Attitudes of people toward climate change regarding the bioclimatic comfort level in tourism cities; evidence from Antalya, Turkey

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Abstract In addition to several negative environmental effects, climate change, which reduces bioclimatic comfort levels especially in urban areas, also has economic implications, especially in cities where the economic structure is tourism-oriented. Considering most of the tourism practices are based on outdoor activities in cities such as Antalya, it is of great importance to determine bioclimatic comfort level as well as the attitudes of people toward climate change who live in those conditions to be able to take proper precautions in terms of tourism and urban planning. Therefore, the purpose of this study was to reveal the bioclimatic comfort conditions of Antalya city center, and a comprehensive questionnaire was conducted with the people living in the area questioning the opinions on reasons and consequences of climate change, perceivable effects of climate change in Antalya, and suggestions to prevent or reduce the adverse effects. The areas with appropriate bioclimatic comfort conditions were determined and mapped via geographical information systems using temperature and relative humidity data of the years between 1960 and 2018. The data gathered via questionnaires were analyzed using confirmatory factor analysis, regression, correlation, and structural equation modelling via SPSS and AMOS software. According to the results, it was determined that in some parts of city center the bioclimatic comfort conditions decreased to levels that could reach harmful dimensions for human health and the analysis of the questionnaires revealed that people living in that area state that the effects of climate change are perceivable as the precipitation seasons have become irregular. According to the participants, it was determined that a 1-unit increase in environmental measures causes a decrease of 0.136 units in disasters ($R^2 = 1.1\%$). In comparison, 1-unit increase of Administrative Precautions will cause 0.030 units decrease in effects of climate change on vital needs ($R^2 = 1.4\%$). These analysis results show that the respondents expect the disaster scenarios to decrease when environmental measures are increased.

Keywords Climate change · Bioclimatic comfort · Tourism cities · Structural equation model · Antalya

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Introduction

Today, more than 50% of the world's population lives in urban areas. The urban population is expected to triple between 2000 and 2030 (Anguluri & Narayanan, 2017; SCBD, 2013) worldwide. The population growth in urban areas in the next years and the rapid growth of cities in size and population will put substantial pressure on the natural structure of the city (Nor et al., 2017). This reveals the requirement of studying the urban environment.

Urbanization damages natural resources as it alters the land use, transportation, industrial and agricultural production, consumption, and social activity patterns. Unplanned cities gathered around fertile agricultural lands, forests, seacoasts, and river resources cause ecologically severe losses. Landscape planning, which is also crucial in protecting our natural resources and utilizing them by their characteristics, is inevitable to find a place in the planning process in our country, mainly in urban planning (Mansuroğlu & Dağ, 2019).

Due to the industrial revolution, increasing the use of fossil fuels, population growth, urbanization, improper land use, unconscious disposal of waste in nature, and deforestation disrupted the flow of the nature and prompted many environmental difficulties, including global warming. Global warming and climate change issues, one of the greatest problems encountered by the world, affect all areas of our lives and creates adverse effects on many factors, such as ecosystems, the existence and health of living things, and water resources. These adverse effects, such as melting of glaciers, rising sea levels, displacement of climatic zones, increased frequency of severe weather events and related natural disasters, drought, erosion, desertification, and shortage of clean water resources, epidemics, a raise of agricultural pests, such as IPCC (2007) (Solomon et al., 2007; IPCC, 2012; IPCC, 2013), experienced for a long time are expected to increase and cause more problems in the coming years.

Climate changes are expected to generate significant risks for people and ecosystems (IPCC, 2012). In addition to global disasters due to global warming and climate change, specific climate risks can occur in urban areas (e.g., urban heat island, impervious surfaces that increase floods, coastal development threatened by sea-level rise, etc.) (Carter et al., 2015; Gartland, 2012; Gill et al., 2007; Smith et al., 2009; Wilbanks et al., 2007). Consequently, it is predicted that all countries and even cities will be affected by climate change in various dimensions and will encounter several adaptation difficulties. Thus, Fünfgeld (2010) states that the international community is working toward reducing climate change.

Especially in sensitive urban areas prone to degradation, it is important to create local strategy plans for adaptation to climate change and to integrate them into regional plans and policies (Defra, 2013; Carter et al., 2015; Sanchez et al., 2018). The development of urban green infrastructure systems plays a decisive role in reducing the impact of global climate change and providing bio-comfort. However, given the complexity of urban systems and the interrelationships between their constituent elements, it becomes difficult to separate the effects of climate change into specific sectors and themes (Carter et al., 2015). Hence, Doherty et al. (2016) indicate that although humans have adapted their environment throughout history, climate change has presented new and unique challenges threatening the lives and source of income. Since the thermal comfort of human beings is an expression of satisfaction due to the current weather conditions (Lee, 1953; Abuloye et al., 2017).

Studies on human comfort have generated worldwide interest because climatic comfort is often the basis of planning for housing, health, and tourism areas (De Freitas, 2003; World Health Organisation (WHO 2011). People's feelings of bio-comfort sometimes differ significantly depending on their metabolic rate, type of clothing, workload, age, gender, weight, emotions, cultural influences, past climate experiences, and climate zone. Outdoor workers also tolerate higher temperatures than sedentary workers, while older individuals tend to prefer warmer conditions than younger individuals (Stewart and Oke, 2010; Jendritzky & Tinz, 2009). Human health and biocomfort are more affected by climate than the other elements of the human physical environment (Lenzuni et al., 2009). The effects of climate on human beings, physical and mental efficiency, constitute the main theme of human biometeorology (Akinbobola et al., 2017). Biocomfort is the human body response to climatic factors, such as temperature, relative humidity,

and wind speed and is a requirement for quality of life. The biocomfort index is an indicator applied to estimate the comfort of the human body in various climatic environments. It is defined as the heat exchange among human and climatic environments (Moustris et al., 2018). Biocomfort is a factor directly affecting people's ability to move outdoors and the quality of their experience in these areas. With global warming due to climate change, it has become one of the parameters attached to urban planning studies (Çetin, 2019).

