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Modeling of Stochastic Process of Implementation of Various Combinations of Dangerous Meteorological Phenomena in the Mountains of the Caucasus

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Abstract: The mountainous regions of Caucasus are characterized by the exceptional variety of dangerous meteorological phenomena that often cause significant material damage and human losses. These dangerous meteorological phenomena often occur simultaneously and exacerbate the situation. For example, increased wind during heavy rains, fog during snowstorms, hurricanes with hail, etc. To reduce the negative effects of such phenomena, it is necessary to know their probabilistic characteristics in given area. These meteorological phenomena are independent of each other, therefore the physical process of their occurrence has stochastic nature and it can be investigated as a random process based on the well-known probability theorems of multiplication and addition. Using these theorems, the stochastic process of realizing various combinations of dangerous meteorological phenomena in the Caucasus Mountains is modeled. For the Caucasus Mountains, the most likely is the implementation of snowstorm, hurricane wind or hail in combination with dangerous fog. The occurrence probabilities of one of the complex events, probability of the joint implementation of complex of both events and the periods of risk recurrence are identified.

Key words: Meteorological Phenomena, Mountains of the Caucasus.

1. Introduction

The Central Caucasus is the highest part of the Greater Caucasus between the peaks of Elbrus (in the west) and Kazbegi (in the east). It extends along the Main Caucasus Range between the Azau and Chiper-Azau passes to the Jvari Pass at a distance of about 200 km. The highest peak of the Central Caucasus, like the entire Caucasus, is Elbrus (5642 m).

The Central Caucasus is characterized by an exceptional variety of dangerous, including catastrophic, meteorological phenomena, often causing significant material damage, as well as human casualties (Alibegova and Elizbarashvili, 1980; Dangerous hydrometeorological phenomena in the Caucasus, 1983; Elizbarashvili, 2017). A rather rich literature is devoted to the study of such phenomena (Elizbarashvili *et al.*, 2012; Elizbarashvili *et al.*, 2013; Elizbarashvili *et al.*, 1983; Elizbarashvili and Zubitashvili, 2007; Elizbarashvili and Elizbarashvili, 2012; Elizbarashvili *et al.*, 2014; Elizbarashvili *et al.*, 2018; Varazanashvili, 2012).

Back in the 80s of the last century, for the Caucasus as a whole, such dangerous weather phenomena as extreme temperatures and precipitation, frosts, strong winds, thunderstorms, hail, fogs, blizzards, dust storms, etc. were studied (Alibegova and Elizbarashvili, 1980; Dangerous hydrometeorological phenomena in the Caucasus, 1983). In more detail for Georgia, these phenomena were cleared up somewhat later (Elizbarashvili *et al.*, 2012; Elizbarashvili *et al.*, 2013; Elizbarashvili *et al.*, 1983; Elizbarashvili *et al.*, 2014; Elizbarashvili *et al.*, 2018). The results of these studies were

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generalized in a monograph (Elizbarashvili and Elizbarashvili, 2012), and within the frames of the project of the National Science Foundation of Georgia, all natural elemental phenomena characteristic of Georgia, including endogenous and exogenous processes, were studied (Varazanashvili *et al.*, 2012).

As a result of the conducted studies, it was identified that heavy, including catastrophic, precipitations occur mainly during the displacement of cyclones from the Mediterranean and Black Seas and the intrusion of moisture-enriched air masses from the west (Alibegova and Elizbarashvili, 1980). The most heightened characteristics of heavy precipitations, when their daily amount exceeds 30 mm, are characteristic of the Western and Central parts of the Greater Caucasus with the Black Sea coast. Here, over the year, the number of days with heavy rainfall can be about 30, and the highest daily maximum rainfall reaches 120 mm.

In the study area, the average annual number of days with a thunderstorm is 45-50, the total duration of thunderstorms is 90-110 hours, and the average duration of thunderstorms is 1-2 hours (Elizbarashvili *et al.*, 1983).

Over the territory of Georgia, radiation, advective, advective-radiation, frontal and orographic fogs are widespread. Their distribution over the territory is of complex character, which is explained by the variety of physical and geographical conditions and the peculiarities of atmospheric circulation. At the Mamisoni Pass, the average annual number of days with dangerous fog, when the visibility range is less than 50 m, reaches 160 days, and the average duration of such fog per day is 10 hours (Elizbarashvili *et al.*, 2012).

In the study area, on average over a year, there are more than 3 days with a gale-force wind, and the highest speed reaches 45 m/sec (Varazanashvili *et al.*, 2012).

Hail processes are mainly observed in the warm season of the year, and are most active in spring and in the first half of summer, when the favorable conditions are created for the development of convective clouds. The average annual number of days with hail in the study area is 3-4, and the highest – 10. The maximum diameter of hailstones equals to 2 cm.

Snowstorms are observed throughout Georgia, but they are especially dangerous in mountainous regions, in the pass sections of the Greater Caucasus, Achara-Imereti, Likhi, Trialeti ranges and in the southern Georgian highlands, where strong winds prevail. Snowstorms are observed mainly during the intrusion of cold air masses in the Transcaucasia from the west or simultaneously from the west and east. They usually occur during the passage of cyclones before warm fronts, but sometimes they can also occur behind cyclones during the passage of cold fronts. In the high mountainous part of the Greater Caucasus, snowstorms are common and occur throughout the year. Snowstorm activity reaches its greatest activity from December to April. On the Jvari Pass, the average number of days with snowstorms per year is 24, on Mamisoni Pass – 87 and in Kazbegi – more than 100. The maximum number of days with snowstorms reaches 235 (Elizbarashvili *et al.*, 2018).

However, some dangerous meteorological phenomena often occur simultaneously and exacerbate the situation. For example, wind amplification during a rainstorm, fog during a snowstorm, a hurricane during hailstorm, etc.

The following combinations of catastrophic meteorological phenomena are most dangerous for the Central Caucasus:

- Catastrophic precipitation – hurricane wind (R50-Hu);
- Catastrophic precipitation – hazardous fog (R50-Fd);
- Hail – hurricane wind (Ha - Hu);
- Hail – dangerous fog (Ha-Fd);
- Hurricane wind – dangerous fog (Hu-Fd);
- Snowstorm – dangerous fog (B-Fd);

where R50 – is a catastrophic precipitation, when the daily precipitations exceed 50 mm, Ha–hail, and Hu – hurricane wind, when the wind speed exceeds 32 m/sec, B – snowstorm, and Fd –dangerous fog, when the visibility range is less than 50 m.

To reduce the negative consequences of such phenomena, knowledge of the physical process of their implementation in a given area is necessary.

2. Material and Methodology

The listed meteorological phenomena are independent of each other; therefore, the physical process of their occurrence has a stochastic character and it can be studied as a random process based on the theorem of multiplication and addition of probabilities known in probability theory (Kobysheva, 1971):

$$P(AB) = P(A) P(B), \quad (1)$$

$$P(A + B) = P(A) + P(B) - P(AB), \quad (2)$$

where A and B – are meteorological phenomena, P – is the probability.

Let phenomena A and B can occur, when a certain set of conditions is fulfilled and make up a system of mutually incompatible phenomena:

$$(AB), (AB_), (A_B), (A_B_), \quad (3).$$

The first of them means that both phenomena have occurred, the second means that the phenomenon A has occurred, but the phenomenon B did not occur, etc. Phenomena (3) are incompatible and form a complete system of phenomena.

If the probabilities of phenomena P(A) and P(B) are known, then according to the probability multiplication theorem we have (Agekyan, 1972):

$$P(AB) = P(A) P(B)$$

$$P(AB_) = P(A) - P(AB)$$

$$P(A_B) = P(B) - P(AB)$$

$$P(A_B_) = 1 - \{P(AB) + P(AB_) + P(A_B)\} \quad (4).$$

In the Central Caucasus, within Georgia the observation data of 5 meteorological stations were available (Figure 1). In the direction from west to east, these are the following stations: Mamisoni Pass (2854 m above sea level), Kazbegi (3653 m), Gudauri (2194 m), Jvari Pass (2395 m) and Pasaauri (1070 m).

One of the basic requirements for the series of meteorological elements is that they must be comparable with each other. Given this requirement, it is desirable to have data for all stations for a single observation period. Therefore, the data for the period 1961-2010 recommended by the World Meteorological Organization (WMO) were used at Gudauri, Jvari Pass and Pasaauri stations. Unfortunately, after the collapse of the USSR, in 1992, some high-altitude meteorological stations were closed, including Kazbegi and Mamisoni Pass, which currently do not function. However, for uniform coverage of the territory with data, the observation data of these stations were also used. The material used is the archive of the Institute of Hydrometeorology of Georgia, which satisfies all the requirements for the series of meteorological elements, as well as literary data (Elizbarashvili *et al.*, 2012; Elizbarashvili and Elizbarashvili, 2012; Elizbarashvili *et al.*, 2014; Elizbarashvili *et al.*, 2018; Varazanashvili *et al.*, 2012).



Figure 1. Research area and location of meteorological stations

3. Research Findings and Discussion

Table 1 presents the probabilities of various hazardous meteorological phenomena in the study area.

Table 1. Probabilities of various catastrophic meteorological phenomena in the Central Caucasus (%)

Stations	Height, m	R50	Ha	Hu	B	Fd
Pasanauri	1070	0.2	0.5	0	0	0
Kazbegi	3653	0,2	0,5	0	28.2	24.7
Mamisoni Pass	2854	0	2.2	0.9	23.8	43.8
Gudauri	2194	0.1	2.5	0	3.3	30.7
Jvari Pass	2395	0	1.6	0	6.5	41.6

From the Table 1 it follows that in the high-mountain zone of the Central Caucasus, the snowstorm and fog are most likely. The probability of a snowstorm is 3-28%, and the probability of a dangerous fog reaches 24-44%. In the mid-mountain zone of the region, these catastrophic meteorological phenomena are absent (Pasanauri). The probability of other hazardous meteorological phenomena is significantly less. The probability of a dangerous fog and snowstorm with the height of the area naturally increases, however, starting from a height of 3000 m, the probability of fog decreases (Figure 2), which is apparently associated with a decrease in cloudiness and precipitations (Elizbarashvili, 2017).

Table 2 presents the results of modeling the stochastic process of implementing various events and combinations of catastrophic meteorological phenomena according to (4) formulas.

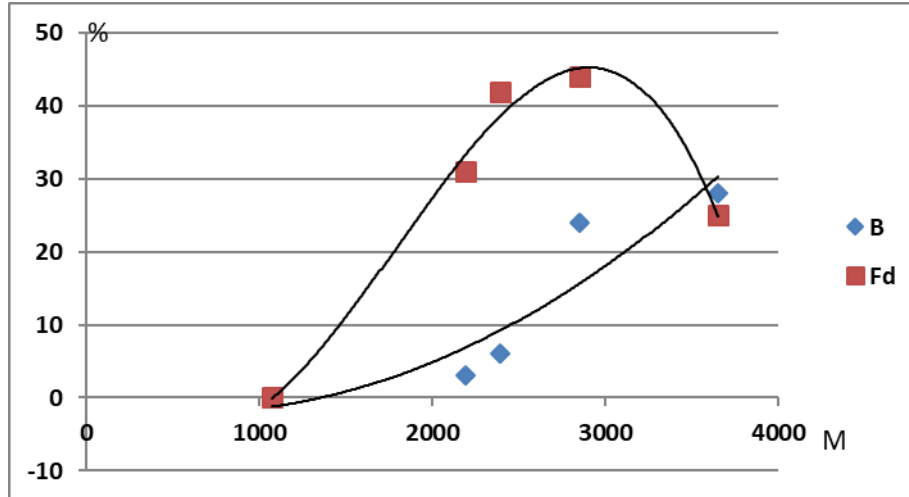


Figure 2. Change in probability of snowstorms (B) and hazardous fogs (Fd) with elevation

Table 2. Model probabilities of various combinations of catastrophic meteorological phenomena (%)

Stations	Event version	R50-Hu	R50-Fd	Ha -Hu	Ha- Fd	Hu- Fd	B- Fd
Pasanauri	P(AB)	0	0	0	0	0	0
	P(AB_)	0.2	0.2	0.5	0	0	0
	P(A_B)	0	0	0	0	0	0
	P(A_B_)	99.8	99.8	99.5	100	100	100
Kazbegi	P(AB)	0	0.1	0	0.1	0	7
	P(AB_)	0.2	0.1	0.5	0.4	0	21
	P(A_B)	0.5	24	0	24	25	18
	P(A_B_)	99.3	75.8	95.5	75.5	75	54
Mamisoni Pass	P(AB)	0	0	0.1	1	0.4	10
	P(AB_)	0	0	2.1	1.2	0.5	13.8
	P(A_B)	0.9	44	0.8	42.8	43.4	33.8
	P(A_B_)	99.1	56	97	55	55.7	42.4
Gudauri	P(AB)	0	0.1	0	0.8	0	1
	P(AB_)	0.1	0.1	2.5	1.7	0	2.3
	P(A_B)	0	30.6	0	29.9	30.7	29.7
	P(A_B_)	99.9	69.2	97.5	67.6	69.3	67
Jvari Pass	P(AB)	0	0	0	0.7	0	3
	P(AB_)	0	0	1.6	0.9	0	3.5
	P(A_B)	0	41.6	0	40.9	41.6	38.6
	P(A_B_)	100	58.4	98.4	57.5	58.4	52.9

From the Table 2 it follows that from the considered complexes of catastrophic meteorological phenomena the most likely complexes for the Central Caucasus are combined with dangerous fog: catastrophic precipitation — dangerous fog (R50-Fd), hail – dangerous fog (Ha-Fd), hurricane wind – dangerous fog (Hu-Fd) and snowstorm – hazardous fog (B-Fd), due to the significant frequency of hazardous fogs. The greatest probability of a snowstorm – hazard fog combination in Kazbegi and in the Mamisoni Pass reaches 7 and 10%, respectively. The complex of catastrophic precipitation-hurricane wind (R50-Hu) phenomena, due to the small probability of its components, is not realized. Complexes of catastrophic meteorological phenomena practically do not form in the mid-mountainous zone (Pasanauri).

Table 3 presents the number of days with a different combination of catastrophic meteorological phenomena occurring in nature, and their recurrence periods calculated by us.

Table 3. The number of days per year with a different combination of catastrophic meteorological phenomena and the period of their recurrence (years / day)

Stations		R50-Fd	Ha –Hu	Ha- Fd	Hu- Fd	B- Fd
Kazbegi	Number of days	0.37	0	0.37	0	26
	The recurrence period	2.7 years	-	2.7 years	-	14 days
Mamisoni Pass	Number of days	0	0.37	3.6	1.5	36.5
	The recurrence period	-	2.7 years	100 days	250 days	10 days
Gudauri	Number of days	0.37	0	0.29	0	3.6
	The recurrence period	2.7 years	-	3.4 years	-	100 days
Jvari Pass	Number of days	0	0	2.6	0	11.1
	The recurrence period	-	-	142 days	-	33 days

From the Table 3 it follows that the catastrophic precipitation-dangerous fog (R50-Fd) complex is implemented at the high-altitude stations of eastern Georgia – Kazbegi and Gudauri with a frequency of 2.7 years, i.e. 0.37 days per year on average. With the same periodicity, the hail – hurricane wind (Ha-Hu) complex is observed only in western Georgia (Mamisoni Pass); here, the hurricane – dangerous fog (Hu-Fd) is also characteristic, which is observed 1.5 times a year on average with a frequency of 250 days. At all high mountainous stations, the hail – dangerous fog (Ha-Fd) combination is observed. Their recurrence period in Kazbegi and Gudauri is 2.7-3.4 years, and in the sections of passes (Mamisoni Pass and Jvari Pass) decreases to 100-140 days. Most often, a snowstorm – dangerous fog (B-Fd) complex takes place in the high mountainous zone of the Central Caucasus. The average annual number of days with a combination of these components is about 4 in Gudauri, 11 – in Jvari Pass, 26 – in Kazbegi, and more than 36 – in Mamisoni Pass. Accordingly, the recurrence period of the complex is 100, 33, 14 and 10 days.

4. Conclusions

1. Among the catastrophic meteorological phenomena in the high mountainous zone of the Central Caucasus, the most probable are snowstorms and fogs. The probability of snowstorms is 3-28%, and the probability of dangerous fogs reaches 24-44%.

2. The most probable are the complexes of phenomena in combination with hazardous fog: catastrophic precipitation — dangerous fog (R50-Fd), hail – hazardous fog (Ha-Fd), hurricane wind – hazardous fog (Hu-Fd) and snowstorm – dangerous fog (B - Fd), that can be explained by the significant frequency of dangerous fogs.

3. Most often, a snowstorm – hazardous fog (B-Fd) complex takes place in the high mountains of the Central Caucasus. The average annual number of days with a combination of these components

is about 4 in Gudauri, 11 – in Jvari Pass, 26 – in Kazbegi, and more than 36 – in Mamisoni Pass. Accordingly, the recurrence period of the complex is 100, 33, 14 and 10 days.

4. The catastrophic precipitation- dangerous fog complex (R50-Fd) takes place at the high-altitude stations of Eastern Georgia – Kazbegi and Gudauri with a frequency of 2.7 years, i.e. 0.37 days per year on average. With the same periodicity, the hailstorm – hurricane (Ha-Hu) complex is observed only in western Georgia (Mamisoni Pass).

5. At all high-altitude stations, the hail – dangerous fog (Ha-Fd) combination is observed. Their recurrence period in Kazbegi and Gudauri is 2.7-3.4 years, and in the sections of passes (Mamisoni Pass and Jvari Pass) decreases to 100-140 days.

References

- Agekyan, T. A., 1972. *Fundamentals of the theory of errors*. Nauka, 170, Moscow.
- Alibegova, Zh.D., Elizbarashvili, E.Sh. 1980. *Statistical structure of atmospheric precipitations in mountainous regions*. Gidrometeoizdat, 136. Leningrad.
- Kobysheva, N.V. 1971. *Indirect calculations of climatic characteristics*. Gidrometeoizdat, 191, Leningrad.
- Dangerous hydrometeorological phenomena in the Caucasus*. 1983. Gidrometeoizdat, 263, Leningrad.
- Elizbarashvili, E. Sh. 2017. *The climate of Georgia*. 360. Tbilisi, Georgia.
- Elizbarashvili, E.Sh., Varazanashvili, O.Sh., Tsereteli, N.S., Elizbarashvili, M.E. and Elizbarashvili, Sh.E. 2012. Dangerous fogs on the territory of Georgia. *Meteorology and Hydrology*, 2, 52-59.
- Elizbarashvili, E.Sh., Varazanashvili, O.Sh., Tsereteli, N.S. and Elizbarashvili, M.E. 2013. Hurricane winds in Georgia. *Meteorology and hydrology*, 3, 43-46.
- Elizbarashvili, E.Sh., Gongladze, N.Sh., Vlasova, S.R., Alborova, B.G. and Popov, A.A. 1983. About thunderstorm activity in eastern Georgia. *Bulletin of AN SSSR., Series of geography*, 1, 104 - 110.
- Elizbarashvili, E.Sh., Zubitashvili, T.K. 2007. Fogs in eastern Georgia. *Proceedings of the Russian Academy of Sciences, Series of geography*, 5, 112-115.
- Elizbarashvili, E.Sh., Elizbarashvili, M.E. 2012. *Natural meteorological phenomena in the territory of Georgia*. 104, Tbilisi, Georgia.
- Elizbarashvili, E.sh., Amiranashvili, A.G., Varazanashvili, O.Sh., Tsereteli, N.S., Elizbarashvili, M.E., Elizbarashvili, Sh.E. and Pipia, M.G. 2014. Hailstorms in the Territory of Georgia. *European Geographical Studies*, (2), 2, 55–69.
- Elizbarashvili, E., Elizbarashvili, M., Kartvelishvili, L., Pipia, M. and Elizbarashvili, Sh. 2018. Blizzard on the Territory of Georgia. *European Geographical Studies*, 5(1), 50–60.
- Varazanashvili, O., Tsereteli, N., Amiranashvili, A., Tsereteli E., Elizbarashvili, E., Dolidze, J., Qaldani, L., Saluqvadze, M., Adamia, Sh., Arevadze, N., Gventcadze, A. 2012. Vulnerability, hazards and multiple risk assessment for Georgia. *Natural Hazards*, 64. 2021-2056.

Paleoclimate of Eastern Black Sea Region in Turkey and The Importance of Glacial Lakes and Their Sediment Record

Türkiye’de Doğu Karadeniz Bölgesinin Paleoiklimi ve Buzul Göllerinin ve Sedimanlarının Önemi

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Abstract: *To be able to make sustainable management plans we should know previous conditions of any region. Natural archives and their preserved proxies are used to track past environmental and climatic changes in time scales longer than instrumental records. Most of the natural archives that have been used to reveal the past are coming from the central, south central and northwestern Anatolia. However, glacial lakes and their sediment in the northeastern part of Turkey are untapped source of information. Here, I will discuss existing knowledge from different natural archives in Anatolia, and in southern Black Sea coast since the Late Glacial and possible future research questions in northeastern part of Turkey.*

Key words: *Glacial lakes, paleoclimate, paleolimnology, the Black Sea.*

Özet: *Sürdürülebilir yönetim planları yapabilmek için herhangi bir bölgenin referans koşullarını bilmemiz gerekir. Doğal arşivler ve onların korunan indikatörleri geçmiş çevresel ve iklimsel değişiklikleri, ölçülen kayıtlardan daha uzun zaman ölçeğinde takip etmede kullanılırlar. Geçmiş ortaya çıkarmakta kullanılan doğal arşivlerin çoğu iç, güney ve kuzey-batı Anadolu’dan gelmektedir. Buna rağmen, Türkiye’nin kuzey-doğu bölümündeki buzul gölleri ve onların sedimanları kullanılmayan bilgi kaynağıdır. Burada, Anadolu’da ve Karadeniz’in güneyindeki kıyılarda Geç Buzul döneminden beri, farklı doğal arşivlerden var olan bilgileri ve Türkiye’nin kuzey-doğusunda olası gelecek araştırma sorularını tartışacağım.*

Anahtar kelimeler: *Buzul göller, paleoiklim, paleolimnoloji, Karadeniz.*

1. Introduction

For effective ecosystem management, we need to know reference (background) conditions prior to human disturbances, the range of natural variability, and the time and level of occurring disturbances (Smol, 1992). Long term ecological and environmental monitoring data would be helpful to get this information. However, it is usually not easy to collect long term monitoring data, which is based on field works for ecologists. Usually they rarely exceed three years, which is a typical duration to collect samples for PhD students suggested via many universities in the world (Smol, 2008). Even, to obtain last fifty years of environmental monitoring data for either an aquatic or terrestrial ecosystem is almost impossible. Then, it becomes difficult or impossible to determine the nature and timing of changes in the ecosystem, which is essential for effective ecosystem managements, with these short term

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environmental datasets (Smol, 2019). On the other hand, we know that at least within the last century, which we can also call this period as an Anthropocene, natural ecosystems have been densely effected by anthropogenic impacts (Corlett, 2015). Most of the ecosystems are far from their reference conditions now. Plus, current warming climate is a global trend (Neukom et al., 2019).

Even though, people are not able to monitor these systems for long term periods, there are natural archives collecting information about them. Natural archives are diverse, such as marine and lake sediments, cave deposits, tree rings (Bradley, 1985, pp.6-7). And, usually, one should be chosen according to your environmental question, time interval, and resolution that you are interested in. Mostly lake sediments are the common one to track century to decadal changes since the Late Glacial (Bradley, 1985, pp. 6-7; Jones et al., 2006). If varve deposition occurs in a lake, then they also provide annual and even seasonal dating by means of counting varves (Zolitschka et al., 2015). In Turkey, Lake Van has continuous varves (Wick et al., 2003), and Nar lake and Eski Acı Göl (Old Bitter Lake) has discrete varve occurrence (Roberts et al., 2001; Roberts et al., 2016) in their sediment records.

To study same contemporary limnological problems using primarily lake sediments is called as paleolimnology (Smol, 2008). Those problems could be acidification (Charles ve Smol, 1990; Battarbee, 1994), eutrophication (Bennion, 1994), salinity change (Fritz, 1991; Frenzel and Boomer, 2005), water level fluctuations (Fritz, 1991), and lake water temperature changes (Korhola, 1999; Leng and Marshall, 2004). Those are within the lake problems and they can be tracked via autochthonous proxies preserved in the lake sediments, such as diatoms, Cladocera, Chironomidae, Ostracoda, stable oxygen isotopes, etc. Also allochthonous proxies from the lake's catchment or air can be deposited in the lake sediments which enables to track past vegetation change (Bottema, 1995), and pollution (Rose, 2001). Except the lakes forming varves, chronology of the lake sediment usually based on ^{210}Pb and ^{135}Cs dating techniques for short cores (Appleyby, 2001) and ^{14}C dating technique for the long cores (Björck and Wohlfart, 2001).

2. Paleoclimate of The Region

Both Soreq Cave record in southern Levant, in Israel (Bar-Mathews et al., 2000) and Sofular Cave record in southern Black Sea coast, in Turkey (Fleitmann et al., 2009; Göktürk et al., 2011) are well dated, high resolution archives revealing past climate of Eastern Mediterranean region. Soreq Cave record include number of low d^{18}O values, which is interpreted as increase in annual rainfall, during last 140 kyr (thousand years) in Eastern Mediterranean (Bar-Mathews et al., 2000). The last one was occurred from 8,5 to 7 kyr (Bar-Mathews et al., 2000). Sofular Cave is located in northwestern Turkey, on the Black Sea coast. According to their isotope records precipitation was increased during the early Holocene both in the southern Black Sea coast (Göktürk et al., 2011) and in the Mediterranean coast (Bar-Mathews et al., 2000). Sofular Cave data is well compatible with Greenland Interstadials (Fleitmann et al., 2009) and Soreq Cave record matches sapropel formations in the Mediterranean Sea (Bar-Mathews et al., 2000).

Lake sediments give information from south (Eastwood et al., 1999), central (Roberts et al., 2001; Roberts et al., 2011; Roberts et al., 2016), north-western (Miebach et al., 2016) and eastern Anatolia (Wick et al., 2003) and they are mostly located in lowlands of Anatolia under the human impact (Woldring and Bottema, 2003; England et al., 2008).

As elsewhere, the Late Glacial Maximum, was a cold and dry period both in the Levant (Bar-Mathews et al., 2000; Bartov, et al., 2002; Bar-Yosef, 2011) and in Anatolia (Fleitmann et al., 2009; Göktürk et al., 2011; Miebach et al., 2016). YD (Younger Dryas) was dry too (Wick et al., 2003; Göktürk et al., 2011; Dean et al., 2015; Miebach et al., 2016). Early Holocene was wetter according to the oxygen isotope data (Bar-Mathews et al., 2000; Fleitmann et al., 2009; Göktürk et al., 2011; Dean et al., 2015) and pollen records (Woldring and Bottema, 2003; Wick et al., 2003; Miebach et al., 2016). Increase in the lake water level due to high precipitation was also observed from lacustrine archive in central Anatolia during this time (Roberts et al., 2001), however, the mid Holocene was drier (Roberts et al., 2011). The last 600 years until the 20th century have been driest period during the Holocene in northern

Anatolia according to the Sofular Cave record (Göktürk et al., 2011). Despite of relatively stable Holocene climate worldwide, there have been also a few rapid climate changes (RCC) during the Holocene (Bond et al., 1997; deMenocal et al., 2000). During these RCC (9.3, 8.2, 4.2 ka events), the climate was colder and drier with less precipitation in Anatolia (Dean et al., 2015).

An abrupt change in Black Sea faunal composition at around 7500 cal yr BP has been revealed from Black Sea sediment records (Ryan et al., 1997; Williams et al., 2018). However, that change was gradual according to Ivanova et al. (2015). That is also corresponding to the increased annual precipitation over the Eastern Mediterranean according to the speleothem records from the caves (Bar-Mathews et al., 2000; Göktürk et al., 2011). There are also, palaeolimnological studies from marginal marine environments (Berndt et al., 2019), and coastal lakes on the Black Sea shore, in Turkey (Sekeryapan, 2011), revealing past environmental changes during the Holocene/mid-late Holocene.

Human's respond to these rapid climate changes during the Holocene is still a subject of question however there are also some studies revealing that it was less strong than the one during the Late glacial and the Early Holocene transition (Bar-Yosef, 2011; Floh et al., 2015). During the late Glacial and early Holocene human's respond must have been high (Bar-Yosef, 2011), whereas during the rapid climate changes of the Holocene (during 8.2 ka, 9.8 ka events) people was resilient to it anymore (Floh et al., 2015).

Despite of its mid- latitudes Turkey has several mountain glacials (recent and Pleistocene) (Çiner, 2004) and also glacial lakes due to its diverse topography. Some of them are located in the northeaster Turkey (Çiner, 2004), on the Black Sea coast. There have been several glacial lakes located on these mountains. Their sediment records are untapped source of information both in terms of past climate and environmental change about this area. There have only been a few publications about species composition in these lakes (Aygen et al., 2012). Since they are located in high mountains, remote from human influence, they might be perfect source of information to track past global climate changes, too.

3. Glacial Lakes and Their Paleolimnology

When you want to reconstruct past climate change using the lake sediments, you usually need to differentiate human effect and climate effect in your data. Because if you use water level fluctuations depending on past precipitation and evaporation rations to reveal past climate change in an endorheic lake, you should give some evidences that there were no human influence effecting water level changes in that lake. That is especially important in an area like Anatolia that highly inhabited since almost the 9 000 BP via human societies (Hodder, 2010), and anthropogenic impacts have been observed since the 7th millennium BP (Woldring and Bottema, 2003). Usually remote alpine lakes are directly affected via climate changes and their sediment archives are used to reconstruct regional and global climate changes (Catalan et al., 2013; Moser et al., 2019).

Alpine lakes are sensitive, remote, freshwater ecosystems, mostly composed of glacial or volcanic lakes. They endure environmental conditions including at least 8 month's ice cover in a year and high UV radiation. Those conditions in turn determine their ecosystem function and species diversity (Moser et al., 2019). They are mostly small, and dilute (oligotrophic) freshwater lakes. They are also important freshwater sources. Since they are located mostly in pristine, protected area, they are called as sentinels of global environmental changes (Moser et al., 2019).

3.1. Glacial lakes in northeastern Anatolia

Despite it is located in mid- latitudes, Anatolia has several glacials and also glacial lakes because of its diverse topography (Çiner, 2004). However, those lakes are untapped source of information except a few publications about their species composition (Aygen et al., 2012). In the northeastern part of Turkey, there are recent and Pleistocene glacials on the Kaçkar Mountain (Çiner, 2004). Northern hillsides of this mountain includes several glacial lakes; most probably among Pleistocene glacials (Çiner, 2004). Glacial lakes are far from human impact and were not altered directly by human. Yet, current tourism in the region may affect them. Their remote location in pristine areas makes them the sentinels of these mountains and both regional and global climate changes. Alpine lakes are sensible to

climate change and it is easy to track climate change in the absence of anthropogenic impacts. Moreover, glacial lakes may deposit varves, which provide annual dating opportunity via counting them (Ojala et al., 2012; Zolitschka et al., 2015). However, their sediments are untapped source of information for the past climate of this region in Anatolia. Even, their contemporary limnological monitoring is very scarce (Aygen et al., 2012).

3.2. Paleolimnological studies in glacial lakes and its possible application to the ones in North East Anatolian region: What they can tell us about the past environment and climate of the region?

Glacial lakes can record both past environmental changes both within the lake and in its surrounding area. Their sediments can contain products of glacial erosion, biological and chemical remains within lake, and from its catchment (Hodgson and Smol, 2008). Their sediments can be used for reconstruction of deglaciation (e.g. in glacial lakes, deglaciation can be seen as a transition from siliciclastic glacial to organic non-glacial sediments) (Hudgson & Smol, 2008). Together with ¹⁴C chronologies we can know when the land became ice free. Glacials all around the world are retreating in 21st century (Zemp, et al., 2015). And, we know that current glacials in Turkey are also retreating since the 20th century (Çiner, 2004). Mountains are the first locations effected by the global climate change (Beniston, 2003), and alpine lake's sediment can archive those global changes (Catalan et al., 2013; Moser et al., 2019). Their sediment can be used for the studies related with the climate and ecosystem change and human impacts (Hudgson and Smol, 2008).

4. Conclusion

The glaciers in the Kaçkar Mts. were maximum in the Last Glacial Maximum (LGM), and younger glacial advance took place during the Late Glacial (Sarıkaya et al., 2011). From the data of lake sediments in the south, central, north-western and eastern Anatolia we know that past climate of these regions was including some alterations between wet and dry periods since the Late Glacial (Roberts et al., 2001; Wick et al., 2003; Roberts et al., 2011; Roberts et al., 2016). During the late glacial the climate was cold and dry (Wick et al., 2003) and it was even colder and drier during the YD (Wick et al., 2003). However, lacustrine records from the other parts of Anatolia might be limited to reveal past climate change in the south eastern Black Sea coast where we know that current climate and climate dynamics are quite distinct from the other parts of Anatolia (Türkeş, 1996; Türkeş and Erlat, 2003).

Sofular Cave record from the south-west Black Sea coast also reveals wetter early Holocene conditions with an interruptions of an abrupt dry phase (around 8.2 ka event) and more drought during the last 600 years until the 20th century (Göktürk et al., 2011), despite of its dry and cold late Glacial conditions (Fleitmann et al., 2009; Göktürk et al., 2011).

Sofular Cave is in the same present-day climate with the eastern Black Sea region in Turkey according to Türkeş (1996), so that it can give us a general perspective of the past climate of the region (especially during the Holocene). However, we still can get the benefits of high resolution glacial lacustrine sediments in the south east Black Sea coasts to reveal past climate change of this region. It has been well known that lake sediments are excellent archive revealing past environmental and climate changes. Although most of the paleolimnological studies in Anatolia have been carried out in the lowland lakes close to the archaeological sites, alpine lakes can give us direct results for the past climate change without obscuring past human effect to these ecosystems.

References

- Appleby, P.G., 2001. Chronostratigraphic techniques in recent sediments. Pp: 171-203. In Last, W.M.; Smol, J.P. (ed.), *Tracking Environmental Change Using Lake Sediments. Volume 1. Basin Analysis, Coring, and Chronological Techniques*, Kluwer Academic Publishers, Dordrecht, Boston, London, 171-203.
- Aygen, C., Ozdemir, D., Ustaoglu, M.R. 2012. Discovering the Hidden Biodiversity of Crustacea (Branchiopoda, Maxillopoda, and Ostracoda) Assemblages in the High Mountain Lakes of Kackar Mountains (Turkey). *Journal of Animal and Veterinary Advances*, 11, 67-73.
- Bar-Mathews, M., Ayalon, A., Kaufman, A. 2000. Timing and hydrological conditions of Sapropel events in the Eastern Mediterranean, as evident from speleothems, Soreq cave,

- Israel. *Chemical Geology*, 169, 145–156.
- Bartov, Y., Mordechai, S., Yehouda, E., Amotz, A., Ze'ev, R. 2002. Lake levels and sequence stratigraphy of Lake Lisan, the Late Pleistocene precursor of the Dead Sea. *Quaternary Research*, 57(1): 9–21.
- Bar-Yosef, O. 2011. Fluctuations and Early Farming in West and East Asia. *Current Anthropology*, 52/S4, S175-S193.
- Battarbee, R.W. 1994. Diatoms, lake acidification and the Surface Water Acidification Programme (SWAP): a review. *Hydrobiologia*, 274, 1-7.
- Beniston, M., 2003. Climatic change in mountain regions. A review of possible impacts. pp. 5–31. In: Diaz, H. (Ed.), *Climate Variability and Change in High Elevation Regions: Past, Present & Future*. Springer, New York..
- Bennion, H. 1994. A diatom-phosphorous transfer function for shallow, eutrophic ponds in southeast England. *Hydrobiologia*, 275/276, 391-410.
- Berndt, C., Frenzel, P., Çiner, A., Ertunç, G., Yıldırım, C. 2019. Holocene marginal marine ostracod successions from the Kızılırmak River delta; Implications for depositional environments and sea-level changes at the Southern Black Sea coast. *Sedimentary Geology*, 382, 103–121.
- Björck, S., Wohlfarth, B., 2001. 14C chronostratigraphic techniques in paleolimnology. Pp: 205-245. In Last, W.M.; Smol, J.P. (ed.), *Tracking Environmental Change Using Lake Sediments. Volume 1. Basin Analysis, Coring, and Chronological Techniques*, Kluwer Academic Publishers, Dordrecht, Boston, London, 205-245.
- Bond, G., Showers, W., Cheseby, M., Lotti, R., Almasi, P., deMenocal, P., Priore, P., Cullen, H., Hajdas, I., Bonani, G. 1997. A Pervasive Millennial-Scale Cycle in North Atlantic Holocene and Glacial Climates. *Science*, 278, 1257-1266.
- Bottema, S., Woldring, H. 1984. Late Quaternary vegetation and climate of Southwest Turkey II. *Palaeohistoria*, 26, 123-149.
- Bottema, S. 1995. Ancient Palynology. In Science in Archeology: A Review. *American Journal of Archaeology*, 99/1, 79-142.
- Bradley, R. S. 1985. *Quaternary Paleoclimatology. Methods of Paleoclimatic Reconstruction*. Allen & Unwin., USA, UK, Australia.
- Catalan, J., Pla-Rabes, S., Wolfe, A.P., Smol, J.P., Rühland, K.M., Anderson, N.J., Kopacek, J., Stuchlik, E., Schmidt, R., Koinig, K.A., Camarero, L., Flower, R.J., Heiri, O., Kamenik, C., Korhola, A., Leavitt, P.R., Psenner, R., Renberg, I. 2013. Global change revealed by palaeolimnological records from remote lakes: a review. *Journal of Paleolimnology*, 49:513–535.
- Charles, D. F., Smol, J.P. 1990. The PIRLA II project: Regional assessment of lake acidification trends. *Internationale Vereinigung für Theoretische und Angewandte Limnologie: Verhandlungen*, 24, 474-480.
- Corlett, R.T. 2015. The Anthropocene concept in ecology and conservation. *Trends in Ecology & Evolution*, 30/1, 36-41.
- Çiner, A. 2004. Turkish glaciers and glacial deposits. *Developments in Quaternary Sciences*, Vol. 2, Part 1, 419-429.
- Dean, J.R., Jones, M.D., Leng, M.J., Noble, S.R., Metcalfe, S.E., Sloane, H.J., Sahy, D., Eastwood, W.J., Roberts, N.C. 2015. Eastern Mediterranean hydroclimate over the late glacial and Holocene, reconstructed from the sediments of Nar Lake, central Turkey, using stable isotopes and carbonate mineralogy. *Quaternary Science Reviews*, 124, 162–174.
- deMenocal, P., Ortiz, J., Guilderson, T., Sarnthein, M. 2000. Coherent High- and Low-Latitude Climate Variability During the Holocene Warm Period. *Science*, 288, 2198-2202.
- Eastwood, W.J., Roberts, N., Lamb, H.F., Tibby, J.C. 1999. Holocene environmental change in southwest Turkey: a palaeoecological record of lake and catchment-related changes. *Quaternary Science Reviews*, 18, 671-695.
- Fleitmann, D., Cheng, H., Badertscher, S., Edwards, R.L., Mudelsee, M., Göktürk, O.M., Fankhauser, A., Pickering, R., Raible, C.C., Matter, A., Kramers, J., Tüysüz, O. 2009. Timing and climatic impact of Greenland interstadials recorded in stalagmites from northern Turkey. *Geophysical Research Letters*, 36, L19707, doi:10.1029/2009GL040050.
- Flohr, P., Fleitmann, D., Matthews, R., Matthews, W., Black, S. 2016. Evidence of resilience to past climate change in Southwest Asia: Early farming communities and the 9.2 and 8.2 ka events. *Quaternary Science Reviews*, 136, 23-39.
- Frenzel, P.; Boomer, I. 2005. The use of ostracods from marginal marine, brackish waters as bioindicators of modern and Quaternary environmental change. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 225, 68-92.
- Fritz S.C., Juggins, S., Batterbee, R.W., Engstrom, D.R. 1991. Reconstruction of past changes in salinity and climate using a diatom-based transfer function. *Nature*, 352(6337), 706-708.
- Göktürk, O.M., Fleitmann, D., Badertscher, S., Cheng, H., Edwards, R.L., Leuenberger, M., Fankhauser, A., Tüysüz, O., Kramers, J. 2011. Climate on the southern Black Sea coast during the Holocene: implications from the Sofular Cave record. *Quaternary Science Reviews*, 30, 2433-2445.
- Hodder, I. 2010. A decorated house found at Çatalhöyük. 2010 Season Review. Çatalhöyük 2010 Archive Report.
- Hodgson, D. A., Smol, J.P. 2008. High latitude paleolimnology. pp. 43-64. In: Vincent, W.F., Laybourn-Parry, J. (Eds.), *Polar Lakes and Rivers - Limnology of Arctic and Antarctic Aquatic Ecosystems*. Oxford University Press, Oxford, UK.
- Ivanova, E.V., Marret, F., Zenina, M.A., Murdmaa, I.O., Chepalyga, A.L., Bradley, L.R., Schormikov, E.I., Levchenko, O.V., Zyrjanova, M.I. 2015. The Holocene Black Sea reconnection to the Mediterranean Sea: New insights from the northeastern Caucasian shelf. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 427, 41–61.
- Jones, M.D., Roberts, C.N., Leng, M.J., Türkeş, M. 2006. A high-resolution late Holocene lake isotope record from Turkey and links to North Atlantic and monsoon climate. *Geology*, 34, 361-364.
- Korhola, A. 1999. Distribution patterns of Cladocera in subarctic Fennoscandian lakes and their potential in environmental reconstruction. *Ecography*, 22, 357-373.

- Leng, M.J., Marshall, J.D. 2004. Paleoclimate interpretation of stable isotope data from lake sediment archives. *Quaternary Science Reviews*, 23, 811-831.
- Miebach, A., Niestrath, P., Roeser, P., Litt, T. 2016. Impacts of climate and humans on the vegetation in Northwestern Turkey: palynological insights from Lake Iznik since the Last Glacial. *Climate of the Past*, 12, 575-593.
- Moser, K.A., Baron, J.S., Brahney, J., Oleksy, I. A., Saros, J. E., Hundey, E. J., Sadro, S. A., Kopáček, J., Sommaruga, R., Kainz, M. J., Strecker, A. L., Chandra, S., Walters, D. M., Preston D. L., Michelutti, N., Lepori, F., Spaulding, S. A., Christianson, K. R., Melack, J. M., Smol, J.P. 2019. Mountain lakes: Eyes on global environmental change. *Global and Planetary Change*, 178, 77–95.
- Neukom, R., Steiger, N., Gómez-Navarro, J.J., Wang, J., Werner, J.P. 2019. No evidence for globally coherent warm and cold periods over the preindustrial Common Era. *Nature*, DOI: 10.1038/s41586-019-1401-2
- Ojala, A.E.K., Fancus, P., Zolitschka, B., Besonen, M., Lamoureux, S.F. 2012. Characteristics of sedimentary varve chronologies - A review. *Quaternary Science Reviews*, 43, 45-60.
- Ryan, W.B.F., Pitman, W.C., Major, C.O., Shimkus, K., Maskalenko, V., Jones, G.A., Dimitrov, P., Görür, N., Sakiñç, M., Yüce, H. 1997. An abrupt drowning of the Black Sea shelf. *Marine Geology*, 138, 119–126.
- Roberts, N., Reed, J.M., Leng, M.J., Kuzucuoğlu, C., Fontugne, M., Bertaux, J., Woldring, H., Bottema, S., Black, S., Hunt, E., Karabyıkoğlu, M. 2001. The tempo of Holocene climate change in the eastern Mediterranean region: New high-resolution crater-lake sediments data from central Turkey. *The Holocene*, 11, 721–736.
- Roberts, N., Eastwood, W.J., Kuzucuoğlu, C., Fiorentino, G., Caracuta, V. 2011. Climatic, vegetation and cultural change in the eastern Mediterranean during the mid-Holocene environmental transition. *The Holocene*, 21/1, 147–162.
- Roberts, N., Allcock, S.L., Arnaud, F., Dean, J.R., Eastwood, W.J., Jones, M.D., Leng, M.J., Metcalfe, S.E., Malet, E., Woodbridge, J., Yiğitbaşıoğlu, H. 2016. A tale of two lakes: a multi-proxy comparison of Lateglacial and Holocene environmental change in Cappadocia, Turkey. *Journal of Quaternary Science*, 31, 348–362.
- Rose, N. 2001. Fly-ash particles. pp: 319-349. In Last, W.M.; Smol, J.P. (ed.), *Tracking Environmental Change Using Lake Sediments. Volume 2. Physical and Chemical Techniques*. Kluwer Academic Publishers, Dordrecht, The Netherlands.
- Sarıkaya, M.A., Ciner, A., Zreda, M. 2011. Quaternary Glaciations of Turkey. pp. 393-403. In: Ehlers, J., Gibbard, P.L., Hughes, P.D. (ed), *Developments in Quaternary Science, Vol.15. Quaternary Glaciations – Extend and chronology: a closer look*. Elsevier, The Netherlands.
- Sekeryapan, C. 2011. *Paleolimnological Investigations From Modern Coastal Lakes on Thrace and Black Sea Coast of Turkey During the Mid-late Holocene*, Ph.D. Thesis. Metu, Ankara.
- Smol, J.P. 1992. Paleolimnology: an important tool for effective ecosystem management. *Journal of Aquatic Ecosystem Health*, 1, 49-58.
- Smol, J.P. 2008. *Pollution of Lakes and Rivers: a paleoenvironmental perspective (2nd ed)*. Blackwell Publishing.
- Smol, J.P. 2019. Under the radar: long-term perspectives on ecological changes in lakes. *Proceeding of Royal Society B*, 286: 20190834. <http://dx.doi.org/10.1098/rspb.2019.0834>
- Türkes, M. 1996. Spatial and temporal analysis of annual rainfall variations in Turkey. *International Journal of Climatology*, 16, 1057-1076.
- Türkes, M., Erlat, E. 2003. Precipitation changes and variability in turkey linked to the North Atlantic oscillation during the period 1930-2000. *International Journal of Climatology*, 23, 1771-1796.
- Wick, L., Lemcke, G., Sturm, M. 2003. Evidence of Lateglacial and Holocene climatic change and human impact in eastern Anatolia: high-resolution pollen, charcoal, isotopic and geochemical records from the laminated sediments of Lake Van, Turkey. *The Holocene*, 13/5, 665-675.
- Williams, L.R., Hiscotta, R.N., Aksua, A.E., Bradleyb, L.R., Hornec, D.J., Stoica, M. 2018. Holocene paleoecology and paleoceanography of the southwestern Black Sea shelf revealed by ostracod assemblages. *Marine Micropaleontology*, 142, 48–66.
- Woldring, H., Bottema, S. 2003. The vegetation history of East-Central Anatolia in relation to archaeology: the Eski Acıgöl pollen evidence compared with the Near Eastern environment. *Palaeohistoria*, 43/44, 1–34.
- Zemp, M., Frey, H., Gartner-Roer, I., Nussbaumer, S.U., Hoelzle, M., Paul, F., Haeberli, W., Denzinger, F., Ahlstrom, A.P., Anderson, B., Bajracharya, S., Baroni, C., Braun, L.N., Caceres, B.E., Casassa, G., Cobos, G., Davila, L.R., Granados, H.D., Demuth, M.N., Espizua, L., Fischer, A., Fujita, K., Gadek, B., Ghazanfar, A., Hagen, J.O., Holmlund, J.O., Karimi, N., Li, Z., Pelto, M., Pitte, P., Popovnin, V.V., Portocarrero, C.A., Prinz, R., Sangewar, C.V., Severskiy, I., Sigurdsson, O., Soruco, A., Usabaliyev, R., Vincent, C. 2015. Historically unprecedented global glacier decline in the early 21st century. *Journal of Glaciology*, Vol. 61, No. 228, 745-762.
- Zolitschka, B., Francus, P., Ojala, A.E.K., Schimmelmann, A. 2015. Varves in lake sediments – a review. *Quaternary Science Reviews*, 117, 1-41.

Investigation of The Dynamics of Landscapes on The Basis of Vegetation Indication (Sample Area along Kura River)

*Peyzaj Dinamiğinin Bitki Örtüsü Gösterme Esasına Göre İncelenmesi
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Abstract: The dynamics of landscapes in the Kura River, inhabited by highly populated, were studied based on the change in the nature of the surface cover, especially the NDV index. During the study, vegetation was considered as a key indicator. The NDV index was compared with Landsat 5 and 8 satellite data for different years (2002, June 14 and 2019, June 9) and anthropogenic changes were determined. Acquired materials were processed in ArcGIS version 10.3 and maps showing the NDV index for the relevant periods were made by us. In the end, these maps were compared, the areal of the territories reflecting the performance of the index were compared, and the impact of anthropogenic factors on the dynamics of landscapes were analyzed. The study area covers 1,764 km², extending 255 km along the Kur river. The area extends from Mingachevir reservoir to Carli village of Kurdamir district. The study area is divided into 5 sectors at a distance of 50 km for a clear view of the dynamics of landscapes.

Key words: NDVI, Kura river, anthropogenic effects, Landsat 5 and 8, GIS.

Özet: Çok kalabalık olanların yaşadığı Kur nehri'ndeki manzara dinamikleri, yüzey örtüsünün niteliğindeki, özellikle de NDV endeksindeki değişime dayanarak incelenmiştir. Çalışma sırasında, bitki örtüsü kilit bir gösterge olarak kabul edildi. NDV endeksi, farklı yıllar için (2002, 14 Haziran ve 2019, 9 Haziran) Landsat 5 ve 8 uydu verileriyle karşılaştırıldı ve antropojenik değişiklikler belirlendi. Elde edilen malzemeler ArcGIS 10.3 versiyonunda işlenmiş ve ilgili dönemlere ait NDV endeksinin gösteren haritalar tarafımızca yapılmıştır. Sonunda, bu haritalar karşılaştırılmış, endeksin performansını yansıtan alanların alanlarının karşılaştırılması yapılmış ve antropojenik faktörlerin peyzaj dinamikleri üzerindeki etkisi analiz edilmiştir.

Çalışma alanı, Kur nehri boyunca 255 km. Bölge, Mingachevir rezervuarından Kurdamir bölgesindeki Carli köyüne kadar uzanır. Çalışma alanı, peyzaj dinamiklerini net olarak görmek için 50 km mesafedeki 5 sektöre ayrılmıştır.

Anahtar sözcükler: NDVI, Kura nehri, antropojenik etkiler, Landsat 5 ve 8, CBS.

1. Introduction

Investigation area covers hydromorph and semi-desert landscapes along Kura river on the intensive tectonic depression of Kura-Araz plains in Azerbaijan. It covers 2% area of the Azerbaijan Republic.

The Kura River is used both for irrigation and drinking water throughout the country. At one time, there were extensive Tugai forests along the Kura River. However, as a result of anthropogenic impact the area of these forests has sharply decreased. Structural-geomorphological studies of Shirinov N.Sh. (Shirinov, 1963) were used to make some adjustments based on landscape studies in the separation of morphostructures in the Kur-Araz lowland. Kura-Araz lowland are divided into 5 landscape-ecological morphostructures regions due to modern and new tectonic distribution regime, tectonic structure, lithological composition of the rocks, character and distribution of exogenous

processes, and landscape generally. 1. Hydromorphic-acoustic complexes of accumulative alluvial-lake plains along Kura River, 2. Semi-deserts of Shirvan accumulative alluvial-proluvial plain, 3. Semi-deserts and steppes of Mughan accumulative alluvial plain, 4. Semi-deserts of hilly denudation-accumulative alluvial plains along Caspian Sea shore and 5. Semi-deserts of Salyan accumulative smooth alluvial-marine plain (Ismayilov, 2010,2011,2014). Hydromorphic-acoustic complexes of accumulative alluvial-lake plains along Kura River cover a very large landing area of the Kura-Araz lowland. At present, the process of sedimentation is in progress. This complex is different from other morphostructures of Kura-Araz plain due to landscape-ecological features. The Kura River flows through the central part of this plains, creating complex meandr curves. Standing lakes formed during the final stage of meandr curves and their development have played an important role in the landscape-ecological differentiation and formation of accumulative plain along Kura River. Most of standing lakes dry up during summer months and a thick layer of salt is formed at the bottom. Most of these lakes are surrounded by dense tamarisks and sometimes with shrubs. Nutrition sources of lakes are flood waters and precipitation. 54 meandr curves from Mingachevir to the mouth of Gargar river where the first curve is creted along Kura river and 24 standing lakes on the left bank of the river are observed (Ismayilov and Amanova, 2015; Guliyeva, 2014, 2017).

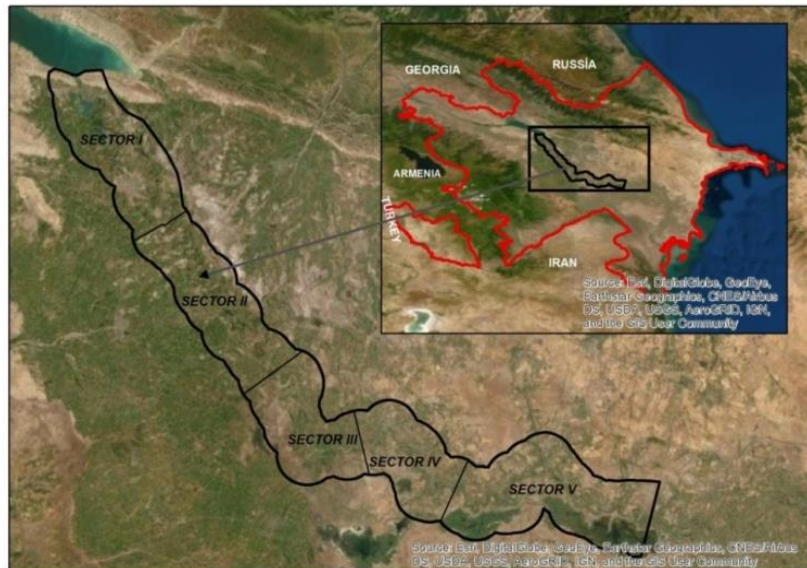


Figure 1. Location of investigation area.

In this section, two terraces levels are clearly selected in the Kura River and Tugai forests including poplar, willow, elm, bindweed and etc. are formed over them. According to tectonic fractures, the Kura River extends in latitude from the mouth of Gargar river to the northeast to the Zardab city. At the result many standing, dry and relict river valleys stand on the left bank of river (Amanova, 2015, 2016). Alluvial-lake-chala plains along Kura river are divided into two parts like right and left banks due to morphological features. Left bank plains of Kura river cover areas to the Garasu depression in the north. Right bank plains of Kura river cover areas extending to the zero line horizontally areas on the shore of Caspian Sea (Ismayilov, Mammadbeyov, Yunusov and Amanova, 2012). According to the investigations, plains along Kura river and their hydromorph and semidesert landscapes have been formed in Khvali and Holosen. The formation of the plain and natural systems that have formed on its surface is still underway. Many positive and negative relief forms in the plains give hilly, roughly forms to them. This also strengthens the internal differentiation of the landscape and causes the formation of more complex structural landscapes (Figure 2).

