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Multi-Scalar Mapping of Potential Voters in Tunisia's 2019 Presidential Elections

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Abstract

In Tunisia, and after the 2011 revolution, the electoral potential increased between 2011, 2014, 2017, 2018 and 2019. Similarly, the structure of this potential, by age and sex, has evolved during these different periods. During the 2019 presidential and legislative elections, 6,620,983 people were registered to vote within Tunisia (www.isie.tn). The structure of this electoral potential deserves to be mapped and analysed on different scales. In this study and using the Hyperatlas software, we have mapped and analyzed the Tunisian electoral potential for 2019, by sex and age group. HyperAtlas is a means of multiscale analysis. It is a "tool for measuring and mapping territorial inequalities" (Ysebaert et al., 2011). After the creation of the registration database for elections, we were able to visualize and analyse the inequalities in distribution and structures between the three regions (North, Central and South), the six sub-regions (NE, NO, CE, CO, SE and SO), the 24 governorates of the territory and the 275 delegations of the country, on the one hand, and between the different units on the other hand.

Keywords

Multi-Scalar Mapping, Presidential Elections, Potential Voters, Tunisia

1. Introduction

Since 2011, Tunisia has had several parliamentary, presidential and communal elections. Generally, the number of registrants, in Tunisia and abroad, varies between the various elections. During the 2019 presidential and legislative elections, 6,620,983 people were registered vote inside the Tunisian territory (www.isie.tn). The potential of voters within the country has increased between

2011, 2014, 2017, 2018 and 2019. Similarly, the structure of this potential, by age and sex, has changed during these different periods. This structure deserves to be mapped and analysed according to different scales.

In this study, we used the Hyperatlas software to map and analyze the Tunisian electoral potential of 2019 on different scales. We also analyzed this potential by sex and age group.

This study consists of three parts. The first part is introductory, in which we have described the methodology of the work and we have also presented the software and the data used. In the second part, we studied the potential of electors at different scales, by sex and by age group. Finally and in the third part, we presented some summary elements and some recommendations.

2. Presentation of the Study Area and Methodological Elements

2.1. The Study Area

Tunisia is subdivided into three major zones: the North, the Centre and the South. Each zone comprises two regions: the North East, the North West, the Central East, the Central West, the South East and the South West. Each region is composed of x number of governorates. The whole territory is composed of 24 governorates. Each governorate has an X number of delegations. There are 275 delegations across the country (Dhieb & Belarem, 2016; Dhieb et al., 2015). In this study, we use four scales of analysis; the zone, the region, the governorate and the delegation (**Figure 1** and **Figure 2**).

2.2. The Data Used

We used the registration data for the elections. They are extracted on the web

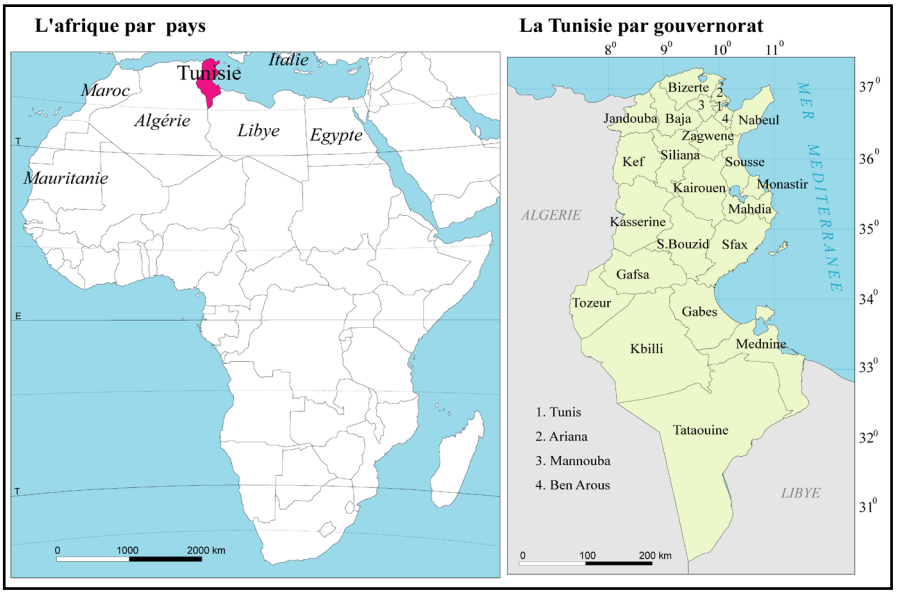


Figure 1. Study area (source: Ben Fguira & Belarem, 2018).