Climate changes will affect human life in several ways. Some sectors in close relationship with climate will also be affected by these negativities. Tourism is one of the most important of these sectors. Considering that the external environment and natural factors have a direct impact on tourism movements and tourist decisions, it is inevitable that climate changes will impact tourism. Therefore, Didascalou et al. (2007) remark that the competitiveness of a destination depends on ideal climatic conditions suitable for the type of tourism provided. Consequently, disadvantaged climate areas are less favored by tourism planners and tourists (Corobov, 2007). Thus, the studies that were conducted to emphasize the significance of the subject (Lenzuni et al., 2009; Matzarakis et al., 2014; Abuloye et al., 2017; Staiger et al., 2019; Algeciras et al., 2020; Anna et al., 2020; Hasanah et al., 2020; Rozbicka & Rozbicki, 2020) are gaining importance day by day.

Turkey has rich opportunities with its natural beauties, historical attractions, socio-cultural characteristics, and tourism. In tourism, where natural, cultural, and historical values are accepted as a resource, the adverse effects on the environment directly harm the tourism sector. According to Karadeniz et al. (2018), tourism is one of the sectors most concerned by global warming and contributes to globalization in three dimensions: socially, spatially, and economically (Viner & Agnew, 1999). The climate of Turkey, which is surrounded by seas on three sides, may differ in regional dimension due to its rugged topography and orographic features. Turkey is one of the countries that will be most concerned by climate change with its diverse climate structure, and different regions will be affected in several measures and forms (Öztürk, 2002).

Within the scope of this study, firstly the bioclimatic comfort condition of Antalya, the most important tourism center of Turkey, was revealed and the attitudes of people living in the city concerning the reasons and outcomes of climate change due to global warming, known as the world's most important environmental problem, and their suggestions on the subject were examined. Moreover, some suggestions have been produced for city planning and landscape architecture professional discipline to eliminate this problem.

Materials and method

Material

The research area, located on the Mediterranean coast, one of Turkey's major tourism attractions, has been determined as Antalya city center. The population of Antalya has reached 2.548.308 in year 2020 by the increase of migration due to tourism and agricultural activities. The total number of tourists that visited the city in 2019 is over 15 million (TUIK, 2020).

The primary materials of the study include:

– Climate data (1960–2018) obtained from 8 different meteorology stations in the research area.
– Arc Gis 10.5 and Arc Map 10.5 software were utilized to reveal the bioclimatic comfort of the city within the scope of the research.
– People living in Muratpaşa, Konyaaltı, Kepez, Döşemealtı, and Aksu districts of Antalya.
– Questionnaire forms used to reveal the opinions of people on global warming and climate change in Antalya.
– Literature.
– IBM SPSS Statistics 25.0 (Statistical Package for Social Science), IBM SPSS Amos 24.0, and Microsoft Excel programs used for the evaluation of questionnaires in the study.

Method

The research was performed by applying a four-step method (Fig. 1). In the first step, a literature review on the subject was performed, research questions related to the research area were presented, and the research model was designed. In the second step, climate data were gathered from six meteorological
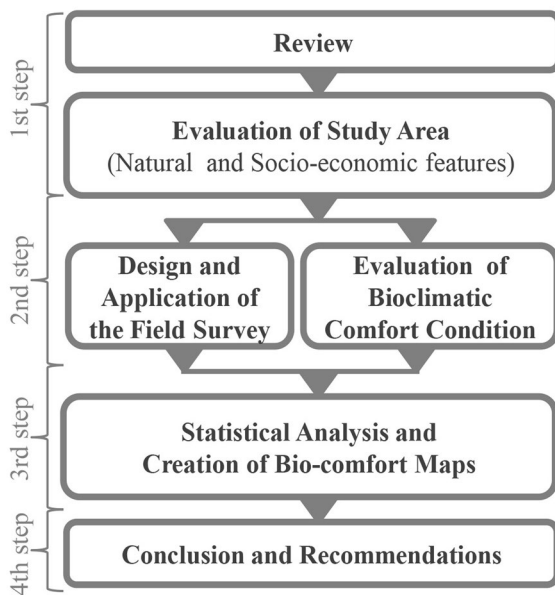
Fig. 1 Method flowchart

stations in the research area, and the bio-comfort map of the study area was created. The bioclimatic comfort conditions in the living spaces in the summer months, when the tourism activities of the people living in the study area are intensive, were revealed. In the third step, considering the biocomfort conditions of the people living in the study area, the questionnaires used as face-to-face interviews were designed and performed, and the analysis was applied to the data to answer the research question. In the fourth step, findings obtained from the research and analysis conducted within the scope of the research were interpreted, and precaution recommendations were explained in terms of the landscape architecture professional discipline for the current and predicted effects of climate change.

The New Summer Index (SSI) (Pepi, 1987) was applied to reveal the bioclimatic comfort situation of the city during the summer months. Bioclimatic comfort areas were listed. In the study, temperature (°F) and relative humidity (%) data obtained from six meteorology stations in Antalya city center were processed on Arc Gis 10.5 software. Climate maps were created with the Interpolation method using the "Inverse Distance Weighted (IDW)" command in the Arc map 10.5 software.

