HACETTEPE UNIVERSITY

GEOMATICS ENGINEERING DEPARTMENT

GMT353
CARTOGRAPHY

Thematic Map Production Assignment

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1. INTRODUCTION

This study was carried out as a requirement for the GMT353 Cartography course, which asks students to create two thematic maps based on a particular region and data theme. The assignment's main goal is to give students hands-on experience with spatial representation of statistical data while also strengthening their theoretical understanding of map design through practical applications. By doing this, students should improve their ability to communicate visually as well as their ability to make data-driven decisions in cartographic contexts.

The provinces that make up Turkey's West Black Sea Region (TR8), which is categorized at the NUTS-1 level, have been chosen as the study's geographic focus. Two thematic maps were created using data from 2021. The choropleth mapping technique is used in the first map to visualize the population distribution, and a dot map is used in the second to show the number of registered motor vehicles. The Turkish Statistical Institute (TÜİK) provided both datasets, guaranteeing their consistency and dependability. These themes were picked because they have the ability to highlight spatial trends associated with the region's transportation and population patterns.

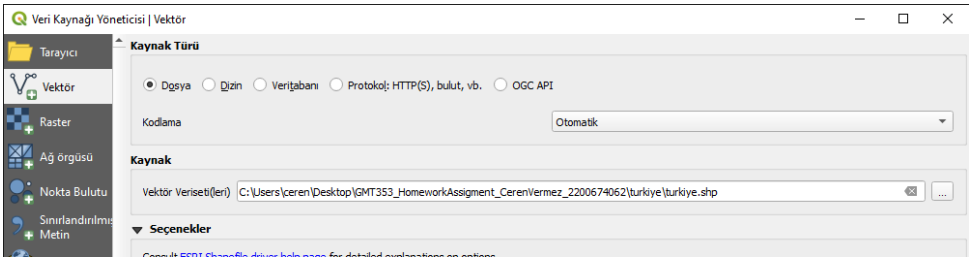
This project's primary goals are to show how various mapping approaches can be used depending on the type of data and investigate how cartographic factors like visual hierarchy, classification schemes, and symbology affect the efficacy of thematic map design. The generated maps' overall communicative power, visual balance, and readability are given special attention. Depending on the thematic focus, the advantages and disadvantages of each technique are compared in this way.

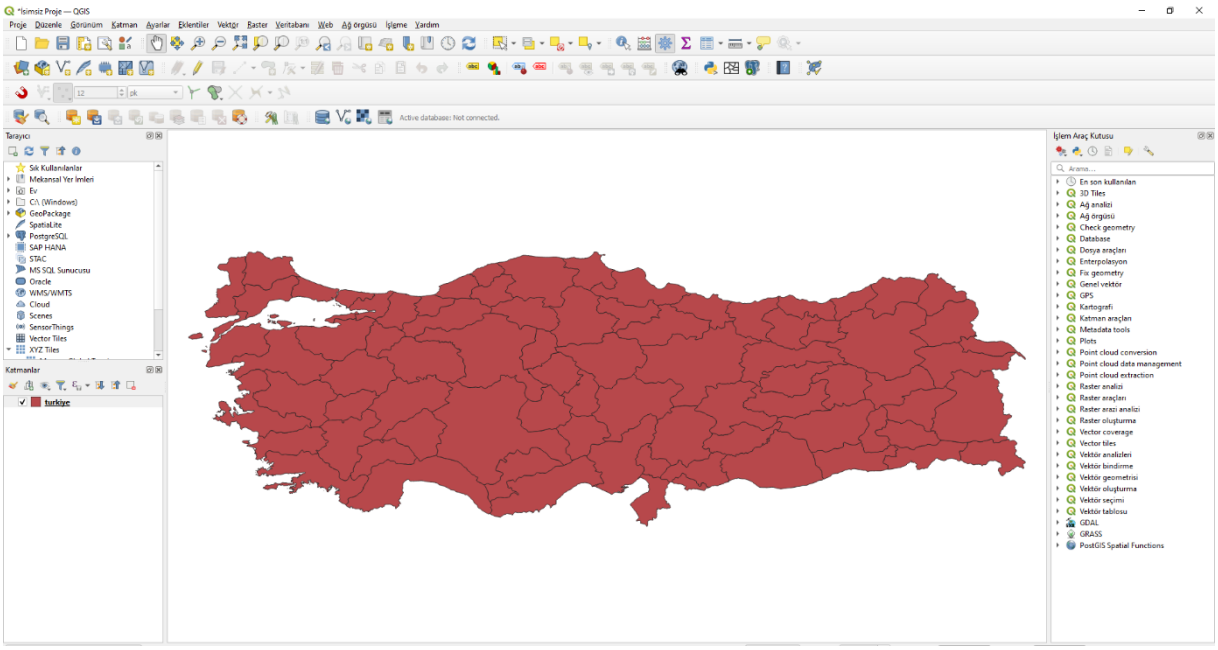
This report presents a systematic overview of the procedures followed throughout the map production process, including data preparation, visualization choices, and design considerations. In doing so, the study highlights not only the technical accuracy of the maps but also their visual and semantic effectiveness as tools for geographic communication.