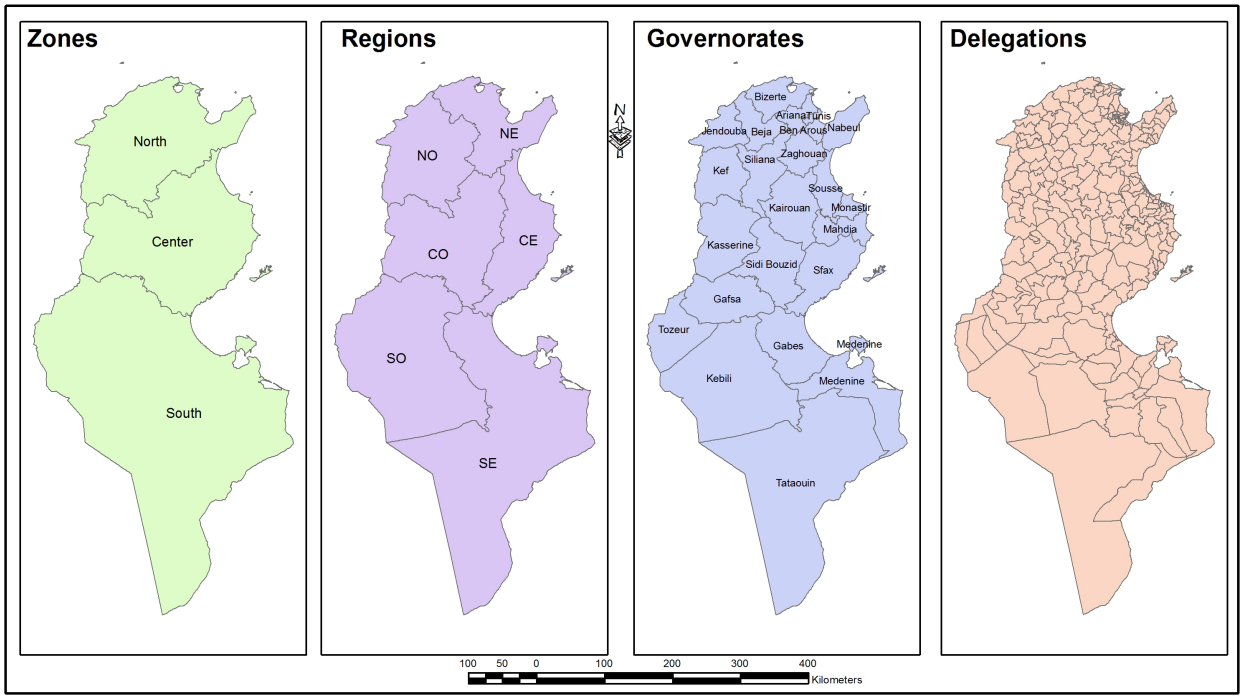


Figure 2. The scales of mapping and analysis of electoral data.

from the Independent Higher Authority of Elections I.H.A.E. (www.isie.tn). Population data are extracted from the website of National Institute of Statistics N.I.S. (www.ins.nat.tn). We used the 2014 Census of Population and Housing. This census is used by the I.H.A.E., to prepare and verify the list of potential voters. In addition to these two main sources, we use other previous studies (Belarem, 2017; Gana & Van Hamme, 2016; Gana et al., 2012; Gana, 2011; Belhedi, 1992a, 1992b, 2005; Franklin et al., 1992a; Franklin, 1992b; Delwit, 2019; http://hypercarte.imag.fr; https://en.wikipedia.org).

2.3. Methodology and Software Used

This work is based on the fruit on cooperation between the teams of researchers at the CNRS RIATE (UMS 2414), Géographie-cités (UMS 8504) and the SYFACTE research laboratory at the University of Sfax. In fact, this cooperation produced a Tunisian socio-economic hyperatlas. We used the data and map background files of this HyperAtlas, after making the necessary modifications, to create an electoral HyperAtlas.

We used the Excel software to process and organize statistical data. Two tables are provided: the first is that of structure. It is composed of several sheets "respecting a defined model" (Benoit Le, 2011). In the second file, we introduced the inventory data for the elections. The ratio type data will be generated automatically by HyperAtlas.

We also used a MID/MIF file that includes the geometric description of the spatial units. This file is generated under the Mapinfo software, after the creation of the vector map background.

We have integrated the three geometry, inventory and structure files into the HyperAdmin software. The generated product is a HyperCarte extension file (.hyp). This file can be opened and manipulated on the HyperAtlas software for the generation of maps and cartographic reports. HyperAtlas is an embossed multi-scalar analysis tool. It is "a tool for measuring and mapping territorial inequalities" (**Figure 3**) (Ysebaert et al., 2011; Benoit Le, 2011).

3. Mapping and Analyzing the Potential of Voters

Following the creation of the registration database, we were able to visualize and analyze the inequalities in the distribution of population and registrants for elections between the three regions (North, Central and South), the six sub-regions (NE, NO, CE, CO, SE and SO), the country's 24 governorates and 275 delegations, on the one hand (Belarem, 2017), and between the different units of the different scales on the other. Hyperatlas offers the advantage of comparing different spatial units of the same scale, and of comparing one spatial unit with other units of different scales.

