

# Monitoring Land cover change

# Why land cover?

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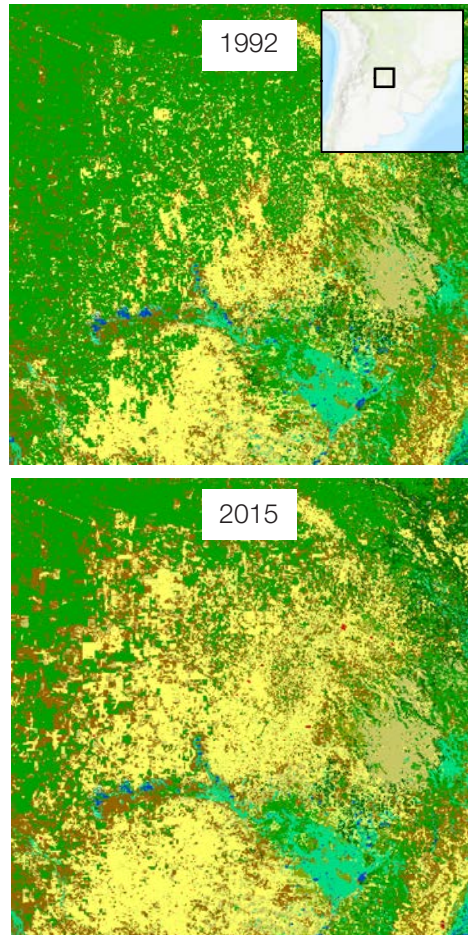
## Measuring land cover change helps monitor pressures on ecosystems and biodiversity.

Loss of biodiversity and pressures on ecosystem services are among the most pressing global challenges. Global biodiversity loss is so intense that it has recently been described as 'biological annihilation'.

Detrimental changes in land cover and land use are the leading contributors to terrestrial biodiversity loss. These changes generally occur slowly, but they are associated with declines in species diversity and populations, and can have a major impact on ecosystems.

Monitoring the various elements of biodiversity at global scales is difficult. However, it is increasingly possible to measure changes in the extent and spatial structure of natural habitats. Land cover change is the best measure currently available to monitor pressures on ecosystems and biodiversity globally.

### Clearance of dry forest in the Argentinian Gran Chaco region



*Note:* Clearance of broad-leaved forest (green) for cropland (yellow) and cattle grazing (shrubland in brown) has occurred on a massive scale.

*Source:* ESA/UCL Geomatics (2017)

# Why now?

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## Advances in Earth observation and data processing improve measurement of land cover changes at the global scale.

Land cover datasets are typically based on observations from satellite-mounted sensors. These sensors record the intensity of reflectance of different wavelengths of the electromagnetic spectrum from the surface of the Earth. The raw data are then processed into analysis-ready intermediate datasets.

Land cover detection is complex. At global scales it requires massive volumes of data and computing capacity. For algorithms to automatically classify land cover types they must be ‘trained’ or programmed to recognise land cover using prepared datasets where the land cover type is already known for a large number of locations.

In recent years, new datasets have been made available that allow for some analysis of changes in land cover consistently at the global scale. These datasets are results of decades of Earth observation missions by different national and supranational space organisations.

The OECD has taken this opportunity to strengthen the information base for its policy analysis. The suite of OECD’s land cover indicators draws on several Earth observation-based datasets. The initial batch of indicators are a first step to improve information on:

- loss and gain of natural and semi-natural vegetated land
- conversions between land cover classes, including conversions to and from cropland and conversion to artificial surfaces
- built-up area growth
- surface water change.



### **Indicators on land cover change are high-level proxies for pressures on terrestrial ecosystems and biodiversity.**

These indicators are state-of-the-art and will likely be further refined. There are limitations inherent to almost all Earth observation-derived information, such as sensitivity to the resolution and classification scheme used, and also limits on what can be remotely observed and automatically classified in practice using the tools and techniques available.

# An OECD Green Growth headline indicator

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**Changes in the biophysical characteristics of natural habitats are the best proxy available to monitor pressures on ecosystems and biodiversity.**

The OECD headline indicator seeks to measure changes from more *natural* to more *anthropogenic* land cover types. This is because at the global scale, natural vegetated areas are critical for the conservation of biodiversity and the provision of ecosystem services.

The headline indicator measures changes in natural and semi-natural vegetated land which is used to identify the less anthropogenic and less intensively used vegetated

land. This broad definition has the advantage of being flexible enough to apply usefully across the Earth's biomes in all their extraordinary diversity.

