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FAOSTAT ANALYTICAL BRIEF 37

Land cover statistics

Global, regional and country trends

2000–2019

>> FAO Statistics Division

HIGHLIGHTS

→ **In 2019, herbaceous crops covered on average 1.5 billion hectares in total, or 11 percent of the global land surface. Tree-covered areas were 4.7 billion hectares, or roughly one-third of the total land surface, while grassland and shrub-covered areas combined covered 4.3 billion hectares.**

→ **Regional and country results for herbaceous crops were consistent with existing land use information on arable land. Country data showed that India, China, the United States of America, the Russian Federation and Brazil have, in descending order, the largest areas, above 150–200 million hectares each.**

→ **Wetlands covered on average 260 million hectares globally in 2019. Europe (including the Russian Federation) has the largest wetland area worldwide.**

→ **Comparisons of land cover statistics with land use information showed good agreement across major classes, indicating the possibility to use land cover data to gap fill land use information on arable land, permanent meadows and pastures, forest land and inland waters.**

FAOSTAT LAND COVER STATISTICS

INTRODUCTION

Land cover statistics provide information on the bio-physical aspects of the land surface. They codify the observable features of its living and non-living components, including natural and managed ecosystems such as croplands, forests, and urban areas, into simplified classes such as herbaceous crops, tree-covered areas and built-up areas.

Land cover and land use statistics are closely interrelated, supporting improved understanding of key local, regional and planetary trends that help quantify human-driven land dynamics, such as conversion of land to or from agriculture, deforestation and land degradation. In this perspective, land cover information and statistics are used in FAOSTAT as geospatial input to estimate greenhouse gas (GHG) emissions from drained organic soils (FAO, 2020) and from burning biomass (Prosperi *et al.*, 2020). Land cover statistics can furthermore be used to support data quality assessment and quality control (QA/QC) and gap filling of FAO land use statistics (FAO, 2021a, 2021b, 2021c).

The FAOSTAT land cover statistics (FAO, 2021d) are based on the Food and Agriculture Organization of the United Nations (FAO) Land Cover Classification System (FAO-LCCS) (Di Gregorio, 2005). Information is derived by aggregating three independent geospatial products, generated from remote sensing by specialized agencies, specifically: *a)* the European Space Agency Climate Change Initiative (CCI); *b)* the National Aeronautics and Space Administration (MODIS); and *c)* the Copernicus Global Land Service (CGLS). These products are available for different periods, based on the type and duration of the satellites and sensors from which they are derived: 1992–2019 for CCI; 2001–2019 for MODIS;

and 2015–2019 for CGLS. All three datasets have comparable global accuracies; they are generated independently by means of different raw data processing chains and algorithms adapted to the different satellite products from which they are sourced (see more details in Explanatory Notes). They are widely used in a number of FAO applications (e.g. WaPOR on remote sensing for water productivity) as well as within the United Nations (UN) system, including in support of Sustainable Development Goals (SDG) indicators (e.g. SDG 15.4.2 on the Mountain Green Cover Index and SDG indicator 15.3.1 on the proportion of land that is degraded). The three land cover data products have different applications depending on specific technical requirements. For instance, the higher thematic detail of the agricultural land cover classes of CCI makes it suitable for applications that distinguish between rainfed and irrigated crops, or between herbaceous and woody crops. Conversely, the higher spatial resolution of CGLS allows it to detect surface features in more detail, but within analyses limited to shorter periods compared to CCI and MODIS. The latter land cover product can in turn be paired to the MODIS burnt area, produced using the same satellite sensor, to derive indicators in a consistent manner, for instance GHG estimates (FAO, 2021e).

FAOSTAT statistics harmonize the land cover legends of the three underlying land cover products by mapping them, using the FAO-LCCS approach, into the common UN land cover legend of the UN System of Environmental Economic Accounting (United Nations, European Commission, Food and Agricultural Organization of the United Nations, International Monetary Fund, Organisation for Economic Co-operation and Development and World Bank, 2014). This results in statistics for 14 classes of land cover (see Table 1 below) that are disseminated separately for CCI, MODIS and CGLS to provide users with the full range of variability in the information provided across specific land cover classes and different regions.

