

Environmental Analysis and Landscape Mapping

Landscape Architecture / Land Landscape Heritage

TUTORIAL 3

A Gis methodology for defining potential limits to urbanization

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Aims

The tutorial presents a GIS based procedure for the definition of potential limits to urbanization. The exercise is based on a methodology developed by Iacopo Zatti and Fabio Lucchesi, Department of Architecture, Università degli Studi di Firenze, within the Prin 2010 Project “Postmetropoli” Post-metropolitan territories as emergent forms of urban space: coping with sustainability, habitability and governance. Further information is available at the following link.

The methodology produces a spatial mask showing the potential limits to urbanization, to future urban growth and to settlement systems transformation taking into account different spatial constraints. In particular, the mask is composed by the spatial integration of the following conditions:

- Slope with a declivity > 10 %
- Internal water bodies
- Swamps and humid areas
- Protected areas (National and regional Parks, Eu special protection areas, other local protected areas)
- High agricultural value, according to the Lombardia region classification of agricultural soils

Each condition is represented by one spatial layer according to specific data sources. The idea is that when at least a condition is verified, a potential limit to urbanization occurs. The spatial combination of the spatial conditions produces a new mask that can be used for further analysis and spatial operations.

References

- Batty M. (2001), "Polynucleated Urban Landscapes", *Urban Studies*, 38 (4), 635-655.
- De Landa M. (2000), *A Thousand Years of Nonlinear History*, Swerve Edition, New York.
- MacKaye B. (1928), *The New Exploration: A Philosophy of Regional Planning*, Harcourt, Brace and Company, New York.
- Muratori S., (1967), *Civiltà e territorio*, Centro Studi di Storia Urbanistica, Rome.

Data Source

<http://www.geoportale.regione.lombardia.it/>

- DUSAF 5.0 (vector)
- Aree_protette (vector)
- Valore agricolo dei suoli (raster)
- DTM20 (raster)

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PART 1

Dusaf 5: Wetlands and Water Bodies

The Dusaf 5 database is related to the Land-use for all the provinces of Lombardy (Destination of Use of Agricultural and Forestry Soils). The information presented are: land use, rows/hedges.

Therefore, in this first part of the tutorial, *Wetlands* and *Water Bodies* features are selected from the Dusaf 5 database as potential areas where to limit urbanisation.

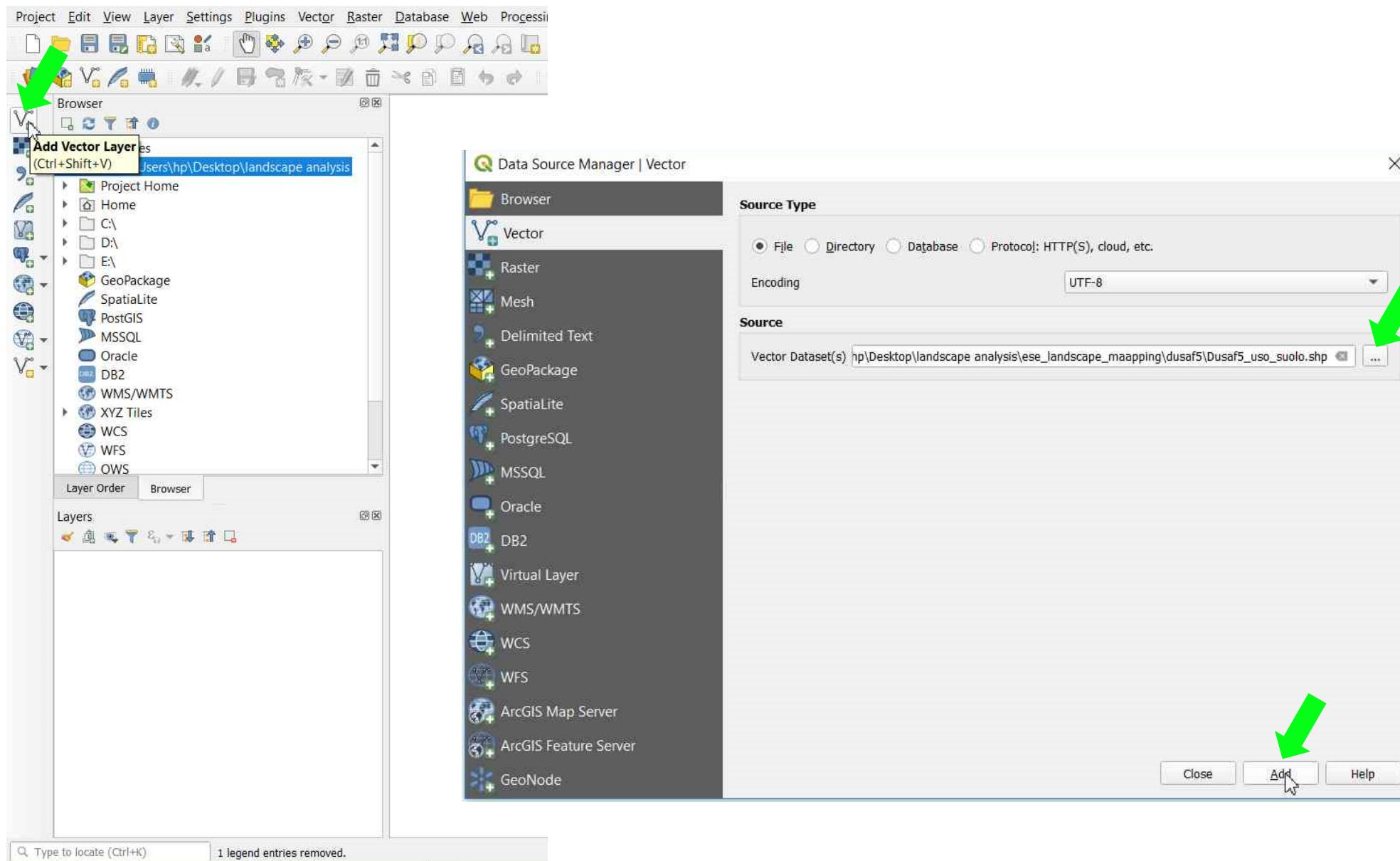
Tools

- Manage Layer Toolbar → Add Vector Layers
- Select Features → Select features using an expression
- Export → Save Selected Features As...

Metadata

http://www.geoportale.regione.lombardia.it/metadata?p_p_id=PublishedMetadata_WAR_geoportalemetadataportlet&p_p_lifecycle=0&p_p_state=maximized&p_p_mode=view&_PublishedMetadata_WAR_geoportalemetadataportlet_view=editPublishedMetadata&_PublishedMetadata_WAR_geoportalemetadataportlet_uuid=%7B8A509A02-97FD-458A-84D1-280F81A96640%7D&_PublishedMetadata_WAR_geoportalemetadataportlet_editType=view&_PublishedMetadata_WAR_geoportalemetadataportlet_fromAsset=true&rid=local

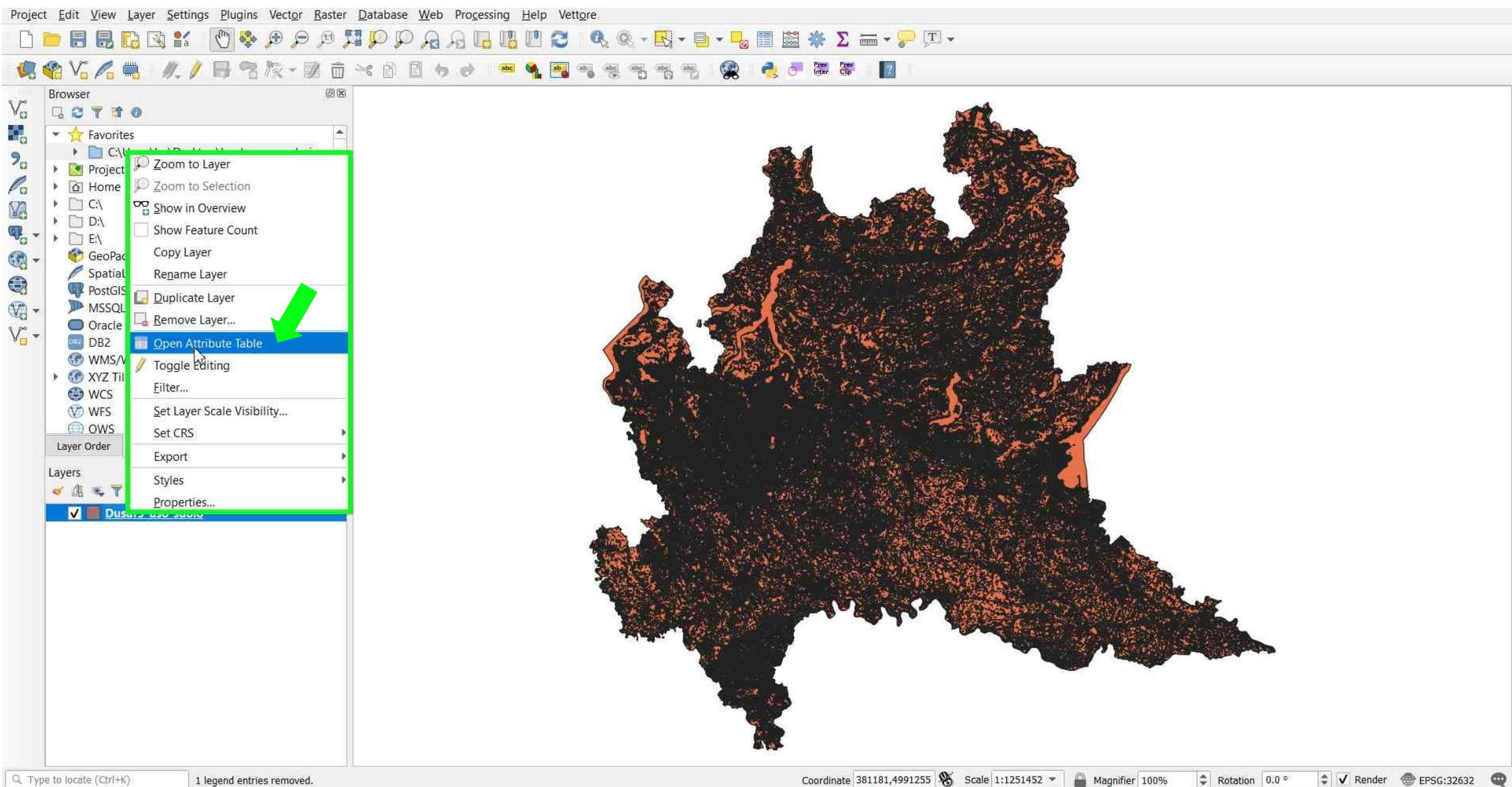
ADD VECTOR LAYERS → Press the 'Add vector Layer...' button in the **Manage Layer** toolbar to upload the vector files : *Dusaf5_uso_suolo*



Click to choose the
data source

Click **Add** to visualise
the selected .shp file

SELECT FEATURES → Right click on the layer to open the **Attribute Table**



SELECT FEATURES → Press the icon to Select features using an expression

The screenshot shows the QGIS interface with a green box highlighting the 'Select features using an expression' button in the toolbar. A green arrow points to this button from the top-left. The 'Browser' panel on the left shows a project structure with a layer named 'Dusaf5_uso_suolo'. The main window displays a table with 13 rows and several columns, and a map view at the bottom.

Dusaf5_uso_suolo :: Features Total: 345848, Filtered: 345848, Selected: 0

	COD5	LIV_1	LIV_2	LIV_3	LIV_4	LIV_5	SHAPE_AREA	SHAPE_LEN
1	1111	1	1	1	1		2825677.44032...	34236.035485
2	1111	1	1	1	1		193446.871753...	4251.0705012
3	1111	1	1	1	1		4164.12414024...	257.009492462
4	1111	1	1	1	1		36870.5525230...	1219.0808559
5	1111	1	1	1	1		40907.0639526...	1546.0525220
6	1111	1	1	1	1		8958.62301767...	529.101468426
7	1111	1	1	1	1		542554.302795...	6562.5290247
8	1111	1	1	1	1		77265.9655021...	1831.7372900
9	1111	1	1	1	1		653414.351109...	9716.6847051
10	1111	1	1	1	1		17034.1116875...	806.300830750
11	1111	1	1	1	1		3145.49994200...	241.088431849
12	1111	1	1	1	1		22632.9357147...	712.802843059
13	1111	1	1	1	1		70385.6885766...	1147.0597158

Show All Features

Type to locate (Ctrl+K) 1 legend entries removed. Coordinate 381181.4991255 Scale 1:1251452 Magnifier 100% Rotation 0.0° Render EPSG:3

SELECT FEATURES → Type the Expression "**LIV_1**" = '4' OR "**LIV_1**" = '5' → Click **Select Features** to run the expression → Close

Dusaf5_uso_suolo : Features Total: 345848, Filtered: 345848, Selected: 0

	COD5	LIV_1	LIV_2	LIV_3	LIV_4	LIV_5	SHAPE_AREA	SHAPE_LEN
1	1111	1	1	1	1		2825677.44032...	34236.0
2	1111	1	1	1	1		193446.871753...	4251.07
3	1111							0.94
4	1111							1.08
5	1111							0.95
6	1111							0.14
7	1111							0.52
8	1111							0.73
9	1111							0.58
10	1111							0.08
11	1111							0.84
12	1111							0.28
13	1111							0.15

Select by Expression - Dusaf5_uso_suolo

Expression **Function Editor**

`"LIV_1" = '4' OR "LIV_1" = '5'`

Search... Show Values

group field

Double-click to add field name to expression string.
Right-Click on field name to open context menu sample value loading options.

Values Search... All Unique 10 Samples

Output preview: 0

Help

Select features

Values "4"= WETLANDS

Values "5"= WATER BODIES

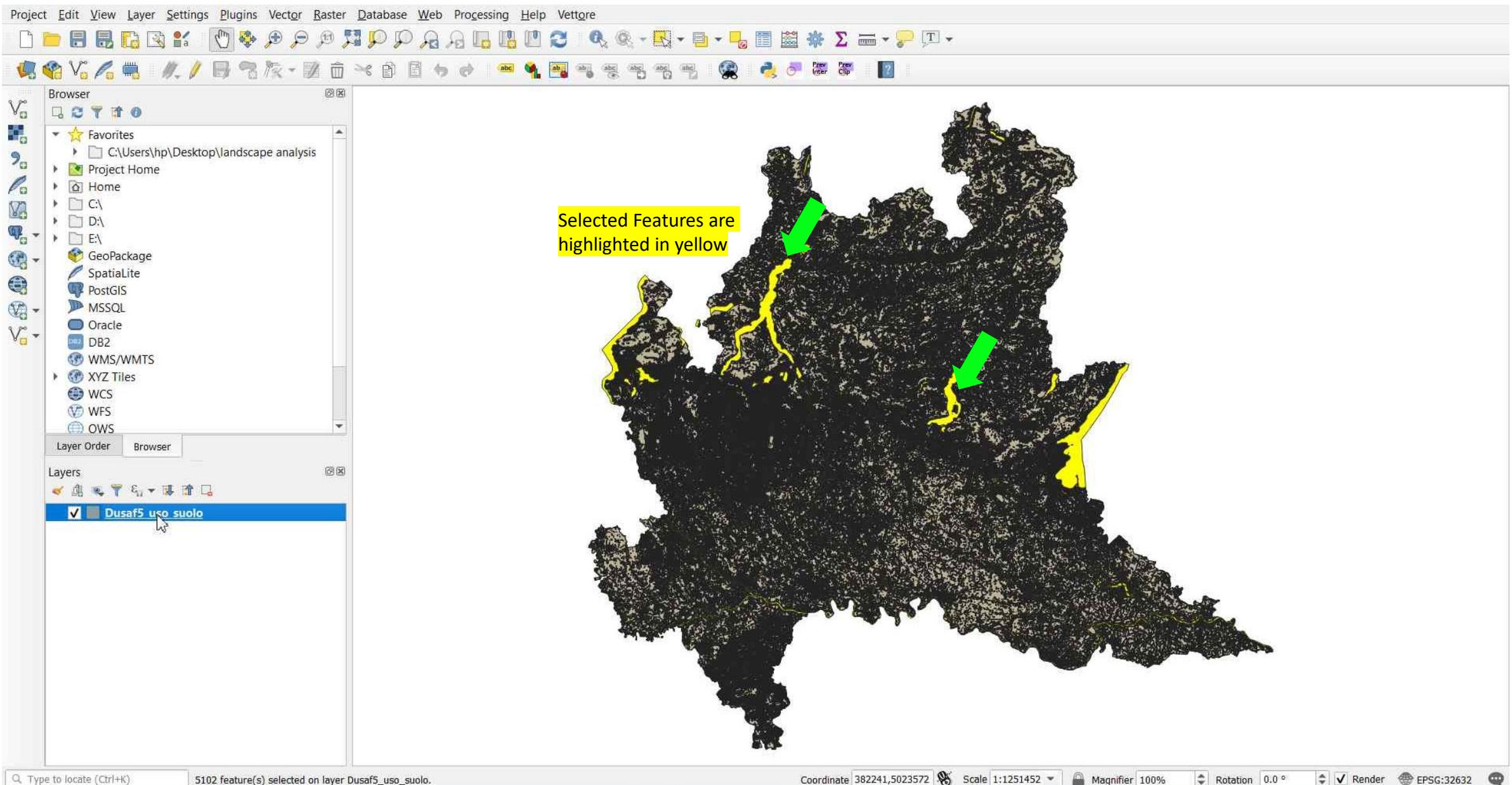
ARTIFICIAL SURFACES
URBAN FABRIC
111 Continuous urban fabric
112 Discontinuous urban fabric
INDUSTRIAL, COMMERCIAL AND TRANSPORT UNITS
121 Industrial, commercial and public units
122 Road and rail networks and associated land
123 Port areas
124 Airport
MINES, DUMPS AND CONSTRUCTION SITES
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132 Dump sites
133 Construction sites
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222 Fruit trees and berries plantations
PASTURES
231 Pastures
HETEROGENEOUS AGRICULTURAL AREAS
242 Complex cultivation patterns
243 Land principally occupied by agriculture, with significant areas of natural vegetation