IDW is one of the most preferred techniques among interpolation and map generation methods as it gives opportunity of getting more reliable results, reduces the margin of error rate, and the mathematical formulas integrated to the method enable to comment on the study area. It is an interpolation technique applied to determine the cell values of non-sampled points with the help of the values of known sample points. The cell value is calculated by examining the various points away from the relevant cell and depending on the increase in distance. The predicted values are a function of the distance and size of the neighboring points, and the importance and effect on the cell to be estimated decreases with increasing distance.

$$z(x_o) = \frac{\sum_{i=1}^{n} z(x_i).d_{i0}^{-r}}{\sum_{i=1}^{n} d_{i0}^{-r}}$$

The location X_0 where the predictions are made is a function of neighboring measurements ($z(X_{0i})$ and $i = 1,2,\ldots,n$); r is the exponent that determines the assigned interval for each of the observations, and d is the distance separating the observation location X_i from the prediction location X_0. The larger the base, the smaller the assigned weight of observations far from the forecast location. Increasing the base means that the predictions are significantly related to the nearest observations. Mathematical formulas were as described above, and they were calculated in the ArcGIS environment, which is a GIS software, and maps were created (Çetin et al., 2018; Taylan & Damçayırı, 2016).

Temperature and relative humidity maps provided by the interpolation method were evaluated in terms of bioclimatic comfort by using the SSI formula via the Raster Calculator command in the Arc map 10.5 software (Fig. 2). The temperature and relative humidity data of the years between 1960 and 2018 gathered by 8 different meteorological stations that are located within the study area boundaries were used to conduct the study method.

1.98 * (Ta − ((0.55 − 0.0066 * RH)
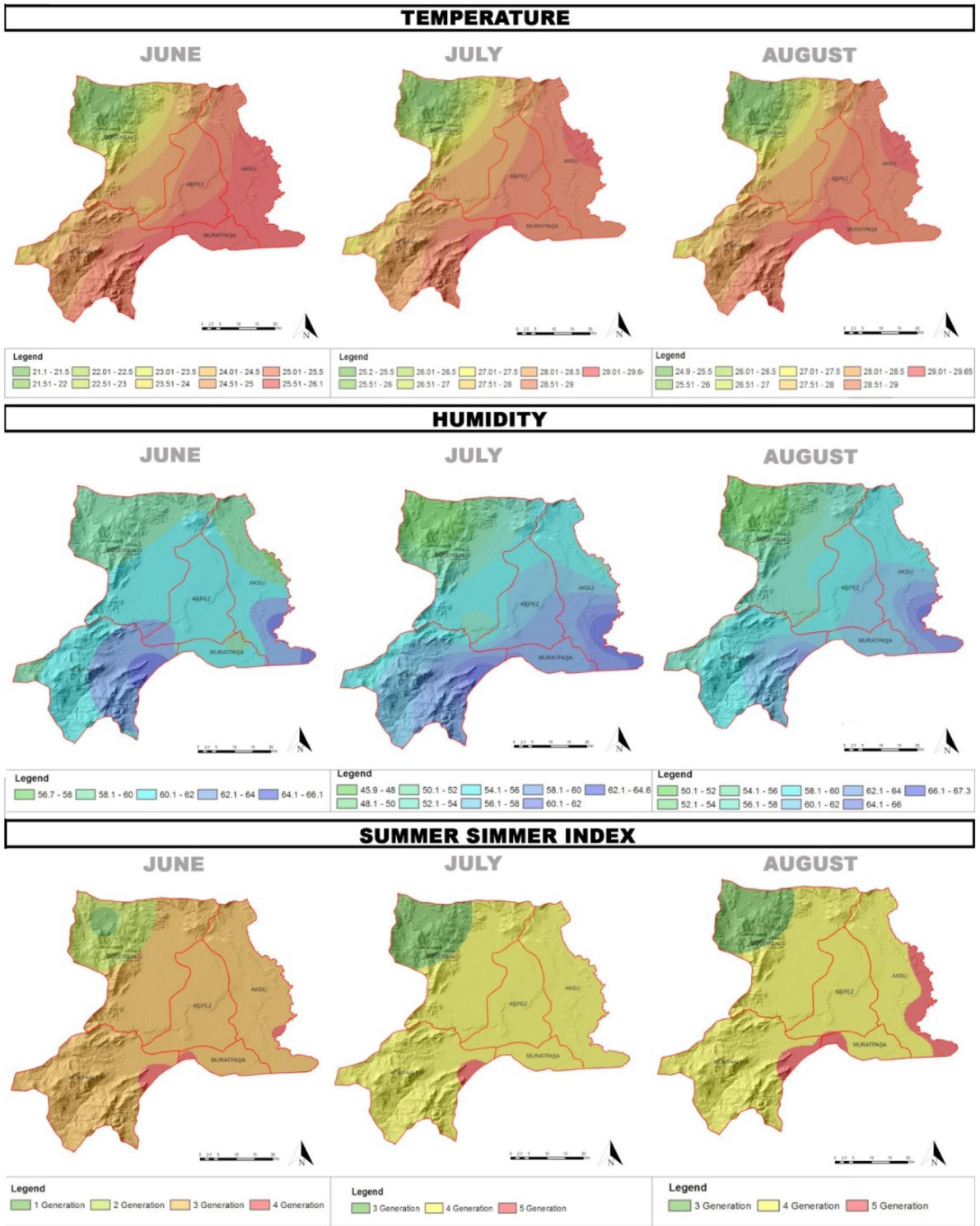 * (Ta − 58))) − 56.83

Ta - Temperature (°F)
RH - Relative Humidity

Fig. 2 Bioclimatic comfort conditions of central districts of Antalya

Table 1 Generation zones of human thermal comfort

SSI value (°F)	Generation (zone)	Thermal comfort class for human
70–77	1	Some people feel a little cold; many people feel comfortable
77.1–82	2	Most people feel comfortable
82.1–90	3	Many people feel comfortable. Some people feel a little hot
90.1–99	4	Comfort decreases due to temperature increase
99.1–111	5	It feels scorching. Sunstroke may occur as a result of being outside for an extended period
111.1–124	6	There is a high degree of discomfort and a high probability of heatstroke. Everyone feels uncomfortable
124.1–149	7	There is a danger of heatstroke for elderly or weak people. In this area, the environment is scorching, and the level of discomfort is maximum
More than 149.1	8	The circulatory system of individuals exposed to these conditions for a long time may collapse

The SSI indicates the dangers of exposure to various combinations of temperature and humidity, based on physiological studies. Seven zones are identified in Table 1 (Pepi, 1987).

