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An assessment of population decisions on territorial plans in Türkiye[1]

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Abstract
Accurate determination of the future population of a settlement to be planned is important for optimal use of public resources, and land as a scarce resource. In this paper, the calculations for population projections, which are among the main determinants of spatial plan decisions, were questioned through the Territorial Plans. The population decisions of a total of 62 provinces were examined over twenty 1/100,000-scale Territorial Plans approved by the Ministry of Environment, Urbanization and Climate Change, together with their planning reports. The basis for this consisted of: (1) population projections and forecasts, (2) average annual population growth rate calculations, and (3) population sizes. Results have shown that the extrapolation techniques used were applied incorrectly, and the population forecasts on which the plans are based were made independent of the projection calculations. In the examinations conducted over the average annual population growth rates, it was observed that the plans for each province were assigned extremely high populations without taking their current trends into account. For the 33 provinces where a comparison can be made with the projections of TURKSTAT (Turkish Statistical Institute) for the year 2025, it is found that among all the provinces only one could achieve the forecast results. Findings indicate that the following adjustments are needed: (1) more advanced population projection techniques, including demographic data, should support the extrapolation techniques, (2) the territorial plans should be revised, and (3) decisions on plans should be based on appropriate techniques and realistic population forecasts.

Keywords
Population forecast, Population projection, Provinces/regions, Territorial plans, Türkiye.

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1. Introduction

Planning is the task of rationally arranging the appropriate tools to achieve a desired goal within a specified time period. In the case of spatial planning, the aim of planning is to create the spatial form and structure that a settlement will need in the future. Since what is expected from a plan is provision of the necessary physical/spatial infrastructure for people who will be in that settlement (to live, work, visit, recreate, etc.), it is an important planning task to detect what kinds of needs must be met, and for how many people. Therefore, predicting the future population is among the substantial operations of the planning process. In case the future population is not determined accurately, the aim and goals of the outcome of the entire planning process may not be achieved.

In the literature, and in practice, the concepts of "estimate", "forecast", and "projection" are often used interchangeably despite their significant differences in terms of meaning, methodologies, and implications (see Pittenger, 1976; Isserman, 1984; Berke et al., 2006; Park & LaFrombois, 2019). Population forecast, an inseparable part of planning at any scale (Lingaraj & Runte, 1975), is the basis on which land use decisions are formulated and public resources are allocated (Rayer, 2008; Wilson & Rowe, 2011; Renski & Strate, 2013; Wilson et al., 2018; Park & LaFrombois, 2019). The forecasting of the future population of a settlement has a central role in the early stages of land-use planning, such as analysis and synthesis (Isserman, 1984), as well as in final stages such as determining future land uses. As noted by Park and LaFrombois (2019, 237) "[t]o create plans, planners must understand past demographic trends and future projections, and these data must be accurately applied in order to make sound planning decisions."

The future population that forms the basis for planning is determined in two stages: mathematical projection of population, and population forecasting based on different scenarios. For the purposes of the first stage there are different techniques that cover either direct or indirect methods of projection. The direct methods mainly involve (1) comparative forecasting, (2) ratio and correlation methods, (3) growth composition analysis, and (4) extrapolation techniques (Isard, 1960; Atalık, 1989). Related to the last three of these methods, three types of techniques are widely utilized in planning practice because they do not require advanced data and modeling skills (Alho, 1990; Ahlburg & Land, 1992; Rayer, 2008; Athukorala et al., 2010; Park & LaFrombois, 2019). First, the structural models, which "rely on observed relationships between demographic and other variables (e.g., land uses, employment) and base population changes on projected changes in those other variables" (George et al., 2004, 5), utilize regression models and are covered by the types of techniques in (2). Second, the cohort-component technique, being a more precise variation of the growth composition analysis (Isard, 1960), "divides the population into age-sex cohorts and accounts for the fertility, mortality, and migration behavior of each cohort." (George et al., 2004, 5). Third, the "trend extrapolation" techniques, in which the future population is calculated merely as a function of time, use historical data and simple regression. With this method, a statistical model that best describes current trends, by using official census data in the form of a time series, is sought (Çubukçu, 2015). Different mathematical functions are compared via graphical and quantitative evaluation (such as error calculations, R^2 and F-tests for coefficients). From this comparison, models that best describe the current trend, and whose error has an acceptable range, are selected. With the parameters obtained from these models, different projection values are obtained, which define the upper and lower limits. This range of different population values means that 'if current trends continue in a similar way, the population of the settlement will be at least as much as the lower limit, at most as much as the upper limit'.

Surely, the mathematical calculation is not the mere input for population forecasts. It should be articulated with subjective evaluation of the planning environment. This upper-lower limit argument, therefore, is a search for a

balance mechanism between positivistic and interpretive approaches. In parallel with this viewpoint, it is found that the current population projection results are overlooked in Türkiye because population forecast methodology is based on an overwhelmingly subjective interpretation. For this reason, the present authors think that an upper-lower limits question is an important debate to take place within the planning circles.

Since extrapolation techniques are based merely on data observed in past years, they are closed off to any current external data. However, the effects of social, economic, political and other dynamics, unforeseen events, or the possibility of interfering in the current trends with plan decisions, are always at stake (Kocaman, 2002). Therefore, an integration of statistical calculations and evaluation of real life dynamics are necessary procedures. In the aforementioned second stage, to this aim, the planning team will make a population forecast on the assumption that some possible externalities might have an effect on population increase/decrease. For example, the migration rate might be expected to accelerate more than the past trends, resulting from some recent transportation infrastructure investments. In such situations, the population size that the plan will be based on is the "forecast", obtained by interpreting external factors, following the condition of staying within the projected population range. In sum, as George et al. (2004, 2) noted:

> A forecast reflects a judgment and it can be proven right or wrong by future events (or, more realistically, it can be found to have a relatively small or large error). Projection is a more inclusive term than forecast: All forecasts are projections but not all projections are forecasts. Projections and forecasts sometimes refer solely to total population, but often include information on age, sex, race, and other characteristics as well.

In the present study, territorial plans (TPs) were examined regarding their population calculations. It was found that the future population sizes were determined as 'extremely high' in all of them[2], and both the population projection calculations and population forecasts deviated from methodological principles. Findings call for an urgent revision of population projection figures in these plans by using appropriate data and methodologies.

2. Errors in population forecasts and the case in Türkiye

It is a common fact that every decision concerning the future involves some degree of uncertainty and assumption. Hence, the selected projection calculations are forecasts involving some degree of error. The accuracy of the forecasts depends on population size, and is highly sensitive to geographical extent, the time horizon for the projection, and the base years, the stability of the growth rate, fertility rate and life expectancy, and volatility of net migration. In the case of smaller population size and area, the error is likely to get larger. The larger time horizon reveals the same impact on error and thus decreases the precision. On the contrary, the slow and positive growth rates, lower levels of migration, lower fertility rate, and higher life expectancy produce higher precision (see Wilson, 2013; Wilson et al., 2018; Rayer & Smith, 2010; George et al., 2004; Dai et al., 2022).