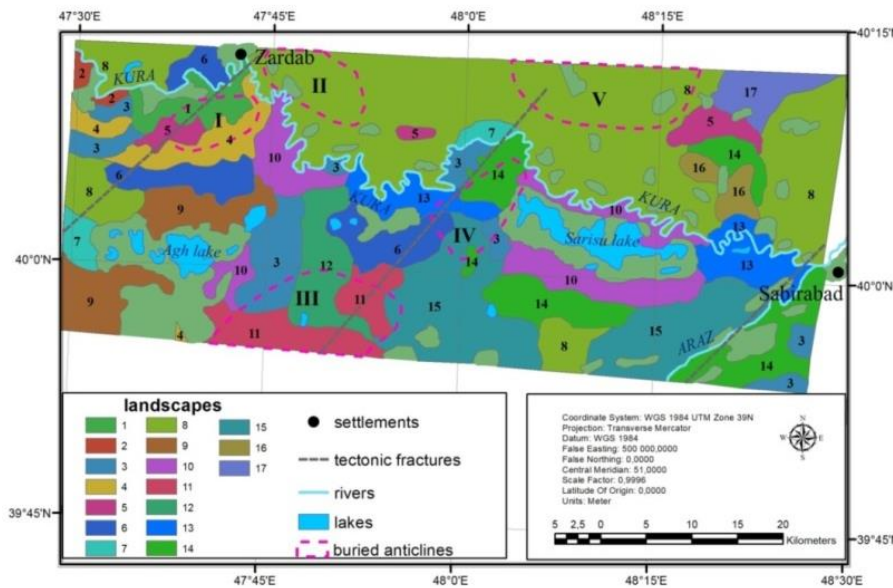


Figure 2. Effects of buried aticlines to the formation of landscape-ecological structure of accumulative alluvial-lake-chala plains along Kura river.

1. Repeated tamarisks in place of Tugai forests, 2. field complex in place of chala-saline plants, 3. field complex in place of chala-saline, artemis-saline plants, 4. Iris, grain-iris 5. Artemis semi-deserts, 6. Hole-meadow plants, 7. Salsola, 8. Semi-desert with artemis, artemisian-salsola, hole-salsola, 9. Semi-desert with artemisian-salsola, 10. Marsh-meadow, tamarisk-sedgering, 11. Semi0desert with eolian hills, 12. Salsola, hole-meadow, cultural plants, 13. Grain, reedian-grain, 14. Artemis, 15. Cultural plants with salsola-ephemer, 16. Ephemer, poa-bulbosa, 17. Caragana

Buried anticlines: I. Sotheren Zardab, II. Northeren Zardab, III. Shirin Sand, IV. Mammadli, V. Chartaz

Extension of hills to the east along the Kura and occurrence of marine sediments in the Shirin-sand natural boundary region are connected with the buried anticline (Shirinov N.Sh., 1963). Deflation processes intensified as the result of opening the surface of the sea sands in some places and small lakes of eolian origin were formed in depressions (Ismayilov M.J. and Amanova Sh.S, 2018).

The rise of the land relative to the modern valley of Kura river contributed to the formation of the Agh, Mehman and Sarysu lakes in the middle part of the right plains along Kura river. Formation of these lakes along Kura river and apeearing meandrs are connected to the buried anticlines.

2. Material and Methodology

We have used traditional and modern methods, such as, mathematical-statistical, observation, comparison, cartographic, systematic analysis, historical-geographical, aerospace, field research.

Vegetation index can be used as an indicator to quantify the greenness of plants within remote sensing materials. There are a lot of vegetation indexes, but an important index to use is the Normalized Difference Vegetation Index (NDVI). By analyzing images recorded from visible red (RED) and near-infrared (NIR) wavelengths, we can determine the coverage of vegetation in the investigation areas. We can express NDVI as following (Rouse , Haas , Deering and Sehell, 1974):

$$NDVI = (NIR - RED) / (NIR + RED)$$

Normalized Difference Vegetation Index (NDVI) was calculated using following equation. During analyzes we use Band 4 and 5.

$$NDVI = (Band 5 - Band 4) / (Band 5 + Band 4)$$

The NDVI values range from -1 to +1. But in the investigation area these values range from -0.26 to +0.67.

3. Results

We have learned NDV indexes based on remote sensing materials. We have prepared NDV index maps of the investigation area, during 2002 and 2019 years (Figure 3 and 4). In the end, these maps were compared, the areal of the territories reflecting the performance of the index were compared, and the impact of anthropogenic factors on the dynamics of landscapes were analyzed (Figure 5).

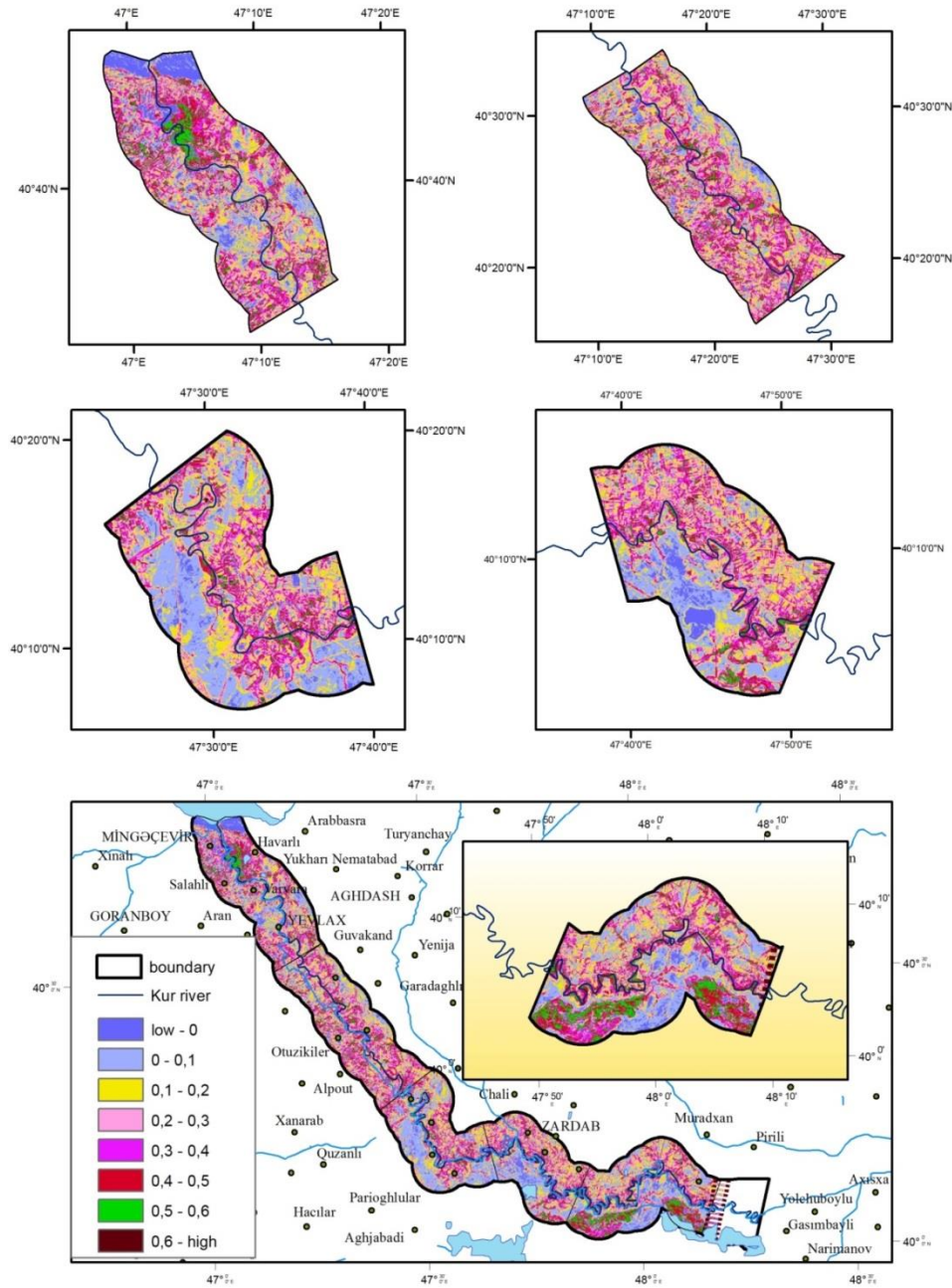


Figure 3. NDV index at a distance of 5 km from the Kur river coast (2002, June 14).

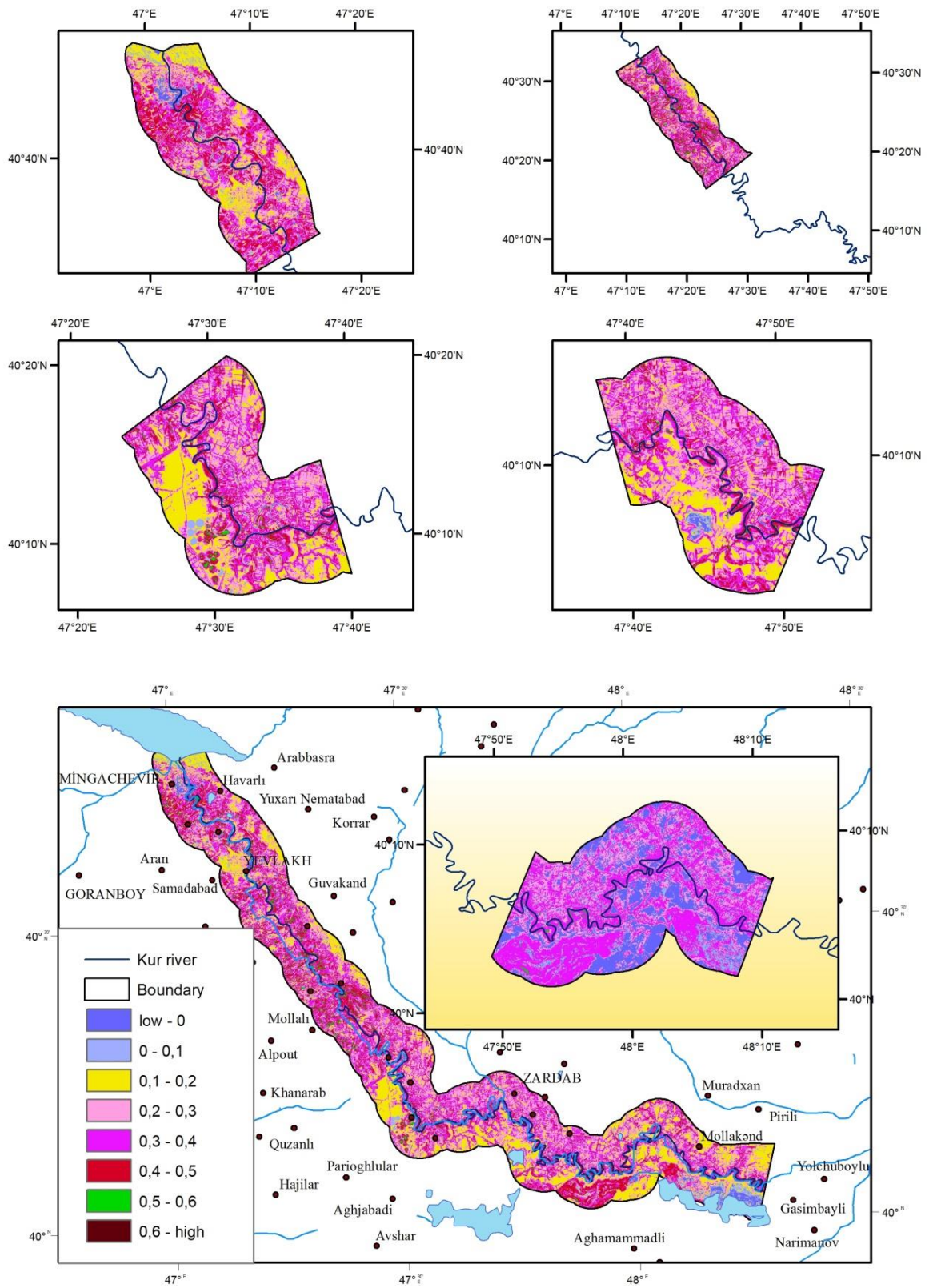


Figure 4. NDV index at a distance of 5 km from the Kurariver coast (2019, June 9).

Investigation of The Dynamics of Landscapes on The Basis of Vegetation Indication

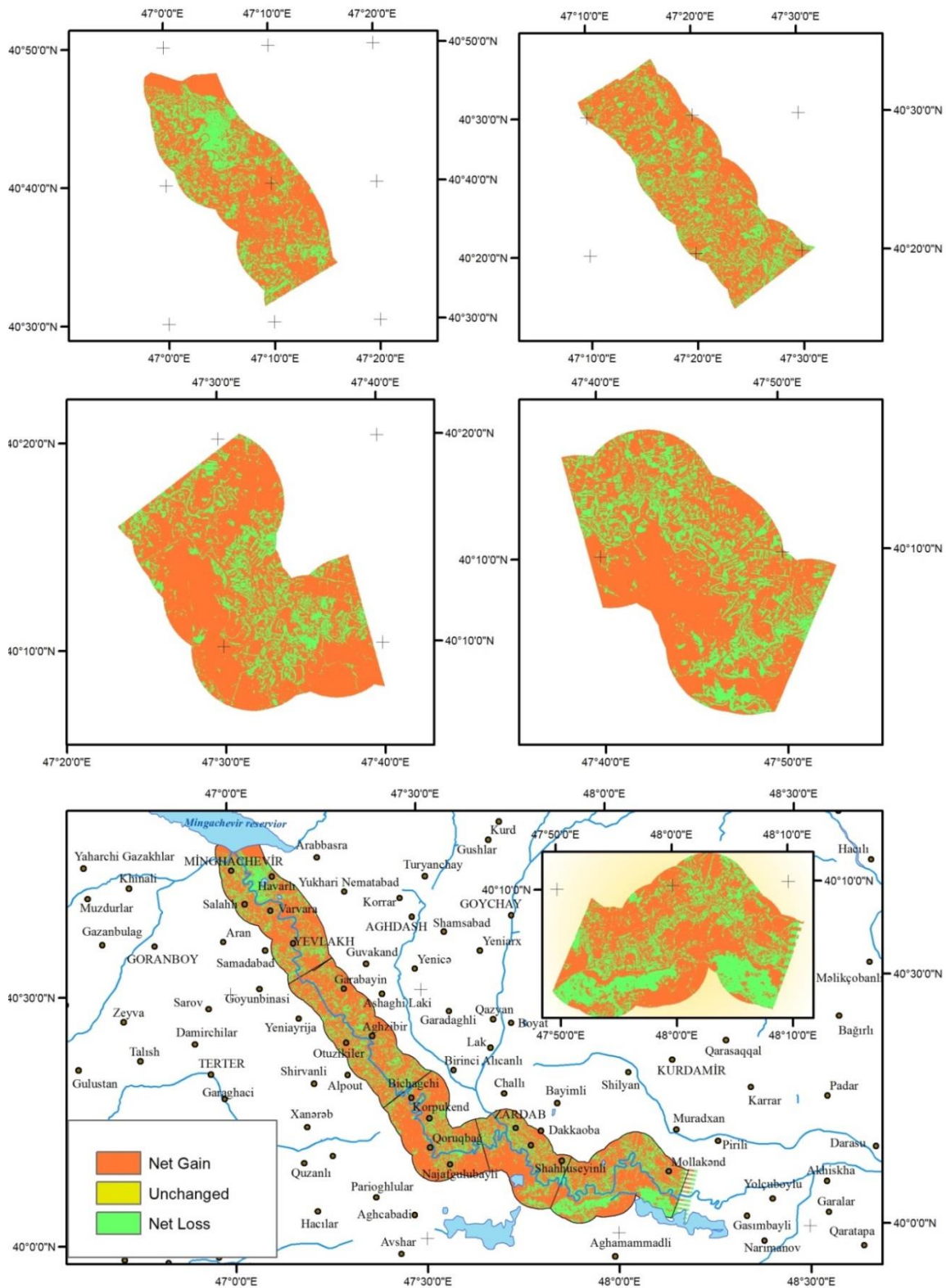


Figure 5. Dynamics of NDV indices at a distance of 5km from the Kurariver coast (Comparison of 2002 and 2019).

To analyze anthropogenic effects in investigation area we have learned land use and directions. We analyzed settlement areas, growing zones, pastures, forests, swamp and etc. To determine anthropogenic effect we analyzed settlement area dynamic during 2002 and 2019 years, and we determined that area of them has decreased (Table 1).

Table 1. Statistical indicators of land use.

sectors	Area		settlements					growing zones		pastures		forests		swamps
	km ²	%	2002		2019		dynamics	(km ²)	%	(km ²)	%	(km ²)	%	(km ²)
			km ²	%	km ²	%								
I	387	22	34,9	10	64,5	17	54	70,6	18	120,7	31	2	1	-
II	390	22	13,95	4	28,3	7	49	156,3	40	87,5	22	37,8	10	-
III	320	18	8,3	3	24,7	8	34	139,9	44	131,4	41	12,4	4	-
IV	272	15	12,5	5	34,1	13	37	91,1	33	146,6	54	4	1	-
V	395	23	21	5	41,9	11	50	123,2	31	240,2	61	3	1	64
total	1764	100	90,65	5	193,5	11	47	581,1	33	726,4	41	59,2	3	64

For comprehensive survey anthropogenic modifications have researched, NDV indexes have analyzed, and communication between them has appeared. The first 50 km territory continues from the Mingachevir reservoir to the settlements of Eymur and Arabshaki villages of Aghdash district covering 387 km². It covers 22% of investigation area.

Table 2. Statistical indicators of NDV index in the sector I.

NDV index	year 2002		year 2019		dynamics	
	km ²	%	km ²	%	km ²	%
Low-0	48	12,4	15	3,9	-33	-68,8
0-0,1	68	17,6	16	4,1	-52	-76,5
0,1-0,2	71	18,3	78	20,2	7	9,9
0,2-0,3	68	17,6	100	25,8	32	47,1
0,3-0,4	62	16,1	104	26,9	42	67,7
0,4-0,5	47	12,1	65	16,8	18	38,3
0,5-0,6	21	5,4	8	2,1	-13	-61,9
0,6 -high	2	0,5	0	0	-2	-100

In 2002, areas that NDV indexes were below 0 covered 12,4% (48 km²) of sector I. But it has fallen 3,9% (15 km²) in 2019. Areas where the NDV index is 0-0,1 cover 4,1% (decrease by 76.5%), 0,1-0,2 cover 20,2% (increase by 9,9%), 0,2-0,3 cover 25,8% (increase by 47,1%), 0,3-0,4 cover 26,9% (increase by 67,7%), 0,4-0,5 cover 16,8% (increase by 38,3%), 0,5-0,6 cover 2,1% (increase by 61,9%) of sector I. Areas where the NDV index is higher than 0.6 have disappeared completely (Table 2). Areas where NDV index is higher than 0,5 correspond to the boundaries of forest areas, their destruction indicates the strong economic activity of the population in sector I. The area with the NDV index of 0.3-0.5 corresponds to the cultivation area, which indicates an increase in cultivation in the area. Pastures correspond to the area where NDV index is 0.1-0.3. As is known, expansion is also observed in these areas (Figure 6).

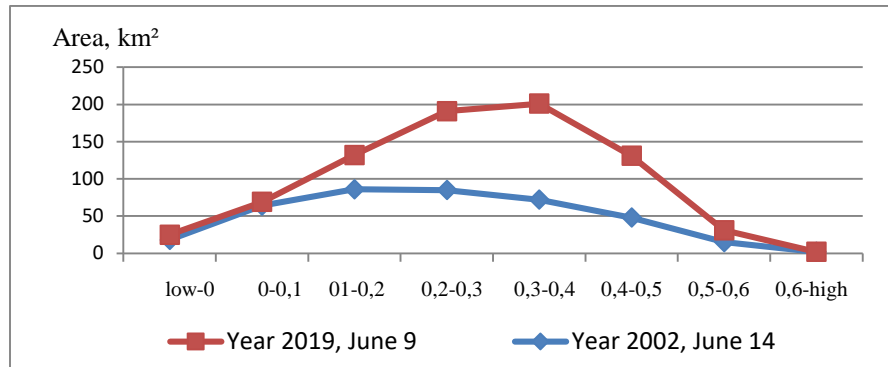


Figure 6. Dynamics of NDV indexes in the sector I.

In 2002, settlements covered 10% (34,9 km²) of sector I, but in 2019 it rises to 17% (64.5 km²). Growing zones cover 18% (70,6 km²), pastures cover 31% (120,7 km²), forests cover 1% (2 km²) of sector I (Table 1).

The second 50 km area covers 390 km² up to the Bichagchi settlement of the Zardab district.

In 2002, areas that NDV indexes were below 0 covered 4,6% (18 km²) of sector II. But it has fallen 1,8%→ (7 km²) in 2019. Areas where the NDV index is 0-0,1 cover 1,3% (decrease by 92.2%), 0,1-0,2 cover 11.8% (decrease by 46.5%), 0,2-0,3 cover 27.2% (increase by 24.7%), 0,3-0,4 cover 31.1% (increase by 79.2%), 0,4-0,5 cover 21.3% (increase by 72.9%), 0,5-0,6 cover 4.1% (increase by 6.7%) of sector II. Areas where the NDV index is higher than 0.6 have disappeared completely (Table 3). In 2002, settlements covered 4% (13.9 km²) of sector II, but in 2019 it rises to 7% (28.3 km²). Growing zones cover 40% (156.3 km²), pastures cover 33% (87.5 km²), forests cover 10% (37.8 km²) of sector II.

Table 3. Statistical indicators of NDV index in the sector II.

NDV index	year 2002		year 2019		dynamics	
	km ²	%	km ²	%	km ²	%
Low-0	18	4,6	7	1,8	-11	-61,1
0-0,1	64	16,4	5	1,3	-59	-92,2
0,1-0,2	86	22,1	46	11,8	-40	-46,5
0,2-0,3	85	21,8	106	27,2	21	24,7
0,3-0,4	72	18,5	129	33,1	57	79,2
0,4-,5	48	12,3	83	21,3	35	72,9
0,5-0,6	15	3,9	16	4,1	1	6,7
0,6 -high	2	0,5	0	0	-2	-100

As can be seen from Figure 7, the area where the index is 0.2-0.5 increased.

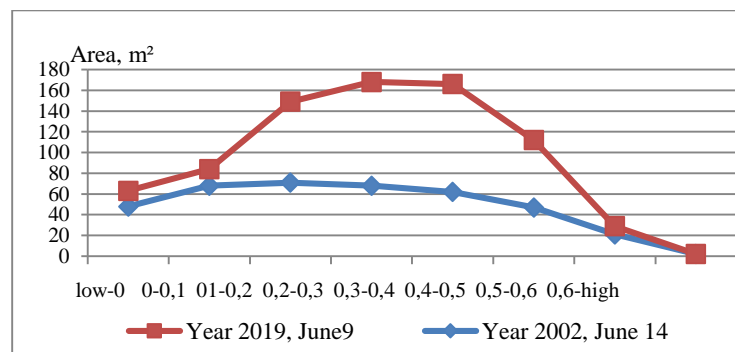


Figure 7. Dynamics of NDV index in the sector II.

The third 50 km territory continues to the village of Allahkulubagi, covering 320 km².

In 2002, areas that NDV indexes were below 0 covered 6% (19 km²) of sector II. But it has fallen 1,9%-ə (6 km²) in 2019. Areas where the NDV index is 0-0,1 cover 1,9% (decrease by 94.1%), 0,1-0,2 cover 22.8% (increase by 4.3%), 0,2-0,3 cover 31.3% (increase by 78.6%), 0,3-0,4 cover 28.8% (increase by 114%), 0,4-0,5 cover 12.5% (increase by 60%), 0,5-0,6 cover 1.3% (increase by 33.3%) of sector III. Areas where the NDV index is higher than 0.6 have disappeared completely (Table 4).

Table 4.Statistical indicators of NDV index in the sector III.

NDV index	year 2002		year 2019		dynamics	
	km ²	%	km ²	%	km ²	%
Low-0	19	6	6	1,9	-13	-68,4
0-0,1	101	31,6	6	1,9	-95	-94,1
0,1-0,2	70	21,9	73	22,8	3	4,3
0,2-0,3	56	17,5	100	31,3	44	78,6
0,3-0,4	43	13,4	92	28,8	49	114
0,4-0,5	25	7,8	40	12,5	15	60
0,5-0,6	6	1,9	4	1,3	-2	-33,3
0,6 - high	1	0,3	0	0	-1	-100

As can be seen from Figure 8, the area where the index is 0.1-0.5 increased.

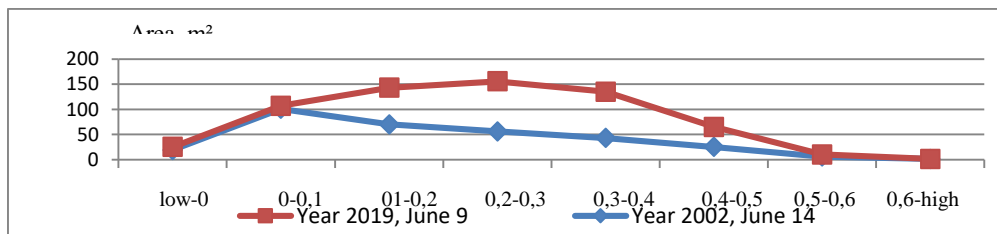


Figure 8. Dynamics of NDV index in the sector III.

In 2002, settlements covered 3% (8.3 km²) of sector III, but in 2019 it rises to 8% (24.7 km²). Growing zones cover 44% (139.9 km²), pastures cover 41% (131.4km²), forests cover 4% (12.4 km²) of sector III.

Next 50 km distance continues to Seyidlar village covering 272 km².In 2002, areas that NDV indexes were below 0 covered 7% (19 km²) of sector IV. But it has fallen 2.2%-ə (6 km²) in 2019. Areas where the NDV index is 0-0,1 cover 1.5% (decrease by 93.8%), 0,1-0,2 cover 18.1% (decrease by 15.5%), 0,2-0,3 cover 35.7% (increase by 83.1%), 0,3-0,4 cover 31.3% (increase by 93.2%), 0,4-0,5 cover 11.1% (increase by 15.4%), 0,5-0,6 cover 0.7% (decrease by 71.4%) of sector IV. Areas where the NDV index is higher than 0.6 have disappeared completely (Table 5).

Table 5.Statistical indicators of NDV index in the sector IV.

NDV index	year 2002		year 2019		dynamics	
	km ²	%	km ²	%	km ²	%
Low-0	19	7	6	2,2	-13	-68,4
0-0,1	65	23,9	4	1,5	-61	-93,8
0,1-0,2	58	21,3	49	18,1	-9	-15,5
0,2-0,3	53	19,5	97	35,7	44	83,1
0,3-0,4	44	16,2	85	31,3	41	93,2
0,4-,5	26	9,6	30	11,1	4	15,4
0,5-0,6	7	2,6	2	0,7	-5	-71,4
0,6 -high	1	0,4	0	0	-1	-100

As can be seen from Figure 9, the area where the index is 0.2-0.5 increased.

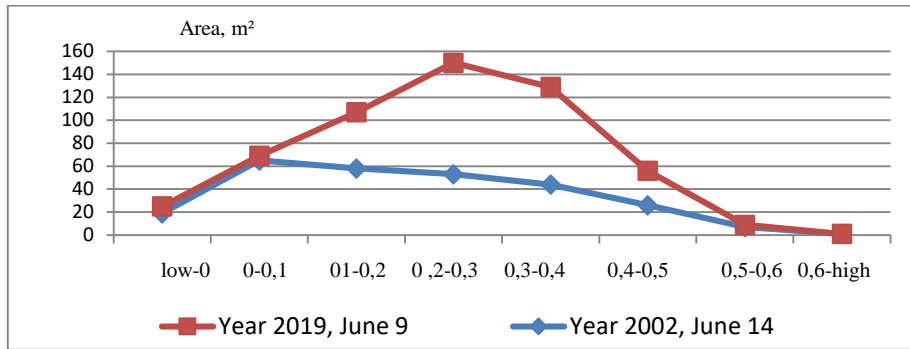


Figure 9. Dynamics of NDV index in the sector IV.

In 2002, settlements covered 5% (12.5 km²) of sector IV, but in 2019 it rises to 13% (34.1 km²). Growing zones cover 33% (91.1 km²), pastures cover 54% (146.6 km²), forests cover 1% (4 km²) of sector IV.

Last 50 km distance covers 395km². As can be seen from the table, areas with an index of 0.2-0.5 during the comparable period have increased twice. According to the form, these areas correspond to the cultivated lands and show that anthropogenic load has increased in the landscape over the past 17 years.

In 2002, areas that NDV indexes were below 0 covered 5.6% (22 km²) of sector V. But it has fallen 1.8% (7 km²) in 2019. Areas where the NDV index is 0-0,1 cover 1.8% (decrease by 68.2%), 0,1-0,2 cover 25.6% (increase by 40.3%), 0,2-0,3 cover 28.1% (increase by 91.4%), 0,3-0,4 cover 25.1% (increase by 70.7%), 0,4-0,5 cover 16.7% (increase by 11.9%), 0,5-0,6 cover 0.8% (decrease by 90.6%) of sector V. Areas where the NDV index is higher than 0.6 have disappeared completely (Table 6).

Table 6. Statistical indicators of NDV index in the sector V.

NDV index	year 2002		year 2019		dynamics	
	km²	%	km²	%	km²	%
Low-0	22	5,6	7	1,8	-15	-68,2
0-0,1	94	23,8	12	3,1	-82	-87,2
0,1-0,2	72	18,2	101	25,6	29	40,3
0,2-0,3	58	14,7	111	28,1	53	91,4
0,3-0,4	58	14,7	99	25,1	41	70,7
0,4-,5	59	14,9	66	16,7	7	11,9
0,5-0,6	32	8,1	3	0,8	-29	-90,6
0,6 -high	4	1,1	0	0	-4	-100

As can be seen from Figure 10, the area where the index is 0.2-0.5 increased.

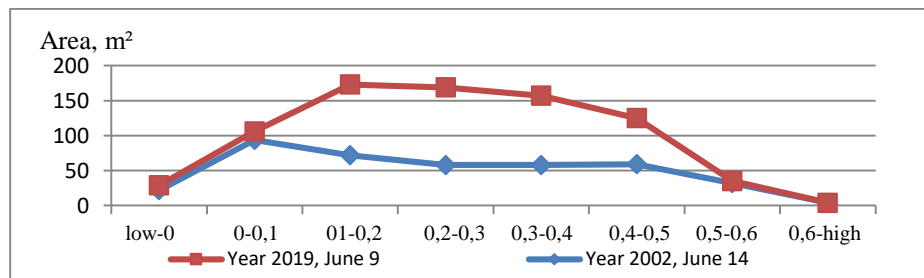


Figure 10. Dynamics of NDV index in the sector V.

In 2002, settlements covered 5% (21 km²) of sector V, but in 2019 it rises to 11% (41.9km²). Growing zones cover 31% (123.2 km²), pastures cover 61% (240 km²), forests cover 1% (3 km²) of sector V. In sector V, 64 km² area is covered by swamps.

4. Discussion

Before us investigation area has researched by Shirinov N.Sh., Suleymanov M.A and others (Suleymanov, 1965,2005; Shirinov N.Sh. and Suleymanov M.A., 1964). They have learned by traditional methods such as analysis of topographic maps of different periods, paleo-geographical, paleo-geomorphological, survey of population, geobotanical, etc. This work took a long time, the results obtained were subjective.Unlike them, we have learned with modern methods as Filiz Bektas Balcik and Baturalp Arisoy, Afirah Taufik, Rouse, Venkata Ravibabu Mandla, Tucker C. And others (Afirah, Sharifah and Asmala, 2016; Vani Vand Venkata, 2017; Balcik and Arisoy, 2018; Rouse, Haas, Deering and Sehell, 1974; Tucker, 1979).

5. Conclusions

For the last 40 years, Tugai forests along the Kura river , which have played an important role in climate mitigation for the dominant semi-desert landscape with rich biodiversity, have been eliminated in the study area. Only 5% of the study area contained rebuilt Tugai forests. Forests are transformed to anthropogenic landscapes such as growing zones, settlements, pastures, roads and etc.

Vegetation is a component of the landscape more responsive to anthropogenic effects, that is why we learn dynamics of land use based on NDV indexes. Comparative analysis of the available spatial data shows that the increase in the area of seliteb landscapes (settlements) by the research sectors varied between 34-54%. The highest increase in Seliteb landscapes (54%) was in the sector I, where cities are more prevalent. In sector V, the highest dynamic indicator of these landscapes (50%) is related to recent refugee camps. The majority of seliteb landscapes have increased due to growing zones and forest areas.

We have concluded our NDV indexes results as following table 7. Areas where NDV indexes below 0,2 point have decreased, it means that areas covered by soil have decreased, it has been covered by vegetation or settlements, roads and etc. Areas where NDV indexes over 0,5 point have also decreased, it means that forest areas have decreased, it has been covered by pastures and growing zones.

Table 7.Statistical indicators of NDV index in the investigation area.

NDV index	year 2002		year 2019		dynamics	
	km ²	%	km ²	%	km ²	%
Low-0	126	7,142857	41	2,324263	-85	-67,5
0-0,1	392	22,22222	43	2,437642	-349	-89,1
0,1-0,2	357	20,2381	347	19,6712	-10	-2,8
0,2-0,3	320	18,14059	514	29,13832	194	60,6
0,3-0,4	279	15,81633	509	28,85488	230	82,4
0,4-,5	205	11,62132	284	16,09977	79	38,5
0,5-0,6	81	4,591837	33	1,870748	-48	-59,3
0,6 -high	10	0,566893	0	0	-10	-100

References

Afirah T., Sharifah S.S.A. and Asmala A., 2016. Classification of Landsat 8 Satellite Data Using NDVI Thresholds. *Journal of Telecommunication, Electronic and Computer Engineering*, 8 (4): 37-40

Amanova Sh.S., 2016. Anthropogenic dynamics of the forest landscape of plains and their optimization. *Geography and Natural Resources*, 1: 29-32

Amanova Sh.S., 2015. Optimization of ecological landscapes of Ajinohur low land and surrounding areas. *Works of young scientists*,11:140-144

Balcik F.B. and Arisoy B., 2018. Analysing the impact of vegetated areas on land surface temperature using remotely sensed data. *Eurasian GIS Congress*, 206-210

- Guliyeva I.F., 2014. Concerning the antropogenic transformation of Talyshs mountain forest landscapes. *Baku World Forum of Young Scientist*, 49-54
- Guliyeva I.F., 2017. Effects of antropogenic factors to the vegetation covers of Talish mountain. *Materials of Conference I of Young Scientistists*, 228-230
- Ismayilov M.J., 2011. Identification of the structural and functional features of modern landscapes of contact zones for the purpose of spatial planning. *Actual problems of landscape planning*. 138-142
- Ismayilov M.J., 2010. Formation of geophysical features of landscapes of the Eastern Caucasus. *Transaction of the Azerbaijan Geographical Society*, XIX: 74-80
- Ismayilov M.J. and Amanova Sh.S., 2015. Influence of land use to antropogenic transformasion of landscapes in Ajinohur low mountainous and surrounding areas. *News of Baku University, Series of natural sciences* 4, p.158-175
- Ismayilov M.J. and Ismayilova L., 2014. Scientific-methodological approaches of revelation of landscape-recreation potential of mountain geosystems (an example of southern slopes of the greater Caucasus). *ANAS, News, Earth sciences*, 3-4; 86-92
- Ismayilov M.J., Mammadbeyov E.Sh., Yunusov M.I. and Amanova Sh.S., 2012. Landscape-ecological variety of Ajinohur foothills and their protection. *Globalization and geography*, 289-295
- Ismayilov M.J. and Amanova Sh.S., 2018. Investigation of the influence of climate changes to the formation of surface structure of landscapes based on GIS (Ajinohur low mountain and surrounding areas). *Eurasian GIS Congress*. 34-40
- Rouse J.W., Haas R.H., Schell J.A., Deering D.W. and Harlan J.C., (1974) Monitoring the vernal advancement and retrogradation of natural vegetation. *NASA/GSFC, Type III, Final report, Greenbelt MD*: 1-371
- Suleymanov M. A., 2005. *Geographical rules of natural and antropogenic landscapes of the Azerbaijan Republic*, Elm: 248, Baku
- Suleymanov M. A., 1965. *Natural landscapes of Jeyranchol-Ajinohur lowland*. Elm: 258, Baku.
- Shirinov N.Sh. and Suleymanov M.A., 1964. Anomalies in the landscape of the southern foothills of the Greater Caucasus. *Heralds of Azerbaijan University*, 2: 195-2005
- Tucker C., 1979. Red and photographic infrared linear combination for monitoring vegetation. *Remote sensing of Environment*, 2: 127- 150
- Vani V. and Venkata R.M., 2017. Comparative study of NDVI and SAVI vegetation indices in Anantapur district semi-arid areas. *International Journal of Civil Engineering and Technology (IJCIET)*, 8(4):559–566

The Role of Anthropogenic Factors in the Transformation of Lankaran Zone Biomes

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Abstract: Understanding the nature and the amount of land cover change are important issues among land use planners and environmental scientists, because these changes are one notable source of global environmental problems, with deep and disturbing impacts on ecological, hydrological, soil evolution, and on society at large. These changes usually have an obvious anthropogenic source, but several ecological and geographic variables such as industry, fossil fuels, and transportation also influence the nature and magnitude of these changes. Land transformation, habitat degradation, and fragmentation are typical processes that cause the transformation of biomes in this region. From this perspective, the study of the problem anthropogenic landscape transformation is necessary and practical.

Key words: Landscape, Lankaran Province, ecosystems, transformation, anthropogenic factors, biomes, land-use

1. Introduction

The given paper describes the role of anthropogenic factors in the transformation of biomes of the Lankaran region (southern Azerbaijan). The formation and differentiation of the modern biomes of the studied region are influenced by anthropogenic factors. The landscape differentiation features were identified taking into account the morphometric elements of the studied region relief, features of the mountainous ranges, climate change, and human activities. Finally, the article emphasizes the importance of realization for the transformation of natural biomes and evidence-based recommendations are given.

2. Material and Methods

The present study concerns the Azerbaijani region of Lankaran, which is on the coast of the Caspian Sea, near the southern border with Iran. A peculiar, semi-subtropical climate with prolonged summer draughts and heavy precipitation in other seasons of the year is typical for this region. The annual average temperature is +14°C, and precipitation ranges from 1000-1600 mm increasing from south to north. The region is home to the Hyrcan National Park, where a variety of fauna and flora are preserved. It is also home to some of Azerbaijan's most important agricultural products: 59% of domestic vegetables and almost 100% of domestic tea and citrus plants are produced in Lankaran.

The landscape of the Lankaran can be divided into two parts: Lankaran plain and Talish Mountains. 26% of the territory of the region is covered with forest. The province is also characterized by its richness of the natural features. A suitable geographical location, climate-relief conditions, as well as picturesque mountain landscape complexes and Caspian beaches create great opportunities for the local development of agriculture and tourism. In this regard the natural landscape has been considerably altered for agriculture, principally citrus fruits and early vegetables, as well as for livestock (cattle). Due to its location on the Caspian Sea just 40km from Iran, Lankaran was an important point on the caravan routes between Europe and Asia for a long time. Therefore, the utilization of the region's natural resources has a long history.

Recent decades have been witness to dramatic increases in population, intensive activities in the land-use capability, changes to forests and anthropogenic landscape transformation in the study area. Croplands, pastures, plantations, and urban areas have expanded in recent decades, accompanied by large increases in

energy, water, and fertilizer consumption, along with considerable losses of biodiversity. Since the mid-twentieth century, anthropogenic influences have intensified the transformation of natural landscapes in the province. One consequence of world population growth is an alarming increase in land-use in the global environment, including the conversion of rich ecological areas into cropland, and fertile lands into urban areas (Al-sharif and Pradhan, 2014).



Figure 1. Geographic position of Lankaran Province.

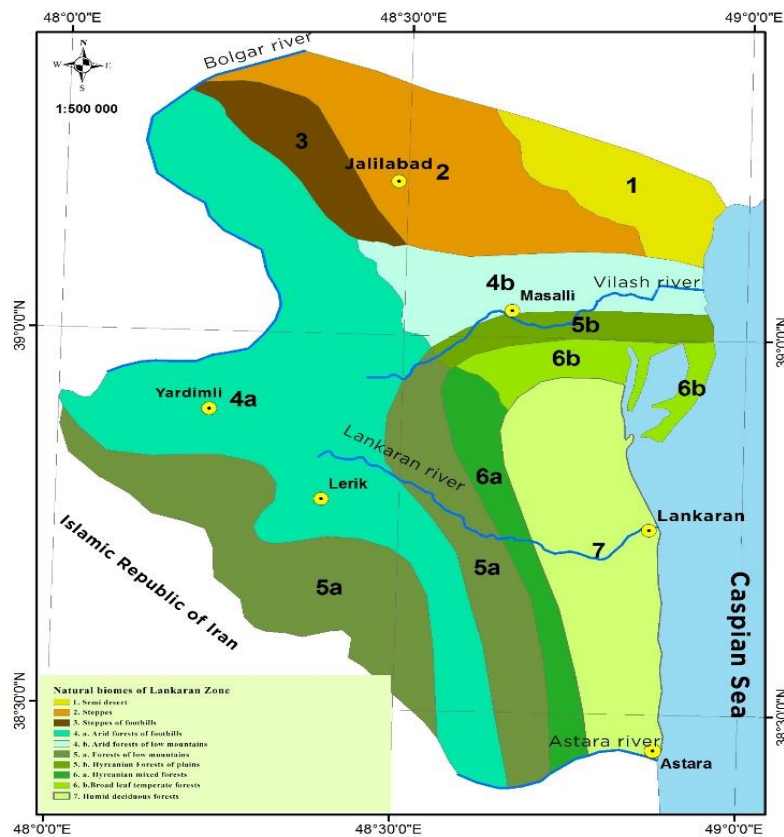


Figure 2. Natural biomes of Lankaran Province.

Azerbaijan experienced two periods of deforestation that reduced the forest area from 2.6 million ha, or 30 per cent of the land area, to 1.14 million ha by 2015. The first period was from 1861 to 1921, when wood was needed for construction for oil exploitation. The second, was after independence from the Soviet Union (FAO and Forestry Department of the Ministry of Ecology and Natural Resources of Azerbaijan, 2017). In the 1924-2018 period, an absolute number of people in the study area increased 3-4 times. Overpopulation and demand natural resources increased the tension between landscapes with limited natural resources and

ecological potential, and leads to the disruption of the ecological balance. Such changes in land use have enabled humans to face the challenge of managing trade-offs between immediate human needs and maintaining the capacity of the biosphere to provide goods and services in the long term. This process further intensified the anthropogenic transformation. At the same time, anthropogenic processes such as terracing, irrigation, melioration, construction of hydrotechnical installations and roads have led to the formation of new urban landscapes. At present, in the province, there is almost no land not influenced by human activity. Population, agriculture, transport, and tourism are the most important factors driving the anthropogenic transformation of landscapes in the studied area. The study of the anthropogenic factors of the transformation of the natural biomes of the region is necessary for determining how to mitigate damage to local biomes.

3. Dynamics of biome transformation

Specific species of vegetation in the province, including numerous endemic and relict plants, are widely spread in the studied area. The foothills of the region, low and middle mountainous areas were once covered with forests (Figure 2). During the Soviet period, the use of the Talysh Mountain forests of Azerbaijan was centrally organised. After 1980s, when the Soviet socio-economic system collapsed, the local people in the Talysh Mountains turned increasingly toward subsistence farming, using wood for heating, cooking and building, both for personal use and for sale. The unregulated collection of this wood, together with an increasing use of the forest for pastureland, led to the degradation and loss of large numbers of trees. As result local ecosystems have been completely changed: anthropogenic activity has diminished the area of the forests, drastically changing their boundaries. The decline is closely linked to an increase in populations and settlements, the expansion of agriculture in the area, unplanned forest felling, and grazing. One of the anthropogenic factors affecting the landscape of the natural region is also due to the increase in the construction of facilities for tourism and recreation.



Figure 3. Cutting down trees in Masalli, Lankaran Province.

Other plant species are widely spread in the Lankaran Province as well. These include mosses, grasses, small-leaved shrubs, and dwarf trees. These areas were also subjected to transformation, and the wetlands were dried up at the same time. In addition to the demolition of forests on smooth mountain slopes and the widening of river valleys to make way for fertile sown areas, other forests are transformed into bush areas. Summer

grazing of high-mountain pastures impacts the forests at the upper timberline. During the 1990s and early 2000s, summer pasture at higher altitudes was grazed less intensively than during the Soviet period due to a breakdown of infrastructure. Since 2010, work to restore infrastructure, such as repairing or renewing bridges, and the availability of better vehicles for equipment transport, have led to a sharp rise in grazing pressure. Climate change may be expected to result in lower timberlines moving up mountain slopes. At the higher altitudes, regular grazing prevents forest species recruitment and means that the upper timberline cannot move higher. Climate change will most likely result in a reduction in forest area e.g. in Azerbaijan (UNDP, 2011).

The severity of the anthropogenic transformation fluctuates depending on the geomorphological conditions, climatic conditions and local economic activity. For the effective preservation of biodiversity at any level, including rare species and a component of unique communities, urgent protection of local habitats must be imperative (Suleymanov, 2005). Conservation of this area for future generations requires targeted action to prevent detrimental human activity. The most important protected areas in this part of Azerbaijan are: the Gizil-Agach National Park (88,400 ha wetlands and marine area, designated to protect waterfowl), the Zuvand conservation area (15,000 ha, mountain meadows and forests, designated to protect game birds, bear, leopard, and rare reptiles), and the the Hyrcan National Park (3,000 ha, humid thermophilous Hyrcanian forests, designated to protect the unique plant communities rich in relic and endemic species). At present, the economic activity of people intensifying in the area has led to substantial change and reconstruction of landscape components, degradation of the sensitive ecosystems of the area, and the emergence of re-derivative complexes on the spot (Figure 4). Therefore the distance from settlements affects the neighboring forest area significantly. The biodiversity and density of the species composition of forests are higher the further one moves away from settlements. In other words, as a distance from the urban area increased, forest degradation decreased.

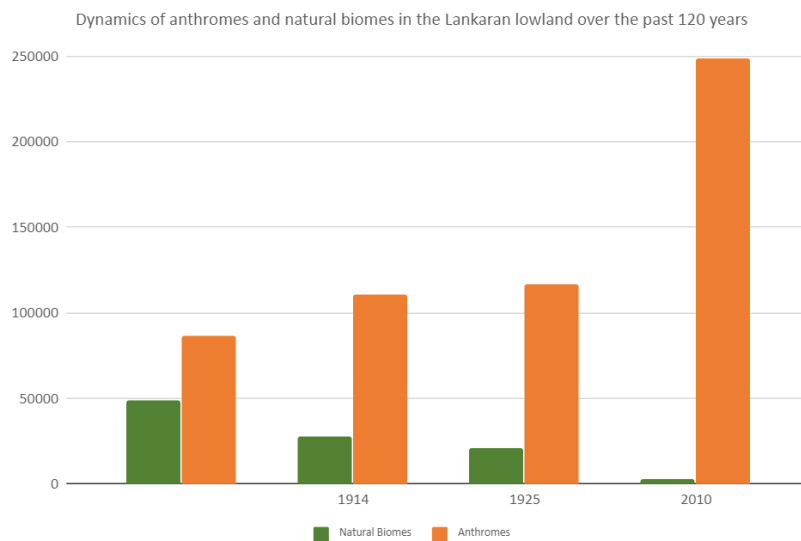


Figure 4. Dynamics of changes in anthromes and natural biomes in Lankaran Province between 1890–2010.

4. Conclusions

The study indicated that forest disturbance was related to distance to urban areas and human activities. Natural ecosystems are almost completely lost because of significant anthropogenous transformation. The ecological imbalance of landscapes is directly related to anthropogenic effects, which is manifested in the rapid destruction of ecosystems, the reduction of biodiversity, the decline of biological productivity. The richness and intensity of the species composition of forests grow as they move away from settlements. The main factors limiting the restoration of natural biomes are the pastoral activities of cattle, the cutting down of trees, and the ongoing draining of marsh and meadow land. In order to solve the problems arising from the anthropogenic impacts of natural landscapes in the Lankaran province further regulation, management, and planning of the existing anthropogenic influences is necessary. For effective preservation of the whole biodiversity of the plant

and animal species, including rare species and a component of unique communities it is necessary to ensure urgent protection of habitats. The challenge now is to provide good economic options for the local population, while preserving long-term the Hyrcanian Forest ecosystem. Farming should be planned purposefully, with human impact limited to certain frameworks. At the same time, environmental diversity and the natural features of the study area should be taken seriously in the optimizing of any conservation plans.

Without doubt, one of the greatest challenges facing natural ecosystems is to help in the creation of the cognitive basis for the transformation of the biomes and its noneconomic richness into workable parameters in educational and decision-making processes and at the same time to create the affective basis for not only understanding but also loving nature.

References

- Al-sharif, A.A., Pradhan, P. 2014. Monitoring and predicting land use change in Tripoli Metropolitan City using an integrated Markov chain and cellular automata models in GIS. *Arabian Journal of Geosciences*, 7-10.
- Anonymous 2000. *Biodiversity Assessment for Azerbaijan*. https://rmportal.net/library/content/118_azerbaijan/at_download/file
- Anonymous 2010. *Biodiversity Analysis Update for Azerbaijan*. http://pdf.usaid.gov/pdf_docs/Pnadt411.pdf
- Anonymous 2017. *Forest Resources Assessment and Monitoring to Strengthen Forest Knowledge Framework in Azerbaijan*. https://www.thegef.org/sites/default/files/project_documents/05-022017_Project_document_from_FA_0.pdf.
- Anonymous 2011. *Sustainable Land and Forest Management in the Greater Caucasus Landscape*. <https://www.thegef.org/project/sustainable-land-and-forest-management-greater-caucasuslandscape>
- Kozłowski, G., Gerber, E. 2014. *Exposition: Green treasure of Azerbaijan - Relict trees of the Hyrcanian forest in the Talysh Mountains of Azerbaijan*. Natural History Museum Fribourg (NHMF). 17-20. Fribourg, Switzerland.
- Suleymanov M.A. 2005. *Geographical regularity of natural and anthropogenic landscapes of Azerbaijan*. 96-99, Baku.
- Zev N., Arthur S.L. 1983. *Landscape Ecology- Theory and Application*. Springer-Verlag Press, 200-211, Berlin.
- Shoostari, S.J., Shayesteh, K., Gholamalifard, M., Azari, M., López-Moreno, J.I. 2017. Land cover change modeling in Hyrcanian forests, northern Iran: a landscape pattern and transformation analysis perspective. *Proceedings of Cuadernos de Investigacion Geografica.*, 3-5.

Protected Areas in Azerbaijan: Landscape-Ecological Diversity and Sustainability

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Abstract: Establishment of protected areas is one of the most important activities in the conservation of natural resources, biodiversity and gene pools, including, promoting a healthy lifestyle for people in the world. The concept of preserving landscape-ecological diversity and sustainable development promotes the improvement of socio-economic indicators and at the same time ensuring the protection of the environment and ecosystems. The aim of the paper is to examine the relationship between landscape-ecological diversity in protected areas in Azerbaijan and the factors that contribute to this relationship with sustainable development. The article identifies landscape-ecological differences, including the principles and development of protected areas such as National Parks, Nature Reserves and Habitat/Species Management Areas in Azerbaijan. For the first time, a landscape-ecological frame model was developed to ensure environmental balance. A medium-scale digital (1: 600,000) "ecological carcass" map of Azerbaijan has been developed and its structural elements explored. Currently, only 10% of the territory of Azerbaijan are protected areas. Given the anthropogenic pressure on landscapes in Azerbaijan, it has been established that the structure of the territorial organization of protected areas does not comply with existing environmental balance norms. To do this, proposals to increase the area of protected sites to 15% of the country's territory were justified. The current state of use of protected areas in the development of ecotourism has been considered and evaluated as an element of sustainability. Indicators of tourism activity in national parks were analyzed on the basis of statistical sources.

Key words: Protected areas, national park, nature reserve, landscape, sustainability, ecological carcass, ecotourism.

1. Introduction

In recent decades, the rate of extinction of fauna and flora as a result of anthropogenic influences has surpassed the evolutionary process. The risk of species extinction has worsened by almost 10% over the last decades (United Nations, 2019). The creation of protected areas has become one of the most important steps in the conservation of natural resources and wildlife of the world. The effective management and location of such areas in biodiversity-critical areas play an important role in sustainable development. International Union for Conservation of Nature (IUCN) has approved Key Biodiversity Areas (KBAs) in the terrestrial, freshwater and mountain areas of the world to provide a global approach in identifying important areas for biodiversity (IUCN, 2016). Thus, the Important Bird Areas in which BirdLife International has operated since 1980 have been incorporated into other protected areas and formed the KBAs (Güven *et al.*, 2016). The KBAs have international importance for the conservation of biodiversity on a global scale. KBAs are sites, in that they are relatively limited in extent, and could thus potentially be

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managed as protected areas or by other effective means to conserve biodiversity. (Dudley *et al.*, 2014). According to the UN report (United Nations, 2019), the share of protected areas in the KBAs has increased by 10% between 2000 and 2010, compared with 3% in 2010-2018. With the current trend, by 2030, about 50% of each KBAs will be covered globally by protected areas.

Protected areas in Azerbaijan covers 10.3% of the country's territory. The total KBAs areas are up to 15%. Based on the classification of protected areas by the 6 categories defined by the IUCN, the protected areas of Azerbaijan belong to 1st (Strict Nature Reserve), 2nd (National Parks) and 4th (Habitat/Species Management Area) categories. According to the number of protected areas, 24% of them are Strict Nature Reserves, 22% are National Parks and 54% are Habitat/Species Management Areas. Determining the landscape-ecological diversity of each protected area in order to ensure the sustainability of such areas is one of the important prerequisites.

Thus, the fact that protected areas in Azerbaijan are located in both highland and plains is the main reason for landscape diversity. More than 50 landscape ecological systems have been identified in the national park areas using the methods presented in the article. An ecological carcass model has been developed to ensure the sustainability of these systems in protected areas. The ecological carcass is a combination of ecosystem territorial management regimes that support environmental sustainability, prevent loss of biodiversity and landscape degradation (Tishkov, 1995; Elizarov, 1998). The functions of this concept are implemented by applying appropriate legal, economic and management mechanisms that relate to the level of existing economic infrastructure and environmental management technologies. The purpose of the ecological carcass is to ensure the environmental sustainability of the area in the most efficient manner while maintaining systematic management of nature. The ecological carcass is not a form of nature conservation, but a way of managing nature, which ensures long-term sustainable integration of human and natural resources.

Another factor that contributes to sustainability in protected areas, especially national parks, is the proper eco-tourism policy. The preservation of natural monuments and cultural heritage for future generations should be a priority goal when promoting eco-tourism in national parks (Tore *et al.*, 2012). Increase in visitors to national parks, especially in recent years, raises the importance of sustainability in terms of environmental protection. In this context, the eco-tourism indicators investigated in the article, some of the problems and solutions are intended to ensure sustainability in protected areas.

2. Materials and Methods

In the study we used a landscape map of Azerbaijan (2017), multispectral images based on Earth Explorer USGS (Landsat 8), as well as materials obtained from literature and field studies. Satellite images have been analyzed, in particular, in the definition of landscape-ecological systems for each national park. The analysis is based on images of the last 2 years. Azerbaijan's 1: 600,000 scale modern landscape map (2017) was also used during system identification. Thus, using ArcGIS software, the landscape map and protected areas were brought to the same coordinate system and the landscape systems that fell into the area were identified. The results of the observations we have made during our field studies have also been helpful.

In the analysis of the research, the methods utilized in mapping, statistical, comparative, system-structural and literature sources were used. Cartographic techniques have been used in the mapping process and the comparative research method used in the determination of landscape systems. The system-structural method was taken into account in the development of the environmental framework throughout the country. Statistical data is available from official websites of the State Statistics Committee of the Republic of Azerbaijan and the Ministry of Ecology and Natural Resources.

3. Analysis and Discussion

The Eldar Pine Botanical Reserve, declared in 1910 in Azerbaijan, is the first reserve in the Caucasus. The Goygol Nature Reserve, established in 1925, the Zagatala and the Kyzylagaj reserve in 1929, the Hirkan reserve, established in 1936, are the first protected areas in Azerbaijan. Nature reserves with had been created in later decades, such as Turyanchay, Pirgulu, Gobustan, Basitchay, Shirvan, Ismayilli, and others were had contributed to the further expansion of the environmental network across the country and the coverage of various geocomplexes.