The survey carried by mutual interviews to determine the opinion of people living in Antalya on global warming and climate change was performed between March and June 2019. The survey was applied in six stages. The stages are listed as follows:

a) Determination of sampling size: The sample size of the survey study was based on 386 samples according to the 5% margin of error (95% confidence interval) for the population of more than 100 thousand people, which is the population size suggested by Balcı (2015).

b) Selection of inquiry method: Since interviews are safer and faster, an on-site questionnaire method with standard forms was applied to discover the opinions of the people on global warming and climate change.

c) Preparation of the questionnaire: A questionnaire consisting of two parts, views on global warming and climate change and the socio-economic structure, was prepared. Ranking of importance and participation level questions were applied in the questionnaire. Thirteen judgments were presented to determine the reasons for global warming and climate change and the scenarios that may arise, and ten judgments to determine what can be done to reduce their effects. The demographic characteristics of the individuals were studied in terms of gender, age, marital status, educational status, profession, and income status.

d) Pre-testing the questionnaire and correction of errors: The prepared questionnaire was applied randomly to 30 people living in Antalya center by mutual interview method. A re-organized questionnaire was put into practice with the feedback obtained from these people.

e) Application of the questionnaire: A questionnaire was randomly applied to the individuals living in Antalya center by mutual interview method.

f) Evaluation of survey results: Survey results were evaluated with the help of the IBM SPSS Statistics 25.0 program. The questionnaire includes the question types in order of importance (with three options) and the level of participation (3 and 5 Likert scales). Individuals were allowed to express their opinions more simply by adding the other option to the questions other than the one-option question.

The survey data was transferred to the Microsoft Excel program, organized, and prepared for analysis. Descriptive statistical analysis was applied to the data to be able to describe and summarize the data quantitatively. Explanatory factor analysis was used to classify the variables and define the relationship between measured variables. The validity of the scales that were used within the study were tested via reliability analysis, and confirmatory factor analysis was used to confirm or reject the research theory. The distribution of the data was Normality test to be able to decide to use parametric or non-parametric tests on data comparing the phase of the study. Mann–Whitney U, the Kruskal–Wallis test, Spearman correlation tests, and linear regression analysis were applied to the data

to conduct comparison to define the relationship between the variables. Data analysis was tested using IBM SPSS Statistics 25.0 (Statistical Package for Social Science) and IBM SPSS Amos 24.0 package programs. The statement "Precipitation will become more changeable," one of the statements about the scenarios that may arise due to global warming, was excluded from the analysis since it was not classified under any factor.

Results and discussions

Bioclimatic comfort condition of the city

Antalya is one of the most dynamic cities in sea tourism, with its many natural and historical touristic values. While its economic and spatial organization based on activities carried out primarily in outdoor during the summer months makes it an internationally acknowledged tourism city, the climatic effects due to climate change and global warming directly affect the bioconformity of the users in outdoors of the city. Currently, according to the scientific studies (Akinbobola et al., 2017; Attia et al., 2019; Gomez-Martin et al., 2020; Shevchenko et al., 2020) analyzing the long-term climate data of the city, the temperature and humidity values are in an increasing trend (Bacanlı & Çukurluoğlu, 2018). Within the scope of the study, respondents' views on the effects of climate change, the measures to be taken, and the bioclimatic comfort situation in the study area during the summer months, when tourism activities take place the most, were analyzed and mapped (Fig. 2).

The analysis maps in Fig. 2 show that the temperature and humidity are felt intensely during the summer months. In terms of bioclimatic comfort zones, the comfort zones in the city vary between 1 and 4

generations in June. In July and August, it was determined that the suitability to bioclimatic comfort decreased further, and the city center was classified between 3 and 5 generations in terms of bioclimatic comfort classes. When evaluated according to the classification criteria of Pepi (1987), it was determined that the bioclimatic comfort conditions of the city's central districts decreased to levels that could reach harmful dimensions for human health and that the bioclimatic comfort level of the city, in general, was low.

Evaluation of the survey study

Demographic characteristics

The opinion of people on global warming and climate change may differ due to demographic characteristics. The data regarding the gender, age, marital status, educational status, profession, and income status of the 386 participants of the study are presented in Table 2. Rate of the participants, 47.4% were women, and 52.6% were men. Table 2 shows that 74.6% of the participants were single, 24.4% had an income of 6001 TL (Turkish Lira), and above, 52.3% were between 18 and 24, and 50% were high school graduates.

Opinions on the scenarios possible to arise by climate change and precautions to take

Exploratory factor analysis was applied to the scales of opinions on the scenarios that are possible to arise by the climate change and precautions to take, and the resulted sub-dimensions with reliability analysis are presented in Table 3.

When the factor analysis was applied to the scenarios that may arise due to global warming, they were

Table 2 Socio-economic characteristics of respondents

Marital status	(%)	Income (TL[*])	(%)	Age groups	(%)	Education	(%)
Married	21.5	Less 2.000	7.0	18–24	52.3	Illiterate	0.3
Single	74.6	2001–3000	23.8	25–34	27.2	Primary school	0.5
Divorced	3.9	3001–4000	13.0	35–44	11.7	Secondary school	1.3
		4001–5000	16.8	45–54	4.9	High school	50.0
		5001–6000	15.0	55–64	2.8	High school (university)	6.0
		+6001	24.4	+65	1.0	University	37.0
						Post-graduate	4.9

[*]At the time of the field study, 1 USD dollar = 5.35 TL

Table 3 Effects of climate change and measures that can be taken explanatory factor analysis