In its current edition, the headline indicator distinguishes nine broad land cover classes: tree cover, grassland, wetland, shrubland, sparse vegetation – classified as (semi-) natural land – as well as cropland, bare land, inland water and artificial surfaces.



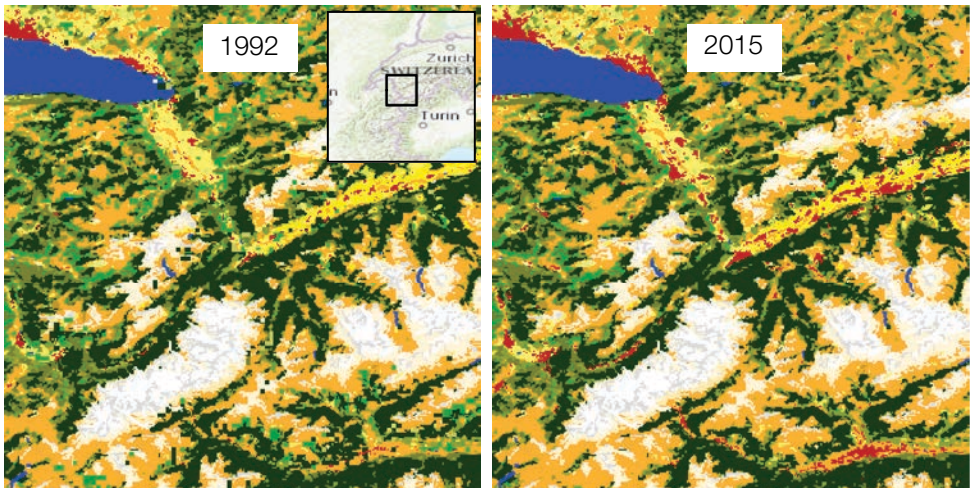
## Monitoring progress towards Green Growth

Our ability to sustain economic and social progress in the long run will depend on our capacity to reduce dependence on natural capital as a source of growth, abate pollution, enhance the quality of physical and human capital and reinforce our institutions. An indicator on changes in land use and land cover has been included in the set of Green Growth headline indicators. They are to be used in the country reviews carried out by the OECD, in policy analyses at national and sub-national level, and in public communication by the OECD.

Read the 2017 report and browse data on <http://oe.cd/ggi>.

## Urbanisation in the Alpine valleys

Land cover change in Haute-Savoie (left), Lake Geneva and Valais (upper left, centre and right) and Aosta (lower-right) regions of France, Switzerland and Italy. Urbanisation (red) of cropland (yellow) and grassland (orange) is widespread.



Source: ESA/UCL-Geomatics (2017)

### NOTE

**This indicator measures quantity (the area converted), not quality or value.** It cannot distinguish between the loss of habitats with high biodiversity value (e.g. primary tropical forests) and with lower value (e.g. some commercial forestry). Furthermore, it does not capture degradation of the land if the class remains the same. Future work will attempt to better identify sensitive ecosystems where supported by available data at the global scale.

# Loss and gain of natural and semi-natural areas

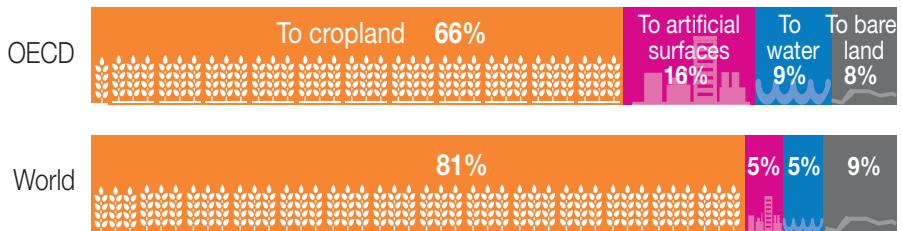
**OECD and G20 countries continue to convert land from its more natural state to more anthropogenic systems, with potentially harmful impacts on biodiversity and ecosystems.**

Worldwide, 2.7% of (semi-)natural vegetated land has been lost to other land cover types since 1992. This represents an area twice the size of Spain.

- OECD and G20 countries account for over half of this loss, which occurs primarily in Brazil, the People's Republic of China, the Russian Federation, the United States and Indonesia.
- The gap between (semi-)natural land gain and loss for OECD and G20 countries is approximately the area of France: 636 000 km<sup>2</sup>
- Among OECD countries, from 1992 to 2015, the most intense losses of (semi-)natural land have occurred in Korea and Israel.