Although there is little experience in organizing and managing national parks in Azerbaijan, some progress has been made in this area. The creation of the first national parks dates back to 2003. In the same year, the Ministry of Ecology and Natural Resources established the Ordubad, Shirvan and Aghgol national parks. As a continuation of this work, the national parks of Hirkan and Altiagach in 2004, Absheron National Park in 2005, Shahdag National Park in 2006, Goygol National Park in 2008, Samur-Yalama National Park in 2012 and, finally, Kyzylagaj National Park in 2018 was created (Table 1). Most of the national parks were created based on the expansion of previously existing reserves.

In 2008, the area of Hirkan National Park was almost doubled and increased from 21,435 hectares to 40,358 hectares. On November 25, 2009, the Ordubad National Park was expanded by the Decree of the President of the Republic of Azerbaijan at the expense of the Shahbuz State Nature Reserve, Shahbuz, Julfa and Ordubad districts' area to the 42797.4 hectares (the previous area was 12,131 hectares). By the same order, the national park was renamed and called Zangazur National Park named after academician Hasan Aliyev. By the Decree of the Cabinet of Ministers of the Republic of Azerbaijan dated July 8, 2010, the territory of Shahdag National Park was expanded to 14,613.1 hectares and was increased to 130,508.1 hectares (the previous area was 115,895 ha). Currently, national parks make up 4.9% of the country's territory.

The total area of protected areas in the country is 892 547.39 hectares. There are 10 national parks, 10 state nature reserves and 24 Habitat/Species Management Area (Zakaznik) in the country. The share of protected areas throughout the country is 10.3% (tables 1 and 2). For comparison with European countries, it is possible to note that this figure is 53.6% in Slovenia, 40.9% in Luxembourg, 39.7% in Poland, 39.3% in Croatia, 37.8% in Germany and 37.6% in Slovakia. The lowest countries in Europe are Turkey with 0.2%, Bosnia and Herzegovina 1.4%, Ukraine 4%, Moldova 4.2%, Montenegro 6.4%, etc. (UNEP-WCMC and IUCN, 2019).

Table 1. Share indicators of protected areas in Azerbaijan.

Protected area	Area, ha	in percents	By country, %
National Parks	421 366.4	47.2	4.9
Nature Reserves	120 723.04	13.5	1.4
Zakazniks	350 457.95	39.3	4
Total	892 547.39	100	10.3

The management of protected areas in the republic is regulated by the "Law on Specially Protected Natural Areas and Objects" (2000). According to the law, state nature reserves has the status of nature protection agencies and research institutions territory, created to preserve the natural state of typical and rare natural complexes and objects of study of natural processes and phenomena. The main objectives in the creation of the reserves are to preserve the natural and genetic fund, biological diversity, ecological systems, and natural complexes and objects, to conduct scientific researches and monitoring.

National Parks - with the status of nature protection agencies and research institutions territory where natural complexes are located have special ecological, historical, aesthetic and other value used for nature conservation, educational, scientific, cultural and other purposes. The main objectives of national parks are to create conditions for tourism and recreation; development and application of scientific methods of nature protection and ecological education; environmental awareness and environmental monitoring of the population.

The next specially protected area is the Zakazniks (Habitat/Species Management Areas). Zakazniks - areas of particular importance to the protection or restoration of natural complexes or their components, as well as maintain the ecological balance. These reservoirs may be complex, biological, paleontological, hydrological and geological profile. Any activity that may cause damage to natural complexes and their components is prohibited in the Zakazniks. In addition, the activities of protected areas guided by the Constitution and laws of the Azerbaijan Republic, international treaties supported by Azerbaijan, decrees and orders of the President of the Azerbaijan Republic, decrees and orders of the Cabinet of Ministers, the regulatory legal acts of the Ministry of Ecology, regulations of parks and reserves.

Table 2. Biodiversity in the National Parks of Azerbaijan.

N:	National Park	Administrative and territorial units	Protected species	Area (ha)	Date of creation
1	Zangazur NP named after acad. H.Aliyev	Ordubad, Shahbuz, Julfa d.	Fauna: Leopard, muffin, wild boar, wild cat, Pallas's cat, brown bear, wolf, jackal, badger, etc.; Flora: Tussilago farfara, Berberis vulgaris, Dorema glabrum, Cephalaria, Iris grosshemii	42 797.4	June 16, 2003
2	Shirvan NP	Baku c. Garadagh d., Salyan and Neftchala d.	Fauna: gazelles, flamingo, Mute swan, badger, wolf, fox, wild boar, jackal, beaver etc. Flora: dark-salt, salty-saline, wormwood-ephemeral plant formations, etc.	54 373.4	July 5, 2003
3	Aghgol NP	Aghjabadi and Beylagan d.	Fauna: Badger, fox, boar, beetle, Eurasian otter, reed cat, Mallard, Western swamphen, Whooper swan and others. Flora: Artemisia vulgaris, Halocnemum strobilaceum, Kalidium caspicum, Phragmites australis, etc	17 924	July 5, 2003
4	Hirkan NP	Lankaran and Astara d.	Fauna: black stork, bear, spotted deer, wildcat, squirrel, badger, raccoon, leopard, Lynx, Francolinus, etc. Flora: Albizia julibrissin, Parrotia persica, Buxus hyrcana, Gleditsia caspica, Quercus castaneifolia, Diospyros lotus, Rubus etc.	40 358	February 9, 2004
5	Altiaghaj NP	Khizi and Siyazan d.	Fauna: deer, brown bear, wild boar, lynx, raccoon, rabbit, fox, wolf, woodpecker, etc. Flora: Fagus orientalis, Mespilous, Paliurus spina-christi, Rosa cinnamomea, Crataegus	11 035	August 31, 2004
6	Absheron NP	Baku c. Khazar d.	Fauna: Caspian seals, Macrovipera, Caspian turtles, water birds (seagulls, coot, mallard, etc.) Flora: Canvolvulus Persica, Crepis Parviflora B., Daucus Carota L., Juncus Acutus L., Phragmites Communis, Tamarix Ramosissima	783	February 8, 2005

7	Shahdagh NP	Guba, Gusar, Ismayilli, Gabala, Oghuz and Shamakhi d.	Fauna: roe deer, boar, brown bear, wolf, jackal, raccoon, lynx, lizard, eagle, steinadler etc Flora: Taxus baccata L., Pinus kochiana Klotzch ex C. Koch., Juniperus foetidissima Willd, Castanea sativa Mill., Atropa caucasica Kreyer, etc.	130 508.1	December 8, 2006
8	Goygol NP	Goygol, Dashkasan, Goranboy d.	Fauna: Caucasian deer, roe deer, wild boar, brown bear, European wildcat, wolf, jackal, etc. Flora: Euonymus europaeus, Fraxinus excelsior, Viola, Mespilus, Pinus eldarica Nedw.	12 755	April 1, 2008
9	Samur-Yalama NP	Khachmaz d.	Fauna: Reed cat, lynx, Caucasian deer, Caucasian chamois, European wildcat, wild boar, etc. Flora: Oak, peanuts, fraxinus, Alnus incana, Crataegus, Ribes, Prunus avium, Mespilus	11 772.45	November 5, 2012
10	Gizilaghaj NP	Lankaran, Masalli and Neftchala d.	Fauna: wolves, foxes, jackals, wild boars, Eurasian beaver, pelicans, black storks, marbled duck, etc. Flora: Ceratophyllum demersum, Algae, Phragmites.	99 060.0	September 26, 2018
Total:				421 366.4	

Landscape-ecological diversity of protected areas. Here we consider landscape-ecological diversity as a combination of landscape and biodiversity of any territory. A change in the amplitude of the relief from -27 m above sea level to 4466 m in Azerbaijan led to landscape-ecological diversity. From this point of view, the sharp differences in relief in protected areas make the landscape-ecological diversity even more colorful. Depending on the location in protected areas, different landscape types can be seen, ranging from the semi-desert landscape to the nival landscape. Azerbaijan's protected areas can be divided into two groups due to their mountainous and flat landscapes. 62% of the total protected areas are located in the highlands and 38% in the plains.

Due to the geographical features of the national parks of Azerbaijan, there is a unique landscape and ecological diversity. The diversity that is associated with relief is given in Table 3. The table of the landscape-ecological diversity is based on a comparison of the landscape map of the Azerbaijan Republic (Landscape map, 2017) with a map of protected areas, satellite images and field surveys (Figure 1). The analysis shows that with the change of altitude in the national parks in the mountainous areas, ecosystems changing and acquiring new qualities. Located here, the Shahdag National Park, the largest national park in the South Caucasus, is located in the middle and highlands of the Greater Caucasus, combining various forest ecosystems, mountain meadows, and rock-glacial complexes. The other national parks located in the mountainous areas are Zangezur, Hirkan, Altiagac, and Goygol.

Although 40% of the areas of the national parks are located in the plains, the landscape and environmental diversity here is quite high. Despite the low amplitude of the relief, relatively low-lying fields in the area, Oxbow lake sediments, underground water distribution at different depths create smooth, flat seaside relief, and colorful ecosystems. As a result, this increases landscape-environmental diversity. These are Shirvan, Aghgol, Absheron, Samur-Yalama and the newly created Gizilaghaj National Park. Most of the national parks in the plains are below the ocean level. Information on biodiversity of National Parks is given in Table 2.

Landscape-ecological carcass- is a system of measures aimed at preserving the landscape and biodiversity in a given territory. There is a need for the creation and modeling of landscape-ecological carcass based on geographical location data for the preservation of the ecological balance of each country, region or the world as a whole. In modern conditions, the dramatic increase in anthropogenic impacts has resulted in an increase in the value of natural resources and ecosystems as well. The rapid progress of this situation in the modern world requires a well-regulated nature management procedure. At present, environmental management in Azerbaijan is at the local level. From this point of view, the study of the elements of nature as a whole system is very important in ensuring sustainability.

Table 3. Landscape-ecological diversity in national parks.

N:	National Park	Amplitude of the relief height (m)	Landscape-ecological systems
1	Zangazur NP named after acad. H.Aliyev	2000 - 3904	Mediterranean steps, xerophyte bush's, alpine meadows, sub nival and nival rocks, and perennial snow and glaciers
2	Shirvan NP	-27 - 47	Semideserts of eol and marine plains, hydromorphic and saline depressions, seaside terraces and sand ridges
3	Aghgol NP	-10 - 0	Semideserts of alluvial plains, aqual-lake complexes, coastal swamp, swampy meadow and salinity
4	Hirkan NP	50 - 1000	Relict Hirkan Forest Ecosystems of Plains, Low and Medium Mountains
5	Altiaghaj NP	700-1500	Mountain forests, mountain meadows, mountain steppe ecosystems
6	Absheron NP	-27 – (-26)	Seaside swamps, wetlands, eol sands and aqual-marine complexes
7	Shahdagh NP	600 - 4466	Oak-hornbeam, beech-hornbeam, beech-oak forests ecosystems of low, medium and highlands; subalpine and alpine meadows, subnival and nival
8	Goygol NP	1200 - 3066	Oak-hornbeam, beech-hornbeam forests of medium and lowlands, mountain meadows, aqual-lake complexes
9	Samur-Yalama NP	-27 - 60	Intrazonal plain forests, meadow-forests, seaside rocks and sandy semi-desert, tourism and recreation complexes
10	Gizilaghaj NP	-27 – (-26)	Aqual-marine complexes, coastal reeds, swamps, wetlands, and seaside sands ridges

Different structural and administrative elements of the environmental carcass can vary depending on regional geographical features. Due to its role in maintaining environmental stability in Azerbaijan and to ensure its sustainability, specific regimes for the use of certain areas have been identified. We consider it expedient to divide the structural-managerial elements of the landscape-ecological carcass in Azerbaijan into four levels. These are the national, regional, local and individual farmers' levels. Separate structural elements are given depending on the scale of each level (Figure 2). The management of protected areas is organized at the national level. The main goal of the activity is to limit and regulate the anthropogenic impact in such areas. At the regional level, it is expected to regulate anthropogenic impacts on natural complexes and forest ecosystems which are not belonging to protected areas. At the local level, the management of the ecological frame is organized to regulate anthropogenic loads. These include the use of natural ecosystems based on landscape planning, the protection, and conservation of natural monuments and small forest areas. The last part of the management structure is at the level of individual farmers. This level includes regulation of grazing norms in the context of improved land use, erosion control measures, and strengthening of slopes.

Depending on the time and place, the elements of the environmental carcass may also change. Each of these elements has a role in the efficient functionality of the ecological framework. Failure of one element

can affect other parts of the system as well. To maintain interconnection between systems, river systems, natural monuments that play the role of ecological corridors, such as large forest strips, should be considered in the organization of the ecological frame. Taking into account the necessity of links between the elements of the structure, it is important to integrate such natural objects into the composition of the ecological carcass. Such structural elements were used during the preparation of the map of the Azerbaijan Landscape-ecological carcass (Figure 3). All protected areas are regarded as the landscape-ecological core of the carcass. Ecological corridors have been identified along the river beds flowing through the territory of Azerbaijan. Other elements included in the map are wetlands, unprotected natural forest ecosystems, and various natural monuments (caves, mud volcanoes, rocks, sea and river terraces, etc.).

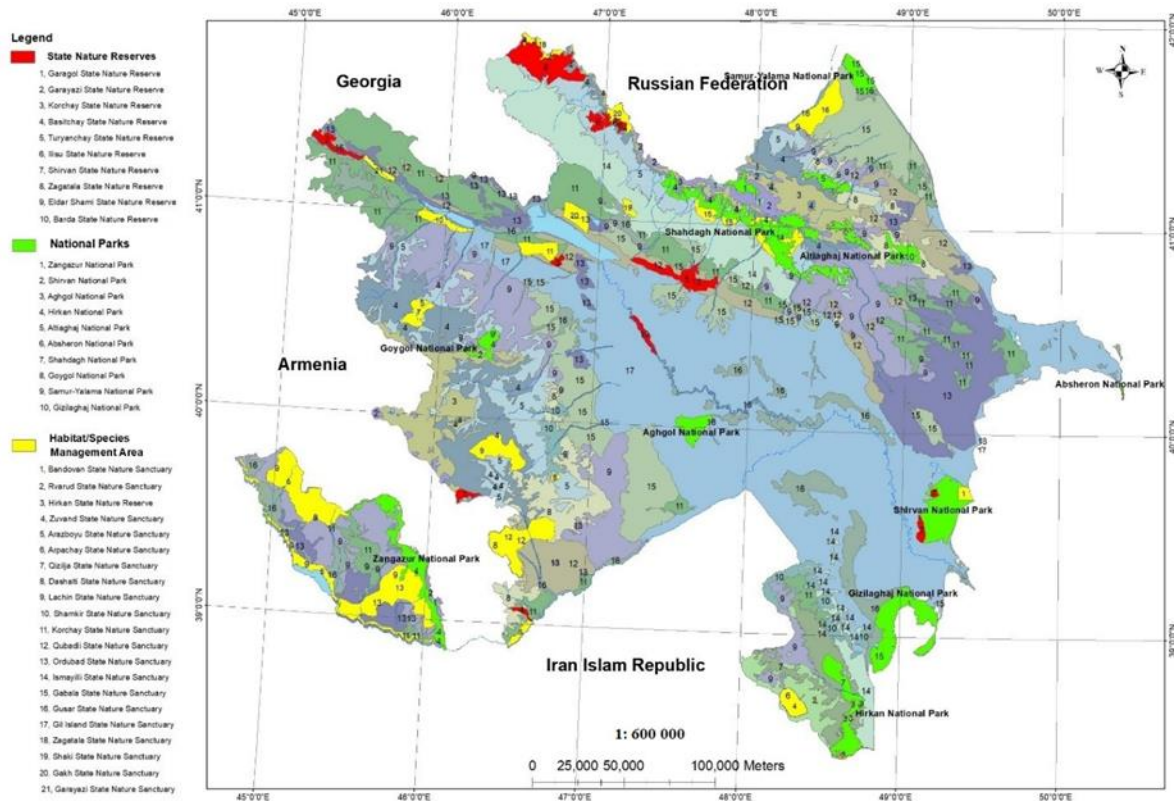


Figure 1. Azerbaijan Landscapes and Protected Areas.

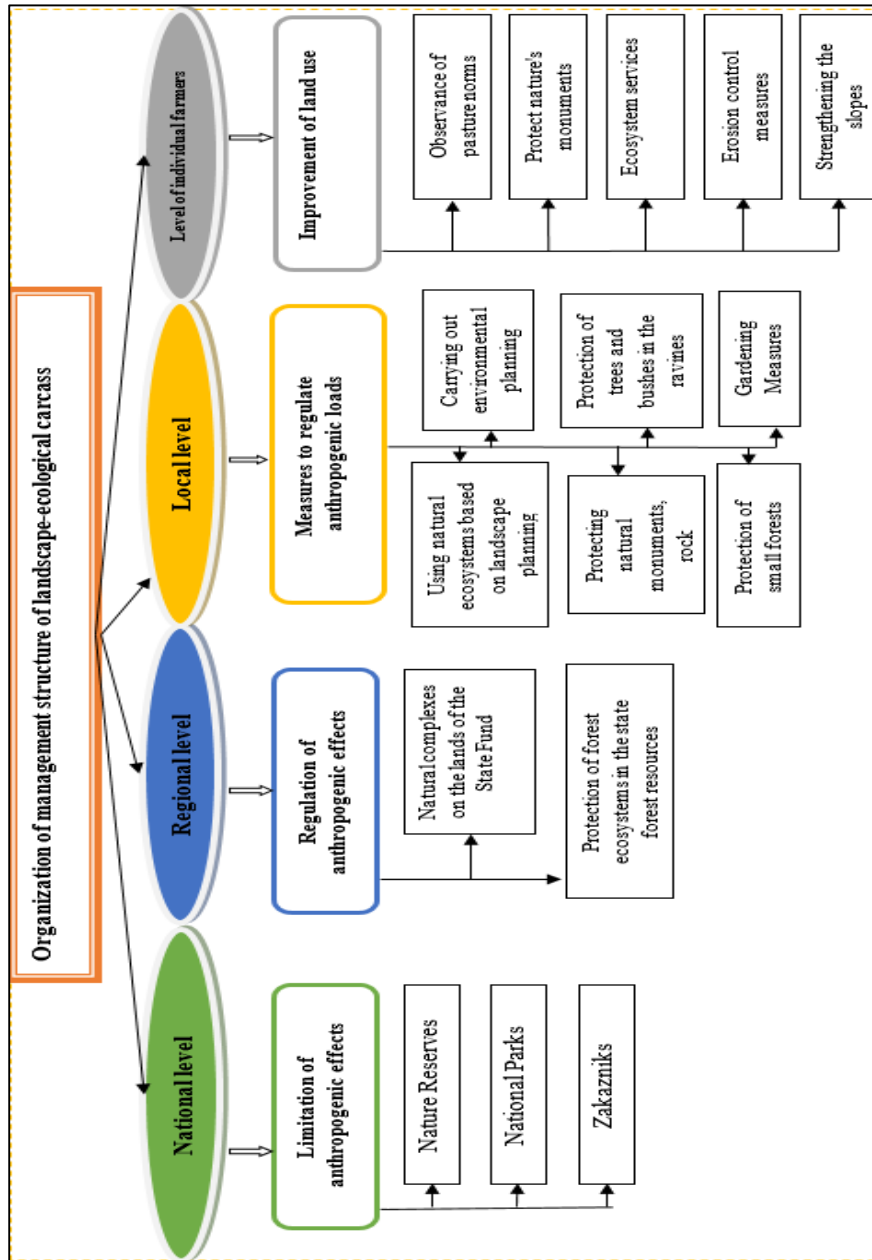


Figure 2. Structural-management model of landscape-ecological carcass.

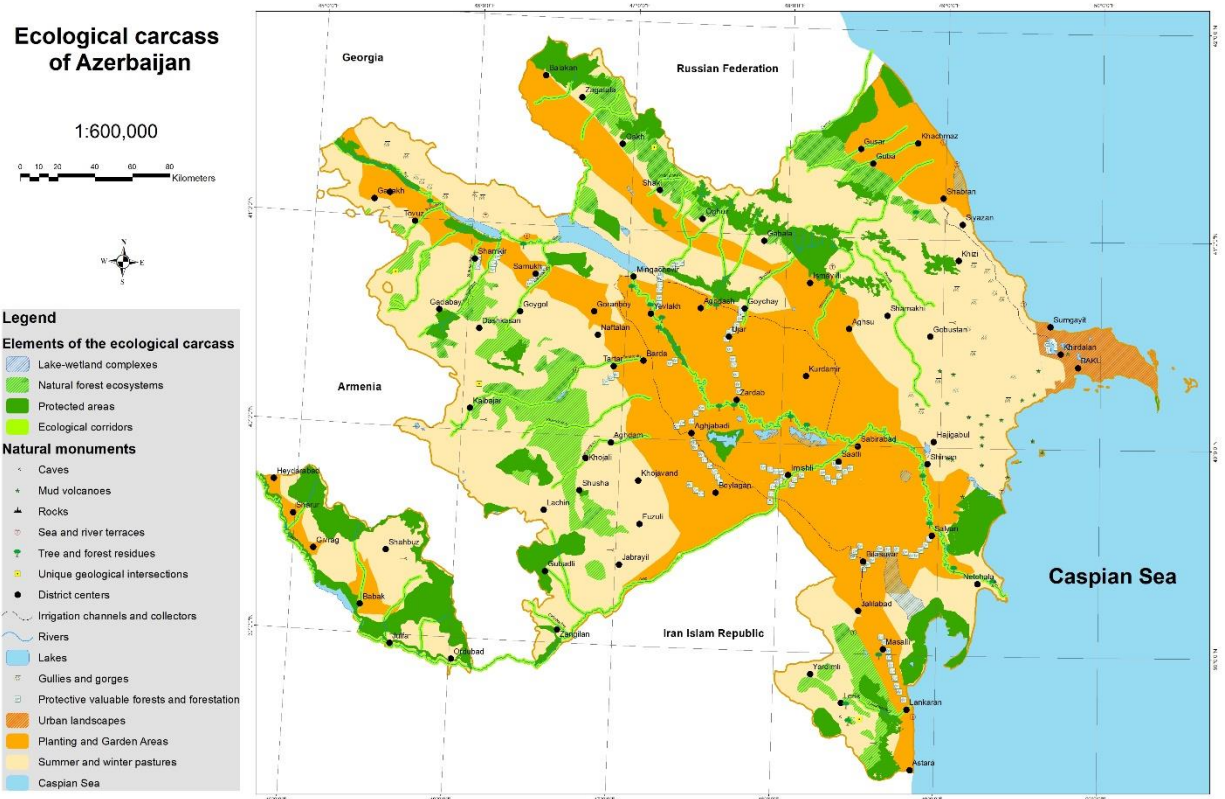


Figure 3. Landscape -ecological carcass map of Azerbaijan.

Problems and difficulties. There are also challenges and difficulties depending on the area where the protected areas are organized and managed. In order to maintain sustainability and protection of the natural gene pool in such areas, it is necessary to study and identify the causes. At present, national parks of the country have such problems as management of a territorial organization, the territorial ratio of park-interior structures, in the design of natural functional units, ongoing lack of financial resources, the selection of ecotourism routes, the establishment of relationships between protected areas and economic activities, and the lack of qualified personnel (some of them are given in the pic. 3). In mountainous areas, it is difficult to prevent natural disasters, especially forest fires, in difficult relief conditions. An example of the complexities of the territorial structure and the difficulties of managing from a single center is the Shahdag National Park. There are separate subdivisions of this national park, covering the territory of 6 regions.

An example of protected areas located on the plain is Samur-Yalama National Park. Here, some parts of the unique plain forests are occupied by population and tourism facilities, some rare trees in the forest have dried up, the fruit trees and shrubs in the lower reaches of the forest and animal feed have been destroyed, and the tall fences inside the park have disrupted wildlife migration, caused animals to attack villages frequently. In this park, for the proper management, there is a need for an organization of environmental education with the local communities, the removal of stone fences, and etc.

Unsystematic grazing of animals is observed both in the mountains and in the plains. In winter season plains and during the summer months mountains are severely eroded. This leads to the degradation of biodiversity, especially soil and vegetation, and desertification. Although the law provides for grazing 4-

8 sheep per 1 ha in a pasture, this figure is higher. It is possible to observe 25-30 and sometimes 50 heads of sheep per hectare. This means that the norm is repeatedly violated.

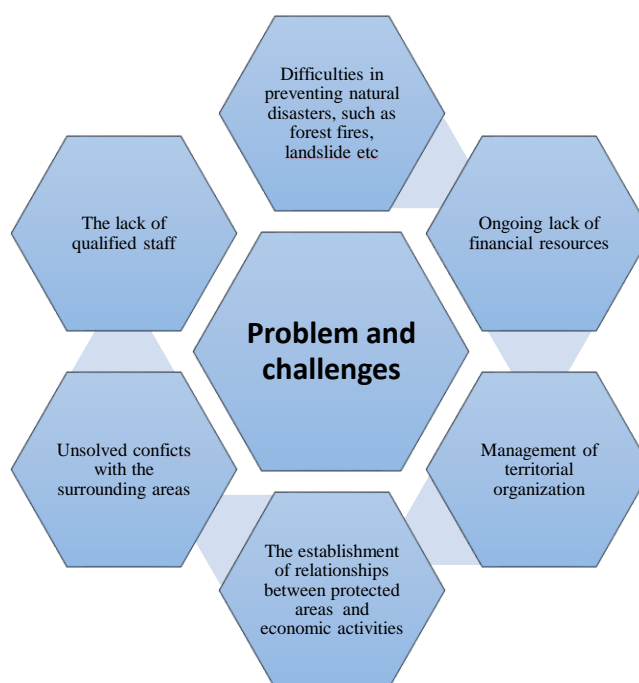


Figure 4. Some difficulties in protected areas of Azerbaijan.

The loss of valuable grazing areas in the coming years will be inevitable if such negative consequences are not prevented soon enough. For this reason, there is a need to develop additional activities and ecosystem services, especially in residential zones close to protected areas. One of the key aspects of successful management of protected areas is the support of local stakeholders (Wells and McShane, 2004). Promoting ecosystem services for sustainability (Schirpke, 2017; Guerbois and Fritz, 2017) and implementation of programs can be an important solution in this regard. Thus, the development of other alternative farms can lead to a decline in the number of sheep and livestock. Fruit and its processing, expanding beekeeping, collecting medicinal herbs, selling local crafts, handicrafts, and stimulating activities for local businessmen will lead to improved living standards and at the same time protecting biodiversity.

Ecotourism in national parks. Ecotourism is seen as a tool for conservation and sustainable development (Ceballos-Lascurain, 1998, p. 8). So, how to maintain sustainable development for an ecotourism site has become a critical issue (Tsaour *et al.*, 2006). Ecotourism plays a highly important role as an effective tool for the concept of sustainable development. Ecotourism, as alternative tourism, involves visiting natural areas to learn, to study, or to carry out activities environmentally friendly, that is, tourism based on the nature experience, which enables the economic and social development of local communities (Kiper, 2013). The development of ecotourism, in particular, contributes to the development of the regions and the improvement of living standards. There are great opportunities for the development of this type of activity in national parks of Azerbaijan. Landscape diversity, biodiversity, fascinating natural monuments, and rich resources of national parks located in plain and mountainous areas give it a reason. Although some efforts have been made to improve the infrastructure in national parks in recent years, there are still shortcomings. It is important to improve and mark all ecotrails necessary for tourists' movement in national parks, as well as to increase security measures. There is a need for the restoration of several historical

monuments located in the high mountains. The total number of ecotrails is currently about 100 (Table 4). Depending on the type of trail, it is possible to move by foot, horse or car.

It is positive that the number of visitors to national parks has increased 10 times, especially in the last 5 years. Thus, in 2013 the number of visitors to the national parks was 1,634, while in 2017, the number was 184,504. The number of foreign citizens increased from 484 to 5798 in those years. Visitors of Absheron, Shirvan, Altiagac, and Shahdag national parks are higher than others because of the location close to the capital.

Table 4. Tourism activities in national parks (The State Statistical Committee of the Republic of Azerbaijan, <https://www.stat.gov.az>, Accessed: 01 Sep. 2019).

Activities / Years	2010	2011	2012	2013	2014	2015	2016	2017
Number of ecotrails and routes - total, units	19	82	58	58	74	43	90	101
From them:								
water	1	1	1	-	-	-	-	-
with a horse	2	5	5	6	7	5	26	26
on foot	14	50	43	42	59	28	42	49
Number of visitors, people	2062	5248	1781	1634	1432	74771	198583	184504
citizens of foreign countries	108	445	336	484	183	733	2801	5798

Thus, protected areas play a very important role in preserving the country's biodiversity and promoting sustainable development. Measures for the protection and expansion of these natural pearls should be carried out continuously, and public awareness activities should be taken into account. There is a need for the creation of protected areas in the KBAs, with approved by the IUCN. From this point of view, it is advisable to create zakazniks along the Mil plain, on the delta of the Kura River, around Hajigabul, Sarisu, Mehman and Agzibir lakes. It is possible to expand the areas of the Altynagac, Hirkan, and Goygol national parks. The Sultanbud forest, which is widely spread on the Karabakh plain, should be declared a reserve. It is expedient to create a zakaznik about 50 meters of both coasts along the Gusarhe River basin. Thus, the creation of protected areas along the river basin is critical to improving the relationship between marine and terrestrial ecosystems.

4. Conclusions

Although the total area of Protected Areas in Azerbaijan has increased by 1.8% over the last 10 years, it cannot be considered in accordance with existing environmental standards. To achieve this, it is advisable to increase the total protected areas up to 15% by creating new national parks and expanding the existing protected areas in the country over the next 10 years.

An analysis of a table drawn up by comparing modern landscape map and satellite images with the locations of national parks reveals that the landscape and ecological diversity of national parks in mountainous areas is higher than that of plain national parks. This also shows that mountainous areas have higher ecotourism potential. Based on the statistical data analyzed, the increase in the number of visitors to national parks shows that tourists' interest in the landscape and environmental diversity of Azerbaijan has increased recently.

For the first time, the structure-management model of the landscape-ecological frame and the map of the medium-sized landscape-ecological frame of Azerbaijan (1: 600,000) have been developed. The structure-management model includes four levels (republican, regional, local and farmer), and the

environmental map shows nuclear, ecological corridors, wetlands, unprotected natural forest ecosystems, and various natural monuments. It is advisable to use these elements in the organization and management of sustainable environmental development in Azerbaijan.

References

- Bird Conservation International (2019) 29:177–198. © BirdLife International, 2018 doi: 10.1017/S0959270918000102
- Ceballos-Lascurain, H. (1998). Introduction. In K. Lindberg, M. E. Wood, & D. Engeldrum (Eds.), *Ecotourism: A guide for planners and managers* (pp. 7–10). North Bennington: The Ecotourism Society.
- Dudley, N. (Editor) (2008). *Guidelines for Applying Protected Area Management Categories*. Gland, Switzerland: IUCN. x + 86pp
- Dudley, N., Boucher, J.L., Cuttelod, A., Brooks, T.M., and Langhammer, P.F. (Eds.). (2014). *Applications of Key Biodiversity Areas: end-user consultations*. Cambridge, UK and Gland, Switzerland: IUCN.
- Erken, Güven & Isfendiyaroglu, Sureyya & Yeniyurt, Can & Erkol, Itri & Karataş, Ahmet & Ataol, Murat & Crossman, Neville. (2016). Identifying key biodiversity areas in Turkey: a multi-taxon approach. *International Journal of Biodiversity Science, Ecosystem Services & Management*. 10.1080/21513732.2016.1182949.
- Guerbois, C., Fritz, H., (2017). Patterns and perceived sustainability of provisioning ecosystem services on the edge of a protected area in times of crisis. *Ecosystem Services*, 28, 196–206.
- IUCN (2016). *A Global Standard for the Identification of Key Biodiversity Areas, Version 1.0*. First edition. Gland, Switzerland: IUCN.
- Schirpke U., Marino D., Marucci A., Palmieri M., Scolozzi R. (2017) Operationalising ecosystem services for effective management of protected areas: Experiences and challenges, *Ecosystem Services*, 28, 105–114
- Tore, E. & Cevik, G & Gokdemir, M & Eren, O & Korkmaz., (2012). Ecotourism Policy Supported by Environmental Planning Procedure – an Environmental Planning Experience. Case of Identification of Igneada as an Eco-Town. *Journal of environmental protection and ecology*. 13. 628-642.
- Tsaur, S.-H., Lin, Y.-C., & Lin, J.-H. (2006). Evaluating ecotourism sustainability from the integrated perspective of resource, community and tourism. *Tourism Management*, 27 (4), 640–653.
- Tuğba Kiper (2013). Role of Ecotourism in Sustainable Development, *Advances in Landscape Architecture*, Murat Özyavuz, IntechOpen, DOI: 10.5772/55749. Available from: <https://www.intechopen.com/books/advances-in-landscape-architecture/role-of-ecotourism-in-sustainable-development>
- United Nations (2019) *The Sustainable Development Goals Report*, New York
- UNEP-WCMC and IUCN (2019), *Protected Planet: [PA by countries; The World Database on Protected Areas (WDPA)/The Global Database on Protected Areas Management Effectiveness (GD-PAME)]* [On-line], [august/2019], Cambridge, UK: UNEP-WCMC and IUCN. Available at: www.protectedplanet.net.
- Wells, M.P., McShane, T.O., 2004. Integrating protected area management with local needs and aspirations. *AMBIO: A J. of the Human Environment*. 33 (8), 513–519.
- Xüsusi mühafizə olunan təbiət əraziləri və obyektləri haqqında Azərbaycan Respublikasının qanunu, № 840-IQ, 24 mart 2000-ci il Landşaft xəritəsi. Azərbaycan Respublikası. (2017). Miqyas 1:600000. E.K.Əlizadə, A.A.Mikayılov, M.C.İsmayılov, S.Y.Quliyeva və b. Ekologiya və Təbii Sərvətlər nazirliyi. BKF. Bakı.
- Елизаров А.В., Экологический каркас - стратегия степного природопользования // *Степной Бюллетень*, 1998, Вып. 2-4, с. 76-91
- Пономарев, А.А., Байбаков, Э. И., & Рубцов, В. А. (2012). Экологический каркас: анализ понятий. *Ученые записки Казанского университета. Серия Естественные науки*, 154 (3), 228-238.
- Тишков А.А., Охраняемые природные территории и формирование каркаса устойчивости статья // *Оценка качества окружающей среды и экологическое картографирование*, И.Г. РАН, 1995, с. 94-107

The Impact of Trophic Status and Climate Change on the Benthic Community in Lake Sevan, Armenia

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Abstract: Artificial water level drop and eutrophication radically changed the ecosystem of Lake Sevan. During 1928-2018 the Values of Primary Production of the Lake (VPPL = phytoplankton production + phytobenthos production) and varied energy equivalent of biomass (Bz) and gross production (Pz) of zoobenthos varied by a factor of 10 or more. Strong positive dependencies of both Bz and Pz on VPPL were found. Similar dependencies were also revealed separately for Chironomidae, Oligochaeta and detritivores. Regression equations of dependencies were then used to estimate the development of zoobenthos under different trophic conditions: oligotrophic, mesotrophic and eutrophic. Significant climate change was observed over the past 80 years. From 1935–2012, the annual mean temperature in Armenia increased by 1.03°C. The climate change projections for Lake Sevan are an increase of mean annual water temperature of 0.5°C by 2030, 2°C by 2070 and 4°C by 2100 against the baseline of 9.1°C. Observations showed that in Lake Sevan an order of magnitude increase of VPPL results in an increase of the gross production of macrozoobenthos by factor of 7. Meanwhile, a 4°C temperature increase is estimated to increase the rate of zoobenthos production (Pz/Bz) only by a factor of 2. Therefore, the most effective measure required for the mitigation of climate change effects on the Lake Sevan ecosystem is keeping the trophic status of the lake as low as possible, and should include:

- runoff prevention of organic materials from agricultural, industrial and domestic origins into Lake Sevan;
- prohibition of any activity that involves the use of organic phosphorus and organic nitrogen directly in the lake.

Key words: trophic status, zoobenthos, climate change, temperature increase.

1. Introduction

Eutrophication and temperature increase radically change aquatic ecosystems. Climate change is among the most serious environmental challenges facing humanity and the ecosystems that provide the goods and services on which it relies (Harrod, 2016). Global mean surface temperatures have increased by 0.75°C over the past century, with the rate of change increasing from the 1970s (Trenberth *et al.*, 2007). Warming has also been recorded in freshwater ecosystems worldwide (Bates *et al.*, 2008), including mean water temperature increase 0.3°C over the last 40 years in Lake Sevan (Poddubny, 2010a). Lakes are effective sentinels for climate change because they are sensitive to climate, respond rapidly to change, and integrate information about changes in the catchment. Fast turnover times from organismal to ecosystem scales in lakes are a prerequisite for detecting such rapid changes (Adrian *et al.*, 2009). Climate change is projected to cause significant alterations to aquatic food web structure, dynamics and biodiversity, and primary and secondary production (Wrona *et al.*, 2006). Among the effects of climate change are the increase of water temperatures with the consequent diminution of dissolved oxygen, and the reduction of available habitats for most stenothermal organisms.

An environmental forecast can be based on “one of two methodological approaches: first, by creating dynamic models in which systems are studied, and second, in statistical processing of time series of observations and extrapolation of these series to the future” (Mikhailovsky, 1983). Having the unique time series of 90 years of observations, the second approach will be the basis of our methodology.

Forecasting, and environmental forecasting in particular, is a risky and ungrateful process. A good example is the forecast of the development of ecosystems of lowland reservoirs built between 1930-1950 on the Volga, Kama (Russia) and Dnieper (Ukraine) rivers, made by leading hydrobiologists and ichthyologists of the USSR, who absolutely did not take into account the processes of self-dispersal of the northern species towards the south and vice versa. The errors of quantitative forecast were even more significant: the productivity of phytoplankton turned out to be much higher, and that of zooplankton and commercial fish – significantly less than predicted. In this case, errors in the forecast of fish productivity of reservoirs resulted in an overestimation of ten times of the actual zoobenthos biomass (Nikolayev, 1980).

Nevertheless, the need for environmental forecasts (of course, reliable!) is acute; the number of their potential consumers is growing. They are of particular importance in the light of the environmental impact assessment of projects (Rosenberg et al., 1994), in connection with the adoption of *The Law on Environmental Impact Assessment and Expertise*” (2014).

The impact of climate change on the different links of the aquatic food chain has been studied mainly in marine ecosystems. In the North Sea the main changes occurred in both phyto- and zooplankton and included a shift in phenology, the composition and abundance, an increase in phytoplankton biomass and associated decrease in zooplankton biomass (Reid, 2006). In the zoobenthos of the Barents Sea there was a positive correlation of the biomass of boreal species and a negative correlation of the biomass of arctic species with temperature fluctuations, in which there was a 3 to 7-year lag period of biomass response to temperature for several dominant species (Frolova et al., 2007). Climate change affects the distribution and productivity of fish species (Cheung et al., 2010), has an impact on the sustainability of marine fisheries and aquaculture, and on the livelihoods of communities that depend on fisheries (Wrona et al., 2006). Climate warming likely will cause a shift in the distribution limits for fish species with a change in growth performance and physiology, or even extinction of the species in the world (Mazumder et al., 2015).

Meanwhile, there are very limited data on the impact of climate change on different aspects of functioning of aquatic food chains in freshwater ecosystems. The purpose of this work is to show on the example of Lake Sevan the impact of changes in trophic status and climate change on the benthos in a large freshwater high-altitude limnic waterbody. This is possible due to the unique and fairly intensive long-term historical data base for Lake Sevan (1928-2018). The spatial stability and relative longevity of macrobenthic organisms make them the most convenient objects in the study of long-term environmental changes (Viter, 2011), including for environmental forecasting.

Lake Sevan (40.47°N, 45.33°E) is located in the northern part of the Armenian Volcanic Highland, in Gegharkunik Province of Armenia. The basin of Lake Sevan makes up one sixth of the total territory of the country. Lake Sevan is the largest lake of the Caucasus Region and one of the largest freshwater mountain lakes in Eurasia. All other neighboring great lakes – the Caspian Sea, Lake Van, Lake Urmia and Lake Tuz are saline or hypersaline.

The importance of Lake Sevan in the economy of Armenia can scarcely be exaggerated: it is the main source of irrigation water and provides low cost energy and fish, recreation and tourism. Lake Sevan and the wetlands of the basin are significant breeding, resting, foraging and wintering areas for waterfowl.

To use the lake’s water effectively, Soviet managers devised a plan to preempt the evaporation process by reducing the lake’s surface area. The bed of the out-flowing Hrazdan River was excavated, and a tunnel for the outflow was constructed at a depth of 40 m below the lake surface. The tunnel was inaugurated in 1949; the plan involved taking of 1 km³ water annually for energy and for irrigation. During

1949–1964 the lake level dropped at a rate 1 m year^{-1} (Lind and Taslakyan, 2005; Babayan *et al.*, 2005). Compared to 1931, the 2002 lake level was lowered almost 20 m, the surface area had decreased 13% and the volume 44% (Lyatti, 1932a; Jenderedjian *et al.*, 2005).

The water-level decreases, from this artificial outflow process, influenced an array of hydrological conditions in the lake and at the lakeshore; the lake has undergone such changes which naturally would take thousands of years. The most important of these were: the draining of wetlands, worsening water quality, invasive species succession and biodiversity loss. Lake Sevan experienced increasing eutrophication. This led to seasonal anoxia near the bottom, decreased water transparency, reduced areas of macrophytes, and increases of phytoplankton, zooplankton and zoobenthos production by an order of magnitude. Fish catches doubled due to introduced and invasive species. Meanwhile the number of endemic fish species declined to critical levels and all of them are listed in the Red Book of Armenia (Gabrielyan, 2010a, c, d). Lake Sevan caused deep violations of functional blocks and links in the ecosystem, an imbalance of production and destructive relationships, which led to species succession in all links of the food chain and to the intensification of bioproduction processes (Pavlov, 2010).

Recognizing the true values of wetlands, Armenia became a Contracting Party to the Convention on Wetlands on 6 November 1993 and designated three sites of international importance, including the Lake Sevan Ramsar site, which includes the lake and its basin.

The Lake Sevan management strategy was changed after the adoption of two laws about Lake Sevan. *The Law about Lake Sevan* (2001) “recognizes strategic significance” of the lake for the people of Armenia as an ecosystem with “economic, social, scientific, historical, cultural, aesthetical, recreational and spiritual value”. *The Law about Approval of Annual and Complex Measures on Conservation, Restoration, Reproduction, and Use of the Ecosystem of Lake Sevan* (2001) mandates the raising of the lake water level by 2029 to 1903.5 m above sea level “as a prerequisite for the restoration of the former quantitative and qualitative indicators of water and the prevention of eutrophication, as an elaborate presupposition of survival and water quality eutrophication”. In this case, one should have expected a steady increase in the thermal stability of the lake, an improvement in the oxygen regime of the bottom water layers, restriction of nutrient inputs from bottom sediments and a significant limitation of the catchment effect (Oganesyan *et al.*, 1977, 1985; Oganesyan and Parparov, 1986; Oganesyan, 1988; Danielyan *et al.*, 2011). However, it should be borne in mind that when developing the scientific basis of for the amount of lake level increase, the current projections of climate change were not taken into account.

In this paper, we analyze changes in the long-term (1928–2017) biomass and energetics, and energy budgets of major taxonomic groups of macrobenthic fauna in Lake Sevan. We quantify the relationships between primary production of the lake and the biomass and production of major zoobenthos taxa. Our objective is to understand the response of the zoobenthos community to changes in lake trophic levels, thereby providing baseline information that should assist managers when considering future water level and water intake manipulations. In particular, the results should assist with continued restoration and rehabilitation by taking into account projected global warming processes, as well as other major links of the lake's food chain: zooplankton and fishery.

2. Material and Methods

2.1. The study area

Lake Sevan is situated at an altitude 1900.38 m a. s. l., with a surface area 1238 km^2 and volume 38.1 km^3 (as of January 1, 2019). Prior to draining activities, the lake was situated at an altitude 1916.20 m a. s. l., the surface area was 1416 km^2 and volume 58.5 km^3 (as of January 1, 1931). A minimal water level of 1896.32 m a. s. l., surface area of 1236 km^2 and volume of 32.9 km^3 were observed in 2002.

The climate of Lake Sevan basin (4891 km²) is influenced by its high-mountain location. On the shore the annual number of sunny hours varies from 2,328 to 2,779.

Mean temperature ranges from –5°C in January to 16°C in July, with average annual temperature 5°C. The duration of the frost-free period is about 150 days (Gyozalyan, 1979).

The average annual precipitation in the lake basin ranges from 380 mm on the southern shore to 940 mm on the slopes of mountains. Over the lake, from 340 to 720 mm of precipitation falls annually (Climatic Atlas of the Armenian SSR, 1975).

Lake Sevan consists of the deeper Minor Sevan and relatively shallow Major Sevan, which are separated from each other by capes, forming a wide (5.4 km) strait. The length of the lake is 72.5 km; the largest width of Major Sevan is 30 km, and the Minor Sevan – 14 km.

28 rivers and streams flow into Lake Sevan, and the River Hrazdan flows out of the lake.

Sevan is a dimictic lake with spring and summer circulation. During summer, Lake Sevan water is thermally stratified, with temperature-derived density differences separating the warm surface waters (the epilimnion), from the colder bottom waters (the hypolimnion).

The water of Lake Sevan has had high transparency, averaged over 12 m in the year, with a maximum up to 22 m. In 1978–2004, the water transparency averaged 2.5–4.5 m annually, with a maximum of 6–8 m. Starting in 2005 until 2014–2017 the water transparency increased to 6–12 m (Gyozalyan, 1981, 1984; Bobrov, 2010; Jenderedjian and Hakobyan, 2018).

Until the 1950's the lake was characterized by the year-round presence of dissolved oxygen in the water. In 1974–2007 in the bottom layers of water, areal anaerobic conditions for 2–4 months became common (Slobodchikov, 1955; Gyozalyan and Khorlashko, 1979; Gyozalyan, 1983, Poddubny, 2010b).

The water level increase led to an increase of transparency and improved oxygen conditions in the water near the bottom (Krylov *et al.*, 2016, 2018). However, during the water “bloom” in 2018 and 2019, water transparency dropped to 0.2–0.4 m in the zone of congestion of blue-green algae.

Bottom substrates are categorized as river sediments, stones, pure sands, silty sands, yellow (oxidized) and black (reduced) silt, and limestone bedrock. River sediments are present offshore of river mouths at depths of 3-7(13) m. Stones occur in limited areas at 2–3 m depths. Pure sands are common at depths up to 2–4 m and up to 25 m at the steep shores. Sands become siltier as depths increase. At 7–16 m the sediments become predominantly oxidized yellow silt. As the depths increase, the yellow color of the silt becomes darker, and at depths of 25–33 m the silt is black. During the circulation period (spring and summer), the black silts are covered with a yellow oxidized layer. Small areas of limestone bedrock are present at 26–43 m. The drop in water level has significantly reduced the areas of stones and sands from historic values (Lyatti, 1932b; Afanasyev, 1933; Jenderedjian *et al.*, 2007, 2012).

In the composition of phytoplankton three main groups of algae were found: diatoms (Bacillariophyta), green (Chlorophyta) and blue-green (Cyanophyta). Representatives of the yellow-green (Xanthophyceae), Peridinaceae, and Euglenophyta did not constitute a significant portion to the quantitative indicators but they are important as biodiversity indicators. Before the water level lowering the qualitative composition of phytoplankton of Lake Sevan was poor. In the cold season diatoms dominated, in the warm season – green algae. Blue-green algae in the lake played a subordinate role; representatives of the genus *Anabaena* were completely absent. As the water level decreased, qualitative changes in phytoplankton appeared – some species migrated to pelagial from the coves, others were found in the lake for the first time. Significant changes occurred from 1964, when the first mass “blooming” of the lake by blue-green algae was detected; the blue-green algae from genera *Anabaena* and *Aphanizomenon* appeared and began to dominate in the lake. Water “bloom” indicated a dramatic change towards eutrophication. By 1976, phytoplankton biomass increased 19 times compared with 1947 and became comparable with the biomass of eutrophic lakes. From the 1980s, there have been no continuous “blooms” of water in the lake, but local

“blooms” have been observed every year in the shallow bays. Between 2004-2010 in the lake 164 taxa were registered: 83 (51%) diatoms, 54 (33%) - green and 16 (10%) - blue-green algae. The average phytoplankton and chlorophyll biomass values corresponded to the indices of mesotrophic lakes. However, in 2018 and 2019, an outbreak of a number of blue-green bacteria was observed, which led to intensive water “blooming” by blue-green algae, for the first time in 40 years. The reasons behind this were unprecedented high summer temperature – more than 3°C higher than the long-term average and an increase in the content of dissolved organic phosphorus (Vladimirova, 1947; Stroykina, 1953; Meshkova, 1962, 1975; Ghazaryan and Navasardyan, 1979; Legovich, 1979; Hovsepyan *et al.*, 2010; Hovsepyan, 2013; Environmental Monitoring and Information Center SNCO, report 2018).

48 zooplankton species were found in Lake Sevan: Rotifera 28, Copepoda 9 and Cladocera 11 species. During 1936–2018 the zooplankton average annual number ranged 12–138 thousand specimens m^{-3} and a biomass – of 0.4–2.0 $g\ m^{-3}$ wet weight; rotifers and copepods were dominated in numbers, while daphnia and cladocerans dominated in terms of biomass. The main reason for the disappearance of a number of species and the appearance of new ones was the eutrophication of the lake. The subsequent water level increase from 2002 contributed to the introduction of plankton of a new species. Among them *Daphnia magna* was identified, which soon became the majority of zooplankton biomass. However, in 2018 *D. magna* completely dropped out of the zoobenthos composition, obviously, in connection with the water “blooming”, as well as with a significant increase in the number of whitefish. Changes in lake’s morphometry and fluctuations of trophic level did not have a noticeable effect on the vertical and horizontal distribution of zooplankton (Meshkova, 1947, 1953, 1962, 1975; Simonyan, 1976, 1991; Krylov *et al.*, 2010, 2013, 2018; Nikoghosyan and Hakobyan, 2012; Nikoghosyan, 2013).

The phytobenthos includes both microphytes and macrophytes. Microphytes include 25 species of green, 33 species of blue-green and about 200 forms of diatom algae. The development of fouling begins in early spring, when coastal stones are covering with cortical colonies of blue-green algae. Later, the first shoots of green algae appear. The maximum development of Enteromorpha and Cladophora is at the beginning of autumn. Diatoms observed in large quantities on the strings of green and on the colonies of blue-green algae. In these foulings are refuge and food for oligochaetae of the Naididae family, small larvae of mayflies, caddisflies and chironomids (Vladimirova, 1947; Jenderedjian and Poddubnaya, 1987).

Macrophytes consist of 6–7 species of cryptogam and 21 species of vascular plants. Of cryptogam plants *Chara globularis* and *Ch. intermedia* are widespread, of mosses – *Fontinalis antipyretica*. Of submerged flowering plants most common are pondweeds – *Potamogeton pectinatus* and *P. perfoliatus* and spiked water-milfoil (*Myriophyllum spicatum*). Semi-submerged vegetation occupies tranquil coastal zones in coves and bays, as well as temporarily or permanently separated from the lake wetlands: flowering rush (*Butomus umbellatus*), bulrushes *Scirpus compactus* and *S. tabernaemontani*, reed *Phragmites australis*, water knotweed (*Poligonum amphibium*), *Zannichellia major*, water crowfoot *Ranunculus divaricatus* and star duckweed (*Lemna trisulca*). Semi-submerged vegetation is important as a nesting site for wetland birds, amphibian breeding, feeding of juvenile fish. Prior to drawdown, macrophytes occupied depths up to 19 m with estimated maximum biomass 600,000 tones. During 1964–2018 maximal biomass fluctuated between 30,000–100,000 tones. The drastic changes in the biomass of macrophytes are explained by reducing of water transparency, leveling the coastline, and thereby increasing the depressing role of the surf (Arnoldi, 1929; Fridman, 1948; Ghambaryan, 1979, 1984; Barseghyan, 1990; Jenderedjian, 1996; Jenderedjian, *et al.*, 1999; Bobrov, 2010).

The zoobenthos consists of micro- (unicellular organisms), meio- (size below 3 mm), macro- (size 3-50 mm) and megabenthos (size above 50 mm) (Konstantinov, 1986).

From representatives of microbenthos only infusoria are studied; their number of species in fouling of Lake Sevan is close to 50 (Zharikov and Anokhina, 1984; Zharikov, 2010).

A total 100 species of meiobenthos animals were identified, including 48 representatives of the permanent components: hydra – 2, flatworms – 3, nematodes – 23, water bear – 1, ostracods – 9, water fleas – 5, cyclopids – 3, and harpacticides – 2. Among nematodes, there was a noticeable replacement of the oxyphilic species of family Chromadoridae on less demanding on water quality species of family Monchisteridae. In 1986-1993 the average annual number of meiobenthos varied within 93–195 thousand specimens m^{-2} with a biomass and gross production of 1.2–1.8 and 2.1–3.5 $g\ m^{-2}$ wet weight, respectively (Fridman, 1948, 1950; Gagarin and Hakobyan, 1991, 1992; Hakobyan, 1996a, 1996b, 2010).

A total of 171 species of macrobenthic animals, mostly cosmopolitan Palearctic and Holarctic species, were described for Lake Sevan and small coastal water bodies. Of these 100 species (oligochaetae 26, leeches 8, limnid 11 and bivalve 7 molluscs, amphipods 2, larvae of dragonfly 1, mayflies 2, caddisflies 7, nonbiting midges 32, and bags 4) were found directly in the lake.

The only representative of megabenthos, the narrow-clawed crayfish (*Astacus leptodactylus*), was first found in Lake Sevan in the 1970s. Perfectly adapted to the conditions of the lake, crayfish acquired commercial importance in 1990s. The commercial pressure affects the state of the crayfish population by reducing the number of size-age groups. Crayfish is most common at depths of up to 20–22 m with the maximum reliable depth of capture 33 m. It prefers a silty, sandy bottom with thickets of macrophytes. The commercial pressure, poaching, use of nets and special not selective traps affects the state of the crayfish population by reducing the number of size-age groups. Currently commercial stocks of crayfish in Lake Sevan are under severe decline (Hovhannisyan and Ghukasyan, 1996; Hovhannisyan, 1998; Jenderedjian, 1998; Ghukasyan, *et al.*, 2006, 2010; Badalyan, 2012a, 2012b):

Ichthyofauna consists of 3 endemic – Ishkhan or Sevan trout (*Salmo ischchan*), Sevan scraper (*Varicorhinus capoeta sevangi*) and Sevan barbel (*Barbus goktschaikus*), 1 introduced – whitefish (*Coregonus lavaretus sevanicus*) and 5 invasive species – Prussian carp (*Carassius auratus gibelio*), South Caspian spiralin (*Alburnoides bipunctatus armeniensis*), topmouth gudgeon (*Pseudorasbora parva*), common carp (*Cyprinus carpio*), rainbow trout (*Parasalmo mykiss*). All native species are in serious decline and listed in the Red Data Book of Armenia (2010). Currently the most important commercial fish is the whitefish, which has been introduced in 1924–1927 to consume zooplankton resources underutilized by local fish species (Fortunatov, 1927). Until the end of 1950's, in the basis of fish catches were Ishkhan and Koghak. In 1970-1990's registered fish catches were on average 3 times higher than in 1920-1960's. It should be mentioned that according to expert estimations, poaching has always been higher than recorded catches (Gabrielyan, 2010b).

2.2. Material

Extensive historical data sets were used to evaluate the impacts of water level changes and associated changes on the zoobenthos (Table 1).

The energy values of biomass and gross production of major taxonomic and feeding groups of benthic animals were compared with the values of primary production of the lake VPPL = phytoplankton + phytobenthos productions (Tables 2 and 3).