		Component 1	Component 2	Component 3	Component 4	Sub-dimension
Effects of climate change and measures that can be taken explanatory factor analysis	Global wars	0.784	0.099	−0.087	0.018	Disasters
	Floods	0.616	0.088	0.26	−0.233	
	Epidemics/pandemics	0.478	0.438	−0.109	−0.082	
	Desertification	0.436	0.224	−0.11	−0.116	
	Extinction	0.131	0.711	0.041	0.029	Vital needs
	Hunger	0.165	0.632	0.099	−0.081	
	Agricultural destruction	0.303	0.628	−0.036	0.068	
	Glacier melting	0.027	−0.03	0.772	0.003	Climatic effects
	Increase of climate change effects	−0.194	0.153	0.691	−0.036	
	Temperature rise in oceans	0.238	−0.296	0.459	0.361	
	Reduction of clean water resources	−0.136	0.339	0.373	0.466	
	Explained cumulative variance%	22.012	34.789	43.394	51.789	
	Cronbach's alpha	0.682	0.557	0.404	-	
	KMO and Barlett test	0.745 ($p=0.000^*$)				

		Component 1	Component 2	Sub-dimension
Measures to be taken reliability and explanatory factor analysis	Nature conservation	0.816	0.146	Environmental precautions
	Plantation	0.765	0.118	
	Increasing urban green areas	0.746	0.108	
	Recycling	0.652	0.178	
	Education	0.484	0.447	Administrative precautions
	Taxes	−0.089	0.729	
	Reducing consumption	0.077	0.682	
	Laws	0.323	0.552	
	Public transportation	0.212	0.535	
	Bicycle trails	0.289	0.48	
	Explained cumulative variance%	34.9	48.1	
	Cronbach's alpha	0.77	0.644	
	KMO and Barlett test	0.834 ($p=0.000^*$)		

*Meaningful at 0.05 level

grouped in 3 basic sub-dimensions as "Disasters," "Vital Needs," and "Climatic Effects," and the rainfall variable was not connected with any group. In consequence of the KMO test, the sample adequacy of the factor analysis was appropriate ($KMO=745$). In the reliability analysis of the sub-dimensions, the Cronbach alpha values ranged between 0.404 and 0.682. When factor analysis was applied to precautions to

Table 4 Confirmatory factor analysis goodness of fit indices (CFA) for impacts and measures scales

	Model of effects	Model of measures
Chi square/degree of freedom (CMIN/DF)	1.8	2.5
Root mean square residual (RMR)	0.009	0.037
Root mean square error of approximation (RMSEA)	0.045	0.063
Goodness of fit index (GIF)	0.963	0.956
Adjusted goodness of fit index (AGFI)	0.943	0.929
Comparative fit index (CFI)	0.929	0.937

prevent climate change and global warming, it was divided into two basic sub-dimensions, "Environmental Precautions" and "Administrative Precautions." As a result of the KMO test, the sample adequacy of the factor analysis was appropriate (KMO = 834). In the reliability analysis of the sub-dimensions, the Cronbach alpha values ranged from 0.644 and 0.770. Confirmatory factor analysis of the effects of climate change and global warming and measures to be taken are given in Table 4.

When the sub-dimensions resulting from the explanatory factor analysis and reliability analysis are

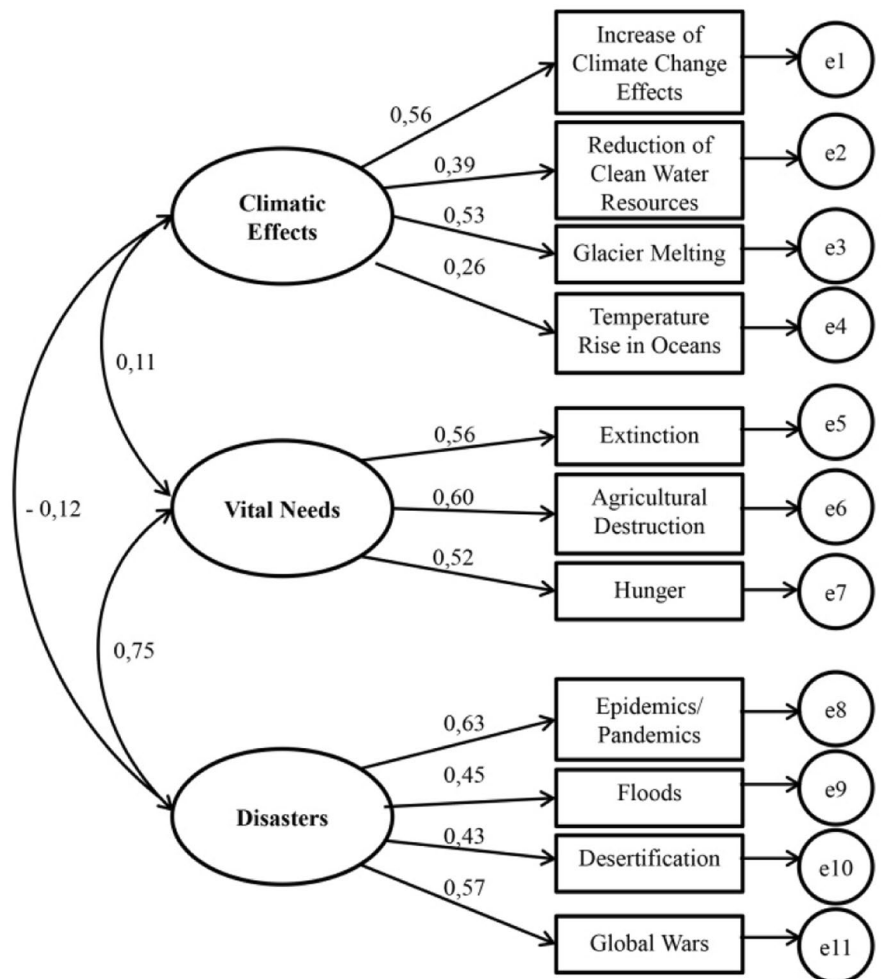**Fig. 3** Structural equation model (SEM) of climate change effects

Table 5 Normality distribution tests of sub-dimensions

	Statistics	SD	p
Climatic effects	0.345	386	0.000
Disasters	0.262	386	0.000
Vital needs	0.426	386	0.000
Environmental Precautions	0.413	386	0.000
Administrative precautions	0.096	386	0.000

[*]Meaningful at 0.05 level

tested with the confirmatory factor analysis, the index of goodness of fit is relatively high. The established models are given in Fig. 3.

