Geospatial Vulnerability Assessment of the Huerta de Valencia

Agricultural Fragmentation, Urban Pressure and Priority Areas for Protection

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ABSTRACT
This technical review summarises a GIS-based assessment of the Huerta de Valencia using 24 landscape units from the regional Huerta Protection Plan. The method integrates three dimensions: agricultural fragmentation, urban pressure, and adaptive capacity. Fragmentation is described with eight landscape metrics; urban pressure combines land artificialisation between 2006 and 2024 with linear infrastructure; and adaptive capacity combines slope, summer soil moisture, and proximity to the irrigation network. The three components are normalised and integrated into a territorial vulnerability index to identify sectors requiring greater protection, management, or improvement.

1. OBJECTIVE AND STUDY AREA

The objective is to compare the territorial condition of the Huerta de Valencia and identify internal differences in agricultural fragmentation, urban pressure, adaptive capacity, and final vulnerability. The analysis uses the **landscape units defined by the PAT** as common spatial units, allowing direct comparison across the protected peri-urban agricultural system.

Figure 1. Study area in the metropolitan environment of Valencia. Source: Akhbour (2026), own elaboration.

> **Study scale:** approximately 23,000 ha across 40 municipalities. The Huerta is a protected peri-urban irrigated landscape structured by historic irrigation networks and exposed to intense metropolitan land-use pressure.

2. DATA SOURCES

Dataset	Source / date	Role in the analysis
Landscape units	PAT Huerta de Valencia	Common analysis units and territorial framework
Agricultural parcels	SIGPAC 2025	Agricultural surface and patch structure
Imperviousness Density	Copernicus 2006 / 2024	Detection of new artificialised surfaces
Land cover / land use	Generalitat Valenciana	Agriculture-vegetation, water, artificial classes
Hydrography	CNIG	Irrigation canals and ditches for proximity analysis
Road and railway network	CNIG	Linear infrastructure pressure and intersections
Digital Terrain Model	MDT05	Slope calculation
Soil Water Index	Copernicus, summer 2025	Mean soil-moisture condition

3. INTEGRATED GIS WORKFLOW

The workflow first prepares the official spatial datasets and then develops three analytical blocks. Each block is normalised so that the resulting values can be compared across landscape units. The final vulnerability assessment integrates exposure, sensitivity, and adaptive capacity.

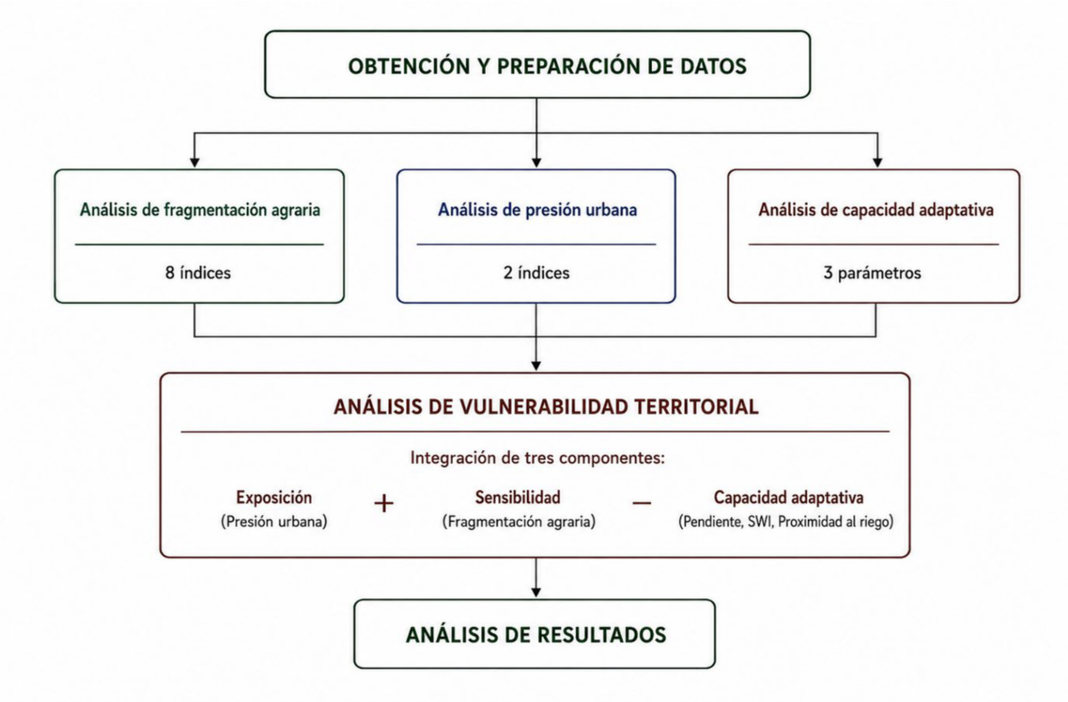


Figure 2. General methodological workflow. Source: Akhbour (2026), own elaboration.