FOREST AND SEMINATURAL AREA
FORESTS
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312 Coniferous forest
313 Mixed forest
SCRUBS AND/OR HERBACEOUS VEGETATION
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324 Transitional woodland-scrub
OPEN SPACES WITH LITTLE OR NO VEGETATION
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335 Glaciers and perpetual snow
WETLANDS
INLAND WETLANDS
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412 Peat bogs
COASTAL WETLANDS
421 Salt marshes
423 Intertidal flats
WATER BODIES
INLAND WATERS
511 Water courses
512 Water bodies
MARINE WATERS
521 Coastal lagoons
522 Estuaries
523 Sea and ocean

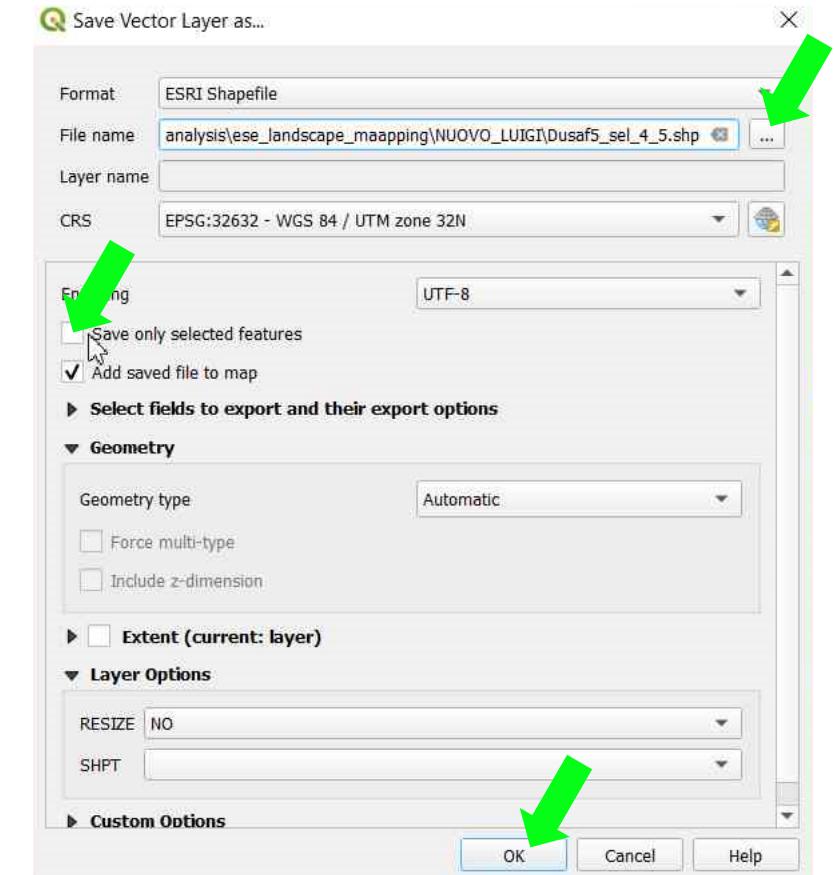
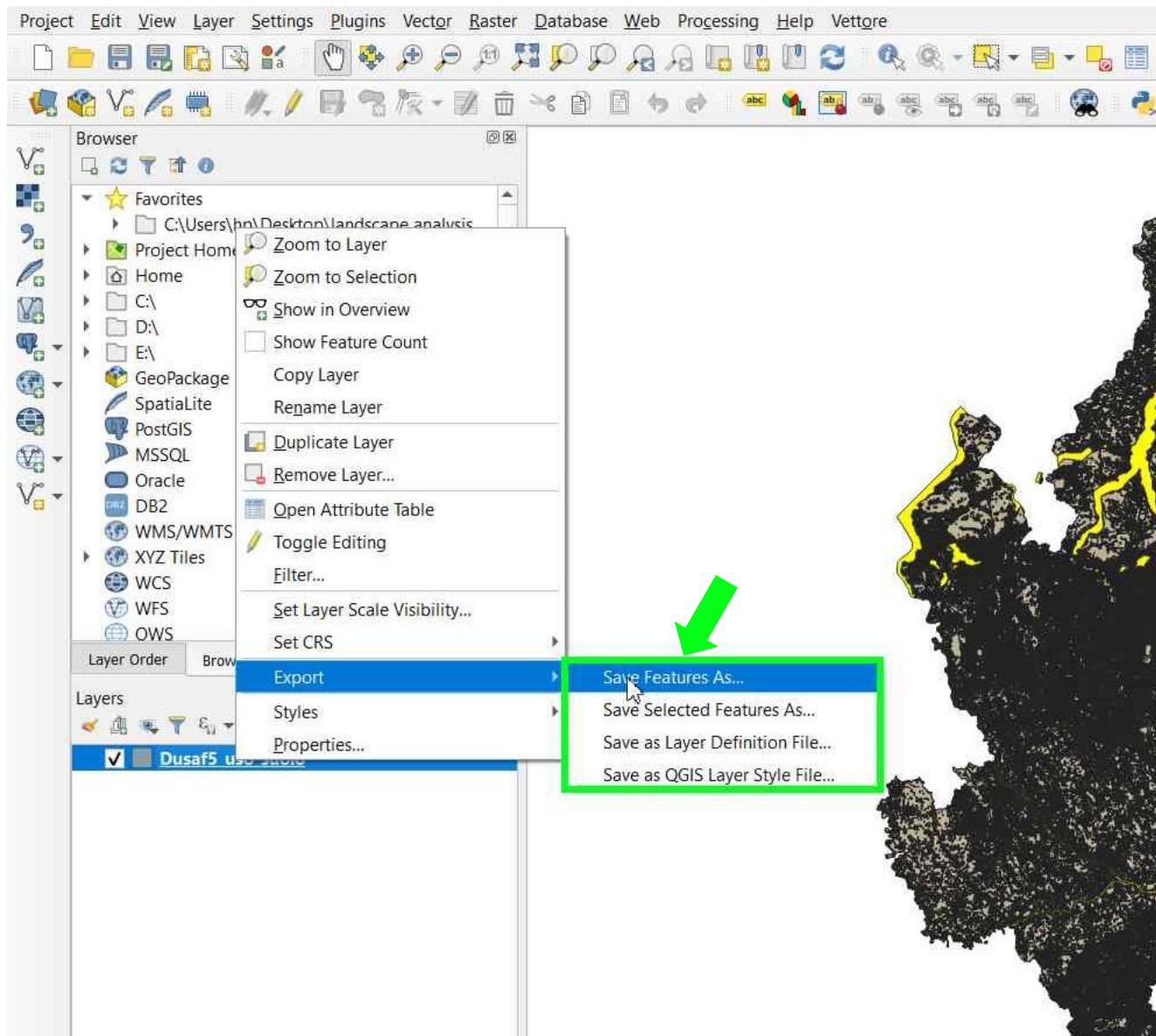
Click **All Unique** to see all the selectable values from a field.

To add a value to the expression double click its name in the list.

SELECT FEATURES → Wetlands and Water Bodies have been selected

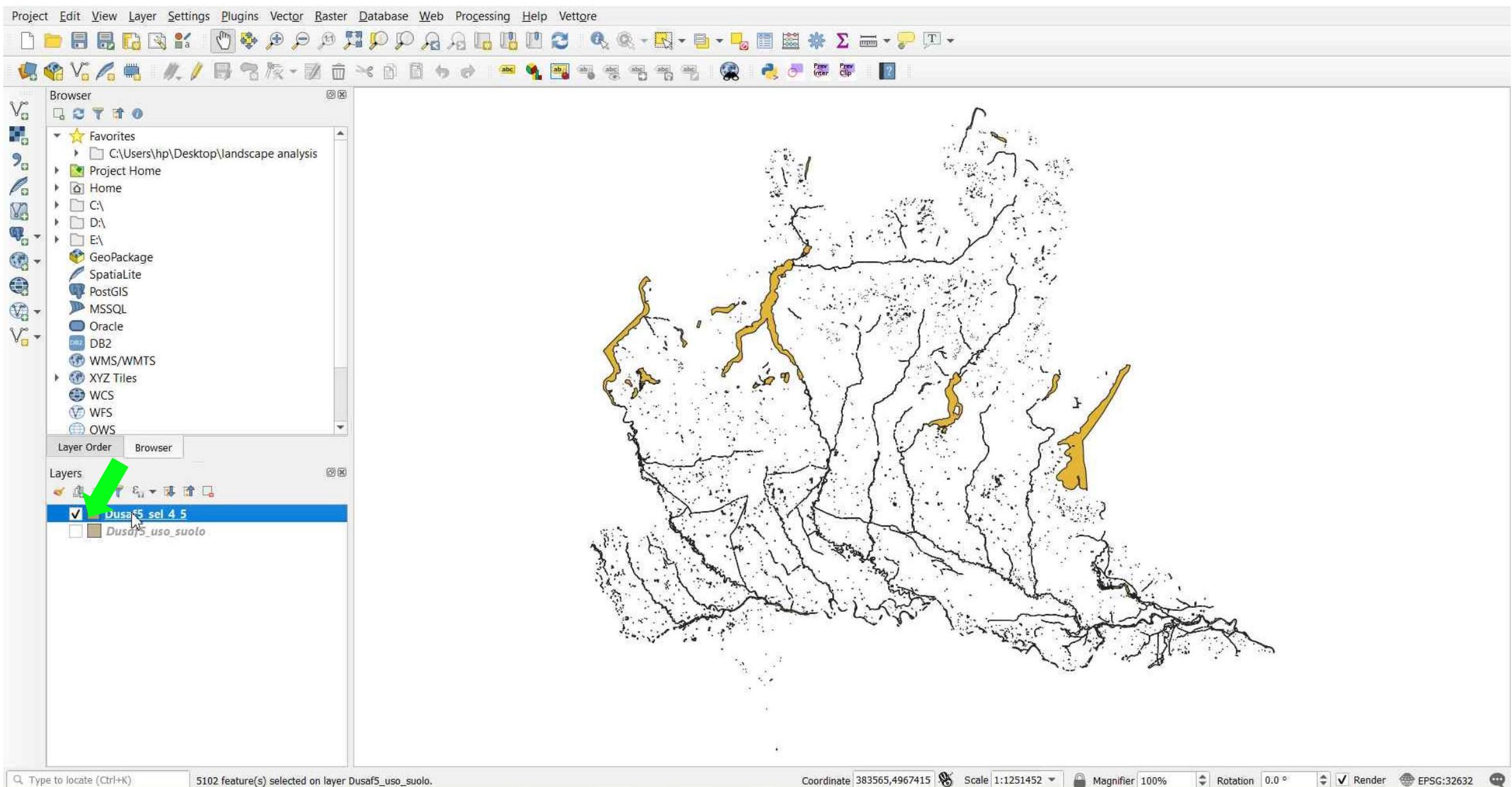


EXPORT → Right-click to **Export** → **Save (Selected) Features As...** → **File name** to select the directory and name the new vector layer → **OK**



!! Flag “**save only the selected features**”

EXPORT → Turn off the *Dusaf5_uso_suolo* layer to visualise only the new vector layer file



PART 2

Arete Protette (Protected Areas)

This map service contains boundaries of protected areas in Lombardy:

- Regional Parks, Natural Parks and the Stelvio National Park - Natural Reserves
 - Natural Monuments - Local Parks of Supra-municipal Interest (PLIS) - Special Conservation Areas / Sites of Community Importance (ZSC, SIC) - Special Protection Areas (ZPS).

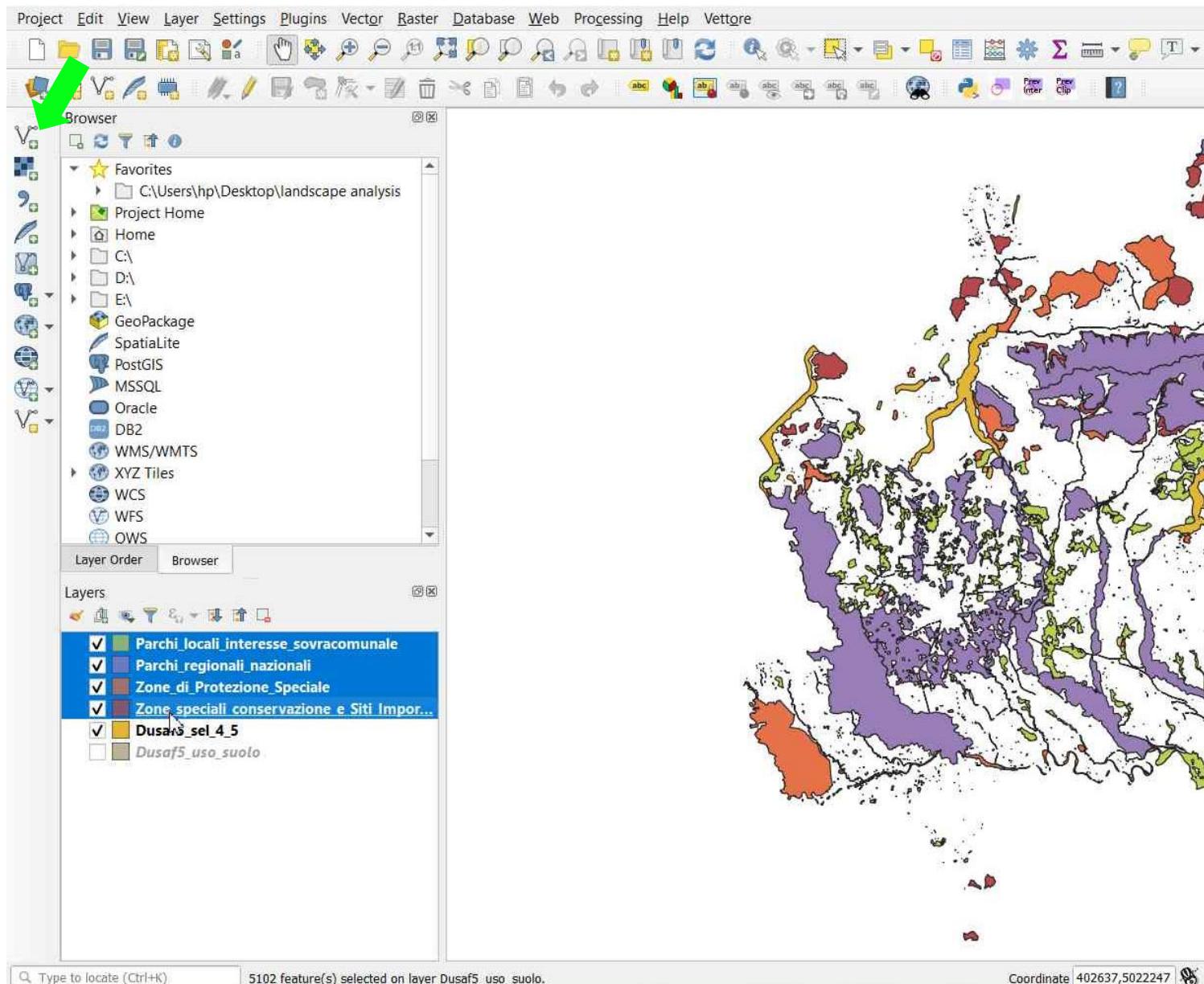
Tools

- Manage Layer Toolbar → Add Vector Layers
- Geoprocessing → Merge / Fix Geometries / Dissolve
- Export → Save Selected Features As...