In confirmatory factory analysis and SEM, the coefficient values between the factors are expected to be equal to or below 0.80, while the regression coefficients of the variables are expected to be equal to or above 0.30 (Hoyle, 1995). The results of structural equation models presented in Fig. 3 show that the fit indices between all variables except "Temperature rise in Oceans" variable are between expected intervals. As the model presents, fit indices are not affected by the value of "Temperature rise in Oceans," so this value can be avoided. Consequently, the validity of the measures used in this research has been proved by this model, which means the designed factors can be measured by the questionnaire used in this research (Table 5).

Figure 4 shows the fit indices between all the variables that were used to evaluate the precautions that should be taken to mitigate the existing effects and avoid the damage on nature and society caused by climate change are all between expected intervals. This means the measures used in this research to determine the precautions against climate change are statistically approved.

H_0: The distribution of the data fits the normal distribution.

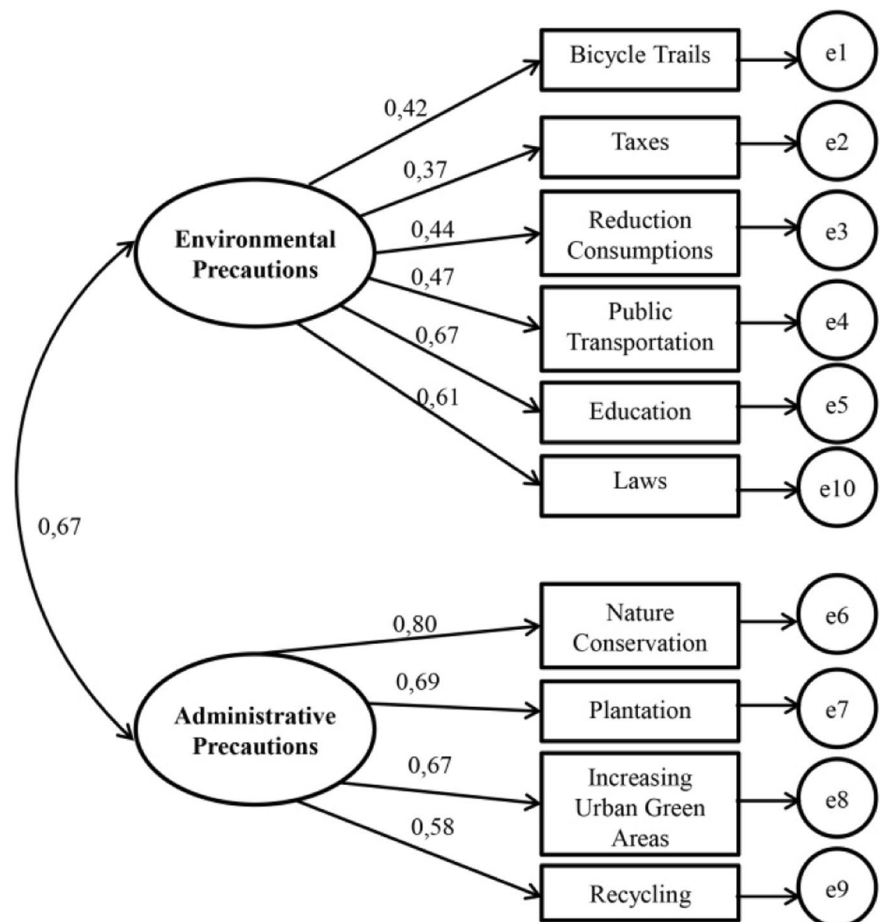**Fig. 4** Structural equation model (SEM) of precautions against climate change

Table 6 Statistical analysis of global warming and climate change effects and required measures according to socio-demographic characteristics