On the other hand, as stated by George et al. (2004, 84) "[t]he choice of projection method has no consistent impact on forecast accuracy. No single method uniformly produces more accurate population projections than all other methods…. [while] expert opinion … can contribute to higher precision". There are some studies showing that increasing the number of projection techniques, and their use in combination, improves the forecast accuracy. The studies that inspect population projection practices involve, but certainly are not limited to, analyzing the error structure of projection techniques, and focusing on the impact of their choices when (1) producing projections (Rayer, 2008), (2) comprehensive assessment of errors of population forecasts, (3) exploring the potential benefits of using a combination of forecasts instead of a single technique (Rayer & Smith, 2010), and (4) examining and testing a particular method (Hamilton–Perry) that is used in population forecasting (Swanson et

al., 2010).

As Rayer (2008, 417) stated: "[p]lanners and other practitioners that produce population forecasts are faced with making decisions regarding the choice of methods, input data, assumptions, treatment of special populations, and so forth." Athukorala et al. (2010) produced a list of the main methods used in population forecasting, and showed that they can be carried out in a definite and transparent manner, while excluding externalities in population estimates. In their particular case, that was for the provision of essential services, based on reliable population data, in two regional Councils of Queensland (Australia). Wilson (2019) proposed a guide, providing an overview of projection methods, of where to find projection data and related information, and comments on the results of population projections of Australia. Studies, in the body of literature, on developing projection model proposals are quite common. Some examples involve developing a simulation model for regional population trends (Lingaraj & Runte, 1975), a probabilistic model for population and household forecasts for large subnational regions (Wilson, 2013), or multiple (autoregressive integrated moving average, ARIMA) time series models for states (Tayman et al., 2007).

An operational way to examine the accuracy of population forecasts is to compare the population estimates made in the past with the observed population data (see Wilson & Rowe, 2011; Renski & Strate, 2013; Wilson et al., 2018; Rees et al., 2019). Park and LaFrombois (2019) analyzed past population estimates of cities with increasing and decreasing populations, and investigated how cities utilized population projections in guiding their future plans. The results showed that population projection errors exist in all cities, independent of their population trends. However, it was found that growth was expected for most cities, despite the actual decline in their population. Since "[a] declining or shrinking population is considered unhealthy and undesirable .... local policymakers and planners may avoid mentioning population decline or they may choose the most favorable population projection results" (Hollander et al., 2009; Pallagst et al., 2017 cited in Park & LaFrombois, 2019). Isserman (1984, 208-209) argued that:

> … for basic changes in the way population forecasts are made and used in the planning process [and discussed the need for] the systematic analysis of factors not considered by today's formal models, and a new generation of research methods and skills must be developed to study the future and planning's ability to shape it. …. [In laying out his main hypothesis, he noted that]: At worst, analysts prepare projections knowing that they will be used as forecasts, but remain unable or unwilling to evaluate the underlying assumptions that will determine whether a projection is a good forecast; and users adopt the projections as forecasts without understanding their conditional nature and the need to evaluate the underlying assumptions.

Skaburskis and Teitz (2003) based their discussion on their US experience, and explained the possible underlying reasons for why 'technical' forecasts turn into exaggerations. In searching for the possible reasons for the tendency to accept and use the exaggerated results they related the possible reasons (2003, 431, 439-440) to:

> our own interests and to institutional concerns, to the way social, political and economic processes react to change, and to the way we gain knowledge of these processes …. [all of which range] from the most individual and subjective, to the most systemic and uncontrollable.

This critical position is also in line with what some scholars consider as the ethical dimension of forecasts. For instance, Flyvbjerg (2005, 57) states that "many forecasters deliberately manipulate costs and benefits to help projects get approved …. [in so called] …. pursuit of public good …. even if it is not especially useful from a public point of view". Furthermore, Flyvbjerg et al. (2005, 142) noted that "[i]ndeed, accurate forecasts may be counterproductive, whereas biased forecasts may be effective in competing for funds and securing the go-ahead for construction" (see also Wachs, 1990; 2016).

In some countries, the population

projections are made by demographers who belong to a specific professional domain, and mainly perform their works in official institutions. For example, in Australia, projections at national regional levels are made by the Australian Bureau of Statistics (ABS), while the projections for local and small areas are carried out by the State and Territory Governments (Wilson & Rowe, 2011; Wilson, 2019). Similarly in the US, the U.S. Census Bureau's Population Estimates Program is responsible for this, in addition to providing the control for other data series, such as the American Community Survey and the Current Population Survey (Renski & Strate, 2013).

In Türkiye, TURKSTAT is responsible for the production of national level population projections based on Address Based Population Registration System (ABPRS) since 2007. Before this time, general population censuses (GPCs) were used. In 2012, for the first time; for the year 2023 province-based, and for the years 2050 and 2075 country-based population projections were calculated by TURKSTAT (2013). Those first-time provincial-level projections were subsequently repeated for the following two years, i.e., 2024 and 2025, the latter being used for one of the examinations in the present paper. National level population projections are primarily used for national policy-making projections. Regional and local level spatial planning practices, on the other hand, produce independently their own population projections. In other words, TURKSTAT's population projections and planners' population projections are two separate fields of policy making, which needs to be coherent with each other.

The level of error in population forecasts in planning studies in Türkiye has been high since earlier times. Between 1930s and 1960s plans were commonly prepared for 50 years-period by the rule of the very first law on planning in the 1930s (Law No. 2290), population projections fell below the actual numbers. For example, the population of Tekirdağ (on the north coast), which was projected to be 24,000 in 1997, the population of Nevşehir (Central Anatolia Region), which was projected to be 15,000 in 1996, and the population of Simav (to the west), which was projected to be 15,000 in 1994, were exceeded or approximated in 1965 (Yavuz et al., 1978, 210). The population forecast made in 1929 for a 50-year period for the capital city of Ankara (Central Anatolia Region) was between 250 and 300 thousand, which had already been exceeded within 20 years. The Izmir (on the Aegean coast to the west) Land Use Plan, approved in 1955, forecasted that the population in 2000 would be 400 thousand, yet it already passed 500 thousand in the 1970s. In short, population forecasts in early planning studies have generally fallen far below the growth level of cities. Since the 2000s, the error level is still high, but in the opposite direction. For the last decades, future population figures have somehow been determined as much higher than the observed figures. This conversion resembles the situation half a century ago in Great Britain, where the population projections were calculated too low between 1955 and 1965, and too high after the 1970s (Hall, 1981). Regarding Türkiye, the previous period was characterized by low forecasts and high actualization. By way of the present calculation, the results show high forecasts and low actualization. Errors in population forecasts bring their own problems in terms of successful planning and urbanization. High population decisions result in more development areas, urban sprawl, and/or higher density than required.

