Data Model for the Huerta de Borboto (Valencia):

GIS Integration, Environmental Indices and Accessibility Analysis

Universitat Politecnica de Valencia (UPV) | Advanced GIS Technical Review

ABSTRACT
This technical review presents a GIS data model developed for the Huerta de Borboto, in Valencia. The work integrates cadastral information, agricultural parcel data, land-use layers, orthophotos, hydrography, transport networks, public transport stops, and water-source data into an ArcGIS Pro geodatabase. It also applies Sentinel-2 image processing in Google Earth Engine to calculate NDVI, NDWI, and NDMI indicators, then uses ArcGIS Pro to analyse seasonal vegetation dynamics, soil-water conditions, erosion risk, public-transport proximity, and road accessibility for buildings. The result is a structured territorial database designed to support agricultural protection, environmental diagnosis, and planning decisions in the Huerta landscape.

1. OBJECTIVE AND TERRITORIAL CONTEXT

The project aims to design a geospatial data model for the Huerta de Borboto, a protected agricultural area within the municipality of Valencia. The work focuses on organising official spatial data into a coherent geodatabase and converting it into useful information for territorial analysis.

Borboto forms part of the Huerta Protection Plan area. The scanned report identifies the zone as protected agricultural land, with restrictions on urban expansion and a planning focus on preserving agricultural function, landscape value, and rural connectivity.

2. DATA ACQUISITION

The workflow compiles official datasets from cadastral, agricultural, environmental, imagery, transport, and municipal sources. These layers were used as raw inputs for the geodatabase and later processed to create analysis-ready information.

Source layer	Main contribution to the model
Cadastre	Parcel limits, cadastral reference, parcel area, rural or urban classification, crop type and productivity intensity.
SIOSE AR	High-resolution land-cover and land-use information for the study area.
SIGPAC	Agricultural parcel data, crop information, irrigation status, and slope-related attributes.
COSCV	Land-cover and land-use classification from the Valencian regional system.
PNOA	High-resolution orthophotos used for visual interpretation and spatial checking.

Source layer	Main contribution to the model
Hydrography and transport layers	Water features, road networks, tracks, lanes, and transport infrastructure.
Municipal open data	Public transport stops and water fountains used for proximity/accessibility analysis.

> *The value of the project is not only the number of layers collected. Its strength is the conversion of scattered official datasets into one operational model for analysis and decision support.*

3. CADASTRAL PROCESSING AND GEODATABASE DESIGN

The cadastral component was processed in two parts. Graphic parcel data were downloaded and prepared in QGIS, while alphanumeric data were obtained from the Cadastre electronic office. The Type 17 table was filtered to retain the crop, productive-intensity, and cadastral-reference fields needed for the model.

Graphic and alphanumeric information were integrated through cadastral references. Duplicate records were checked, parcels with the largest surface were retained where needed, and the final parcel layer was exported for processing in ArcGIS Pro.

Geodatabase element	Role
RawData	Stores original imported datasets with minimal modification.
Edicion	Contains intermediate layers created during clipping, selection, topology correction, and cleaning.
Base	Holds the final processed model ready for analysis, mapping, and export.
Domains	Standardise land-cover, crop, irrigation, hydrological, SIGPAC, and transport values.

4. TOPOLOGY, DATA CLEANING AND FINAL MODEL

The ArcGIS Pro workflow applies clipping, buffering, parcel selection, topology rules, and spatial joins. These operations reduce inconsistencies between layers and keep the analysis focused on the Borboto study area.

The topology rules target common geometric errors. Parcel coverage is checked to avoid internal gaps and overlaps, while hydrography is constrained to remain inside the study area. Additional cleaning steps solve intersections, redundant polygons, and duplicated attributes.

Operation	Purpose
Clip and buffer	Restrict external datasets to the study area and its relevant spatial context.
Select by attributes	Separate rural parcels, urban parcels, cultivable parcels, and irrigation-related subsets.
SNAP and eliminate	Correct geometric gaps, intersections, and small redundant polygons.
Spatial join	Attach alphanumeric information from multiple sources to polygon features.
Domain assignment	Improve consistency by limiting attributes to valid categorical values.

5. REMOTE SENSING AND ENVIRONMENTAL INDICES

The image-analysis component uses Google Earth Engine to process Sentinel-2 Surface Reflectance imagery. The workflow applies cloud filtering, masks clouds with the QA60 band, calculates NDVI, NDWI, and NDMI, and creates monthly or seasonal composites for the years analysed.

Index	Main interpretation in the review
NDVI	Vegetation vigour and photosynthetic activity. Higher values are linked to active or dense vegetation.
NDWI	Water content and surface-moisture behaviour. It complements NDVI by highlighting water availability patterns.
NDMI	Vegetation moisture condition. It helps detect moisture stress and seasonal crop-water variation.