Vulnerability framework

IV = IF + IPU - ICA

IF represents agricultural fragmentation (sensitivity), IPU represents urban pressure (exposure), and ICA represents adaptive capacity. Higher IF and IPU increase vulnerability, while higher ICA reduces it.

4. AGRICULTURAL FRAGMENTATION

Agricultural fragmentation is evaluated with eight landscape metrics. The metrics capture complementary properties of the agricultural mosaic: relative agricultural area, patch density, edge complexity, mean patch size, physical cohesion, interspersion, landscape division, and aggregation.

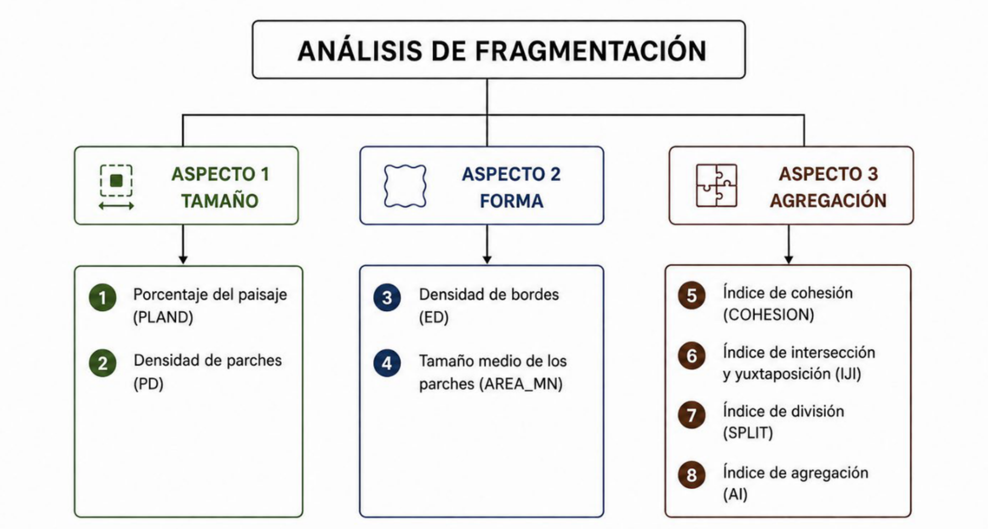


Figure 3. Fragmentation metrics grouped by size, form, and aggregation. Source: Akhbour (2026).

Metric	Direction before normalisation	Entropy weight
PLAND	Inverse	25.49%
PD	Direct	8.08%
ED	Direct	6.22%
AREA_MN	Inverse	3.76%
COHESION	Inverse	14.42%
IJI	Direct	8.86%
SPLIT	Direct	25.20%
AI	Inverse	7.96%

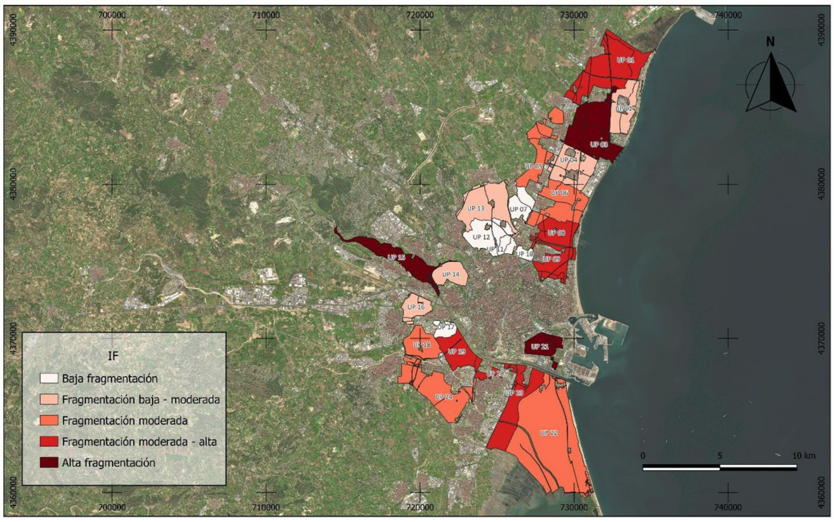


Figure 4. Final agricultural fragmentation index (IF). Source: Akhbour (2026), own elaboration.