Significant climate change has been observed over the past 80 years. From 1935–2012, the annual mean temperature in Armenia increased by 1.03°C and precipitation decreased by 10%.

The climate change projections for Lake Sevan are (Table 4):

- increase of mean annual water temperature against the baseline 9.1°C in 2030 by 0.5°C, in 2070 by 2°C, and in 2100 by 4°C;
- decrease of annual inflow in 2030 by 7%, in 2070 by 14%, and in 2100 by 24%;

Table 1. Average annual biomass of different systematic groups of zoobenthos and zoobenthos energy biomass and annual gross production in Lake Sevan.

Year	Oligochaeta	Hirudinea	Gastropoda	Bivalvia	Amphipoda	Ephemeroptera	Odonata + Tricoptera	Chironomidae	Total macrobenthos	Summary biomass (B)	Summary gross production (P)	P/B
	g m ⁻² wet biomass									Joule m ⁻²		
1928	1.64	0.41	0.03	0.12	0.62	0.01	0.05	0.38	3.26	13,191	18,335	1.39
1938	2.05	0.51	0.12	0.31	0.56	0.01	0.03	0.46	4.05	15,826	22,631	1.43
1948	1.98	0.30	0.06	0.20	0.69	0.01	0.02	0.66	3.92	15,322	21,451	1.40
1955	4.13	0.33	0.13	0.25	0.67	0.01	0.02	1.16	6.60	26,911	36,868	1.37
1962	2.04	0.35	0.46	1.23	0.78	0.03	0.04	1.71	6.64	20,960	39,614	1.89
1966	2.63	0.50	0.45	1.09	0.60	0.06	0.03	3.10	8.46	27,027	65,676	2.43
1971	3.19	0.30	0.48	1.44	0.78	0.06	0.01	7.20	13.46	40,175	95,215	2.37
1976	7.04	0.28	0.35	0.85	0.45	0.04	0.00	21.90	30.91	92,576	240,698	2.60
1978	12.57	0.19	0.41	1.11	0.24	0.01	0.00	22.42	36.95	119,017	274,929	2.31
1979	12.05	0.21	0.36	1.11	0.19	0.01	0.00	18.80	32.73	107,332	235,057	2.19
1980	10.54	0.15	0.29	1.02	0.10	0.01	0.00	10.68	22.79	79,105	148,717	1.88
1981	9.77	0.09	0.26	0.82	0.10	0.01	0.00	6.20	17.25	63,723	102,594	1.61
1982	9.57	0.04	0.33	0.74	0.08	0.01	0.00	5.14	15.91	59,862	92,187	1.54
1983	10.53	0.03	0.31	0.72	0.04	0.00	0.00	5.50	17.13	64,982	94,224	1.45
1984	11.84	0.03	0.35	0.71	0.04	0.00	0.01	5.60	18.58	71,486	97,936	1.37
1985	10.57	0.03	0.29	0.48	0.07	0.00	0.01	7.66	19.11	70,380	112,608	1.60
1986	9.14	0.03	0.15	0.26	0.09	0.00	0.01	4.29	13.97	54,786	73,413	1.34
1987	8.38	0.02	0.08	0.18	0.04	0.00	0.00	2.53	11.23	46,317	54,191	1.17
1988	8.96	0.01	0.10	0.20	0.01	0.00	0.00	2.80	12.08	49,622	59,546	1.20
1989	7.43	0.01	0.05	0.10	0.03	0.00	0.00	2.21	9.83	40,817	48,572	1.19
1990	7.51	0.01	0.07	0.14	0.09	0.00	0.00	2.07	9.89	41,157	48,565	1.18
1991	7.54	0.01	0.08	0.13	0.06	0.00	0.00	3.03	10.85	43,588	60,587	1.39
2004	5.52	0.01	0.06	0.10	0.06	0.00	0.00	1.71	7.46	30,721	41,781	1.36
2008	6.91	0.01	0.04	0.01	0.23	0.00	0.00	3.05	10.25	41,099	61,649	1.50
2012	2.45	0.02	0.17	0.02	0.40	0.02	0.00	1.70	4.78	17,760	30,725	1.73
2015	1.77	0.03	0.01	1.13	0.23	0.01	0.00	2.77	5.94	17,768	39,090	2.20
2016	1.38	0.09	0.15	1.07	0.63	0.01	0.00	2.26	5.59	16,592	36,005	2.17
2017	0.77	0.14	0.22	0.44	0.73	0.02	0.01	1.08	3.40	10,745	22,457	2.09

References: 1928 (Arnoldi, 1929), 1938 (Fridman, 1950), 1955 (Markosyan, 1959), 1976 (Nikolayev, 1985), 1978 and 1980 (Ostrovsky, 1985), 1984–1991, 2004 (Jenderedjian, 2005; Jenderedjian et al., 2005), 2005–2017 (Hakobyan and Jenderedjian, 2010; Hakobyan 2016; Jenderedjian and Hakobyan, 2016, 2018), 1948, 1961, 1966, 1971, 1979, 1982–1983 (calculations based on archival materials of the Scientific Center of Zoology and Hydroecology).

Table 2. Perennial values of phytoplankton production of Lake Sevan (κJoule m⁻² year⁻¹)

Years	Production	Years	Production	Years	Production	Years	Production	Years	Production
1939	2400	1968	10700	1978	23870	1985	8220	1997	12800
1947	3500	1969	10400	1979	12790	1986	13260	2001	10400
1959	4610	1972	8900	1980	16640	1987	10660	2005	6100
1961	9700	1974	20100	1981	13350	1988	13310	2009	2900
1962	12500	1975	16300	1982	12480	1989	11390	2013	2800
1966	23300	1976	29590	1983	8680	1990	12570		
1967	12900	1977	31090	1984	12480	1991	14670		

References: Ghambaryan, 1968; Parparov, 1990; Simonyan, 1991; Jenderedjian, 2019.

- decrease of annual precipitation against the baseline 592 mm in 2030 by 3%, in 2070 by 6%, and in 2100 by 9%.

A projected lake water-temperature increases were used to estimate the expected changes in the functioning of macrozoobenthos in Lake Sevan.

Table 3. Development of macrophytes in Lake Sevan in different years

Year	Maximal biomass, tones	Energy equivalent, kJoule m ⁻² year ⁻¹
1928	600,000	869
1948	200,000	296
1955	100,000	156
1961-1962	60,000	96
1966-1967	50,000	81
1974-1978	30,000	49
1980	17,000	28
1983	33,000	54
1984-1991	40,000-60,000	83 (66-99)
2004-2009	50,000-75,000	101 (81-121)
2010-2017	75,000-100,000	140 (120-160)

References: Arnoldi, 1929; Fridman, 1948, 1950; Ghambaryan, 1979, 1984; Barseghyan, 1990; Jenderedjian, 1996; Jenderedjian, et al. 1999; Bobrov, 2010.

Table 4. Climate change projections for Lake Sevan.

Year	1961–1990	2030	2070	2100
Mean annual Temperature, °C	9.1	9.6	11.1	13.1
Precipitation, mm	592	573	557	540
Inflow, mln. m ³	787	734	673	595

Reference: Armenia's Third National Communication on Climate Change, 2015.

2.3 Methods

A single Petersen grab sample of 0.1 m² was obtained at each site visit during 1928–1971, and two Petersen grab samples of 0.025 m² per sample were obtained during 1976–2017. Samples were collected weekly, monthly or once in a year from 9 to 27 semi-transects at depths of 2, 4, 7, 10, 15, 20, 25, 30, 40, 50, and 60 m. Samples at 70 m were taken during 1928–1966 and at 80 m – during 1928–1948. The average biomass of bottom animals for each sampling depth and depth zones: littoral (0-8.5 m), sublittoral (8.5-27.5 m) and profundal (>27.5 m) was calculated separate for Major Sevan and Minor Sevan, the then for the whole Lake Sevan taking into account the distribution of areas between the corresponding isobaths (Kireev, 1933), adjusted for water level during the study period.

For calculation of productivity of zoobenthos, annual turnover ratios P/B of production (P) to biomass (B), from published studies for dominant species in Lake Sevan were used (Table 5).

To estimate annual energy budgets, the macrobenthic community of Lake Sevan was divided into four functional feeding groups: detritivores, herbivores, filter feeders (all together primary consumers or so called “peaceful”), and predators (secondary consumers).

Detritivores included Oligochaeta except the family Naididae, the gastropod *Valvata piscinalis*, and chironomid larvae (except *Procladius sp.*, *Cryptochironomus sp.*, and those species that inhabit periphyton and plants). Herbivores included all Gastropoda except *V. piscinalis*, the oligochaeta family Naididae (except *Chaetogaster spp.*), the amphipod *Gammarus pulex*, chironomid larvae that inhabit periphyton and plants, and mayfly (Ephemeroptera) larvae. All Bivalvia mollusks were considered to be filter feeders. Predators included the oligochaeta *Chaetogaster spp.*, leeches (Hirudinae), caddisflies (Trichoptera), and the chironomids *Procladius sp.* and *Cryptochironomus sp.* (Sushkina, 1949; Zhadin, 1952; Meshkova, 1957; Chekanovskaya, 1962; Mamayev, 1972; Lukin, 1976; Alimov *et al.*, 1977; Alimov, 1981; Manukyan, 1993; Silva *et al.* 2008). Because the amphipod *G. lacustris* inhabits a variety of substrata, it has mixed food sources (Markosyan, 1948). We assumed that the diet of *G. lacustris* consisted of 50% plants, 40%

detritus, and 10% living animals in littoral and of 90% detritus and 10% living animals in sublittoral and profundal, and its biomass was apportioned into the herbivore, detritivore, and predator categories accordingly (Jenderedjian et al., 2012; Jenderedjian and Hakobyan, 2017).

Table 5. Ratios (P/B) of annual production (P) to biomass (B) of dominant macrozoobenthos species.

Taxon	Year	Depth, m	P/B	Source
Oligochaeta				
<i>Limnodrilus hoffmeisteri</i>	1984–1985	2–7	1.5–2.2	Jenderedjian, 1989b, 1994a, 1994b
<i>Potamothenix alatus paravanicus</i>	1984–1987	2–7	2.1–3.4	
		10–25	1.3–1.9	
		30 ^{Major Sevan}	0.9–1.1	
		30 ^{Minor Sevan}	0.2–0.4	
		40	0.4–0.5	
		50	0.2–0.3	
		60	0.1–0.2	
	1947–1948	40–80	0.4–0.6*	
<i>Tubifex tubifex</i>	1984–1985	2–7	1.6–2.2	
Hirudinea				
<i>Glossiphonia complanata</i>	1952–1954	6–10	1.4**	Meshkova, 1957
<i>Helobdella stagnalis</i>			2.4**	
	1974–1976		2.9	Nikolayev, 1980b, 1985
<i>Herpobdella octoculata</i>	1952–1954		3.3**	Meshkova, 1957
	1974–1976	6.0	Nikolayev, 1980b, 1985	
Gastropoda				
<i>Valvata piscinalis</i>	1978	7–13	1.4	Ostrovsky, 1981
Bivalvia				
<i>Euglesa cingulata</i>	1978	2–20	1.3**	Ghukasyan, 1990a, 1990b
<i>Euglesa nitida</i>		2–15	2.5**	
<i>Euglesa casertana</i>		15–30	1.1**	
Amphipoda				
<i>Gammarus lacustris</i>	1937–1939	7–13	2.0	Markosyan, 1948
			1.4–1.5	Ostrovsky, 1983a
	1974–1976	6–10	4.7	Nikolayev, 1980a, 1985
			4.7	
1980–1983	2–7	1.7–1.8	Manukyan, 1993	
Ephemeroptera				
<i>Caenis luctuosa</i>	1979	2–4	4.2***	Hakobyan and Ostrovsky, 1984
Chironomidae				
<i>Procladius culiciformes</i>	1979–1980	10–20	6.5–7.5	Ostrovsky, 1984
<i>Cladotanytarsus atridorsum</i>	1947–1948	30–40	3.6**	Sharonov, 1951
		4–25	10.5**	
		1–14	9.5**	
		14–25	5.2**	
		20–30	3.8**	
<i>Glyptochironomus barbipes</i>	1979–1980	2–5	5.0	Ostrovsky, 1983a
<i>Chironomus plumosus</i>	1974–1976	6–10	6	Nikolayev, 1981, 1985
	1979–1980	5–15	4.5–5.7	Ostrovsky, 1983b
20–30		3.0–3.8		
<i>Chironomus tentans</i>	1947–1948	10–30	4.0**	Sharonov, 1951
<i>Chironomus markosjani</i>	1979–1980	10–25	1.4–2.7	Ostrovsky, 1986
	1947–1948	30–40	3.3**	Sharonov, 1951
<i>Polypedilum scalaenum</i>	1947–1948	1–10	8.8**	

*Recalculation accounting for oxygen content **Calculation by growth rate data ***Recalculation by seasonal P/B ratio

Three scenarios of trophic levels were considered: the annual VPPL 3, 10 and 30 mJoule m⁻², which overall correspond to Lake Sevan oligotrophic (1928-1959, 2010-2017), mesotrophic (1961-1972, 1979-2008) and eutrophic (1974-1979) periods, respectively. For those taxonomic groups that didn't revealed correlation with VPPL, the average weighted data for respective years were used.

The temperature factors $Q_{10} = 2.25$ for Oligochaeta and Amphipoda, $Q_{10} = 2.5$ for Hirudinea and insects larvae, and $Q_{10} = 3.2$ for molluscs were used to adjust production ratios (P/B) for water temperatures differing from the initial ones (Winberg, 1956, 1983; Sushchenya, 1972; Alimov, 1975, 1981; Kashirskaya *et al.*, 1980; Ivleva, 1981).

Biomass energy density values (joules per milligram wet weight) were established as follows: Oligochaeta 4.7, Hirudinea 4.2, Gastropoda 1.7, Bivalvia 1.3, Amphipoda 3.8, Ephemeroptera 3.8, Trichoptera 4.2, and Chironomidae 2.5 (Winberg, 1950; Birger *et al.*, 1967; Ostapenya, 1968; Sherstyuk, 1971; Kititsyna, 1978; Manukyan 1993).

An assumption has been made that the increase of annual water temperature on 2°C degree will extend the duration of oxygen deficiency ($O_2 < 1 \text{ m g}^{-1}$) period in the bottom layer of water on 1 month, regardless the trophic level of the lake (Rice, *et al.*, 2012). During the seasonal oxygen deficiency, the growth rate of benthic animals assumed to be zero (0). In practice, the latter was applied only to the dominant oligochaeta species *Potamothrix alatus paravanicus*, the only representative of macrozoobenthos, inhabiting in great numbers black silts in the profundal zone.

3. Results and Discussion

The perennial (1928-2017) changes of the macrozoobenthos biomass are given in the Figure 1.

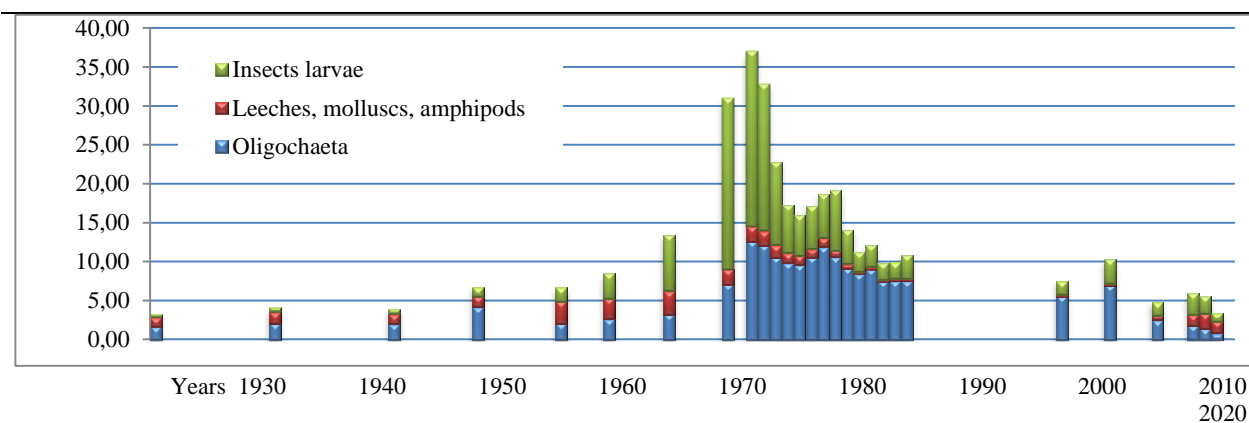


Figure 1. Perennial fluctuations of the macrozoobenthos biomass (g m^{-2} wet weight).

References: Arnoldi, 1929, Fridman, 1950, Markosyan, 1959, Nikolayev, 1985, Ostrovsky, 1985, Hakobyan and Jenderedjian, 2010; Hakobyan 2016; Hakobyan and Jenderedjian, 2016, 2018.

During the natural water level (1928-1932) and initial increase of water exploitation (1933-1948), the average annual biomass of zoobenthos community was $3\text{-}4 \text{ g m}^{-2}$, of which (mean \pm standard deviation) oligochaetae $50\pm 0.3\%$, insect larvae $14\pm 2\%$, leeches, molluscs and amphipoda $35\pm 2\%$; $n=3$.

The intensive use of ages-old water reserves (during 1949-1962 each year the outflow was more than 1 km^3 and the water level drop was about 1 m) for production of electricity and irrigation of fertile but dry Ararat Valley was followed by intensive water “bloom” in 1964 and until mid-1980’s. In 1955-1971 the zoobenthos biomass increased to $7\text{-}13 \text{ g m}^{-2}$, mainly due to increased biomass of insect larvae (oligochaetae $37\pm 13\%$, insect larvae $34\pm 12\%$, leeches, molluscs and amphipoda $29\pm 8\%$; $n=4$).

The maximal biomasses of zoobenthos were recorded in 1976-1979 – $31\text{-}37 \text{ g m}^{-2}$, of which more than half were chironomid larvae (oligochaetae $31\pm 6\%$, insect larvae $63\pm 5\%$, leeches, molluscs and amphipoda $6\pm 0.3\%$; $n=3$).

In subsequent years, the biomass of zoobenthos gradually decreased to $16\text{-}23 \text{ g m}^{-2}$ in 1980-1985 (oligochaetae $57\pm 5\%$, insect larvae $36\pm 5\%$, leeches, molluscs and amphipoda $6\pm 0.3\%$; $n=6$), $10\text{-}14 \text{ g m}^{-2}$

in 1986-1991 (oligochaetae 73±3%, insect larvae 25±3%, leeches, molluscs and amphipoda 6±0.3%; n=6), and 7-10 g m⁻² in 2004-2008 (oligochaetae 71±3%, insect larvae 26±3%, leeches, molluscs and amphipoda 6±0.3%; n=2). During these years oligochaetae has made in average 2/3 of the zoobenthos biomass.

Lastly, in 2012-2017, the average biomass decreased to 3-6 g m⁻², the biomass has begun to resemble that of 1928-1948, and the taxonomic structure (oligochaetae 32±10%, insect larvae 39±5%, leeches, molluscs and amphipoda 29±11%; n=4) – that of 1955-1971.

A positive correlation revealed for the Lake Sevan zoobenthos biomass with VPPL fluctuations with the lag period of biomass response from 2 to 4 years; nevertheless, for oligochaeta biomass the lag period was from 7 to 9 years, for chironomids biomass – 2 years, for molluscs biomass – 5 years. For amphipods biomass the correlation with the VPPL was negative with the lag period from 3 to 4 years.

Changes in the taxonomic structure of zoobenthos by depth zones over time are given in Figure 2.

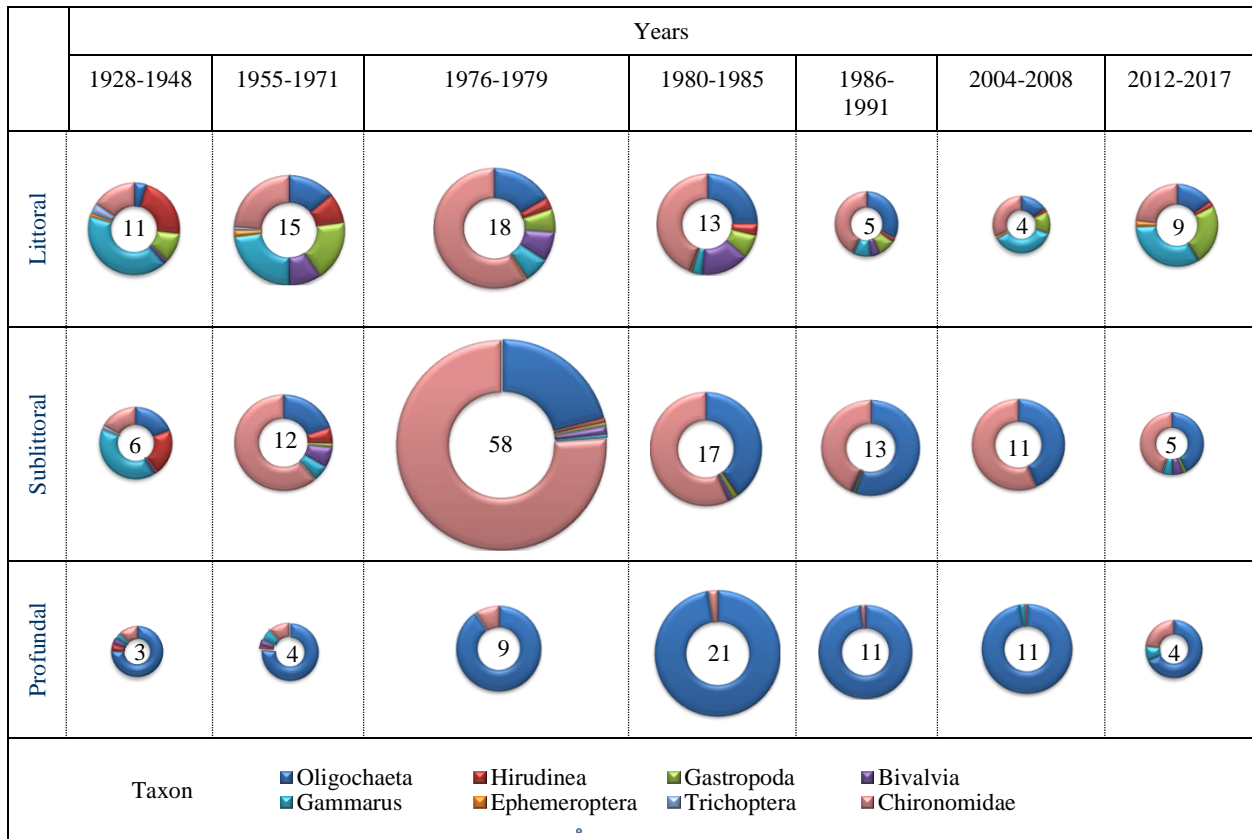


Figure 2. Biomass distribution of different taxonomic groups by depth zones of Lake Sevan in different years. The numbers in the circles mark the total wet biomass of zoobenthos (g m⁻²).

In 1928-1948, the zoobenthos community was distinguished by high diversity in all depth zones. The highest biomass was in the littoral zone, the lowest in the profundal zone. The littoral was dominated by amphipods, while the subdominant groups were leeches, chironomids and gastropods. Amphipods were dominant in the sublittoral zone as well, while leeches, oligochaetae and chironomids subdominated. Oligochaetae dominated the profundal, and chironomids sub-dominated, with relatively high proportion of molluscs and amphipods, since the minimum oxygen saturation in the bottom water was more than half of the annual maximum (Lyatti, 1932b; Slobodchikov, 1955). The situation was similar in 1955-1971.

In 1976-1979, the maximum biomass of zoobentos shifted to the sublittoral zone mainly due to increase of the biomass of chironomid larvae. Due to worsening oxygen conditions in the bottom layer of water, with insufficient exception, only oligochaeta *P. alatus paravanicus* and small number of chironomid larvae *Procladius culiciformis* survived in the profundal zone.

In 1980-1985, the maximal biomass of zoobentos shifted to the profundal zone.

The reverse processes were observed in 1986-1991 and 2004-2008. In these years, oligochaetae and larvae of chironomids together consisted 99% of the total biomass in sublittoral and profundal zones. With a few exceptions, leeches, molluscs and amphipods were observed only in the littoral zone.

In 2012-2017, in all depth zones, the structure of zoobenthos and biomass distribution over the depth zones became more or less similar to those in 1928-1948.

The foregoing indicates that the profundal zone zoobenthos biomass reacts slower to fluctuations of the VPPL slower and less pronounced than the sublittoral zone zoobenthos biomass. Indeed, the values of the zoobenthos biomass in sublittoral zone are the most consistent with the VPPL for the previous 2 years, while in the profundal – for the previous 7-9 years. In the littoral zone the zoobenthos biomass are the most consistent with the VPPL for the previous 1-2 years; however, the correlation here is less expressed, since the defining factor is the macrophyte component of VPPL, which is not only a source of food but also a refuge for benthic animals. The intensity of macrophytes development is the smaller, the greater is the value of primary production of plankton and its share in the total primary production energy flow decreases from $11\pm 10\%$ ($n=5$) in oligotrophic years a much lower proportion of $0.6\pm 0.2\%$ ($n=6$) in mesotrophic and $0.2\pm 0.02\%$ ($n=3$) in eutrophic years.

Perennial changes in the macrozoobenthos trophic structure are given in Figure 3.

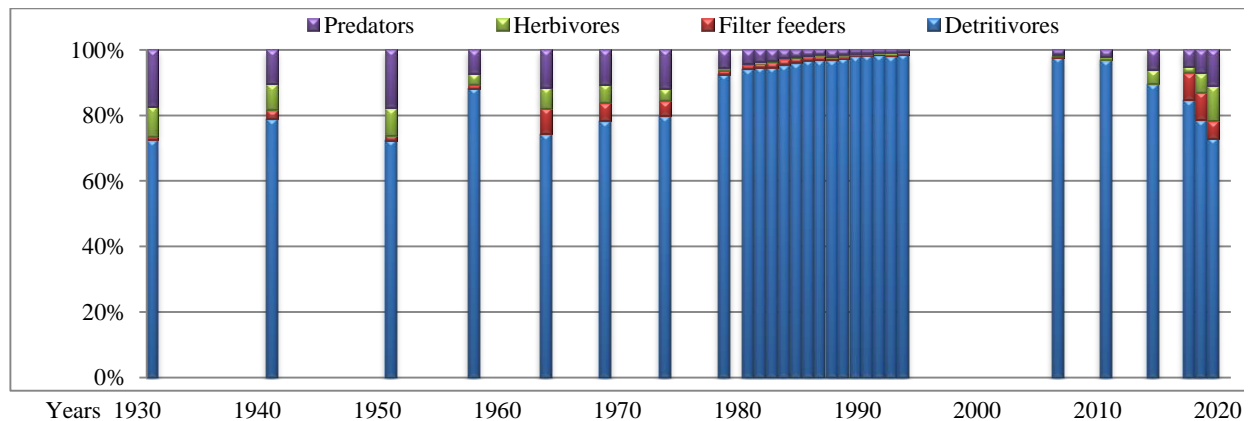


Figure 3. Perennial fluctuations in the macrozoobenthos trophic structure as per cent of the energy biomass. References: Jenderedjian, *et al.*, 2012; Jenderedjian, 2019.

During 1928–1971, the proportions of biomass energy density (Joules m^{-2}) in the different feeding groups remained comparatively stable (predators $12\pm 4\%$, detritivores $78\pm 5\%$, herbivores $6\pm 2\%$, and filter feeders $4\pm 2\%$; $n=7$). Drastic changes occurred after 1971. In 1976–2008, the average proportion ($n=17$) of predators, herbivores, and filter feeders declined to $2\pm 1\%$, $0.3\pm 0.2\%$ and $1.0\pm 0.5\%$, respectively; in contrast, the proportion of detritivores increased to $97\pm 2\%$. Reversible changes occurred in 2012-2017. In comparison with 1976-2008, the average proportion ($n=4$) of detritivores declined to $81\pm 2\%$, predators, herbivores, and filter feeders increased to $7\pm 3\%$, $6\pm 4\%$ and $6\pm 4\%$, respectively. The trophic structure of zoobenthos has begun to resemble that of 1928-1971.

Thus, the changes that occurred in the quantitative and qualitative development of zoobenthos in 2004-2017 convincingly indicate a shift in the trophicity of Lake Sevan in the direction of oligotrophy: a

significant reduction in the VPPL, improved oxygen conditions in the near-bottom water layers, and expansion of areas covered with macrophytes. This is also confirmed by an increase in the transparency of water from 2-6 m in 1978-2006 up to 5-15 m in 2010-2017, and the shift in the composition of zooplankton from smaller to larger species (Krylov *et al.*, 2018). Seems to be, the positive tendencies in the trophic status of Lake Sevan are mainly the consequence of an increase of 4 m of the lake level from 2002 to 2017.

The patterns described above confirm the earlier assumption that quantitative changes of zoobenthos biomass at a certain stage will be accompanied by qualitative changes in the zoobenthos structure (Jenderedjian, 2019).

Regretfully, in July 2018 and June 2019, week-long outbreaks of Lake Sevan water “blooming” took place, initiated by unprecedented high summer temperatures and increased concentrations of dissolved phosphates in the water. This coincided with increased water withdrawals from the lake and corresponding only 6 cm lake level increase during the past 8 years.

Based on empirical equations (Table 6), under Lake Sevan conditions, with an increase of VPPL by an order of magnitude (from 3 to 30 mJoule m⁻²) and the same temperature conditions, the biomass of oligochaetae will increase by 5 and gross production by 6 times, gastropods by 7 and 7 times, bivalve molluscs by 6 and 7 times, larvae of chironomids by 24 and 21 times, and biomass and production of amphipods will decrease by 4 and 4 times. The total biomass and production of zoobenthos will increase by 5 and 7 times, of which detritivores will increase 7 and 12 times.

Table 6. Parameters of dependence* equations ($Y = a \times X^b$, n – number of pairs, r² – correlation coefficient) of the biomass (B) and gross production (P) of different groups of benthic animals from the VPPL (PP_{-0, -1, ..., -9} for the same and previous 1 ... 9 years), in Joule m⁻²). The three right-hand columns show estimated values of the corresponding indicators with an annual primary production value of 3, 10, and 30 mJoule m⁻².

Taxonomic or trophic group*	Y	X	n	a	b	r ²	3,000,000	10,000,000	30,000,000
Oligochaeta	B _{Oli}	PP _{-7;-9}	22	0.301	0.712	0.68	12,342	29,096	63,636
	P _{Oli}	PP _{-7;-9}	22	0.117	0.761	0.64	9,891	24,733	57,084
Molluscs	B _{Gas}	PP ₋₅	11	0.0002	0.838	0.60	56	154	385
	P _{Gas}	PP ₋₅	11	0.0003	0.848	0.60	91	253	642
Amphipoda	B _{Gam}	PP _{-3;-4}	12	3×10 ⁷	-0.615	0.59	2,961	1,409	716
	P _{Gam}	PP _{-3;-4}	12	1×10 ⁷	-0.545	0.55	4,205	2,178	1,195
Chironomidae	B _{Chi}	PP ₋₂	22	2×10 ⁻⁶	1.383	0.81	1,815	9,595	43,842
	P _{Chi}	PP ₋₂	22	2×10 ⁻⁵	1.332	0.80	8,483	42,173	182,203
Detritivores	B _{Det}	PP _{-2;-4}	22	0.055	0.839	0.74	14,169	38,874	97,684
	P _{Det}	PP _{-2;-4}	22	0.002	1.089	0.78	13,065	48,484	160,861
“Peaceful”	B _{Pea}	PP _{-2;-4}	22	0.127	0.787	0.75	15,031	38,816	92,317
	P _{Pea}	PP _{-2;-4}	22	0.009	0.990	0.77	18,119	59,531	176,729
Total macrozoobenthos	B _{Tot}	PP _{-2;-4}	22	0.321	0.737	0.75	18,041	43,796	98,431
	P _{Tot}	PP _{-2;-4}	22	0.075	0.870	0.72	24,084	68,45	177,966

*No dependence from the VPPL was revealed by leeches, mayflies and caddisflies, and predators, herbivores and filter feeders.

Reference: Jenderedjian, 2019.

From the above mentioned it may seem that the higher the trophicity of the lake, the more food is available for fish. This is not the case. Obviously, not all zoobenthos production is eaten by fish. Firstly, a significant part of it is eaten by zoobenthos predators themselves. Secondly, vast areas of the bottom of the lake (profundal, lower sublittoral) are permanently or temporarily inaccessible to fish due to unfavorable oxygen conditions. Thirdly, fish feed selectively, preferring certain groups of animals. In general, the animals that are most eaten by fish are those swimming in the near-bottom layer of water (amphipods, leeches), then that are located on or near the bottom surface (molluscs, insects larvae) and the least of all that are living in the bottom lake sediments (oligochaetae). However, the detailed analysis of the relationships between fish, benthos (and plankton) communities is an objective of another paper.

The long-term dynamics of actual (1928-2017) and forecasted (2030, 2070 and 2100) values of gross production (including consumption by second-order consumers, i. e., predatory zoobenthos) of macrobenthos animals are reflected in Figure 4.

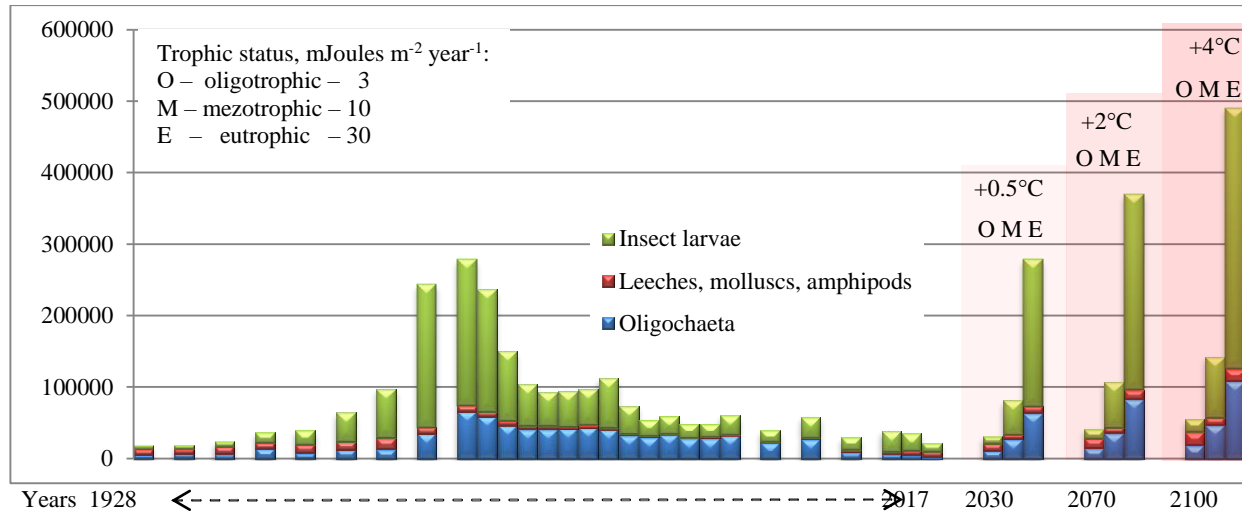


Figure 4. Perennial changes of the actual (1928-2017) and forecasted macrozoobenthos production (Joules m⁻²) under projected water-temperature increase of 0.5°C by 2030, 2°C by 2070 and 4°C by 2100.

In general, all other conditions being equal, an increase in temperature by 0.5°C will lead to an increase in the zoobenthos production rate by 9%, by 2°C – by 45%, and by 4°C – by 90%. Meanwhile, the change of trophic status of the reservoir from oligotrophic to eutrophic leads to 740% increase in the gross production of zoobenthos. Although this forecast does not take into consideration the inevitable succession of cryophile species by more thermophile ones, however, it is evident that the most effective measure for mitigation and adaptation of possible negative consequences of climate change on the ecosystem of Lake Sevan will be the unconditional restriction of any type of invasion of organic matter of allochthonous origin into the lake.

4. Conclusions

- A positive correlation revealed for the Lake Sevan zoobenthos biomass with VPPL fluctuations with the lag period of biomass response 2-4 years; for oligochaeta – 7-9 years, for chironomids – 2 years, for molluscs – 5 years. For amphipods biomass the correlation with the VPPL was negative with a 3-4 year lag period.
- The lag period for the zoobenthos biomass response to the VPPL in littoral is from 1 to 2 years, in sublittoral – 2 years, and in the profundal – from 7 to 9 years.
- Quantitative changes of the zoobenthos biomass at a certain stage will be accompanied by qualitative changes in the zoobenthos trophic structure.
- An increase of the trophic level of Lake Sevan from oligotrophic to eutrophic will increase the gross production of zoobenthos by 740%.
- Temperature increases of 0.5, 2, and 4°C will lead to estimated increases in zoobenthos production rate by 9%, 45%, and 90%, respectively.
- The most effective measure for mitigation and adaptation of possible negative consequences of climate change on the Lake Sevan ecosystem will be the complete restriction of any type of allochthonous organic matter of into the lake.

References

- Adrian, R., C. M. O'Reilly, H. Zagarese, S. B. Baines, D. O. Hessen, W. Keller, D. M. Livingstone, R. Sommaruga, D. Straile, E. V. Donk, G. A. Weyhenmeyer and M. Winder, 2009. Lakes as sentinels of climate change. *Limnol Oceanogr*, 54(6): p. 2283–2297.
- Afanasyev, G. D., 1933. Donnyye otlozheniya oz. Sevan [Bottom sediments of Lake Sevan]. Basseyn oz. Sevan (Gokcha), v. 3, is. 2, Tbilisi: p. 3–121. [In Russian]
- Alimov, A. F., 1975. Intensivnost' obmena u presnovodnykh dvustvorchatykh mollyuskov [Metabolic rate in freshwater bivalve mollusks]. *Ekologiya*, № 1: p. 10-20. [In Russian]
- Alimov, A. F., 1981. Funktsional'naya ekologiya presnovodnykh dvustvorchatykh mollyuskov [Functional ecology of freshwater bivalve mollusks]. L.: 248 pp. [In Russian]
- Alimov A.F., Vasilyeva L.V., Kachalova O.L., Pankratova V.Ya. and Finogenova N.P., 1977. Donnaya fauna r. Tyup i Tyupskogo zaliva oz. Issyk-Kul' [Bottom fauna of the river. Tyup and Tyup Bay lakes. Issyk-Kul]. *Gidrobiologicheskkiye issledovaniya na r. Tyup i Tyupskom zalive oz. Issyk-Kul'*. L.: p. 132-139. [In Russian]
- Arnoldi, L. V., 1929. Materialy po izucheniyu donnoy produktivnosti oz. Sevan [Materials on the study of bottom productivity of Lake Sevan]. *Tr. Sevansk. ozernoy st.* v. 2, is. 1: p. 1–96. [In Russian]
- Armenia's Third National Communication on Climate Change, 2015. "Lusabats" Publishing House, Yerevan. 165 p.
- Babayan, A., K. Jenderedjian, S. Hakobyan, S. Muradyan and M. Voskanov, 2005. Lake Sevan – Experience and Lessons Learned Brief. Managing Lakes and their Basins for Sustainable Use. International Lake Management Committee Foundations: Kusatsu, Japan: p. 347–362. http://www.worldlakes.org/uploads/21_Lake_Sevan_27February2006.pdf
- Badalyan, N. S., 2012a: Sevana lchi yerkarach'anch' khets'getni (*Pontastacus leptodactylus* Eschscholtz, 1823) bnut'agiry lchi makardaki bardzrats'man paymannerum: [Characteristics of Lake Sevan Narrow-clawed Crawfish (*Pontastacus leptodactylus* Eschscholtz, 1823) in conditions of rising lake levels.] T'eknatsukan atenakhosut'yan seghmagir: [Characteristics of the Growth of Lake Sevan Crawfish *Pontastacus leptodactylus* Esch.] Yerevan. 25 ej; [In Armenian]
- Badalyan, N. S., 2012b: Sevana lchi yerkarach'anch' khets'getni *Pontastacus leptodactylus* Esch.-i achi arrandznahatkut'yunnery. *Hayastani kensab.* handes, 1(64). p. 108-110: [In Armenian]
- Barseghyan, A. M., 1990. Vodno-bolotnaya rastitel'nost' Armyanskoy SSR. [Wetland vegetation of the Armenian SSR] Yerevan: 354 pp. [In Russian]
- Bates, B. C., Kundzewicz, Z. W., Wu, S. and Palutikof, J. P. (Eds), 2008. Climate Change and Water. Technical Paper VI of the Intergovernmental Panel on Climate Change. Geneva: IPCC Secretariat.
- Birger, T. I., A. YA. Malyarevskaya and G. A. Olivari, 1967. Kormovaya tsennost' bentosa Dnepra, Kakhovskogo i Kremenchugskogo vodokhranilishch i yeye izmeneniye pod vozdeystviyem zaregulirovaniya stoka [The feeding value of the benthos of the Dnieper, Kakhovka and Kremenchug reservoirs and its change under the influence of flow regulation] // *Gidrobiologicheskii rezhim Dnepra v usloviyakh zaregulirovaniya stoka.* Kiyev: p. 311–350. [In Russian]
- Bobrov, A. A., 2010. Rastitel'nyy pokrov oz. Sevan i yego pritokov [The plant cover of Lake. Sevan and its tributaries] // *Ekologiya ozero Sevan v period povysheniya yego urovnya.* Makhachkala, Nauka DNTS: p. 51–74. [In Russian]
- Chekanovskaya, O. V., 1962. Vodnyye maloshchetinkovyye chervi fauny SSSR [Aquatic Oligochaeta of the fauna of the USSR]. M.-L.: 409 pp. [In Russian]
- Cheung, W. W. L., Lam, V. W. Y., Sarmiento, J. L., Kearney, K., Watson, R., Zeller, D., Pauly, D. 2010. Large-scale redistribution of maximum fisheries catch potential in the global ocean under climate change. *Global Change Biology*. 16, p. 24–35, doi: 10.1111/j.1365-2486.2009.01995.x
- Climatic Atlas of the Armenian SSR, 1975. Klimaticheskii atlas Armyanskoy SSR. Yerevan: 177 pp. [In Russian]
- Danielyan K., B. Gabrielyan, S. Minasyan, L. Chilingaryan, G. Melkonyan, A. Karakhanyan, P. Tozalakyan, A. Vanyan, G. Pirumyan, E. Gukasyan and L. Sargsyan, 2011. Integral'naya otsenka ekologicheskogo sostoyaniya ozero Sevan (GEO – Lake Sevan) [Integrated Environmental Assessment Lake Sevan (GEO – Lake Sevan)]. Yerevan, Gevorg-Gray: 100 pp. [In Russian]
- Fortunatov, M. A., 1927b. Foreli Sevanskogo ozero: conspecies *Salmo ischchan* Kessler [Trouts of Lake Sevan: conspecies *Salmo ischchan* Kessler]. *Tr. Sevansk. ozernoy st.* t. 26, vyp. 2: p. 1-131. [In Russian]
- Fridman, G. M., 1948. Bentos pribrezhnoy zony ozero Sevan [Benthos of the coastal zone of Lake Sevan]. *Tr. Sevansk. gidrobiol.* st. v. 10: p. 7–39. [In Russian]
- Fridman, G. M., 1950. Donnaya fauna ozero Sevan [Bottom fauna of Lake Sevan]. *Tr. Sevansk. gidrobiol.* st. v. 11: p. 7–92. [In Russian]
- Frolova E. A., O. S. Lyubina, D. R. Dikaeva, O. Yu. Akhmetchina and A. A. Frolov, 2007. Effect of Climatic Changes on the Zoobenthos of the Barents Sea (on the Example of Several Abundant Species). *Doklady Biological Sciences*, v. 416: pp. 349–351. DOI: 10.1134/S0012496607050079.
- Gabrielyan, B., 2010a. Ishkhan – *Salmo ischkhan* Kessler [Ishkhan – *Salmo ischkhan* Kessler]. Hayastani Hanrapetut'yan kendanineri Karmir girk': Yerevan, HH bnapahpanut'yan nakhararut'yun. p. 185-188 [In Armenian]

- Gabrielyan, B., 2010b. Sevani koghak – *Varicorhinus capoeta sevangi* (Filippi) [Sevani koghak – *Varicorhinus capoeta sevangi* (Filippi)]. Hayastani Hanrapetut'yan kendanineri Karmir girik': Yerevan, HH bnapahpanut'yan nakhararut'yun. p. 189 [In Armenian]
- Gabrielyan, B. K., 2010c. Ryby ozera Sevan [Fish of Lake Sevan]. Yerevan, izdatel'stvo "Gitutyun" NAN RA: 252 pp. [In Russian]
- Gabrielyan, B., 2010d. Sevani begulu – *Barbus goetschaicus* Kessler [Sevan barbel – *Barbus goetschaicus* Kessler]. Hayastani Hanrapetut'yan kendanineri Karmir girik': Yerevan, HH bnapahpanut'yan nakhararut'yun. p. 190: [In Armenian]
- Gagarin, V. G. and S. A. Hakobyan, 1991. K faune nematod ozera Sevan [To the fauna of the nematodes of Lake Sevan]. *Inf. byul.: Biologiya vnutrennikh vod. L., №90*: p. 25-28. [In Russian]
- Gagarin, V. G. and S. A. Hakobpyan, 1992. Ekologicheskiy obzor svobodnozhivushchikh nematod ozera Sevan [Ecological review of free-living nematodes of Lake Sevan]. *Inf. byul.: Biologiya vnutrennikh vod. L., №92*: p. 36-38. [In Russian]
- Ghambaryan, M. E., 1968. Mikrobiologicheskiye issledovaniya ozera Sevan [Microbiological studies of Lake Sevan]. Yerevan: 165 pp. [In Russian]
- Gambaryan, P. P., 1979. Raspredeleniye makrofitov oz. Sevan [Distribution of macrophytes of Lake Sevan]. *Tr. Sevansk. gidrobiol. st. t. 17*: p. 123-129. [In Russian]
- Ghambaryan, P. P., 1984. Makrofity ozera Sevan [Macrophytes of Lake Sevan]. *Limnologiya gornyx vodoyemov. Tez. dokl. Vses. soveshch., Yerevan*: p. 55–56. [In Russian]
- Ghazaryan, A. G. and Ye. A. Navasardyan, 1979. Materialy k izucheniyu fitoplanktona ozera Sevan [Materials for studying the phytoplankton of Lake Sevan]. *Tr. Sevansk. gidrobiol. st. v. 17*: p. 75-87. [In Russian]
- Ghukasyan, E. Kh., 1990a. Vosproizvodstvo massovykh vidov dvustvorchatykh mollyuskov ozera Sevan [Reproduction of mass species of bivalve mollusks of Lake Sevan]. *Biol. zhurn. Armenii*, v. 43, №10–11: p. 550–552. [In Russian]
- Ghukasyan, E. Kh., 1990b. Ekologiya dominiruyushchikh vidov dvustvorchatykh mollyuskov ozera Sevan [Ecology of the dominant species of bivalve mollusks of Lake Sevan]. Avtoref. kand. dis. Minsk.: 20 pp. [In Russian]
- Ghukasyan, E. Kh., N. S. Badalyan, R. R. Hovhannisyan and M. A. Dallakyan, 2006: Sevana lchi khets'getni kensabanakan ts'uts'anishneri p'vop'vokhut'yunneri veraberyal [On Changes in Biological Indicators of Lake Sevan Crawfish]. *Hayastani kensab. handes*, 3-4 (58). p. 322-324: [In Armenian]
- Ghukasyan, E. Kh., N. S. Badalyan and D. L. Sahakyan, 2010. Ekologicheskiye osobennosti dlinnopologo raka v ozere Sevan i dinamika yego promyslovykh zapasov [Ecological features of narrow-clawed crawfish in Lake Sevan and the dynamics of its commercial reserves]. *Ekologiya ozera Sevan v period povysheniya yego urovnya. Makhachkala, Nauka DNTS*: p. 224–228. [In Russian]
- Gyozalyan, M. G., 1979. O temperaturnom rezhime oz. Sevan v svyazi so spuskom yego urovnya [About the temperature regime of the lake. Sevan in connection with the descent of its level]. *Tr. Sevansk. gidrobiol. st. v. 17*: p. 5–23. [In Russian]
- Gyozalyan, M. G., 1981. Nekotoryye gidrofizicheskiye kharakteristiki evtrofirovannogo ozera Sevan [Some hydrophysical characteristics of eutrophic lake Sevan]. *IV s"yezd Vses. Gidrobiol. Obshestva. Tez. dokl. Kiyev*, v. 4: p. 101–102. [In Russian]
- Gyozalyan, M. G., 1983. Defitsit kisloroda v ozere Sevan [Oxygen deficiency in Lake Sevan]. *Tr. Sevansk. gidrobiol. st. v. 18*: p. 95–109. [In Russian]
- Gyozalyan, M. G., 1984. O nekotorykh sovremennykh morfometricheskikh i gidrologicheskikh kharakteristikakh Malogo i Bol'shogo Sevana [On some modern morphometric and hydrological characteristics of Minor and Major Sevan]. *Limnologiya gornyx vodoyemov. Tez. dokl. Vses. soveshch., Yerevan*: p. 57–58. [In Russian]
- Gyozalyan, M. G., L. I. Khorlashko, 1979. O kislorodnom rezhime ozera Sevan (po dannym 1974–1976 gg.) [On the oxygen regime of Lake Sevan (according to data from 1974–1976)] // *Tr. Sevansk. gidrobiol. st. v. 17*: p. 24–37. [In Russian]
- Hakobyan, S. A., 1996a. Izmeneniye vidovogo sostava nematod v svyazi s kachestvom vody ozera Sevan [Changes in the species composition of nematodes in connection with the quality of water of Lake Sevan] // *Sovr. probl. gigiyeny okruzh. sredy i okhrany zdorov'ya naseleniya. Tez. dokl. resp. konf., Yerevan*: p. 6.
- Hakobpyan, S. A., 1996b. Meyobentos ozera Sevan [Meiobenthos of Lake Sevan]. Avtoref. kand. dis. Sevan: 24 pp. [In Russian]
- Hakobyan, S. A., 2010. Meyobentos ozera Sevan [Meiobenthos of Lake Sevan]. *Ekologiya ozera Sevan v period povysheniya yego urovnya. Makhachkala, Nauka DNTS*: p. 201–205. [In Russian]
- Hakobyan, S. A., 2016. Makrozoobentos litoral'noy zony i zatoplennykh uchastkov poberezh'ya ozera Sevan [Macrozoobenthos of the littoral zone and flooded sections of the coast of Lake Sevan]. *Ozero Sevan. Ekologicheskoye sostoyaniye v period izmeneniya urovnya vody. Yaroslavl, OOO "Filigran"*: s. 164-172. [In Russian]
- Hakobyan, S. A., I. S. Ostrovskiy, 1984. Ekologiya i produktsiya podenok v ozere Sevan [Ecology and production of mayflies in Lake Sevan]. *Limnologiya gornyx vodoyemov. Tez. dokl. Vses. soveshch., Yerevan*: s. 3-4. [In Russian]
- Hakobyan, S. H. and K. G. Jenderedjian, 2010. Makrozoobentos ozera Sevan [Macrozoobenthos of Lake Sevan]. *Ekologiya ozera Sevan v period povysheniya yego urovnya. Makhachkala, Nauka DNTS*: p. 206-214. [In Russian]
- Hakobyan, S. H. and K. G. Jenderedjian, 2016. Current state of the zoobenthos community of Lake Sevan. *Electronic Journal of Natural Sciences, Ecology v. 2(27)*: p. 18–22.