3. Materials and methods

The hierarchy of the spatial planning system in Türkiye consists of spatial strategic plans (SSP), territorial plans (TP), land-use plans (LUP), and implementation plans (IP) from the topmost level to the lowest. In the present study, the TPs were examined (i.e., they are the top-level spatial plans currently in effect as there is no spatial strategic plan approved to date).

A total of twenty 1/100,000-scale TPs, approved as of 2020, covering 62 provinces were examined. Regarding the study period, there are no TPs in effect for the remaining 19 provinces countrywide. All of the examined plans, revisions and amendments, and

their reports are accessible on the website of the Ministry of Environment, Urbanization and Climate Change (MEUCC) (Figure 1).

The planning reports (PRs) of the TPs showed that each province was managed independently from other provinces covered by the same plan. Populations, economic and social conditions, land use situations, and planning decisions were all based on provincial boundaries with strict administrative separation. In other words, each province in each plan could be examined individually because they were analyzed and planned separately by the planning authority.

A summary of the typological examination of the TPs (which include the provinces and time horizon (in years), population forecast, and classification of projection productions/methods used in their PRs) is presented in the Appendix. Among all 62 provinces covered in these plans, target years differ as follows: 2023 for one plan (3 provinces), 2035 for one plan (3 provinces), 2043 for one plan (2 provinces), 2045 for one plan (3 provinces), 2026 for three plans (10 provinces in total), 2040 for six plans (21 provinces in total), and 2025 for seven plans (20 provinces in total).

In the present study, first, the content of typology is explained. Subsequently, all 62 provinces were examined in terms of their calculated annual average population growth rates (AAPGRs). Finally, the population forecasts of 33 provinces in 11 TPs having the same or approximate (by 1-2 years) target year as 2025, which is the province-based projection year of TURKSTAT, were compared with TURKSTAT data. The reason for the comparison with these projection data was due to the fact that the population projections produced by TURKSTAT were largely consistent with the observed data over the years.

4. Results and discussion

4.1. Typological investigation in the context of population projections and forecasts

The population values of twenty TPs in total were examined in two stages: "Projections" and "Forecasts". It was observed that the PRs did not include a comprehensive assessment of demographic characters and population projections for the first stage. They also did not include any assessment of the population change in the past, household size, migration, birth and mortality rates, etc. concerning the demographic structure of settlements in the planning area. Additionally, necessary elements of projection methodologies, such as assessment of the years used in the projection, time periods, techniques(s) used in obtaining the data for missing years, projection calculations (and their graphical analysis and R^2, F, t statistics), and their significances concerning the population projection were not

Figure 1. *Twenty 1/100,000 scale TPs approved by the Ministry of Environment, Urbanization and Climate Change as of 2020. Source: Prepared by using the TP data obtained from the MEUCC website.*

presented in the reports. Finally, it was observed that the second stage was carried out completely independent of the results of the first stage.

The technical analysis of projection calculations for the first stage resulted in four different types: (1) non-technical, (2) incorrect/incomplete use of the technique, (3) improper use of the technique, and (4) technique without content. The term 'non-technical' in type 1 refers to non-use of any projection technique. The 'incorrect/incomplete use of the technique' in type 2 refers to fundamental methodological mistakes in the projection processes. The expression 'improper use of the technique' in type 3 refers to some manipulated procedures that distort technical validity. Finally, the expression 'technique without content' in type 4 refers to performing irregular and contradictory procedures together.

In the second stage plans were associated with the groups they belong to. Type 1 covers TPs, in which only overall forecasts are made without any population projection process. Type 2 covers TPs, in which forecasts based on only one single projection result without explaining the data. Forecasts were made independently from the TURKSTAT population growth rate, despite the fact they were claimed to be made accordingly. Type 3 covers TPs, in which data consistency and content are not disclosed, and the population forecast is undertaken by averaging the results of projections corresponding to improper use of the technique. Type 4 covers TPs, where the forecasts were made using projection techniques whose content was not deemed logical. Some non-clarified coefficient calculations were made and then improperly averaged with each other. These types (summarized in the Appendix) are described below, respectively.

1. Type 1 (Non-technical): The nine TPs of this type (see Appendix) have their population with no projection calculation and no supportive information. For example, only a one-sentence non-technical claim about population forecast was provided in the PR of the Adıyaman-Şanlıurfa-Diyarbakır Planning Region TP (Figure 2), and urban, rural, and total population forecasts were given at the provincial and district levels in tables (see ÇŞİDB, 2013a). In these types of TPs, for which the term 'projection' was used in their PRs, no explanation about population projection techniques, or their data, results, and evaluations were provided. In fact, population forecast was considered as population projection, despite the fact that the two are distinct processes.
2. Type 2 (incorrect/incomplete use of the technique): There are two plans of this type (see Appendix). As for the Kırşehir-Nevşehir-Niğde-Aksaray Planning Region TP, total population projections were produced for years 2005, 2010, 2015, and 2025 by exponential extrapolation only, and 'population forecast' was made for 2025. The population projections and forecasts for 2025 are quite different from each other. In PR under the section titled "Development Areas and Spatial Decisions", there is a statement run-

5.3. POPULATION FORECASTS

The 2010 populations and the expected populations of the provinces in the Adıyaman-Şanlıurfa-Diyarbakır Planning Region 1/100,000 Scale Territorial Plan in 2045, which is accepted as the target year, are given in the tables below.

Provinces	2010		
	Urban	Rural	Total
Adıyaman	392,574	198,361	590,935
Şanlıurfa	1,021,382	641,989	1,663,371
Diyarbakır	1,124,305	404,653	1,528,958
Planning Region Total	**2,538,261**	**1,245,003**	**3,783,264**

Provinces	2040		
	Urban	Rural	Total
Adıyaman	832,500	227,500	1,060,000
Şanlıurfa	2,110,000	1,075,000	3,185,000
Diyarbakır	2,207,500	535,000	2,742,500
Planning Region Total	**5,150,000**	**1,837,500**	**6,987,500**