2. DATA PREPARATION

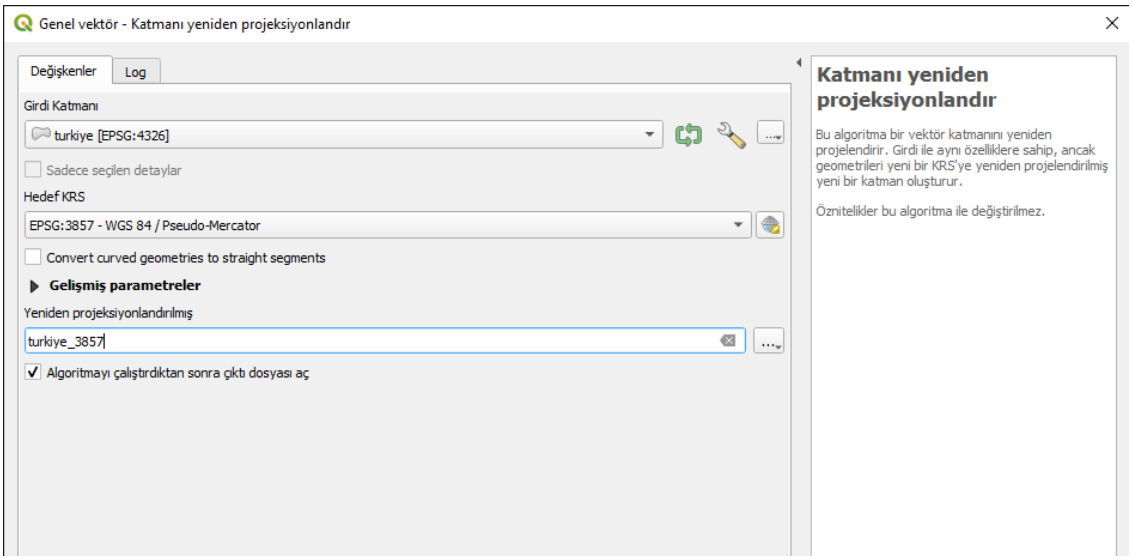
The production process of both maps started with a common data preparation phase. Initially, the shapefile layer (“turkiye.shp”) containing the provincial administrative boundaries of türkiye was added to the project. This layer is by default assigned to the EPSG:4326 – WGS 84 coordinate reference system, which is a geographic coordinate system using degrees (°) as its angular unit.

However, during thematic map production, accurate area and distance measurements are essential, and this system becomes inadequate. Measurements in degrees do not yield accurate surface areas, distortions may occur in shapes, and visual comparisons can become misleading. Therefore, the shapefile layer was reprojected to EPSG:3857 – WGS 84 / pseudo-mercator. This projection maps the Earth’s surface onto a plane using metric units (meters), making it more suitable for both calculations and visual representation. The transformation was done using the “reproject layer” tool in QGIS.