- Harrod, Ch., 2016. Climate change and freshwater fisheries. In.: Freshwater Fisheries Ecology, First Edition. Edited by John F. Craig. Sons, Ltd. Published by John Wiley & Sons, Ltd.: p. 641–694.
- Hovnannisyan, R. R., 1998. Ekologicheskiye osobennosti rechnogo raka ozera Sevan [Ecological features of the crayfish of Lake Sevan]. Autoref. cand. diss. Yerevan: 24 pp. [In Russian]
- Hovhannisian, R. and Ghukasyan E., 1996. Some ecological peculiarities of Lake Sevan Higher Crustacea, *Pontastacus leptodactylus* Esch. Lake Sevan: problems and strategies of action. Proceedings of the international conference. Sevan, Armenia: p. 99–101.
- Hovsepyan, A. A., 2013: Fitoplanktonayin hamakets'ut'yan p'vop'vokhut'yunnery Sevana lchi jri makardaki bardzrats'man paymannerum [Changes in phytoplankton community in Lake Sevan during water level increase] Teknatsukan atekhosutyanyan seghmagir: Yerevan. 22 pp. [In Armenian]
- Hovsepyan, A. A., Ghambaryan L. R. and Oganesyanyan, R. O., 2010. Planktonnyye vodorosli ozera Sevan [Plankton algae of Lake Sevan]. Ekologiya ozera Sevan v period povysheniya yego urovnya. Makhachkala, Nauka: p. 90–104. [In Russian]
- Ivleva, I. V., 1981. Temperatura sredi i skorost' energeticheskogo obmena u vodnykh zhivotnykh. [The temperature of the environment and the rate of energy metabolism in aquatic animals] Kiyev: 232 pp. [In Russian]
- Jenderedjian, K. G., 1989b. Osobennosti biologii i produktsiya oligokhet v ozere Sevan [Peculiarities of biology and production of Oligochaeta in Lake Sevan]. Autoref. cand. dis. L.: 24 pp. [In Russian]
- Jenderedjian, K., 1994a. Population dynamics of *Potamothenis alatus paravanicus* Poddubnaya and Pataridze (Tubificidae) in different areas of Lake Sevan // *Hydrobiologia*, v. 278: p. 281–286.
- Jenderedjian, K., 1994b. Influence of environmental factors on the production of *Potamothenis alatus paravanicus* Poddubnaya and Pataridze (Tubificidae) in different areas of Lake Sevan. *Hydrobiologia*, v. 278: p. 287–290.
- Jenderedjian, K., 1996. Energy budget of Oligochaeta and its relationship with the primary production of Lake Sevan, Armenia. *Hydrobiologia*, 334: p. 133–140.
- Jenderedjian, K., 2005. Mechanisms of qualitative and quantitative development of zooplankton and zoobenthos in two major lakes in Armenia. NEF Newsletter No14, March 2005: p.15-16.
- Jenderedjian, K. G., 1998. O sovremennom rasprostraneni desyatnogikh rakov v Armenii [On the modern distribution of decapod crayfish in Armenia]. Tez. dokl. resp., nauchn. konf. po zoologii. Yerevan, p. 54–55. [In Russian]
- Jenderedjian K. G., 2019. Strukturno-funktsional'naya organizatsiya zoobentosa v usloviyakh raznonapravlennykh izmeneniy troficheskogo statusa krupnogo presnogo vysokogornogo vodoema (na primere ozera Sevan, Armenia) [The structural and functional setup of zoobenthos under the multidirectional changes of the trophic status of a large freshwater high mountain lake (on the example of Lake Sevan, Armenia)]. Avtoref. dokt. dis. Yerevan: 46 pp. [In Russian]
- Jenderedjian, K., A. Babayan, K., S. Hakobyan, S. Muradyan and M. Voskanov, 2005. Lake Sevan Experience and Lessons Learned Brief. Managing Lakes and their Basins for Sustainable Use: A Report for Lake Basin Managers and Stakeholders. International Lake Management Committee Foundations: Kusatsu, Japan: p. 347-362. http://www.worldlakes.org/uploads/21_Lake_Sevan_27February2006.pdf
- Jenderedjian, K. G. and S. A. Hakobyan, 2016. Kolichestvennyye kharakteristiki i kachestvennyy sostav makrozoobentosa kak pokazateli izmeneniy velichin pervichnoy produktsii ozera Sevan [Quantitative characteristics and qualitative composition of macrozoobenthos as indicators of changes in the primary production of Lake Sevan]. Ozero Sevan. Ekologicheskoye sostoyaniye v period izmeneniya urovnya vody. Yaroslavl', OOO "Filigran": s. 187-197. [In Russian]
- Jenderedjian, K. G. and S. A. Hakobyan, 2017. Vzaimootnosheniya khishchnik (ryba) – zhertva (zoobentosa i zooplankton) v usloviyakh izmeneniy troficheskogo statusa krupnogo presnogo vysokogornogo vodoyema (na primere ozera Sevan, Armeniya) [Relations between predator (fish) and prey (zoobenthos and zooplankton) under conditions of changes in the trophic status of a large fresh high mountain reservoir (on the example of Lake Sevan, Armenia)]. *Biol. zhurn. Armenii*, t. 69(3): s. 26-32. [In Russian]
- Jenderedjian, K. and S. Hakobyan, 2018. The status of zoobenthos of Lake Sevan during the different strategies of water level management. Ecology, *Electronic Journal of Natural Sciences*, No 1(30): pp. 35–38.
- Jenderedjian, K. and S. Hakobyan, A. Jenderedjian, 2007. Use of benthic invertebrates as indicators of pollution origin in aquacultural and urban areas. Air, Water and Soil Quality Modelling for Risk and Impact Assessment. Springer: p. 217–220.
- Jenderedjian, K. and S. Hakobyan, M. A. Stapanian, 2012. Trends in Benthic Invertebrate Community Biomass and Energy Budgets in Lake Sevan, 1928–2004. *Environmental Monitoring and Assessment*; 184(11):6647–71. doi: 10.1007/s10661–011–2449–0. Epub 2011 Dec 27 Springer: 25 pp.
- Jenderedjian, K., S. Hakobyan, V. Ancharakyan, A. Babayan, M. Hayrapetyan, N. Margaryan, A. Pahlevanyan, H. Rubenyan and M. Voskanov, 1999. Inventory of Armenian Ramsar sites: in search of ways for restoration of the lost, and rehabilitation of degraded wetlands, especially as waterfowl habitat. Yerevan – Sevan – Arpi: 142 pp.
- Jenderedjian, K. G. and T. L. Poddubnaya, 1987. Vidovoy sostav i raspredeleniye oligokhet v ozere Sevan [Species composition and distribution of oligochaetae in Lake Sevan] . *Biol. zhurn. Armenii*, t. 40, №1: p. 36–42. [In Russian]

- Kashirskaya, Ye. V., V. YA. Pankratova and I. Toderash, 1980. Bioenergetika prirodnykh populyatsiy *Chironomus plumosus* L. v predelakh areala [Bioenergy of natural populations of *Chironomus plumosus* L. within the area of distribution]. Vid i yego produktivnost' v areale. Mat. III Vsesoyuz. Soveshch. Vil'nyus: p. 13-15. [In Russian]
- Kititsyna, L. A., 1978. Ekologo-fiziologicheskiye osobennosti massovykh form zoobentosa [Ecological and physiological features of mass forms of zoobenthos]. Vodoyem-okhladitel' Ladyzhinskoy GRES. Kiyev: p. 100–117. [In Russian]
- Konstantinov, A. S., 1986. Obshchaya gidrobiologiya [General hydrobiology]. M.: 472 pp. [In Russian]
- Krylov, A. V., A. O. Hayrapetyan, S. E. Bolotov, S. A. Hakobyan, D. B. Kosolapov, Yu. V. Gerasimov, M. I. Malin, A. V. Romanenko and B. K. Gabrielyan, 2016. Izmeneniya ekosistemy ozera Sevan i osobennosti struktury osnovnykh elementov yego bioty v period povysheniya urovnya vody [Changes in the Lake Sevan ecosystem and structural features of the main elements of its biota during a period of rising water level]. Ozero Sevan. Ekologicheskoye sostoyaniye v period izmeneniya urovnya vody. Yaroslavl', OOO "Filigran": p. 273–272. [In Russian]
- Krylov, A. V., S. A. Hakopyan, A. A. Nikogosyan and A. O. Hayrapetyan, 2010. Zooplankton ozera Sevan i yego pritokov [Zooplankton of Lake Sevan and its tributaries]. Ekologiya ozera Sevan v period povysheniya yego urovnya. Makhachkala, Nauka DNTS: p. 168–200. [In Russian]
- Krylov, A. V., Yu. V. Gerasimov, B. K. Gabrielyan, E. S. Borisenko, S. A. Hakobyan, A. A. Nikoghosyan, M. I. Malin and A. A. Hovsepyan, 2013. Zooplankton ozera Sevan v period prodolzhayushchegosya povysheniya urovnya vody i snizheniya plotnosti ryb [Zooplankton of Lake Sevan during the period of continuing increase in the water level and decrease in the density of fish]. Biologiya vnutrennikh vod, №3: p. 37–45. [In Russian]
- Krylov, A. V., D. B. Kosolapov, N. G. Kosolapova, A. A. Hovsepyan and Yu. V. Gerasimov, 2018. The Plankton Community of Sevan Lake (Armenia) after invasion of *Daphnia (Ctenodaphnia) magna* Straus, 1820. ISSN 1062–3590, *Biology Bulletin*, 2018, v. 45, №5, © Pleiades Publishing, Inc.: p. 505–511.
- Legovich, N. A., 1979. O "tsvetenii" vody v ozere Sevan (po itogam nablyudeny 1964-1972 gg.) [On the "blooming" of water in Lake Sevan (based on observations from 1964–1972)]. Tr. Sevansk. gidrobiol. st. v. 17: p. 51-74. [In Russian]
- Lind, D. and L. Taslakyanyan, 2005. Restoring the fallen blue sky: management issues and environmental legislation for Lake Sevan, Armenia. *Environ.* v. 29.1: p. 29–103.
- Lukin, Ye. I., 1976. Piyavki presnykh i solonovatovodnykh vodoyemov. Fauna SSSR. Piyavki [Leeches of fresh and brackish water bodies. Fauna of the USSR. Leeches]. t. 1. Nauka, L.: 484 pp. [In Russian]
- Lyatti, S. Ya., 1932a. Materialy gidrokhimicheskikh issledovaniy [Materials of hydrochemical studies]. Mater. po issled. oz. Sevan i yego basseyna. v. 4, №1, L.: 63 pp. [In Russian]
- Lyatti, S. Ya., 1932b. Gidrokhimicheskiy ocherk ozera Sevan [Hydrochemical sketch of Lake Sevan]. Mater. po issled. oz. Sevan i yego basseyna. v. 4, №2, Tbilisi: 34 pp. [In Russian]
- Lyatti, S. Ya., 1932c. Grunty ozera Sevan [The Soils of Lake Sevan]. Mater. po issled. oz. Sevan i yego basseyna. t. 4, №4, Tbilisi: 42 pp. [In Russian]
- Mamayev, B. M., 1972. Opredelitel' nasekomykh po lichinkam. [Identifier of insects by larvae] Prosveshcheniye, M.: 400 pp. [In Russian]
- Manukyan, G. M., 1993. Biologiya gammarid i ikh rol' v zootsenoze ozera Sevan i yego pritokov [Biology of gammarid and their role in the cenose of Lake Sevan and its tributaries]. Autoref. cand. dis. Yerevan: 27 pp. [In Russian]
- Markosyan, A. K., 1948. Biologiya gammarusov oz. Sevan [Biology of gammaruses of the lake. Sevan]. Tr. Sevansk. gidrobiol. st., t. 10: p. 40-74. [In Russian]
- Markosyan, A. K., 1959. Produktivnost' bentosa ozera Sevan [Benthos productivity of Lake Sevan]. Tr. VI soveshch. po probl. biol. vnutr. vod. L.: p. 139–145. [In Russian]
- Mazumder, S. K., M. De, A. G. Mazlan, C. C. Zaidi, S. M. Rahim and K. D. Simon, 2015. Impact of global climate change on fish growth, digestion and physiological status: developing a hypothesis for cause and effect relationships. *Journal of Water and Climate Change*, 06.2, IWA Publishing: p. 200–226. DOI: 10.2166/wcc.2014.146
- Meshkova, A. M., 1957. Piyavki ozera Sevan [Leeches of Lake Sevan]. Tr. Sevansk. gidrobiol. st. v. 15: p. 48–87. [In Russian]
- Meshkova, T. M., 1947. Zooplankton oz. Sevan [Zooplankton of Lake Sevan]. Tr. Sevansk. gidrobiol. st. t. 9: p. 3-68. [In Russian]
- Meshkova, T. M., 1953. Zooplankton oz. Sevan (biologiya i produktivnost') [Zooplankton of Lake Sevan (biology and productivity)]. Tr. Sevansk. gidrobiol. st. t. 13: p. 6-171. [In Russian]
- Meshkova, T. M., 1962. Sovroyemennoye sostoyaniye planktona v ozere Sevan [The current state of plankton in Lake Sevan]. Tr. Sevansk. gidrobiol. st. v. 16: p. 15–89. [In Russian]
- Meshkova, T. M., 1975. Zakonomernosti razvitiya zooplanktona v ozere Sevan [Patterns of development of zooplankton in Lake Sevan]. Yerevan: 277 pp. [In Russian]
- Mikhailovsky, G. E., 1983. Printsipy ekologicheskogo monitoringa vodnykh soobshchestv [The principles of environmental monitoring of water communities]. *Chelovek i biosfera*. Vyp.8. - M.: Izd-vo Mosk.un-ta, 1983: p. 55-67. [In Russian]
- Nikoghosyan, A.A., 2013: Zooplanktoni kensazangvatsi dinamikan Sevana lchum jri makardaki bardzrats'man paymannerum [The dynamics of zooplankton in the conditions of water level increase in Lake Sevan]. *Hayastani kensab*. handes, v. 4(65). p. 53–53. [In Armenian]

- Nikoghosyan, A. A. and S. H. Hakobyan, 2012: P'op'okhut'yunner Sevana lchi zooplanktonum jri makardaki bardzratsman paymannerum [Changes in the zooplankton of Lake Sevan level during the water level increase]. *Hayastani kens. handes*, v. 3(64). p. 54–59. [In Armenian]
- Nikolayev, I. N., 1980. K teorii ekologicheskogo prognozirovaniya limnicheskikh ekosistem [On the theory of ecological forecasting of limnic ecosystems]. *Vodnyye resursy*, № 5: s. 100-109. [In Russian]
- Nikolayev, S. G., 1980a. Produktsiya sevanskogo *Gammarus lacustris* Sars (Amphipoda, Gammaridae) [Production of Lake Sevan *Gammarus lacustris* Sars (Amphipoda, Gammaridae)]. *Gidrobiol. zhurn.* v. 16, №4: p. 51–56. [In Russian]
- Nikolayev, S. G., 1980b. Ekologiya i produktsiya *Herpobdella octoculata* i *Helobdella stagnalis* (Hirudinea) ozera Sevan [Ecology and Production of *Herpobdella octoculata* and *Helobdella stagnalis* (Hirudinea) of Lake Sevan]. *Zool. zhurn.* v. 59, №9: p. 1421–1425. [In Russian]
- Nikolayev, S. G., 1981. Zhiznennyi tsikl i produktsiya *Chironomus plumosus* (Chironomidae, Diptera) ozera Sevan [Life Cycles and production of *Chironomus plumosus* (Chironomidae, Diptera) of Lake Sevan]. *Zool. zhurn.* v. 60, №5: p. 711-717. [In Russian]
- Nikolayev, S. G., 1985. Struktura donnykh soobshchestv ozera Sevan v gody rezkogo povysheniya trofii ozera i yeye izmeneniya po sravneniyu s oligotrofnym periodom [The structure of the bottom communities of Lake Sevan during the years of a sharp increase in the trophic status of the lake and its changes in comparison with the oligotrophic period]. Avtoref. cand. dis. M.: 24 pp. [In Russian]
- Oganesyan, R. O., 1988. Antropogennoye evtrofirovaniye ozera Sevan i puti predotvrashcheniya yego otritsatel'nykh posledstviy [Anthropogenic eutrophication of Lake Sevan and ways to prevent its negative consequences]. Avtoref. dokt. dis. M.: 48 pp. [In Russian]
- Oganesyan, R. O., A. A. Simonyan, A. S. Parparov, A. I. Smoley and M. G. Gyozalyan, 1985. Osobennosti prognozirovaniya resursov ozera Sevan [Peculiarities of Lake Sevan resource forecasting]. V sb. Problemy issledovaniya krupnykh ozer SSSR. L.: p. 220–224. [In Russian]
- Oganesyan, R. O., A. S. Parparov and A. I. Smoley, 1977. Novyy troficheskiy status ozera Sevan [New trophic status of Lake Sevan]. *Krugovorot veshchestv i energii v vodoyemakh. Antropogennoye vliyaniye na vodoyemy. Listvennichnoye na Baykale*: p. 7–10. [In Russian]
- Oganesyan, R. O. and A. S. Parparov, 1986. O vozmozhnosti upravleniya resursami ozera Sevan [On the possibility of managing the resources of Lake Sevan]. *Tez. dokl. V Vses. gidrobiol. obshestva. Tol'yatti*, v. 2: p. 273-275. [In Russian]
- Ostapenya, A. P., 1968. Raschet kaloriynosti sukhogo veshchestva vodnykh organizmov [Calculation of the caloric content of the dry matter of aquatic organisms]. *Gidrobiol. zhurn.* v. 4, №2: p. 85–89. [In Russian]
- Ostrovsky, I. S., 1981. Ekologo-produktsionnaya kharakteristika *Valvata piscinalis* (Ectobranchia, Valvatidae) v ozere Sevan [Ecological-production characteristic of *Valvata piscinalis* (Ectobranchia, Valvatidae) in Lake Sevan]. *Zool. zhurn.* v. 60, №6: p. 825–834. [In Russian]
- Ostrovsky, I. S., 1983a. Produktsiya massovykh vidov zoobentosa i ikh rol' v ekosisteme ozera Sevan [Production of mass species of zoobenthos and their role in the ecosystem of Lake Sevan]. Avtoref. kand. dis. L.: 24 pp. [In Russian]
- Ostrovsky, I. S., 1983b. Rost i razvitiye lichinok *Chironomus plumosus* L. (Chironomidae, Diptera) v ozere Sevan [Growth and development of the *Chironomus plumosus* L. larvae (Chironomidae, Diptera) in Lake Sevan]. *Ekologiya* 1: p. 62–69. [In Russian]
- Ostrovskiy, I. S., 1984. Ekologo-produktsionnaya kharakteristika populyatsii *Procladius sp.* (Diptera, Chironomidae) v ozere Sevan [Ecological and production characteristics of the population *Procladius sp.* (Diptera, Chironomidae) in Lake Sevan]. *Tr. Sevansk. gidrobiol.* st. v. 19: p. 120–137. [In Russian]
- Ostrovsky, I. S., 1985. Zoobentos ozera Sevan i yego dinamika [Zoobenthos of Lake Sevan and its dynamics]. *Tr. Sevansk. gidrobiol.* st. v. 20: p. 132–187. [In Russian]
- Ostrovsky, I. S., 1986. Rost i produktsiya *Chironomus markosjani* v ozere Sevan [Growth and production of *Chironomus markosjani* in Lake Sevan]. *Evolyutsiya, vidoobrazovaniye i sistematika Chironomidae (pod red. N. N. Kuznetsova i A. Istominoy)*. Novosibirsk: p. 120–130. [In Russian]
- Parparov, A., 1990. Some characteristics of the community of autotrophs of Lake Sevan in connection with its eutrophication. *Hydrobiologia* v. 191: p. 15-21.
- Pavlov, D. S., 2010. Vvedeniye [Introduction]. *Ekologiya ozera Sevan v period povysheniya yego urovnya*. Makhachkala, Nauka DNTS: p. 3–6. [In Russian]
- Poddubny, S. A., 2010a. Gidrodinamicheskiye protsessy [Hydrodynamic processes]. *Ekologiya ozera Sevan v period povysheniya yego urovnya*. Makhachkala, Nauka DNTS: p. 49–50. [In Russian]
- Poddubny, S. A., 2010b. Gidrofizicheskiye kharakteristiki vodnoy massy [Hydrophysical characteristics of water mass]. *Ekologiya ozera Sevan v period povysheniya yego urovnya*. Makhachkala, Nauka DNTS: p. 41–49. [In Russian]
- Reid, P. C., 2006. Impacts of Climate Change on Plankton. In: *Marine Climate Change Impacts, Annual Report Card 2006*. Eds. Buckley, P.J., Dye, S.R. and Baxter, J.M), Online Summary Reports, MCCIP, Lowestoft, www.mccip.org.uk.

- Rice, E.W., R. B. Baird, A. D. Eaton and L. S. Clesceri, editors, 2012. Standard Methods for the Examination of Water and Wastewater, 22nd edition. Publisher: American Public Health Association, American Water Works Association, Water Environment Federation: 1496 pp.
- Rosenberg, G. S., V. K. Shitikov and P. M. Brusilovskiy, 1994. E kologicheskoye prognozirovaniye (Funktional'nyye prediktory vremennykh ryadov) [Environmental forecasting (Functional predictors of time series)] Ecological forecasting – Tolyatti: 182 pp.
- Sharonov, I. V., 1951. Lichinki tendipedid ozera Sevan (biologiya i biomassa) [Larvae of the tendipedid of Lake Sevan (biology and biomass)]. Tr. *Sevansk. gidrobiol.* st. t. 12: s. 35-91. [In Russian]
- Sherstyuk, V. V., 1971. Kaloriynost' kormovykh organizmov Kremenchugskogo vodokhranilishcha [Caloric content of food organisms of the Kremenchug reservoir]. *Gidrobiol. zhurn.* v. 7, №6: p. 99–103. [In Russian]
- Simonyan, A. A., 1976. Vertikal'noye raspredeleniye planktonnykh rakoobraznykh v ozere Sevan [Vertical distribution of plankton crustaceans in Lake Sevan]. *Biol. zhurn. Armenii*, v. 29, №11: p. 92–97. [In Russian]
- Simonyan, A.A., 1991. Zooplankton ozera Sevan [Zooplankton of Lake Sevan]. Yerevan: 299 pp. [In Russian]
- Slobodchikov, B. YA., 1951. Gidrokhimicheskiy rezhim ozera Sevan po dannym 1947–1948 gg. [Hydrochemical regime of Lake Sevan according to data from 1947–1948]. Tr. *Sevansk. gidrobiol.* st. v. 12: p. 5–28. [In Russian]
- Slobodchikov, B. YA., 1955. Kislorodnyy rezhim ozera Sevan po dannym 1947-1948 gg. [Oxygen regime of Lake Sevan according to 1947-1948]. Tr. *Sevansk. gidrobiol.* st. t. 14: s. 165-182.
- Stroykina, V. G., 1953. Fitoplankton pelagiali ozera Sevan [Phytoplankton of pelagic zone of Lake Sevan]. Tr. *Sevansk. gidrobiol.* st. v. 13: p. 171-213. [In Russian]
- Sushchenya, L. M., 1972. Intensivnost' dykhaniya rakoobraznykh [Crustacean respiration rate]. Kiyev: 196 pp. [In Russian]
- Sushkina, A. P., 1949. Pitaniye i rost nekotorykh bryukhonogikh mollyuskov [Nutrition and growth of some gastropod mollusks]. Tr. Vsesoyuz. Gidrobiolog. obshch., t. 1: p. 118-131 [In Russian]
- Trenberth, K.E., P.D. Jones, P. Ambenje, R. Bojariu, D. Easterling, A. Klein Tank, D. Parker, F. Rahimzadeh, J.A. Renwick, M. Rusticucci, B. Soden and P. Zhai, 2007: Observations: Surface and Atmospheric Climate Change. In: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA. p. 235–336.
- Viter, T.V., 2011. Makrozoobentos gidrotekhnicheskikh sooruzheniy bukht Sevastopol'skaya i Kamyshovaya [Macrozoobenthos of hydraulic structures of the Sevastopol and Kamyshovaya bays]. UDK 574 .578. http://www.nbu.gov.ua/portal/natural/ekbez/2011_25_1/11vtvsik.pdf. [In Russian]
- Vladimirova, K. S., 1947. Fitoplankton oz. Sevan [Phytoplankton of Lake Sevan]. Tr. *Sevansk. gidrobiol.* st. v. 9: p. 69–114. [In Russian]
- Winberg, G. G., 1950. Intensivnost' obmena i razmery rakoobraznykh [Metabolic rate and size of crustaceans]. *Zhurn. obshch. biol.* t. 11, № 5: p. 367-380. [In Russian]
- Winberg, G. G., 1956. Intensivnost' obmena i pishchevyye potrebnosti ryb. [Metabolic rate and nutritional needs of fish] Minsk: 253 pp. [In Russian]
- Winberg, G. G., 1983. Temperaturnyy koeffitsiyent Vant-Goffa i uravneniye Arreniusa v biologii [The Van't Hoff temperature coefficient and the Arrhenius equation in biology]. *Zhurn. obshch. biol.*, v. 44, №1: p. 31–42. [In Russian]
- Wrona, F. J., T. D. Prowse, Reist, J. D., Hobbie, J. E., Lévesque, L. M. J. and W. F. Vincent, 2006. Climate Impacts on Arctic Freshwater Ecosystems and Fisheries: Background, Rationale and Approach of the Arctic Climate Impact Assessment (ACIA). *AMBIO: A Journal of the Human Environment* v. 35(7). [doi:10.1579/0044-7447\(2006\)35\[326:CIOAFE\]2.0.CO;2](https://doi.org/10.1579/0044-7447(2006)35[326:CIOAFE]2.0.CO;2). JSTOR 4315751.
- Zhadin, V. I., 1952. Mollyuski presnykh i solonovatykh vod SSSR. [Molluscs of fresh and brackish waters of the USSR] M.-L.: 376 pp. [In Russian]
- Zharikov, V. V., 2010. Sostav, ekologiya i raspredeleniye infuzoriy [Composition, ecology and distribution of ciliates]. *Ekologiya ozera Sevan v period povysheniya yego urovnya*. Makhachkala, Nauka DNTS: p.134-167. [In Russian]
- Zharikov, V. V. and Anokhina, L. Ye., 1984. Perifiton ozera Sevan [The Periphyton of Lake Sevan]. *Biol. Zhurn. Armenii*, v. 37 (8): p. 641-647. [In Russian]
- 37 (8): p. 641-647. [In Russian]

Second Home Tourism in the Eastern Black Sea Region of Turkey: Development Issue and Mobility Pattern*

*Doğu Karadeniz Bölgesi'nde (Türkiye) İkinci Konut Turizmi: Gelişme Konusu
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Abstract: Eastern Black Sea Region is one of the most important regions in the development of second home tourism for the mountainous areas in Turkey. There is considerable literature gap on research about second-home tourism in the mountainous areas of Turkey. For this reason, in this study, we aim to determine the development issue and mobility patterns of second home tourism in the Eastern Black Sea Region of Turkey. The research population consists of seven provinces located in the Eastern Black Sea region. The sample of the study is thirty highlands in Eastern Black Sea Region. A multistage cluster sampling technique was applied at the sample selection. The primary data were collected by the use of questionnaire surveys conducted with a total of 900 second homeowner selected by convenience sampling during July 2010. A total of 60 digital TIFF format monoscopic aerial photographs were analysed by using Erdas Imagine LPS and ArcGIS 9.3 software for showing the second home increase in the area. At the sampling highlands, 2.830 dwelling units have increased in the last thirty years. According to the questionnaire results of the study, second homeowners generally come to the region in May and June. Most of them leave the area in September. Second homeowners spend mostly 91-120 days in the region. The beautiful landscape and weather conditions are main motivations to acquire a second home from the region. Second-home demand in the region is gradually increasing. Therefore, the determination of main motivation sources for the second home demand and movement pattern towards the second homes provide useful information for planning issues. The study is also a pioneer research about the second homes in the mountainous area at Turkey.

Key words: Second homes, second home tourism, mountainous areas, mobility pattern, Eastern Black Sea Region, Turkey.

Özet: Doğu Karadeniz Bölgesi Türkiye'de dağlık alanlarda ikinci konutların gelişme göstermesi bakımından en önemli bölgelerden biridir. Türkiye'de dağlık alanlarda ikinci konut turizmi konusu literatürde önemli bir boşluktur. Bu nedenle bu çalışmada Türkiye'nin Doğu Karadeniz Bölgesi'nde ikinci konut turizminin gelişmesi ve ikinci konutlara olan hareketlerin deseninin belirlenmesi amaçlanmıştır. Araştırma evrenini Doğu Karadeniz Bölgesi'nde yedi ilde bulunan yaylalar oluşturmaktadır. Araştırma örnekleme ise Doğu Karadeniz Bölgesi'nde bulunan 30 yayladır. Örnekleme seçiminde çok aşamalı kümeleme tekniği uygulanmıştır. Birincil veriler Temmuz 2010'da, kolay ulaşılabilir durum örnekleme tekniği ile seçilen 900 ikinci konut sahibine uygulanan anketlerle toplanmıştır. Bölgedeki ikinci konut artışının belirlenmesi için toplam 60 adet dijital monoskopik hava fotoğrafı, Erdas Imagine LPS ve ArcGIS 9.3 yazılımları kullanılarak analiz edilmiştir. Örnekleme giren yaylalarda son otuz yılda 2.830 adet konut artışı olmuştur.

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Anket sonuçlarına göre ikinci konut sahipleri bölgeye genellikle Mayıs ve Haziran aylarında gelmektedir. Onların çoğu Eylül ayında bölgeden ayrılmaktadır. İkinci konut sahipleri bölgede çoğunlukla 91-120 gün geçirmektedir. Bölgeden ikinci konut edinmede başlıca motivasyon güzel peyzaj ve hava koşullarıdır. Bölgede ikinci konutlara olan talep giderek artmaktadır. Bu nedenle ikinci konut talebi için başlıca motivasyon kaynaklarının belirlenmesi ve ikinci konutlara yönelik hareketlerin deseninin belirlenmesi planlama konusu için faydalı bilgiler sağlamaktadır. Çalışma aynı zamanda Türkiye'de dağlık alanlarda ikinci konutlar konusunda öncü bir araştırma olmuştur.

Anahtar sözcükler: İkinci konutlar, ikinci konut turizmi, dağlık alanlar, hareketlilik deseni, Doğu Karadeniz Bölgesi, Türkiye.

1. Introduction

The roots of use of second-homes date back to Ancient Egypt, Greece, and Rome. People mostly preferred to spend their leisure time in rural areas to escape from the crowded urban centres. Experience of tiring urban life makes rural areas more fascinating (Müller, 1999: 31). Therefore, mountain areas became attractive for the development of second homes because of nature-rich and beautiful landscapes. . Especially after the Second World War, the demand for second homes increased in many countries with the migration of the population to urban areas and the emergence of the middle class (Müller, 1999: 31).

Second homes were preferred recurrently for centuries generally with the purpose of animal husbandry in the traditional sense, in old Turkish communities, which were nomadic, although not in today's sense. With the increase in temperatures at the beginning of summers, thousands of people left their villages (Qishlaqs) and seasonally migrated to mountainous areas with a cooler climate, where they could graze their herds. This seasonal migration is called transhumance (Alagöz, 1993: 1). The word "Yayla (highland)" was derived from the root "yay," which means summer in old Turkish and the verb "yaymak," which means grazing animals in an open area in a disorganized way. Accordingly, a highland is a summer place of residence, which is high, cool, and on top of the mountains and used for residence in summer. Therefore, most of the people who lived in villages and towns of Anatolia went to highlands in summer. For example, Ertuğrul Bey used to spend his summer months in the Domaniç Mountains together with his clan (Alagöz, 1993: 1). However, the meaning and scope of the word "yayla (highland)," which was known as the place resided by the Turkish clan in summer, changed over time. For example, it became a tradition in Istanbul to leave homes and go to "sayfiye" (summer house) apart from the grandees in the palace and city in the mid of the 19th century. "Sayf" is an Arabic word meaning "summer season." In dictionaries, the exact meaning of the word "sayfiye" is stated as "summer house." In rural areas, the phrase "going to highlands" is rather used (Alkan, 2014: 15-17).

Second homes started to develop in Turkey in the 1950s as a result of factors such as industrialization, urbanization, improvement of transportation facilities, an increase in spare time, and fashion (Emekli, 2014: 34). First, second homes in the modern sense began to develop, especially in Istanbul and its surroundings. Thus, many districts such as Yeşilköy, Florya, Küçük Çekmece, Kartal, and Pendik were summer places of residence in the past (Özgüç, 1977: 81). However, they have become permanent residential areas due to the expansion of the city. In Turkey, second home settlements started, especially in coastal areas, with the effect of mass tourism in the 1950s (Alkan, 2014: 15-16). In the 1960s, second home settlements increased in coastal areas for instead domestic tourism when the demand expected in foreign tourism could not be fulfilled (Kılıçaslan, 2006: 149). In the 1980s, intensive second home settlements emerged in coastal areas with the enactment of the Cooperatives Law numbered 1163 and the Construction Law numbered 3194. Doğaner (1992) describes second homes in Turkey as the descent of the "mountain house" down to the sea level. However, mountainous areas started to be preferred as the next unconsumed rural spaces due to settlements and population density on the coasts over time, even though coastal rural spaces were the first places preferred for second homes in Turkey (Somuncu *et al.*, 2012). As a result of the increase in second homes in coastal areas, mobility to these areas, urbanization of the coastal regions over time, and exceeding the bearing capacity from place to place as of the 1980s, mountainous areas began to be preferred. The period of 1980-1990 is the first period when tourism and recreation began to develop on highlands (Somuncu *et al.*, 2010: 115).

Consequently, the construction of second homes was also initiated in addition to hotels and boarding houses in mountainous areas during this period. Hence, second homes constructed closely to the birthplaces of city-dwellers or places to which they migrated within the city are interesting in terms of the development of second homes. This situation is similar to the case of many Parisian people who were born in the Massif Central and still live in Paris; they have got second homes in Aveyron and the Massif Central to use them for holiday purposes or in retirement (Özgüç, 1977: 84). During this period, corresponding to the period of the Sixth Development Plan (1990-1994), second homes developed distantly from the coasts and depending especially on family bonds; however, the highlight in the protection-usage balance increased in the tourism intended development on the coasts (Naycı, 2009: 92). For this reason, the development of second homes slowed down.

In Turkey, the mobility to mountainous areas for summer (summer house) led to second home settlements in a sense. Transhumance related to animal husbandry refers to the fact that people and animals head for highlands, stay there for a while and perform economic activities in summer, during the hottest months (Emiroğlu, 1977: 19). Therefore, settlement for transhumance in mountainous areas is an old phenomenon. Still, nowadays, settlements in mountainous areas have taken a different form with the decline in animal husbandry. Urban conditions and other driving factors, factors such as the desire for cooling in hot and dry summer months and family bonds, etc. have increased the construction of second homes in mountainous areas. On the other hand, the spread of services to rural and mountainous areas has enabled the diversification of activities in rural areas. In Turkey, individuals, who have migrated from the Eastern Black Sea Region to the nearby cities and other big cities since the 1950s, their children, and grandchildren, have got second homes by constructing summer houses or renewing and using the existing houses on the highlands and in mountainous areas which their ancestors used for the purpose of animal husbandry.

The Eastern Black Sea Region is among the prominent places where second homes are increasingly owned in mountainous areas. In the Eastern Black Sea Region, traditional transhumance activities were common before 1950. Between 1950 and 1980, migration from rural areas to cities increased in Turkey with modernization, an increase in transportation facilities, shrinkage of lands through inheritance, limited sources of income, and fascinating factors in cities, etc. The Eastern Black Sea Region, where economic resources were insufficient, was one of the regions that experienced the most intensive migration from rural areas to cities. From 1950 to 1980, the population decreased in many places in the Eastern Black Sea Region due to migration. Between 1980 and 1990, highlands started to be used for touristic and recreational purposes in the Eastern Black Sea Region. On the highlands, the construction of hotels, boarding houses, and three to four-storey second homes, which did not comply with the rural architecture, increased. In 1990 and afterward, 16 highlands in the region were announced as touristic centers with the Council of Ministers' Decision. On the highlands in the region, the demand for recreation and tourism is increasing with each passing day. This demand has caused the construction of second homes on highlands to gain momentum. This leads to a spatial and functional change in the highlands (Somuncu *et al.*, 2012: 73-75).

While the mobility to the highlands in the Eastern Black Sea Region was based on animal husbandry at the beginning, it occurs for relaxation and entertainment, in other words, tourism nowadays. People, their children, and grandchildren who migrated from the region in the 1950s and afterward cause an increase in the number of homes in the area by transforming their available homes on the highlands for protecting their family bonds, for peace, fresh nature, etc. or by constructing homes for recreational purposes. In this world, which is increasingly spatializing, holiday houses stand out in the sense of place and significance (Aronsson, 2004: 77). Since people have migrated from the region for years, coming together in their second homes has become a tradition for the local people nowadays.

1.1. Development of second homes in Turkey

In Turkey, second homes started to develop as of the 1950s. However, there are no statistical data available concerning second homes. According to the results of the study entitled "Second Home Inventory" and conducted by the Ministry of Tourism for coastal provinces in 1990, there were 102.400

second homes in total in Turkey during this period (Ministry of Tourism, 1990: 6). The province-based data on second homes are only for 1989; in other words, data are available in the study published by the Ministry in 1990. These data include only sixteen coastal provinces. The spatial pattern of second homes had already been formed, primarily until the 1980s. In 1989, second homes were mostly available in Muğla (20155), Aydın (17354), Mersin (12531), Izmir (11783), and Balıkesir (7902) provinces (Ministry of Tourism, 1990) (Figure 1).

Within the first ten years of their development, second homes concentrated around Istanbul, Bursa, and Kocaeli provinces, which are, in particular, the main big cities of Turkey. In the following periods, they developed around the main holiday destinations in the Aegean and Mediterranean Regions. On the Marmara coasts, mostly industrial activities were common; however, industrial activities always clashed with coastal tourism. On the Marmara coasts, second homes were observed in many settlements on the low coasts suitable for tourism (Doğaner, 1998: 28), (Figure 1).

However, not suitable climatic conditions for coastal tourism in the Black Sea Region, much more difficult transportation to the region, and its location far from the main cities creating a touristic demand were among the factors that caused the number of second homes in the region not to increase so much quantitatively.

However, in the Western Black Sea Region, there are second home settlements in Kerpe, Kovanağzı, Cebeci, Kumcağız (Kocaeli), etc., which are developing with the effect of big cities such as Istanbul, Ankara, Kocaeli, and Sakarya (Ministry of Tourism, 1990) (Figure 1).

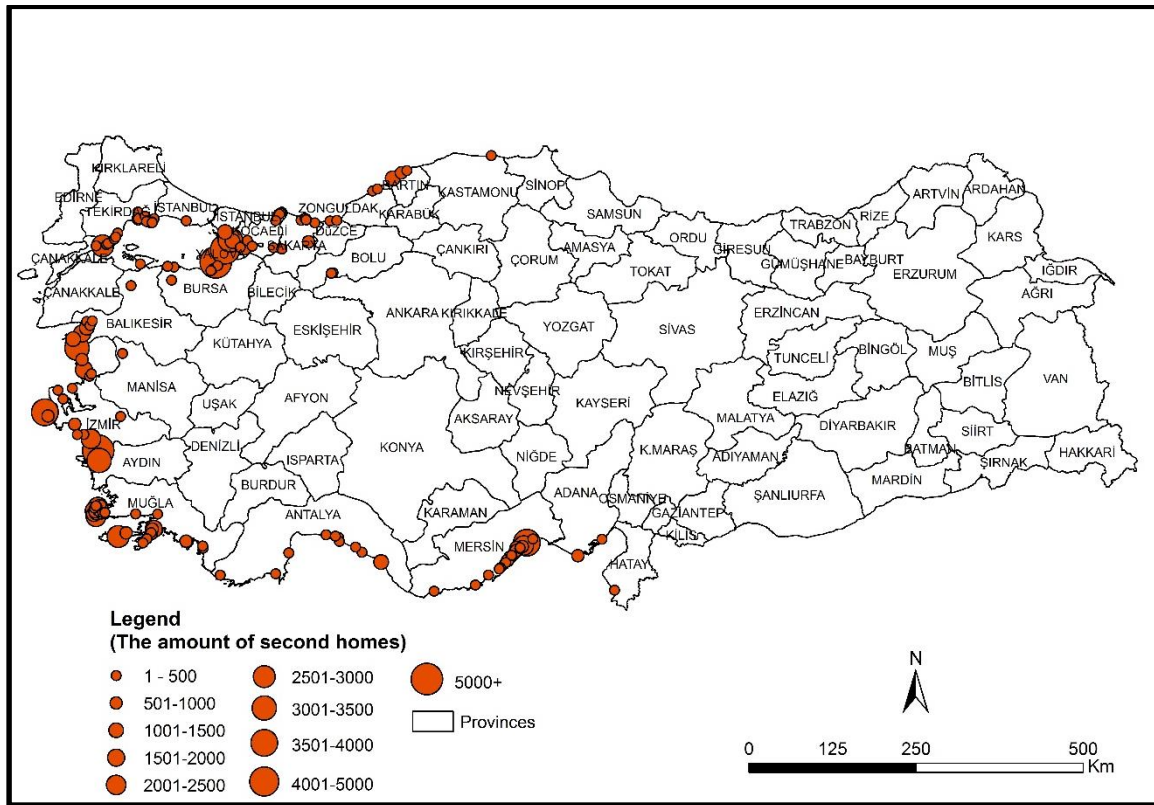


Figure 1. Distribution of second homes at the coastal settlements according to the amount, 1989.

Source: Ministry of Tourism, 1990 data were used for the mapping.

It is difficult to access an organized dataset. However, there were 546.454 summer-seasonal houses in 2008 and 559.934 summer-seasonal dwellings in 2013 in Turkey according to the digital data prepared by the General Directorate of Population and Citizenship Affairs (General Directorate of

Population and Citizenship Affairs, 2014). These data reflect the change on a regional basis although they do not show change at the level of provinces. Significant increases were also observed in some regions where there were fewer second homes in 1989 (Figure 2). However, smaller increases were recorded in other regions where there were relatively more second homes (Barke, 2007: 205). Second homes develop especially in regions where mass tourism is intensive. Since 1989, there has been a definite and significant increase in the number of second homes on the Mediterranean and Aegean coasts. Furthermore, in Turkey, second homes have developed around the provinces such as Istanbul, Bursa, Kocaeli, and Sakarya, where population accumulates significantly, in other words, in low areas on the coast of the Sea of Marmara.

As of the 1990s, the second home market has begun to develop in the Black Sea Region. In the 1980s, migrations occurred to big cities from the provinces in the region. During the 1990s, the regional population, which settled in big cities, started to construct houses in the region to maintain their family, relative, and friendship relationships, to spend time in their hometowns, to relax and to be far from the big city, etc. Therefore, the number of second homes started to increase in mountainous areas and on the highlands in the Black Sea Region during the 1990s. In the region, the number of second homes, which was 2.381 in 1989, increased up to 169.282 in 2008. Thus, the second home supply capacity of the Black Sea Region, which included 2.3% of the total second home supply, reached 31% in 2008 (Figure 2). It is quite challenging to determine the number of second homes on the highlands and in villages, and it is possible that they have not fully been reflected in statistical data. When second homes on the highlands and in villages are reflected on the statistical data, it is possible that a higher supply capacity will appear in the Black Sea Region.

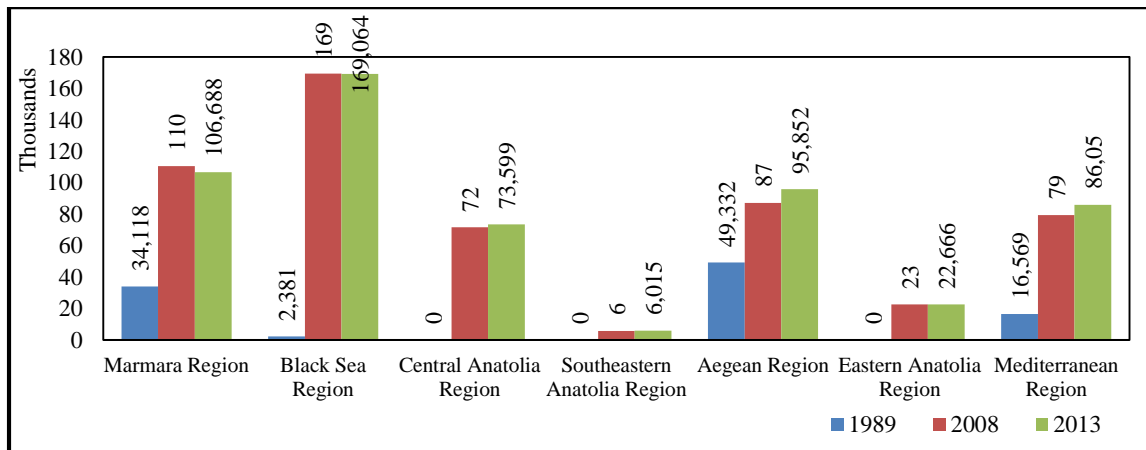


Figure 2. Regional distribution of second homes in Turkey

Source: (Ministry of Tourism, 1990: 6; General Directorate of Population and Citizenship Affairs, 2014) data were used.

Second homes that develop in the Eastern Black Sea Region are different from second homes on the Aegean and Mediterranean coasts. Here, family bonds have affected the development of homes. While old family homes were heavily transformed and used, an increase has been observed in homes built for holiday purposes recently.

The second home phenomenon in Turkey was specifically addressed within the context of coastal areas (Manisa and Görgülü, 2008; Okuyucu and Somuncu, 2015; Zoğal and Emekli, 2018; Küçük and Kılıç, 2018). However, the topic of second homes in mountainous areas has been a significant research gap. In general, migrants lead to an important tourism movement. On the contrary, their tourism constitutes an “invisible segment”. Every year many of people return to take vacations in their hometowns for short or long leisure breaks to discover their cultural root. In the Eastern Black Sea Region, the increase in the construction of second homes is mainly related to the migrations of the region. The region experienced migration to big cities such as Istanbul and Ankara due to the increase

in rural unemployment as of the 1950s, shrinkage of lands through inheritance, the decrease in income obtained from animal husbandry and population increase, etc. People in the region who migrated to big cities and provincial and district centers nearby cause an increase in the number of homes in the area by transforming old family homes or constructing new homes due to reasons such as coming together with the family and relatives, relaxing, maintaining their traditions and rituals, etc. Additionally, people from the Eastern Black Sea Region living in metropolises such as Istanbul, Ankara, etc. and other cities noticed various values they had, especially the natural beauties, view, and air of their highlands. Hence, the increase in the number of second homes in the region has gained momentum. Visiting relatives and friends in the hometown of the migrant is a powerful driver for their housing acquisition. The fact that the development of second homes in mountainous areas was not addressed as a topic in Turkey was the main starting point of the study. Therefore, the study aimed to determine the reasons for the development of second homes in mountainous areas and put forward the pattern of visits made to mountainous areas in respect of second homes. More specifically, it was aimed in the study to specify the reasons for the development of second homes in the Eastern Black Sea Region and the pattern of mobility for touristic purposes towards second homes in the area.

2. Method

2.1. The study area: Eastern Black Sea Region

The study area is the Eastern Black Sea Region where located in the north-eastern corner of Turkey (Figure 3). The region with the mountainous shoreline covers 36,837 km² (4.7% of the country) and has a population of 2.6 million (2009 census). The Eastern Black Sea region consists of seven provinces, including five provinces of Ordu, Giresun, Trabzon, Rize, and Artvin, located along the eastern coast of the Black Sea, and two inland provinces of Gümüşhane and Bayburt. The border with the Republic of Georgia forms the eastern boundary of this region. It exhibits great diversity in geological structure, topography, climate and vegetation cover. Georgia forms the eastern boundary of this region. It exhibits great diversity in geological structure, topography, climate and vegetation cover.



Figure 3. Eastern Black Sea Region of Turkey

Within the region, high mountain ranges run parallel to the Black Sea coast in the north with an undulating plateau on the southern foot of the mountains. High ridges trending east-west rise abruptly

from the Black Sea coast, and the coastal plain is thus narrow. The mountain ranges get higher, narrower, and steeper toward the eastern area. Less than 50 km from the coast, the Eastern Black Sea Mountains rise to more than 3700 m, with a maximum elevation of 3932 m in the Kaçkar range, one of the steepest topography in the world (Japan International Cooperation Agency & State Planning Organization the Republic of Turkey 2000). The climate of the region is highly humid with an annual rainfall of 2000 to 2500 mm. Thus, country's densest forests grow in this area. In addition, the area is hard to access due to its distance from developed areas and harsh topographical conditions (Somuncu and İnci 2004). Cropping land is scarce in rural areas of the Eastern Black Sea Region due to its mountainous and uneven topography. For this reason, livestock husbandry has been an important economic activity for centuries. Seasonal migration between low lying villages and high mountain pastures has been an integral part of rural life in the region. Herders living in the region use the highlands for pasture and for haymaking for winter fodder. The Turkish word *yayla* (Alp; German: Alm; French: Alpage) refers to a place where farmers go to spend the summer; it is either a residence on a mountaintop or a summer pasture (Özden *et al.*, 2004). In fact, most towns and villages in the Eastern Black Sea Region have their highland, the upper limit for this being around 3000 meters. The transhumance begins with the hot weather that comes in early summer, and in those cool highlands, the herders will live in wood or stone cabins, to return again to their villages with the approach of autumn (Dubin and Lucas 1989; Somuncu 1989). There are over a thousand highlands in the Eastern Black Sea Region. This traditional transhumance system has experienced a great change since the 1950s to the present day (Somuncu, 2010). In Turkey, domestic migrations in the 1950s left important marks on the settlement, urbanization, and economic formation of the country. Due to the increase in domestic migration, the urban population in Turkey increased quantitatively. However, problems such as squatting, unplanned urbanization, infrastructure problems, unemployment, and an increase in crime rates, etc. emerged (Özdemir, 2012: 4). During this period, the Eastern Black Sea Region became one of the regions that experienced the highest level of migration.

2.2. Population and sample of the research

The population of the research is 1161 highlands in 7 provinces (Trabzon, Rize, Artvin, Giresun, Ordu, Gümüşhane and Bayburt) in the Black Sea Region. However, these highlands are not homogenous in terms of their functional characteristics. Therefore, with the information gained from the related authorities and from the fieldwork realized at the beginning of the research, the highlands in the region had been categorized in four groups according to their properties (Table 1).

Table 1. Highland groups and characteristics in the Eastern Black Sea Region

Group of highland	Properties of highland
1. Group of highlands	Access is difficult, partly abandoned and is being used as mountain pasture, mostly yaylas in high elevation (2000 m +).
2. Group of highlands	Access is good in some places, function as mountain pasture is partially altered, yaylas that are being used for livestock grazing and recreation by local people.
3. Group of highlands	Access is easy, function as mountain pasture largely lost and yaylas are being used as recreational purposes by local people.
4. Group of highlands	Access is easy, mostly low-areas, function as mountain pasture has completely lost; yaylas are being used for recreational purposes by local people as well as for tourist purposes.

The selection of the highlands as a sample of the research is based on the development level of provinces where these highlands are located. The seven provinces which the highlands locate take place in different socio-economic development levels according to the Socio-economic Development Index developed by the State Planning Organization (SPO) in 2003. The Index of SPO group the provinces of the country in five levels, where the most developed provinces take place in the first level. The determination of the sample according to the development index level provides to pursue the effect of different socio-economic development levels on the situation yaylas. The effect of development level has taken as an independent variable in the choice of sample, supposing the possible effects of social structure on human and natural environments.

The provinces in the Black Sea Region in which the highlands locate take place in third (Trabzon, Rize, Artvin), fourth (Ordu, Giresun), and fifth (Gümüşhane, Bayburt) level of development. From each level, one province has been selected as a sample in which there are more highlands than the others. Accordingly, Trabzon, Giresun and Gümüşhane are determined as the sample provinces. Then, the highlands of the selected provinces have been categorized in four groups according to their properties defined in Table 1. From these groups, the sample highlands have been selected. From each province 10 yaylas, totally 30 yaylas are selected from the four groups successively, one highland from the group which has the lowest number of highland, two and three highlands from the following groups, and 4 highlands from the group which has the higher number of highlands (Table 2).

Table 2. Sample highlands and their properties

Province	Highland (Alp)	Group of highland	Altitude	Area (Ha)
Trabzon	Geyikli Highland	I	2144	66.5497
	Eskale Highland	I	2058	498.2312
	Simene Highland	I	2080	114.2246
	Yaylabası Highland	I	2014	341.1813
	Işıklar Highland	II	1826	951.8532
	Düzköy Highland	II	1840	522.3378
	Alazlı Highland	II	1931	547.9534
	Karadağ Highland	III	1875	276.4843
	Hırsafa Highland	III	1712	261.6911
	Hıdırnebi Highland	IV	1404	381.921
Giresun	Göktepe Highland	I	2149	445.3004
	Pancarbeleni Highland	I	1980	672.1887
	Şeyh Highland	I	2025	558.7169
	Pazarsuyu Highland	II	2000	468.2634
	Göbel Highland	II	1965	607.6389
	Kurtulmuş Highland	II	1875	367.3957
	Eğriçarık Highland	II	1800	113.7474
	Bektaş Highland	III	2070	267.5985
	Kümbet Highland	III	1734	1.019.725
	Kulakkaya Highland	IV	1624	50.0468
Gümüşhane	Kazikbeli Highland	I	2335	545.023
	Alistre Highland	I	2208	541.1508
	Gölcügez Highland	I	2225	218.7895
	Çekümce Highland	I	2224	300.0616
	Aktaş Highland	II	2187	168.4652
	Davunlu Highland	II	2212	711.8006
	Kadırga Highland	II	2292	1.084.71
	Şahmelik Highland	III	2200	431.8638
	Erikbeli Highland	III	1700	133.8021
	Dörtkonak Highland	IV	1950	228.8906
Total				12.897.6065

The Eastern Black Sea Region is the only region where highland-oriented rural tourism developed regionally in Turkey. Touristic and recreational activities in the region have led to a rapid increase in second homes over time. Furthermore, the Eastern Black Sea Region is the most important region, where traditional transhumance activities are still carried out in Turkey. Traditional transhumance activities include animal husbandry and rural production as well as relaxing, entertaining,

spending time with the family and relatives, attending festivals, and various activities on the highlands in summer. Therefore, those who use highlands within the context of traditional transhumance and those who go there only for relaxation were considered as second homeowners in the study. Second homeowners who use the highlands were classified into two categories as those (owning homes) who migrate to highlands for animal husbandry and those (owning homes) who migrate to highlands for relaxing and having a holiday. The population around the highland clusters of the provinces included in the sample constitutes the universe. Surveys were applied to homeowners in four different highland groups through the face-to-face interview technique. The determined highlands were accessed via the convenience sampling technique. The sample consists of 900 houses of second homeowners, who are the users of the highlands in the region (Table 3).

Table 3. Distribution of surveys according to highland groups

Type of survey	1. Group of highlands	2. Group of highlands	3. Group of highlands	4. Group of highlands	Total
Second home owners	352	348	116	84	900

2.3. Data and data collection instruments

The aerial photographs were used to determine the land-use changes that occurred in highlands during the course of time. The aerial photos taken on different dates were obtained from the General Command of Mapping (Turkey) in TIFF format. Out of these aerial photos the first one is in the scale of 1/23.000, and taken in 1973; the second one is in the scale of 1/35.000, and taken in 2004. Also, numerical land models were produced by using topographic maps that were in scale of 1/25.000. In order to rectify the aerial photographs, the coordinates of the checkpoints were calculated with local measurement methods. Erdas Imagine LPS was used in the rectification of the photos. ArcInfo GIS 9.3 was run to calculate areas of gains and losses and to determine land use/land cover changes between 1973 and 2004 in each of the highlands.

To investigate the changes that occurred between 1973 and 2004, three major land use/land cover categories were distinguished: pastures, forests, and highland settlements. In addition, changes during the years 1973 and 2004 were determined through characterization of building and road network as points and lines respectively on GIS medium. The present study consisted of the interpretation of aerial photographs supported by the fieldwork. All of the 30 highlands in the research area were visited thoroughly for on-site observations.

In terms of the research objectives, this is a descriptive and explanatory study. In the study, the quantitative research method was employed. Questions related to the general information about the home residents were first included in the surveys applied to the second homeowners in the area. In the following sections of the surveys, questions regarding the mobility to the area for touristic purposes, home characteristics, and duration of the area usage were included. The questions were prepared as closed-ended questions. The surveys were applied in July 2010.

2.4. Data analysis

In the study, Erdas Imagine LPS and ArcGIS 9.3 were used for the analysis of the data obtained from the GCM. The data were coordinated in the UTM coordinate system and compared to the maps obtained concerning the change in homes between 1973 and 2004. For the analysis of the surveys, SPSS 16 software was used. The descriptive statistical methods were used for the analysis of the data. The data were presented in tables and graphs.

3. Results of The Research

In this section, findings on the increase in second homes within the area, spatial findings, and findings obtained from the residents' surveys will be evaluated.

3.1. The increase in second homes within the area, 1973-2004

In thirty highlands, which form the study area, settlement areas expanded as a result of the increase in the demand for second homes. The change in settlement areas was determined by comparing the number of buildings and building areas. The number of buildings, building areas, and the change between 1973 and 2004 are presented in Table 4. 2830 buildings were added to the number of buildings, and 24230 hectares were added to the building areas from 1973 to 2004. The highest increase in the number of buildings and building areas was observed in Trabzon province, and the least increase was observed in Giresun province. Among the highlands included within the scope of the study, Işıklar and Düzköy (Trabzon), Bektaş and Kümbet (Giresun), Kadirga and Alistire (Gümüşhane) became the highlands with the highest number of homes between 1973 and 2004.

Table 4. The change at the settlements of highland between 1973-2004

Provinces	Highland	Number of building			Area of building (hectare)		
		1973	2004	Change	1973	2004	Change
Trabzon	Geyikli	46	112	66	0,322	0,883	0,561
	Eskale	278	450	172	1,946	3,408	1,462
	Simene	61	100	39	0,427	0,7585	0,3315
	Yaylabaş	119	159	40	0,833	1,173	0,34
	Işıklar	471	685	214	3,297	5,116	1,819
	Düzköy	423	715	292	2,691	5,443	2,482
	Alazlı	177	279	102	1,239	2,106	0,867
	Karadağ	166	263	97	1,162	1,9865	0,8245
	Rısafa	103	265	162	0,721	2,098	1,377
	Hıdırnebi	142	379	237	0,994	3,0085	2,0145
Total		1986	3407	1421	13,902	25,9805	12,0785
Giresun	Göktepe	81	100	19	0,567	0,7285	0,1615
	Pancarbeleni	247	281	34	1,729	2,018	0,289
	Şeyh	118	223	105	0,826	1,7185	0,8925
	Pazarsuyu	165	252	87	1,155	1,8945	0,7395
	Göbel	65	135	70	0,455	1,05	0,595
	Kurtulmuş	74	127	53	0,518	0,9685	0,4505
	Eğriçarık	80	61	-19	0,56	0,427	-0,133
	Bektaş	560	653	93	3,92	4,7105	0,7905
	Kümbet	415	720	305	2,905	5,4975	2,5925
	Kulakkaya	174	111	-63	1,218	0,777	-0,441
Total		1979	2663	684	13,853	19,79	5,937
Gümüşhane	Kazıkbeli	54	216	162	0,378	1,755	1,377
	Alistire	119	270	151	0,833	2,1165	1,2835
	Gölcüğeş	123	135	12	0,861	0,963	0,102
	Çekümce	60	52	-8	0,42	0,364	-0,056
	Aktaş	222	391	169	1,554	2,9905	1,4365
	Davunlu	148	236	88	1,036	1,784	0,748
	Kadirga	484	613	129	3,388	4,4845	1,0965
	Şahmelik	115	163	48	0,805	1,213	0,408
	Erikbeli	36	34	-2	0,252	0,238	-0,014
	Dörtkonak	54	30	-24	0,378	0,21	-0,168
Total		1415	2140	725	9,905	16,1185	6,2135
Total of three provinces		5.380	8.210	2.830	37,66	61,889	24,229

In the study area, there was a continuous decrease in transhumance activities after the 1950s. While a decrease was expected in the number of buildings in the area in this case, an increase was observed in the number of buildings (Figure 4). The increase in the number of houses in the highlands started in the 1980s and gained momentum in the 1990s. During that period, the increase in forestlands in the highlands, the decrease in the functionality of animal husbandry, and the development of recreational/touristic functionality instead of this led to the construction of new homes and touristic facilities (Somuncu *et al.*, 2012: 69). The increase in the number of houses on the highlands was affected

by the fact that people who had migrated from the region in the 1950s, their children, and grandchildren constructed homes in the region for relaxation and coming together with the family and relatives in the 1980-1990s. In addition, those, most of whom came from nearby villages, towns, and cities for the purpose of animal husbandry and relaxation, had an effect on the increase in the number of homes.