## Most natural and semi-natural land is converted to cropland

Loss of natural and semi-natural vegetated land by cover type, 1992-2015



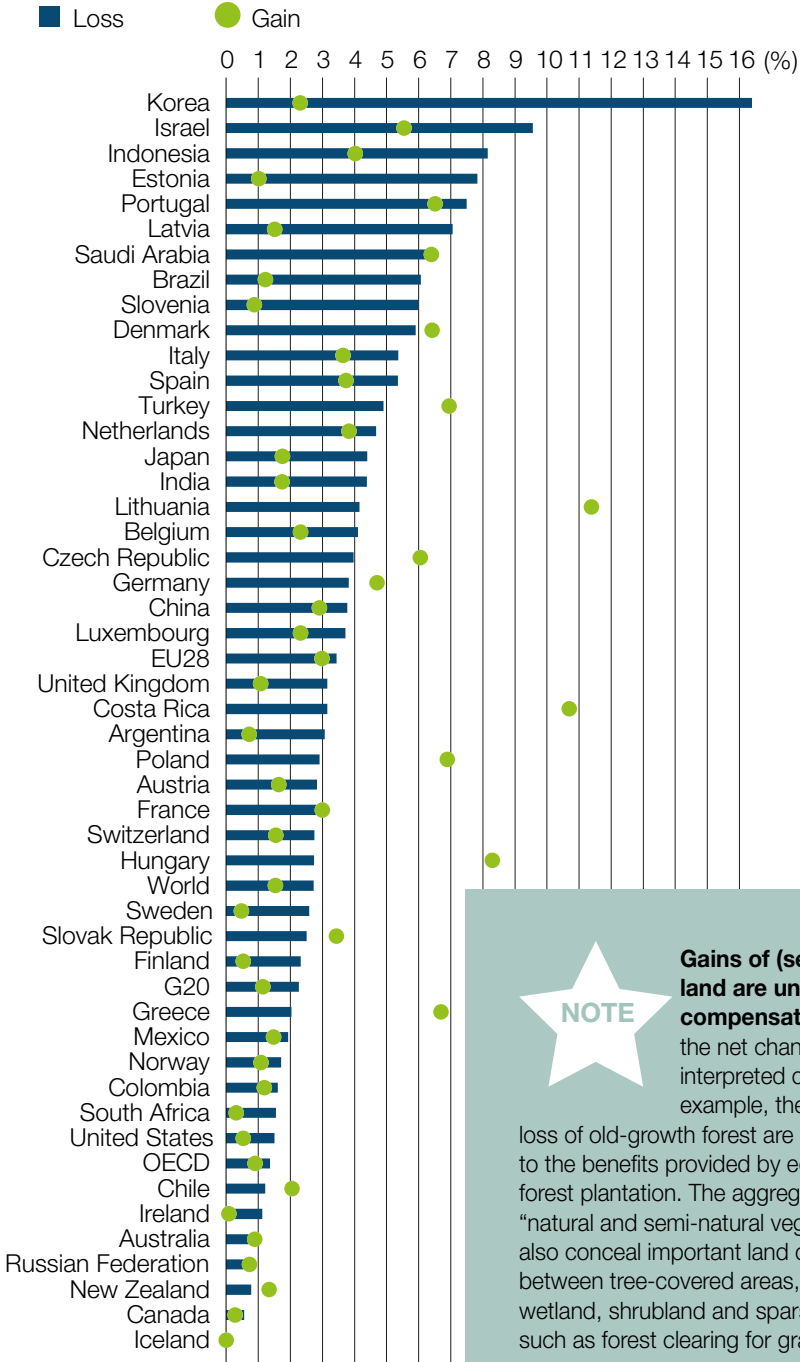
The headline indicator is based on data from the **Climate Change Initiative Land Cover** project, lead by the European Space Agency.

These datasets provide information on change between land cover types.

They aim to provide a harmonised, stable and consistent account of long-term land cover status and changes that is 'immune' to short-term seasonal and temporary changes (e.g. snow cover in winter, crop rotation, forest burn scars).

This data product has been developed to support climate modelling and contribute to the Global Climate Observing System.

## Loss and gain of natural and semi-natural vegetated land, 1992-2015



**Gains of (semi-)natural land are unlikely to compensate for losses:**

the net changes should be interpreted carefully. For example, the costs of the loss of old-growth forest are not comparable to the benefits provided by equally sized new forest plantation. The aggregated category of “natural and semi-natural vegetated land” can also conceal important land cover conversions between tree-covered areas, grasslands, wetland, shrubland and sparse vegetation, such as forest clearing for grazing.