Metadata

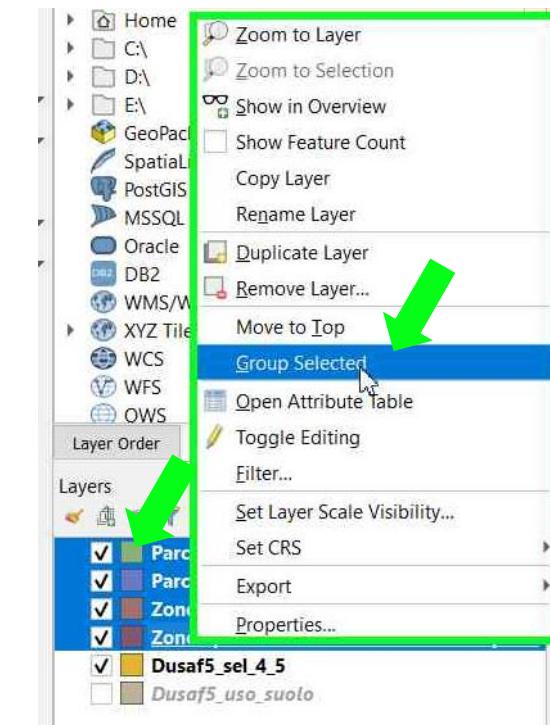
http://www.geoportale.regione.lombardia.it/metadata?p_p_id=PublishedMetadata_WAR_geoportalemetadataportlet&p_p_lifecycle=0&p_p_state=maximized&p_p_mode=view&_PublishedMetadata_WAR_geoportalemetadataportlet_view=editPublishedMetadata&_PublishedMetadata_WAR_geoportalemetadataportlet_uuid={2C140B4A-AEBA-4928-B162-F40E7D0601CB}&_PublishedMetadata_WAR_geoportalemetadataportlet_editType=view&_PublishedMetadata_WAR_geoportalemetadataportlet_fromAsset=true&rid=local

ADD VECTOR LAYERS → Click **Add vector Layer** on the **Manage Layer** Toolbar to upload files



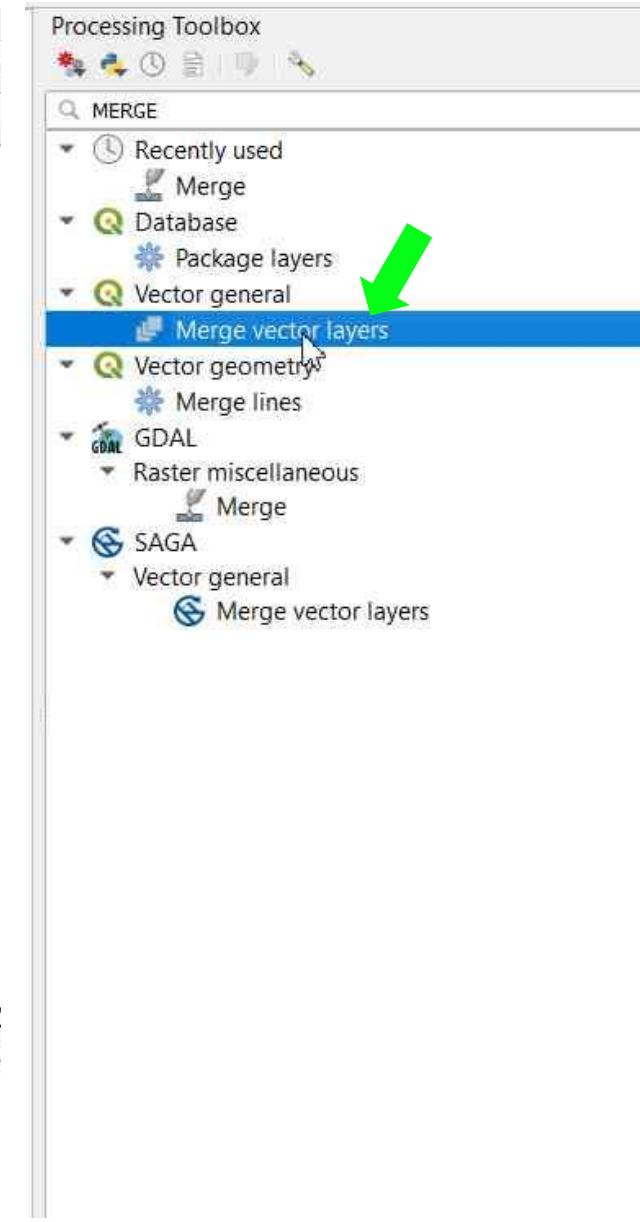
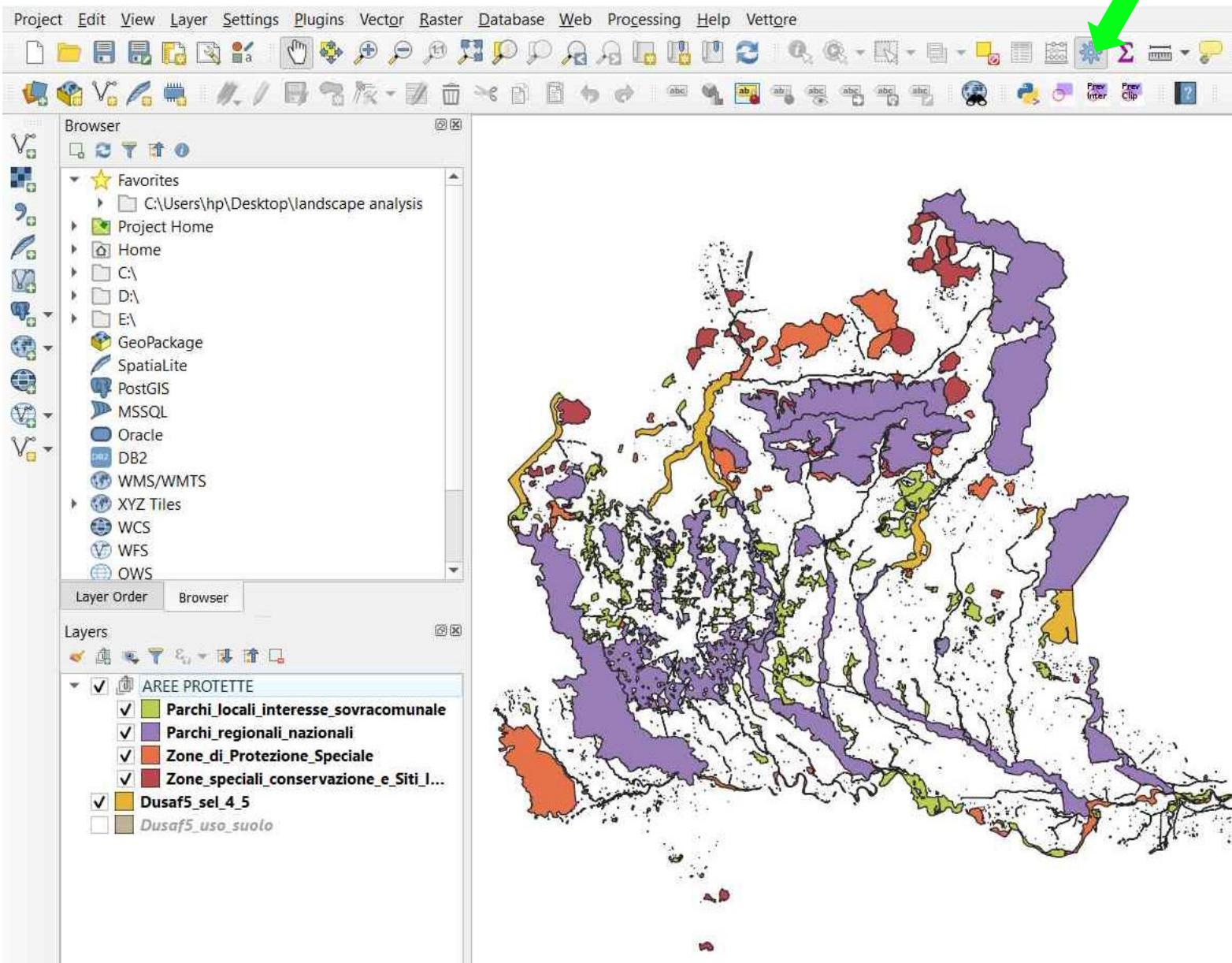
DATA TO ADD

- Parchi_locali_Interesse_sovracomunale (PLIS)
- Parchi_regionali_nazionali
- Zone_speciali_conservazione_e_Sit_Importanza_Comunitaria
- Zone_di_Protezione_Speciale (ZPS)

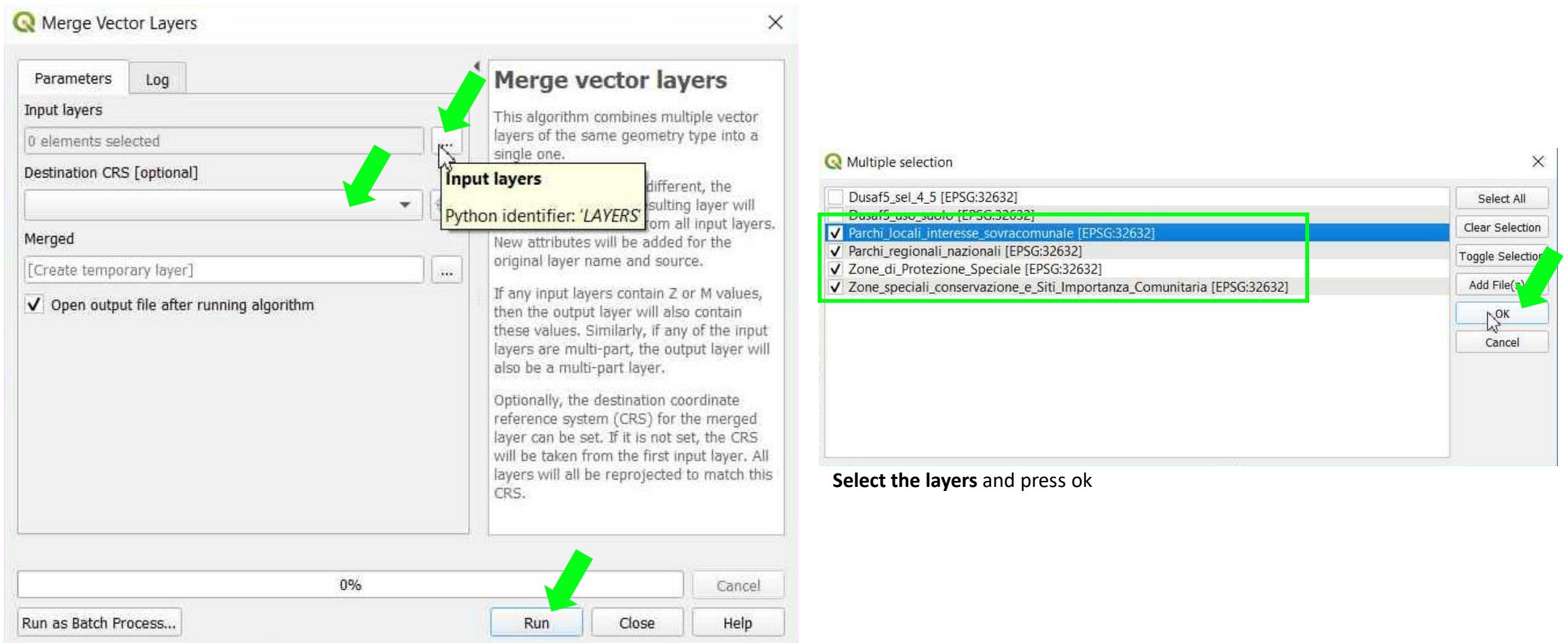


Right-click on the selected layers and **Group Selected** to group layers

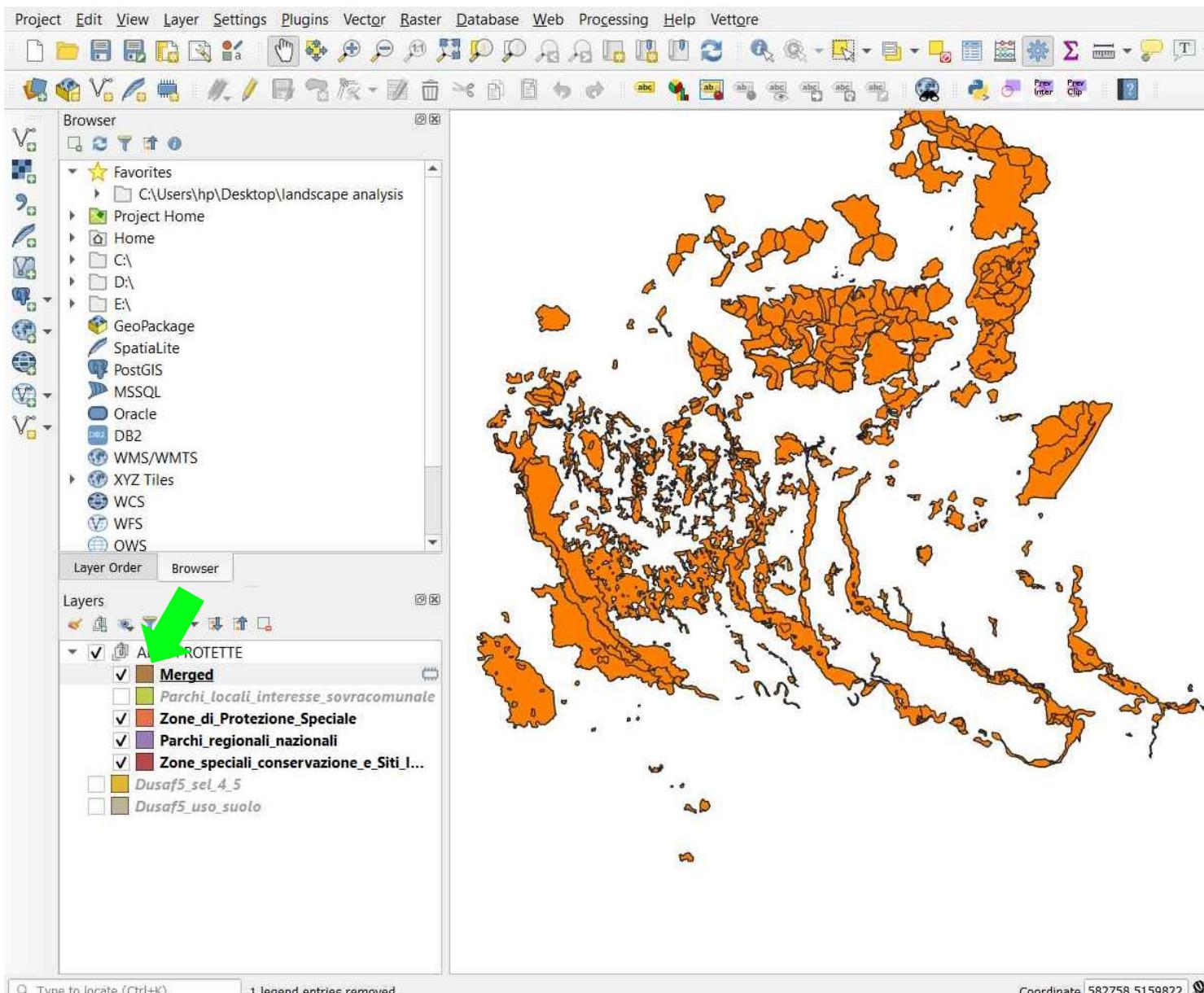
MERGE LAYERS → Click the icon to open the **Processing Toolbox** → Merge Vector Layers



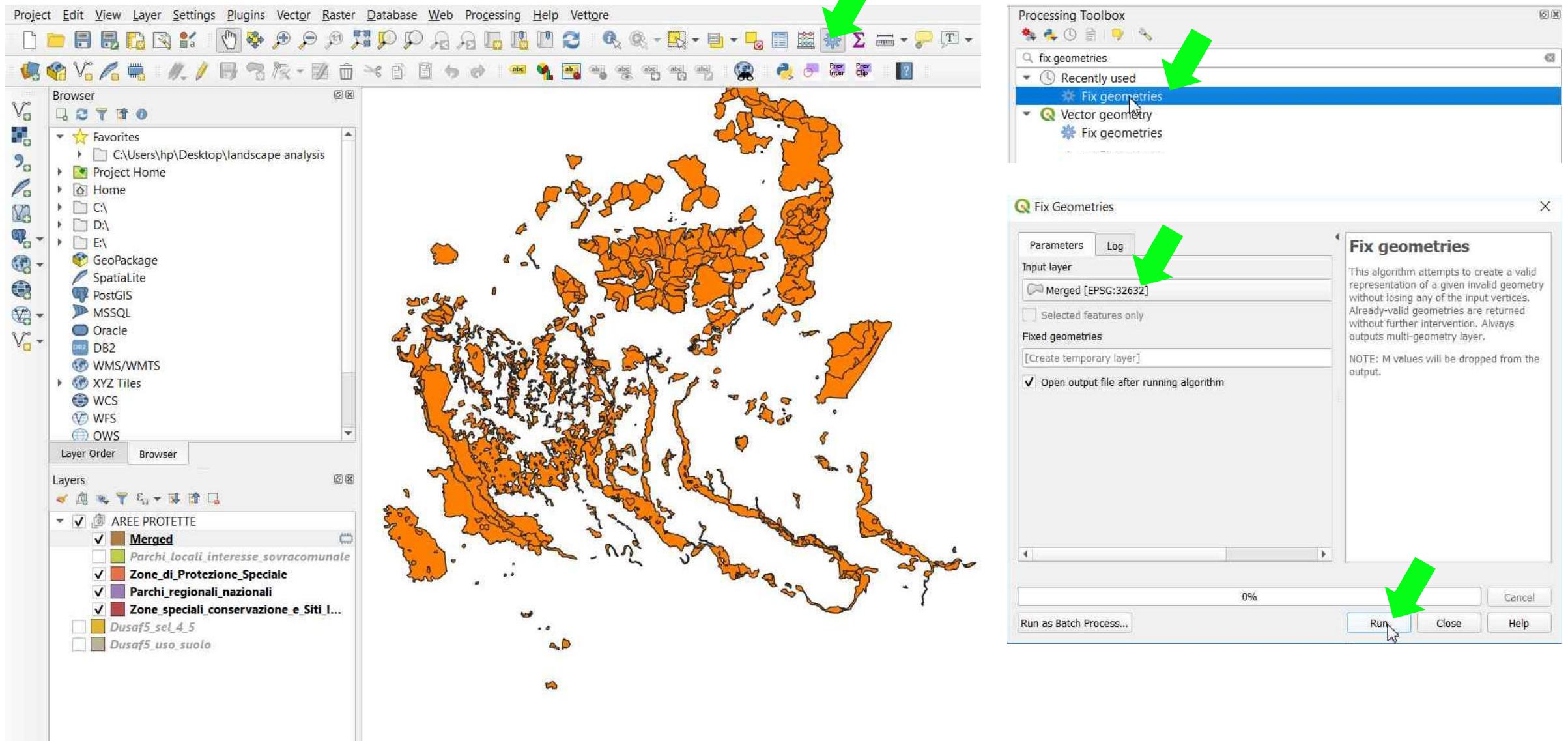
MERGE LAYERS → Click on **Input Layer** to select the layers to merge → Select the **Destination CRS** → Run