		Climatic effects	Disasters	Vital needs	Environmental precautions	Administrative precautions
Gender (Median + SD)	Male	4.72 (4) ± 0.99–6	6.27 (6) ± 1.64–7	3.42 (3) ± 0.82–4	4.51 (4) ± 1.04–5	10.79 (10) ± 3.12 -16
	Women	4.55 (4) ± 0.92–5	6.20 (5) ± 1.67–8	3.39 (3) ± 0.85–5	4.49 (4) ± 1.43 -16	10.46 (10) ± 3.33 -24
	Total	4.63 (4) ± 0.95–6	6.23 (6) ± 1.65–8	3.41 (3) ± 0.83–5	4.50 (4) ± 1.26 -16	10.62 (10) ± 3.23 -24
	p	0.027*	0.435	0.619	0.653	0.274
Age (Median + SD)	18–24	4.59 (4) ± 0.92–5	6.32 (6) ± 1.73–8	3.46 (3) ± 0.89–5	4.46 (4) ± 0.99–7	10.49 (10) ± 3.10–16
	25–34	4.66 (4) ± 0.91–3	6.00 (5) ± 1.41–6	3.24 (3) ± 0.53–2	4.50 (4) ± 0.99–5	10.93 (10) ± 3.20–17
	35 +	4.71 (4) ± 1.10–6	6.33 (6) ± 1.72–7	3.51 (3) ± 0.99–4	4.61 (4) ± 1.99 -16	10.53 (10) ± 3.57–24
	Total	4.63 (4) ± 0.95–6	6.23 (6) ± 1.65–8	3.41 (3) ± 0.83–5	4.5 (4) ± 1.26–16	10.62 (10) ± 3.23–24
	p	0.725	0.293	0.112	0.758	0.494
Marital Status ((Median + SD)	Married	4.63 (4) ± 1.07–6	6.19 (6) ± 1.59–7	3.45 (3) ± 0.94–4	4.63 (4) ± 1.96–16	10.71 (10) ± 3.72–24
	Single-widow	4.63 (4) ± 0.92–5	6.24 (6) ± 1.67–8	3.40 (3) ± 0.80–5	4.47 (4) ± 0.99–7	10.59 (10) ± 3.09–16
	Total	4.63 (4) ± 0.95–6	6.23 (6) ± 1.65–8	3.41 (3) ± 0.83–5	4.50 (4) ± 1.26–16	10.62 (10) ± 3.23–24
	p	0.55	0.979	0.941	0.726	0.87
Education (Median + SD)	High school or less	4.70 (4) ± 1.00–6	6.17 (5) ± 1.61–8	3.41 (3) ± 0.86–5	4.59 (4) ± 1.54–16	10.88 (11) ± 3.35–24
	College and university or higher education	4.56 (4) ± 0.90–5	6.30 (6) ± 1.69–7	3.41 (3) ± 0.81–5	4.41 (4) ± 0.85–5	10.34 (10) ± 3.07–17
	Total	4.63 (4) ± 0.95–6	6.23 (6) ± 1.65–8	3.41 (3) ± 0.83–5	4.50 (4) ± 1.26–16	10.62 (10) ± 3.23–24
	p	0.164	0.392	0.769	0.679	0.118
Occupation (Median + SD)	Self-employment	4.63 (4) ± 0.94–4	6.09 (5) ± 1.48–6	3.37 (3) ± 0.81–4	4.30 (4) ± 0.84–4	9.87 (10) ± 2.86–10
	Officer	4.43 (4) ± 0.77–3	6.38 (6) ± 1.72–6	3.50 (3) ± 0.86–3	4.83 (4) ± 1.25–5	11.05 (11) ± 3.00–13
	Worker	5.06 (5) ± 1.34–6	5.74 (5) ± 1.15–4	3.26 (3) ± 0.51–2	4.42 (4) ± 0.85–3	11.26 (11) ± 3.39–17
	Other	4.81 (4) ± 0.99–4	6.30 (6) ± 1.87–7	3.46 (3) ± 0.91–4	4.68 (4) ± 2.25–16	10.65 (10) ± 4.18–24
	Student	4.54 (4) ± 0.88–5	6.40 (6) ± 1.75–8	3.44 (3) ± 0.90–5	4.47 (4) ± 1.03–7	10.62 (10) ± 3.12–16
	Private sector	4.63 (4) ± 0.97–4	5.83 (5) ± 1.20–4	3.23 (3) ± 0.60–3	4.31 (4) ± 0.68–3	10.63 (10) ± 2.54–10
	Total	4.63 (4) ± 0.95–6	6.23 (6) ± 1.65–8	3.41 (3) ± 0.83–5	4.5 (4) ± 1.26–16	10.62 (10) ± 3.23–24
	p	0.056	0.229	0.677	0.104	0.396

Table 6 (continued)

		Climatic effects	Disasters	Vital needs	Environmental precautions	Administrative precautions
Income (Median + SD)	Less than 2000 TL	4.56 (4) ± 0.97–3	6.78 (6) ± 1.93–7	3.48 (3) ± 1.05–4	4.59 (4) ± 1.50–7	9.85 (9) ± 2.73–8
	2001–3000	4.75 (4) ± 1.02–6	5.84 (5) ± 1.42–7	3.45 (3) ± 0.80–4	4.61 (4) ± 1.84–16	11.02 (11) ± 3.51–24
	3001–4000	4.32 (4) ± 0.51–2	6.60 (6) ± 1.76–7	3.48 (3) ± 0.81–3	4.48 (4) ± 1.01–4	10.62 (10) ± 3.08–11
	4001–5000	4.75 (4) ± 0.97–3	6.34 (6) ± 1.80–8	3.25 (3) ± 0.53–2	4.42 (4) ± 0.88–4	10.75 (10) ± 3.46–17
	5001–6000	4.57 (4) ± 0.90–4	5.95 (5) ± 1.39–5	3.45 (3) ± 0.94–5	4.38 (4) ± 1.02–5	10.26 (10) ± 3.08–16
	More than 6001 TL	4.66 (4) ± 1.05–5	6.37 (6) ± 1.68–7	3.39 (3) ± 0.91–5	4.51 (4) ± 0.94–3	10.56 (10) ± 3.10–16
	Total	4.63 (4) ± 0.95–6	6.23 (6) ± 1.65–8	3.41 (3) ± 0.83–5	4.50 (4) ± 1.26–16	10.62 (10) ± 3.23–24
	p	0.164	0.006*	0.538	0.691	0.559

H_1: The distribution of the data does not fit the normal distribution.

According to the results of Kolmogorov–Smirnov normality tests, five subscales do not exhibit normal distribution (H_0 acceptance: $p < 0.05$). Therefore, nonparametric tests were preferred in the analysis of variables.

The comparative analysis (the Kruskal–Wallis test, Mann–Whitney U test) are presented in Table 6 by comparing the sub-dimensions related to the effects of global warming and climate change.

According to the Mann–Whitney U test results applied by gender, only climatic effects scores differ significantly ($p < 0.05$). Men who participated in the survey showed statistically significant participation in the climatic effects of climate change than women. According to the results of the Kruskal–Wallis test applied by the age and occupation of the subjects, there was no significant difference between the opinions of the subjects concerning the effects of climate change and the measures to be taken, depending on their age groups and professions ($p > 0.05$). Mann–Whitney U test results applied according to marital status, and education level revealed that the opinions of the subjects on the effects of climate change and the measures to be taken did not differ significantly according to marital status and education levels ($p > 0.05$). Regarding the results of the Kruskal–Wallis test applied according to income, there was a significant difference only in the climate change effects scores in the Disasters group ($p < 0.05$). While the participation level of those with an income of 2001–3000 TL in this category is significantly lower than all other groups, the participation level of those with an income of 5001–6000 TL is lower than those with an income of 3001–4000 TL and less than 2000 TL.