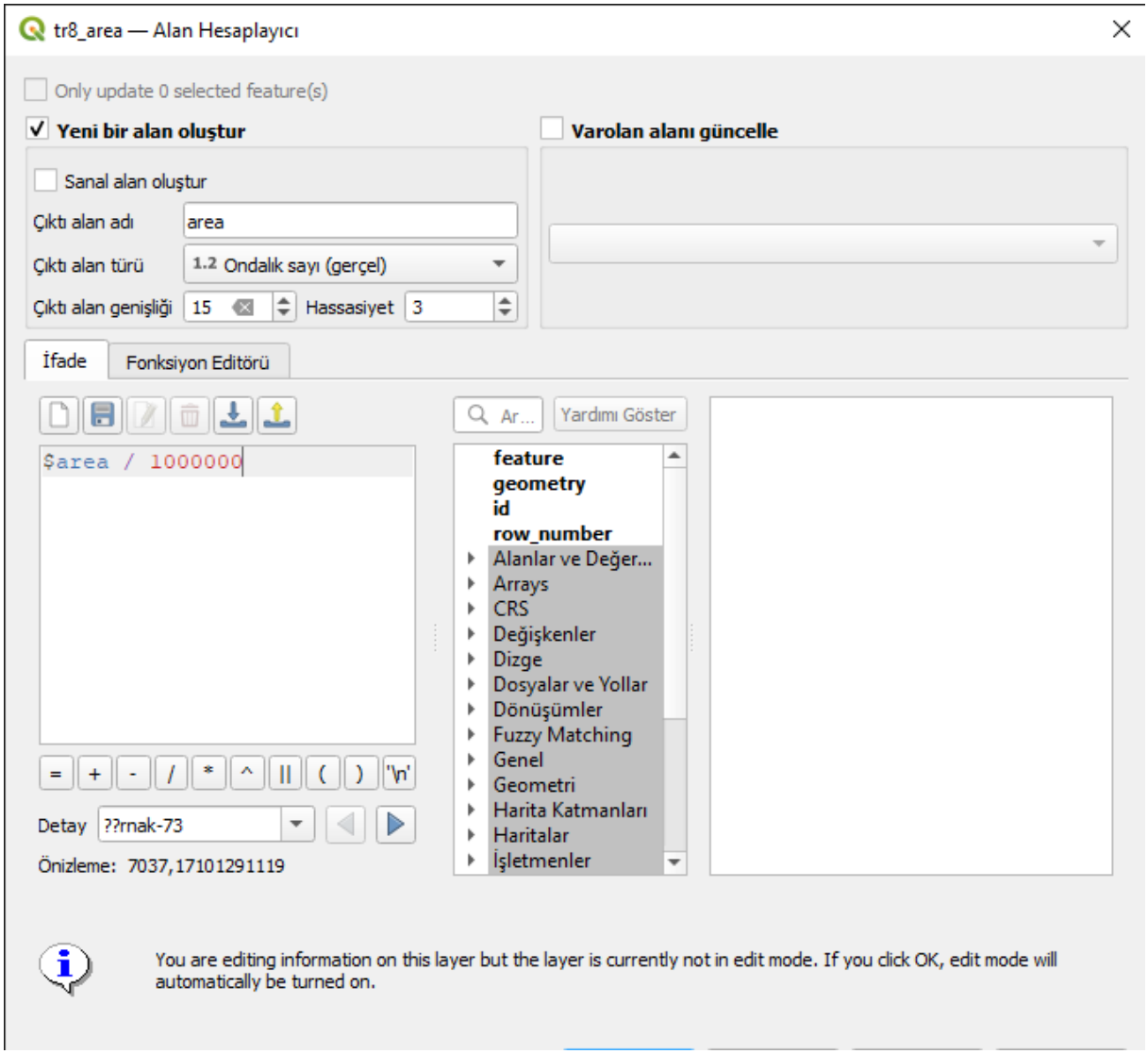


➢ ***Toolbox > Reprojected Layer***

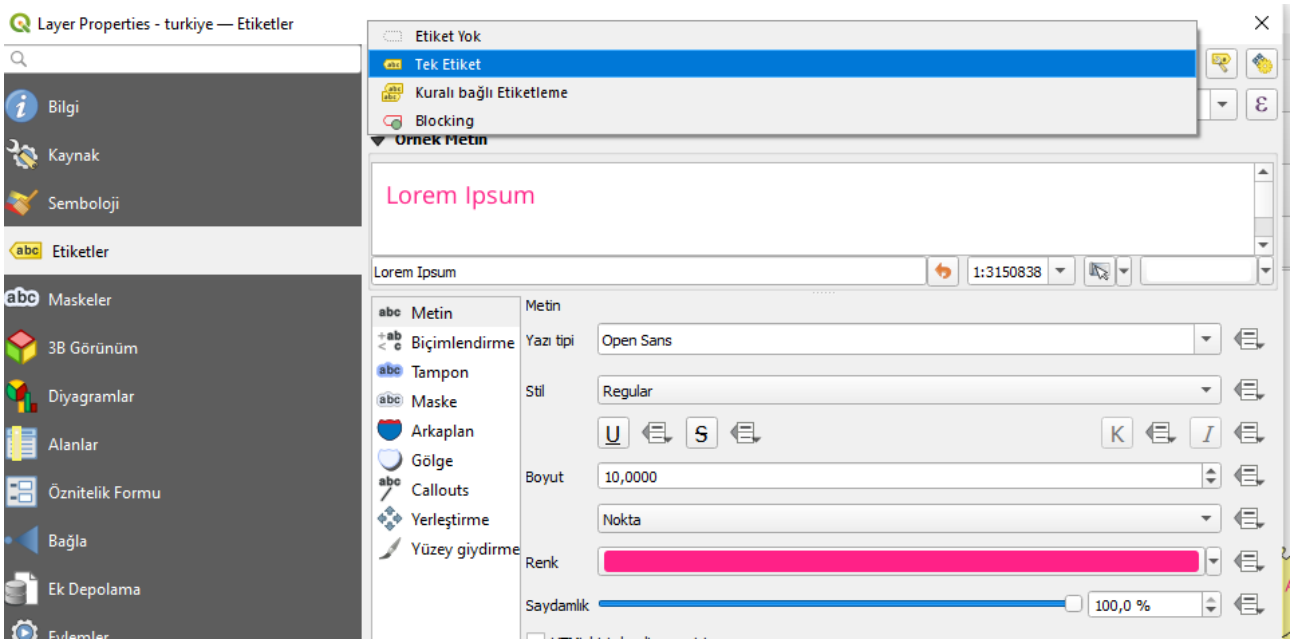


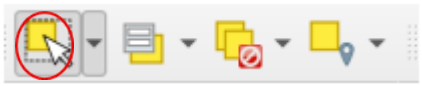
Following the reprojection, the area of each polygon was calculated in square kilometers. A new field named “area_km2” was created in the attribute table using the expression $area/1000000. This field was especially used to compute derived metrics such as population density.