In the following paragraphs, we map and analyze the spatial distribution of electors, the ratio of registrants and the overall population, and the structure of registrants by age and sex.

3.1. Spatial Distribution of Population and Registrants for the 2019 Elections

Maps A1, A2, A3 and A4 show the distribution of the Tunisian population, according to the different scales of analysis. Moving from small to large scale, the spatial distribution of the population becomes more detailed.

In the A4 map we see a concentration of population in delegations of the eastern coast of the country. Map A3 shows that the most populous governorates are in the eastern part of the country. Several reasons explain this phenomenon. Among these factors, we can mention that the east coast of the country is a plain or concentrates most industrial and tertiary activities and job offers (Chouari & Belarem, 2016).

Map B4 shows the distribution of registrants by delegation. It is noted that

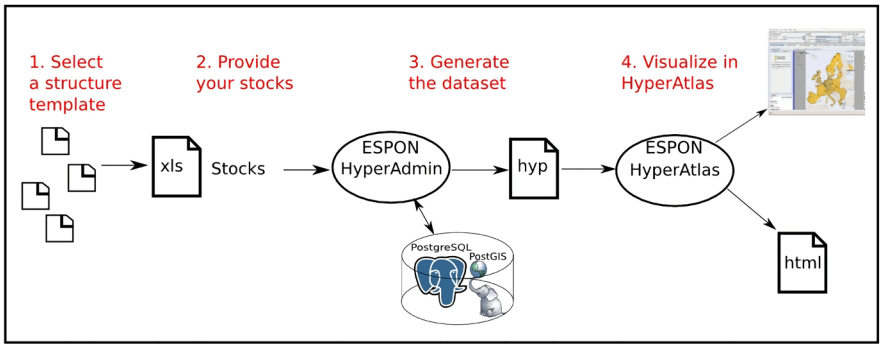


Figure 3. Map generation process with HyperAdmin and HyperAtlas (Source: http://hypercarte.imag.fr/).

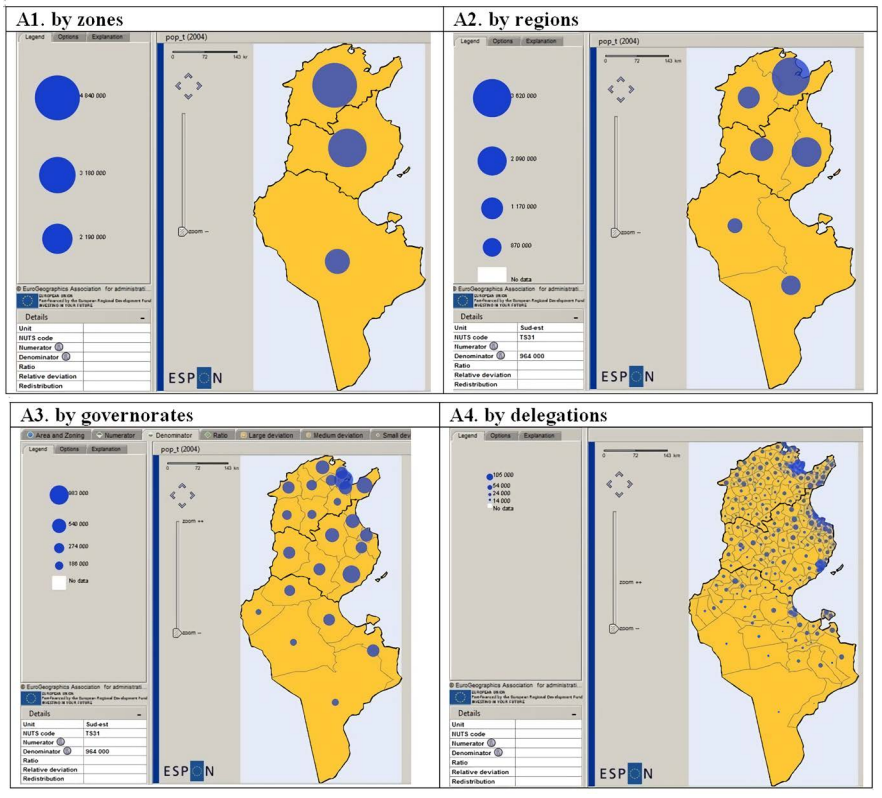
there is a cleavage between the coast and the interior of the country, in number of registered. Maps B1, B2, B3, and B4 are almost identical to those of the population (Figure 4(a). maps A1, A2, A3 and A4). The number of registrants is therefore proportional to the number of people.

The coastal areas monopolize almost three-quarters of the population. But even in the coastal zone, the difference in the distribution of registrants is very remarkable. The three major urban centers; the Greater Tunis, the Greater Sfax and Sousse take over the majority of the registrants. In these three population basins, the largest number of registered workers is recorded.