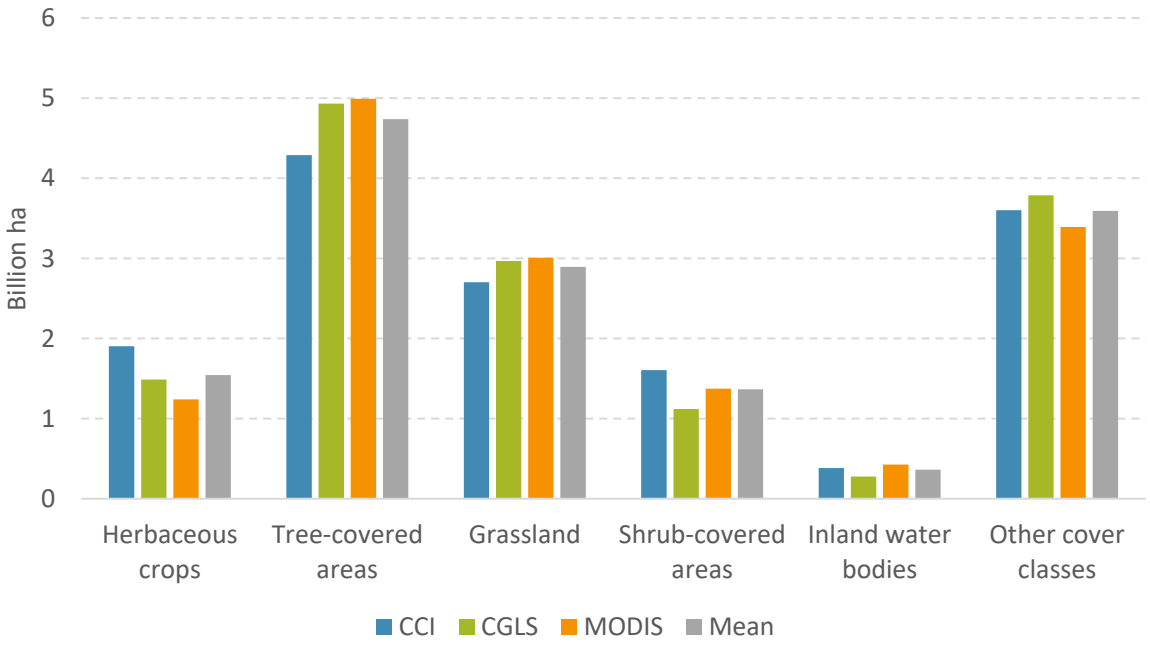
This analytical brief presents global, regional, and country results of land cover statistics, with a focus on classes relevant for food and agriculture, in particular herbaceous crops. For each land cover class analysed, results are presented for the three individual land cover products and summarized in terms of the resulting means and associated errors.

GLOBAL OVERVIEW

The global mean land surface was estimated to 14.7 billion hectares (ha) in 2019. Tree-covered areas accounted for 4.7 billion ha. An additional 4.3 billion ha consisted of either grassland or shrub-covered areas. Herbaceous crops covered about 1.5 billion ha and inland water bodies 360 million ha. Land cover types not typically associated with agriculture, such as built-up areas, bare land (deserts) and permanent snow and ice covered a significant portion of the remaining land surface, totalling 3.5 billion ha (Figure 1). Artificial surfaces covered about 100 million ha.

In general, the statistics generated with CCI data were quite different from the MODIS- and CGLS-derived data, while the latter two products agreed more closely with each other.

