Individual Visualisation Example, Student Number: 25153376

Land pressure under population growth: Exploring cropland dynamics at the global scale

Overview

This visualisation explores the tension between agricultural and urban expansion. By linking national population trajectories with cropland extent, it allows users to identify countries where growth may be placing disproportionate pressure on productive land systems between the years 1990 and 2023. While the visualisation does not map urban expansion directly, cropland extent is used as a proxy to explore land-use pressure associated with demographic growth at the global scale. It combines a global map of cropland classes with interactive time series charts for population and agricultural land, enabling users to identify potential spatial patterns. The project contributes to broader discussions in urban and regional studies around food systems, land-use pressure and sustainability in the context of long-term global change.

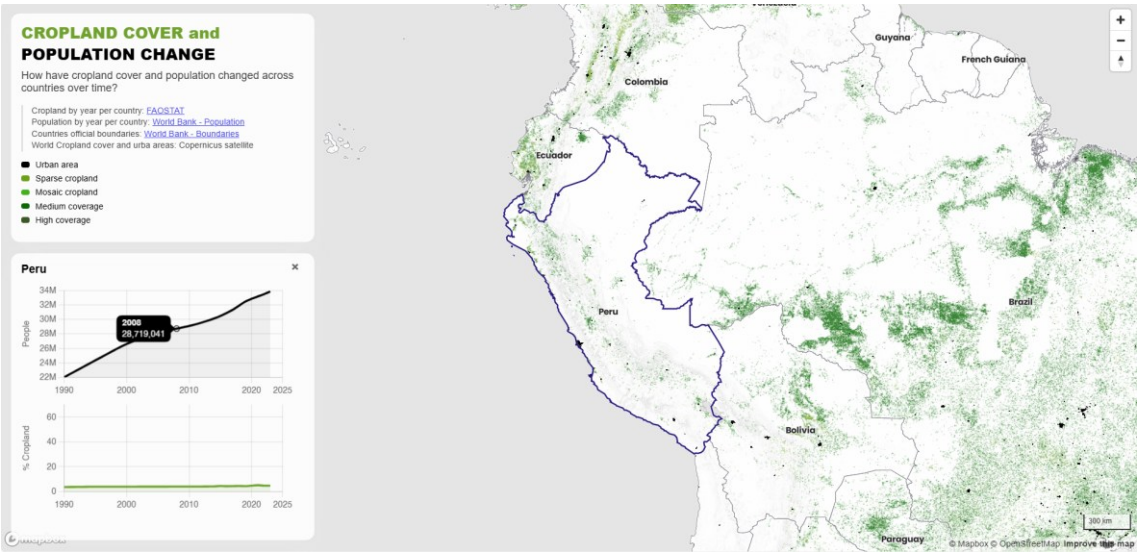

Figure 1: Cropland cover and population growth interactive map

Technical Aspects

The visualization integrates a series of open-source datasets:

- Population data from the World Bank, for annual national population estimates.
- Cropland data from FAOSTAT, for total area, which was then transformed into percentage per area, at the national level across the same time period.

- Administrative boundaries from a global country boundary dataset for spatial reference and visualization.
- Additionally, urban areas and cropland extent layers from Copernicus Global Land Cover (from Sentinel satellite at a resolution of approximately 100 metres) were used to provide additional context regarding land use.

The period between 1990 and 2023 was selected because of the significant technological change since 1990, which strongly influenced how societies interact with the environment. The year 2023 was chosen as the end point as it is the most recent year for which data were consistently available across all datasets.

The data was cleaned and spatially joined in RStudio using country codes as unique identifiers followed by a name standardization. Countries represented by multiple geometries were merged into a single feature to ensure spatial consistency, while countries with missing values were retained in the final visualization and explicitly labelled as "NO DATA" according to the affected variable. All spatial data were reprojected to WGS84 to ensure web compatibility and exported as GeoJSON.

Cartographic Aspects

The visualization was created using Mapbox for the map component and JavaScript for the time-series charts. Cartographic design combines temporal charts linked to a global map view in equirectangular projection to avoid shape deformation. Before users interact with the map, a welcome page is used to introduce the topic and interaction logic.