➢ **Layer > Attribute Table > Area Calculator**



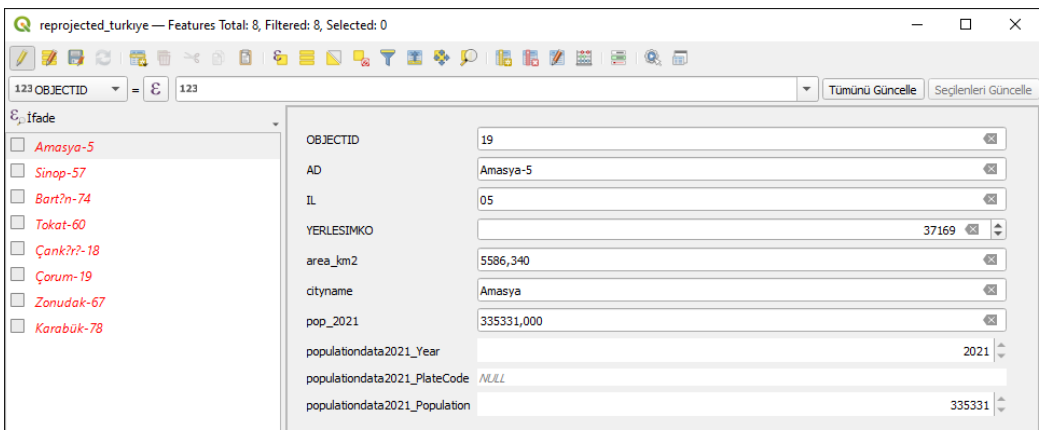
The analysis was limited to only the tr8 region. Labels were used to identify provinces visually, and then provinces outside of TR8 were manually selected and deleted using the selection tool. This ensured that mapping efforts focused solely on the target region.