Figure 1: Global land cover statistics by source, 2019



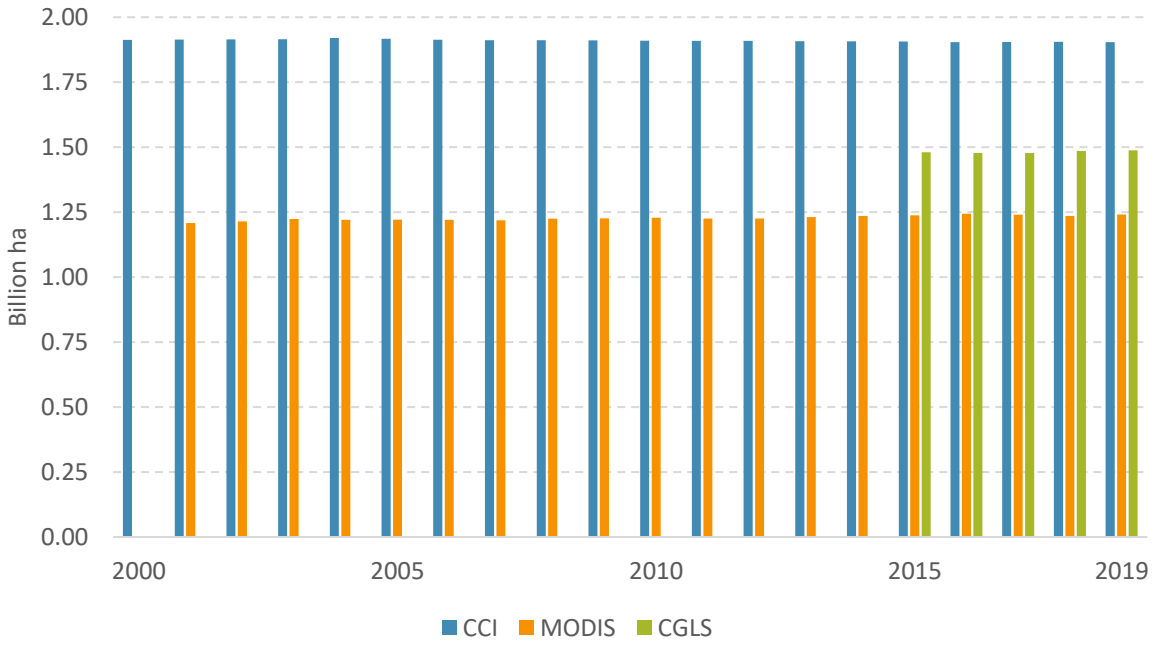
Source: FAO, 2021d.

HERBACEOUS CROPS

In 2019, the global area of herbaceous crops from the three products was 1.5 ± 0.4 billion ha. Values ranged from 1.2 (MODIS) to 1.5 (CGLS) and 1.9 (CCI) billion ha (Figure 2), corresponding to an error of 27 percent (computed as the half range divided by the mean; it represents an uncertainty in land cover extent generated using three different products; hereafter referred to as error). MODIS and CGLS were in closer agreement with each other compared to CCI.

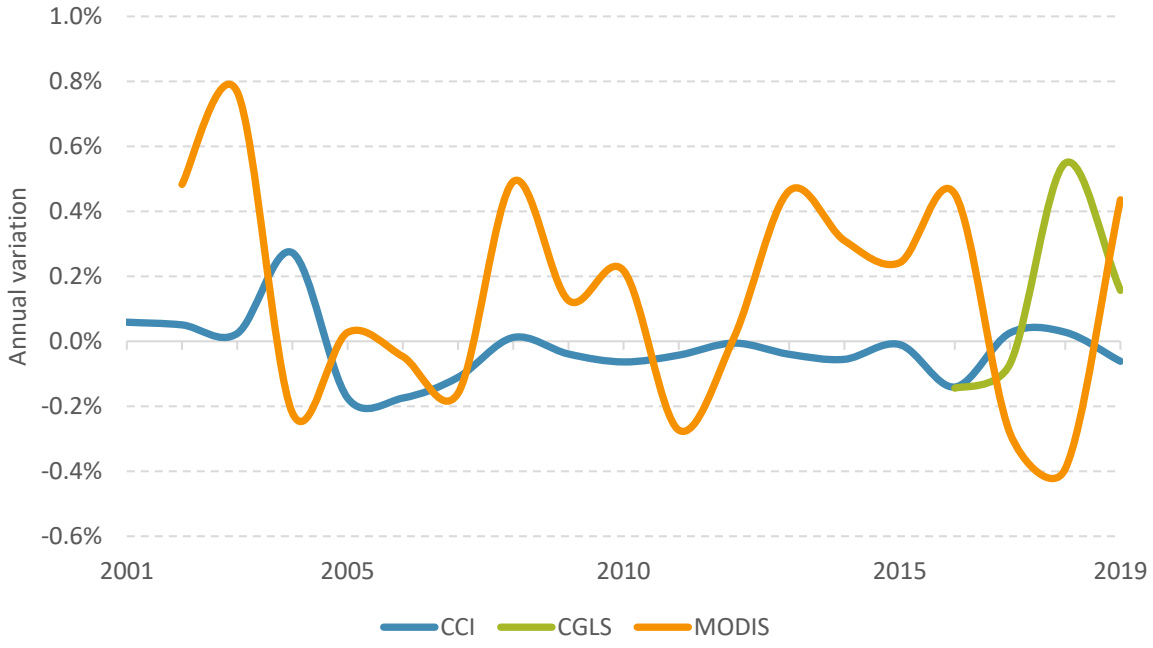
We furthermore performed an analysis of land cover change dynamics derived from the CCI, MODIS and CGLS land cover products. Large variability and significant differences were observed in land cover change data across the three land cover products, at annual to decadal temporal scales, and including at global spatial aggregations. This suggests that the national aggregates of land cover products disseminated in FAOSTAT should not be used to compute land cover change statistics. Figure 3 provides an example for the class of herbaceous crops.