Figure 2. *The only explanatory statement for the population forecasts in the PR of the Adıyaman-Şanlıurfa-Diyarbakır Planning Region 1/100,000 Scale Territorial Plan. Source: Translated from ÇŞİDB, 2013a, 34.*

ning as "Due to the inevitable rapid urbanization created by globalization, the rural population was kept optimum and the projection populations were decided with the idea that the urban centers would keep the main population in the direction of development trends." (ÇŞİDB, 2007a, 9). In this statement, the term "population projections", in fact, means "population forecasts". There is no concrete and technical information to justify or support this growth idea. Similarly, in PR of the Erzurum-Erzincan-Bayburt Planning Region TP, it was stated that the population projections were produced by using 1985, 1990, 1995, and 2000 general population censuses (GPCs), and 2010 and 2011 ABPRS data (see ÇŞİDB, 2016b). Methodologically, in population projections, we would expect population data to be in the form of time series with regular intervals. However, in this TP, 2005 data are missing and the time interval between 2010 and 2011 is 1 year. Furthermore, although no census was carried out in 1995, no information is given about the source of this population data for that year. It was stated that since the projection populations in rural settlements and many urban settlements approach to zero; the AAPGR assumed by TURKSTAT in its 2023 projections were also taken into account, which are 2.2‰ for Erzurum; 8.4‰ for Erzincan; and -3.4‰ for Bayburt (ÇŞİDB, 2016b, 26) (Figure 3). It is seen that Bayburt's AAPGR is some negative value, which means that it is losing population. Its urban, rural, and total populations in the base year of 2013 were observed as 45,307, 30,313, and 75,620, respectively. However, in contrast to the observed decline, population forecasts for the year 2045 represent significant increases to 86,000, 31,500, and 117,500, respectively. Although the AAPGR value of TURKSTAT in 2023 is negative, no explanation was provided for this extraordinary increase in Bayburt's urban and rural populations.

3. Type 3 (improper use of the technique): There are seven plans of this type (see Appendix). According to the PR of the Ordu-Trabzon- Rize-Giresun-Gümüşhane-Artvin Planning Region TP (see ÇŞİDB, 2011c, 2017), population

5.3. POPULATION FORECASTS

For the provinces in the Planning Region, population projections for 2045 were produced using the 1985, 1990, 1995, and 2000 population censuses and 2010-2011 Address Based Population Registration System data of TURKSTAT, and exponential method, the least squares method, compound interest method, and arithmetic method. Projections, which are detailed in the research report, were produced separately for urban settlements, i.e., district and town centers, and on the basis of districts for rural settlements. In the projection results, the approaching to zero finding for the population produced for especially rural settlements, besides many urban settlements, did not make it possible to use the projection results directly in the population forecasts in the plan period.

Therefore, for plan period population forecasts, the annual average population growth rates assumed by TURKSTAT in its 2023 projections were also taken into account. These values are 2.2‰ (2.2 per thousand) for Erzurum; 8.4‰ for Erzincan; and -3.4‰ for Bayburt.

The 2013 populations and the expected populations of the provinces in the Erzurum-Erzincan-Bayburt Planning Region 1/100,000 Scale Territorial Plan in 2045, which is accepted as the target year, are given in the tables below.

Table 7. Provinces and the Planning Region – Current Populations (2013)

Provinces	2010		
	Urban	Rural	Total
Erzurum	766,729	-	766,729
Erzincan	169,153	50,843	219,996
Bayburt	45,307	30,313	75,620
Planning Region Total	**981,189**	**81,156**	**1,062,345**

Plan amendment approval boundary

Table 8. Provinces and the Planning Region – Population forecasts (2045)

Provinces	2010		
	Urban	Rural	Total
Erzurum	1,270,000	-	1,270,000
Erzincan	323,000	73,500	396,500
Bayburt	86,000	31,500	117,500
Planning Region Total	**1,679,000**	**105,000**	**1,784,000**

Figure 3. *Explanatory statement for the population forecasts in the PR of the Erzurum-Erzincan-Bayburt Planning Region 1/100,000 Scale Territorial Plan. Source: Translated from ÇŞİDB, 2016b, 26.*

projections were produced by using extrapolations of ABPRS data for 2007, 2011, and 2015. Although these data have been generated annually since 2007, the production of population projection for year 2026, by using only three years, weakens the accuracy of the results in terms of the requirements of the regression. Since the produced results and their graphical and quantitative evaluations were not given in PR; it is not known whether the results were statistically significant. It was not explained why specifically these three techniques used were selected for the calculations. The logic behind taking the average of different regression results, which is contrary to methodological principles, was not explained either. Population forecasts, which are quite different from the calculated values, are not supported with any convincing justifications about their calculation processes and techniques. The PRs of the remaining six TPs do not contain information about the data used in population projections. Three to four extrapolation techniques were used in each one of these plans. The logic and rationale behind the selection of these specific regression models were not explained. Statistical test results, graphical and quantitative evaluations, which demonstrate the usability of the results, were not provided. Moreover, the average of different model results was taken again without a logical base. Population forecasts were made but no information was provided about their calculations, processes, and techniques.

4. Type 4 (technique without content): Two TPs were observed under this type (see Appendix). Explanations regarding population projections and forecasts in the sections titled "Population Projections" in the PR of both TPs contain the same sentences. It is stated that the coefficient values to be used as multiplier for each sector were obtained by proportioning the employment statistics of 1990 and 2000 to the population. These coefficients were not presented in PRs, while the economic sectors of each district were listed. Despite not being related to the base year situation, they were directly taken as the basis for 'Economic Sector Forecasts' for the future. In the next stage, it was stated that the population projections were produced by three extrapolation techniques, but these resultant figures and the averages (despite being an improper use of methodology) that were said to be used, were not presented in the reports. It is stated that the final forecasts for 2040 were obtained by proportioning the coefficient value obtained from sectoral data with the 'average population projection', which has no rationale supporting it (Figure 4). Since these values were not given in PRs, it is not understood by the present authors how population forecasts were carried out.

In sum, the population values of the twenty TPs examined were questioned in two stages. Population projection calculations/techniques were examined in the first stage, and the rationale of the population forecasts were examined in the second stage. Regarding the calculations/techniques, it was determined that all the plans were inadequate in terms of statistical evaluations. As for the elements of the second stage of the examination of

> In addition to these conditions taken into account, the coefficient values to be used as multiplier for each sector were obtained by proportioning the employment statistics of 1990 and 2000 to the population. In the next stage, population projections were produced using the least squares method, compound interest method, and arithmetic method and the population projections were obtained by taking the average of [the results of] these three methods. By proportioning the multiplier values obtained from sectoral data and the average population projection, the final population projections for 2040 were obtained.

Figure 4. *The only and identical explanatory statements for the population forecasts in the PRs of the Mardin-Batman-Siirt-Şırnak-Hakkari and Malatya-Elazığ-Bingöl-Tunceli Planning Regions 1/100,000 Scale Territorial Plans. Source: Translated from ÇŞİDB, 2019a, p. 32 and ÇŞİDB, 2015c, 34.*

the forecasts, it was observed that they were determined independently of the projections produced.

4.2. Examinations regarding the annual average population growth rate calculations

In this section, some basic data are compiled, primarily for discussing the population forecasts of TPs, which were found inaccurate or incomplete in terms of methodology. All these data are at the provincial level and include ABPRS data for 2007-2019 and population projection data for 2025 from TURKSTAT, the approval (base) year and the target year of the plans and their population forecasts.