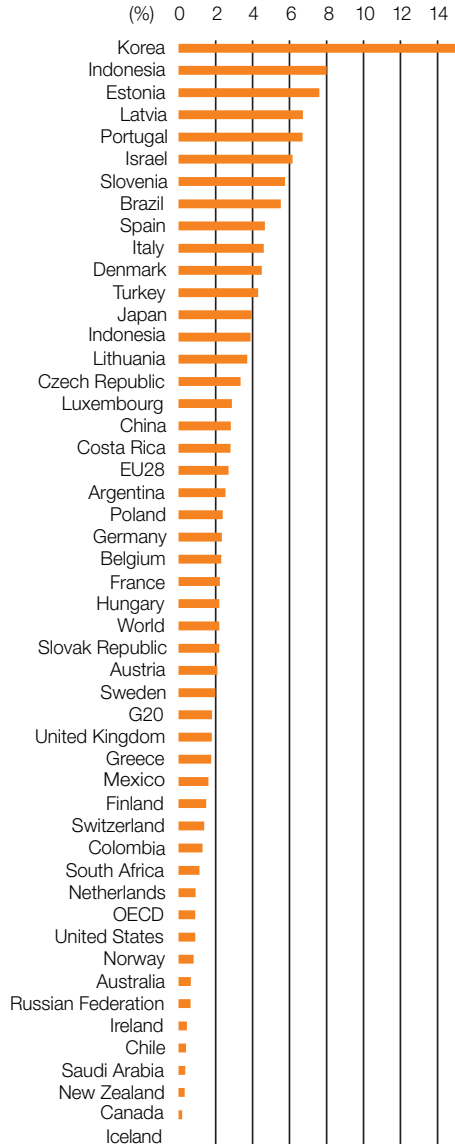
# Agricultural expansion

## Agricultural expansion is the main driver of natural and semi-natural land loss.

Losses in (semi-)natural vegetated land are most often due to conversions to cropland. Of OECD countries, Korea, Estonia, Latvia and Portugal saw the most intense conversions to cropland.

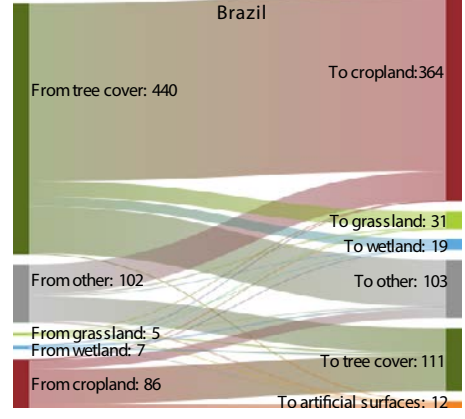
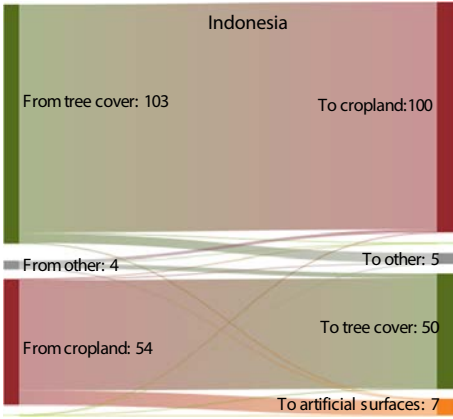
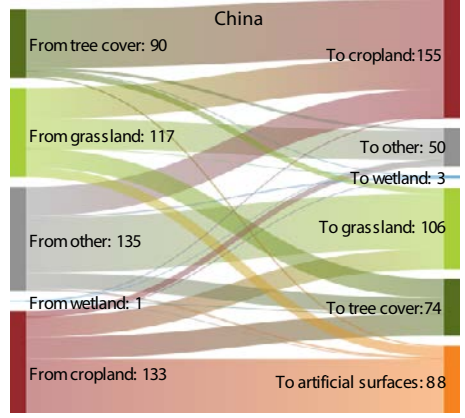
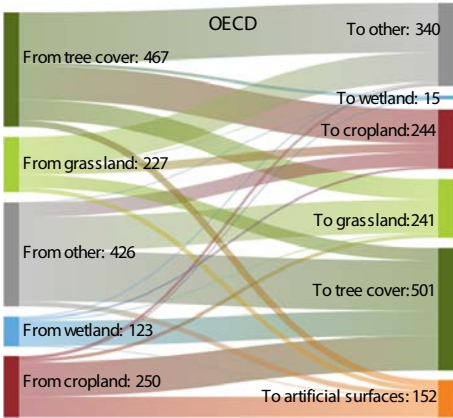
In most countries, new cropland is converted primarily from tree-covered areas but conversions from grassland and shrubland are important in some countries. In some cases the change may be due to re-cultivation of previously abandoned agricultural land.