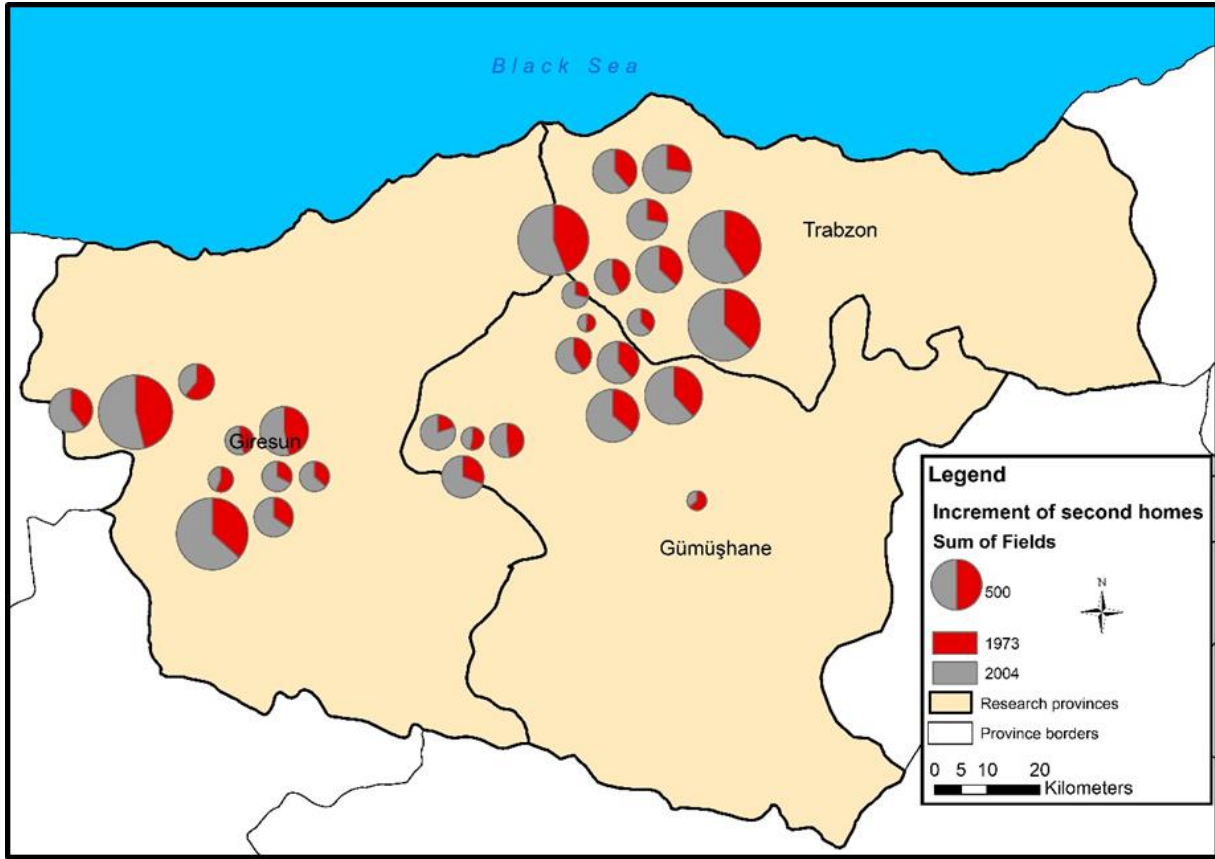


Figure 4. Spatial distribution of number of buildings at highlands settlements between 1973-2004

3.2. Second home owners on the highlands of the Eastern Black Sea Region

3.2.1. Demographic profiles of respondent

Surveys were applied to a total of 900 homes within the scope of the study. Of the participants, 72.2% were male, and 27.8% were female. It was observed that the group of people aged 65 and above was dominant in the area (33.8%). This was followed by the 55-64 age group (22.6%) and 45-54 age group (18.7%), respectively. Most of the interviewed people were primary school graduates (43.7%). When the employment status of the interviewed people is evaluated, the highest rate belongs to retirees with 33.7%, which is followed by farmers with 23.3% and housewives with 17.3% (Table 5).

While the highlands in the Eastern Black Sea Region were initially used for animal husbandry, they have been used especially for relaxation and recreational purposes for the last 30 years. The participants were asked about their real intention for getting homes on the highlands and for going to uplands. Of the interviewed people, 60.3% (543 people) gave an answer to a change of air and relaxation. Of the participants, 39.7% (357 people) stated that they were on the highlands for grazing animals (Table 6). According to this finding, the second homeowners in the region were evaluated in two categories in the following section as second homeowners who had homes for the purpose of animal husbandry and second homeowners who had homes for touristic and recreational purposes.

Table 5. Demographic profiles of second home owner at the region

Variables	Frequency	%
<i>Gender</i>		
Male	650	72.2
Female	250	27.8
<i>Age</i>		
18-24	47	5.2
25-34	80	8.9
35-44	97	10.8
45-54	168	18.7
55-64	203	22.6
65+	305	33.8
<i>Education level</i>		
Never went to school	210	23.3
Primary school graduate	393	43.7
Secondary school graduate	113	12.6
High school graduate	111	12.3
Graduated from a University	67	7.4
Master's and doctorate graduates	2	0.2
Other	4	0.4
<i>Job</i>		
Farmer	210	23.3
Public employee	38	4.2
Private sector employee	40	4.4
Retired	303	33.7
Student	19	2.1
Self-employed	106	11.8
Housewife	156	17.3
Unemployed	26	2.9
Other	2	0.2

Table 6. The main visitation purpose of the highlands

Answers	Frequency	%
Grazing of animals	357	39.7
Weather exchange, relaxation and holiday	543	60.3

3.2.2. Second home ownership and second home characteristics at the Eastern Black Sea Region

Second homes are classified as homes used for commercial purposes only, homes used personally, and, finally, second homes used for both commercial and personal purposes. Especially in significant holiday destinations, commercial use is performed by bigger companies (Müller, 1999: 145). In the Eastern Black Sea Region, 94.6% of the participants stated that they owned the second homes they used. In the area, commercial use is not common yet. Homeowners on the highland stated that they

mostly owned their homes for 1-10 years (32.5%) and 11-20 years (23.9%). This shows that the increase in the number of homes on the highlands occurred in the period following the increase in recreational use, in particular. Of the participants, 88.3% said that they owned the homes they used. Second homes develop in various forms. In addition to urban forms such as villa type, apartment block type, etc., it is possible to transform and use old rural homes. In other words, surplus homes in rural areas are transformed into second homes (Roca *et al.*, 2012: 50). Therefore, second home landscape typologies such as old transformed permanent homes and purposefully constructed homes emerge (Müller and Marjavaara, 2012: 54). In the study area, reinforced concrete (23.6%) and fired block bricks (21.7%) were mostly used in the construction of homes. However, wood (15.9%) and stone (15.4%) materials were used less. This indicates that there was an increase in industrial construction materials in the area together with the increase in second home construction in mountainous areas. Nevertheless, traditional homes complying with geographical conditions are decreasing in the area over time (Figure 5 and Figure 6). Nowadays, new buildings and old buildings are used as second homes in the area. These homes are generally not so big. The homes of the participants in the area were found to be mostly (57.2%) 50-100 m² (Table 7).

Table 7. Second home ownership and second home characteristics

Variables	Frequency	%
<i>Second home ownership</i>		
I have not got a home	49	5.4
I have a home	851	94.6
Total	900	100
<i>Ownership period</i>		
1-10 years	277	32.5
11-20 years	203	23.9
21-30 years	122	14.3
31-40 years	82	9.6
41-50 years	76	8.9
50+ years	91	10.7
Total	851	100
<i>Property status of second home</i>		
Own house	795	88.3
Belonging to one of your family members	66	7.3
Tenant	34	3.8
Other	5	0.6
Total	900	100
<i>Construction material of the second homes</i>		
Wooden	143	15.9
Stone	138	15.4
Wood-stone mixed	140	15.6
Reinforced concrete	212	23.6
Fired brick	195	21.7
Briquet	65	7.2
Other	5	0.6
Total	898	100
<i>Residential area</i>		
0-25 m ²	26	2.9
25-50 m ²	272	30.3
50-100 m ²	514	57.2
100 + m ²	86	9.6
Total	898	100



Figure 5. Traditional highland dwelling



Figure 6. As a result of increasing industrial construction materials at highlands the changing landscape of the highlands, Bektaş Highland (Giresun Province)

3.2.3. *The motivation for owning a home at the Eastern Black Sea Region*

In this section, firstly, those who migrate to highlands during summer months were asked about their real intentions in this migration. The participants were asked, “What is your real intention in going to highlands during summer months?” Of the interviewed 900 people, 543 (60.3%) stated that they migrated to highlands during summer months for change of air, relaxation, and holiday. Of the participants, 357 (39.7%) stated that they migrated to highlands for grazing their animals during summer months (Table 6). The relationship of people with mountainous areas in Anatolia began when they went to highlands for animal husbandry activities in previous times. In the past, highlands were the areas used as grasslands, where animal husbandry was intensive. Over time, these places have turned into areas where tourism and recreation have developed, and second homes have heavily been owned (Somuncu *et al.*, 2012: 4-5). Findings on the real intention in the migration to using the highlands in the region during summer months show that the function of the highlands in the region is changing. Traditional transhumance activities are gradually decreasing in the Eastern Black Sea Region, and the demand for relaxation and having a holiday (60.3%), which is the basic motivation for the increase in the number of homes constructed on the highlands, is gradually increasing. The current data indicate that the second homeownership in the traditional sense in the region has decreased, and the region has turned into a modern mountainous holiday destination (Somuncu, 2010: 9).

There are not many scientific studies on second homes in the mountainous areas in Turkey. We have very few pieces of empirical evidence regarding what the motivation for the use of second homes in mountainous areas is and why people find these places attractive. In Turkey, second homes in mountainous areas were a significant cultural characteristic approximately 30 years ago. There was a tradition of going to highlands for grazing animals. With the effect of limited economic opportunities in mountainous areas, the decrease in primary sectors such as animal husbandry, modernization, and globalization, mountainous areas have lost a significant part of the population through migration. The use of second homes is a characteristic of modern developments. Second homes have been used in the Western communities for more than 100 years (Kaltenborn and Clout, 1998: 123). In Turkey, second homes in the modern sense have been used on the coasts approximately for the last 60 years; however, there have also been developments in this issue in mountainous areas. The most apparent example of this is the Eastern Black Sea Region. Factors such as recreational activities, establishing relationships with nature, social relationships, life stage, children, investment, and having a holiday can influence having a second home (Kaltenborn and Clout, 1998: 123).

Of the participants, 60.3% (543 people) stated that they migrated to highlands, in other words, they had second homes in the region for relaxation and holiday. Accordingly, touristic and recreational activities are the main factors in the increase of second homes in the region. Those who migrate to highlands for relaxation and holiday have different reasons to spend their summer months on the highlands. View and nice weather constitute the basic motivation for 261 (48.6%) of the 537 people who migrate to highlands for relaxation and holiday. Moreover, there are still those who go to highlands to maintain the tradition of migrating to highlands (Figure 7). View and natural living are the most significant source of motivation, especially for the use of second homes in mountainous areas in Norway (Kaltenborn and Clout, 1998: 126). Findings obtained from the study area support this fact.

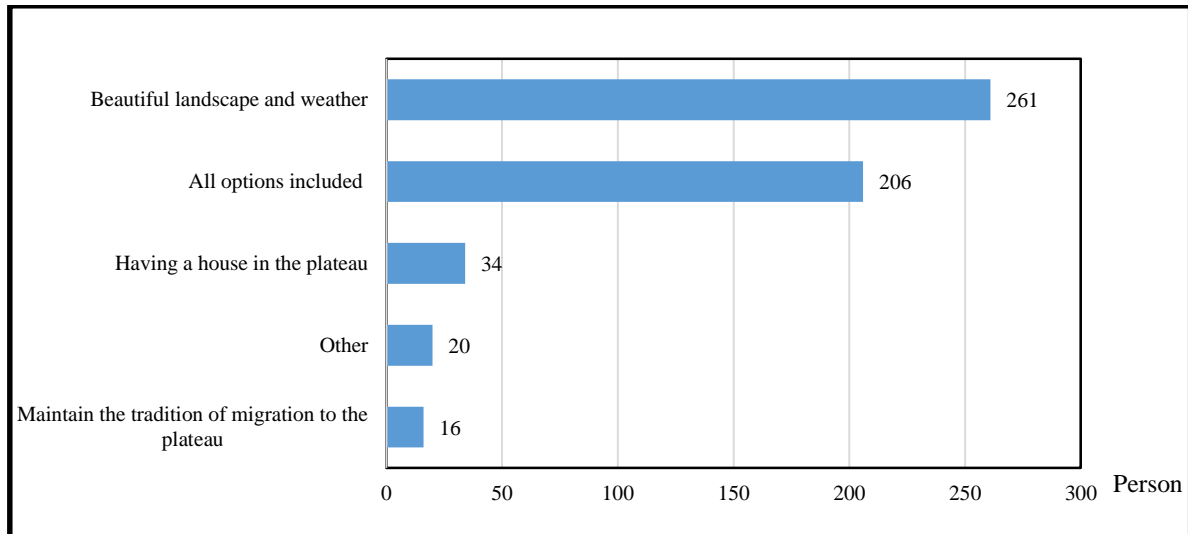


Figure 7. Motivation sources of second home ownership at the region
Explanation: (n= 543, Unknown: 6).

3.2.4. Characteristics of the second home usage and seasonality of the destination

Repetition in tourism is considered in two scales as time scale and space scale. The relationship between traveling time and distance affects the frequency and duration of the visit. For this reason, distance is important in the increase in second homes. For example, second homeowners, who are a few hundred miles away from their second homes, tend to visit less but stay longer (Jaakson, 1986: 369). Seasonal climatic changes such as the increase in temperature during summer months are also determinant in the development of second homes. Unbearable life in cities, desire to move away from high-rise buildings in cities, and recreational demands are among the factors directing families to look for alternative areas outside cities (Roca *et al.*, 2012: 38). The distinctive characteristic of the climate in the Eastern Black Sea Region is that the coastal region is humid and rainy. However, elevation rapidly increases in mountainous areas in the south by beginning from the coast. With the effect of elevation, temperature and humidity decrease. For the people of the Eastern Black Sea Region, humidity and temperature are overwhelming during summer months. Therefore, the local people build summer houses on the highlands to relax since highlands are cool in summer months. This situation indicates that the majority of the second homeowners in the region consist of people living in the cities and towns in the region. However, as of the 1950s, people in the Eastern Black Sea Region have migrated to big cities, particularly Istanbul. The continuation of the family and relative bonds of the people who left the region through migration has been effective in the increase of second homes in the region despite the distance factor. However, factors such as distance, climate, home conditions, etc. affect the seasonality in the use of these homes.

Of those who had a home on the highlands of the Eastern Black Sea Region for relaxation and holiday purposes, 48.6% (260 people) stated that they came to their second homes in June and 29% (155 people) in May. Among the participants, 6.7% (24 people) of the second homeowners, whose primary purpose is to graze their animals, start going to highlands in April following the increase in temperature and melting of snow, 40.3% (144 people) in May and 48.1% (172 people) in June (Figure 8). Accordingly, the usage characteristics of both groups are seasonal.

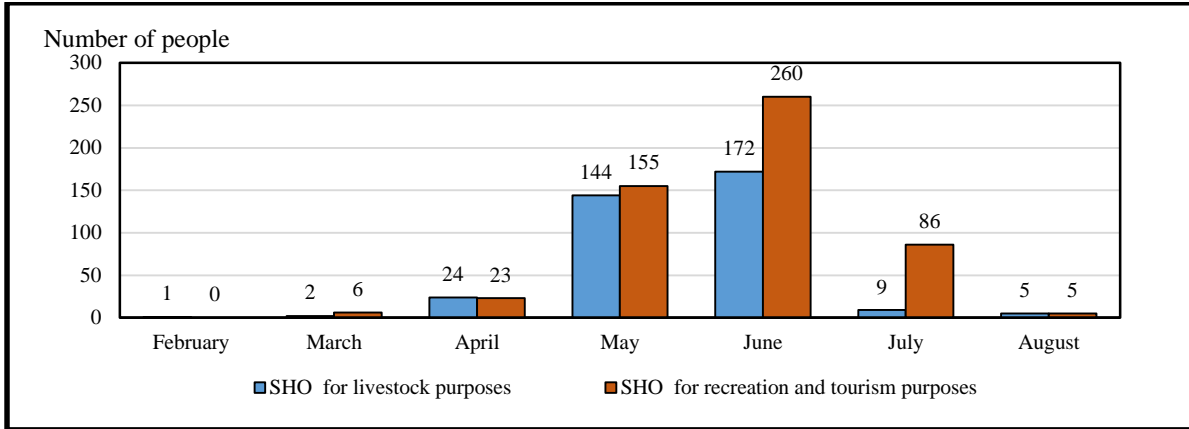


Figure 8. The months when the second homeowners (SHO) arrive to the region Explanation: SHO (Second home owner)

The climatic conditions of the region, working lives of families, responsibilities, and other requirements promote the seasonal use of second homes in the region. Seasonal use attracts attention although second home users in the region mostly consist of retirees (33.7%) (Table 5). In fact, the participants, who came to the region for recreational and touristic purposes, stated that they stayed in the region for 61-90 days (129 people) and 91-120 days (121 people) at most (Figure 9). Second homeowners, who come to highlands for animal husbandry, stay longer than those who come for recreational and touristic purposes. Those, who came to highlands for animal husbandry, stated that they stayed in the region maximum for 91-120 days (116 people), 61-90 days (92 people), and 121-150 days (73 people). Second homes in the region are inconvenient for winter use. Equipment deficiencies such as the lack of natural gas, the insulation of homes, etc. decrease the winter use and encourages the seasonal use of second homes in the region. Second homeowners in the region, most of whom are retirees, spend the cold season in nearby cities, towns, and villages where they reside permanently or in big cities with permanent residences such as Istanbul and Ankara. This situation shows that the usage pattern of second homes in the study area is seasonal. As a matter of fact, most of the participants leave the region towards the end of September.

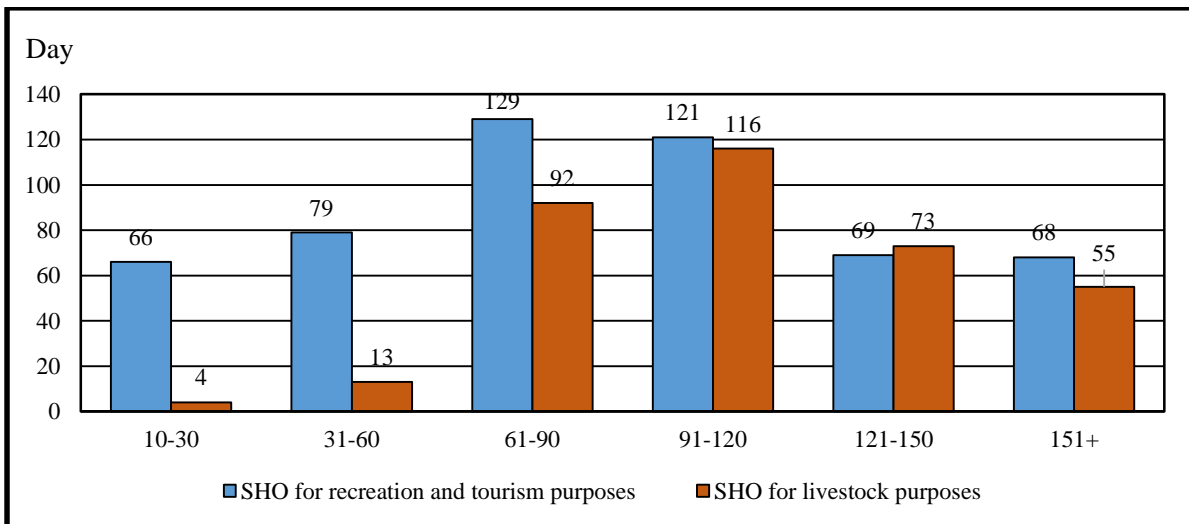


Figure 9. Usage period of second homes at the region Explanation: SHO (Second home owner)

4. Conclusion

Mountainous areas are rebuilt in the natural, cultural, social, and economic context with the post-industrial period. This transformation negatively affects the original and sensitive mountainous ecosystem. Mountainous areas that allow limited economic activities are transformed from the production space to the consumption space due to the increasing leisure time and economic level of the population. Second homeownership and related spatial change are in the middle of this transformation. This study was conducted to examine and develop second homes in the Eastern Black Sea Region within the context of mobility. According to the findings of the study, second home ownership has rapidly increased in the last 30 years. The increase in second home ownership is considered to be related to the gradual liberalization of city-dwellers in site selection and the change in consumption patterns of the middle class with the post-industrial services. It was determined that second homeowners, who were mostly retirees, did not perform production activities while living in mountainous areas. This situation causes a gradual decrease in functions, such as agriculture, animal husbandry, and mining, which are primary economic activities.

It was observed that site selection was not coincidental in the return to rural areas and that coastal and mountainous areas were more preferred (Casado-Diaz, 2012; Cooke and Lane, 2015; Perlik and Membretti, 2018). Considering the occupancy rates of second homes in coastal regions in the world as of the 1950s and in Turkey as of the 1980s, it was detected that the mobility was directed towards mountainous areas (Travis, 2007; Ooi *et al.*, 2015). In this context, the rural space is opened for consumption by being rebuilt in accordance with the tastes of the second homeowner middle class (Bijker and Haartsen, 2012). The fact that reinforced concrete structures are built instead of traditional architecture supports this situation.

People want to spend the summer season away from pollution and cities. For local people, second homeowners are very important in generating income since traditional economic activities have lost their importance. In addition to the economic input of second homes, changes occur in land use and socioeconomic structure since producers, who carry out production activities in mountainous areas, sell their lands to second homeowners and abandon production. Second homeowners spend only the summer season in mountainous areas. The fact that most of the second homeowners are retirees and there is not enough infrastructure in the area for the winter season is effective in this case. Accordingly, when appropriate infrastructure conditions are ensured, the potential of second homeowners to use the area throughout the year increases.

The increase in mobility all over the world since the 1980s has also enabled its effects to be monitored. In this study conducted on changes in the highlands of the Eastern Black Sea Region, outcomes such as illegal settlement, waste problem, and social conflicts with the occupation of pastures in this region were determined. It was specified that the population, who abandoned transhumance and went to cities, used highlands as second home spaces afterward. Population and capital pressure on mountainous areas, in addition to demographic, functional, and spatial mobility, have many dimensions, such as providing infrastructure, access to technology, mass consumption, housing, transportation, society, and reproduction. Moreover, the rural-urban dichotomy loses its clarity, small businesses shift to rural areas, the potential of causing social conflicts occurs due to income inequality, house and land prices increase (Löffler and Steinickie, 2006), and environmental problems due to population increase emerge (Kondo *et al.*, 2012; Perlik and Membretti, 2018).

In addition to the existing problems, the determination and functional evaluation of the highlands in Turkey still cannot be performed completely. The Pasture Law numbered 4342 and dated February 28, 1998, defines highlands as areas where only animal-related activities are carried out. On the other hand, it has been reported that these areas cannot be used for any other purposes and their properties belong to the government (Somuncu *et al.*, 2012). Furthermore, the law regarding construction amnesty will affect controversial applications on the highlands with Article 16 added in June 2018 to the Construction Law numbered 3194 and dated 03.05.1985. It is mentioned that these areas, which cannot be transferred to private property, are transferred to private property within the

scope of Construction Amnesty. These developments experienced after 2004, which is the time limit of this study, rapidly change the number and characteristics of second homes on the highlands. Accordingly, depending on the motivation of people settling in the Eastern Black Sea Region in respect of having a second home, the function of settlements changes, and evolvement is experienced from the production space to the consumption space. When these developments are evaluated within the scope of the second home development trend in mountainous areas, it can be stated that the Eastern Black Sea Region is the most affected region. In addition to these, new topics such as individual, family structures, social harmony, solidarity, exclusion through alienating relationships, values system, belonging, environmental protection, participation, and integration should be investigated with new studies.

Since it is predicted that today's urban population will probably be more active and healthier in their retirement, their potential to own second homes will also be high (McMillan, 2006). Furthermore, it can be stated that the mobility from cities to rural areas will become easier with transportation and technology and the number of second homes will continue to increase with the effect of globalization in the coming years (Benson and O'Reilly, 2009). At this point, the fact that mountainous areas will be opened to consumption with their occupation by cities in the long term places this issue in the center of discussions.

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References

- Alagöz, C.A. 1993. Türkiye'de Yaylacılık Araştırmaları. *Coğrafya Araştırmaları Dergisi*, 2: 1-51.
- Alkan, M.Ö. 2014. Osmanlı'da sayfiyenin icadı. p.15-44. Editor: T.Bora. *Sayfiye Hafiflik Hayali*. İletişim Yayınları, İstanbul.
- Araonsson, L. 2004. Place Attachment of Vacation Resident: Between Tourists and Permanent Residents. p. 75-86. Editors: C.M. Hall & D. K. Müller. *Tourism, Mobility and Second Homes Between Elite Landscape and Common Ground*. Channel View Publications: Clevedon.
- Barke, M. 2007. Second Homes in Spain: An Analysis of Change at the Provincial Level, 1981–2001. *Geography*, 92(3): 195–207.
- Benson, M., O'Reilly, K. 2009. Migration and Search for a Better Way of Life: A Critical Exploration of Lifestyle Migration. *The Sociological Review*, 57(4): 608-625.
- Bijker, R.A., Haartsen, T., 2012. More Than Counterurbanization: Migration to Popular and Less-Popular Rural areas in the Netherlands. *Population, Space and Place*, 18: 643-657.
- Casado-Diaz, M. 2012. Exploring the Geographies of Lifestyle Mobility: Current and Future Fields of Enquiry. p. 120-125. Editor: J. Wilson. *The Routledge Handbook of Tourism Geographies*. Routledge: London and New York.
- Construction Law. 1985. T.C. Official Newspaper, 3194, 03, May 1985.
- Cooke, B., Lane, R. 2015. Re-thinking Rural-Amenity Ecologies For Environmental Management in the Anthropocene. *Geoforum*, 65: 232-242.
- Cooperatives Law (1969). T.C. Official Newspaper, 1163, 24 April 1969.
- Doğaner, S. 1992. Gemlik Körfezi Kuzey Kıyılarının Turizm Coğrafyası. *Türk Coğrafya Dergisi*, 27: 59-84.
- Doğaner, S. 1998. Türkiye Kıyı Kullanımında Turizm Olgusu. *Türk Coğrafya Dergisi*, 33: 25-52.
- Dubin, M., Lucas, E. 1989. *Trekking in Turkey*. Lonely Planet, Hong Kong.
- Emekli, G. 2014. İkinci Konut Kavramı Açısından Turizm Coğrafyasının Önemi ve Türkiye'de İkinci Konutların Gelişimi, *Ege Coğrafya Dergisi*, 23(1): 25-42.
- Emiroğlu, M. 1977. *Bolu'da Yaylalar ve Yaylacılık*, Ankara Üniversitesi Dil ve Tarih-Coğrafya Fakültesi Yayınları: 272, Ankara.
- General Directorate of Population and Citizenship Affairs (2014), Access: 29 October 2015, <http://www.nvi.gov.tr/NVI.html>
- Jaakson, R. 1986. Second-home Domestic Tourism. *Annals of Tourism Research*, 13: 367-391.
- Japan International Cooperation Agency & State Planning Organization of the Republic of Turkey 2000: The study on the regional – plan for the Eastern Black Sea Region in the Republic of Turkey (DOKAP) Final Report, Turkey.
- Kaltenborn, B. P., Clout, H. D. 1998. The Alternate Home-motives of Recreation Home Use. *Norsk Geografisk Tidsskrift-Norwegian Journal of Geography*, 52(3): 121-134.
- Kılıçaslan, Ç. 2006. İkinci Konutların Deniz Kıyılarına Etkisi. *Süleyman Demirel Üniversitesi Orman Fakültesi Dergisi*, A(1):147-156.
- Kondo, M.C., Rivera, R., Rullman Jr. S. 2012. Protecting The Idyll But Not The Environment: Second Homes, Amenity Migration and Rural Exclusion in Washington State. *Landscape and Urban Planning*, 106: 174-182.

- Küçük, H., Kılıç, T. 2018. Karasu İlçesinde (Sakarya) İkinci Konutların Gelişimi. *Akademik Sosyal Araştırmalar Dergisi*, 6(65): 111-130.
- Löffler, R., Steinickie, E. 2006. Counterurbanization and Its Socioeconomic Effects in High Mountain Areas Of The Sierra Nevada (California/Nevada). *Mountain Research and Development*, 26(1): 64-71.
- Manisa, K., Görgülü, T. 2008. İkinci Konutların Turizm Sektöründe Yeniden Kullanılabilmesine İlişkin Bir Model. *Yıldız Teknik Üniversitesi Mimarlık Fakültesi e-Dergisi*, 3(1): 68-78.
- McMillan, L. 2006. Guiding Back From The Precipice: Leveraging The Power Of Recreational Users To Protect Mountain Environments. p. 31-53. Editör: L. Moss. *The Amenity Migrants: Seeking and Sustaining Mountains and Their Cultures*. Wallingford: CABI
- Ministry of Tourism. 1990. *İkinci Konut Envanteri, 1989* (Report No: 1990/3), Turizm Bakanlığı Yatırımlar Genel Müdürlüğü, Ankara.
- Müller, D. K., Marjavaara, R. 2012. From Second Home to Primary Residence: Migration Towards Recreational Properties in Sweden 1991–2005. *Tijdschrift Voor Economische En Sociale Geografie*, 103(1): 53-68.
- Müller, D.K. 1999. *German Second Home Owners in The Swedish Countryside: On The Internationalization of The Leisure Space*. Unpublished Doctoral Dissertation, Umeå University Department of Social and Economic Geography, Umeå.
- Naycı, N. 2009. Kıyı Alanlarında Kitle Turizmi: Türkiye’de Kalkınma Planları Bağlamında Kıyıların Dönüşümü ve Tarihi-Doğal Çevreler. *Muğla Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, 22: 81-100.
- Okuyucu, A., Somuncu, M. 2015. Yalova-Çınarcık’taki İkinci Konutların Ekonomik Etkilerinin Değerlendirilmesi. *Coğrafi Bilimler Dergisi*, 13(2): 139-159.
- Ooi, N., Laing, J., Mair, J. 2015. Sociocultural Change Facing in The Rocky Mountain West As A Result Of Mountain Resort Tourism and Amenity Migration. *Journal of Rural Studies*, 41: 59-71.
- Özdemir, H. 2012. Türkiye’de İç Göçler Üzerine Genel bir Değerlendirme. *Akademik Bakış Dergisi*, 30: 1-18.
- Özden, S., Atmış, E., Menemencioglu, K. 2004. Negative Effects of Recent Unplanned Expansion on Highland Ecosystems in Turkey. *Mountain Research and Development* 24(4): 303-306.
- Özgüç, N. 1977. Tatil Evleri. *İstanbul Teknik Üniversitesi Mimarlık Fakültesi Şehircilik Enstitüsü Dergisi*, 14: 69-92.
- Perlik, M., Membretti, A. 2018. Migration by Necessity and by Force the Mountain Areas: An Opportunity for Social Innovation. *Mountain Research and Development*, 38 (3): 250-264.
- Roca, O., Oliverira, J., Roca, Z., Costa, L. 2012. Second Home Tourism in the Oeste Region, Portugal: Features and Impacts. *European Journal of Tourism, Hospitality and Recreation*, 3 (2): 35-55.
- Somuncu, M. 1989. The Kaçkar Mountains of the Eastern Black Sea Coast. *Image of Turkey*, 26:18-23.
- Somuncu, M. 2010. From Mountain Pastures to Mountain Resorts. Newsletter of the Mountain Research Initiative *MRI NEWS*, 5 (December): 9-12.
- Somuncu, M., Akpınar, N., Kurum, E., Çubuk Kaya, N., Özelçi Eceral T. 2010. Gümüşhane İli Yaylalarındaki Arazi Kullanımı ve İşlev Değişiminin Değerlendirilmesi: Kazıkbeli ve Alistire Yaylaları Örneği. *Ankara Üniversitesi Çevre Bilimleri Dergisi*, 2(2): 107-127.
- Somuncu, M., Çubuk Kaya, N., Akpınar, N., Kurum, E., Özelçi Eceral, T. 2012. *Doğu Karadeniz Yaylalarında Çevresel Değişim*. Ankara Üniversitesi Basımevi, Ankara.
- Somuncu, M., İnci, A. 2004: Balancing Protection and Utilization in Overcoming Inaccessibility: A Rural Development Model in Mountainous Area of Turkey. *Mountain Research and Development*, 24(4): 307-311.
- Travis, W.R. 2007. *New Geographies of the American West: Land Use and the Changing Patterns of Place*. Island Press, Washington D.C.
- Zoğal, V., Emekli, G. (2018). Urla’da (İzmir) İkinci Konutların Değerlendirilmesine Yönelik Nitel Bir Araştırma. *Turizm Akademik Dergisi*, 5(1): 189-204.

Clustering the Problems of Sustainable Tourism Development in a Destination: Tsaghveri Resort as A Case*

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Abstract: Over the last decades, Tourism has become one of the leading industries in Georgia in terms of generating income, compensation of the country's trade deficit and rising employment of local population. However, tourism lacks development in the mountain region of the country. On-going re-development requires new approaches for the industries' sustainable development. The purpose of the study is to apply the method of transdisciplinary research to identify interrelated core problems hampering sustainable tourism development. The research employed a case study approach. The method was tested at mountain resort of the Caucasus – Tsaghveri (Borjomi Municipality). The initial information for the research was collected from the data received in the course of fieldwork organized by Austrian University BOKU and Ivane Javakhishvili Tbilisi State University (TSU) in Georgia in July 2018. The study revealed four categories of the destination related problems: leverage, critical, buffering and restricted. The outcome of analysis serves as preliminary information for the problem-solving strategy as well as for making decisions on rational development of destinations. The research gave opportunity to the involved parties to develop skills of participatory research for structuring complex problems.

Key words: Sustainable development, Tourism, Problem solving strategy, Transdisciplinarity, Destination planning, System analysis, Mountain resorts

1. Introduction

Over the last decades, Tourism has become one of the leading industries in Georgia in terms of generating income, compensating the country's trade deficit, and increasing employment among local population. Today, the country with 3,7 million population, receives up to 9 million international travelers. (GNTA, 2019), The industry makes up more than 10,4% of country's GDP, holds above 68% in service export contributes 29.5 % in total, in the country's employment (WTTC, 2019).

Tourism is also considered as a strategic sector, recognized for its potential to revitalize and diversify rural areas, particularly in mountain regions, where the unemployment, low incomes, lack of infrastructure, and high migration remain the major challenges.

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Georgian Government takes efforts to develop mountainous regions by introducing tax benefits for local entrepreneurs, funding infrastructure development projects, adopting strategies and action plans for their sustainable development (Parliament of Georgia, 2015). One of these areas is Tsaghveri resort, located in the municipality of Borjomi.

Tsaghveri was a popular mountain resort among local holiday-makers until collapse of the political regime in the late 20th century. During the last decades of transitional period selected mountain resorts are regaining their popularity. Among them are resorts Borjomi and Bakuriani. Tsaghveri destination, located between these resorts, lags far behind them in its development, carrying the burden of inherited social and economic problems and some environmental risks.

The challenges of sustainable tourism development in destinations usually are presented by a set of complex problems. Coping with such challenges requires holistic system approach and analysis. Lack of knowledge about the problems and interrelations between them became a special subject for a system-based transdisciplinary studies (Khokhobaia, 2018). Regarding Georgia, the relevance of study these issues and the first attempts to identify problems in the context of transdisciplinary approaches has been recently initiated. The importance of full scale indebt studies in this regard is well proved by wide range of challenges which are facing the rapidly recovering Georgian tourism destinations (Khelashvili, 2017, 2018).

The purpose of this case study is to apply an innovative transdisciplinary methodology to identify high-leveraged problems challenging the sustainable tourism development in Caucasus region. The identified problems are considered as basic and valuable information to develop a relevant problem-solving strategy.

This research is a part of the project -“Transdisciplinarity for Sustainable Tourism Development in the Caucasus Region | CaucaSusT” funded by the Austrian Development Agency (ADA) in the scope of the Austrian Partnership Programme in Higher Education and Research for Development APPEAR. The project addresses capacity building of universities in Armenia and Georgia in the field of transdisciplinary teaching and research with a focus on sustainable tourism development. The program includes both teaching and field study practices in capacity building process.

In our research we use primary data that was obtained by students during the field study practice in Tsaghveri resort in Borjomi municipality. The field practice was organized by Austrian and Georgian partner universities (the University of Natural Resources and Life Sciences/BOKU in Vienna and Ivane Javakhishvili Tbilisi State University/TSU) during July 11 -20, 2018 for master degree students from three departments of TSU: Tourism, Human Geography, and the Physical Geography and Environment Sustainable Development. Faculty professors and PhD students supervised the course (Salukvadze *et al.*, 2018). The purpose of field research was to identify the complex problems in tourism destination, which will serve as preliminary information for the problem-solving strategy as well as for making decisions on rational development of destinations.

The research was based on interdisciplinary approach, involving experts and students of Human Geography, Physical Geography and Environment Sustainable Development. Those disciplines are displayed in Figure 1.

Figure 2 shows local and national stakeholders, University teachers and students, as well as national and international partners involved in the fieldwork covered.

The research applied a quantitative and qualitative analysis design, based on document analysis and semi-structured in-depth individual as well as group interviews with different stakeholders (local actors, representative of Borjomi municipality, community organizations etc.), and visual observations of tourist attractions, infrastructure and facilities.

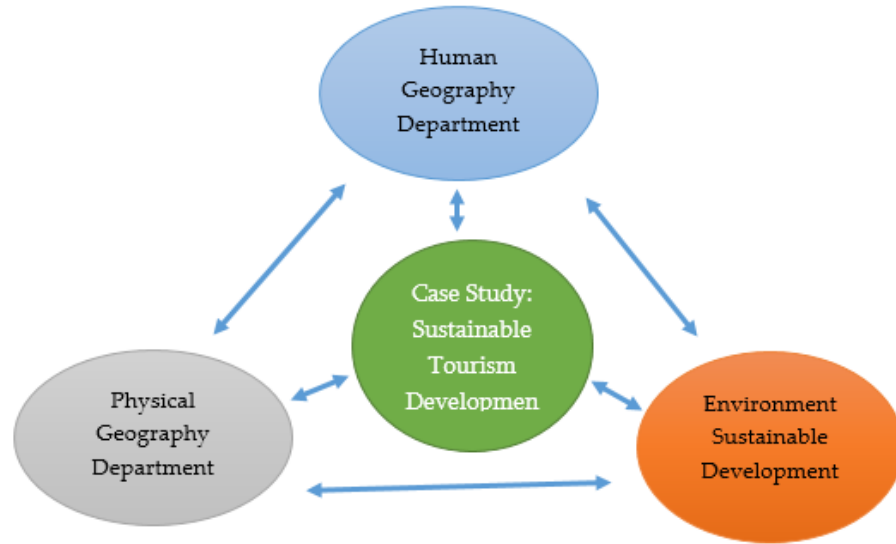


Figure. 1. Disciplines involved in transdisciplinary field work.

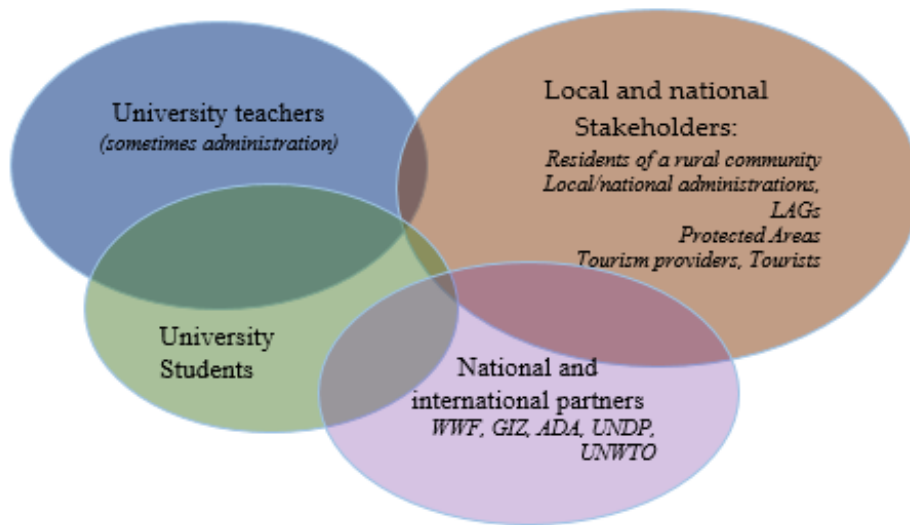


Figure 2. Actors involved in transdisciplinary case study in Tsaghveri.

2. Research Methods

The presented study deals with the complex problems which require a relevant system analysis. The challenge of the tourism development in a destination is a complex of inter-related components that are influenced by different factors. They are considered as a system of problems and the applied methodology is a system-based approach.

The identification of interrelated (complex) problems and finding the rational ways of their solution are subjects to recently developed transdisciplinary research methodology that is widely based on the

system-based approach, implies system thinking and knowledge as of its three forms of knowledge (Hadorn et al. 2008; Pohl and Hadorn, 2007).

Transdisciplinary methodology implies three phases of research (Hadorn et al. 2008; Enengel et al. 2012):

- Problems identification and structuring;
- Problem investigation; or Problem analysis
- Problem transformation (implementation); or bringing results to fruition

According to this concept, the research produces relevant forms of knowledge:

- System Knowledge (what is the case?)
- Transformation knowledge (How can the desired knowledge be accomplished?)
- Target Knowledge (what should be achieved?)

The system approach to a research processes was conceptualized in General System Theory. Its "...subject matter is the formulation and derivation of those principals which are valid for "systems" in general (Bertalanffy, 1968). Peter Kheiter, York University professor, defines the system as a set of components that interact with one another and serve for a common purpose or goal; and underlines nine characteristics of the system, such as: 1. Components; 2. Interrelationships; 3. Boundary; 4. Purpose; 5. Environment; 6. Input; 7. Output; 8. Interface; 9. Constrains (Khaite, 2008) . Based on this approach, the components in our case are presented by "problems" within the boundary of selected destination – Tsaghveri. Most of these "problems" are presumably in a certain direct or indirect relationship – subject to identification and structuring for designing the problem-solving strategy.

Bernhard Freyer, etc, states that system thinking is an absolute necessity to deal with complex problem (Freyer *et al.*, 2017). In the context of system thinking, Frischknecht & Schmied, differentiate "Problems" into three categories: Easy problems - with small number of elements and processes; Complicated problems: with a large number of elements and processes but with stable relation between the elements and almost complete knowledge about the processes; and Complex problems: with many elements and processes, no complete information about the elements, influences, and their interrelations (Freyer *et al.*, 2017 ;Frischknecht and Schmied, 2002).

The initial stage of research implied the Soft System Methodology developed by Peter Checkland, Lancaster University professor, in 70s. (Checkland, 1999). This methodology is also named as System Dynamics – SD (Rees, 2000) and derived as an oppose to Hard System Methodology (HSM) (Burge, 2015). HSM refers to descriptive reality and well defines problems need to be solved; while SSM means an environment which is messy and poorly defined, outcome is not clear (Rees, 2000; Mehregan et al. 2012). The latter closely reflects the conditions of the study destination.

For the following stages of the research we applied a) system thinking as a prerequisite for System Analysis of interacting entities „...where a small shift in one thing can produce big changes in everything (Meadows, 1999) and b) System-oriented Scenario Technique, which describes an approach for applied research and planning. These approaches lead to development of scenarios on the way forward and to findings of recommendations for further actions (Freyer *et al.*, 2017).

The system-based methodology, similar to the presented research, was tested in context of urban development (Wirth *et al.*, 2014). The system properties were represented by impact factors that influence current and future system behavior and are likely to impact other elements (p.118). The initial stages of the research implied formation of an impact matrix, the assessment of direct mutual impacts among the defined factors, ranking of the impact variables into active, passive, ambivalent and buffering, which were done with the system grids and system graphs. Unlike our research, the mentioned article is further expended to collaborative scenario analysis by applying methods of functional-dynamic scenario, integrating a loop

analysis of critical system dynamics into the formative scenario analysis to identify the logic of system feedback loops between two or more impact factors.

The role of impact factors in transdisciplinary research process is emphasized by Pohl and Hadron in connection with the research principal named as achievement of effectiveness through contextualization - "Research must therefore pay particular attention to the impact-related contextualization of a project. One way of achieving this is to elaborate an impact model at the stage of problem identification and structuring that shows the social impacts projects may have when bringing results to fruition" (Pohl and Hadorn, 2007).

And last but not least, in context of factors' interrelations, we focused on feedback category in order to describe relations between factors. In part, the approach implies that "The chain of causal connections may be entirely sequential, or it may include loops" (Freyer et al. 2017; Meadows, 1999). Also, each factor may be influenced by other factor and/or it influences another factor. As system elements (components) are mostly interrelated in one way or another, therefore, the change of each such element causes certain leverage effect on the others. From this view, these components are considered as Leverage element or point.

2.1. Research tools and terminology

In order to reveal the connections between "problems" we applied an Influence Matrix. Five experts, who participated in the field research, were involved in identification of connections between the "problems". At this stage of our study we used a binary (yes/no) valuation of the connections instead of alternative scoring method. Even though, scoring provides better understanding of the connections, it also increases the risk of biased valuation, which we prefer to avoid in this first case study.

The system analysis methodology implies wide range of special terms, occasionally reflected the same content. In this research we use the terminology proposed by Feyer. In part: "connection" which is the generic term for different types of relationships" in the Influence Matrix; The sum of rows also called the "active sums" shows how strong one element influences the rest of the system; the sum of the single columns, called "passive sums" gives an idea how strongly an element is influenced" (Freyer B, etc, 2017, p. 35). The term Influence Factors (IF) is used as a synonym of the System Elements. IF-s are grouped into active and passive sums and are further divided to:

Leverage elements (problems): high active and low passive sums: These elements have power to trigger a lot of change in your system and are comparable easy to control;

Critical elements (problems): IFs with high active and passive sums. These are important elements, because they are hard to control and can trigger a lot of change and chaos in your system;

Restricted elements (problems): These elements are influenced by a lot of other IFs. This means that, if you want to change them single measures are often not enough, but you should consider more holistic strategies to change them successfully;

Buffer element (problems): Elements with low active and passive sums. These elements stabilize your system. They also can be hard to change. These active and passive sums enable you to group your IFs:

The term "problem analysis" is used with a specific meaning and relates to step-wise analysis of connections between identified "problems". The procedure includes:

Finding the cross-cutting connections between identified "problems" and determining the number of these connections for each of them;

Categorizing the connections of each "problem" into "incoming" and "outgoing" to determine the balance between them, also referred as a leverage capacity;

Categorizing the "problems" by their leverage capacity.

The outcome of this analysis is to determine the category of so called "leverage problems" with smallest amount of "incoming" (passive sum) and largest number of "outgoing" (active sum) connections. They are deemed to have the highest leverage capacity and, assuming other conditions equal, should be considered as primary "problems" to be addressed in a problem-solving strategy.

Based on the reviewed above approaches, methodology and terminology, our research process included three consequent phases: Problem identification and analysis; evaluation of connections between identified problems; and categorizing problems with concentration on loops of “leverage problems”.

2.2 Limitations of the study

The authors acknowledge some limitations associated with this early-stage transdisciplinary research in Caucasus region. They basically relate to the following concerns: a) the determined connections between problems are not weighted by the level of their influence (no scoring); b) the study does not consider external “Incoming” and “Outgoing” influences on local “problems”; c) The study applies “Problems” which were identified during the first transdisciplinary filed research in the Caucasus region, hence the reliability of the finding should be tested by time; finally d) It is assumed that the resolution of any “problem” will produce only positive effect on other connected “problems” without creating new ones. These limitations are subject to further adjustments of the methodology to special case studies. The authors believe that the presented research will contribute into shaping the transdisciplinary methodology for Caucasus region and be useful in addressing the challenges of sustainable tourism development in its destinations.

3. Results

3.1 Problem identification and analysis

The search applies the range of 17 problems identified by TSU students during the mentioned above fieldwork in Tsaghveri resort in July 2018. Hereinafter, these findings are referred as “problem” or “problems” as an integral part of Tsaghveri tourism destination systems.

Table 1. Identified tourism-related "problems" in Tsaghveri resort. Field work results (2018).

#	Identified Problems
1	Poorly developed infrastructure
2	Accessibility to regular transport
3	Lack of tourism facilities
4	Insufficient tourism product/experiences
5	Seasonality
6	Non-competitive local products
7	Scarce choice of food etc.
8	Shortage of local qualified personnel, local capacity
9	No cooperation among entrepreneurs
10	Weak regional partnership
11	Insufficient involvement of local population in development processes
12	Non-existence of long-term vision of the destination development
13	Safety and security
14	Difficulties of getting loans, high interest rates
15	Lack of small enterprises, local producers and proper packaging and labeling of local products
16	Lack of service/business consultations
17	Lack of tourist information (web site), no marketing and branding

(1) Identification of connections between the “problems”

This step implies a peer review of identified “problems” to determine connection between them in a binary manner (Yes/No, or in case – 1/0). For this purpose, all identified “problems” were arranged in so

called “Influence Matrix”. Further, five experts involved in the fieldwork marked the connected “problems” in relevant cross cutting cells. Produced matrix-table shows the whole net of connections between the “problems”, as well as the number of such connections which carries each identified “problem”. The sum of active connections can be viewed as an indicator of each “problem’s” capability to influence the overall conditions in case of their resolution. In table 2, the Passive sum of connections shows the level of influence that each “problem” has from other “problems” of the destination. Note: the “problems” are represented by the assigned relevant numerical numbers.

Table 1. Assessments of inter-relations between the identified "Problems".

order # of "problems"	Cause/Effect	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Sum of influence (or "out-flow", or "Active") links
		Poorly developed infrastructure	Accessibility to regular Transport	Lack of tourism infrastructure	Insufficient tourism product/experiences	Seasonality	Non-competitive local products	Scarce choice of food etc.	Shortage of local qualified personnel, local capacity	No cooperation among entrepreneurs	Weak regional partnership	Insufficient involvement of local population in development processes	Non-existence of long-term vision of the destination development	Safety and security	Difficulties of getting loans, high interest rates	Lack of small enterprises local producers and proper packaging and labeling of local products	Lack of service, consultations and	Lack of tourist information (web site), no marketing and branding	
1	Poorly developed infrastructure			1	1	1						1	1	1			1		7
2	Accessibility to Regular Transport				1	1	1					1				1			4
3	Lack of tourism facilities	1			1	1	1					1					1		6
4	Insufficient tourism product/experiences					1						1				1	1		4
5	Seasonality			1			1	1				1						1	5
6	Non-competitive local products				1	1			1		1	1				1			6
7	Scarce choice of food etc.					1	1					1							3
8	Shortage of local qualified personnel, local capacity			1	1	1				1	1	1			1	1	1	1	10
9	No cooperation among entrepreneurs				1		1	1	1		1	1			1		1	1	9

10	Weak regional partnership		1	1	1		1			1						1	1	9
11	Insufficient involvement of local population in development processes	1	1							1	1							5
12	Non-existence of long-term vision of the destination development	1	1	1			1		1	1	1	1	1			1	1	13
13	Safety and security)				1													1
14	Difficulties of getting loans, high interest rates	1			1		1	1								1		5
15	Lack of small enterprises, local producers and proper packaging and labeling of local products					1	1	1	1	1	1	1				1		9
16	Lack of service/business consultations						1	1		1	1	1			1	1	1	9
17	Lack of tourist information (web site), no marketing and branding						1	1							1			3
Sum of "in-coming" (or "influenced", or in-flow, or Passive) links		4	3	5	10	10	10	4	5	6	7	11	6	2	4	7	8	6

In Table 3 the results of experts survey are sorted by revealed number of “passive” (“in-coming”) and “active” (“outgoing”) connections with indication of numerical number of each “problem”.

The table visualizes importance of each “problem” measured by total number of both incoming and outgoing connections, thus, revealing the so called “Critical Elements” of the system (Freyer *et al.*, 2017). Even though the Critical Elements’ (or “problems” in case) potential to fuel changes is high, their solutions, in turn, are widely depended on the status of many other “problems” of the destination. Therefore, giving priority to their resolution may not be the best scenario for improving the overall conditions in the destination.

Table 3. Numerical numbers of connections (in-coming, out-going and inter-linked) between the "problems".

Pr. ##	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total		
12	1	10	11	15	16	17	1	2	3	6	8	9	10	11	13	14	15	16	17	19
16	1	3	4	8	9	10	12	15	5	6	8	9	10	12	14	15	17			17
10	6	8	9	11	12	15	16	2	3	4	6	9	11	12	16	17				16
15	2	4	6	8	12	14	16	4	5	6	7	8	9	10	12	16				16
6	3	5	7	9	10	12	14	15	16	17	4	5	8	10	11	15				16
11	1	2	3	4	5	6	7	8	9	10	12	1	2	9	10	12				16
5	1	2	3	4	6	7	8	15	16	17	3	6	7	11	17					15
8	6	9	12	15	16	3	4	5	9	10	11	14	15	16	17					15
9	8	10	11	12	15	16	4	6	7	8	10	11	14	16	17					15
4	1	2	3	6	8	9	10	13	14	5	11	11	15	16						14
1	3	11	12	14	3	4	5	11	12	13	16									11
3	1	5	8	10	12	1	4	5	6	11	16									11
14	8	9	12	16	1	4	6	7	15											9
17	5	8	9	10	12	16	6	7	12											9
2	10	11	12	4	5	11	15													7
7	5	9	14	15	5	6	11													7
13	1	12	4																	3

(2) Dividing connections of each “problem” into “incoming” and “outgoing, and determining the Leverage capacity.

The next step implied determining of difference between “Incoming” and „Outgoing” links for each “problem” referred as “leverage capacity”. Table 4 shows the amount of links by categories and in total.

Table 2. The amount of links by categories and in total (top-down sorted).

##	Name of "Problem"	Out-going	in-coming	Difference between In-coming and Outgoing	Total (Incoming-Outgoing)
12	Non-existence of long-term vision	-6	13	7	19
16	Lack of extension service/business consultations for producers, entrepreneurs	-8	9	1	17
10	weak regional partnership (no links with Bakurian resort (2023 Freestyle Ski and Snowboard World)	-7	9	2	16
6	Non-competitive local products (high prices for the local market)	-10	6	-4	16
15	lack of small enterprises, local producers and proper packaging and labelling of local products	-7	9	2	16
11	Insufficient involvement of local population (community members in development processes)	-11	5	-6	16
5	Seasonality	-10	5	-5	15
8	Shortage of local qualified personnel, local capacity (no business agreement, planning etc.)	-5	10	5	15
9	no cooperation among entrepreneurs (mistrust between locals)	-6	9	3	15
4	insufficient tourism product/experiences (new and diverse offers)	-10	4	-6	14
1	Poorly developed infrastructure (water, gas, electricity, sewerage, banks, pharmacy)	-4	7	3	11
3	lack of tourism infrastructure (café, entertainment centers, TIC, road signs)	-5	6	1	11
17	Lack of tourist information (web site), no marketing and branding	-6	3	-3	9
14	Difficulty of getting small loans, high interest rates	-4	5	1	9
7	scarce choice of food etc.	-4	3	-1	7
2	Accessibility (regular transport)	-3	4	1	7
13	safety and security (lack of fast emergency and police services)	-2	1	-1	3

(3) Categorizing the “problems”

Prime question for stakeholder regarding the sustainable development of challenged destinations is to determine the rational starting actions in a problem solving strategy. Figure 3 expresses identified connections between the “problems” in Tzagveri destination clearly demonstrates complexity and ineffectiveness of their simultaneous consideration in the decision-making process.