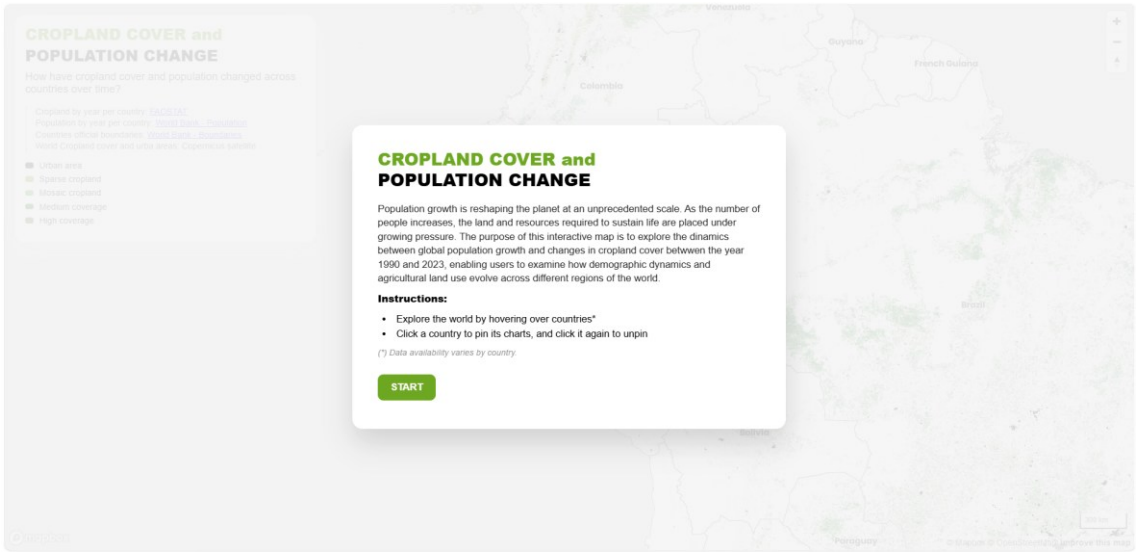

Figure 2: Cropland cover and population growth interactive map – welcome page

The map presents a raster image of cropland cover classified in standardized categories (Copernicus Global Land Service, 2023) and urban areas for an immediate spatial overview of agricultural land distribution. A monochrome and light colored basemap was deliberately selected to prioritize the green and black thematic layers and ensure

proper contrast, reinforcing their role as the primary explanatory layer rather than background context.

Hovering over a country provides immediate feedback, while clicking on a country “pins” and “unpins” the selection and updates the charts. This interaction supports both exploratory browsing and focused comparison, allowing users to move between global patterns and individual national trajectories without losing spatial context.