## Conversions of (semi-)natural vegetated areas to cropland, 1992-2015 (% 1992)





**Patterns of land cover change 1992-2015, thousand km<sup>2</sup>**



**Some conversions from “natural” areas to agricultural land may be beneficial.** For example, some types of traditional farmland provide essential habitats for birds and may have higher biodiversity than some tree-covered areas. The observed conversions from wetlands do not necessarily represent the loss of, for example, Ramsar-type wetland like marshes, peatlands, floodplains, saltmarshes, mangroves, intertidal mudflats, etc.

# Urbanisation

**Urban expansion is another major driver of land cover change. Construction of buildings and other artificial surfaces contributes to the loss of sensitive ecosystems and fragmentation of natural habitats.**

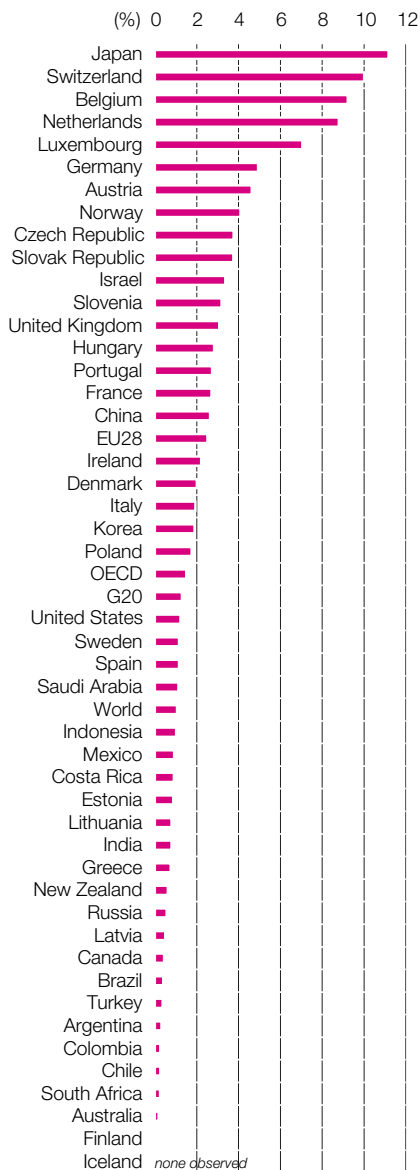
Most new artificial surfaces are built on cropland, with the exception of a handful of countries where development mostly takes place on tree-covered areas, grasslands or shrubland.

In addition to the pressures on biodiversity caused by the loss of farmland and the associated natural habitats, conversions to artificial surfaces involve soil sealing, which irreversibly degrades soil and increases flood risk. Air, noise and light pollution and decreasing access to extra-urban green space affect quality of life.

Among OECD countries, Japan, Switzerland, Belgium, the Netherlands, and Luxembourg saw relatively large conversions from cropland to artificial surfaces.

*Note:* Cropland does not include pasture land, so the total 'lost' agricultural land may be larger.

**Conversions from cropland to artificial surfaces, 1992-2015**  
(% of 1992 cropland)



**Globally, an area the size of the United Kingdom (244 000 km<sup>2</sup>) has been converted to built-up areas since 1990.**

Built-up area in thousand km<sup>2</sup> in 2014 and new constructions since 1990.



**The Global Human Settlement Layer** developed by the European Commission's Joint Research Centre complements the headline indicator with more detailed information on built-up areas – their extent and change over time. This dataset allows for a more accurate mapping of human populations.

Built-up areas mean presence of buildings, where a building is defined as any roofed built-up structure. This definition excludes other parts of urban environments such as paved surfaces (roads, parking lots), commercial and industrial sites (ports, landfills, quarries, runways) and urban green spaces (parks, gardens). The measured area is smaller than “urban area” defined in broader land use terms.

