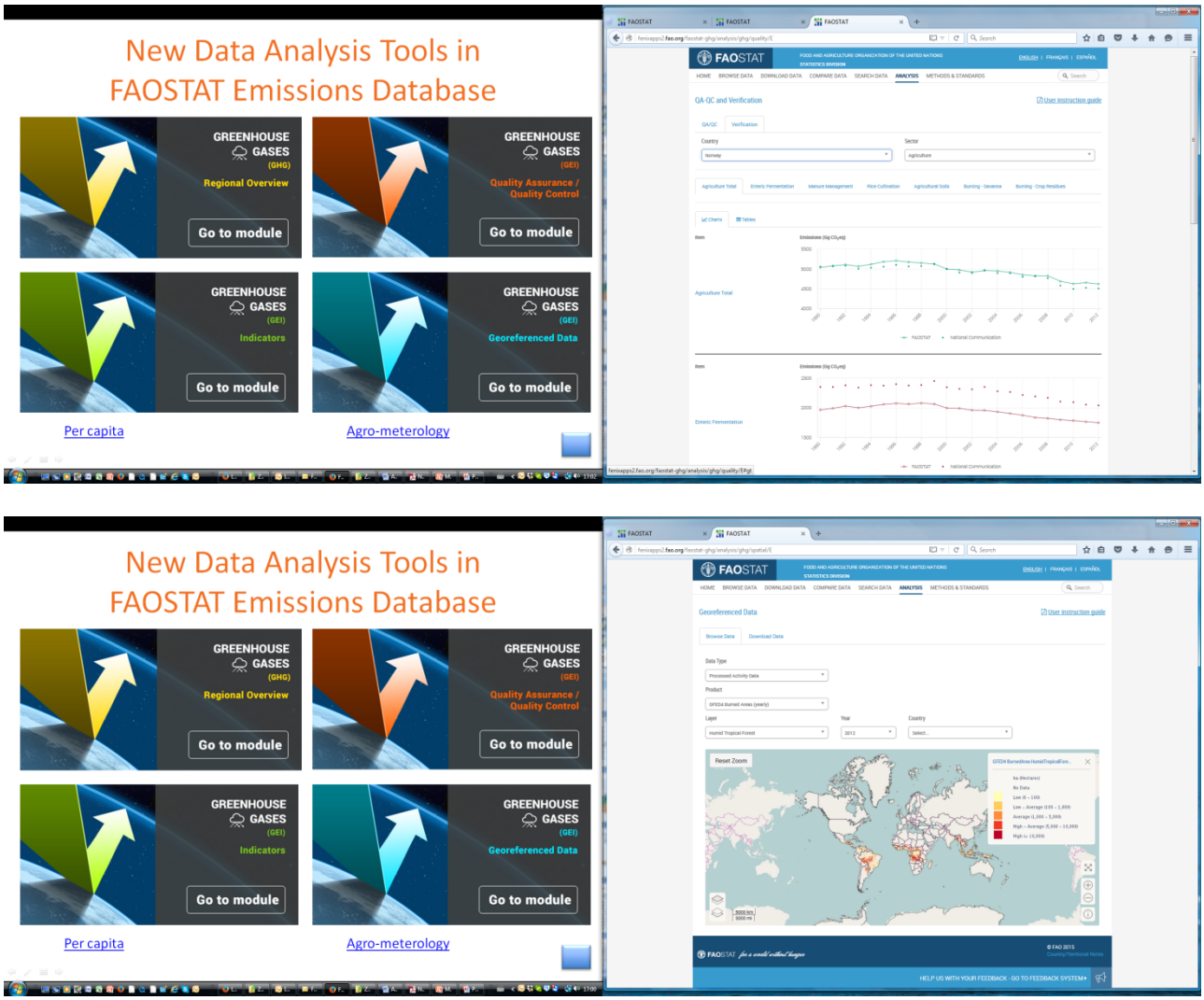
Within this data and capacity development framework, FAO is open to partnership with interested stakeholders, including technical experts, universities, government institutions and the private sector, focusing on:

- Detail a work programme on data collection process, country capacity building, development of country case studies towards improving national, regional and global assessments;
- Survey a sample of countries for barriers and limitations to adopting or developing GHG emission databases and use this information to help devise a strategy to overcome the issues;
- A set of country case studies for capacity building to address both technical and institutional gaps;
- Peer-review of emission inventories and BUR support to improve agri-environmental and GHG data services.