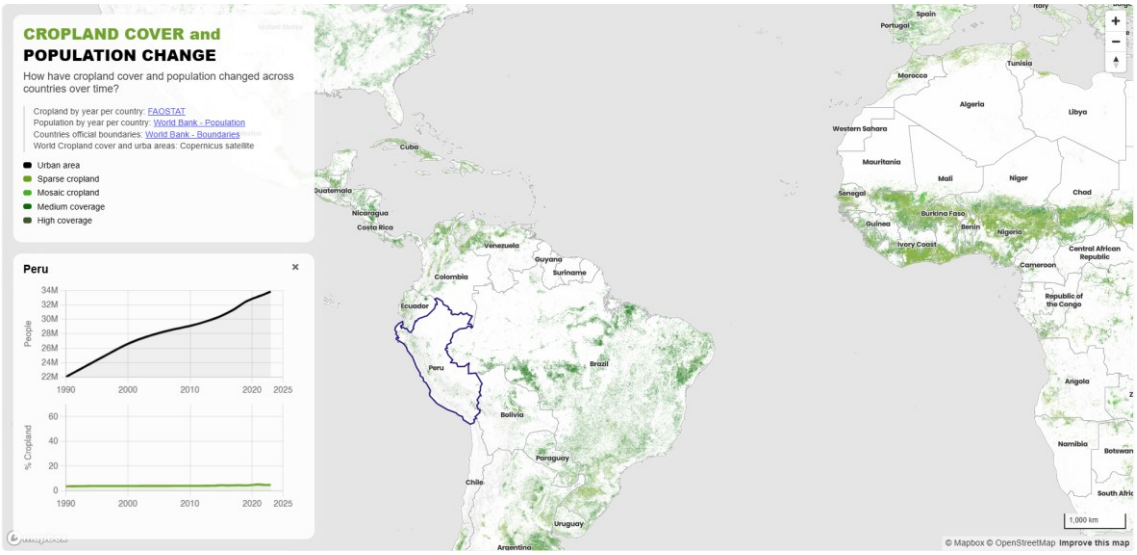

Figure 3: Cropland cover and population growth interactive map – Selected country in context

Zoom levels were constrained to support a global, country-focused analysis. The selected zoom range still allows major urban areas to be visible for additional spatial context without shifting the focus away from national patterns.

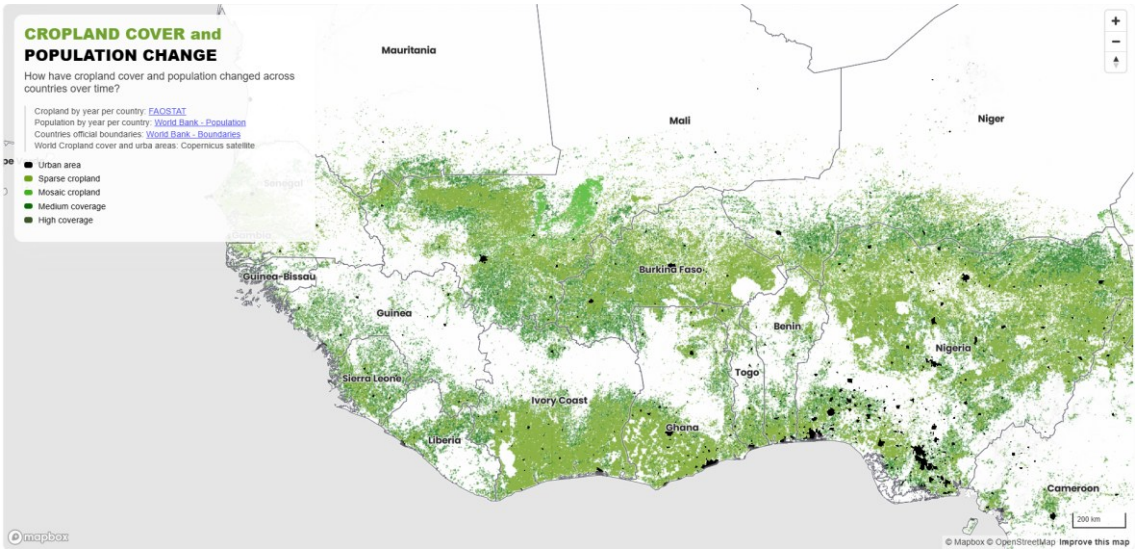

Figure 4: Cropland cover and population growth interactive map

Limitations and Improvements

Data availability varies across countries and years, with some presenting missing values and limiting direct comparison and continuity of time-series analysis. In addition, the

analysis relies on national-level data, which can hide internal variation, particularly in rapidly urbanising countries where cropland loss is often concentrated in peri-urban regions. Cropland definitions may also differ across datasets and over time, affecting consistency.

Future improvements could include:

- Normalizing cropland by population for a more direct comparison.
- Allowing side-by-side country comparisons or indexed charts.
- Adding complementary indicators such as yield, food imports, or urban expansion.
- Integrating multi-scalar analysis with higher spatial resolution land cover data to enable local-scale exploration, while maintaining the current global perspective.

The visualisation is exploratory and descriptive and does not establish causal relationships between population growth and changes in cropland.

References

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