# Surface water change

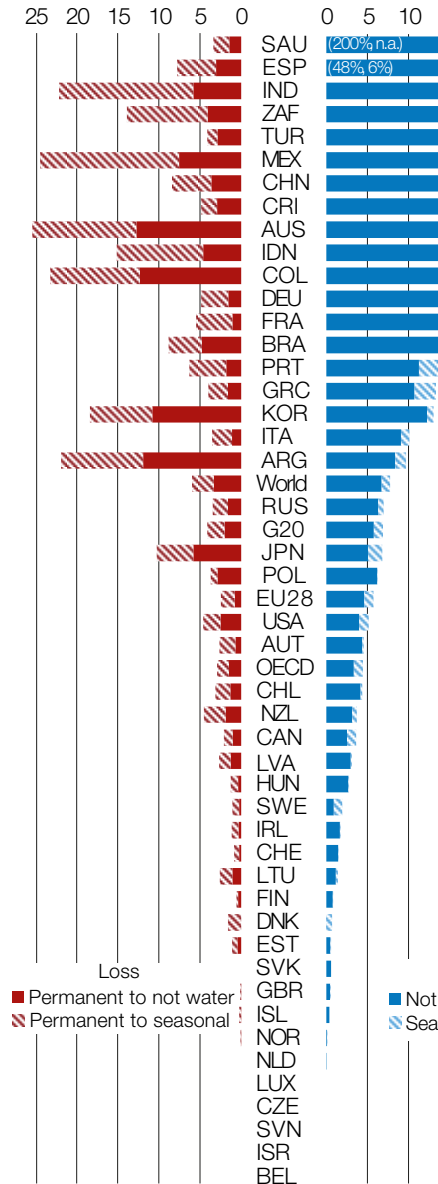
Globally, since 1984, around 180 000 km<sup>2</sup> of land was inundated, mainly through dam-building, with significant consequences on freshwater ecosystems. During the same period, 90 000 km<sup>2</sup> (the area of Portugal) of surface water was lost through drought and unsustainable abstraction for irrigation.

Damming is known to be one of the most important anthropogenic impacts on freshwater ecosystems. Dams fragment river systems and potentially block migration routes, leading to the loss of megafauna. They change the downstream flooding patterns and sediment deposition leading to the loss of floodplains, riparian zones and wetlands. Global dam building is booming with thousands of major projects planned, including a large number in biodiverse locations like the Amazon basin. Dam-building seemed notably intense and extensive in India, China and Brazil.

Globally, surface water loss has been most extensive and most intense in Central Asia where it was (and continues to be) driven by droughts, river diversion and abstraction. Elsewhere, losses are often caused by long-term droughts.

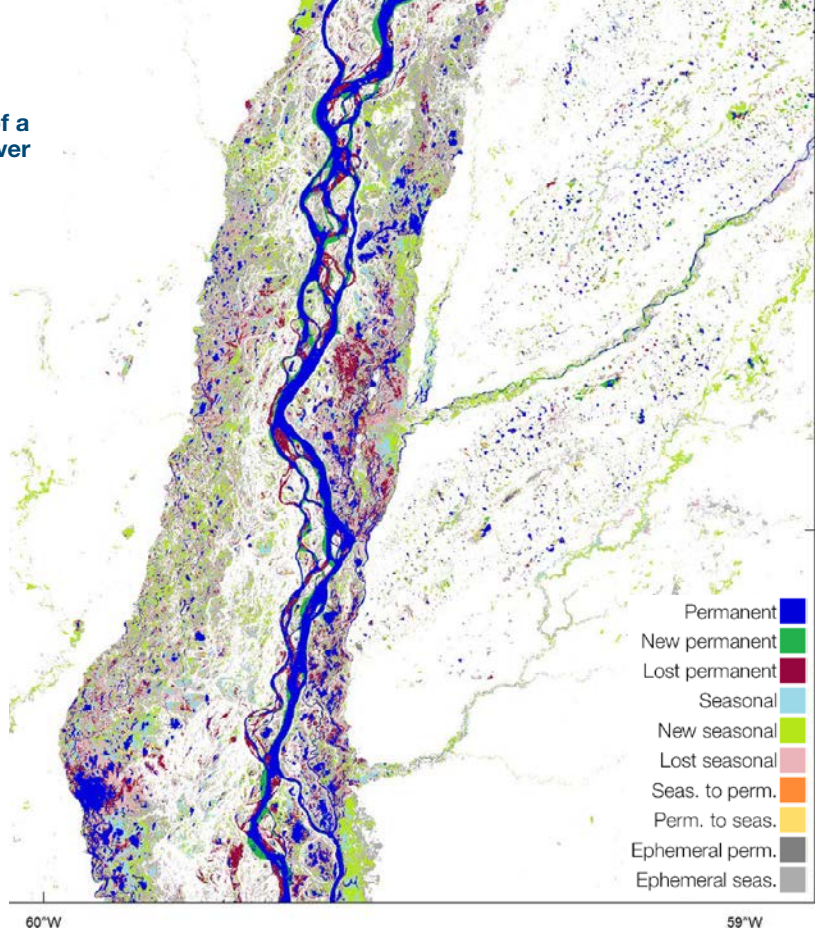
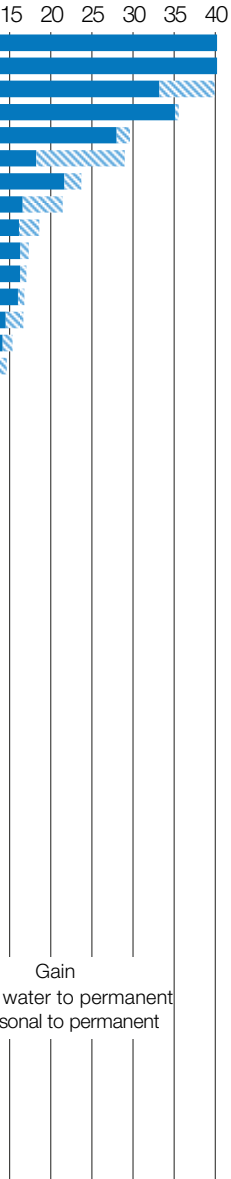
It is important to note that both surface water losses and gains can be detrimental to biodiversity and ecosystems.