With respect to the FAOSTAT emissions database, applications by member countries can be structured along four dimensions:

i) Global, regional and national trend analysis: for regular updates by FAO on the status of global and regional GHG emissions; to be used for evidence-based decision making and planning;
ii) Quality assurance/quality control tool for member countries, to help analyze and fill data gaps and provide a benchmark for further statistical data development;
iii) Indicators to be used for national level analysis and international support to both the climate policy and sustainable development goals processes;
iv) Geospatial analysis, in order to disseminate relevant sub-national information underlying many of the computations in the database.

Figure 9. *The four dimension of applicability and tools of the FAOSTAT emissions dat. Top: QA/QC analysis; Bottom: Geospatial data underlying national-level assessment. Source: FAOSTAT Test Site, 2015.*



These four dimensions provide guidelines for capacity development to improve national data and institutional coordination needed for robust and internationally accepted national, regional and global GHG emissions estimates, with a view to support a more significant role of agriculture in international mechanisms.

Based on the above principles and workplan options, FAO is currently supporting seven countries in West Asia and Pacific (Cabe Verde, Burkina Faso, Senegal, Togo, Benin, Ghana, Cote d' Ivoire), in partnership with UNFCCC, IPCC and national agencies. This project has started in 2014 and is planned until 2017. Significant support to enhance statistical capacity development on agriculture, forestry and land use statistics is undergoing (see, e.g., http://www.fao.org/economic/ess/ess-events/ghg2015/en/ and http://www.fao.org/economic/ess/ess-events/unfccc3/en/)

VI Conclusions

The current availability of emissions data and planned implementation of relevant indicators puts an emphasis on capacity development and support to member countries through successive complexity tiers of available data, depending on national capacity. Progress at national level will in turn benefit the international process, insofar as improved national statistics lead to improved quality and coverage of FAO databases, including FAOSTAT.

To this end, a first set of generic guidelines for ghg inventory implementation, Biennial Update Reporting, and overall guidelines on how to produce robust evidence for decision making and planning have been produced and are available to users (see reference list below). Ongoing work will further lead to the availability in FAOSTAT of relevant additional indicators, to benefit both climate change and sustainable development goals processes.

In conclusion, based on the material presented at APCAS, including oral presentations and follow-up discussions, APCAS delegates are asked to deliberate on the following key issues, whether to:

- Support and endorse the use of the FAOSTAT emission database as a means to assess and analyse national, regional and global emission trends in support of evidence-based decision making and planning of the agriculture sector with respect to climate change processes

- Support and endorse the ongoing additional work on analytical tools, with a view to include relevant agri-environmental indicators, such as emission intensity of commodity products and QA/QC functionalities, within FAOSTAT, in support of improved evidence-based decision making

- Support and endorse capacity development work on emissions from agriculture, forestry and land use, in support of member countries in the Region. Implementation is aligned with SEEA Agriculture, and based on improving statistical processes, from the use of simple yet robust national statistical information available to FAO from member countries, to the development of more complex statistics based on sub-national data

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FAO 2014. Estimating GHG emissions in Agriuclture. FAO, Rome. Available in English, French and Spanish at: http://www.fao.org/3/a-i4260e.pdf ; http://www.fao.org/3/a-i4260f.pdf and http://www.fao.org/3/a-i4260s.pdf

Datasets and related resources

FAOSTAT Emissions database Agriculture: http://faostat3.fao.org/download/G1/*/E

FAOSTAT Emissions database Land Use: http://faostat3.fao.org/download/G2/*/E