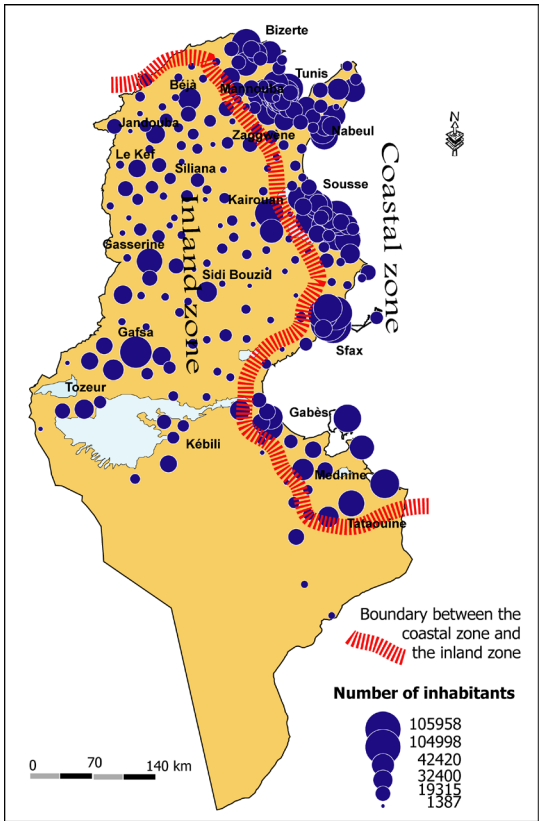
The coastal areas monopolize almost three quarters of the population (Table 1; Figure 4(b)). But even at the level of the littoral zone, the difference of distribution of the registrants is very remarkable. The three major urban centers; Greater Tunis, Grand Sfax and Sousse capture the majority of participants. In these three population basins, the number of the largest registrants is recorded (Figure 4 and Figure 5).

3.2. Spatial Distribution of Registration Rates for the 2019 Elections

The registration rate is the ratio of the number of registrants for elections to the total population. It is generated automatically by HyperAtlas. This rate is represented by the four mapping scales (zone, region, governorate and delegation) in Figure 6. This figure shows the registration rate in the parliamentary



(a)



(b)

Figure 4. (a) Population distribution in 2014; (b) Population distribution by cities (the inner/coastal cleavage) in 2014.

Table 1. Population by governorate in 2018 (www.ins.nat.tn).

Coastal or eastern governorate	Population	Western governorate	Population
Tunis	1,071,375	Kef	246,602
Ariana	642,511	Siliana	227,264
Ben Arous	691,113	Kaurouen	589,481
Mannouba	410,104	Kasserine	455,193
Nabeul	843,220	Sidi Bouzid	449,026
Zagwene	186,210	Gafsa	349,385
Bizerte	589,342	Tozeur	113,444
Baja	306,913	Gbelli	166,260
Jendouba	403,930	**Total of Western gov.**	**2,596,655**
Sousse	726,867	**% of Western gov.**	**22.48**
Monastir	589,683		
Mahdia	435,296		
Sfax	1,004,042		
Gabes	395,755		
Mednine	507,673		
Tataouine	150,761		
Total of Coastal or Eastern gov.	**8,954,792**		
% of Coastal or Eastern gov.	**77.52**	**Total of country**	**11,551,448**

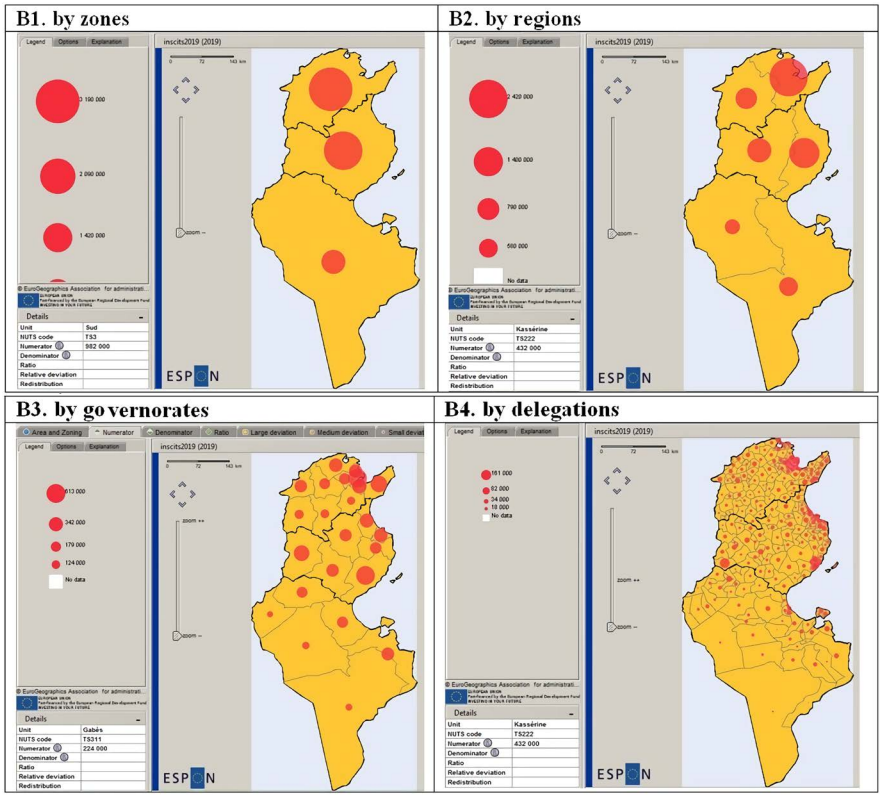


Figure 5. Registrants for the 2019 parliamentary and presidential elections.