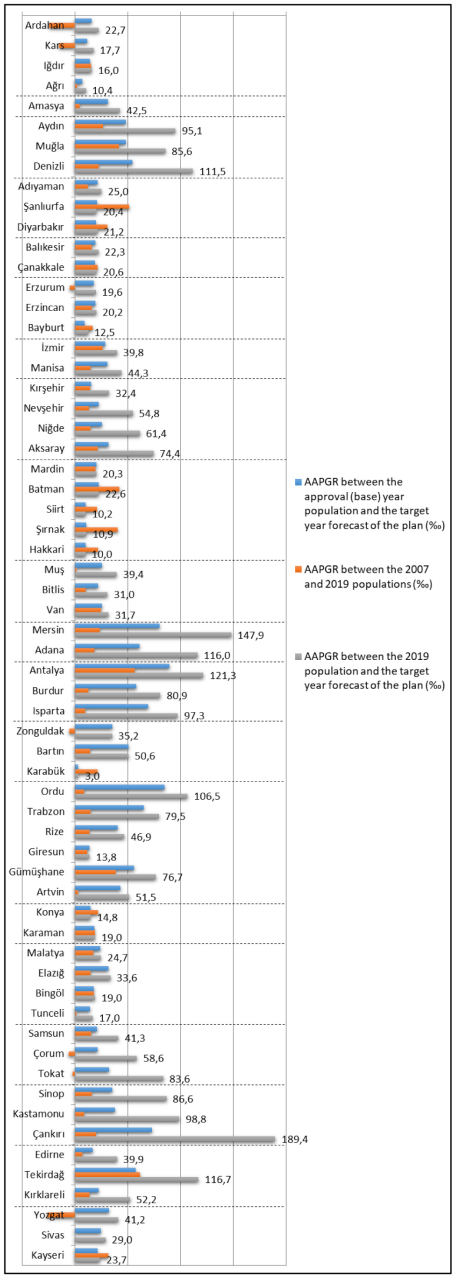


Figure 5. *Comparison of the population forecasts for the provinces in 1/100,000 scale TPs with various annual average population growth rate computations by keeping the order of provinces composing each of the same TP. Source: Prepared from the data obtained from 1/100,000 Scale TP Planning Reports, TURKSTAT 2007 and 2019 ABPRS data.*

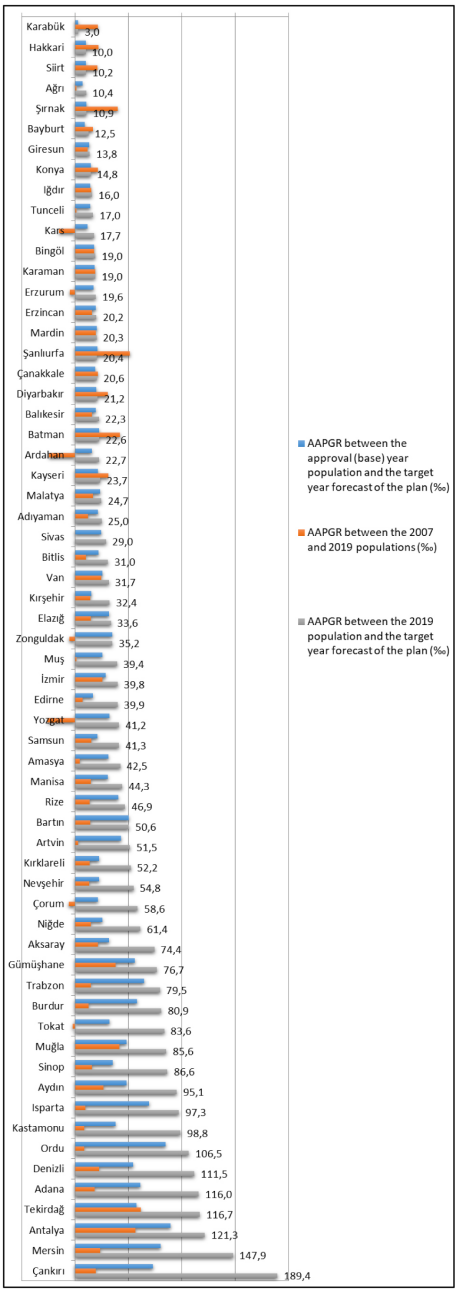


Figure 6. *Comparison of the population forecasts for the provinces in 1/100,000 scale TPs with various annual average population growth rate computations by sorting the provinces in the order of increasing AAPGR between year 2019 and the target year of the plan. Source: Prepared from the data obtained from 1/100,000 Scale TP Planning Reports, TURKSTAT 2007 and 2019 ABPRS data.*

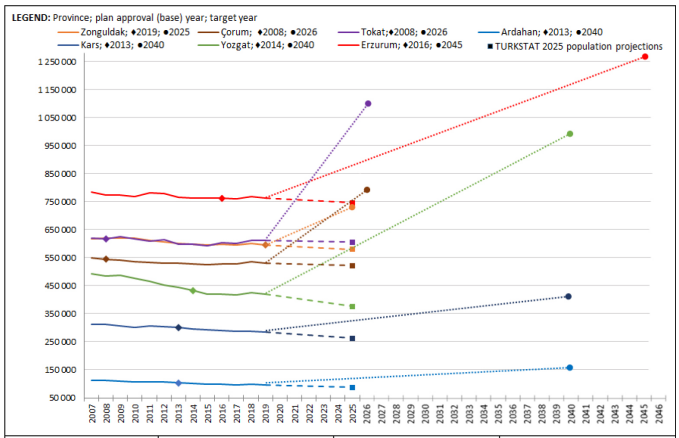
In making comparisons, the annual average population growth rates (AAPGR) were calculated in thousands (‰) using the TURKSTAT formulation, in order to see:

1. the existing trends of each province between 2007 and 2019 populations,
2. the population growth trend proposed by the plan on the provincial basis between the approval (base) year population and the target year forecast of the plan, and
3. the necessary trends that must occur after 2019, in order for each plan to reach its forecast value within remaining time (Figure 5 and Figure 6).

Averages across all provinces were found to be 16.0‰ for the first; 31.4‰ for the second, and 49.4‰ for the third calculation. Accordingly, it was observed that the plans expected an annual average population growth twice the actual trend during the plan horizon. Moreover, in order for population forecasts to be realized, in the remaining years the provinces require more than three times the existing trend's AAPGR.

Regarding the existing trends, there is a total of seven provinces (covered by four plans) with negative AAPGR. In other words, seven provinces have been losing population between 2007 and 2019. The graph of existing population trends of these provinces, their plan approval (base) years, TURKSTAT 2025 population projections, plan target years and population forecasts with respect to years are shown in Figure 7. For all provinces losing population, TURKSTAT projections display similar trends accordingly. In contrast, the plans propose an increase of 18‰ or more per year. This is an indication of how the population forecasts in the plans were exaggerated, in a totally contrasting pattern to the existing trend (Figure 7).