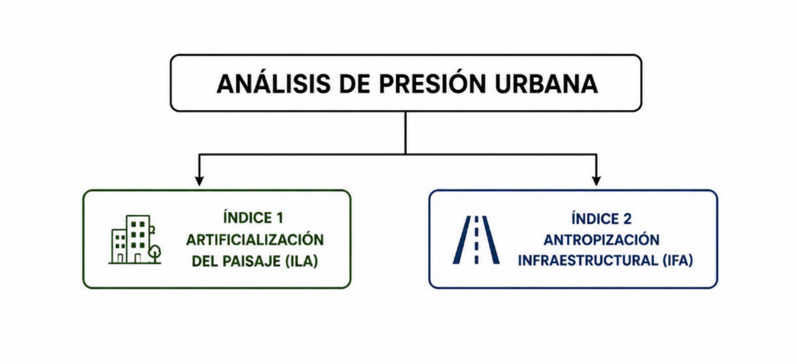
Higher fragmentation	IF
Rovella y Francs, Marjals i Extremals	0.0734
Riu Turia	0.0689
Zona Central - Reial Sequia de Moncada	0.0688

Lower fragmentation	IF
Petra	0.0216
Xirivella	0.0226
Vinalesa, Bonrepos i Mirambell	0.0248

Interpretation: the fragmentation pattern is spatially heterogeneous. Higher values occur in several northern and southern units, while many central and western units maintain a comparatively more continuous agricultural structure.

5. URBAN PRESSURE

Urban pressure combines recent land artificialisation with the territorial effect of linear infrastructure. The artificialisation index (ILA) identifies land that changed from non-artificial in 2006 to artificial in 2024. The infrastructure indicator (IFA) incorporates road and railway length, hierarchy, crossings, and network sections.



Entropy weights
ILA: **69.75%**
IFA: **30.25%**

The weighting gives greater influence to the indicator that provides more differentiation among the landscape units.

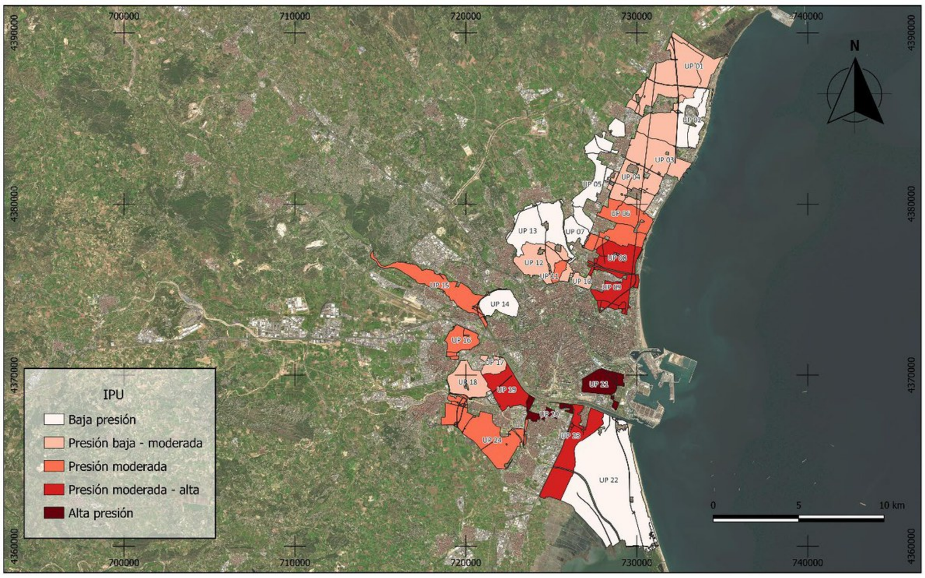


Figure 5. Final urban pressure index (IPU). Source: Akhbour (2026), own elaboration.