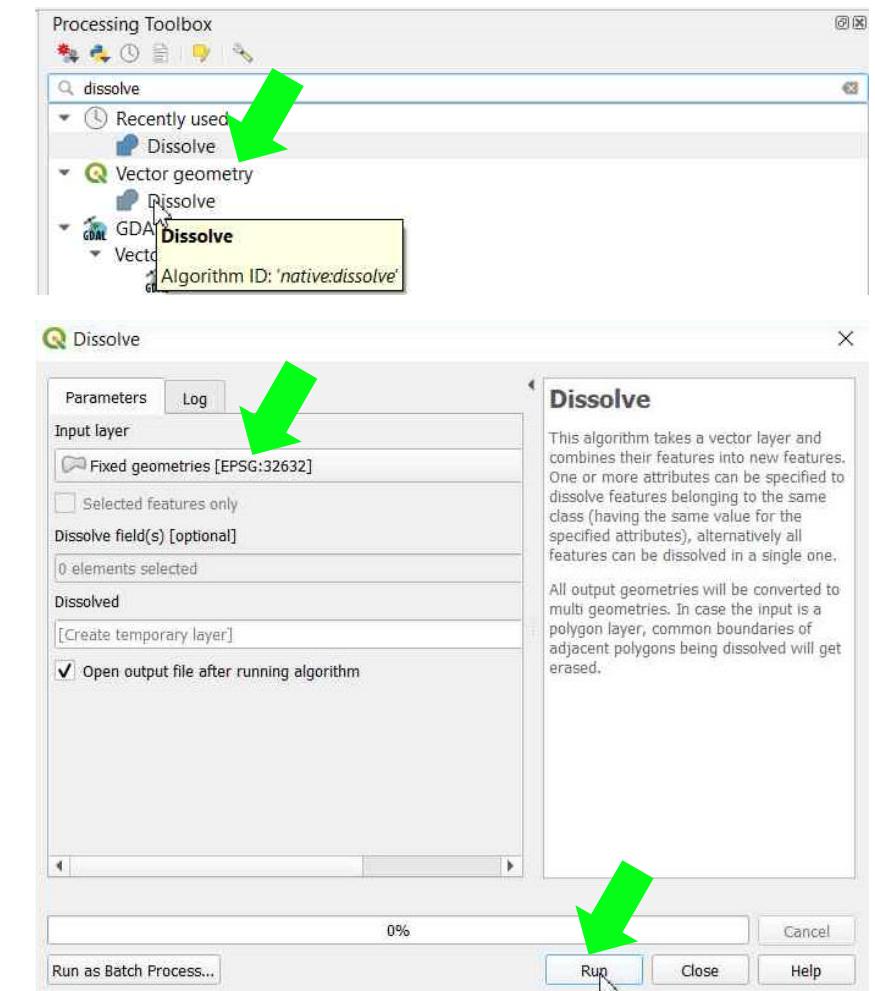
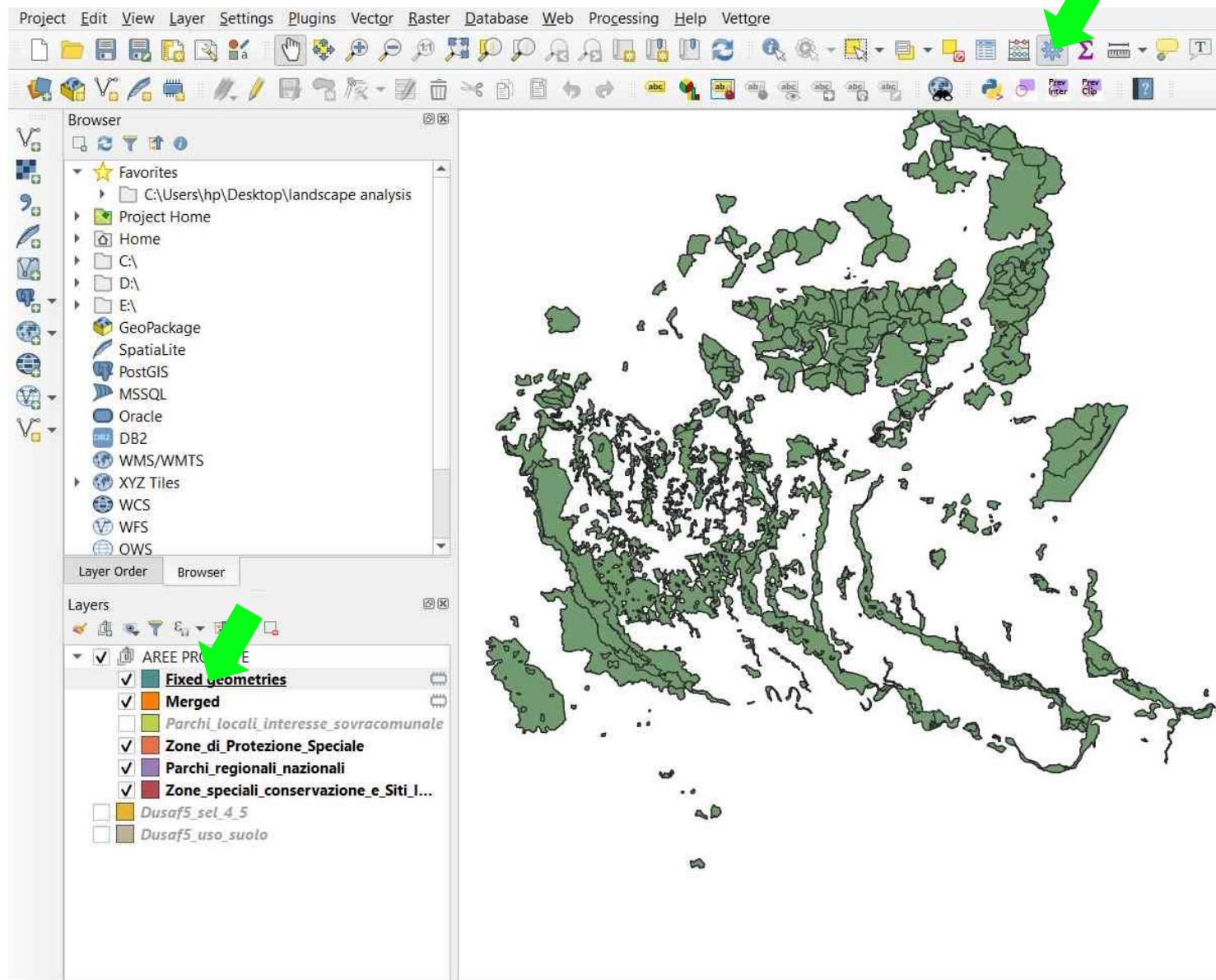
MERGE LAYERS → The layers have been merged



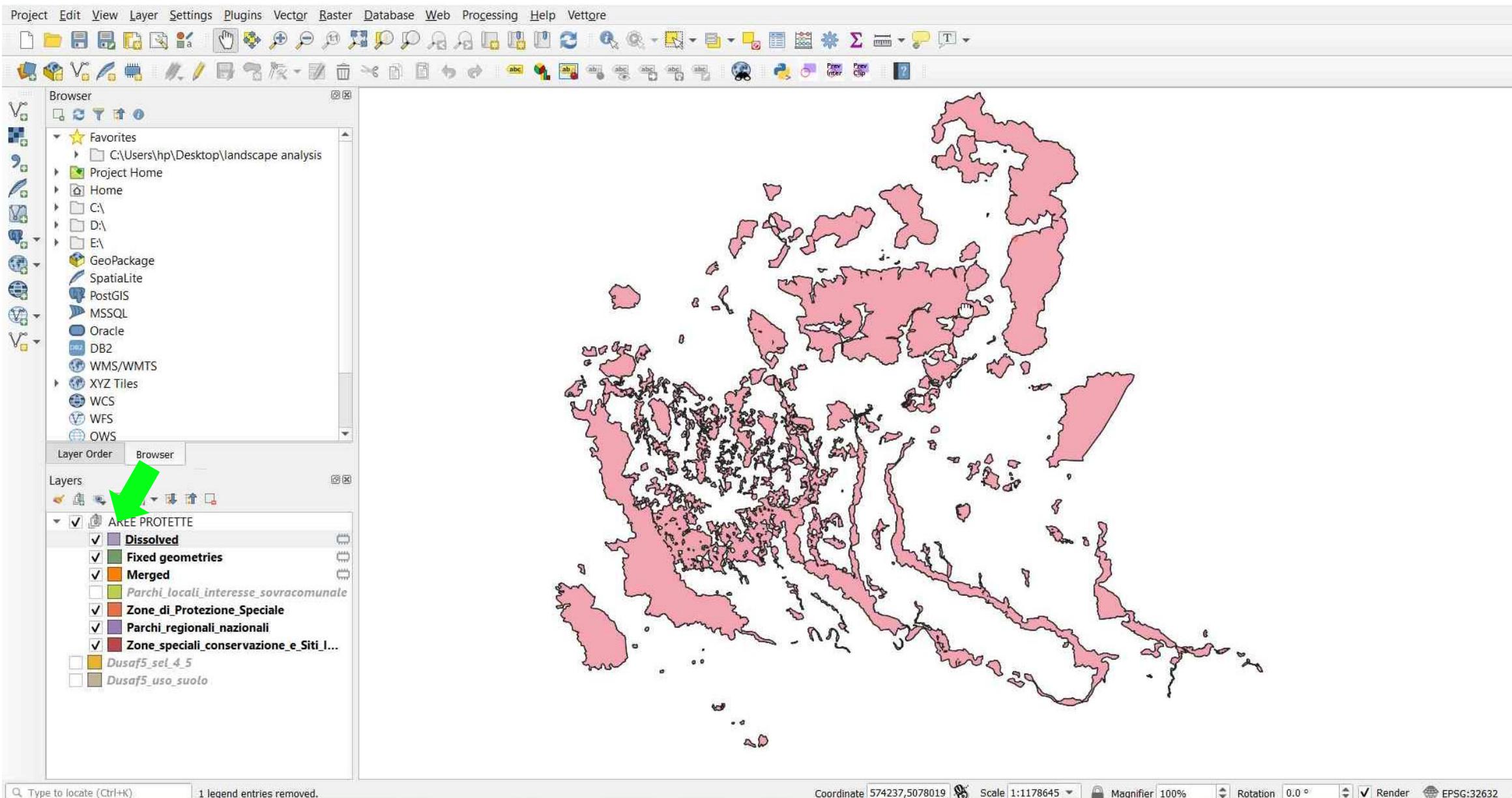
FIX GEOMTRIES → Open the **Processing Toolbox** → **Fix Geometries** → Select the layer *Merged* → **Run** to fix the invalid geometries



DISSOLVE GEOMETRIES → Open the **Processing Toolbox** → **Dissolve** → Select the *Fixed geometries* layer → **Run** to dissolve into a single features



EXPORT → Right-click to Export → **Save Features As...** to make it permanent *Aree_Protette*



PART 3

Valore Agricolo (Agricultural value)

The agricultural value database identifies three classes of agricultural value:

1. Low or absent
2. Moderate
3. High

For the purpose of this tutorial therefore, high agricultural value is selected.

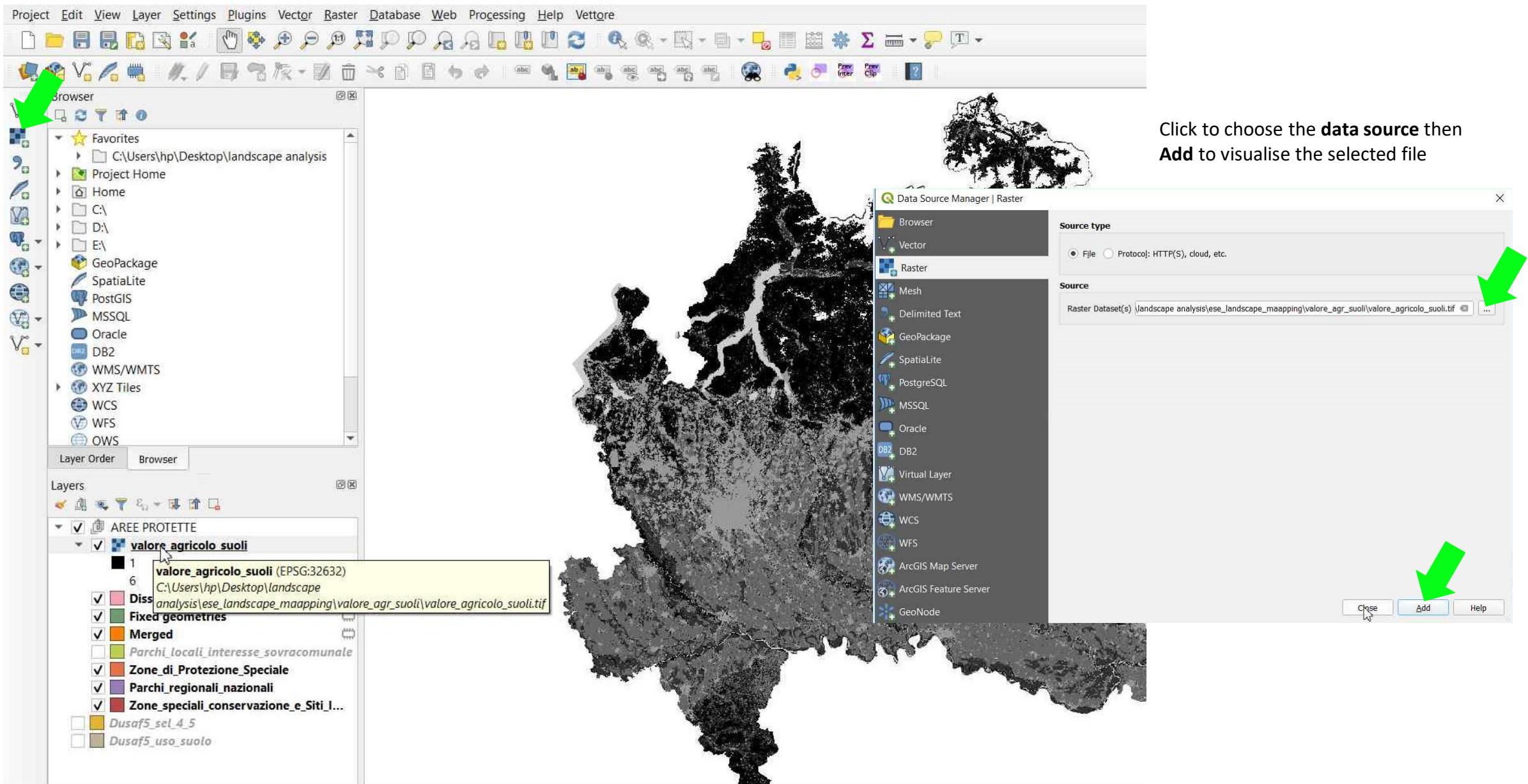
Tools

- Manage Layer Toolbar → Add Raster Layers
- Layer Properties → Symbology
- Raster → Raster Calculator