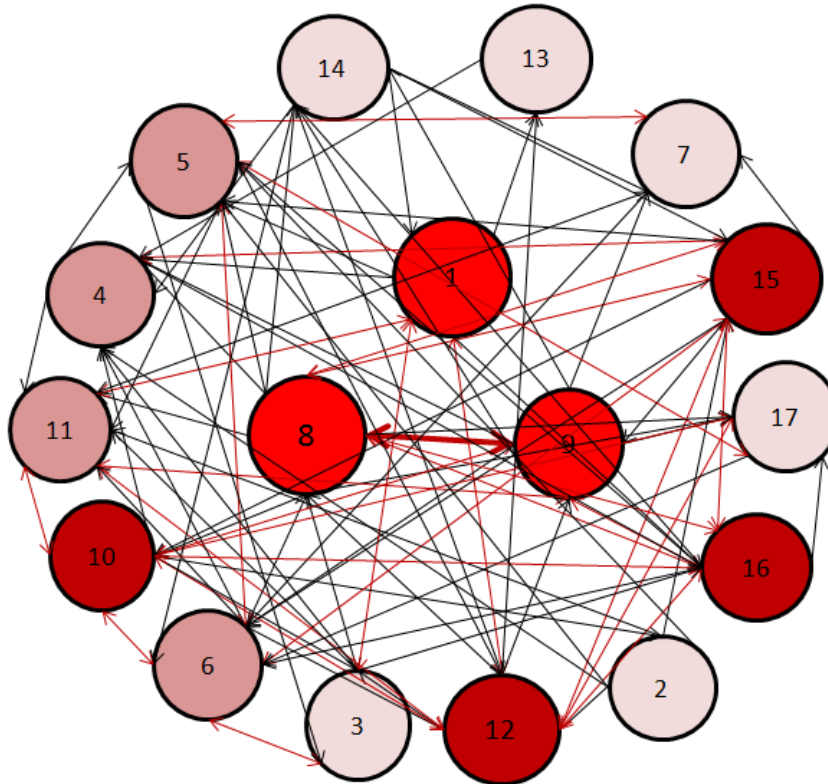


Figure 3. Identified connections between “problems” in Tzagveri destination.

Therefore, further action to cluster the “problems” into manageable amounts is required. In this line, the final step of the analysis is to categorize the “problems” according to their leverage potential. Figure 4 shows implemented analysis by applying a scatter graph with four quadrants for the allocation of “problems” into four categories. The graph differentiates the following categories:

“Leverage Problems” which have below average number of incoming connections (are less influenced by other “Problems”) and above average outgoing connections (meant higher influence on others “Problems”). They are located in NE section of the graph and falls in category of Leverage Elements per Freyer (Freyer *et al.*, 2017: 35; Meadows, 1999: 6; Active impact factors per Wirth, 2013: 122;). Table 5 displays the leverage problems.

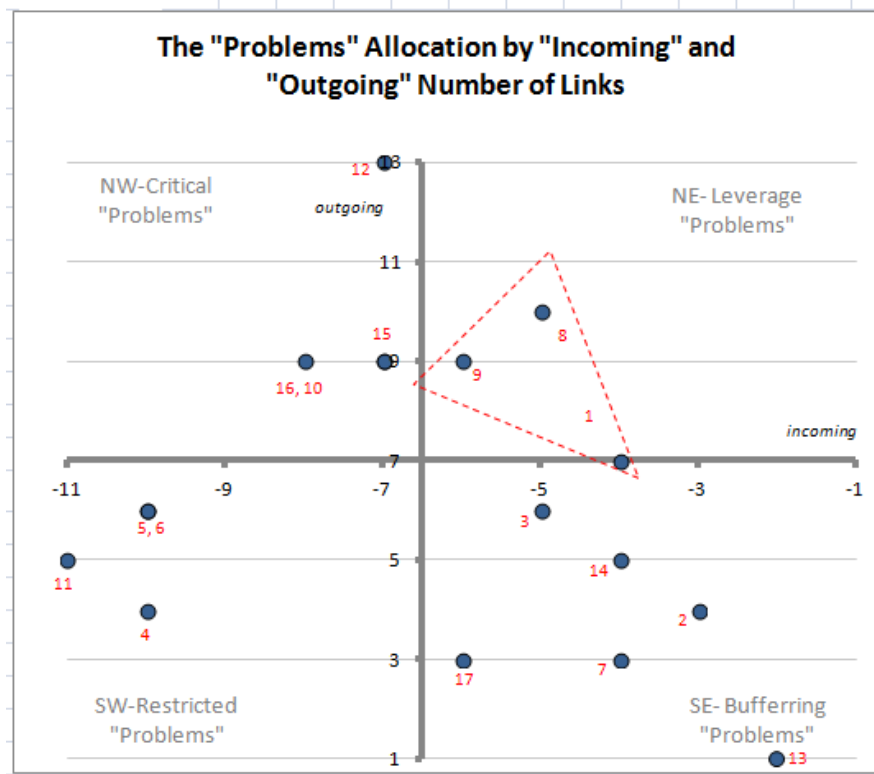


Figure. 4. Categories of identified “problems”.

Table 3 Leverage problems.

Leverage Problem #	Problem name
8	<i>Shortage of local qualified personnel, local capacity (no business agreement, planning etc.)</i>
9	<i>no cooperation among entrepreneurs (mistrust between locals)</i>
1	<i>Poorly developed infrastructure (water, gas, electricity, sewerage, banks, pharmacy)</i>

“Critical Problems” which have above average number of both incoming and outgoing connections, are located in NW section of the graph, and falls in category of “Critical Elements per Freyer (Freyer B, etc, 2017,p.35, and “Ambivalent factors per Wirth, 2013, p.122);

“Restricted Problems” which are most sensitive and reactive, having below average number of outgoing connections and above average incoming connections, are located in SE section of the graph and belong to category of Restricted Elements per Freyer (Freyer B, etc, 2017 p.35); Passive factors (Wirth, 2013,p.122)

“Buffer Problems” which have less than average number of both outgoing and incoming connections, are located in SW section of the graph and considered as Buffer Elements per Freyer (Freyer *et al.*, 2017: 35; Wirth, 2013:122; Meadows, 1999: 7).

The rational way to plan a problems solving strategy for the destination is to start with addressing the “Leverage Problems” with highest leverage potential (SE section). The “Leverage Problems” model implies that resolution of each of them will most effectively lead to mitigation of the others, and further it will diminish the remaining problems as well. This outcome of the research is considered to be valuable and applicable information for experts and managers to prioritize actions based on the chain-effect scenarios. In the case study the findings are as follows:

The “Leverage Problems”: (also referred as “Active” or “High-leverage”) includes: “Poorly developed infrastructure (water, gas, electricity, sewerage, banks, pharmacy)” (#1); Shortage of local qualified personnel, local capacity (no business agreement, planning etc.)(#8); and “No cooperation among entrepreneurs (mistrust between locals) (#9)”. The links between them show that the latter two are directly inter-connected, meaning that the resolution of one of them will directly and positively influence on the other. Unlike these “problems”, development of the infrastructure depends on external to the destination factors (is less pre-determined by local factors). However, its resolution will produce a wide positive effect in the resort area. In general, it is assumed that the resolution (mitigation) of all three “Leverage Problems” should be considered as primary objectives in a problem-solving strategy;

“Critical Problems” (also, referred as “Ambivalent”) are represented by: “Weak regional partnership (no links with Bakuriani resort - 2023 Freestyle Ski and Snowboard World)” (#10); “Non-existence of long-term vision (#12)”; “Lack of small enterprises, local producers and proper packaging and labeling of local products (#15)”; “Lack of extension service/business consultations for producers, entrepreneurs (#16)”. They all are inter-related “Problems”, except the “Weak regional cooperation” (#10) which is not considered to be directly influenced by “Lack of small enterprises...” (#15) and “Lack of extension business service and consultations...” (#16). In reverse, these two “Problems” together with the absence of the “Vision...” (#12) participate in creation of “Weak regional partnership problems...” (#10). Meanwhile, the resolution (or mitigation) of “Leverage Problems” related to a “Lack of quality of staff” (#8) and “No Cooperation among entrepreneurs” (#9) will first of all lead to extension of “Regional cooperation...” (#10). In addition, the positive changes in the same “Leverage Problems” along with such changes in “Poor infrastructure...” (#1) will directly contribute into “Extension of business services and consultations...” (#16). The direct positive impact on “Lack of small enterprises...” (#15) is expected from the improvement of “Staff quality...” (#8), development of “Vision...” (#12), and “Improvement of infrastructure...” (#1). In case the mentioned above “Critical Problems” are addressed, it is expected that all other “Problems” of the whole system will receive positive impact through combined 37 direct connections deriving from these 4 “Critical Problems”.

“Restricted Problems” and “Buffering Problems” (Also, mentioned as “Passive”) are introduced by 10 components of the system, including 4 “Restricted” and 6 “Passive” ones. They make up majority of the system (10 out of 17), however, their resolution carries limited (below average) potential to positively influence on the overall situation and are more or less depended on mitigation of the other “problems”.

The clustering of the “Problems” provides information for first-approach determination of the sequence (steps) in problem solving strategy. In the case study it starts with improvement of infrastructure, upgrading qualification of local business community and development of partnership among local entrepreneurship. This stage will assumedly help to resolve standing “Critical problems”, which in turn produce the maximum positive effect on improving the conditions for sustainable tourism development in one of the Caucasus mountain destination – Tsagveri.

4. Discussion and Conclusions

While a destination related problems usually are well realized by affected businesses and stakeholders as a standing alone challenges (occasionally along with the noticeably and directly related other

problems), it is virtually impossible to understand the whole web and structure of their relations without special scientific research. Hence, understanding of these connections is considered as important and even necessary knowledge for making decisions on problem-solving strategy and rational development of destinations.

As can be seen, the proper combination of triple-bottom transdisciplinary approach with the system analyses methodology and with the relevant research techniques, allowed executing a combined study of social, economic and environmental challenges of sustainable development in a destination. Specifically, the applied 3-step methodology – determination and classification of links between initially identified “Problems” of a destination; sorting them by number of connections and balance of incoming/outgoing connections; followed by clustering the problems and identification of those with highest leverage potential – produces valuable results for planning a problem-solving strategy. It is expected that the mentioned above methodology with common system analysis approach, would need certain adjustment in studies of a specific tourism destinations.

The given research was focused on “Problems” representing a kind of “Factor” in the commonly used dynamic system concepts. We applied a bi-nominal matrix to identify connections between the “Problems”, instead of commonly used matrix with scoring these connections (Wirth et al. 2014; Freyer et al. 2017) The applied bi-nominal matrix simplifies the results but reduces the risk of incorrect answers by less or inexperienced in market economy business respondents and stakeholders. Some modification has been made in clustering the “Problems” and expressing the results in quadrant (system grid) graphs, in order to emphasize the role of high-leveraged “problems” in the case study.

In practical terms, the determined inter-relations between the identified “Problems” and their priority sequencing for the development of sustainable tourism in the study area are viewed as typical for mountain and, in some cases, special for the Caucasus regions. These features are mainly due to transitional processes of local social and economic conditions, along with typical for mountain regions ecologically sensitive environment. Poorly developed infrastructure, as a prime problem (#1), looks typical for mountain areas (Wirth, 2013), but has a special importance in countries with still emerging economy, lacking of sufficient resources for the development of costly infrastructure in remote mountain destinations. In addition, the natural environment and complicated relief of mountain landscapes boosts the cost of infrastructure, like everywhere in the World. The other two “Leverage Problems” – “Shortage of local qualified personnel...” (#8), and “No cooperation among entrepreneurs...” (#9)”, currently can also be considered as more specific for Caucasus destinations, which are part of countries with emerging marketing economy and with roots in centrally-planned one. This transition status well explains the lack of experience among local population in doing business under the developing rules of market economy, free market competitive environment, and needs in marketing activities. The regional specifics are further emphasized by ambivalent “Critical Problems”, which are logical extension of the “Leverage Problems”. The weak regional cooperation (#10), absent of long-term vision (#12), lack of small enterprises...” (#15) and of extensive service/business consultations for entrepreneurs (#16) in combination are specific attributes for economically underdeveloped and remote mountain areas. We believe that the same approach can be applied in other destinations of Caucasus region as well.

According to a scatter graph insufficient tourism products/experiences, non-competitive local product, and lack of involvement of local population belong to the category of restricted problems of long-term solution. Likewise, the mitigation of seasonality problem is also considered as a time-consuming process connected with the development of off-season tourism services. Numerous “Buffering Problems” such as accessibility of local transport services, scarcity of food supply, safety and security issues, difficulties of taking loans, lack of tourism facilities, and the relevant marketing information on the

destinations are broadly depended on general progress in the destination. Thus, they are considered as “passive” component in the problem-solving strategy.

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Conflicts of Interest

The authors declare no conflict of interest.

References

- Bertalanffy, L. (1968): General system theory. *Foundations, Development, Applications* p.32. New York: George Braziller (1973). Available online at https://monoskop.org/images/7/77/Von_Bertalanffy_Ludwig_General_System_Theory_1968.pdf.
- Burge, S. (2015): An overview of the Hard Systems Methodology. *In retrieved* April 18, p. 2017. Available online at <https://www.burgehugheswalsh.co.uk/Uploaded/1/Documents/Hard-Systems-Methodology.pdf>.
- Checkland, P. (1999): Systems thinking. *Systems Practice : Include 30 Year Retrospective*. 1999. *In Rethinking management information systems*, pp. 45–56. Available online at. <https://www.wiley.com/en-us/Systems+Thinking%2C+Systems+Practice%3A+Includes+a+30+Year+Retrospective-p-9780471986065>.
- Enengel, Barbara; Muhar, Andreas; Penker, Marianne; Freyer, Bernhard; Drlik, Stephanie; Ritter, Florian (2012): Co-production of knowledge in transdisciplinary doctoral theses on landscape development—An analysis of actor roles and knowledge types in different research phases. *In Landscape and Urban Planning 105* (1), pp. 106–117. DOI: 10.1016/j.landurbplan.2011.12.004.
- Freyer, B.; Fiala, V.; Paxton, R.; Dorninger, M.; Zangerle, K. (2017): System Development. System Analysis and Scenario Technique - Methods and Practises. Division of Organic Farming 933.310. Vienna.
- Frischknecht, Peter; Schmied, Barbara (2002): Umgang mit Umweltsystemen. *In Methodik zum Bearbeiten von*. GNTA (2018): Annual Report. Georgian Tourism in Figures. Georgian National Tourism Administration. Tbilisi. Available online at <https://gnta.ge/statistics/>.
- Hadorn, Gertrude Hirsch; Biber-Klemm, Susette; Grossenbacher-Mansuy, Walter; Hoffmann-Riem, Holger; Joye, Dominique; Pohl, Christian et al. (2008): Handbook of transdisciplinary research: *Springer* (10).
- Khaiter, P. (2008): General System Theory and System Analysis, 2008. Available online at <https://www.slideshare.net/joelogs/general-systems-theory-and-systems-analysis-presentation>.
- Khelashvili, I. (Ed.) (2017): Problem Identification in Tourism using the Transdisciplinary Approach (Georgia as a case). The 2-nd International Conference – Challenges of Globalisation in Economics and Business: Ivane Javakhishvili Tbilisi State University.
- Khelashvili, I. (Ed.) (2018): Social and Economic Challenges of Sustainable Tourism Development in Georgia. International Scientific Conference: Challenges of Globalization in Economics and Business. International Scientific Conference: Challenges of Globalization in Economics and Business. Tbilisi. Tbilisi: Ivane Javakhishvili Tbilisis State University.
- Khokhobaia, (2018): Transdisciplinary Research for Sustainable Tourism Development. In 18(2), pp. 21-26.
- Meadows, Donella H. (1999): Leverage points: Places to intervene in a system.

- Mehregan, M. Reza; Hosseinzadeh, Mahnaz; Kazemi, Aliyeh (2012): An application of soft system methodology. In *Procedia-Social and Behavioral Sciences* 41, pp. 426–433.
- Parliament of Georgia (2015): Law of Georgia on the development of high mountainous regions.
- Pohl, Christian; Hadorn, Gertrude Hirsch (2007): Principles for designing transdisciplinary research: *oekom Munich*.
- Rees, D. (Ed.) (2000): Integrating the " Hard" and " Soft" Sides of Systems Thinking. *A Case Study in New Zealand Local Government*. p. 527. ICSTM.
- Salukvadze, S.; Salukvadze, G.; Gugushvili, T.; Khokhobaia, M.; Khartishvili, L. (2018): Possibilities of Sustainable Tourism Development in the borough Tsagveri TSAGVERI,. Transdisciplinarity for Sustainable Tourism Development in the Caucasus Region. TSU. ResearchGate.
- Wirth, Timo von; Hayek, Ulrike Wissen; Kunze, Antje; Neuenschwander, Noemi; Stauffacher, Michael; Scholz, Roland W. (2014): Identifying urban transformation dynamics: Functional use of scenario techniques to integrate knowledge from science and practice. In *Technological Forecasting and Social Change* 89, pp. 115–130.
- WTTC (2018): Travel & Tourism Economic Impact. p.11. World Travel & Tourism Council. London. Available online at <https://www.wttc.org/-/media/files/reports/economic-impact-research/countries-2018/georgia2018.pdf>)

Analyzing Tourism Influence on Agricultural Products' Market: A Case Study of the Mestia Municipality, Georgia*

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Abstract: Mestia Municipality is a high mountain district of north-west Georgia, is located in the Greater Caucasus Mountain range. On the one hand, tourism is relatively new and rapidly growing economic activity in Mestia, but on the other, traditional economic activity of the population is agriculture. Analyzing linkages between tourism and agriculture is a vital part of sustainable development process of the municipality. The purpose of this paper is exploring and analyzing links between of tourism and changed/diversified agricultural market in Mestia municipality. The paper applies a triangulation method – qualitative in-depth interviews and desk research. MAXQDA is used for data processing. In-depth interviews were conducted with two targeted group: 1) Representatives of local community-driven economic activities; 2) Representatives of the tourism industry who operate in Mestia municipality. In total, 59 interviews were collected. The fieldwork revealed three main tendencies: 1) Tourism has impact on agricultural product's market in Mestia municipality. Agricultural products were sold mainly outside municipality before developing tourism. Now, tourism has created a great chance to realize productions inside region. 2) With the development of tourism, agricultural cultivated lands are decreasing in Mestia. 3) Rural tourism is emerging in the villages of Mestia Municipality.

Key words: tourism-agriculture nexuses, Mestia, agriculture, rural tourism.

1. Introduction

Tourism can generate many opportunities for local communities. It provides jobs to local people and also creates demand for local agricultural products (Anonymous, 2015). Tourism industry is also regarded as a tool for economic diversification and rural development, especially in developing countries and mountain areas (Gugushvili, *et al.*, 2017; Fwaya and Obonyo 2012). Therefore, exploring and clarifying the relationships between tourism and agriculture is important for future decision making process and sustainable development. Revealing these nexuses is exclusively considerable for Mestia Municipality for which tourism is relatively new economic activity.

Mestia Municipality is located in north-west Georgia, in Samegrelo-Zemo Svaneti province and belongs to the historical-geographical region – “Upper Svaneti” (Zemo Svaneti). It is surrounded by Greater Caucasus Mountain Ranges. Here is the village Ushguli, which is one of the highest permanent settlements in Europe (at an elevation of 2200 m). Mestia, the townlet, is located at an elevation of 1500 m. It is 128 kilometres away from Zugdidi (the capital of Samegrelo-Zemo Svaneti province) and 456

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kilometres away from Tbilisi, the capital of Georgia (Anonymous, 2019). According to the last Population Census (2014) the population of the municipality is 9 316 (there is no latest data).

People's traditional economic activities were farming and land cultivation in Mestia Municipality. We can see that through the flashback to the first Agricultural Census 2004 in independent Georgia. According to the Agriculture Census results (2004) 73.5% of region's holdings main activity was agriculture. Despite highlands typical natural limitations, agriculture (with forestry) was a major source of income for locals. Mestia Municipality has relatively better agronomic capacity for meat, potato, dairy products and beekeeping. Agro products were sold outside municipality, mostly in Zugdidi, before developing tourism industry in this region. This situation was related to extra costs of products transportation and other difficulties. So, this way of realization was uncomfortable and had low economic profitability.

Tourism is a growing industry both in Georgia and in Mestia municipality. According to Georgian National Tourism Administration, tourism share in country's GDP increases yearly as well as number of tourists. Local farmers in Mestia Municipality began to see tourism as an advantageous business and some of them decided to live traditional agricultural activity and go into tourism sector. As a result, the demand for local agricultural goods was created inside municipality. The emerged customers are: tourism food industry representatives, tourists and locals who abandoned or reduced agricultural activities. Thus, realizing products inside region makes farmers life easier.

Integrating with tourism, agriculture has a potential to generate increased growth and development in rural areas (Rogerson, 2012). Creating synergies between these traditional and contemporary economic activities should be the best option for inclusive economic growth in Mestia Municipality. Without any organized plans or politics, tourism has already created opportunities for domestic agricultural earnings. Such a huge impact requires detailed exploration. Especially that, interaction between these sectors is not necessarily positive because of competition for land and human capitals (Rogers and Taufu, 2012). Two less compatible situations – first, shifted and stimulated agricultural market and second, growing numbers of uncultivated agricultural lands – make this relationship very complicated.

There are sufficient numbers of studies relating to agricultural-tourism linkages at the international level. Most of them consider the cases of developing countries and classify the main factors, barriers and opportunities which influence the strength and type of the abovementioned relationship. Some of the revealed findings and considerations are familiar to Mestia Municipality - for example, the locals' lack of ability to guarantee supplies of high quality, competitively priced products on a consistent basis (Rogerson, 2012); absence of direct supply channels connecting customers and sellers in order to share information (Anonymous, 2015); relatively low returns offered by agriculture with respect to other sectors; local agricultural products' connection to other markets (Anonymous, 2010) and like that.

For ensuring the mutually reinforcing of tourism and agriculture, researchers suggest incorporation of tourism activities into rural life, such as agricultural tourism, community based tourism, and the nature based tourism. It is believed that those rural regions with unique cultural and natural charms can be tourist destinations themselves and attract tourists (Fwaya and Obonyo 2012). Mestia Municipality definitely has a special charm, because of the stunning landscapes and population living there, Svans, that is a linguistic and cultural subgroup of Georgians.

Researchers also examine and categorize the main types of relationships can exist between tourism and rural communities, namely: a) conflict; b) coexistence and c) symbiosis or 1) weak; 2) ambiguous and 3) strong linkages (Gurung, 2012). They use international examples to provide a realistic account of what meditations and partnerships are possible, including that challenges that both sectors may face (Anonymous, 2010).

There is no similar study about Mestia Municipality, but there are several researchers who work on tourism-driven economic changes and socio-cultural aspects of tourism services in Kazbegi, other high mountain region of Georgia. Georgian high mountain regions have many in common: limited economic potential; fragmented economic development; and consideration tourism as an engine of income and source of employment which can improve other related industries such as agriculture (Gugushvili et al, 2017).

This paper explains and analyzes the complex case - linkages between agriculture and tourism. It is interested in: tourism influence on changed agricultural outputs' market; how proactive is tourism industry in utilizing local products; if the local farmers are ready to meet tourism demand for quantity, quality, regularity and safety standards requirements in Mestia Municipality.

2. Material and Methodology

The present paper is related to the interdisciplinary research project – “Links between tourism and community-driven economic activities: shaping sustainability in mountain regions” – which was conducted in two high mountain regions of Georgia (Mestia and Kazbegi) in 2018. The project was initiated by Tbilisi State University in collaboration with the University of Giessen.

The research applies a triangulation method – qualitative in-depth interviews and desk research. The qualitative methodology is best suited to evolve understandings of local perspectives. In-depth interviews were conducted with two targeted groups, representatives of: 1) local community-driven economic activities and 2) the tourism industry that operate in Mestia Municipality. Respectively, two separate interview guides were prepared before field work and after a pilot study. Maximum variation purposive sampling was used to select respondents. It is not a probability sample. Respondents' selection process is based on characteristics that are relevant to a particular phenomenon. The purpose of this sample is to provide as much evidence as possible into the topic under study. In total, 59 interviews were collected (average duration of each interview was 30 minutes). The research area covered the center of municipality and other villages in 15 communities.

The research uses the Grounded Theory approach which is widely used in qualitative researches across a widespread of disciplines. Its main focus is not on testing existing theory, but focus on collecting data from the real world as a resource to be used in developing and building new explanations (Gugushvili *et al.*, 2017).

MAXQDA-qualitative data analysis software is used to data processing.

Secondary data were collected from various sources such as published journal articles, theses, workshops, conference reports and etc. The major statistical information about agriculture and tourism in Mestia municipality was requested and received from the National Statistics Office of Georgia and Georgian National Tourism Administration.

MAXQDA and Photoshop were used for data visualization.

3. Research Findings

Tourism food service sector created demand for agricultural products in Mestia Municipality. The fieldwork revealed that main locally-produced agricultural goods in order to realize are: meat; dairy products, namely, cheese for Khachapuri (Georgian national food) and local cheese “Svanuri Sulguni”; potato and honey; relatively less – “Svanuri Salt”. The region is almost a completely rural settlement. Only Mestia has a status of townlet. So, the locals' traditional and major economic activity was agriculture. Because every family had the same products, there was not a chance to realize agricultural outputs inside market, within the municipality (honey is the exception, it was and is sold both inside and outside market by reason of beekeepers comparably small number). Consequently, local farmer sold their agricultural products outside market.

After emerging tourism industry, the situation has changed considerably. With the growth of tourist's number, the hotels, guest houses and other types of lodges have appeared in the municipality. Other employment opportunities were generated outside the agricultural industry. Thus, a possibility of selling agro products inside region was created. This research made clear the specificity of each above mentioned products' realizing process.

During field work, official food safety regulation was strictly required for meat. Due to match this requirement, there is one licensed animal slaughter in Mestia. So, tourism industry representatives can purchase and locals can sell meat products in the region. But there is a big deficit. The capacity of farmers to meet the needs of tourism industry is quite limited. The number of cattle decreases while the demand increases (Figure 1).

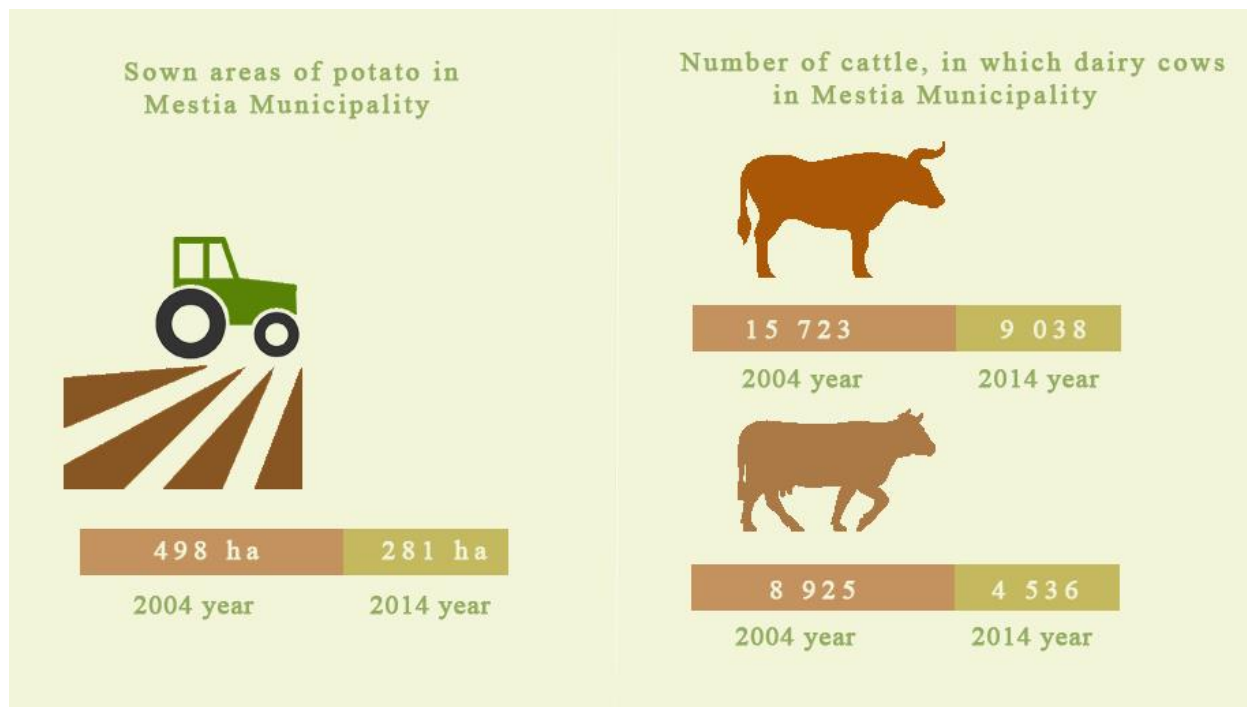


Figure 1. The sown areas of potato and the number of cattle in Mestia Municipality in 2004 and 2014 years.
Source: National Statistics Office of Georgia.

Figure 1 shows the results of the last two Agricultural Censuses hold in Georgia (there are only two Agricultural Censuses in independent Georgia). We see that the capacity to produce the Municipality's main products is dropped sharply. There is no latest statistics, but based on the in-depth interviews, the numbers are likely to be lower.

As for dairy products, cheese, most local producers shifted realization markets from outside to inside municipality. But some farmers living peripheral villages with respect to Mestia and Ushguli (the main tourist destinations) still sell their goods in Zugdidi or other markets. Meanwhile, the tourism industry and the entire municipality are face to the shortage of local cheeses. Buyers fill this deficit from other regions or by even imported products.

It is noteworthy that local potato is characterized by high seasonality. As a result of highlands inclement, local potato can be used in fall, not in summer, during the boom of tourism. So tourism industry mostly is dependent on outside products. On the other hand, during potato season in the municipality, they buy local ones. Also, the "distribution cars" come to the region to sell or exchange

goods in the natural barter way. This circumstance is also advantageous for the residents; they can realize their products even without leaving homes. *“My parents brought potatoes to Kutaisi and sold them there. Then they bought flour, oil, sugar, products which family needed for winter supplies. Now the “distribution cars” come to our homes and we can exchange these products easier.” (Female, Age 31)*

Step by step, tourism is expanding to villages. While in Mestia most people left agriculture and moved to tourism industry, villagers lead them both. It seems to be the beginning of the rural tourism development. Host locals offer tourist to get involved in cuisine, the process of making local specific foods or some rural activities. This encourages direct sales of farm products to tourists. Guest houses in villages were likely to consume more local agricultural products as they required smaller quantities which could be easily provided by local farmers or themselves, by the owners of the lodges who lead agriculture too. As a result, livelihoods which are involved in both sector, are producers and consumers of agro products at the same time.

On the base of the fieldwork, tourism does not give stimulus to agriculture in terms of product growth. Its impact is reflected in the changed realization market yet. *“For my family, the volume of produced agricultural products has not changed after tourism development. But now, doing agribusiness is more enjoyable and appreciated.” (Male, Age 68)*

Due to the scarcity of produced agricultural goods and the absence of food safety evidence, local farmers are not regarded as the stable supplier for tourism food industry. Nevertheless, local products are widely perceived as high quality and tasty ones. Accordingly, the demand for them is also high.

One of the main reasons of the mismatch between supply and demand is the absence of intermediaries. Finding potential buyers or sellers is absolutely dependent on social network and informal relationships.

On the one hand, tourism representatives think that the priority is purchasing local agro foods, but they face to several barriers. On the second hand, among people, agriculture is not considered as an economically profitable sector. *“Agriculture is hard working, time-consuming and unprofitable. Do you know how hard is working as a farmer? Mowing, feeding the cattle, they need to be in the different pastures. Every day you have to take care of them, follow them and it is very labour-consuming. I am very experienced man and believe me, agriculture has never been profitable.” (Male, Age 60)*

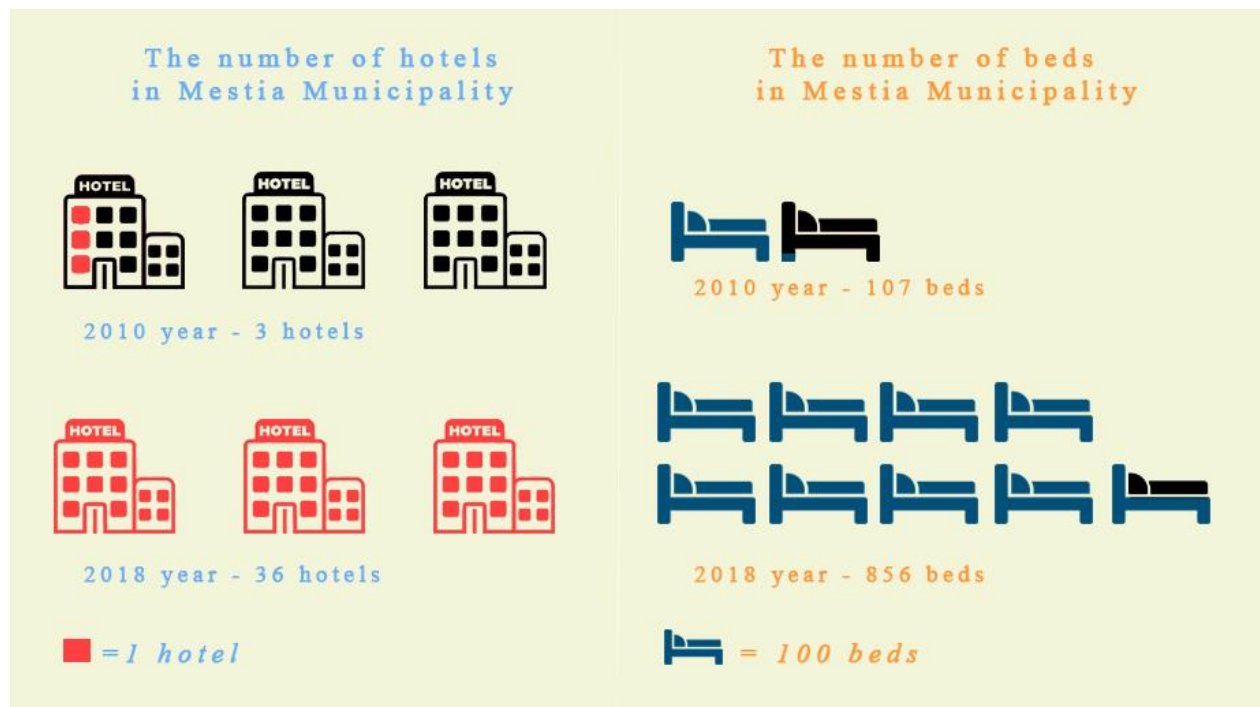
Apparently, tourism has a great influence on agricultural products' market, but they do not develop coordinately and equally. If the tendency of losing agricultural lands and reducing rural activities keeps going, it will be self-destructive for tourism industry too. So, the municipality has to make reasonable plans, reinforces agriculture to meet the need of increasing tourism sector and catches all the positive possibilities which are made by tourism development.

4. Discussion

Tourism-driven demand for greater variety and higher quality food should encourage farmers to increase productions (Torres, 2002), but this is not the case in Mestia Municipality. Georgian agriculture and farming system in general, which is characterized by land fragmentation, should explain the inability of local farmers to fulfill completely tourism-driven demand for agro products. Small and scattered lands could not be the best basis to effective and sufficient agribusiness. More, without technology and modern approaches agriculture is doomed to loss. According to the Agriculture Census results (2014), there are only 32 holdings owning working tractors or hand tractors in the entire Mestia Municipality. Highland's natural limitations make this disadvantageous even worse. Another barrier is unsatisfactory inter-municipality infrastructure (roads connecting the villages) and the absence of inter-municipality public transport.

Considering all this factors, tourism competition with agriculture for land and labour seems to be ended with tourism's favor. *"The half of agricultural lands is uncultivated. People do not want to expend physical energy for agribusiness. They prefer to use resources in tourism or tourism related activities. Also, it seems that imported food is cheaper and affordable."* (Male, Age 60)

Agricultural land loss is common in Mestia after emerging tourism. "Figure 2" shows the numbers of hotels and beds in Mestia Municipality. This data is not comprehensive because it does not include



other types of lodges. However, it clearly explains the tendency. Almost every family in Mestia is able or wants to be able to host tourists.

Figure 2. The numbers of hotels and beds in Mestia Municipality in 2010 and 2018 years.
Source: National Statistics Office of Georgia

In result, many traditional practices and foods are not being followed and are in danger of being lost. According to the respondents' thoughts, Mestia and Ushguli are the core destinations for tourists, so, other villages should maintain agriculture and become regular suppliers. Tough, actually, almost every grant and credit possibilities for locals are used to develop or create tourism business. *"Since then, credits became available for the population, everyone did two things – first of all repaired houses and made them as guest houses and secondly, they bought "Delica" (the car). That way is an easy source of income. When someone earns 200 Gel (the currency of Georgia) per day by using only "Delica", he does not lead agriculture which is like fortune – either there will be a good harvest or not."* (Female, Age 40)

Despite of this complex situation, local products still remain widespread respect. *"If local farmers have sufficient volume of products, I will purchase them with a great pleasure. Using local agricultural goods is my hotel's prestige"*. (Male, Age 25) Most of the tourism representatives are aware of the fact that consumption of local food is recognized as an essential part of their activity because local cuisine and culture are attractions themselves and shape the tourist experience (Anonymous, 2015).

As for farmers who are still selling products (particularly, "Svanuri Sulguni"), outside the municipality, there are several explanations: 1. The main outside market Zugdidi is a capital of a historical

province Samegrelo. Mingrelians (people live in Samegrelo) have special traditional meals for which “Svanuri Sulguni” is a perfect ingredient. So, in Zugdidi the demand for this cheese is constant. Also, Zugdidi is a bigger city and has more opportunities to distribute and to consume products; 2. Before selling, farmers accumulate the whole cheese throughout the year, then go to Zugdidi (or other bigger city) in fall or in winter, when the prices are higher and realize all of them. In return for, they bought essential goods for their families. So, they pay extra transportation cost only once and sell the whole product; 3. Hotels required good quality, regularity of supply and agreements. This requirement is recognized as difficult and they choose the simple traditional way of realizing products.

On the base on interviews, tourists have a desire to try authentic locally produced food and like interactions with local people in the villages. Rural areas are perceived as healthier, offering fresh air and the opportunity for outdoor recreations (Irshad, 2010). This interest is well matched throughout guest houses in the villages. Rural tourism development can provide farmers with an alternative income source. It can also serve social purposes by keeping farmers on the land (Che *et al.*, 2005). Rural tourism is also an integral part of various government organizations and their strategic documents (Dax *et al.*, 2019). But local farmers think that doing both type of business is very challenging and difficult to accomplish it.

To sum up, without technological advances in agriculture and promoting farmers with essential knowledge about marketing issues, agribusiness in Mestia Municipality will be disorganized and less competitive. Filling existing gaps in agriculture increases tourism contributions to local community. Improved agriculture sector makes chance to build strong and positive linkages between them which can produce sustainability in both industries. Also, creating some kind of cooperation platform for customers and product producers, for example websites, will provide supply chain efficiency.

5. Conclusions

The research shows that indeed tourism has a huge impact on local community, both in a positive and negative way.

Positive influence is reflected in generating revenues and creating chance to local farmers to sell their products inside municipality. Despite that agriculture in Mestia municipality has lots of defects and is not sufficiently developed, tourism industry is interested in locally produced foods. But due to ineffective communication system and agriculture shortcomings, opportunities created by tourism are not wholly handled by local farmers.

The negative side is that these two industrial sectors are developing chaotically. A boom in tourism resulted in abandoned agricultural lands and reduced products. This way of development is extremely risky. Instead of diversified economy and promoted local natural products as niche of the municipality, it may bring loss of rural activities and environmental charms on which tourism is dependent.

To counterbalance the negative unfavorable effect, emerging rural tourism in villages seems to be hope to viable agriculture and synchronized improvement of these major sectors. To embody that hope organized cooperation is needed involving locals, experts, government bodies, tourism and other economical industries, NGOs and other stakeholders.

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References

- Anonymous. (2015). *Enhancing Linkages Between Tourism and the Sustainable Agriculture Sectors in The United Republic of Tanzania*. United Nations Publication.
- Anonymous. (2010). *Inclusive Tourism: Linking Agriculture to Tourism Markets*. Geneva: International Trade Center.
- Anonymous. (2016). *Policy Setting for Improved Linkages Between Agriculture, Trade and Tourism: Atrengthening the Local Agrifood Sector and Promoting Healthy Food in Agritourism*. Port-Vila: Government of Vanuatu.
- Anonymous. (n.d.). *მდებარეობა, განლაგება, მუნიციპალურიცენტრი*. Retrieved August 30, 2019, from მესტიის მუნიციპალიტეტი: <http://mestia.gov.ge/ge/mdebareoba-ganlageba-municipaluri-centri>
- Che, D. Veek, A. Veek, G. (2005). Sustaining Production and Strengthening the Agritourism product: Linkages Among Michigan Agritourism Destinations. *Agriculture and Human Values* , 225-234.
- Dax, T. Kharatishvili, L. Khelashvili, I. Muhar, A. (2019). Rural Tourism in Georgia in Transition: Challenges for Regional Sustainability. *Sustainability* .
- Fwaya, E. Obonyo, G. (2012). Integrating Tourism with Rural Development Strategies in Western Kenya. *American Journal of Tourism Research*
- Gugushvili, T. Salukvadze, G. Salukvadze, S. (2017). Fragmented Development: Tourism-driven Economic Changes in Kazbegi, Georgia. *Annals of Agrarian Science*, 49-54
- Gurung, L. (2012). *Exploring Links Between Tourism and Agriculture in Sustainable Development: A Case Study of Kagbeni VDC, Nepal*. Lincoln University.
- Irshad, H. (2010). *Rural Tourism - an Overview*. Government of Alberta. Agriculture and Rural Development.
- Rogers, S. Taufu, L. (2012). *Agriculture and Tourism Linkages in Pacific Island Countries*. Food and Agriculture Organization of the United Nations.
- Rogerson, C. M. (2012). Strengthening agriculture-tourism linkages in the developing World: Opportunities, barriers and current initiatives. *African Journal of Agricultural Research* , 616-623.
- Torres, R. (2002). Toward a Better Understanding of Tourism and Agriculture Linkages in the Yucatan: Tourist Food Consumption and Preferences. *Tourism Geographies* , 282-306.

Southern Caucasian Students' Perceptions of Turkey and Turkish People

Güney Kafkasyalı Öğrencilerin Türkiye ve Türk Algısı

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Abstract: This study aims to measure and analyze the perceptions and attitudes of South Caucasian students, who have been educating in Turkish higher education institutions, on Turkey before and after their arrival in Turkey within the framework of the “soft power” mentality, that Turkey has recently opted for. Via the survey establishing the core of this study, it is intended to measure whether there is a change of perception on Turkey before and after the students' arrival in Turkey, and if there is a change of perception, this study tries to understand the direction of it. Moreover, this study also targets to put forward the common values between Turkey and South Caucasian countries, as well as to advise on what can be done to develop cooperation in the field of education and to strengthen the cultural ties and, additionally, social memory among regional countries. In other words, this study intends to put forward whether the South Caucasian students' perception of Turkey has progressively developed during their stay in Turkey.

Key Words: Perception Survey, South Caucasian, Turkey, Azerbaijan, Georgia, Armenia.

Özet: Bu çalışma Türkiye'nin son dönemde geliştirdiği “yumuşak güç” anlayışı çerçevesinde Türk yükseköğrenim kurumlarında eğitim gören Güney Kafkasya kökenli öğrencilerin Türkiye'ye gelmeden önce ve geldikten sonra Türkiye'ye yönelik algı ve tutumlarının ölçülmesi ve değerlendirilmesini amaçlamaktadır. Bu çalışmanın odak noktasını oluşturan araştırma ile Güney Kafkasya ülkelerinden gelen öğrencilerin Türkiye'ye gelmeden önce ve geldikten sonra Türkiye hakkındaki algıları arasında bir değişim olup olmadığı ve değişim söz konusu ise bu değişimin ne yönde olduğunun ölçülmesi planlanmaktadır. Bununla beraber bu çalışma, Güney Kafkasya ülkeleri ile olan ortak değerlerin ortaya konulması, bölge ülkeleri arasında özellikle eğitim alanındaki işbirliğinin geliştirilmesi, Güney Kafkasya ülkeleri ile Türkiye arasında kültürel bağların ve buna ek olarak toplumsal belleğin güçlendirilmesi için neler yapılabileceği noktasında bazı çıkarımlar yapmayı da öngörmektedir. Diğer bir deyişle bu çalışma Türkiye'ye gelen öğrencilerin Türkiye'de buldukları süre zarfında Türkiye hakkındaki algılarının pozitif yönde gelişip gelişmediğinin tespitini de amaçlamaktadır.

Anahtar sözcükler: Algı Anketi, Güney Kafkasya, Türkiye, Azerbaycan, Gürcistan, Ermenistan.

1. Introduction

With the end of the Cold War, some existing concepts of international relations had begun to be elaborated with a new understanding beyond their conventional meaning. One of such redefined concepts, whose conceptual borders have been broadened, is the concept of “power”. Classical theories of international relations, especially realism, define power within a political/military context and perceive states as power-maximizing actors within the international system. On the other hand,

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when the rigid bloc system of the Cold War began to loosen starting from the 1970s and particularly after the end of the Cold War, students of international relations began to think that economic and socio-cultural potential of states has been as significant as their political and military resources in terms of power production. Therefore, as Joseph Nye indicates, the concept of “soft power”, instead of “hard power” denoting political and especially military power, has begun to be used. Briefly defined, soft power is the capacity of a particular actor to change the preferences of another actor without using military power. In other words, soft power can be described as a political actor’s use of persuasion and consent instead of military power, in order to direct another political actor in line with its own interests (Nye, 2004: 5-11).

The most significant motivation for the conduct of this study is the intent to contribute to the determination of the problems that foreign students from South Caucasia in particular and foreign students in general encounter during their stay in Turkey. Therefore, it is planned that this report will be sent to the relevant bureaucratic units dealing with foreign students in Turkey in order to (1) increase the awareness of the relevant authorities on the problems encountered by the foreign students and (1) to strengthen their will to take initiatives for resolving these problems. The prospective amelioration attempts by these authorities with regard to the solution of the problems encountered by foreign students in Turkey would also contribute to a more positive perception of Turkey in South Caucasian states.

Recently, there emerged a significant rise in the number of foreign students coming to Turkey for getting their undergraduate, graduate and doctoral degrees and all universities tried to enhance their institutional capabilities to meet the expectations of these students. However, when it comes to the region of South Caucasia, in terms of institutional capabilities, there seem to be some deficiencies compared to the other regions of the world. To start with, within the Turkish universities and the departments of international relations, except for a few research institutes, there are not many research centers dedicated to research on the Caucasian region. In other words, this lack of interest in the region resulted in difficulties in understanding the specific problems of the South Caucasian students in Turkey during their education and stay in this country. Particularly, since the South Caucasian graduates from Turkish universities will come up with significant governmental, business and academic positions in their home countries, they will contribute to the bilateral relations between Turkey and their home countries. The positive attitudes and perceptions developed by these students in Turkey during their stay would enhance the future international relations vision of Turkey as well as strengthen the soft power elements developed by Turkey towards South Caucasia. Therefore, this study aims to contribute to the increase the awareness of the Turkish educational decision-makers towards the problems experienced by South Caucasian students in Turkey and to inspire them to ameliorate these problems as much as possible.

2. Literature Review

Generally speaking, the perception surveys on foreigners’ perceptions of Turkey is very important considering the betterment of Turkey’s external image. A significant part of these perception surveys, on the other hand, is the surveys made with the foreign students. Within this framework, the research on the perceptions of students from South Caucasia, with which Turkey has had deep historical, cultural, political and economic ties, with regard to Turkey and Turkish culture, is strategically important for the determination of the policies designed towards the countries of this region.

The previous perception surveys with regard to Turkey show a great focal variety. Some of these studies were conducted over foreigners living abroad, while some others were conducted on foreigners learning Turkish as a foreign language focusing on their ability to learn Turkish as well as their perception of Turkish language and Turkish educational system (Tunçel 2016: 107-108; Güleç ve İnce, 2013: 95-106; Karatay ve Kartallıoğlu, 2012: 1-11). Other perception and attitude surveys on Turkey also include studies on the perceptions of foreigners, who either live abroad or live in Turkey,

and studies on the perceptions of Syrian refugees in Turkey, whose numbers have recently increased tremendously (Yirik- Uslu-Küçük (2015), 263-282, Dalar, Ayhan ve Ataman (2012), 33-37, Yıldız (2015), 141-169).

Besides, there are some studies on Caucasian and European students in Turkey, whose numbers are very limited, and therefore, their place in the literature is very much insignificant. For example, the survey made by Aliyev and Ögülmüş, entitled "An Investigation of Foreign Students' Perception of Intercultural Interaction in Turkey" was performed over 220 participants from Azerbaijan, Kyrgyzstan, Kazakhstan, Turkmenistan, and some European countries including Croatia, the Netherlands, the United Kingdom, Czech Republic, and Slovakia. This study argues that the students coming from Caucasian and Central Asian countries accommodate themselves better in Turkey compared to the students coming from European countries (Aliyev ve Ögülmüş, 2015, 63). According to Aliyev and Ögülmüş, the reason for higher interaction points of Caucasian/Central Asian participants is that similar cultures facilitate accommodation (Aliyev ve Ögülmüş (2015), 64).

Güleç and İnce performed a study via a direct interview with students from countries from different parts of the world including Turkmenistan, Yemen, Kuwait, Azerbaijan, Crimea, Uzbekistan, Colombia, Bosnia-Herzegovina, Serbia, Mongolia, Bulgaria, Kyrgyzstan, and Russia. In this study, they tried to assess the alimentation, dressing and entertainment trends of the students since their arrival in Turkey. The universe of the survey is formed by 138 Turkic or non-Turkic students from Sakarya University Turkish and Foreign Languages Research and Application Center (Türkçe ve Yabancı Dil Araştırma ve Uygulama Merkezi - TÖMER) and the sample of the survey is formed by 29 students from 13 different countries who had attended the education programs of this center. The results of this study revealed that the students had not many troubles in terms of dressing but have some problems with regard to alimentation and entertainment (Güleç ve İnce (2013), 98).

In another significant survey made with 15 foreign undergraduate students (from Azerbaijan, Turkmenistan, Kazakhstan, Mongolia, Greece, Uzbekistan and Georgia) studying in Turkey through semi-structured interview method, it was stated that the students had not experienced any kind of prejudice and exclusion in Turkey because of cultural proximity between Turkish culture and their own cultures. Moreover, this study tried to find out what kind of problems that these students have experienced in Turkey during their study, whether these problems influenced their studies and if they influenced their studies to what degree this influence was experienced. The results of this study revealed that although the foreign students had some degree of financial problems, they had not much-experienced accommodation problems (Kıroğlu, Kesten ve Elma (2010), 26-39).

In addition to the above-mentioned research, a more specific survey was conducted by Özdaşlı on the effects of the Armenia-Azerbaijan conflict and the impact of Turkish regional politics on Azerbaijani students. This survey, entitled "A Research for the Viewpoints of Azerbaijani University Students on Turkey-Azerbaijan Relations after Armenian Opening", evaluated the reconciliation attempts between Turkey and Armenia peaked at 2009 with the protocols signed between these two states and aimed to assess the attitudes of Azerbaijani students on this reconciliation process through questionnaires applied on 208 students via internet (Özdaşlı (2015), 318-326).

Another interesting study is entitled "Social Problems of Foreign Higher Education Students in Turkey: Case Study in SAP Region Universities". This study argues that foreign students generally preferred to go to European countries for studying because of the educational opportunities present in the European countries (Paksoy, Paksoy ve Özçalıcı (2012), 85-94).

In addition to these academic publications in Turkey with regard to the perception of foreign students with regard to Turkey, there are also some graduate theses in which this issue is thoroughly analyzed. One of these theses was prepared by Baki Karabayev, whose field research was performed on 372 students coming from Turkmenistan, Kazakhstan, Azerbaijan, and Kyrgyzstan and studying in six different universities in Turkey. Different from the conventional literature this study argues that the negative perceptions of these students towards Turkish people are higher than their positive perceptions (Karabayev (2001)). Another point emphasized in this study is that although foreign

students came to Turkey with positive perceptions in mind, after they have lived some time in Turkey and got to know Turkey more; in other words, their perceptions became more negative as they acquainted with Turkish culture more (Karabayev (2001), 18).

Another thesis prepared by Bozkaya and entitled “The Perception of Armenian University Students and Academicians Living in Armenia on Turkey’s Membership to the European Union” and it examines the perception of the Armenian students and academicians on Turkey instead of foreign students living in Turkey. Özkaya argues that the existing perception of Turkish and Armenian communities was based on 1915 incidents which resulted in prejudices in front of mutual understanding. This survey was made in line with a questionnaire applied towards 444 Armenian students and academicians in Yerevan and it was a thorough study on their perception of Turkey’s prospective membership process to the European Union (Bozkaya (2016)).

Again, although not much relevant to this current study, another graduate thesis prepared by Terzi entitled “Turkey’s Grand Student Project” is quite conspicuous (Terzi (2013)). In this survey, Terzi’s sample group was the foreign students with scholarships, who came to Turkey for studying since 1992. Not only the questionnaires and interviews with these students but also the letter of intentions that these students had prepared for their application in Turkish universities were studied in this survey in order to put forward these students’ perception of Turkey and the problems that they had encountered during their stay in this country. The sample group was mainly formed by students coming from Central Asian Turkic Republics and countries like Bulgaria, Macedonia, Kosovo and Iran in which many Turkic communities have been living. The reason for these students to choose Turkey as a country of study were found as the higher quality of education, higher quality of the academic cadres, international recognition of Turkish university, special opportunities provided by Turkey, the impact of former graduates of Turkish universities and presence of Turkish language as the language education (Terzi (2013)). Moreover, in this survey, the data delivered from the exchange programs such as Fulbright program of the US, Chevening program of the UK and DAAD program of Germany, was compared with the data obtained from the questionnaires and interviews and some proposals were made for the amelioration of the “Turkey’s Grand Student Project”.

Another significant study made on the social activities of the foreign students studying in Turkey was the graduate thesis entitled “The Factors That Effect Foreign University Students Social Adaptation”. This study mainly analyzes the problems that the foreign students have encountered during their study in Turkey such as the problems of adaptation as well as the factors of age, gender, financial situation, accommodation, the city of living, friendship relations, and participation to socio-cultural and sportive activities together with their level of content with their education.

Additionally, another important research on this topic is the graduate thesis entitled “Kayseri, Turkey and Islam Perceptions of the Foreign Students Who Study in Kayseri”, whose results are published as an article. In this article, it was revealed that there are positive and negative implications of long-term living in Turkey on the foreign students’ perception of Turkey. (Göver ve Yavuzer (2015), 1027).