The indices were imported into ArcGIS Pro for raster calculation, reclassification, zonal statistics, and seasonal comparison. The report shows that winter values are generally low for NDVI, spring values increase with vegetative growth, summer values depend strongly on irrigation, and autumn reflects the end of many crop cycles.

6. SEASONAL VEGETATION AND WATER DYNAMICS

Seasonal NDVI maps reveal strong contrasts between agricultural parcels, urban areas, and non-vegetated surfaces. Spring and summer show the most visible spatial variability, while winter values remain lower for many agricultural parcels.

NDWI maps complement NDVI by showing soil and vegetation moisture behaviour. Higher values appear in cultivated or irrigated zones during wetter periods, while lower values occur where urban cover or dry surfaces dominate.

7. EROSION RISK ASSESSMENT

The erosion analysis selects cultivable parcels and normalises the variables used to describe erosion sensitivity. The model combines slope, irrigation status, and land-use classification into a single index.

> ***Erosion Index*** *= 0.4 x normalised slope + 0.3 x normalised irrigation + 0.3 x normalised classification*

Slope receives the highest weight because it has the strongest physical influence on runoff and soil loss. Irrigation and crop classification receive equal lower weights because they affect vegetation cover, soil moisture, and the probability of erosion under agricultural use.

Variable	Weight	Interpretation
SIGPAC slope	0.4	Greater slope increases runoff and erosion susceptibility.
Irrigation status	0.3	Water-management conditions influence moisture and soil stability.
Cadastral classification	0.3	Crop or land-use type affects vegetation cover and water demand.

8. ACCESSIBILITY AND PUBLIC TRANSPORT PROXIMITY

The accessibility analysis evaluates how Borboto connects to public transport and road infrastructure. Public transport proximity was assessed through buffers of 20, 50, 100, 500, 1,000, and 2,000 metres around metro and bus stops.

At 500 metres, the report identifies no existing stops directly covering the settlement. At 1,000 metres, planned stops begin to improve coverage. At 2,000 metres, the analysis identifies a total of 18 metro and bus stops, including 15 metro stops and 3 bus stops.

Building-to-road accessibility was analysed with the Near tool. The 146 buildings evaluated were classified according to distance to the nearest road: less than 20 m, between 20 and 50 m, and more than 50 m.

Distance to nearest road	Buildings	Interpretation
Less than 20 m	132	Good direct accessibility.
20 to 50 m	13	Intermediate accessibility.
More than 50 m	1	Potential accessibility limitation.

9. RESULTS AND PLANNING VALUE

The final model acts as a structured territorial information system. It links official land-use data with environmental indicators and accessibility metrics, creating a base for diagnosis, monitoring, and planning in the protected Huerta landscape.

The most relevant outputs are the erosion index, seasonal vegetation and water maps, public-transport proximity analysis, building-road accessibility analysis, and integrated protection layers for the Huerta Protection Plan area.

> *The model should be used as a planning and diagnostic tool. It does not replace field knowledge, but it helps decide where detailed review, maintenance, or protection actions should be prioritised.*

10. CONCLUSIONS

The project demonstrates that a well-designed geodatabase can transform dispersed official spatial datasets into a coherent territorial model for Borboto. The approach improves data organisation, supports spatial analysis, and creates a practical basis for sustainable planning.

Remote sensing adds temporal information that static land-use databases cannot provide. NDVI, NDWI, and NDMI help interpret seasonal vegetation activity, water conditions, and potential stress patterns in agricultural parcels.

The accessibility and erosion analyses show how the data model can support applied decisions. It can identify parcels exposed to erosion risk, evaluate public transport coverage, assess building access to roads, and strengthen the management of a protected agricultural area.

11. REFERENCES AND FURTHER READING

Dirección General del Catastro. Cadastral data services and electronic office. https://www.catastro.hacienda.gob.es

Centro Nacional de Información Geográfica. PNOA, SIOSE and national geospatial data services. https://www.cnig.es

Institut Cartogràfic Valencià. Valencian territorial and cartographic data services. https://icv.gva.es

SIGPAC. Agricultural parcel information system. https://www.mapa.gob.es/es/agricultura/temas/sistema-de-informacion-geografica-de-parcelas-agricolas-sigpac/

Google Earth Engine. Cloud-based geospatial analysis platform. https://earthengine.google.com

Copernicus Data Space Ecosystem. Sentinel data access. https://dataspace.copernicus.eu

Esri ArcGIS Pro. GIS desktop software for geodatabase management and spatial analysis. https://www.esri.com/en-us/arcgis/products/arcgis-pro/overview

Keywords: GIS · ArcGIS Pro · Geodatabase · Huerta de Borboto · Sentinel-2 · NDVI · NDWI · NDMI · Erosion Index · Accessibility · Territorial Planning