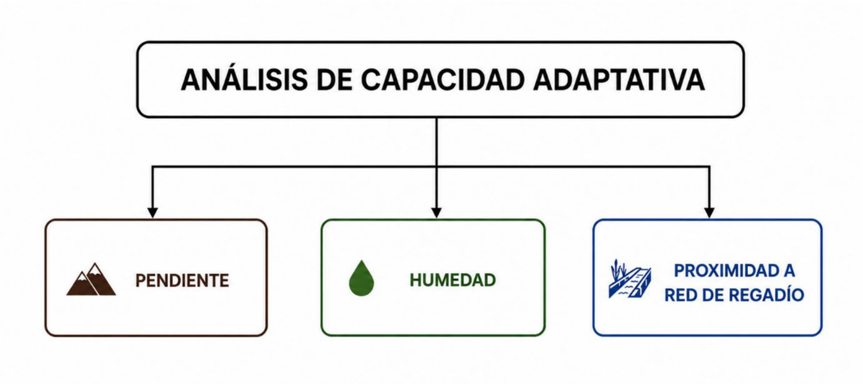
High urban pressure	IPU
Favara	0.1086
Rovella y Francs, Marjals i Extremals	0.0993
Faitanar	0.0781
Castellar-Oliveral	0.0766
Almassera	0.0763

Low urban pressure	IPU
Arc de Moncada	0.0065
Vinalesa, Bonrepos i Mirambell	0.0067
Alters - Reial Sequia de Moncada	0.0109
Sequia de l'Or - Arrossars de l'Albufera	0.0128

The strongest urban-pressure pattern is concentrated in the south and south-east, with an additional focus along the central coastal front. Several interior northern and central units show substantially lower pressure.

6. ADAPTIVE CAPACITY

Adaptive capacity represents the territorial conditions that can help maintain agricultural functionality under external pressure. The index combines terrain slope, soil moisture, and functional proximity to irrigation canals and ditches.



Weights used
Slope: **30%**
Irrigation proximity: **40%**
Soil moisture: **30%**

Slope and irrigation distance are inversely normalised. Soil moisture is directly normalised.

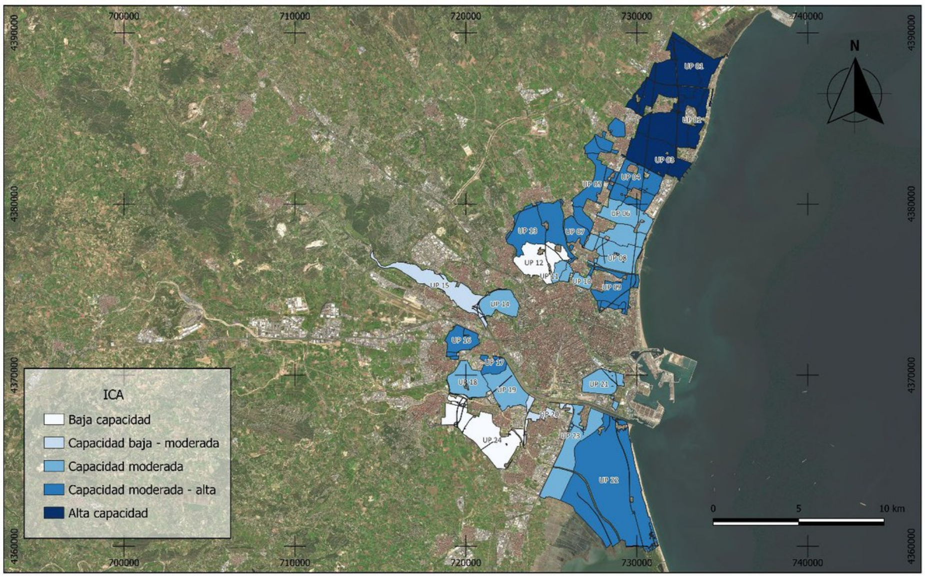


Figure 6. Final adaptive capacity index (ICA). Source: Akhbour (2026), own elaboration.

Higher adaptive capacity	ICA
Final - Reial Sequia de Moncada	0.8792
Zona Central - Reial Sequia de Moncada	0.8303
Extremals del Puig i Pobla Farnals	0.8254
Xirivella	0.7930

Lower adaptive capacity	ICA
Poble Nou	0.4090
Picanya y Paiporta	0.4185
Favara	0.4605
Riu Turia	0.4683

Higher adaptive capacity is concentrated mainly in the northern sector. Several central and southern units show less favourable combinations of slope, soil moisture, and access to the irrigation network.

7. FINAL TERRITORIAL VULNERABILITY

The final index integrates the three analytical blocks after normalisation. It is a comparative indicator across the 24 PAT landscape units rather than an absolute measure of risk. High values indicate the simultaneous presence of stronger urban pressure, greater agricultural fragmentation, and/or weaker adaptive capacity.