The seven provinces at the bottom of Figure 6 require AAPGR over 100‰ to access their forecasted populations after 2019. The populations of these provinces increase with a rate of ‰30.1 per year on average (8.8‰ for Ordu with the lowest rate; 61.8‰ for Tekirdağ with the highest rate). These provinces cannot reach their forecast populations unless they somehow show extraordinary performances of AAPGR ranging from 106.5‰ (Ordu) to 189.4‰ (Çankırı) (Figure 8).



The provinces with negative AAPGR between 2007 and 2019	AAPGR (‰) between the approval (base) year population and the target year forecast of the plan	AAPGR (‰) between the 2007 and 2019 populations	AAPGR (‰) between the 2019 population and the target year forecast of the plan
Kars	11.8	-15.0	17.7
Erzurum	17.6	-4.9	19.6
Ardahan	15.6	-24.5	22.7
Zonguldak	35.2	-5.5	35.2
Yozgat	32.3	-25.9	41.2
Çorum	21.3	-5.8	58.6
Tokat	32.1	-2.2	83.6

Figure 7. *Comparison of the provinces having negative AAPGR between 2007 and 2019 in terms of their existing populations in this period, plan approval (base) years, TURKSTAT 2025 population projections, plan target years, and population forecasts of the plans with respect to years (the table is sorted in the increasing order of the 4th column). Source: Prepared from the data obtained from 1/100,000 Scale TP Planning Reports, TURKSTAT 2007-2019 ABPRS data and 2025 province-based population projections.*

4.3. Examinations regarding population sizes

In this section, a comparison of population forecasts of 33 provinces, having the same or approximate (by 1-2 years) target year comparable to the TURKSTAT 2025 provincial projections, is presented (Table 1). The results show that no province except for Karabük could reach TURKSTAT's projections. However, up to 1.5 times more population than that of TURKSTAT projections are allocated to a total of 16 provinces, which are 1.08 for Giresun, between 1.5 and 2 times for 13 of the remaining provinces, more than double for Ordu and Mersin, and around 3.5 times for Çankırı (Table 1).

In fact, the sizes of these exaggerated population forecasts indicate a critical situation compared to the observed population data of 2019. In

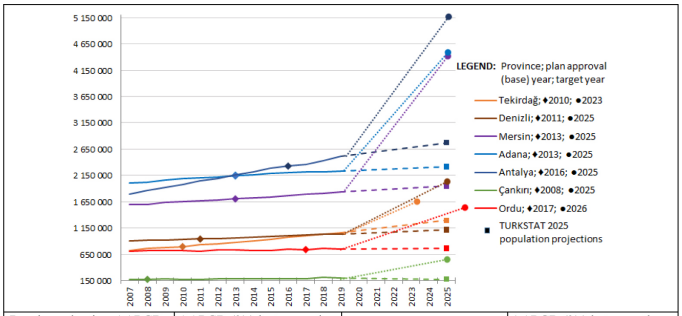
total, for the 33 provinces, the population in 2019 was 26,757,616, while TURKSTAT's 2025 projection was 28,255,425, and the population forecasts of TPs for the same year (or very close by 1-2) was 44,534,313. It was determined that TURKSTAT's projections progressed with a reasonable margin of error. However, populations allocated by TPs appear to be approximately 1.6 times of the projection results. This contradictory situation is also valid at the provincial level calculations. For example, having a population of 754,198 in 2019 according to ABPRS data, 1,590,000 was assigned to Ordu province for 2026 by the TP. As for TURKSTAT's projection for 2025, this is 763,581 which shows a stable population. Mersin and Çankırı's ABPRS figures for 2019 were 1,840,425 and 195,789, respectively, while the population forecasts in the related TPs targeting for 2025 were 4,471,290 and 610,000. However, TURKSTAT's projections for 2025 were 1,950,784 and 176,039, respectively (Table 1).

5. Conclusions

Türkiye's urbanization history has witnessed population movements that made it highly difficult to accurately determine future population figures. Events affecting the natural growth trend and geographical distribution of the population in Türkiye include: (1) Mass movements such as multinational population exchange in the early periods of the Republic; (2) rapid urban population growth due to the intensive migration that began in the 1940s, which was conceptualized as the urbanization of labor (Şengül, 2001); (3) labor migration to Europe in the 1960s; (4) forced migration of Bulgarian Turks in the late 1980s; (5) migration as a result of displacement of local population due to the terror in the Southeastern Anatolia Region in the 1990s, and (6) intensive refugee immigrations over the last decade. In addition, the recognition of year 2000 GPC data of the State Statistical Institute (currently TURKSTAT) as useless and incorrect (see Akpınar, 2005), means that the institutional (conversion of SSI to TURKSTAT) and technical changes (transition from GPC to ABPRS) broke the continuity of the time series data required to make population projections in Türkiye. For these reasons, the high margin of error in projection calculations with time series data can be considered normal, to a certain extent. However, by virtue of the development of statistical techniques and the reliable database provided by ABPRS, demographic data and general censuses have produced more reliable results since 2007.

In terms of urban planning, population data and the population forecasts for the target year are among the main inputs that determine the planning decisions. The problem with population data and their processing affects not only policies at the country level, but also land-use decisions at the local level. In this context, it is equally important to process these data using the correct techniques and accurate population data.

In this paper, the population decisions of a total of 62 provinces covered by a total of twenty 1/100,000-scale TPs published on the website of MEUCC, which is the only responsible authority for those plans, were examined in three steps: (1) population projections and forecasts, (2) annual average population growth rate calculations, and (3)



Provinces having AAPGR over 100‰ between 2019 population and the target year forecast of the plan	AAPGR (‰) between the approval (base) year population and the target year forecast of the plan	AAPGR (‰) between the 2007 and 2019 populations	AAPGR (‰) between the 2019 population and the target year forecast of the plan
Ordu	84.6	8.8	106.5
Denizli	54.6	22.3	111.5
Adana	61.3	18.2	116.0
Tekirdağ	57.4	61.8	116.7
Antalya	89.3	56.5	121.3
Mersin	80.3	23.8	147.9
Çankırı	73.1	19.7	189.4

Figure 8. *Comparison of the provinces having AAPGR over 100‰ between 2019 population and the target year forecast of the plan, in terms of their existing populations in 2007-2019 period, plan approval (base) years, TURKSTAT 2025 population projections, plan target years, and population forecasts of the plans with respect to years (the table is sorted in the increasing order of the 4th column). Source: Prepared from the data obtained from 1/100,000 Scale TP Research Reports, TURKSTAT 2007-2019.*

Table 1. *The state of the 33 provinces having the same or approximate plan target year, comparable in terms of their population size with TURKSTAT 2025 province-based population projections (sorted in the increasing order of the last column).*