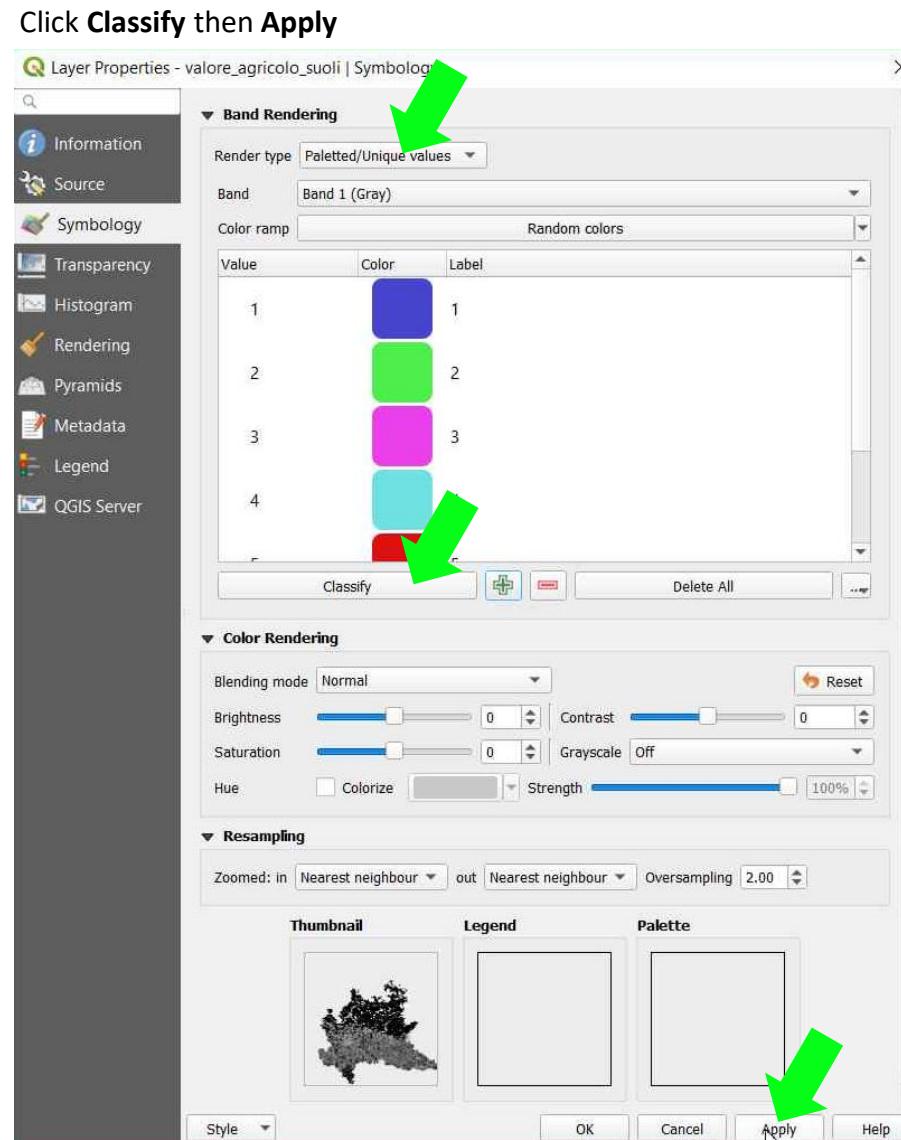
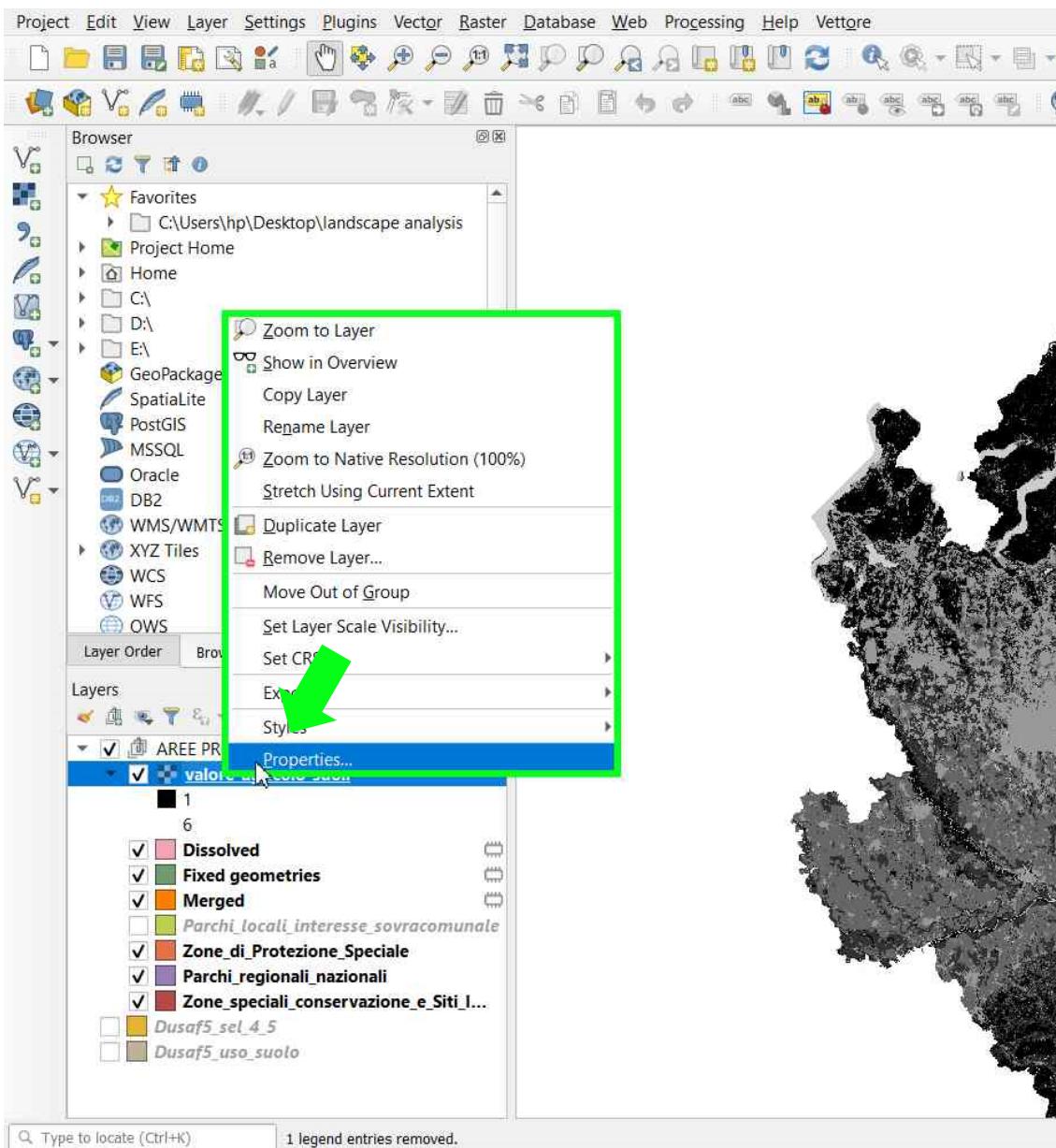
Metadata

http://www.geoportale.regione.lombardia.it/en/metadata?p_p_id=PublishedMetadata_WAR_geoportalemetadataportlet&p_p_lifecycle=0&p_p_state=maximized&p_p_state=view&_PublishedMetadata_WAR_geoportalemetadataportlet_view=editPublishedMetadata&_PublishedMetadata_WAR_geoportalemetadataportlet_uuid=%7B22B66AAB-5FC7-4E59-A5BF-47A33D85D8E9%7D&_PublishedMetadata_WAR_geoportalemetadataportlet_editType=view&_PublishedMetadata_WAR_geoportalemetadataportlet_fromAsset=true&rid=local

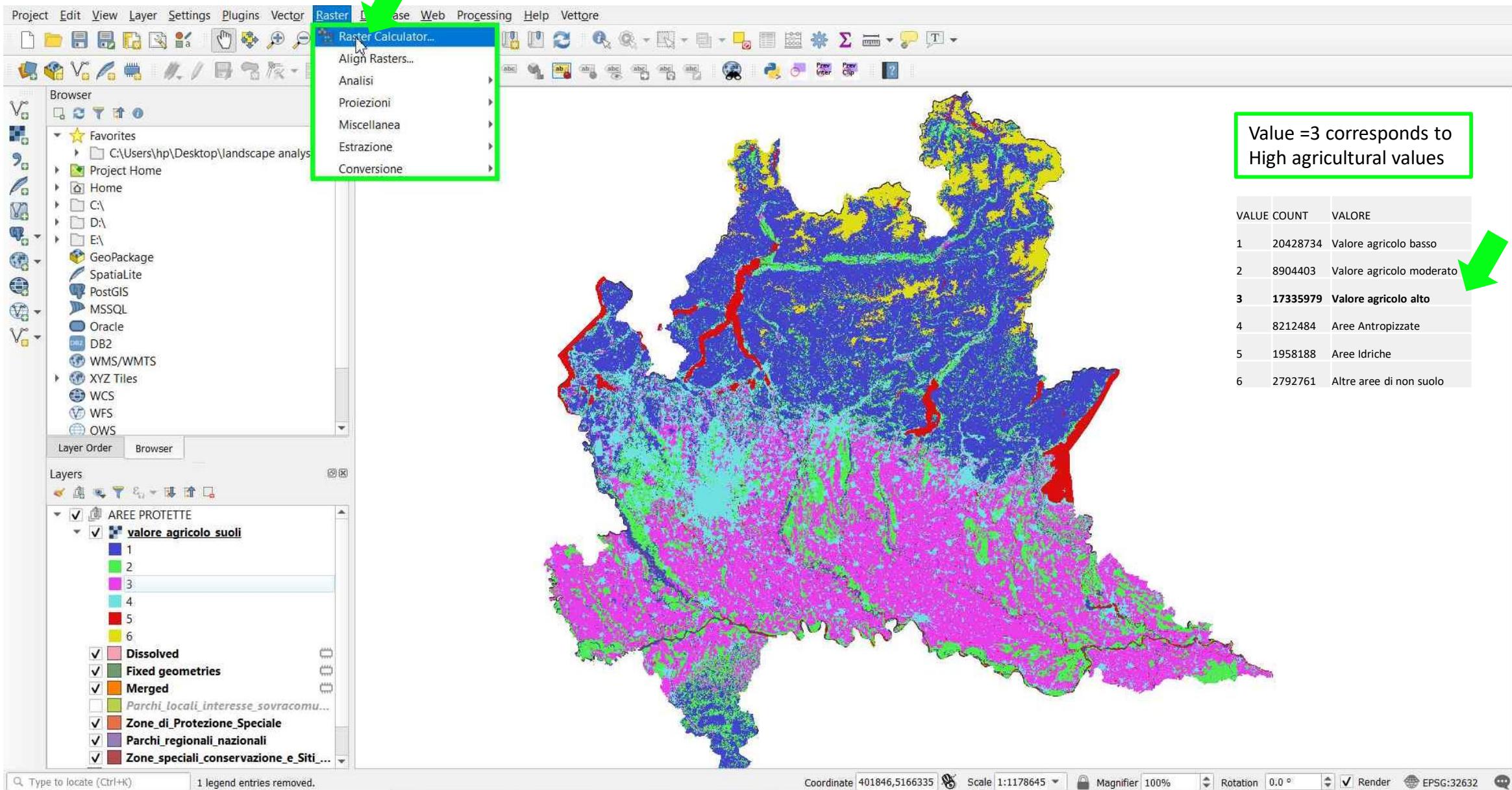
ADD RASTER LAYERS → Click **Add Raster Layer** on the Manage Layer Toolbar to upload the raster file : **Valore Agricolo**



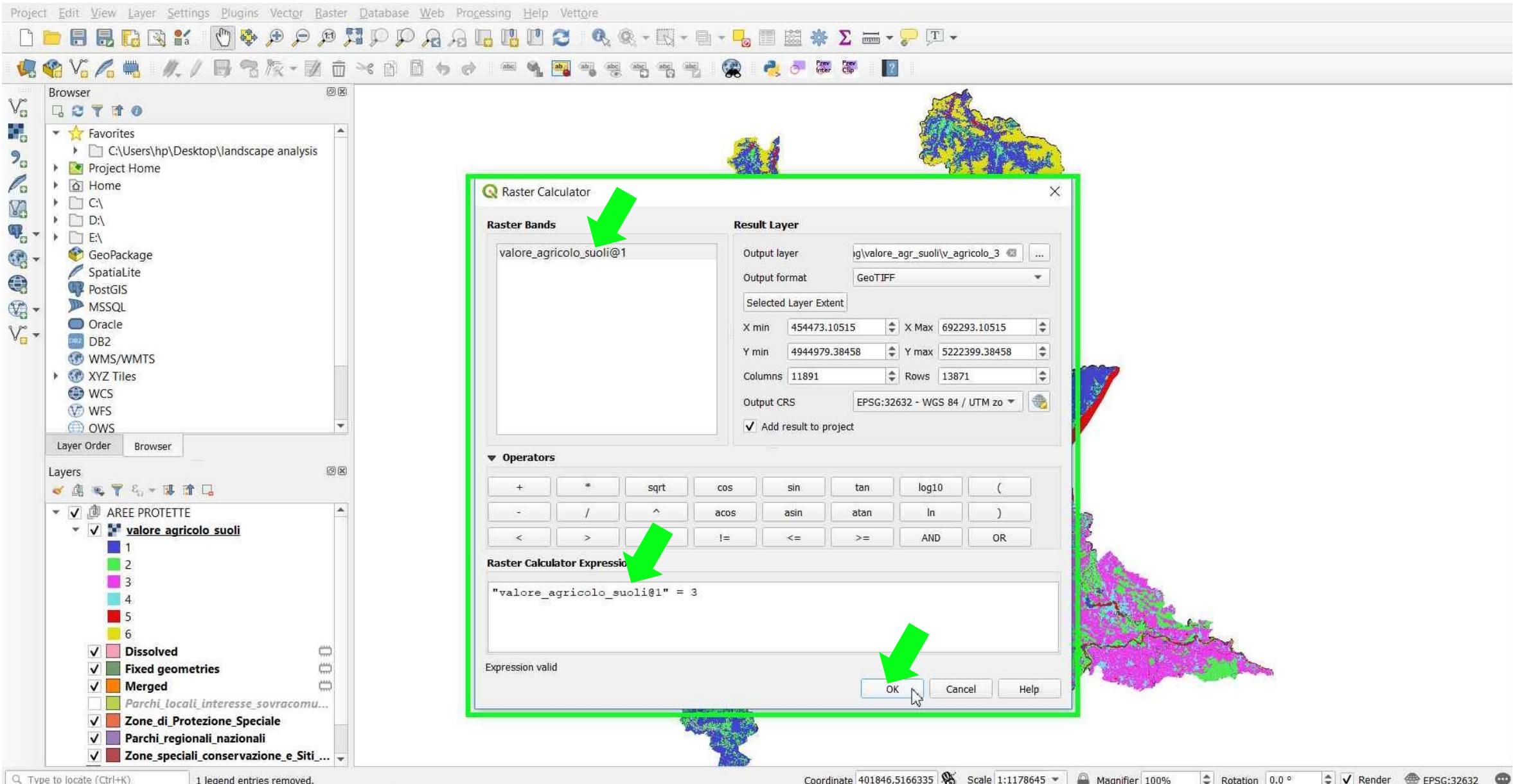
CHANGE SYMBOLIC → Right-click to see the layer *Valore Agricolo* → Properties → Symbology → Render type: select Palettes/Unique values



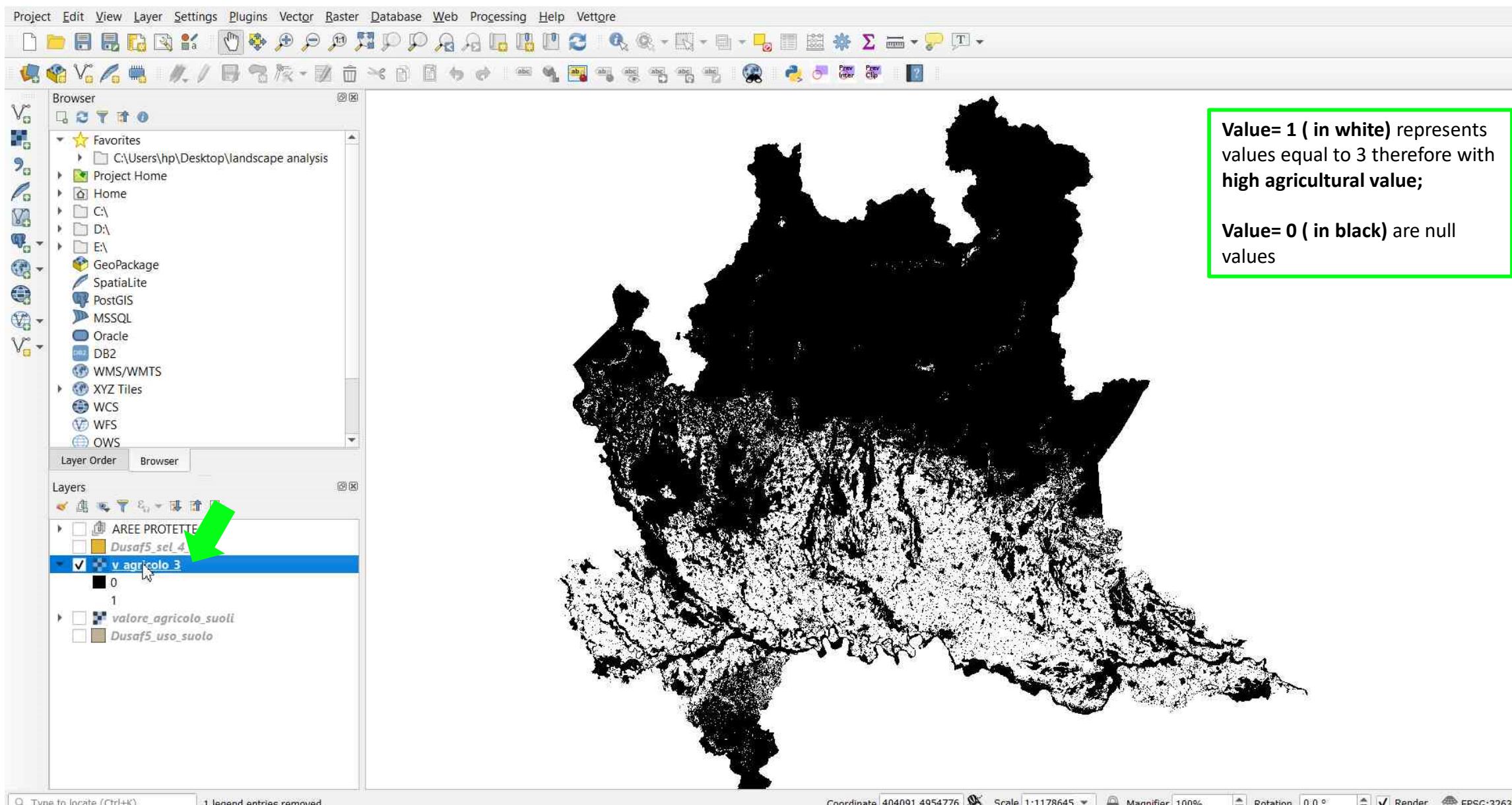
RASTER CALCULATOR → Raster → Raster Calculator to select attribute value=3



RASTER CALCULATOR → Double click on “valore_agricolo_suoli@1” → Type the Expression “**“valore_agricolo_suoli@1”= 3**” → **OK**



RASTER CALCULATOR → A new raster layer has been created *Valore_Agricolo_3*



PART 4

DTM 20

The DTM (Digital Elevation Model, DEM) is represented by a grid structure with sampling step of 20 meters, which can be used to analyse the orographic trend of the Lombardy area. The coverage includes the hilly and mountainous areas of the Lombardy Region.