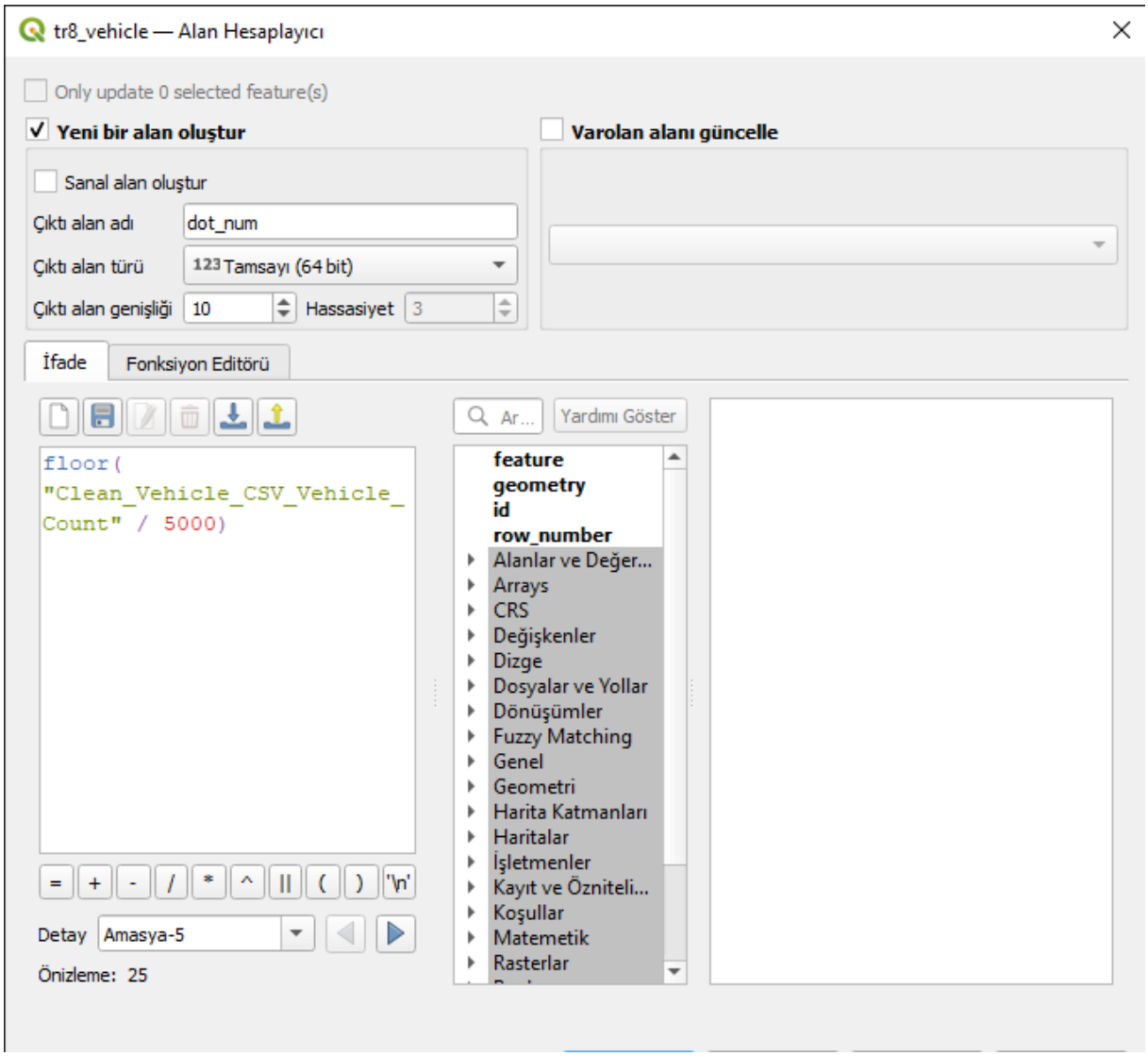


Thematic data such as population and motor vehicle counts were downloaded in csv format from TÜİK's medas system. To prevent matching errors due to Turkish characters, character normalization was applied to both the csv files and the shapefile attributes. For example, "ı" was replaced with "i", and a new cleaned field was created in the shapefile for consistent matching.

Before the join operation, a new key field was created in the shapefile by combining the province name and license plate code (e.g., "populationdata2021_Population"). The same field was present in the csv file, and the join operation was performed in QGIS using this common key. To preserve the joined data, new fields were created (e.g., "pop_2021") and populated with the corresponding values.



For the dot map, a new field named “dot_num” was calculated to determine the number of points corresponding to every 500 vehicles. This field was later used as the source value in the “Random Points Inside Polygons” tool.