Figure 2: Global land cover of herbaceous crops by source



Source: FAO, 2021d.

Figure 3: Estimated global annual land cover change for class herbaceous crops by source

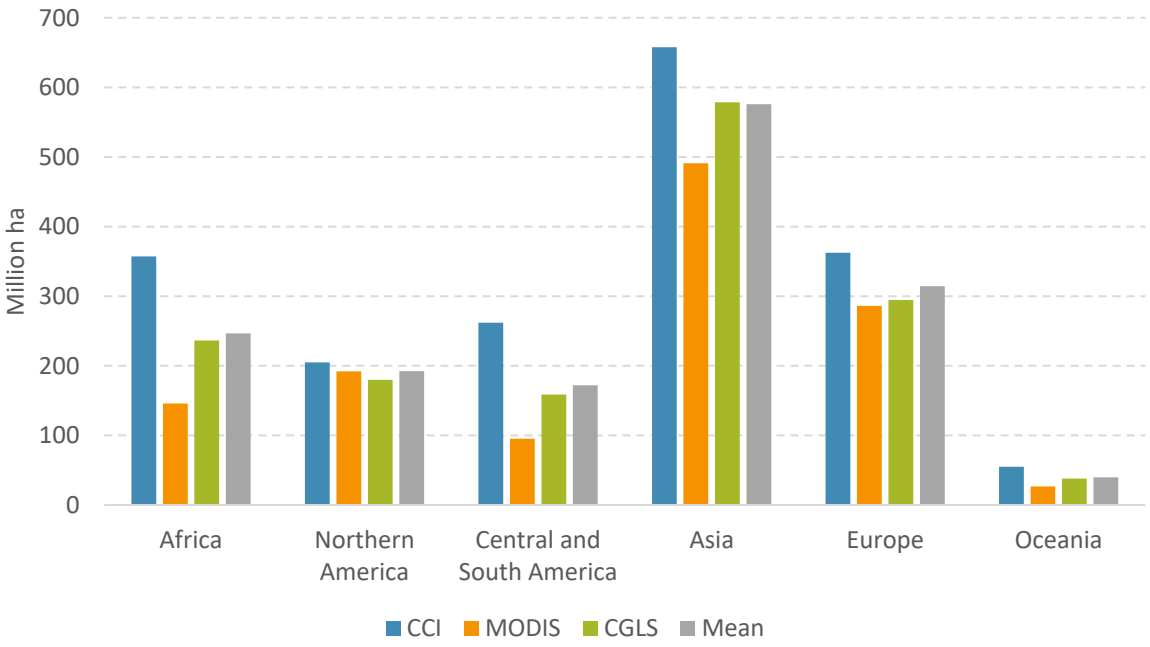


Source: FAO, 2021d.