In this part, areas with a declivity > 10 % are selected.

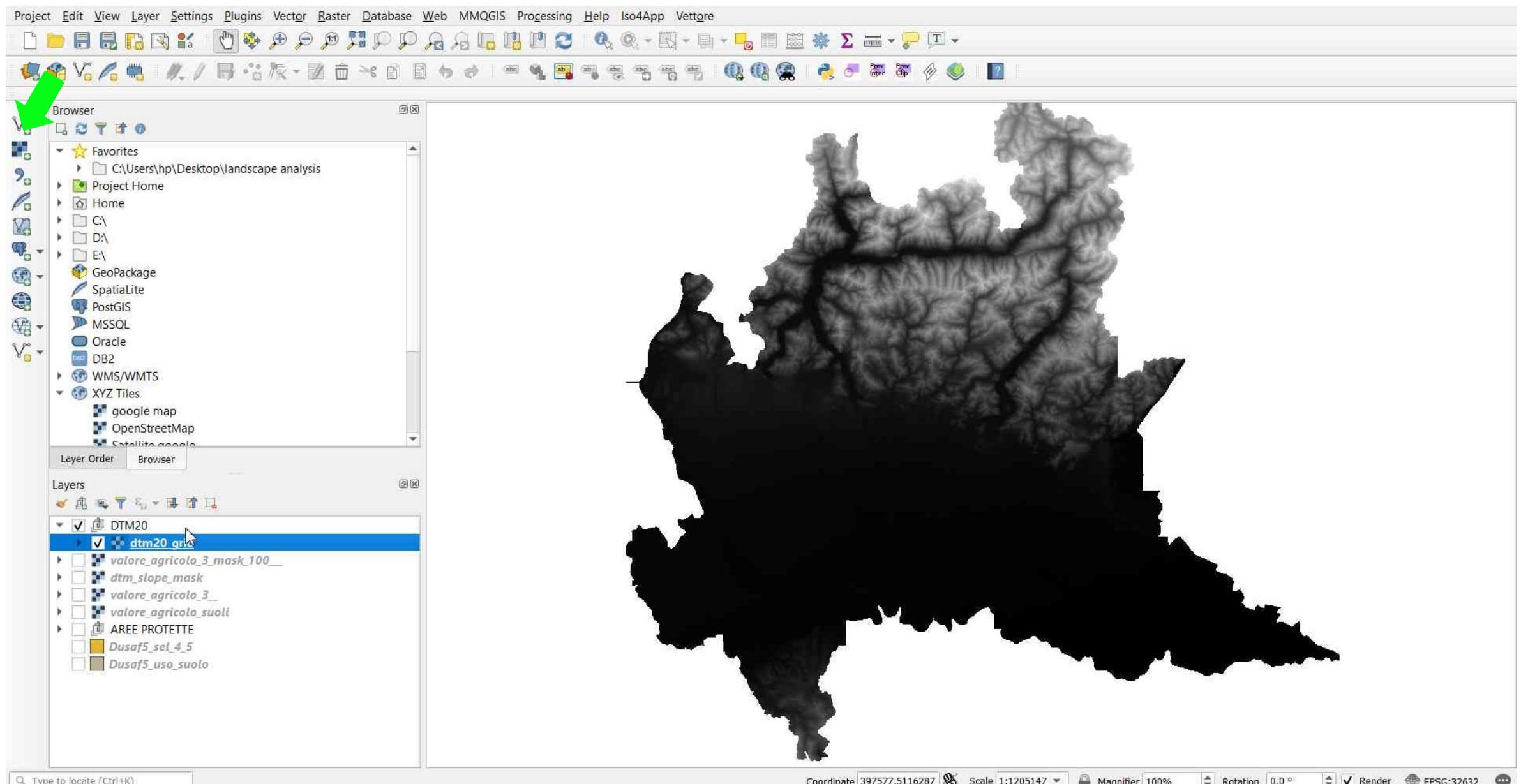
Tools

- Manage Layer Toolbar → Add Raster Layers
- Raster Analisi → Slope
- Raster → Raster Calculator

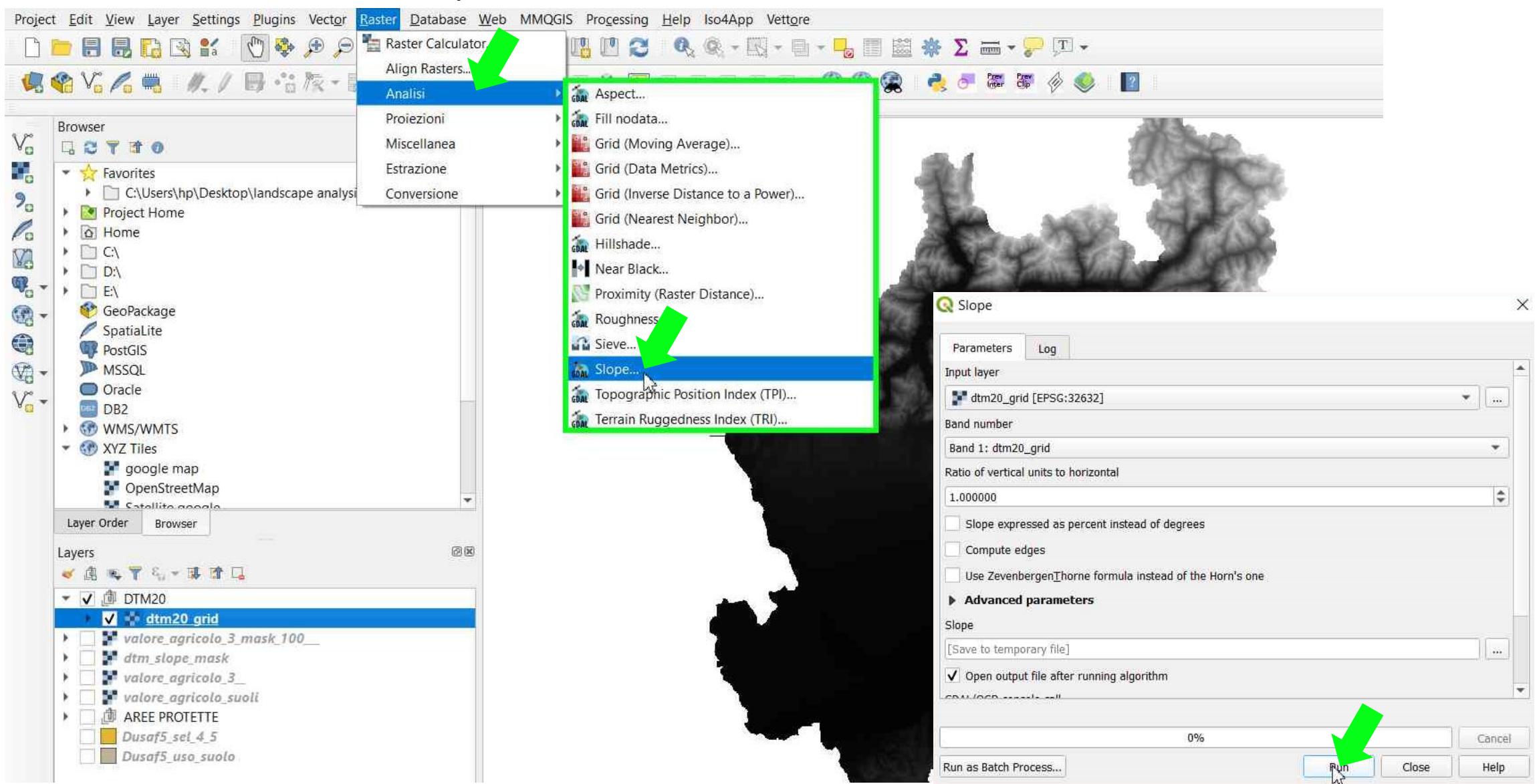
Metadata

http://www.geoportale.regione.lombardia.it/en/metadata?_p_p_id=PublishedMetadata_WAR_geoportalemetadataportlet&p_p_lifecycle=0&p_p_state=maximized&p_p_state=view&_PublishedMetadata_WAR_geoportalemetadataportlet_view=editPublishedMetadata&_PublishedMetadata_WAR_geoportalemetadataportlet_uuid=%7B293FC764-D101-41F5-AC74-235BA0F5E415%7D&_PublishedMetadata_WAR_geoportalemetadataportlet_editType=view&_PublishedMetadata_WAR_geoportalemetadataportlet_fromAsset=true&rid=local

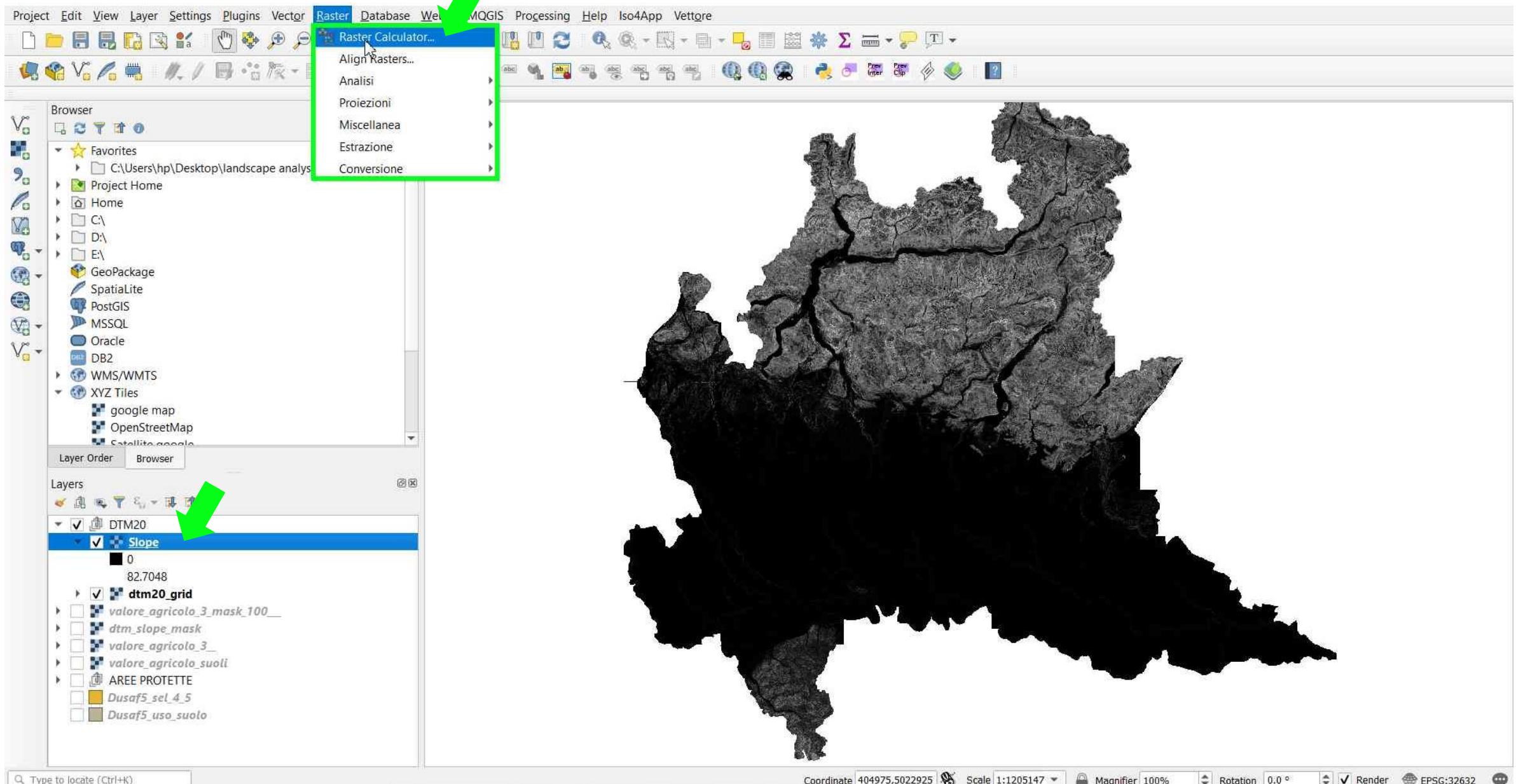
ADD RASTER LAYER → DTM20



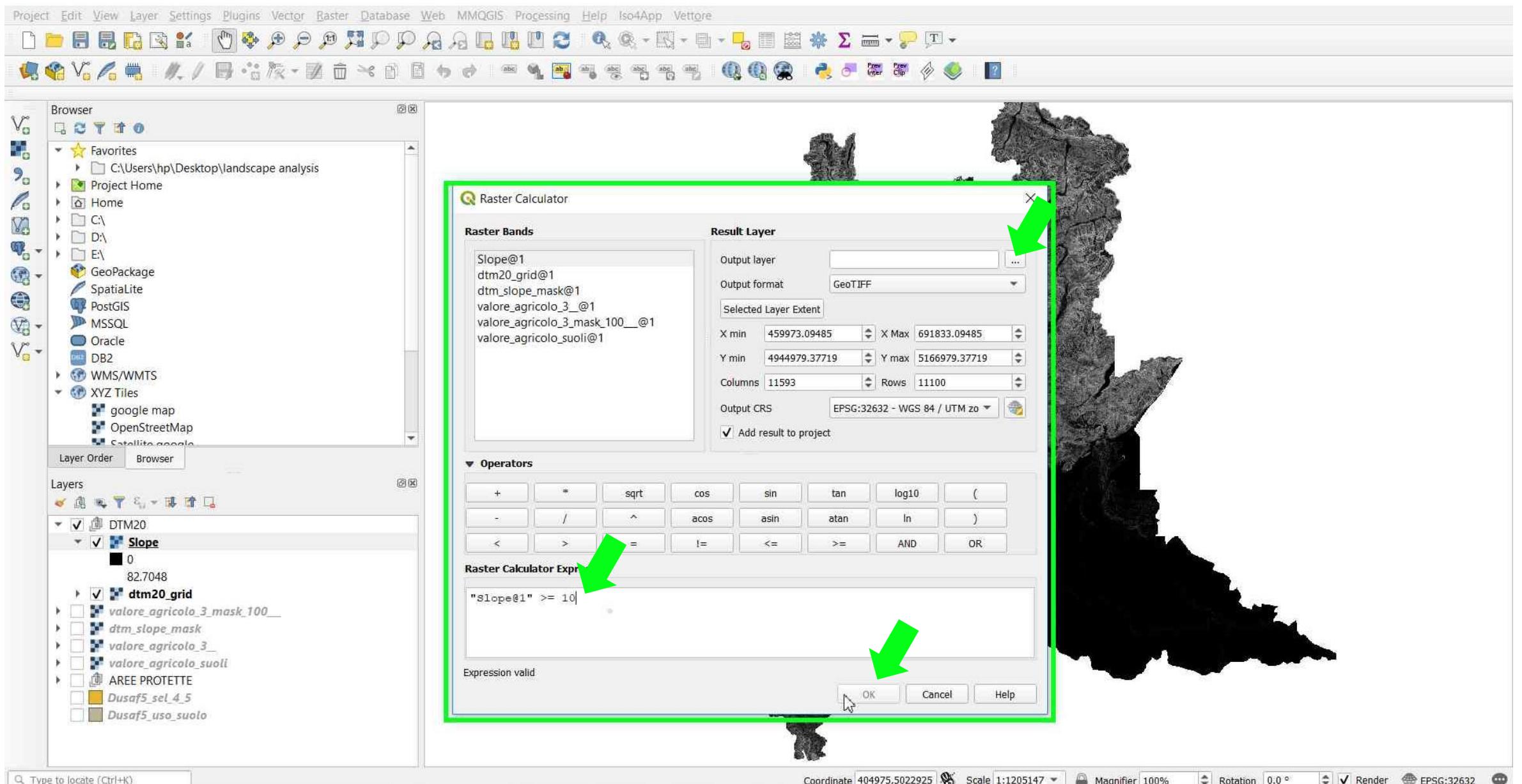
RASTER SLOPE → Raster → Analisi → Slope... → Run