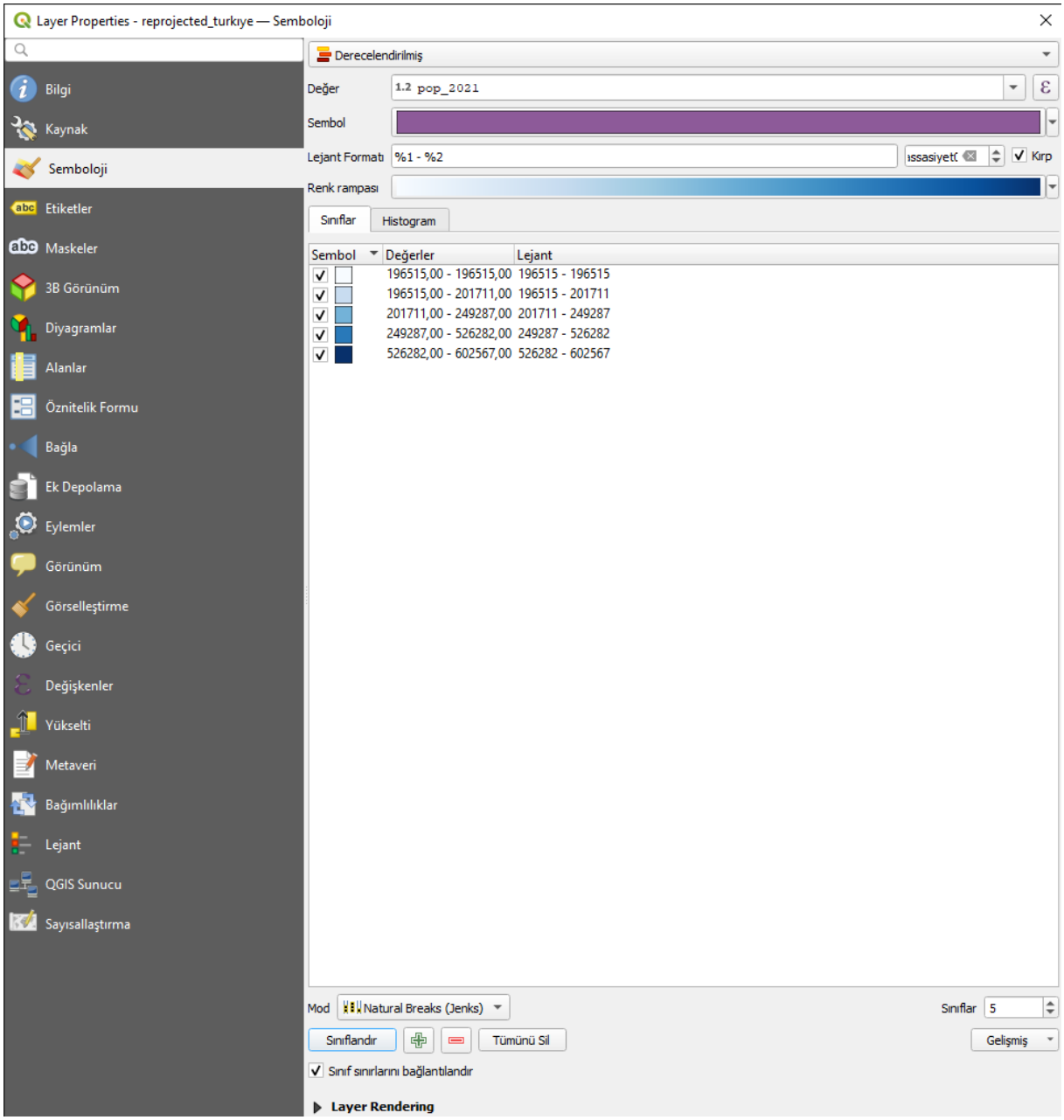
3. MAPS

3.1. CHOROPLETH MAP – POPULATİON (2021)

The choropleth mapping technique was applied to visualize the spatial distribution of population data. This approach uses color tones to represent each provincial polygon based on the population value that corresponds to it. When comparing absolute values at the provincial level, this method works especially well.

The previously made field pop_2021 was used for visualization, and a Graduated symbology was used to style the layer. Natural Breaks (Jenks), a classification technique that creates class intervals based on naturally occurring clusters in the data, was selected because it offers more significant distinctions, particularly for skewed datasets. Five classes in all were established, and the value ranges were computed automatically.

A color ramp progressing from light to dark blue was used. This means that provinces with lower population values were represented with lighter shades, while those with higher values were shown in darker tones. The legend format was set to display absolute values clearly.



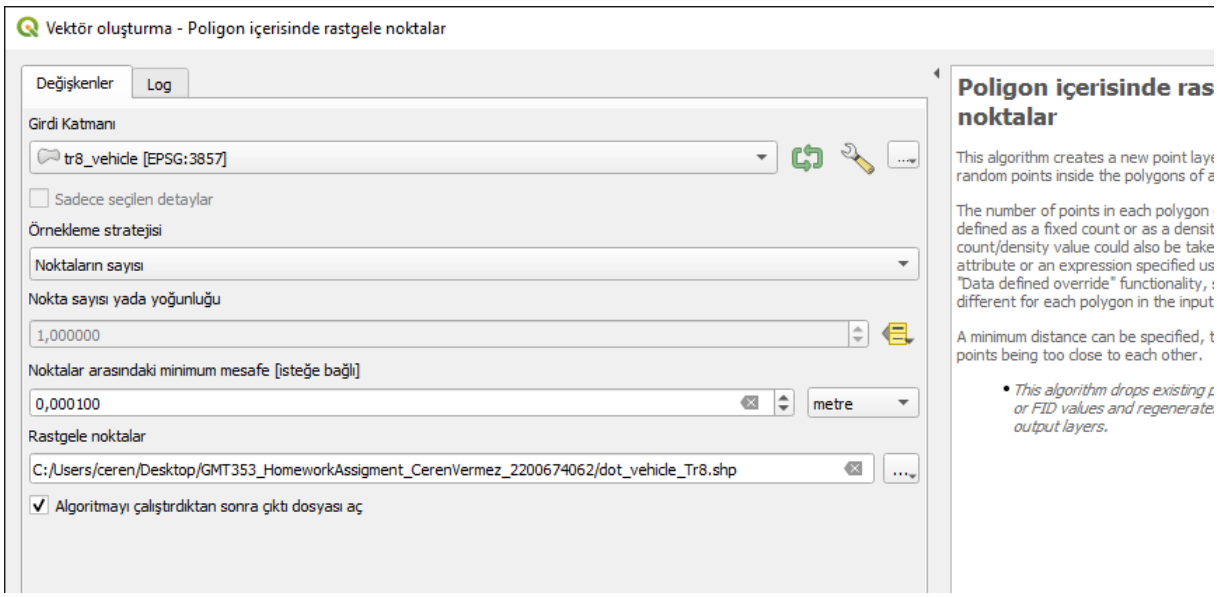
3.2. DOT MAP – NUMBER OF MOTOR VEHİCLES (2021)

The dot mapping technique was used to visualize data about motor vehicles. Using this method, a fixed quantity of the variable is represented by each of the fixed-size dots that are randomly distributed within polygons. Here, 500 cars are represented by each dot.

Using the previously prepared vehicle data, the number of dots for each province was determined prior to the dot map being generated. The "Random Points Inside Polygons" tool subsequently made use of a field named "dot_num." "dot_num" was designated as the source field, and the point count mode was chosen.

A tiny minimum distance criterion was established in order to prevent dots from overlapping on the map. This maintained clarity and avoided clutter. For the dots, a fixed size of 1 mm and a neutral black color were chosen. The overall goal of the design was to graphically depict the area's vehicle density.