Looking at the different regions, in 2019 in Central and South America, the regional mean of herbaceous crops was 173 ± 83 million ha. Values varied ranged widely across products, from 100 million ha (MODIS) to 160 million ha (CGLS) and 260 million ha (CCI), resulting in a 48 percent error around the

mean. In Africa, the regional mean was 255 ± 105 million ha. Values varied ranged from 150 million ha (MODIS) to 240 million ha (CGLS) and 360 million ha (CCI) (41 percent error). In Oceania, the regional mean was 41 ± 15 million ha. Values varied ranged from 27 million ha (MODIS) to 40 million ha (GCLS) and 55 million ha (CCI), with a 38 percent error. There was better agreement across land cover products in Asia, resulting in a regional mean of 547 ± 77 million ha. Values varied from 400 million ha (MODIS) to 580 million ha (CGLS) and 660 million ha (CCI), corresponding to a 23 percent relative error. Good agreement was also present for Europe, with an estimated regional mean herbaceous crop cover of 313 ± 38 million ha. Values varied ranging from 290 million ha (MODIS and CGLS) to 360 million ha (CCI) (12 percent error). Northern America was the region with the best agreement between the three land cover datasets, with a regional mean of 190 ± 10 million ha. Here, CCI mapped about 200 million ha of herbaceous crops, MODIS close to 190 million ha and CGLS 180 million ha, with a 5 percent error. The high agreement was likely also due to more precise and consistent validation data available to develop the three land cover products for this region (Figure 4).

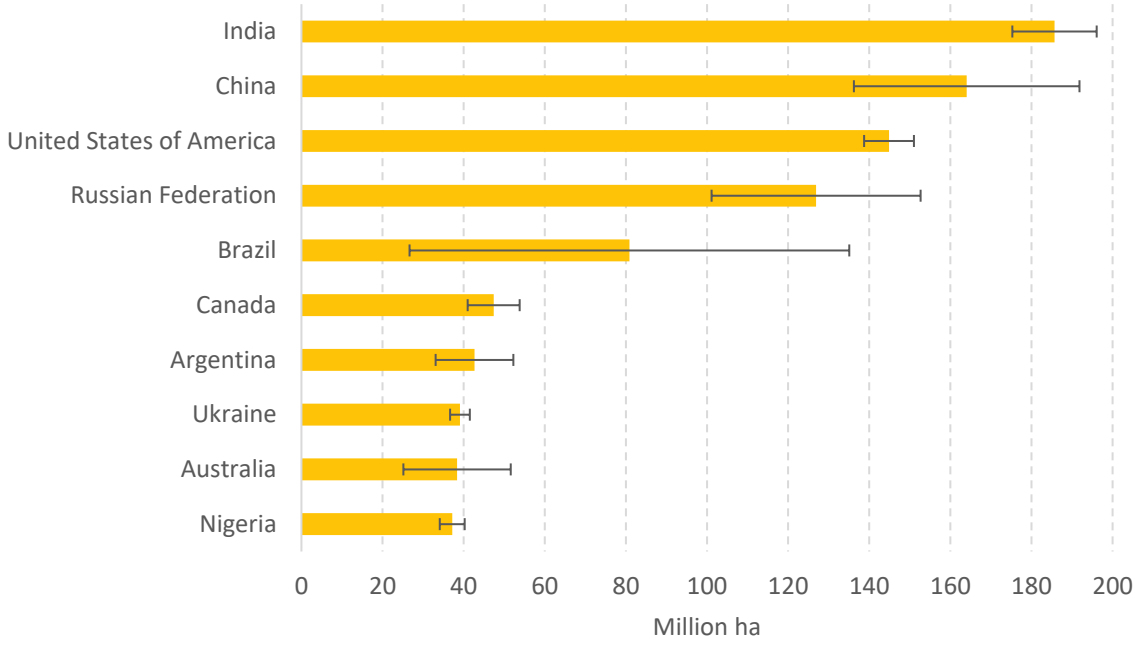
Figure 4: Regional land cover of herbaceous crops by source, 2019



Source: FAO, 2021d.