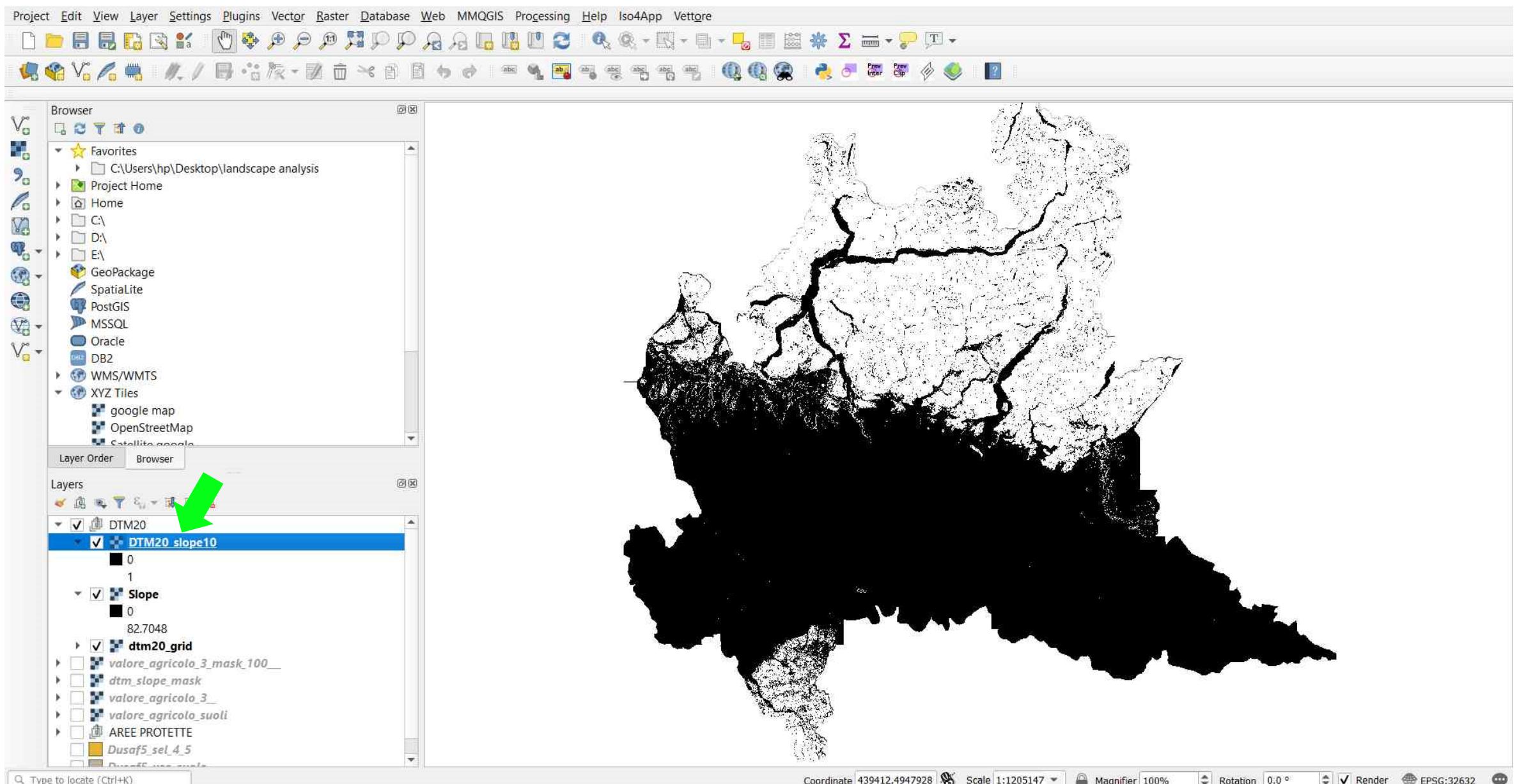
RASTER CALCULATOR → Raster → Raster Calculator to select slope ≥ 10



RASTER CALCULATOR → Double click on “Slope@1” → Type the Expression “*Slope@1*>= 10” → select the Output Layer → OK



RASTER CALCULATOR → A new raster layer has been created *DTM20_Slope_10*

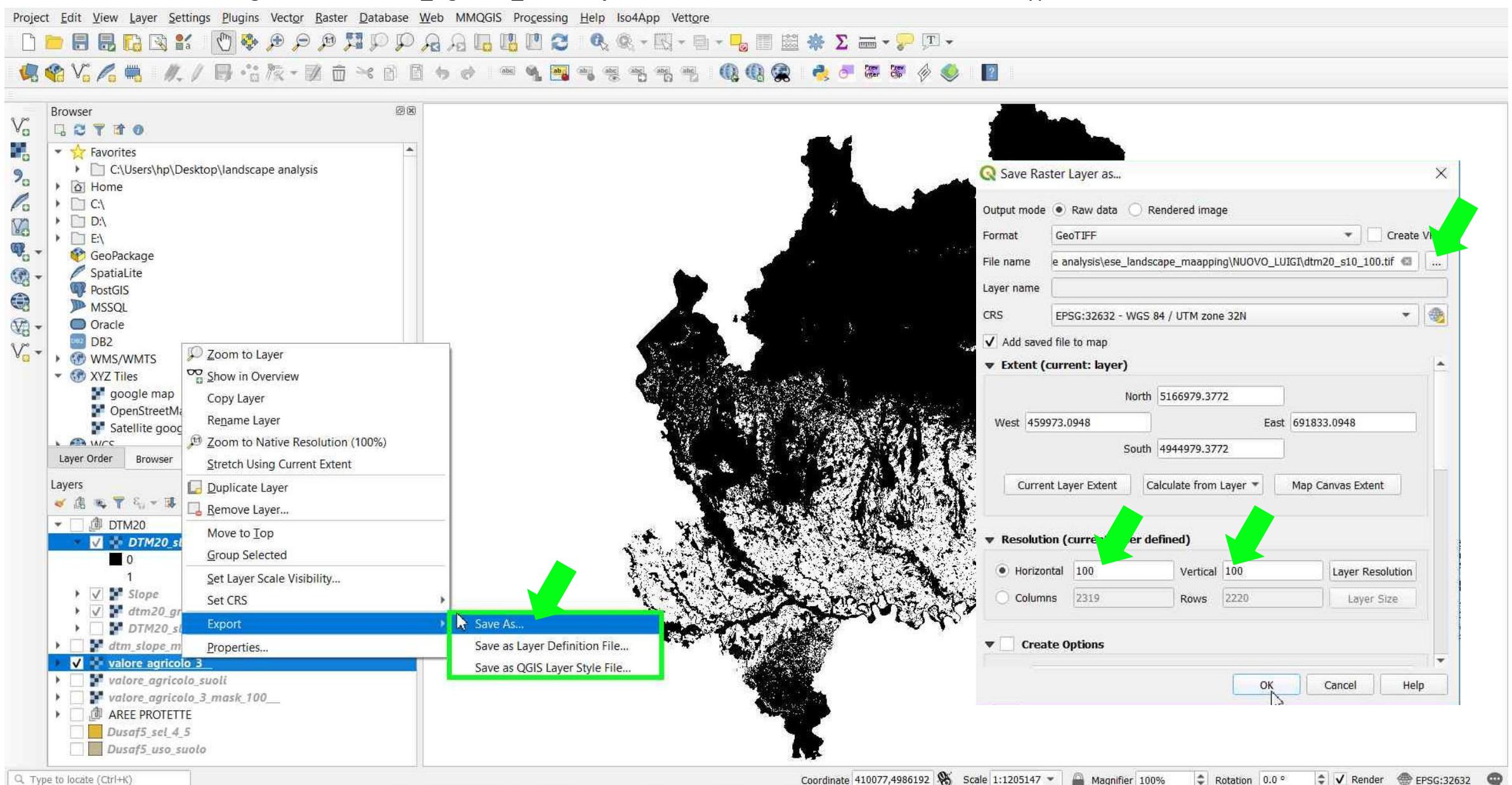


PART 5

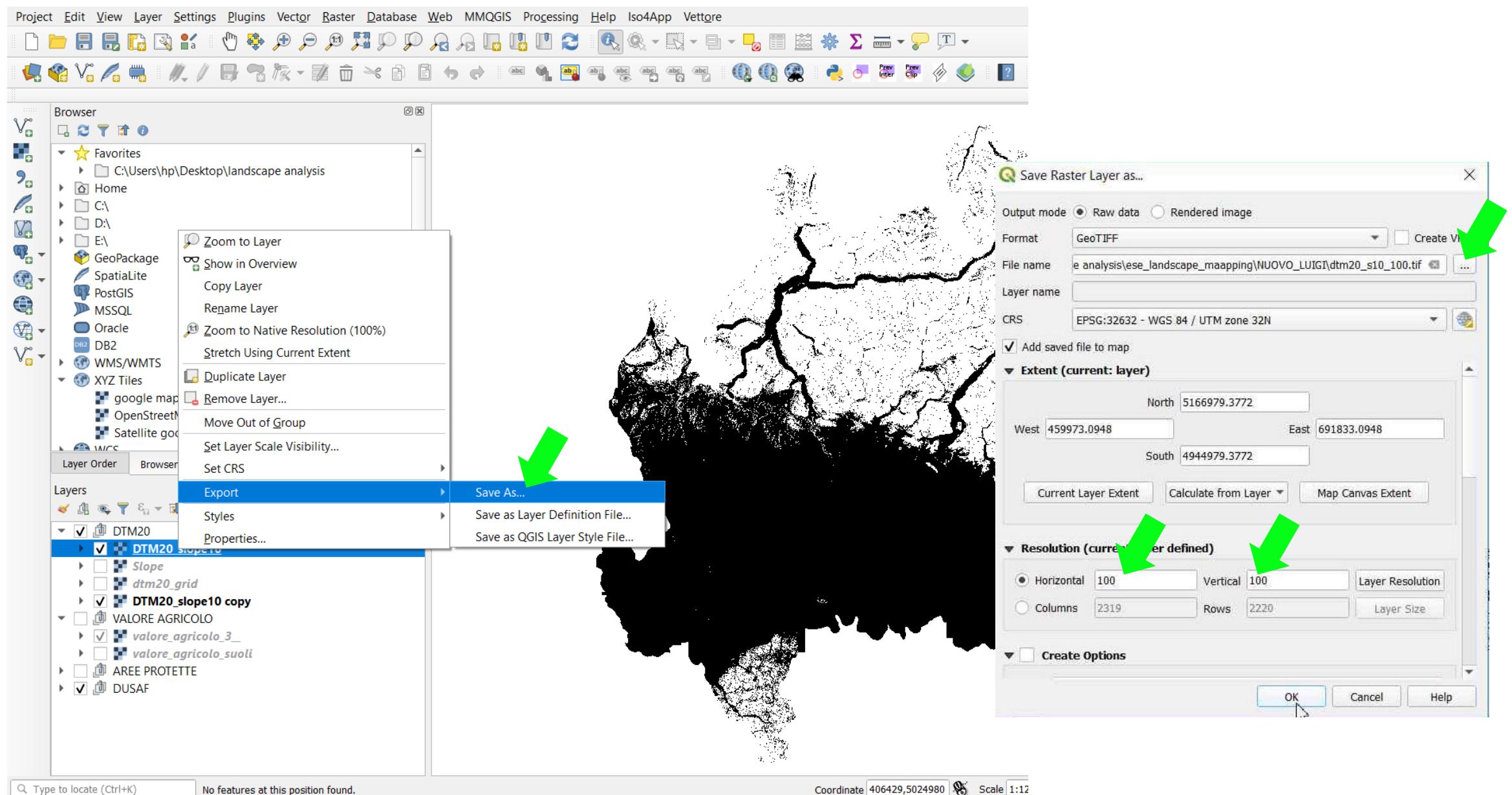
Raster resolution

- Export Raster → Change raster resolution
- Geoprocessing → Vector to Raster

EXPORT RASTER → Right-click to *Valore_Agricolo_3* → **Export** → **Save As...** → Choose File Name → Type **Resolution 100x100**



EXPORT RASTER → repeat the same operation for the layer DTM20_Slope_10

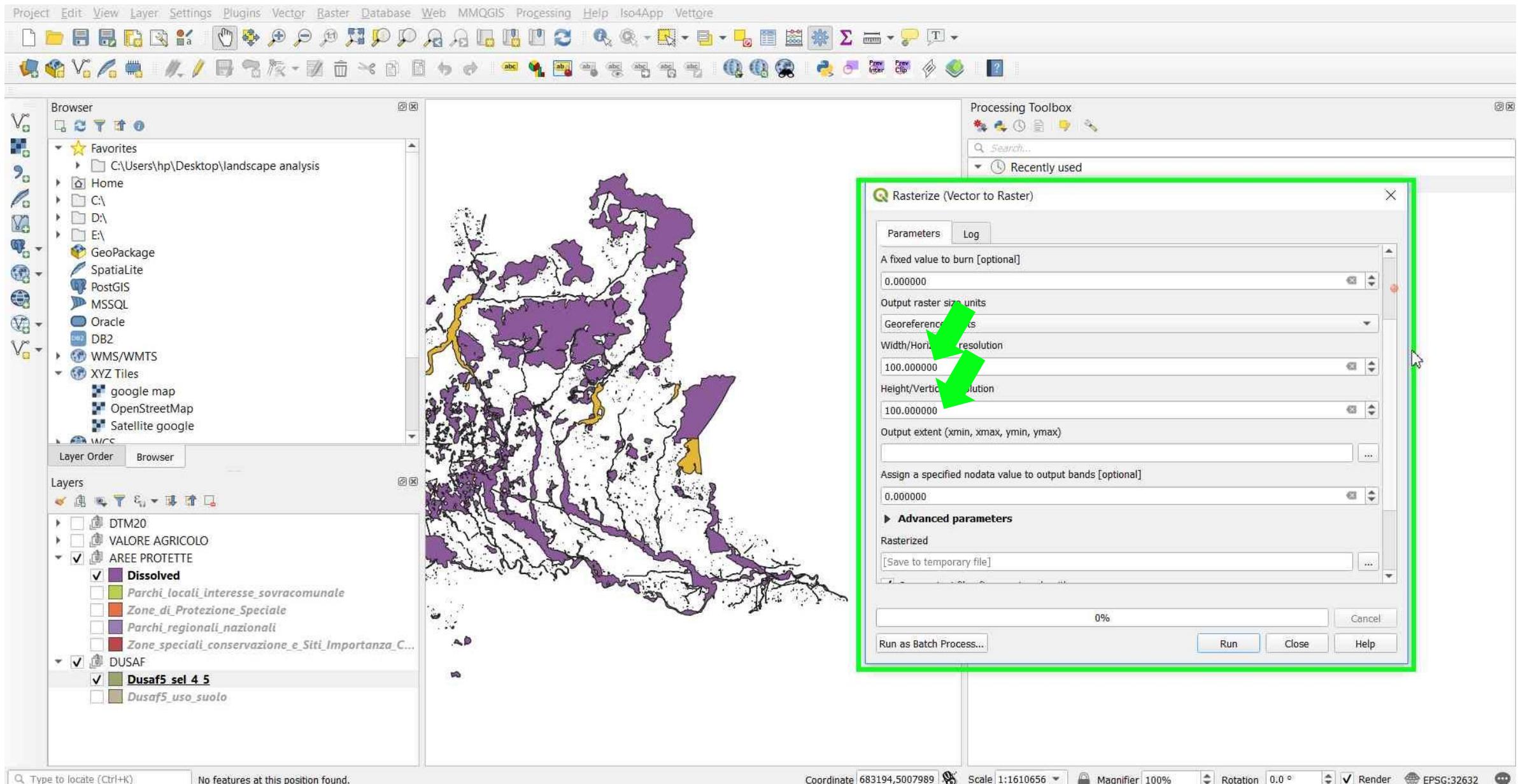


VECTOR TO RASTER → Open the **Processing Toolbox** → **Rasterize (vector to raster)** → run the operation for → **Dusaf_4_5 & Aree_Protette**