The benefit of the dot map is that it uses visual density to directly communicate magnitude. However, the map is meant for visual representation rather than spatial analysis because the points are arranged randomly and do not indicate exact locations.



4. MAP DESIGN AND EVALUATION

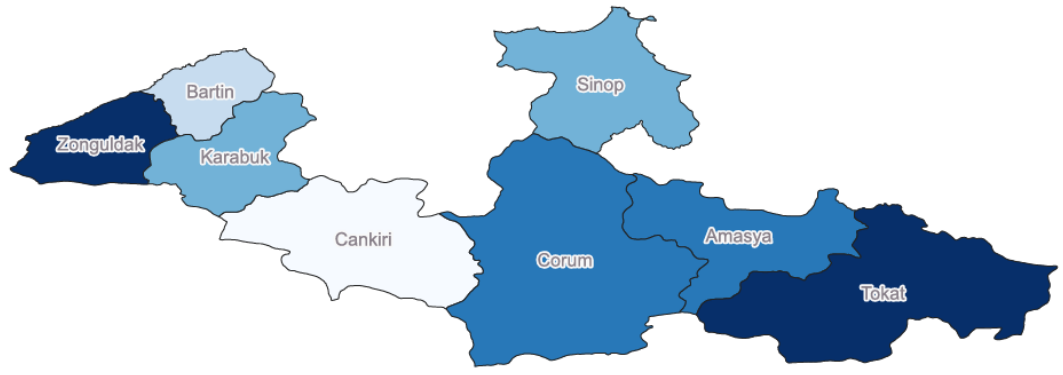
The fundamentals of cartographic design were taken into account when creating the thematic maps. Visual hierarchy, contrast, color harmony, clarity, and symbol consistency are some of these principles. Using a straightforward and practical design approach to prevent clutter, each map sought to convey the data in an understandable and efficient manner.

After classification, color transitions in the population map were maintained as smooth as possible, with darker blue tones highlighting higher values. The title and scale bar were placed to balance the map layout, and the legend was aligned for readability and clarity. Both legibility and aesthetics were taken into account when choosing the typefaces for the map.

Points on the dot map were shown as white and of a set size. Vehicle density in sparse or dense areas could be visually perceived because the distribution was symbolic rather than exact due to the random placement of the points. Each dot was placed in balance with the north arrow, scale, and title, and the legend made it obvious how many vehicles each dot represented.

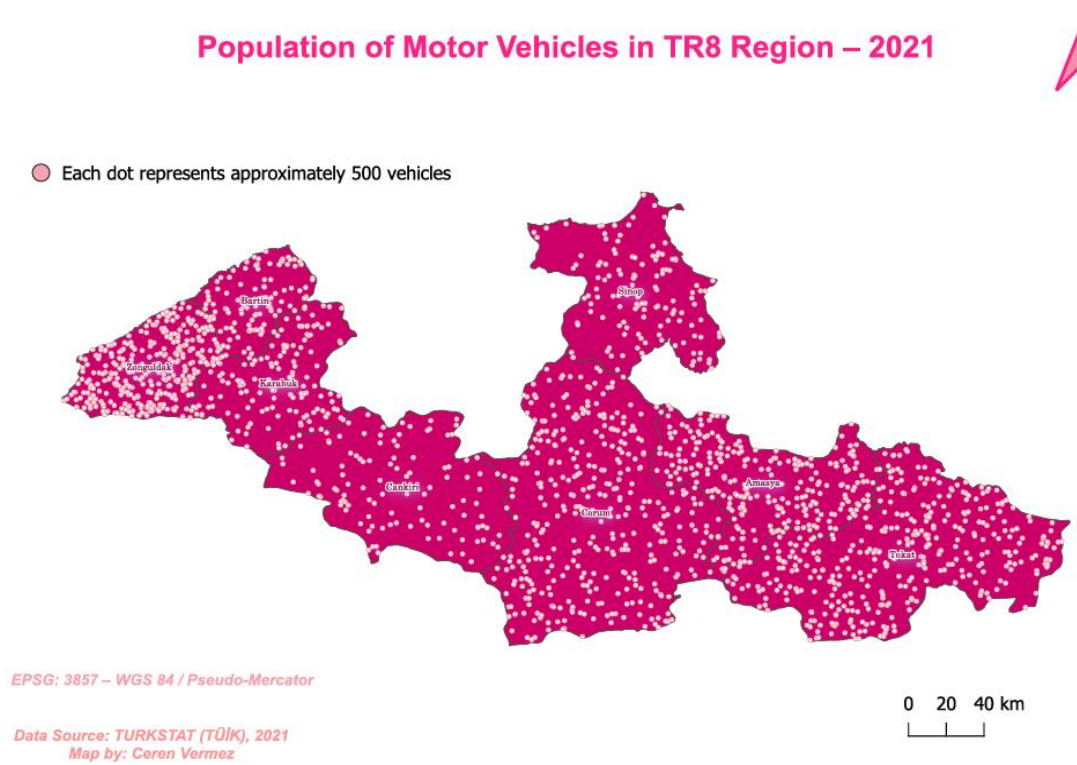
Both maps were made with theme-appropriate visual elements and gave priority to usability and simplicity in order to improve user experience. By choosing neutral color schemes, accessibility factors like color blindness were also taken into account.