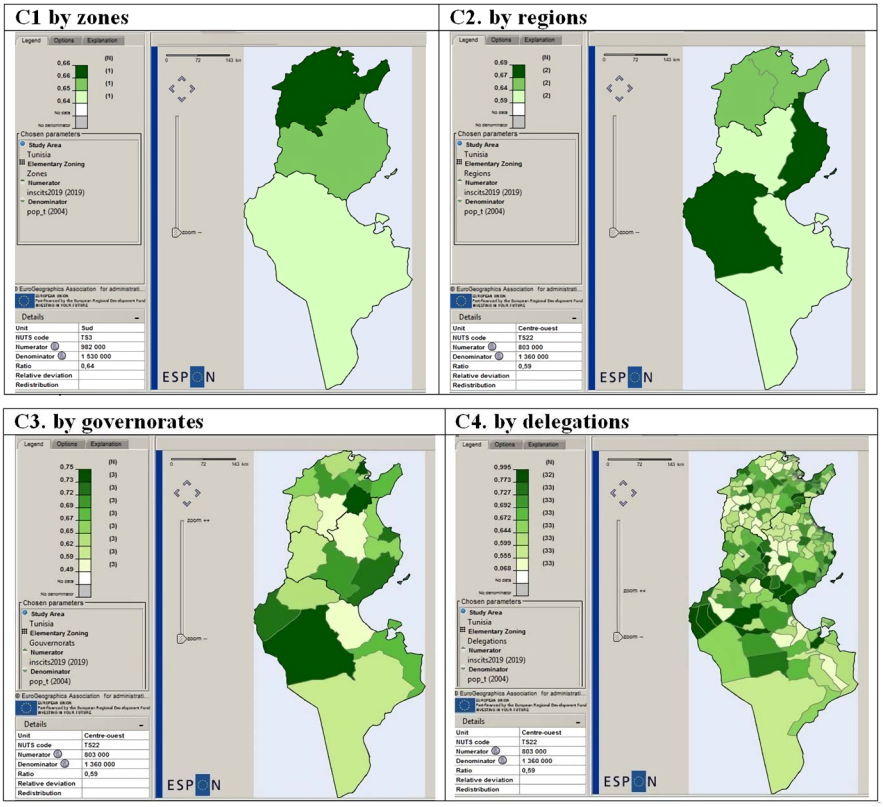


Figure 6. Voter turnout for parliamentary and presidential elections.

and presidential elections. In this figure, we used the degradation of green color. The dark green indicates that participation rates are high. However, light green is used for low rates. Moving from the C1 map to the C4, we notice the growth in detail levels. The C4 map offers much more detail than the C1 map.

At the zone level, the highest rate is recorded in the North. At the level of the six regions, the highest rates are recorded in the Central East and South West.

At the governorate level, it can be seen that, generally, the governorates of the North East, the Sahel and the South West have higher values. The variability of rates is very clear at the delegation level. The highest rates are recorded in the West Central, North East and South West delegations.

Registration rates are not correlated with population. They are, generally, related to other factors such as, for example, the awareness role of people through the ISIE and the mass media, to register. Bringing the registration service closer to the residents is also a very important factor. This is the role of the ISIE.

Map D1 (Figure 7) "proposes a relative perspective of the distribution of the ratio (numerator/denominator) over the units of the elementary zoning: each absolute measure is related to its medium context reference value. The index value is 100 when an elementary unit has exactly the same value than its reference unit. It is 200 when the elementary unit measure is twice the reference one it is 50 when