Final formulatio

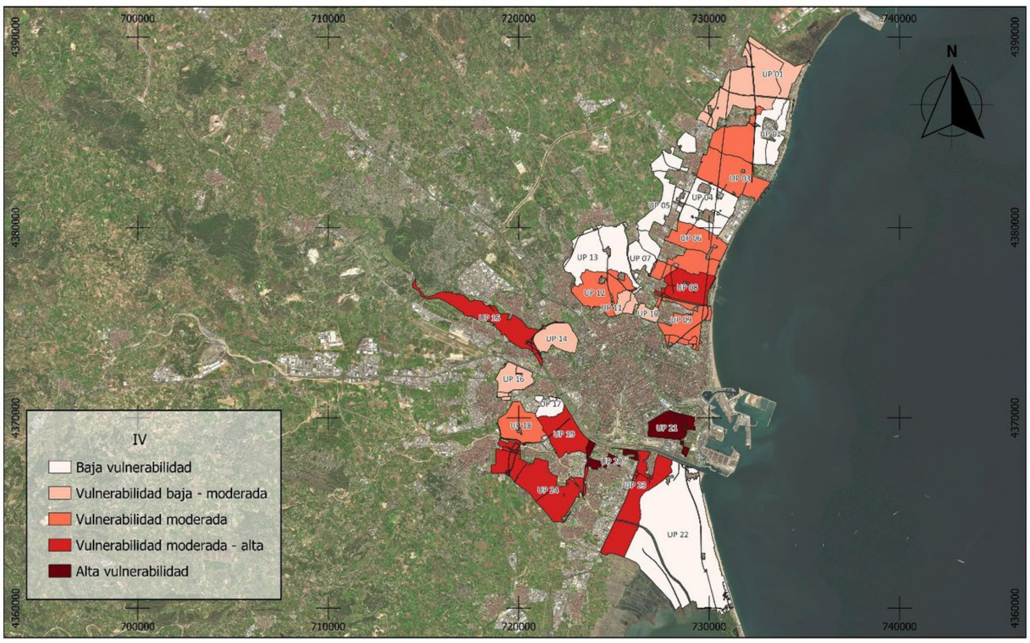


Figure 7. Normalised final vulnerability index. Source: Akhbour (2026), own elaboration.

Priority / higher vulnerability	IV normalised
Favara	1.000
Rovella y Francs, Marjals i Extremals	0.997
Riu Turia	0.809
Castellar-Oliveral	0.734
Faitanar	0.659
Almassera	0.617

Lower vulnerability	IV normalised
Vinalesa, Bonrepos i Mirambell	0.000
Xirivella	0.043
Arc de Moncada	0.045
Extremals del Puig i Pobla Farnals	0.055
Albuixech i Massalfassar	0.074

Priority pattern: the highest vulnerability is concentrated mainly in the southern Huerta and around the port environment, with an additional western focus along the Riu Turia. Several central and northern interior units show comparatively lower vulnerability.

8. METHODOLOGICAL ASSESSMENT AND FUTURE WORK

Current limitation	Recommended improvement
Landscape-unit scale can hide internal variability.	Repeat the assessment at irrigation-sector or functional sub-unit scale.
SWI soil moisture has 1 km spatial resolution.	Integrate higher-resolution soil moisture, field observations, or local sensors where available.
Adaptive capacity uses three biophysical / functional variables.	Add irrigation-network condition, soil quality, erosion, management, abandonment, and socioeconomic variables.
The assessment is mainly a snapshot, except for the 2006-2024 artificialisation comparison.	Build multitemporal series to detect trajectories and rates of territorial change.
Weighting methods differ among analytical blocks.	Test sensitivity to alternative weights and uncertainty assumptions.
Current results describe present conditions.	Evaluate future urban-growth, land-use, and climate scenarios.

9. CONCLUSIONS

1. GIS-based integration provides a coherent way to compare a complex peri-urban agricultural landscape using common spatial units.

2. Fragmentation, urban pressure, and adaptive capacity show different spatial patterns; none of the three dimensions alone explains the final territorial condition.

3. The most vulnerable sectors occur mainly in the south and around the port environment, with Favara and Rovella y Francs, Marjals i Extremals reaching the highest normalised values.

4. The resulting index is best used as a screening and decision-support tool for identifying where protection, detailed diagnosis, or improvement actions deserve greater attention.

> **Planning value:** the method converts heterogeneous agricultural, land-cover, infrastructure, terrain, and moisture datasets into an interpretable spatial diagnosis. It supports prioritisation, but should be complemented with local knowledge and field verification before intervention decisions.

10. REFERENCES AND FURTHER READING

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Keywords: Huerta de Valencia | GIS | Landscape Metrics | Agricultural Fragmentation | Urban Pressure | Adaptive Capacity | Territorial Vulnerability