Population Distribution of TR8 Region – 2021



Prepared by: Ceren Vermez
Course: GMT353 – Spring 2025

Population of Motor Vehicles in TR8 Region – 2021



EPSG: 3857 – WGS 84 / Pseudo-Mercator

Data Source: TURKSTAT (TÜİK), 2021
Map by: Ceren Vermez

5. RESULTS AND EVALUATION

Thematic cartography is a multi-layered, integrative field that goes far beyond simply symbolizing spatial data, as this study has shown. In addition to spatial representation, the creation of maps required the application of holistic conceptual decisions. The importance of choosing mapping techniques that are suitable for the type of data was demonstrated by the choropleth and dot maps created using vehicle and population data from the TR8 region. The dot map allowed users to intuitively understand spatial densities and distribution patterns, while the choropleth map made statistical comparisons between regions easier.

In addition to ensuring technical accuracy, each stage of the mapping process—projection transformation, data cleaning, area calculation, classification, and symbolization—also improved the quality of visual communication. The maps became accessible and useful communication tools as a result of design choices like employing color-blind-friendly palettes, making sure layout structures were balanced, and improving readability. The open-source and adaptable framework of QGIS software greatly aided in productivity and visual output.

This report concludes by restating that thematic maps are more than just data presentation tools; they are comprehensive analytical frameworks that facilitate spatial decision-making, guide the creation of policies, and use powerful visual language to connect data, context, and user insight.

6. REPORT QUESTIONS AND EVALUATION

Question 1: What are the attributes of the coordinate reference system (datum, ellipsoid, prime meridian, unit, projection (if any)) of the shapefile?

The EPSG:4326 coordinate reference system, a popular geographic system, is initially adopted by the shapefile used in this project. The WGS 84 datum, the GRS 1980 ellipsoid, Greenwich as the prime meridian, and degrees (decimal degrees) as the angular unit are some of its essential characteristics. EPSG:4326 does not directly support planar metric measurements because it is not a projected system. Nonetheless, it is a preferred default for many applications due to its high compatibility with global GPS-based datasets and geospatial platforms.

Question 2: What makes this coordinate reference system unsuitable for your thematic map? Which coordinate reference system would be more appropriate?

The geographic coordinate system EPSG:4326 uses angular units (degrees) to express location. It works well for positional accuracy on a global scale, but it is insufficient for thematic maps that need exact area or distance calculations. Measurements become distorted when there is no planar projection, especially when comparing spaces or calculating surface area (such as km^2). A projected coordinate reference system is necessary for these kinds of uses. EPSG:3857 (WGS 84 / Pseudo-Mercator) was selected for this project. This CRS is compatible with QGIS and the majority of web mapping interfaces, supports consistent symbol placement, and enables metric-based spatial computations. It is perfect for regional thematic mapping because of its extensive use in online cartography and spatial visualization.

Question 3: What classification method was used for each map, and why?

The Natural Breaks (Jenks) classification method was used in the choropleth map. When the dataset has significant skewness or outliers, as is frequently the case with population figures across administrative boundaries, this method is especially useful because it finds inherent clusters and gaps in the data distribution. Natural Breaks improves the map's capacity to meaningfully convey important class differences.

In contrast, classification was not used in the dot map. Rather, a proportional point density strategy was used. Each dot was given a fixed value (500 cars, for example), and the total number of points for each administrative unit was determined using that value. This made it possible to visually represent the number of vehicles in the area. The points were randomly distributed within each polygon using the "Random Points Inside Polygons" tool in QGIS, providing a generalized spatial impression rather than precise location data.

Question 4: Explain the visual variables you used for the maps you created and your reasons for those choices.

Color saturation and value were the main visual variables used in the choropleth map. A gradient was employed, with light blue denoting lower values and dark blue denoting higher values. Users can quickly discern between areas with varying population densities thanks to the clear visual hierarchy created by this sequential color scheme. Furthermore, the selection of a perceptually uniform ramp guaranteed that data variations were readable and visually balanced.

Dot count, size, and distribution were the visual variables in the dot map. To emphasize clarity and reduce visual distraction, each dot was set to the same size and color (black). To prevent suggesting erroneous precision in vehicle locations, dot placement was randomized within polygon boundaries. Without creating false spatial associations, this method helps the user perceive density and overall distribution. The map's visual efficacy and communication power are enhanced by the symbology's simplicity.

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