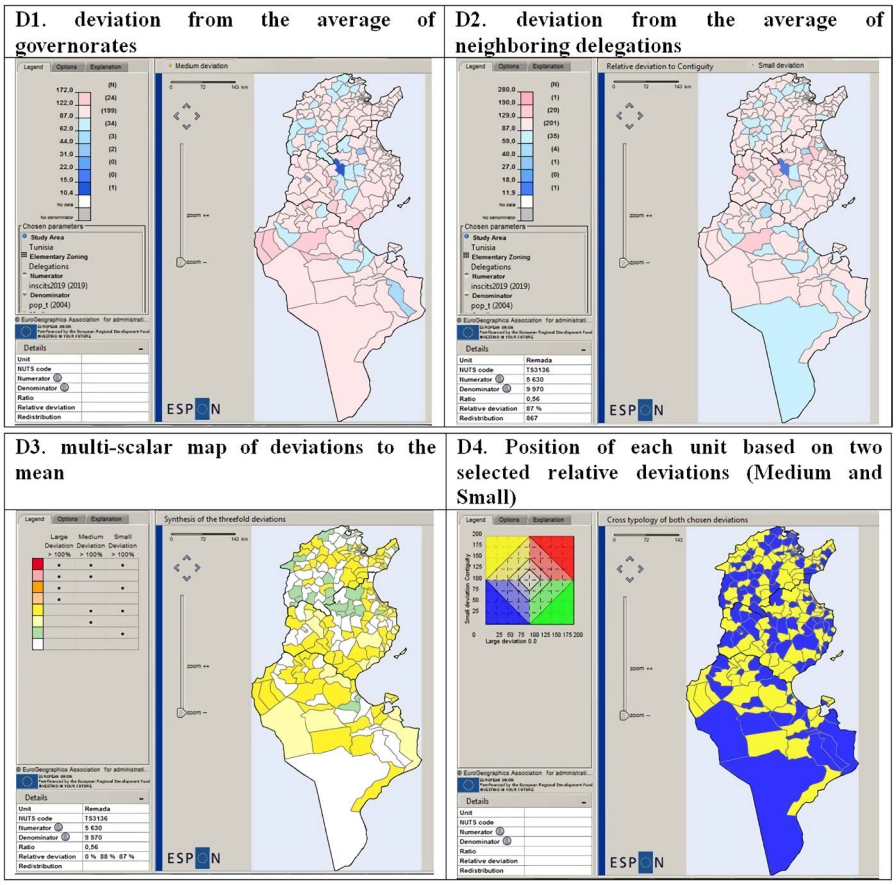


Figure 7. Voter registration rate: summary of variations.

this is half the reference unit" (http://hypercarte.imag.fr/hypercarte_userManual). Delegations colored in pink (degraded) have higher registration rates than the average of the rates recorded at the governorate levels. On the other hand, the spatial units, colored in gradient of blue, have registration rates lower than the average of the rates recorded in all the governorates.

Map D2 "proposes a relative perspective of the distribution of the ratio (numerator/denominator) over the units of the elementary zoning: each absolute measure is related to its small context reference value" (http://hypercarte.imag.fr/hypercarte_userManual). The pink colored space unit has a higher registration rate than the neighboring delegation. On the other hand, the unit colored in blue has a registration rate higher than the rate recorded in its neighborhood (**Figure 7**).

Map D3 "proposes a synthesis of the different perspectives according to the threefold large, medium and small and spatial contexts" (http://hypercarte.imag.fr/hypercarte_userManual). "Its reading is more delicate and it is difficult to deduce a strong spatial structure" (Beauguitte & Lambert, 2015)

Map D4 "of chromatic diamond synthesis provides the position of each unit according to two chosen relative deviations. The color defines the qualitative situation of a region below/above the mean for both criteria. The intensity (color saturation) of the color defines the quantitative situation of the unit according to the criterion of common/exceptional values of deviations on both criteria" (http://hypercarte.imag.fr/hypercarte_userManual).

Map 4 shows, first of all, the delegations in which average behavior occurs: the registration rate is not higher than the national average, nor the average of the governorates, nor that of the neighboring delegations. On the contrary, the delegations in red indicate those where the enrolment rate is higher than the country average, the average of the governorates and those of neighboring delegations (**Figure 7**) (Beauguitte & Lambert, 2015). "This tool makes it possible to perceive studied behaviors by highlighting ordinary individuals and remarkable individuals from a multiscalar point of view" (Beauguitte & Lambert, 2015).

3.3. Distribution of Registrants for the 2019 Elections by Age and Sex

Insofar as the structure of registrants differs from that of voters and can explain it, even in part, it is useful to apprehend it here. We have mapped this structure by sex and by age groups.

3.3.1. Distribution of Registrants by Sex

Generally, registration rates for men are slightly higher than those of women, with small spatial variations between different spatial units, regardless of the scale of analysis.

Figure 8 shows that registration rates for men and women exceed 50% in most governorates. In Sfax, Gabès and Mednine, women's registration rates are

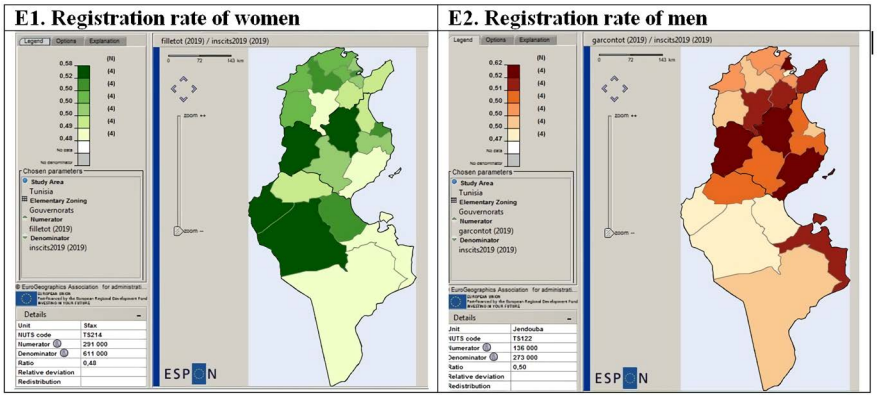


Figure 8. Distribution of registration rates by sex and governorate for the 2019 elections.