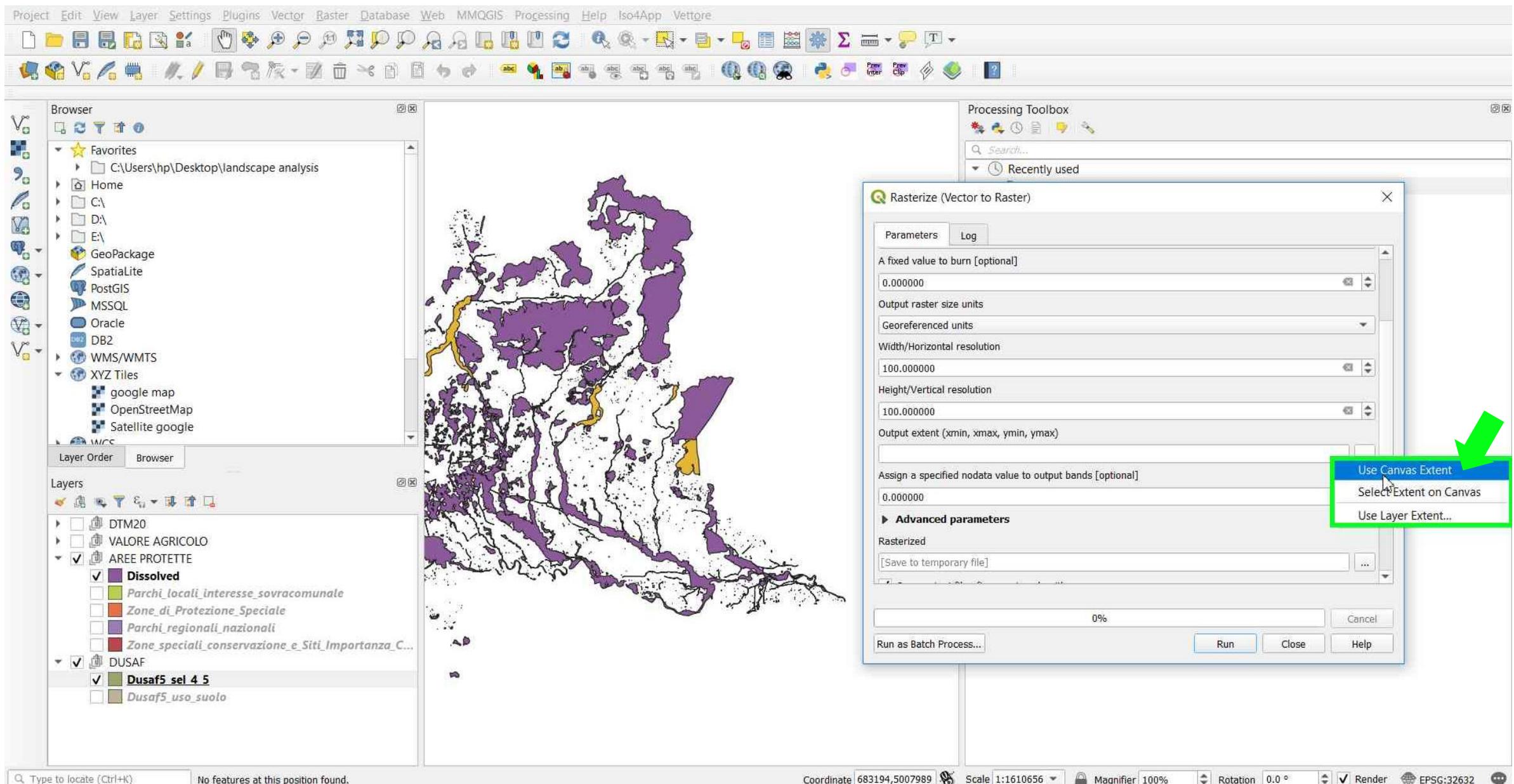
The screenshot shows the QGIS application interface with several panels:

- Top Bar:** Project, Edit, View, Layer, Settings, Plugins, Vector, Raster, Database, Web, MMQGIS, Processing, Help, Iso4App, Vettore.
- Toolbar:** Includes icons for file operations, zoom, selection, and various analysis tools.
- Browser Panel:** Shows the project structure with sections like Favorites, Home, C:\, D:\, E:\, GeoPackage, SpatiaLite, PostGIS, MSSQL, Oracle, DB2, WMS/WMTS, and XYZ Tiles. Under XYZ Tiles, 'google map' is selected.
- Layers Panel:** Displays vector layers: DTM20, VALORE AGRICOLO, AREE PROTETTE (with sub-layers: Dissolved, Parchi_locali_interesse_sovracomunale, Zone_di_Protezione_Speciale, Parchi_regionali_nazionali, Zone_speciali_conservazione_e_Siti_Importanza_C..., and DUSAFA), and DUSAFA (with sub-layers: Rasterized, Dusaf5_sel_4_5, and Dusaf5_uso_suolo). The 'Rasterized' layer is checked.
- Map View:** A central map showing a complex area with purple-shaded regions representing protected areas and a black line representing a boundary or stream.
- Processing Toolbox Panel:** Shows recently used tools: Rasterize (vector to raster), Merge vector layers, Merge, Slope, Dissolve, and many others categorized under Cartography, Database, File tools, Graphics, Interpolation, Layer tools, Network analysis, Raster analysis, Raster terrain analysis, Raster tools, Vector analysis, Vector creation, Vector general, Vector geometry, Vector overlay, Vector selection, Vector table, GDAL, GRASS, qgis2web, and SAGA. The 'Rasterize (vector to raster)' tool is highlighted with a green arrow.

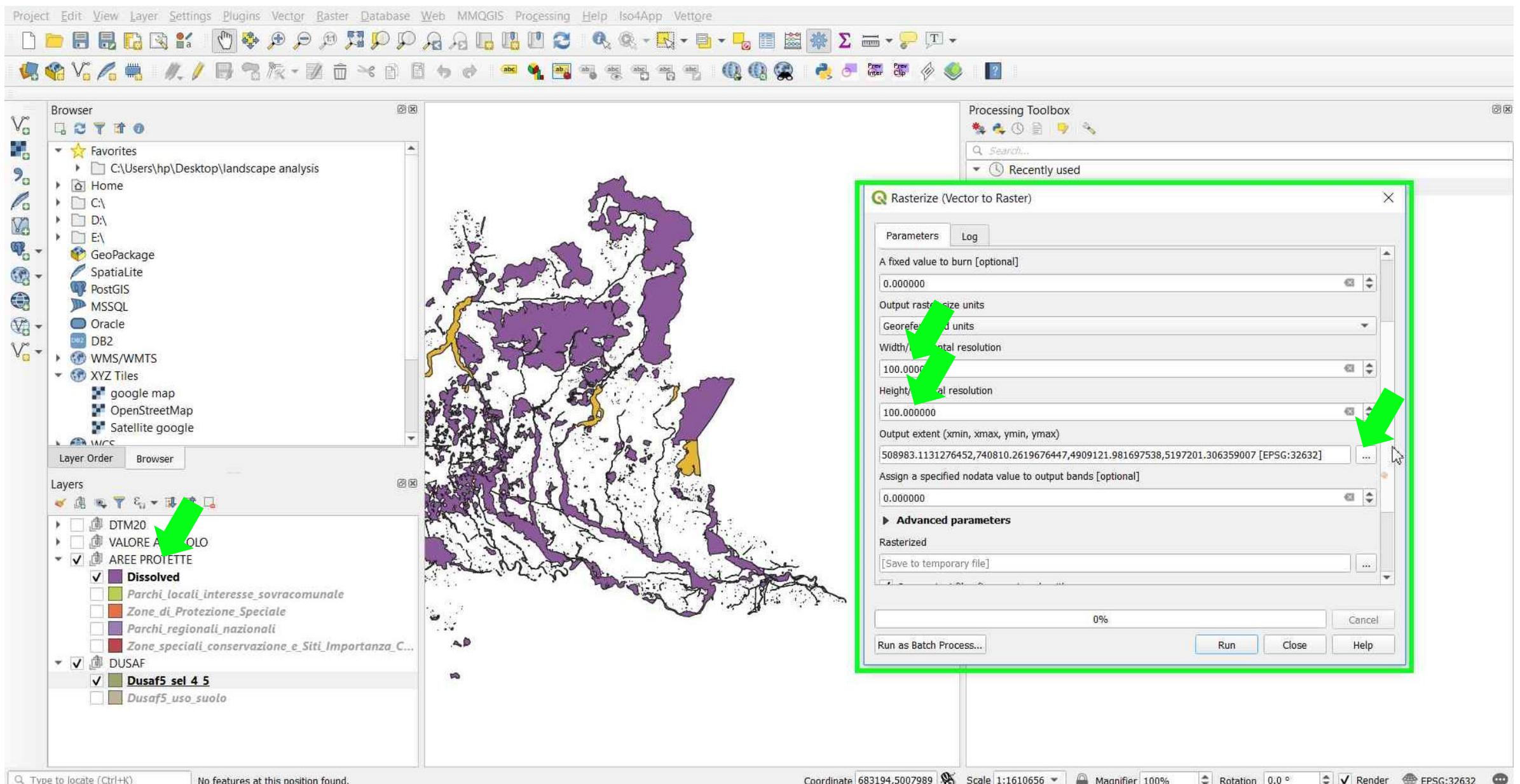
VECTOR TO RASTER → Set Resolution 100x100



VECTOR TO RASTER → Output extent → Use Canvas Extent



VECTOR TO RASTER → Repeat the same operation to *Aree_Protette* vector layer

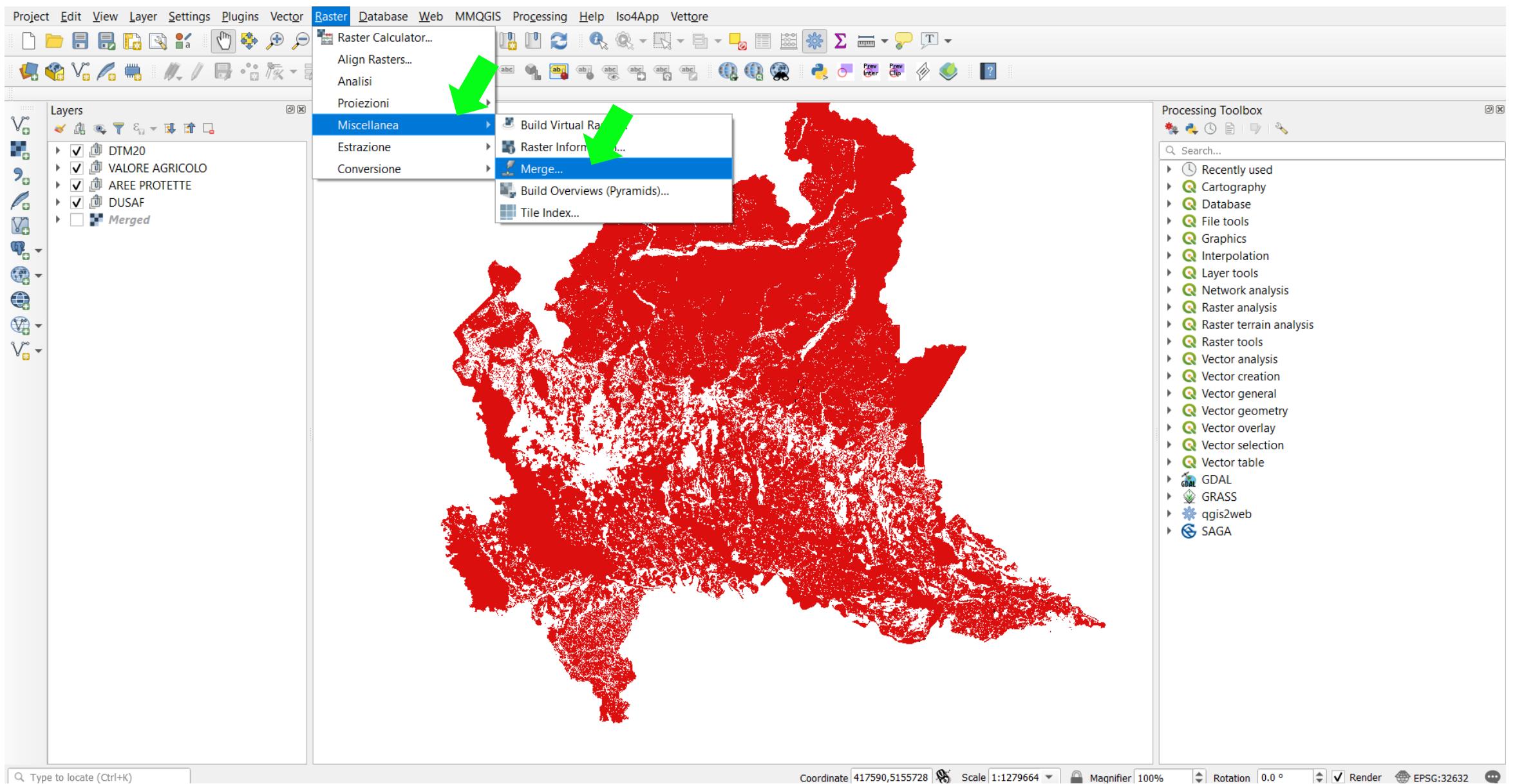


PART 6

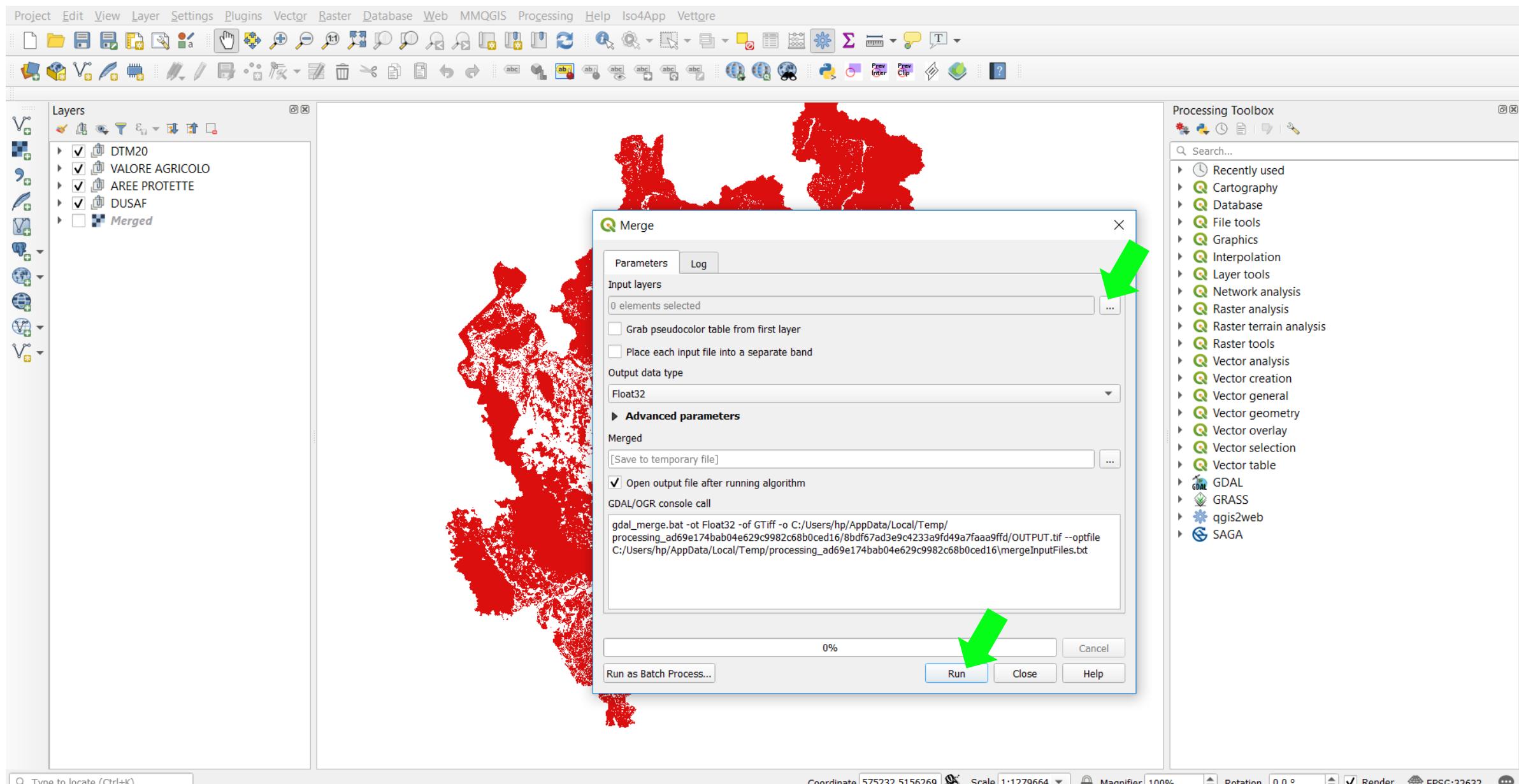
Spatial Mask

- Raster Miscellanea → Merge

MERGE RASTER LAYERS → Raster → Miscellanea → Merge...



MERGE RASTER LAYERS → Select the raster layers from the **Input Layers** window → *DTM20_Slope10 / Aree_protette / Dusaf_4_5 / Valore_Agricolo_3*



MERGE RASTER LAYERS → Raster layers have been merged to produce a spatial mask showing the potential limits to urbanization