Permanent surface water change, 1984-2015 (%)



Note: 1984-2015 change as share of 1984 permanent surface water

## Surface water change of a section of the Paraná river in Argentina, 1984-2015



Source: Pekel et al. (2016)



**The Global Surface Water Change**, a project of the European Commission's Joint Research Centre, documents different facets of surface water state at a 30m resolution globally. This unprecedentedly rich dataset provides information on water occurrence, recurrence, seasonality, water change intensity and transitions.

Permanent surface water is defined as areas that were water for every month of the reference year. Seasonal surface water is defined as areas that were water for 1 to 11 months of the reference year. These data refer only to water surface area, they do not estimate the volume of water gained or lost.

# Next steps

- The suite of OECD land cover indicators presented here show initial results from several global land cover mapping efforts. The indicators allow, for the first time, some comparison of changes across a range of land cover types at the global scale in a consistent manner. This is a major advance compared to what was previously possible.
- The indicators will be complemented, or superseded, as new datasets become available in the future, potentially, those developed for the Global Biodiversity Observing System to measure a set of Essential Biodiversity Variables (EBV).
- Insights into the extent and changes in land fragmentation could be developed. Methodologies have been established, but it is not clear whether available data could support a global indicator. Development of a habitat fragmentation indicator at the global scale would be a valuable extension.

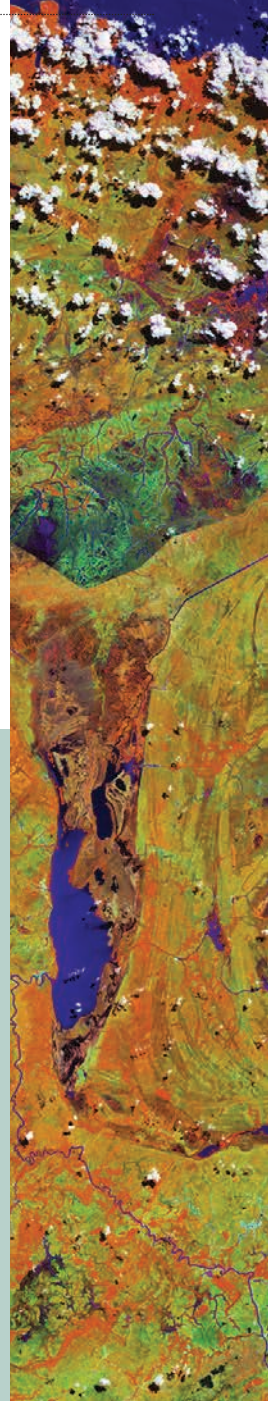
## Monitoring land cover change globally can support countries in their efforts to measure progress towards the United Nations' Sustainable Development Goals, the Aichi Biodiversity Targets and other international targets