Province	Approval (base) year	Plan target year	Population forecast of the plan	2019	TURKSTAT projection for 2025	Proportion of population forecast of the plan to TURKSTAT projection for 2025
Karabük	2019	2025	253,000	248,458	275,389	**0.92**
Giresun	2017	2026	494,000	448,400	458,072	**1.08**
Kırşehir	2007	2025	295,000	242,938	263,109	**1.12**
Kırklareli	2010	2023	445,941	361,836	381,213	**1.17**
Edirne	2010	2023	485,600	413,903	412,595	**1.18**
İzmir	2015	2025	5,545,000	4,367,251	4,672,976	**1.19**
Manisa	2015	2025	1,879,000	1,440,611	1,505,399	**1.25**
Zonguldak	2019	2025	736,000	596,053	580,284	**1.27**
Samsun	2008	2026	1,800,000	1,348,542	1,413,427	**1.27**
Tekirdağ	2010	2023	1,683,200	1,055,412	1,296,443	**1.30**
Amasya	2015	2026	455,000	337,800	338,699	**1.34**
Bartın	2019	2025	268,500	198,249	199,328	**1.35**
Nevşehir	2007	2025	421,000	303,010	305,367	**1.38**
Niğde	2007	2025	524,500	362,861	369,654	**1.42**
Rize	2017	2026	476,500	343,212	333,037	**1.43**
Aksaray	2007	2025	650,500	416,367	450,853	**1.44**
Gümüşhane	2017	2026	281,500	164,521	190,270	**1.48**
Çorum	2008	2026	800,000	530,864	521,647	**1.53**
Muğla	2011	2025	1,643,034	983,142	1,070,849	**1.53**
Artvin	2017	2026	245,000	170,875	159,048	**1.54**
Aydın	2011	2025	1,966,131	1,110,972	1,196,815	**1.64**
Burdur	2016	2025	440,000	270,796	266,085	**1.65**
Trabzon	2017	2026	1,411,000	808,974	840,993	**1.68**
Sinop	2008	2025	367,000	218,243	212,151	**1.73**
Kastamonu	2008	2025	686,500	379,405	388,206	**1.77**
Isparta	2016	2025	797,500	444,914	448,387	**1.78**
Denizli	2011	2025	2,025,117	1,037,208	1,120,115	**1.81**
Tokat	2008	2026	1,100,000	612,747	605,082	**1.82**
Antalya	2016	2025	5,200,000	2,511,700	2,773,397	**1.87**
Adana	2013	2025	4,487,500	2,237,940	2,316,131	**1.94**
Ordu	2017	2026	1,590,000	754,198	763,581	**2.08**
Mersin	2013	2025	4,471,290	1,840,425	1,950,784	**2.29**
Çankırı	2008	2025	610,000	195,789	176,039	**3.47**

** Prepared from the data obtained from the selected 1/100,000 Scale TP Planning Reports, TURKSTAT 2019 ABPRS data and 2025 province-based population projections*

population sizes.

In the first step of the examination, projection techniques and population forecasts used in TPs were questioned in two stages. As a result of typological examinations carried out in the first stage, four types were identified: (1) non-technical, (2) incorrect/incomplete use of the technique, (3) improper use of the technique, and (4) technique without content. In terms of projection calculations/techniques, it was observed that all the plans were methodologically incompetent. The population forecasts in the second stage were determined, independent of the projections produced. Although population forecasting is required to take a value between the lower and upper limits of different projection results that are statistically significant, population forecasts in many TPs exceeded the upper limit of projection results. The explanations about population forecasts in these PRs where forecasts exceed above-limits were based on subjective interpretations, but not on technical and objective reasons.

Based on these findings, it is suggested that revisiting the population decisions of TPs, using a comprehensive approach adopting appropriate techniques is essential. It was determined that many different datasets, calculation methods, and plan horizons (in terms of population calculations) were used in TPs. Such a differentiation might have been acceptable in the case where these plans were prepared by different actors under different conditions. However, TPs in Türkiye are prepared and approved by the single

authority of MEUCC and projections and forecasts are often incorrect. The findings suggest that population calculations should be revised in accordance with methodological principles. If different results appear due to this revision as compared to existing population forecasts, then it means comprehensive revision of TPs should be considered. At this point, the current absence of spatial strategic plans (SSPs) can be considered an opportunity. As such, the plans examined in this paper are the TPs, which are the top-level spatial plans among those currently in effect. In fact, the highest-level plan in the spatial planning system of Türkiye is the SSP, yet although it was first enacted in 2014, there is no SSP that has come into force, to date. Since these plans are expected to be prepared by the ministry in the near future, SSPs may be an opportunity to revise population decisions, among other decisions in the TPs. In this revision, a critical intervention is to standardize or at least harmonize projection techniques, in addition to rearranging the target years in this manner.

An important factor determining the accuracy of population projections is the regular and continuous population database. The data used for these calculations in Türkiye are the time series data held by TURKSTAT. However, since the population data collection system was changed after 2007, and was switched to ABPRS, the question of how to use the population data collected every five years (excluding 1995) before 2007 and annually since 2007 should be addressed. In some of the TPs examined, both population datasets were used together, despite their representation of different time intervals, and in some, 'uncollected' population data were added in some way. The authors of the present paper believe that the ABPRS has proven to be a statistically regular dataset approaching 15 years in the time series since 2007. This series would be sufficient to use in long-term population projections, where pre-2007 population data are no longer necessary. In addition to single-variable extrapolation techniques, it is also possible and necessary to produce projections with further direct techniques, by associating this dataset with other demographic data collected with ABPRS. Following these calculations, close attention should be paid so that the population forecasts of the plans remain between the lower and upper limits of the produced projections, based on technical evaluations to be made by the planning teams.

The main problem identified as a result of the examination is the considerably high differences between population trends and population forecasts. For many provinces whose populations are stable or decreasing, it was observed that the population forecasts are extremely higher than the calculated projections. Population forecast is among the fundamental inputs that directly affect planning decisions. High population forecast results call for excessive urban development area and/or density much more than the optimum level. Over-population forecasts in TPs also bind the lower-scale plans in accordance with the principle of hierarchical integrity of plans. Decisions of the upper-scale plan hierarchically bound lower-level plans. In the case where the problem with this current state of over-populated plans is not resolved, lower-level plans will be faced with the speculative land market, development on the fringe, construction pressure on natural resources, and thus inefficient use of land as a scarce resource, and a waste of public resources. Notwithstanding the question of whether these settlements will be able to provide adequate social and technical infrastructure to carry such large populations is another question to be asked, along with besides others.

Endnotes

[1] 'Çevre Düzeni Planı' is translated as 'territorial plan' with reference to Ministry of Environment, Urbanization and Climate Change's own usage. Scholars may also prefer 'Environmental Plan', 'Environmental Physical Plan', or 'Master Plan'.

[2] Although the spatial strategy plan, which entered into legislation with the Regulation on Spatial Planning in 2014, is the top-level spatial plan, currently there is no sample in effect, to date.

Appendix. Descriptive information, examinations, and projection typology of TPs (sorted in increasing order of approval (base) years in general and within each sub group).