slightly below 50%. They exceed 55% in the governorates of Gbelli, Tozeur, Kassenine and Kairouen, but without reaching 60%. Among men, the highest rates exceed 54%, are recorded in Ariana, Sfax, Kasserine and Kairouen, where the rate reaches 62%. The lowest rates are recorded in the South, in the governorates of Gabes, Tozeur and Gbelli where the rate is 47%.

3.3.2. Distribution of Registrants by Age Group

According to the N.I.S. census, the total population is of the order of 9,910,872 inhabitants. The total number of registrants for the 2019 elections, within the country, is 6,620,983. 50.5% of registrants are men (334,542), and 49.5% are women (3,251,441). The I.H.A.E. disseminated enrolment statistics by sex and by four age groups; between 18 and 25, between 26 and 45, between 46 and 60 and over 60 (Figure 9 and Table 2).

The share of registrants (men and women) in the first age group 18 - 25 is 14%. The second age group (26 - 45) represents 49%. The registrants of the third group (46 - 60 years) define 25%. Finally, the age group, that is to say those who have exceeded 60, defines 17.76%.

The largest share of women (43.98% of all registrants) is in the 26 - 45 age group. They are of the order of 1,471,516. Those, who are between 45 and 60 years old, define (24.44%) of all registrants. Women of the third age are of the order of 531,724. They define 16.23%. Finally, the youngest women (between the ages of 19 and 25) are in fourth place, with 13.7% of all registered (Figure 9 and Table 2).

The largest proportion of registered men (41.82%) is in the 26 - 45 age group. They count 1,399,375. Those in the 45 - 60 age group are in second place, and represent 25.34% of registered men. The registered seniors define 17.67%. Finally the youngest (between 18 and 25 years), are of the order of 458,710. They define 13.70% (Figure 10).

The spatial distribution of registrants shows that the share of women in the first tranche (18 - 25 years) is higher (16%) in the governorates of Kairouen, Kasserine, Monastir and Tataouine, than in the other governorates. On the other hand, their share is decreasing in Tunis, Ariana, Ben Arous and Kébilli.

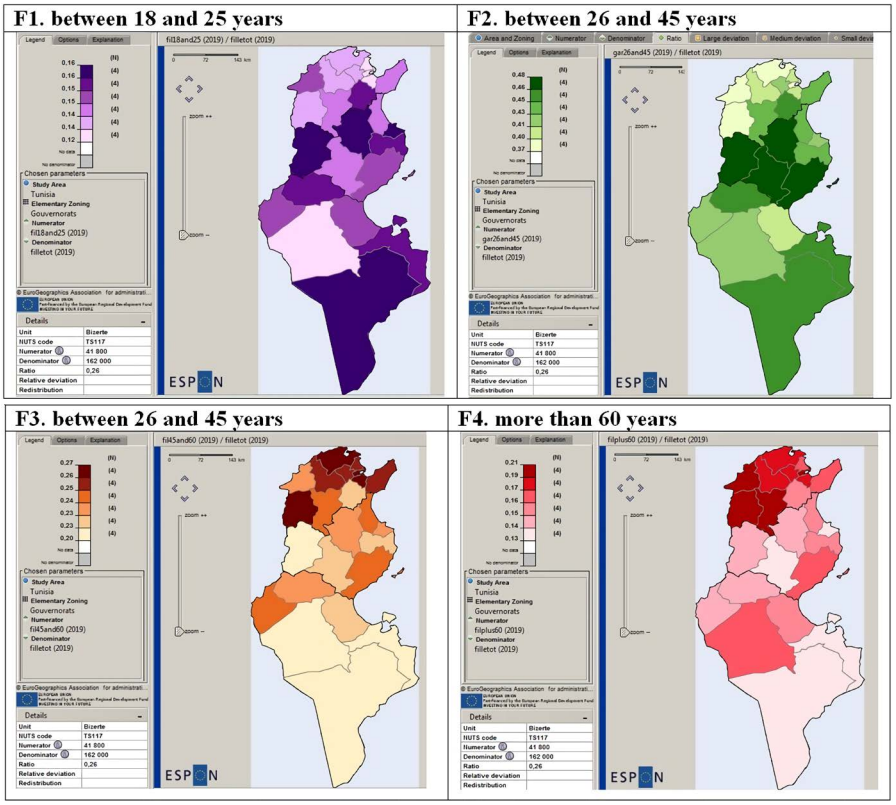


Figure 9. Rates of women registered for elections by age group.