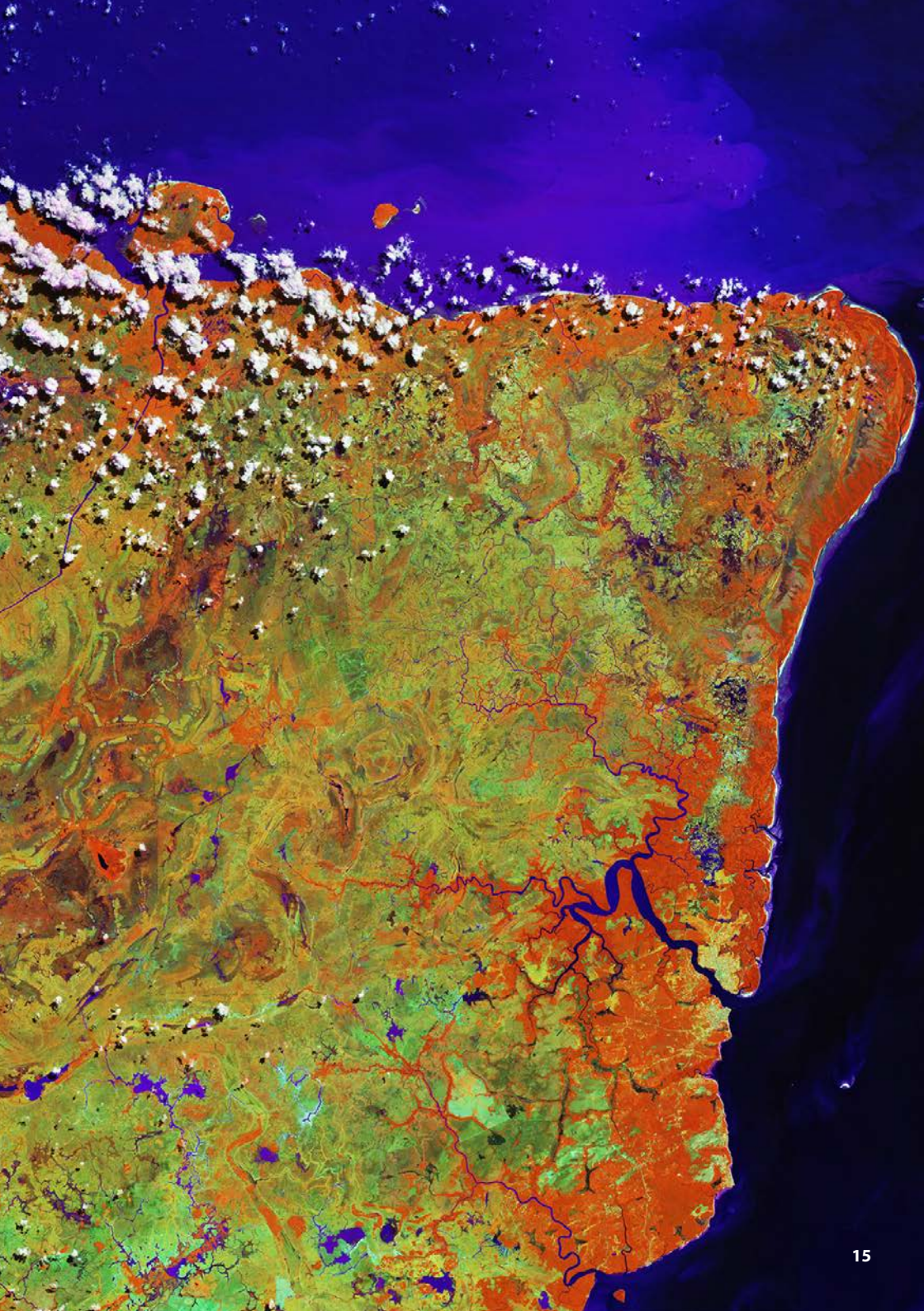


**Aichi target 5:** By 2020, the rate of loss of all natural habitats, including forests, is at least halved and where feasible brought close to zero, and degradation and fragmentation is significantly reduced. See also target 15.



**Sustainable Development Goal 15:** Protect, restore, and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss. See also Goals 6 and 11.





Loss of biodiversity and pressures on ecosystem services are global challenges.

Land cover change is the best measure available to monitor pressures on terrestrial ecosystems and biodiversity. The OECD is developing new indicators on land cover changes and conversions.

*Work on land cover change indicators is in progress. Read the full working paper and browse the data:*

**<http://oe.cd/land-cover>**

## CONTACT

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BETTER POLICIES FOR BETTER LIVES

April 2018