Plans* (all are 1/100,000 scale TPs)	Approval (base) year of the plan	Target year of the plan	The results of examinations over the PRs	Population projection typology
Sinop-Kastamonu-Çankırı Planning Region	2008	2025	No projections were produced, yet urban, rural, and total population forecasts were made at the province and district levels.	Type 1 (Non-technical)
Ardahan-Kars-Iğdır-Ağrı Planning Region	2013	2040		
Adıyaman-Şanlıurfa-Diyarbakır Planning Region	2013	2040		
Balıkesir-Çanakkale Planning Region	2014	2040		
Yozgat-Sivas-Kayseri Planning Region	2015	2040		
Trakya Sub-Region Ergene Basin	2010	2023	No projections were produced, yet population forecasts were made on the provincial and district totals.	
İzmir-Manisa Planning Region	2015	2025		
Amasya İli	2015	2026	No projections were produced, yet population forecasts were made for the provincial total.[1]	
Samsun-Çorum-Tokat Planning Region	2008	2026	(1) No projections were produced, yet upper- and lower-limit population forecasts were made at the provincial level for province, district centers, town, and village totals. (2) Population forecasts were made for each district total and maximum urban populations. (3) For each town upper- and lower-limit urban population forecasts were made.	
Kırşehir-Nevşehir-Niğde-Aksaray Planning Region	2007	2025	(1) Population projections for districts and for the provincial total were produced by exponential method for years 2005, 2010, 2015, 2020, and 2025. (2) Population forecasts were made for each province and district total and no forecasts made for urban and rural populations.	Type 2 (incorrect/ incomplete use of the technique)
Erzurum-Erzincan-Bayburt Planning Region	2016	2045	(1) Population projections for 2045 were produced using exponential, least squares, compound interest, and arithmetic methods and using the 1985, 1990, 1995, 2000 GPCs, 2010, and 2011 ABPRS data. (2) Projections produced for each urban settlement (district and town centers), yet at the district level for rural settlements. (3) For especially rural populations and for many urban settlements since the projections produced were found to approach to zero, these projections were not used. (4) Therefore, the AAPGRs assumed by TURKSTAT in its 2023 projections were also taken into account for population forecasts of the plan period.	
Aydın-Muğla-Denizli Planning Region Zonguldak-Bartın-Karabük Planning Region	2011 2019	2025 2025	(1) Population projections were produced for all settlements using linear, compound interest, and exponential methods. (2) Urban, rural, and total population forecasts were made at the provincial and district levels by a collective evaluation of the average of population projections and the carrying capacities of the approved land-use plans. (3) The adequacy of the existing planned areas was examined by comparing population forecasts with the approved land-use plans.	Type 3 (improper use of the technique)
Muş-Bitlis-Van Planning Region	2011	2035	(1) Population projections were produced for all settlements using exponential, compound interest, arithmetic, and linear regression methods. (2) The average of population projections at the provincial level were tested using cohort-component method. (3) Population forecasts were made for each settlement by a collective evaluation of the average of population projections and the carrying capacities of the approved land-use plans. (4) An evaluation was made as 'areas to be planned' or 'areas that are excessively planned' by comparing population forecasts with the approved land-use plans.	
Mersin-Adana Planning Region	2013	2025	(1) Population projections were produced for all settlements using least squares, compound interest, and exponential methods. (2) Population forecasts were made by a collective evaluation of the average of population projections, the carrying capacities of the approved land-use plans, and the determined ranks and functions for the settlements in the TP. (3) Population forecasts were determined as intervals with lower- and upper limits. (4) The adequacy of the existing planned areas was examined by comparing population forecasts with the approved land-use plans.	
Antalya-Burdur-Isparta Planning Region	2016	2025	(1) Population projections were produced for all settlements using exponential, least squares, compound interest, and arithmetic methods. (2) The average of the population projections was calculated and urban, rural, and total population forecasts were made at the provincial and district levels.[2] (3) Population forecasts were determined as intervals with lower- and upper limits. (4) The adequacy of the existing planned areas was examined by comparing population forecasts with the approved land-use plans.	
Ordu-Trabzon-Rize-Giresun-Gümüşhane-Artvin Planning Region	2017	2026	(1) Population projections were produced using arithmetic, exponential, and compound interest methods and using the 2007, 2011, and 2015 ABPRS data. (2) The averages of these projections were compared with the population forecasts given in the PR of the TP approved on 24 June 2011. (3) The urban population forecasts were made for the towns (municipalities) in the provinces of Artvin, Gümüşhane, Rize, and Giresun and for the districts in the provinces of Trabzon and Ordu.[3]	
Konya-Karaman Planning Region	2018	2043	(1) Population projections were produced for all settlements using least squares, compound interest, and exponential methods. (2) Population forecasts were made by a collective evaluation of the average of population projections, the carrying capacities of the approved land-use plans, and the determined ranks and functions for the settlements in the TP. (3) The adequacy of the existing planned areas was examined by comparing population forecasts with the approved land-use plans.	
Malatya-Elazığ-Bingöl-Tunceli Planning Region Mardin-Batman-Siirt-Şırnak-Hakkari Planning Region	2018 2019	2040 2040	(1) The coefficient values to be used as multiplier for each sector were obtained by proportioning the employment statistics of 1990 and 2000 to the population. (2) Population projections were produced using least squares, compound interest, and arithmetic methods. (3) The average of the population projections was calculated. (4) By proportioning the multiplier values obtained from sectoral data and the average population projection, the final population projections for 2040 were obtained. (5) The adequacy of the existing planned areas was examined by comparing population forecasts with the approved land-use plans.	Type 4 (technique without content)

* The examinations were made on the TPs published on the MEUCC website as of 2020.
[1] In the footnote on page 46 of the related PR it is stated that: "Detailed study for population estimates is included in the appendices of the plan report", although no attachments were found in the report.
[2] On page 12 of that PR it is stated that: "Based on the public investments and tourism potentials (since the other institutions have the authority and they have no future investment programs), the results of the exponential one among all projection methods have been adopted as it is thought that the population will increase more than the estimations made using the current population growth rate for the districts of Alanya, Gazipaşa, Kemer, Manavgat, Serik in Antalya Metropolitan Municipality."
[3] In the related PR, while a brief explanation of population projections and forecasts was made, only the existing municipal populations for 2007, 2011, and 2015 were given in the form of tables. In Appendix-1 of the plan notes, total urban population forecasts of the district and town settlements were determined, yet the total population forecasts of the rural settlements and provincial were not determined.
* Prepared from the PRs of the related TPs (see ÇŞİDB, 2007/2008; 2007a; 2007b; 2009/2010; 2011a; 2011b; 2013a; 2013b; 2013c; 2014; 2014/2015; 2015a; 2015b; 2015c; 2016a; 2016b; 2017; 2018; 2019a; 2019b).

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