In 2019, India had the largest mean area of herbaceous crops (190 million ha) (Figure 5). China and the United States of America followed, with respectively 165 and 145 million ha, ahead of the Russian Federation with nearly 130 million ha and Brazil with about 80 million ha. The remaining countries in this ranking (Canada, Argentina, Australia, Ukraine, Australia and Nigeria) ranged between 40–50 million ha each. The countries where the three datasets agreed more closely were the United States of America (4 percent relative error), India and Ukraine (6 percent each). Large variations were found for Brazil (67 percent) and Australia (34 percent), possibly due to the significant heterogeneity of cropping systems in these two countries, spanning a large range of agri-climatic zones and management types. Country case studies are needed to further investigate the reasons for such large discrepancies and thus improve the precision of land cover information.

Figure 5: Top ten countries by mean herbaceous crops area, in 2019



Source: FAO, 2021d.

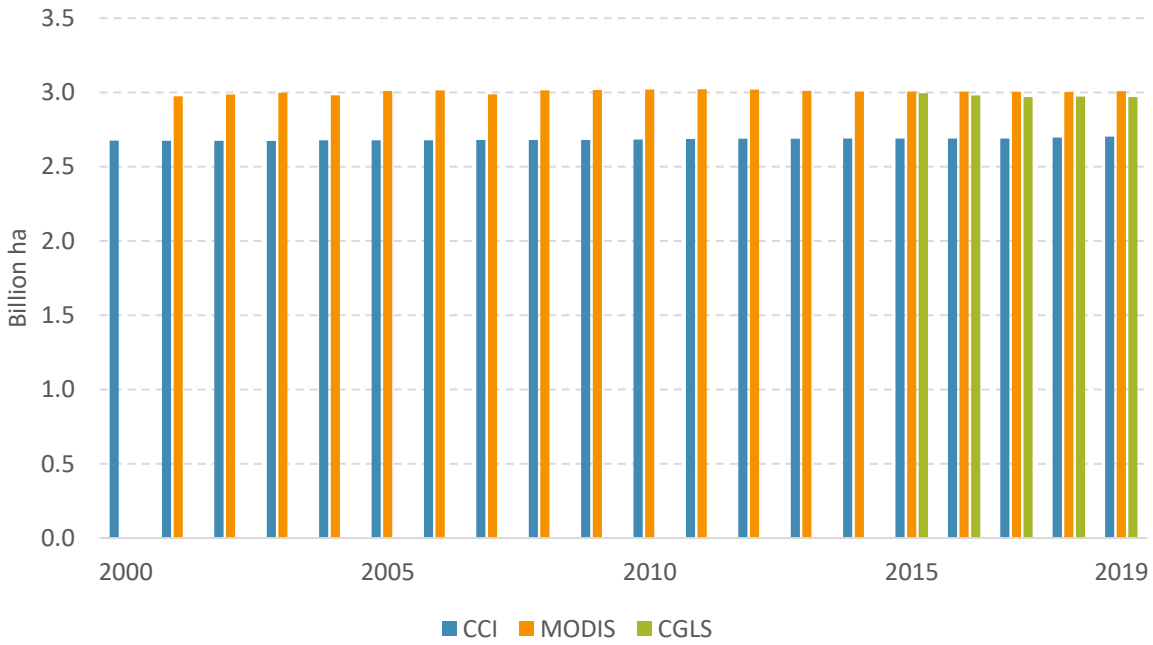
OTHER LAND COVER CLASSES

Grassland and shrub-covered area

In 2019, the global mean grassland land cover area was 2.9 ± 0.15 billion ha. Values ranged between 2.7 billion ha (CCI) and 3 billion ha (MODIS and CGLS) (Figure 6), resulting in a 5 percent error. The overall temporal trends were not significant across the three products.

In 2019, the global mean shrub-land area was 1.4 ± 0.25 billion ha. Values varied ranged from 1.1 (CGLS) to 1.4 (MODIS) and 1.6 (CCI) billion ha (Figure 7), with an error of 18 percent. CCI and MODIS data did not record significant trends for the period 2001–2019, whereas CGLS showed a reduction of about 2 percent during 2015–2019.

Figure 6: Global land cover of grassland by source



Source: FAO, 2021d.

Figure 7: Global land cover of shrub-land by source