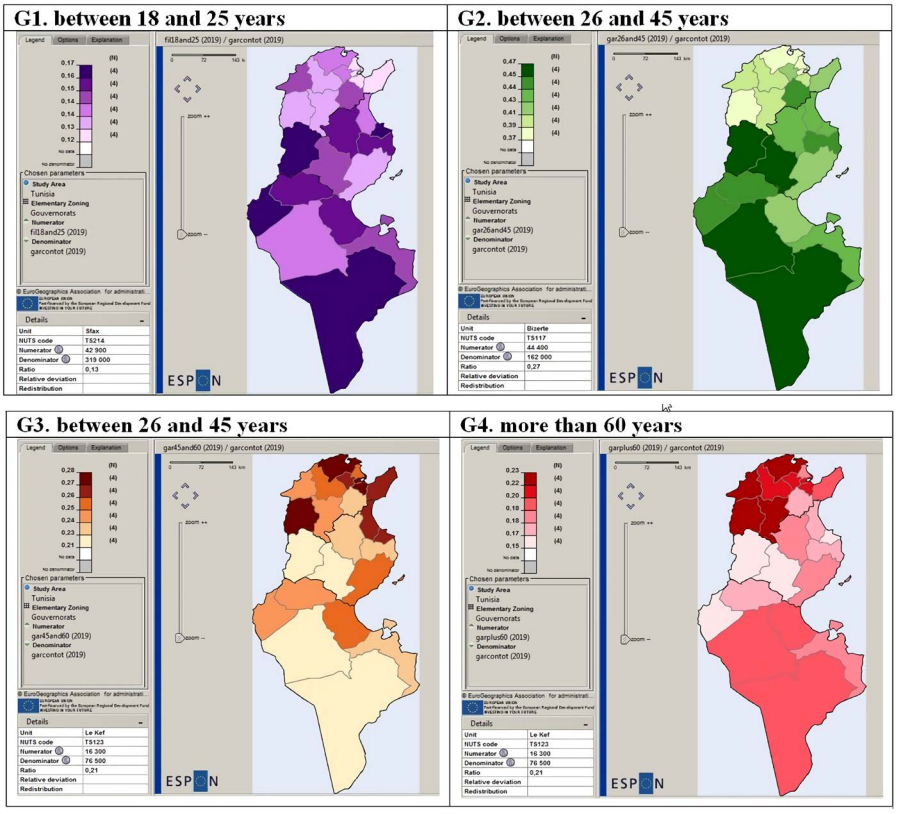


Figure 10. Male registration rates for elections by age group.

Table 2. Distribution of registration by sex and governorate for the 2019 elections (www.isie.tn).

Governorate	registration rate of women	registration rate of men	Governorate	registration rate of women	registration rate of men
Tunis	49	51	Monastir	50	51
Ariana	54	50	Mahdia	50	50
Ben Arous	50	50	Sfax	52	48
Manubah	50	50	Kairouan	62	58
Nabeul	51	49	Kasserine	58	56
Zaghouan	51	49	Sidi Bouzid	51	50
Bizerte	50	50	Gabes	49	51
Beja	50	50	Medenine	52	48
Jendouba	50	50	Tataouine	50	49
Le Kef	50	50	Gafsa	51	49
Siliana	52	48	Tozeur	48	52
Sousse	51	49	Kebili	47	53

It is only 12% in Kebilli. The share of women of the second age group (26 - 45) exceeds 46% in some central governorates (Sfax, Sidi Bouzid, Kairouen and Kasseirne). On the other hand, it is decreasing in three northern governorates (Kef, Siliana and Bizerte) and in Gabès. The proportion of women in the third age group (46 - 60) is decreasing almost gradually from North to South (from 25% in the North to 16% in the South). Finally, the share of women in the last age group, that is to say, those who have passed the age of 60, is decreasing according to a North (21%) - South (12%) gradient (Figure 10).

4. Conclusion and Recommendations

Based on this study, it is understood that multi-scale mapping is a tool for analyzing and visualizing data using different scales. Applied to the Tunisian electoral potential, this method allowed us to compare the position of each spatial unit with other neighborhood units of the same level, and with other units of another level. It was found that modifying the analysis scale was effective and allowed for spatial variations in registrant rates. We can also note that:

- The total number of registrants for the 2019 elections, within the country, is 6,620,983; 334,542 registrants are men and 3,251,441 are women.
- Multiscalar analysis shows that there are spatial disparities between the different levels of analysis, and generally the smaller the spatial unit, the greater the level of detail.
- The largest share of registrants exists in the coastal area.
- There are no major differences in the distribution of registrants by sex. 49.5% of registrants are women and 49.5% are men.
- In terms of age structure, the largest share of enrolments is in the 26 - 45 age

group (49%). The lowest share is in the 45 - 60 age group (25%).

The methodology and technique of mapping and visualization used in this study can be very useful, if applied to the other different electoral variables, especially those relating to results.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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