Table 7 Spearman correlation analysis between sub-dimensions

	Disasters	Vital needs	Environmental precautions	Administrative precautions
Climatic effects	− 0.04 (0.398)	0.04 (0.453)	− 0.02 (0.756)	0.09 (0.085)
Disasters		0.47 (0.000*)	− 0.14 (0.005*)	− 0.06 (0.206)
Vital needs			− 0.07 (0.170)	− 0.11 (0.030*)
Environmental precautions				0.34 (0.000*)

*Meaningful at 0.05 level

Table 8 Regression analysis between sub-dimensions (dependent: effects; independent: measures)

	B	t	p	F	p	R square	Durbin–Watson
Climatic effects							
Stable	4.683	23.128	0.000	2.479	0.085	0.013	1.941
Environmental precautions	−0.083	−1.941	0.053				
Administrative precautions	0.030	1.823	0.069				
Disasters							
Stable	6.845	22.019	0.000	4.176	0.042[*]	0.011	1.641
Environmental precautions	−0.136	−2.043	0.042				
Vital needs							
Stable	3.726	25.679	0.000	5.302	0.022[*]	0.014	2.095
Administrative precautions	−0.030	−2.303	0.022				

[*]Meaningful at 0.05 level

Within the scope of the study, correlation and regression analysis among sub-dimensions were applied to describe better how the participants perceive the scenarios regarding the effects of climate change and the measures to be taken, and the data obtained are presented in Tables 7 and 8.

As a result of the Spearman correlation analysis between sub-dimensions, there was a positive and moderate relationship between Disasters and Vital Needs (47%), a weak negative relationship between Disasters and Environmental Precautions (−14%), a weak negative relationship between Vital Needs and Administrative Precaution (−11%), and a positive and moderate relationship between Environmental Precautions and Administrative Precautions (34%).

In the regression models established, the effects of the measures on climatic effects were found insignificant ($p > 0.05$).

According to the participants, a 1-unit increase in environmental measures causes a decrease of 0.136 units in disasters ($R^2 = 1.1\%$). In comparison, a 1-unit increase in Administrative Precautions will cause a decrease of 0.030 units in vital needs effects ($R^2 = 1.4\%$). These analysis results reveal the respondents expecting a decrease in disaster scenarios when environmental measures are increased. Moreover, according to them, if administrative measures are increased, the effects of climate change and global warming (such as a reduction in agricultural land and products, extinction of plant and animal species, etc.), which make it difficult to meet basic vital needs, will decrease.

Conclusion and recommendations

One of the most felt effects of the climate change is the alteration in outdoor temperature. As the outdoor activities have a significant part of economical organization of the tourism cities, the biocomfort level of these cities gain more importance to sustain touristic income. Thus, the biocomfort conditions of the city center was revealed within the scope of the study which resulted that the bioclimatic comfort level of the study area is generally low and can reach up to the levels that could be harmful for human life in some parts of the city center. Proving this outcome of this study, where people's attitudes in tourism cities on global warming and climate change were also determined, and participants in the survey stated that global warming and climate change affected Antalya. The results of the questionnaire showed that the participants declared that the proof of the climate change and global warming effects in Antalya was the irregularity of rainfall and seasons. Besides, the participants stated that the precipitation in the city became irregular, and the temperature and drought increased.

Changes in climate events can have many different outcomes in tourism cities, from the change of tourism periods to the loss of the tourism potential. Thus, it is essential to take the required precautions by accepting that the effects of climate change and global warming are felt in the tourism sector rather than judging them as a future issue. Based on the results of former studies that were conducted at the study field (Çetin et al., 2018; Mansuroğlu, 2017;

Mansuroğlu & Dağ, 2019; Mansuroğlu et al., 2006, 2012, 2013) and the findings of this current study, some effects of climate change due to global warming on the tourism sector in the Antalya example can be listed as follows:

- With the prolongation of the dry season periods, the loss of the characteristics of natural areas, and the decrease in the original tourism potential.
- Winter tourism in mountainous areas is adversely affected by the irregularity of the snowfall time and/or the alteration of the amount of snow in winter.
- Loss of tourism areas with natural seasonal characteristics as a result of shortening and/or absence of transition periods within seasons.
- Decrease in the number of visitors during extremely hot summer seasons.
- Decrease in underground water resources due to a decline in precipitation.
- The attractions of touristic areas are affected adversely due to massive forest fires.
- Sea-sand-sun tourism is adversely affected by the increase in seawater temperature.
- Tourism being indirectly affected by the reduction in agricultural production or damage of agricultural products.
- The unfavorable effects of some tourism types (botanical tourism, wildlife-bird watching) due to the decrease in plant and animal species and/or the change of vegetation/monitoring periods.

Among the ideas to prevent such obstacles and improve the bioclimatic comfort conditions in the city, studies should be carried out to protect natural areas, support recycling, and increase afforestation. The ideas that can be achieved in terms of fighting global warming and climate change and improving bioclimatic comfort conditions of the city are given as follows:

- Improving bioclimatic comfort conditions of the city must be one of the main goals of city planning authorities.
- Afforestation works should be increased.
- Natural areas should be protected.
- Green areas in cities should be improved.
- Recycling should be supported.
- Bicycle use should be encouraged.
- Public transport should be improved.
- All kinds of consumption should be reduced (water, energy, etc.).
- Education activities should be increased, and active participation of the public should be assured.

Thus, it is necessary to take national measures in fighting climate change due to global warming, which is an environmental difficulty of global importance. It is essential to reduce the adverse effects of tourism, one of the critical sectors of our country, to protect the diversity of tourism and to ensure the participation of local people in the activities to be performed on this matter.

Data availability Data will be available on reasonable request.

Declarations

Conflict of interest The authors declare no competing interests.

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