In addition to these academic publications, a questionnaire made in 2012 by one of the most important research institutes particularly in the field of Turkish Studies, Wise Men Strategic Research Center (Bilge Adamlar Stratejik Araştırmalar Merkezi - BİLGESAM), is one of the most significant studies on the perception of Turk and Turkey in Armenia. As a result of the field research with a sample group of 387 people, it was found out that the least level of sympathy of the Armenian people was towards the Turks (% 24,4) (Akyürek ve Bilgiç (2012), 19). Another important point touched upon in this study was that the sympathy felt towards the Turks by Armenians who had visited Turkey or who had met with the Turks was higher compared to others. According to the authors, it is because of the lack of knowing each other, which nurtured existing prejudices and enmities among Turkish and Armenian peoples (Akyürek ve Bilgiç (2012), 20). Although this study presented significant data in order to ameliorate Turkish-Armenian relations since it was designed for understanding the perception of Turk and Turkey by the Armenians, it did not comprise the Armenian students who had been or is

still being present in Turkey for studying. Therefore, it fails to explain positive or negative changes emerged out of living in Turkey for a long time on the perception of Turk and Turkey.

All in all, most of the studies on the perceptions towards Turkey and Turkish people focus on the resident foreigners in Turkey, while there are some surveys in the literature on the perceptions of the foreign students. Among these studies, while there were some focusing on Georgian and Azerbaijani students, the most significant problem in the literature is the lack of enough studies on the Armenian students in Turkey. Moreover, there emerge some inconsistencies when these studies are analyzed comparatively. The most important contribution of this study, on the other hand, is its simultaneous analysis of the perceptions of Georgian, Armenian and Azerbaijani students on Turk and Turkey as well as the socio-cultural problems that they have been encountering in Turkey in a comparative manner.

3. The Purpose, Scope, Limitations and the Research Methodology

In line with the data obtained as a result of a questionnaire applied on a sample representing the target group, this project aims to compare and contrast the perception of South Caucasian students, who have been studying in Turkey, on Turkey before and after their arrival in this country as well as to reveal relevant data for determining the strategies and precautions in order to maximize the outcome of the opportunities provided for these students. Thereby, it intends to answer whether the presence in Turkey for educational purposes has any impact on the sharpening of the perceptions of Turkey and if there is such an impact, whether it shapes this perception positively or negatively.

In this survey, students from Georgia, Armenia, and Azerbaijan, who have come to Turkey for language education as well as for undergraduate and graduate studies are randomly chosen and interviewed. During these interviews, the students are expected to continue their studies in a Turkish institution and still live in Turkey. Moreover, they are expected to spend at least three months of their academic life as a student in one of the educational institutions in Turkey even including the fields of music, art, and theatre.

During the preparation phase of this study, first, a thorough literature survey is accomplished in a way to examine similar studies. As a result of this literature survey, it is found that no particular study comprising the perceptions of South Caucasian students has existed. It is also understood that as a result of the bilateral problems emerged out of the lack of diplomatic relations between Turkey and Armenia, the closure of the Turkish-Armenian border and the recognition of 1915 Armenian relocation as genocide in Armenia, the number of Armenian students in Turkey is negatively affected. Indeed, most of the survey companies, which have been consulted in preparing this report, stipulated that it would be problematic to conduct such a survey for the Armenian students because of inadequate number of Armenian students in Turkey and the reluctance of most of these students in participating in the survey because of their fear of revealing their identities. This problem turned out to be the most important problem during the preparation of the survey and could only partially be overcome via the efforts of the Armenian associations in Turkey. Only after the persuasion of some Armenian students by these associations, the survey could be conducted on a limited number of Armenian students. These students were assured of the protection of their identity through a quality standard for researchers known as "Trustworthy Research Certificate" and only after that they accepted to participate in the survey. These delays emerged out of the persuasion process of the Armenian students resulted in the demand for additional time for the conduct of the survey unexpected in the project schedule. Despite all these efforts, the number of Armenian students participated in the survey was just 16, compared to the 55 Azerbaijani and 58 Georgian students.³ Therefore the total number of students interviewed was 129.

³ Indeed, in order for the data obtained through a survey to be influential in determining future strategies, the minimum number of statistically reportable sample is generally accepted to be 30. The data obtained from the number of samples below that cannot be accepted as concrete data though they can be considered for evaluation. The difference of the number of samples among groups is important in determining the difference of magnitude of percentage ratios for comparison between two groups. Therefore, in the research with different sample groups, the difference between the number of participants influence the analysis and evaluation procedures.

Another limitation of this survey is the geographical limitation. This study solely focuses on the South Caucasian students coming from Armenia, Georgia, and Azerbaijan. Of course, it can be said that the evaluation of the perception of students, coming to a broader region including North Caucasia or Caucasia in general, on Turkey before and after their arrival in Turkey, might have produced more fruitful results. However, the limits of this survey are determined as South Caucasia and this study is expected to open the way for researchers for further and similar research on North Caucasia or Caucasia in general.

The third limitation of this survey is the lack of a particular higher education institution in Turkey providing education directly for the Caucasian students. Therefore, the students with which the interviews have been conducted are determined through the data obtained from the system of Higher Education Council (Yüksek Öğretim Kurumu – YÖK). Through this data, it is possible to determine the department preferences of the students coming from South Caucasia to Turkey for higher education. The departments most widely preferred by the Georgian students are Theology, Medicine, Law, Tourism, and French Language Teaching. The basic choice of Azerbaijani students seems to be Business Administration, while Economics, Mining Engineering, Tourism, and Law are other important fields of study. The Armenian students, on the other hand, generally prefer French Language Teaching and Tourism, however, the inadequacy of the number of Armenian students should be kept in mind.

The survey is made in accordance with the previous data and performed in educational institutions where South Caucasian students are studying and thanks to the help of some associations and a wider distribution of students is tried to be accomplished. The number of interviews during the survey is shown in the figure below:

Figure 1. The number of questionnaires and percentages of foreign students with regard to their nationality

The nationality of the student	The number of questionnaires	The percentage according to nationality
Azerbaijan	55	%42,6
Georgia	58	%45,0
Armenia	16	%12,4

In the survey, the primary data gathering technique is used. The questionnaires are performed in the institutions of the students by random choice and the face-to-face questionnaire (paper-pen) method is employed.

The field research was made in universities with a random choice between 1 and 27 March 2017. The questionnaires were performed in eight universities via face-to-face interviews. For these questionnaires, during the field research field control, and after the field research telephone control was made. For the field research, the questionnaires were controlled by 20 % by telephone and 10 % in the field.

There are nine demographic questions (the questionnaire form – section 1) and five other questions asked to understand the students' perception of Turkey. The demographic questions are about gender and age of the students, the time period that they have spent in Turkey, the province of residence in Turkey, the financial situation of their families and their scholarship situations.

22 questions were asked to the students about their educational process in Turkey. Some statements are given to the students in order to assess their perceptions of Turkey before and after their arrival in this country and what they thought of these statements was asked. The statements are organized with a 5-point Likert scale and the degree of students' agreement with these statements was

tried to be measured. The evaluations towards these statements were as follows: 5 for “absolutely agree”, 4 for “agree”, 3 for “neither agree nor disagree”, 2 for “disagree”, 1 for “absolutely disagree” and 9 for NA/NI (no answer / no idea).

4.The Analysis and Results of the Survey Conducted with South Caucasian Students

4.1. Demographic characteristics

As illustrated in Figure 2., when the gender distribution of the students is examined, 58,9% of the students are male and 41,1% of the students are female. In addition, as can be seen in Figure 3., while most of the of the Azerbaijani students are males (51,9 %), the students from Armenia and Georgia are mostly females (20% and 43,9 % respectively).

Figure 2. Gender distribution of the students

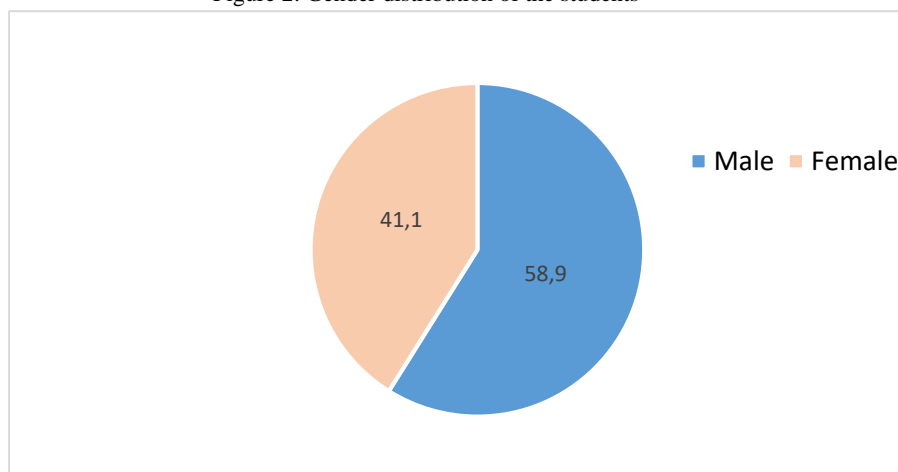
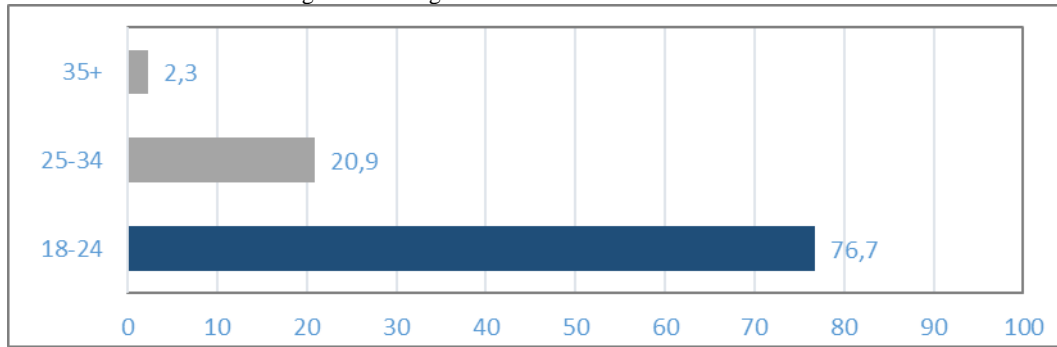


Figure 3. Gender distribution of the students with regard to their nationality

Nationality of the Student	Male	Female
Georgia	%41,6	%43,4
Azerbaijan	%51,9	%35,8
Armenia	%6,5	%20,8
TOTAL	%100	%100

Below- presented figure (Figure 4.), on the other hand, illustrates the age distribution of the foreign students who attended the survey. As it is illustrated in the figure, when the age distribution of the respondents was examined, most of the students (76,7%) are between 18 and 24, while 20,9 % are between 25 and 34 and only 2,3 % are more than 35 years old.

Figure 4. The age distribution of the students



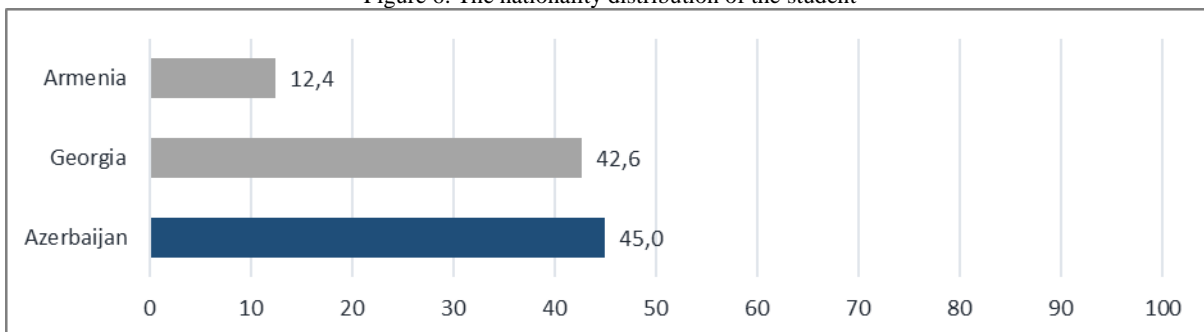
In addition, the age distribution of the respondents regarding their nationalities is illustrated in Figure 5. As can be observed in the following figure, while none of the Azerbaijani and Armenian students are older than 35, 5,5% of the Georgian students more than 35 years old. Nevertheless, regarding their nationalities, most of the students are between the ages of 18-24. More precisely, most of the Georgian, Azerbaijani and Armenian students who attended the survey are younger than 25. The ratio of the Georgian students between the ages of 18-24 is 70%, Azerbaijani students 81,0% and the Armenian students 81.3%.

Figure 5. Age distribution of the students with regard to their nationality

The nationality of the student	18-24	25-34	35+
Georgia	70,9%	23,6%	5,5%
Azerbaijan	81,0%	19,0%	0,0%
Armenia	81,3%	18,8%	0,0%

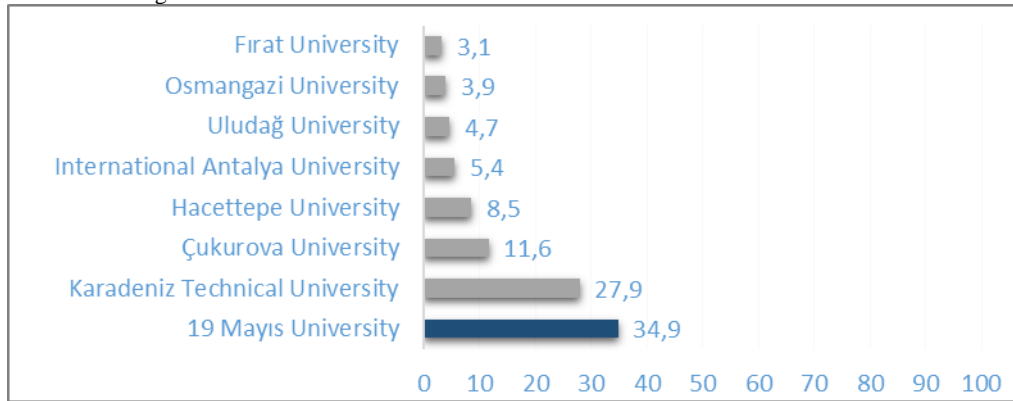
As Figure 6. depicts, when the nationalities of the students interviewed is examined, it is found out that the 42,6 % of the participants are Georgian, 45 % are Azerbaijani and 12,4 % are Armenian. As we have stated in the limitations section of this research, the number of Armenian students participated in the survey was just 16, compared to the 55 Azerbaijani and 58 Georgian students. It is important to reiterate that this is mostly engendered by the fact that the number of Armenian students in Turkey are inadequate when compared to the number of the Azerbaijani and Georgian students. In addition, most of the Armenian students living in Turkey are reluctant to contribute to the survey due to the fear of revealing their identities.

Figure 6. The nationality distribution of the student



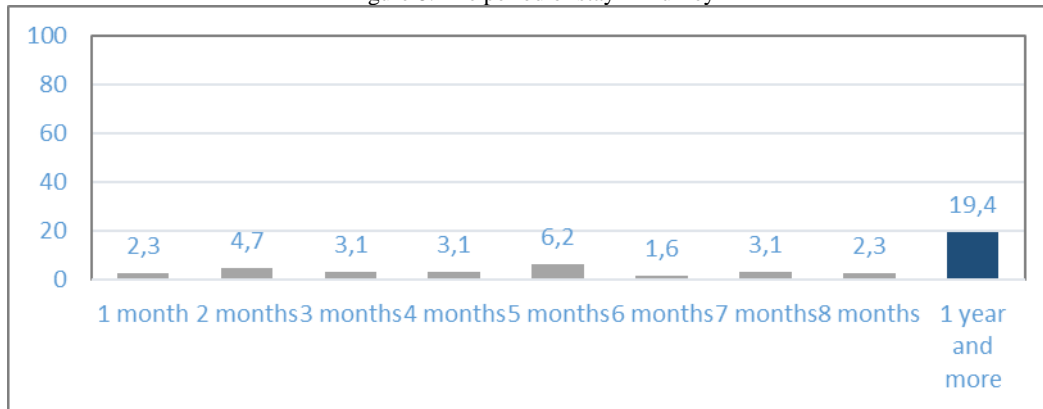
Besides, Figure 7. depicts the universities in which the interviews are made. As can be seen in the figure (Figure 7.) most of the questionnaires have been conducted in Samsun 19 Mayıs University with a rate of 34,9%. The most-widely preferred department of study by the South Caucasian students interviewed is Theology with a rate of 9,3%. The subsequent departments are Business Administration, French Language Teaching and Tourism Administration.

Figure 7. The education facilities in which the students are interviewed



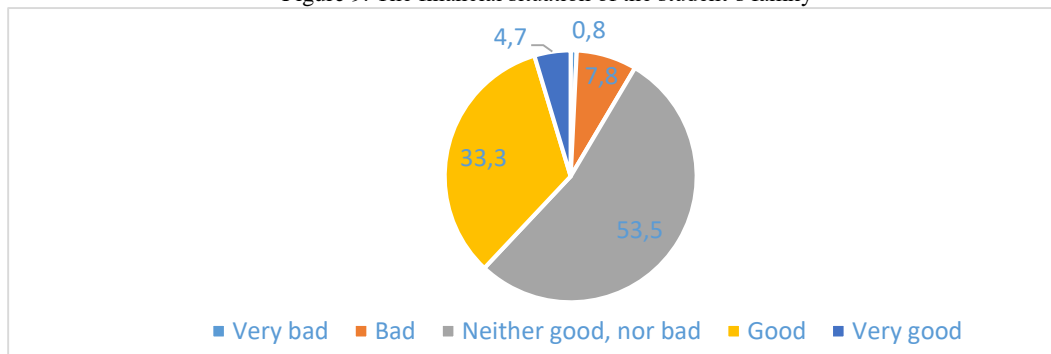
Below-presented figure (Figure 8.) illustrates the findings on the period of stay in Turkey. One can clearly observe in the figure that, when the students' period of stay in Turkey is examined, almost one out of five students has been staying in Turkey for more than a year. The average period of stay in Turkey, on the other hand, is 17 months.

Figure 8. The period of stay in Turkey



The ninth figure (Figure 9), on the other hand, depicts the findings on the question of the financial situations of the foreign students' families. According to the findings, 38% of the students answered that the financial situation of their families is good; while 53,5% of the students told that the financial situation of their families is in the medium range.

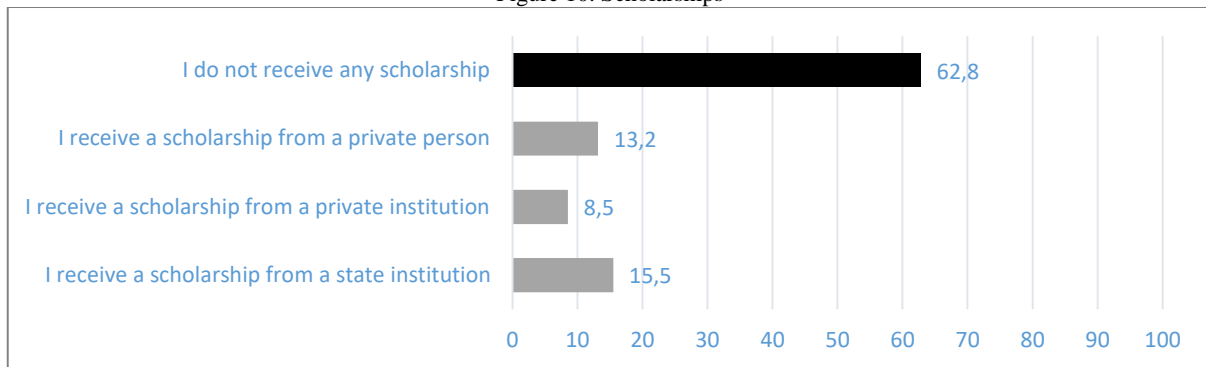
Figure 9. The financial situation of the student's family



When the scholarship situation of the students is examined, it is observed that almost 40% of the students receive scholarships. As can be seen in Figure 10., the rate of receiving a state scholarship

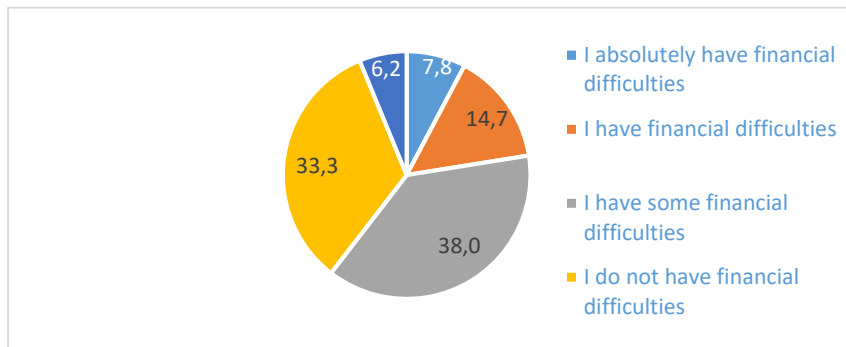
is the highest in the Georgian students since 27,3% of the Georgian students receive scholarships. On the contrary, 80% of the Azerbaijani students do not receive any scholarships.

Figure 10. Scholarships



The following figure (Figure 11.) illustrates the responses to the question of do you have any financial difficulties in living in Turkey or have you experienced any financial difficulties while you were living in Turkey? As can be seen in the figure, only 6,2% of the students stated that they absolutely had financial difficulties while they were living in Turkey. Nevertheless, the percentage of the respondents who stated that they do not have any financial difficulties at all is 7,8. On the other hand, most of the students stated that they have some financial difficulties while they are living in Turkey, with a rate of 38%. The rate of those who state that they experience financial difficulties in Turkey is 22,5%.

Figure 11. The Percentage of Encountering Financial Difficulties



Most of the foreign students accommodate in a private apartment or dormitory during their stay in Turkey. As one can clearly observe in Figure 12, only 3,1 % of the students are living with their relatives. According to the findings of the research on the places of accommodation in Turkey regarding the students' nationalities, while most of the Georgian and Azerbaijani students are living in private apartments, the rate of the Armenian students living in private apartments is only 12,5 %. As can be seen in Figure 13., 87,5 % of the Armenian students stated that they are living in dormitories.

Figure 12. Accommodation in Turkey

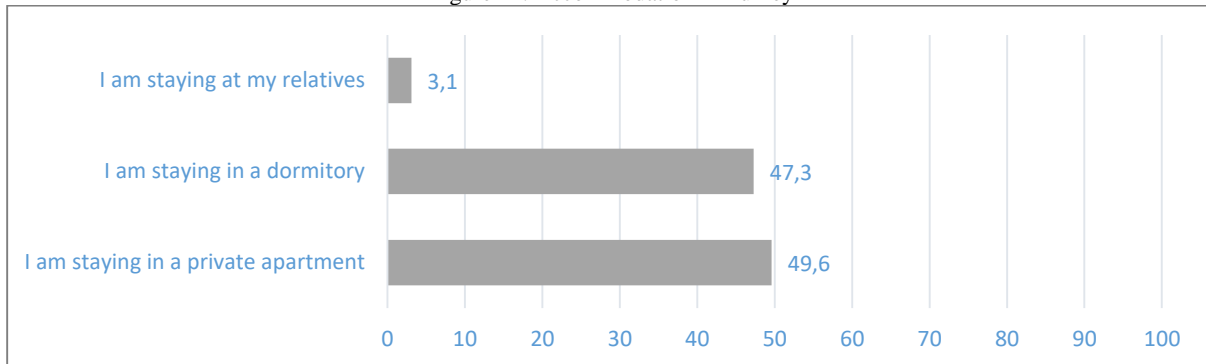


Figure 13. The Place of accommodation of the students with regard to their nationality

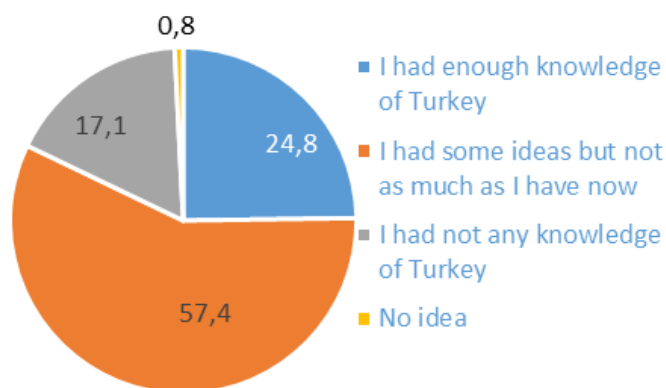
Nationality of the student	I am staying at a private apartment	I am staying at a dormitory	I am staying at my relatives	TOTAL
Georgia	%43,6	%50,9	%5,5	%100
Azerbaijan	%65,5	%32,8	%1,7	%100
Armenia	%12,5	%87,5	%0,0	%100

5. The Perceptions of Foreign Students to Turkey

5.1. Perceptions before their arrival in Turkey

According to the findings of the survey, 82,2% of the students declared that they had some knowledge of Turkey before they arrived in Turkey, though their knowledge before their arrival was less than their present knowledge. This rate is a bit higher for Georgian students. 54 % of the students responded to the question of did you know enough about Turkey before you live in Turkey that they had some ideas about Turkey. As it is illustrated in the following figure (Figure 14.), only 0,8 % of the students stated that they had no idea about Turkey before their arrival.

Figure 14. Foreign students' perception of turkey prior to living in Turkey



It is also important to note that, as one can observe in the following figure (Figure 15.), it was only the Armenian students who stated that they had no idea about Turkey before their arrival. To be more precise, while none (0,0 %) of the Georgian and Azerbaijani students stated that they had no idea

about Turkey before their arrival, 6,3 % of the Armenian students asserted that they had no idea about Turkey before their arrival.

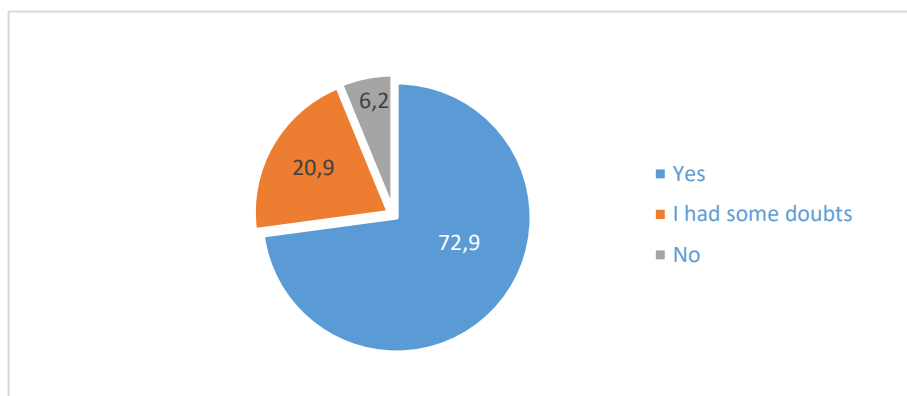
Figure 15. The perception of students on Turkey prior to their arrival with regard to their nationality

Nationality of the student	I had enough knowledge of Turkey	I had some ideas but not as much as I have now	I had not any knowledge of Turkey	No idea
Georgia	%18,2	%54,5	%27,3	%0,0
Azerbaijan	%32,8	%56,9	%10,3	%0,0
Armenia	%18,8	%68,8	%6,3	%6,3

5.1.1 The demand for education in Turkey

Most of the foreign students had a strong will to come to Turkey for studying. Most of the students who have some doubts about studying in Turkey are Georgians and Armenians.

Figure 16. Foreign students' demand for education in Turkey



Below-presented figures (Figures 17, 18 and 19.) depict the answers to the question of did you want to study in Turkey before you have arrived in Turkey. It was asked the students to choose one of the answers among “yes”, “no” or “I have some doubts” and it was asked to tell “why”. According to the findings, the most popular response to the questions of “why” among the students who answered “yes” to the previous question is “the quality of the education in Turkey” (11,5 %) This answer was followed by the answer because “I was interested in/ wonder about Turkey” (10 %). The least popular answers to the same question on the other hand are “because Turkey is a neighbor country with a close culture to my own” and “because Turkey’s conditions are much more advantageous” both with a rate of 3.8 %.

As can be seen in Figure 19., students who answered “no” to the question of did you want to study in Turkey before you have arrived in Turkey, stated that they did not want to come to Turkey either because they want to study in another country or because they do not want to separate themselves from their families.

5.2 The evaluation of educational processes in Turkey

It is observed that more than half of the foreign students could be able to handle their bureaucratic issues except for some minor problems. Most of the students, who argue that they experience serious problems, are the Azerbaijani students with a rate of 13,8%.

When the answer of the foreign students to this particular question is examined, it is observed that 63,6% of them have some problems in establishing friendships. Those who argue for experiencing problems in this respect are Georgian and Armenian students in general.

Figure 17. The reasons for foreign students for demanding education in Turkey

The answers of students who answered "yes"	%
Because I trusted the quality of education	11,5
I was interested in / wonder about Turkey	10,0
I loved Turkey	9,2
Because I wanted to learn about another country/culture	6,9
I wanted to study abroad	5,4
Because Turkey is a neighbor country with a close culture to my own	3,8
Because Turkey's conditions are much more advantageous	3,8

Figure 18. The reasons for foreign students for hesitating about education in Turkey

The answers of students who answered "I have some doubts" (n: 35)	%
Because Turkey was an unknown country / I had the fear of not adapting to Turkey	10,0
Our financial situation is not good / I have the fear of experiencing financial difficulties	3,8
I did not want to separate myself from my family/country	3,8
I wanted to study in my own country but I am accepted by the Turkish university as well	3,1
I came here for work	3,1

Figure 19. The reasons for international students for being reluctant about education in Turkey

The answers of students who answered "no" (n:8)	%
I wanted to study in another country	2,3
I did not want to separate myself from my family	1,5

Figure 20. The percentage of encountering bureaucratic difficulties in Turkey

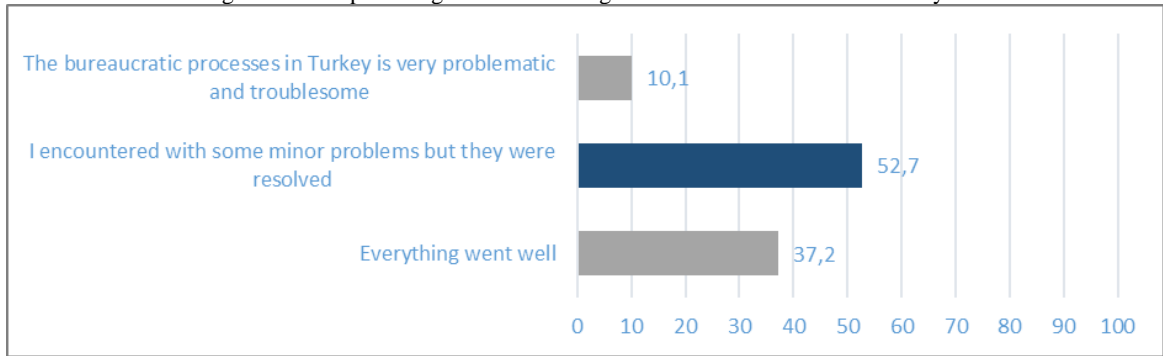
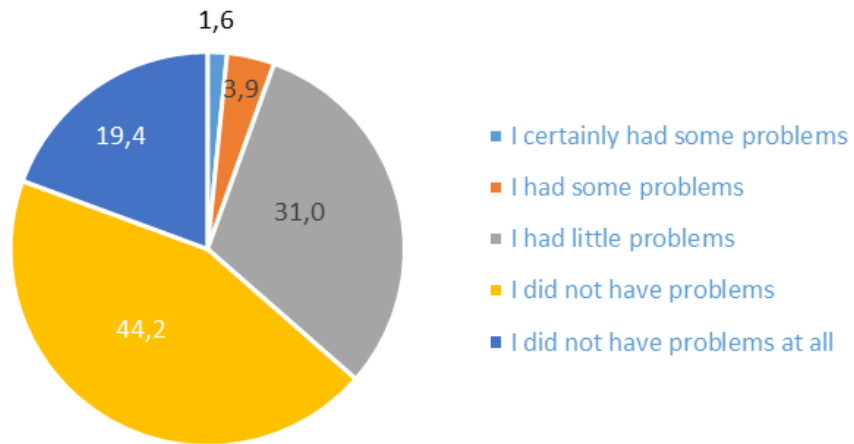


Figure 21. The tendency of foreign students in establishing social links



When the answer of the foreign students to this particular question is examined, it is observed that 39,5% of them feel partially or totally excluded. Most of the students answering in this way are Georgian or Armenian students. The most significant reason for this feeling of exclusion in Turkey seems to be the cultural differences. Interestingly, it is the Azerbaijani students who feel to be excluded because of cultural differences.

Figure 22. The state of exclusion of the foreign students in Turkey

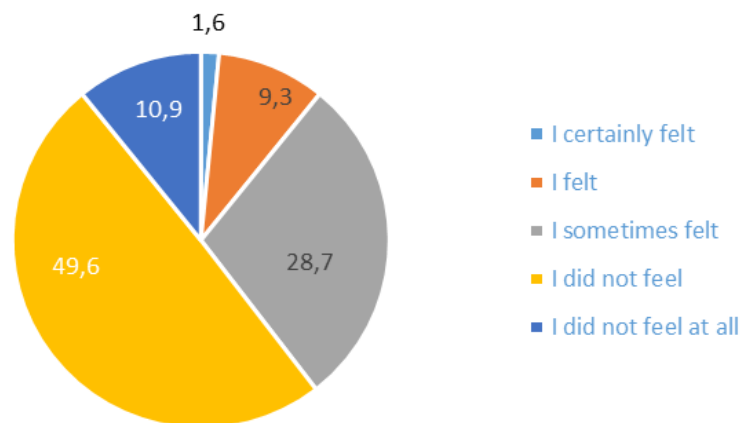
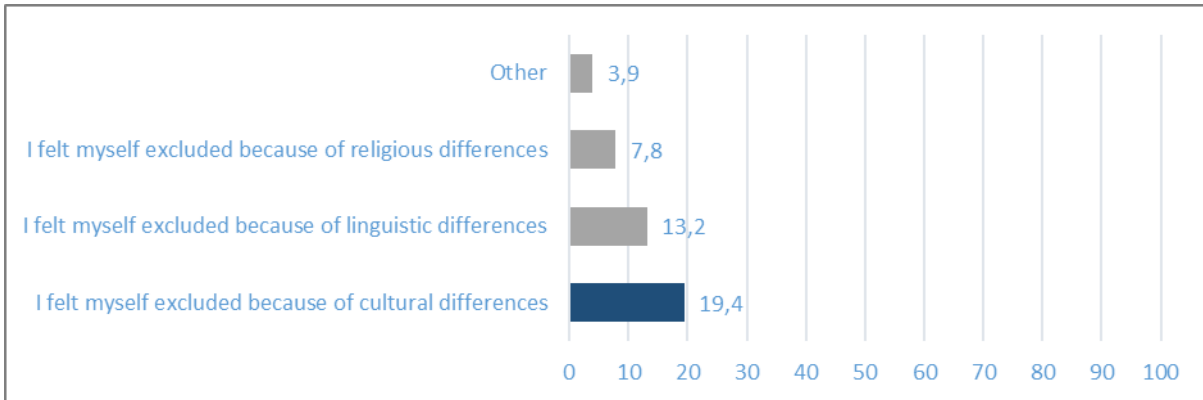
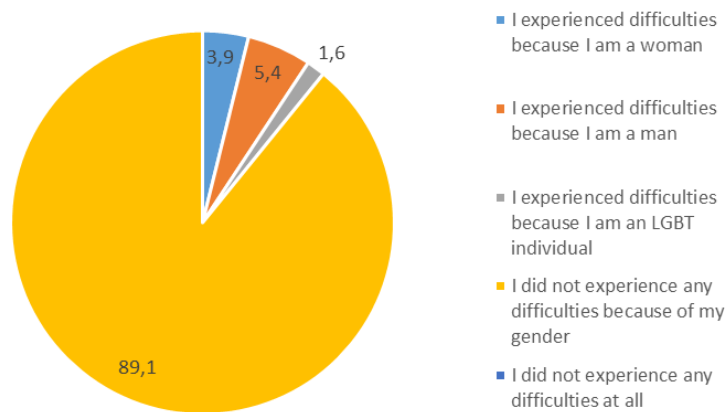


Figure 23. The Reasons for Exclusion of the Foreign Students in Turkey



It is observed that most of the foreign students do not experience any problem emerged out of sexist approaches. As Figure 16. demonstrates, 89,1% of the respondents stipulated that they do not experienced any difficulties of their genders.

Figure 24. Gender-based Approaches in Turkey



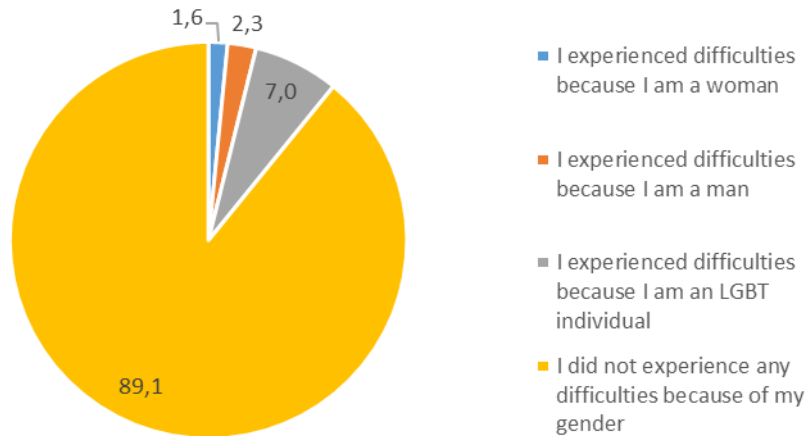
However, the ratio of experiencing some difficulties because of gender-based approaches increase in the educational facilities a bit. As can be seen in Figure 24., 3,9 % percent of the woman respondents stated that they experienced difficulties because of their gender. Evidently, this shows that in smaller environments, where people know each other more, sexist approaches become more visible.

According to the survey, the number of foreign and Turkish friends of 41,1 % of the foreign students are equal. The ratio of foreign students having friendship solely with foreign students is 35,7%. Azerbaijani students are the ones having the least difficulty in establishing a friendship with the Turkish students.

The ratio of participation in social activities is only 40,3%. The social activities that they participate in the most are listed below. When the frequency of participating social activities is examined it is observed that the students participate in such activities for once or when they find time to do so.

55% of the students stipulate that they do not experience any difficulty in participating in social activities. 11,6% of students think that they experience difficulties because they are foreign students.

Figure 25. Sexist Approaches in the Educational Facility in Turkey



When the level of content of the students with regard to the frequency of social activities, it is observed that almost half of them is content; however, students stating that they have no idea reaches a high ratio such as 32,6%, most of whom are the Georgian students.

It is observed that foreign students have not experienced many difficulties in terms of dressing.

The ratio of students who think that they have partially or certainly have difficulties with regard to alimentation is 51,2%. Most of the students thinking in this way are Georgian or Armenian students.

Although generally, foreign students do not think that they have a particular problem with regard to customs and traditions in Turkey, those, who argue that they have some difficulties, reach to a high percentage (45%), most of whom are Georgian or Armenian students.

When the foreign students are asked to what extent their educational expectations have been met or not, 57,4% of the students stated that their educational expectations have been met.

Respondents were asked to evaluate their perception with regard to Turkey before their arrival in this country, according to the findings of the survey it is observed that the general perception is positive.

In addition, it is observed that the students change their mind negatively considering some expressions like “I perceive Turkish culture closer to my own culture”, “Standard of living in Turkey is high”, “There is too much conflict, disturbance, and chaos in Turkey”. Moreover, Turkey is perceived to be more conservative, when the respondents were asked how their perceptions are changed after their arrival in Turkey.

5.3. The Perception of Students on Living in Turkey in the Long Term

24,8% of foreign students have a positive perception of living in Turkey in the long term. Most of the students, on the other hand, do not have a clear vision of living in Turkey in the long term. It is the Azerbaijani students that have the most positive feeling of living in Turkey in the long term since 32,8% of the Azerbaijani students clearly state that they want to live in Turkey in the near future.

When the ratio of foreign students’ advisability of living in Turkey is examined, it is observed that almost two-thirds of the foreign students, particularly Azerbaijani and Georgian students, advise living in Turkey. The number of students who state that they would not advise living in Turkey is very low.

6. Results and Discussion

When the results of the questionnaire are evaluated in the light of the demographic data, it is observed that the sample group is more or less equally divided in terms of gender (58,9% male vs. 41,1% female) and most of them (76,7%) are between the ages of 18 and 24. When the universities

that these students have been studying are examined, it is understood that generally the universities in the Black Sea region are preferred. 34,9% of the students preferred Samsun 19 Mayıs University and 27,8% of the students preferred Karadeniz Technical University in Trabzon. This situation can be explained with geographical proximity because from both provinces (Samsun and Trabzon) regular bus services are available to the South Caucasian countries. It is also observed that almost one of each five students resides in Turkey for more than a year meaning that it is possible to compare and contrast the perceptions of foreign students on Turkey since there is a considerable time period for the emergence of a change in the perceptions.

Concerning the examination of the financial situation of the students, it is understood that generally, the students are from families with a medium range of income. Since the ratio of students who state that their financial situation is bad or too bad is 8,6%, it can be argued that generally, families with a relatively higher income were able to send their children for education in Turkey. In order to finance the accommodation and education costs in Turkey, only 37,2 percent of the students receive a scholarship from a private person, a private institution or a state institution. Moreover, only 22,5% of the students argue that they experience financial difficulties in Turkey. These two additional data form a strong indication for supporting the argument that the financial situation of the families of foreign students is relatively good.

Regarding the type of accommodation of the students, it is found out that half of the Georgian students stay in dormitories whereas most of the remaining half stay in private apartments. The ratio of preferring private apartments is higher for Azerbaijani students. Quite contrarily, most of the Armenian students (87,5%) prefer to stay in dormitories. This is so either because the Armenian students feel more secure in institutional accommodation or because the landlords in Turkey are reluctant to rent their apartments to Armenian students. However, in order to understand the reasons for this preference better, further surveys should be performed.

It can be argued that the South Caucasian students studying in Turkey have a degree of knowledge of this country prior to their arrival. Only 17,1% of the students argue that they have had no idea about Turkey prior to their arrival. It is quite interesting that most of the students arguing that they have had no idea about Turkey before their arrival is Georgian. This gives the impression that the Azerbaijani students have known Turkey because of linguistic and cultural similarities, whereas, contrarily, the Armenian students have known Turkey because of the negative common past of Turks and Armenians emerged out of incidents like the 1915 relocation.

When the perceptions of South Caucasian students with regard to the education system in Turkey are examined, it is observed that three-quarters of these students had a will to study in Turkey. The underlying reasons for that will are the perceptions about the higher quality of education in Turkey and the feelings of curiosity, interest, and love towards Turkey and Turkish people. Those, who have some doubts with regard to studying in Turkey, arguing that the reason for this reluctance is their fear of separation from their families/country and the insufficiency of financial resources to meet education and living costs.

In terms of the bureaucratic procedures with regard to the educational processes of the South Caucasian students in Turkey, it can be argued that almost half of the students have somehow experienced a bureaucratic problem; however, this problem has soon been resolved. Approximately 10% of the students think that the educational bureaucracy in Turkey is tiresome, whereas 40% of the students think that everything went well with these bureaucratic procedures meaning that the content with regard to the educational bureaucracy is considerable.

In terms of the examination of the students' social life, it is observed that 65% of the students' state that they experience no difficulties with regard to establishing friendships. Most of these students are from Azerbaijan. Contrarily the ratio of experiencing difficulties with regard to establishing friendships is higher considering the Georgian and Armenian students. Almost 40% of the students, on the other hand, argue that they have somehow felt excluded by the Turkish students partially or totally. This shows that there are still serious problems with regard to Turkish students'

perceptions of foreign students. Considering the sexist approaches, almost 90% of the students argue that they have not felt any sexist approach towards themselves. When the social circle of the foreign students is examined, it is observed that the ratio of those students having only foreign friends is relatively high (36%) meaning that the foreign students have better communication among themselves. This data is also consistent with the data of the feeling of being excluded. Similarly, 40% of the students do not prefer to participate in any social activity in Turkey and 45% of them argue that they experience some difficulties in participating in social activities in Turkey because they are foreigners and people are distant to them. Almost half of the students argue that they have some problems with regard to alimentation, whereas again almost half of the students argue that they have difficulties with regard to customs and traditions in Turkey. These ratios can be considered quite high.

When the perceptions of South Caucasian students in Turkey before and after their arrival in this country are compared and contrasted, it can be said that there is generally a change in the negative direction. While almost half of the students had argued before their arrival in Turkey that they perceive Turkish culture as a closed culture to their own, this ratio fell to 32,6% after their experiences in Turkey. The figure below shows the changes in perceptions. The expressions in red show a negative change in perceptions, in other words, a decrease in the ratio of the answers of “I absolutely agree” and “I agree”, whereas the expressions in green show a positive change in perceptions, in other words, a decrease in the ratio of the answers of “I absolutely disagree” and “I disagree”. The figure shows that the students’ perceptions of Turkey have negatively changed in most of the fields stipulated below.

Such a negative change can also be observed for the idea of the students living in Turkey in the long term. Only one-quarter of the students have a positive attitude towards living in Turkey in the long term, whereas almost two-thirds of the students have some doubts about that. Still, two-thirds of the students advise other students to study and live in Turkey. Moreover, it is also observed that Azerbaijani students perceive their own culture closer to the Turkish culture and their will to live in Turkey in the long term is higher compared to the Georgian and Armenian students.

Therefore, alike the previous broader literature on the foreign students’ perceptions of Turkey, this research also suggests that the Southern Caucasian students studying in Turkey have encountered a variety of problems including for example the problems of adaptation, gender-based problems and alienation, specifically the Georgian and Armenian students. In addition, the findings of this research also supports the findings of the previous literature, which was mentioned in the literature review part of this article, that is; although foreign students came to Turkey with positive perceptions in mind, after they got to know Turkey more, their perceptions became more negative as they acquainted with Turkish culture more. Likewise, the findings of this research support the previous research regarding the reasons for demanding education in Turkey. So, alike these scholarly publications, the findings of this research suggest that students from Southern Caucasia have chosen to study in Turkey because of the higher quality of education in Turkish universities.

Nevertheless, when all these results are taken into consideration, it is important that the issues discussed below should be developed.

- The recognizability of Turkey in South Caucasian countries should be increased. It is quite conspicuous that almost 18% of the students have no idea about Turkey before their arrival in this country and a significant portion of these students are Georgian. It is very important for the Turkish universities to organize education fairs in South Caucasian countries with the support of the Turkish Foreign Ministry and the Turkish Higher Education Council in order to make them known to the South Caucasian students.

- It is very important to develop accommodation opportunities for the South Caucasian students living in Turkey. It would be convenient to increase the capacity of dormitories for these students. Moreover, the number and amount of scholarships to the students of the region should be increased in order to provide an opportunity for students with lower income rates.

- Since it is observed that a significant portion of the students have some problems in establishing friendships and socialization and have been feeling themselves partially or totally

excluded, some precautions should be taken to ameliorate this situation. The foreign students can be provided with more intensive orientation, more travels, excursions, social and cultural activities with Turkish students can be organized, more rehabilitation activities can be designed for decreasing the adaptation problems of the students and more counseling could be arranged for the foreign students. All these precautions would contribute to decrease the sense of exclusion and to increase socialization of the foreign students.

• It can also be said that the negative change in the perceptions of foreign students with regard to Turkey before and after their arrival in this country is related to the recent developments experienced in Turkish domestic and foreign policy. The development of Turkey's diplomatic, political, economic and socio-cultural relations with the regional countries would contribute to a positive change in the perceptions of South Caucasian students with regard to Turkey.

All in all, it should not be forgotten that these steps stipulated above for the amelioration of the foreign students' perception of Turkey and Turkish culture also contribute to the development of some deficiencies of the Turkish educational system as well as to the further integration of South Caucasian students. Such an amelioration would also enhance the soft power of Turkey vis-à-vis the South Caucasian countries.

References

- Akyürek S. and Bilgiç, M. S. 2012. Ermenistan'da Türkiye ve Türk Algısı. Bilge Adamlar Stratejik Araştırmalar Merkezi, Report No: 41.
- Aliyev, R. and Ögülmüş, S. 2015. Türkiye'deki Yabancı Uyruklu Öğrencilerin Kültürlerarası Etkilşim Algısının İncelenmesi. *21. Yüzyılda Eğitim ve Toplum Dergisi*, Vol 4, No. 12, 49-71.
- Bozkaya, Ö. 2016. Ermenistan'da Yaşayan Ermeni Üniversite Öğrencilerin ve Akademisyenlerin Türkiye'nin Avrupa Birliği Üyeliğine İlişkin Algısı. Unpublished Master's Thesis, Dokuz Eylül University, Social Sciences Institute, Department of European Union.
- Dalar, M., Ayhan, V. and Ataman, M. 2012. Almanya'daki Türkiye Algısı: Saha Araştırmasına Dayalı Bir Analiz. *Yönetim ve Ekonomi Araştırmaları Dergisi*, No. 18, 33-37.
- Göver, İ. H. and Yavuzer, H. 2015. Kayseri'de Öğrenim Gören Yabancı Uyruklu Öğrencilerin Kayseri, İslam, Türkiye Algısı. *Turkish Studies: International Periodical for The Languages, Literature and History of Turkish or Turkic*, Vol. 10, No. 2, 1025-1050.
- Güleç, İ. and İnce, B. 2013. Türkçe Öğrenen Yabancıların Günlük Yaşama İlişkin Kültürel Algıları Üzerine Bir Araştırma. *Sakarya University Journal of Education*, Vol 3, No. 3, 95-106.
- Karabayev, B. 2001. Türk Cumhuriyetlerinden Gelen Öğrencilerin Türkiye Cumhuriyeti Vatandaşlarına Karşı Taşdıkları Kalıp Yargılar. Unpublished Master's Thesis, Niğde Üniversitesi, Social Sciences Institute.
- Karatay, H. and Kartallıoğlu, N. 2012. Kırgız Öğrencilerin Türkiye Türkçesi Öğrenmeye İlişkin Tutumları. *Türkçe Eğitim ve Öğretim Araştırmaları Dergisi*, Vol. 2, No. 4, 1-11.
- Kıroğlu, K., Kesten, A. and Elma, C. 2010. Türkiye'de Öğrenim Gören Yabancı Uyruklu Lisans Öğrencilerinin SosyoKültürel ve Ekonomik Sorunları. *Mersin Üniversitesi Eğitim Fakültesi Dergisi*, Vol. 6, No. 2, 26-39.
- Nye, J. S. 2004. Soft Power: The Means to Success In World Politics, New York: Public Affairs Publications.
- Özçetin, S. 2013. Yükseköğrenim Gören Yabancı Uyruklu Öğrencilerin Sosyal Uyumlarını Etkileyen Etmenler. Unpublished Master's Thesis, Hacettepe University, Social Sciences Institute, Department of Social Services.
- Özdaşlı, E. 2015. Ermeni Açılımı Sonrası Azerbaycanlı Üniversite Öğrencilerinin Türkiye-Azerbaycan İlişkilerine Bakışına Yönelik Bir Araştırma. *Uluslararası Sosyal Araştırmalar Dergisi*, Vol. 8, No. 40, 318-326.
- Paksoy, M. H., Paksoy, S. and Özçalıcı, M. 2012. Türkiye'de Yüksek Öğrenim Gören Yabancı Uyruklu Öğrencilerin Sosyal Sorunları: GAP Bölgesi Üniversiteleri Örneği. *Kahramanmaraş Sütçü İmam Üniversitesi İktisadi İdari Bilimler Dergisi*, Vol. 2, No. 2, 85-94.
- Terzi, H. M. 2013. Türkiye'nin Büyük Öğrenci Projesi. Unpublished Master's Thesis, Ufuk University, Social Sciences Institute, Department of International Relations.
- Tunçel, H. 2016. Yunan Üniversite Öğrencilerinin Yabancı Dil Olarak Türkçeye Yönelik Algıları ve Türkçe Öğrenme Sebepleri. *Atatürk Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, Vol. 20, No. 1, 107-128.
- Yıldız, Ö. 2015. Türkiye Kamplarında Suriyeli Sığınmacılar: Sorunlar, Beklentiler, Türkiye ve Gelecek Algısı. *Sosyoloji Araştırmaları Dergisi*, Vol. 16, No. 1, 141-169.
- Yirik, Ş., Uslu, A. and Küçük, F. 2015. Yerleşik Yabancıların Türkiye'ye İlişkin Sosyo Kültürel Algılarının Demografik Özelliklerine Göre İncelenmesi. *Bartın Üniversitesi İİBF Dergisi*, Vol. 6, No. 11 (2015), 263-282.

Some Demographic Trends in Borderline Regions of East Caucasus Mountains (Georgia)

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Abstract: It is known that demographic trends in Georgia has been drastically changing in recent decades. Particular attention is drawn to the mountainous regions. Borderline regions of east Caucasus Mountains (Khevi, Khevsureti and Tusheti) are facing many demographic challenges that are developed by the various environmental, social and economic circumstances such as complicated terrain, climate, migration, low birth rate, unemployment, insufficient communication. The purpose of the study is to process and analyze the statistical data of the census materials (1989, 2002, 2014) available in the study area (in the border regions of Eastern Georgia - Khevi, Khevsureti, Tusheti); Identifying existing some demographic trends based on these materials; Identifying the causes of negative demographic processes; Develop recommendations to address the demographic problems identified in the study; The study area includes 148 settlements of present day Stepantsminda, Dusheti and Akhmeta municipalities. National Statistics Office of Georgia (GEOSTAT) is the main source of the statistical data (three national censuses: 1989, 2002, 2014) used in the paper. In addition, the outcomes of the field works conducted in 2015 were also used. Geographic Information Systems (GIS) was used for spatial and temporal analyses of the demographic changes and future trends. The dramatic demographic trends were observed in the study area. This investigation has demonstrated that the situation between these three regions is clearly different from each other. In spite of relatively similar environment, the comparatively better demographic situation is in Khevi, which could be explained by the fact that the Military Road of Georgia goes through here. The results include the similarities as well as differences among the study regions. We summarized these patterns in the paper below. This framework can be used to evaluate demographic trends in the borderline regions of east Caucasus Mountains and answer above mentioned questions.
Key words: Demographic trends, sustainable development, Caucasus Mountains, GIS, Georgia.

1. Introduction

Much research in recent years has focused on the demographic crisis in mountainous regions. The demographic trend is any measurable change in the characteristics of a population over time. The trends in Georgian population are similar to global trends that result in a decrease in birth rate and an increase in mortality rate (National Atlas of Georgia., 2018). In-migration and its effects in high-mountain ranges has become an important issue in the past decades. It is assumed that outmigration from mountain areas linked to industrialization will be replaced by a late-modern in-migration phase characterized by globalization (Loffler *et al.*, 2016). At the beginning of the 19th century, the population within the modern boundaries of the country reached 785,000. From 1800 to 1989, the Georgian population trended to increase. In 1989, the population of Georgia exceeded 5 million people. After the collapse of the Soviet Union, the population decreased and was 3.7 million people by 2014 due to various factors (National Atlas of Georgia., 2018).

Like other mountainous regions of Georgia (Kohler *et al.*, 2017) borderline regions of east Caucasus Mountains (Khevi, Khevsureti and Tusheti) are forced many demographic challenges that are developed by the numerous ecological, social and economic factors such as rough terrain, natural

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hazards, and climate, migration, low birth rate, unemployment, bad communication (Kvirkvelia *et al.*, 2016). The scope of these processes differs widely between and within mountain regions due to the site-specific development contexts created by economic, sociopolitical, and environmental circumstances (Kohler *et al.*, 2017). The Eastern Caucasus Border Region - Khevi, Khevsureti, Tusheti is 3040 km². It is located in the northern part of eastern Georgia, on the northern slope of the Caucasus Range (excluding Piraketa Khevsureti), which further aggravates the current climatic conditions. Administratively it covers the territory of today's Stepantsminda, Dusheti and Akhmeta municipalities. The study area covers municipalities of two regions - Mtskheta-Mtianeti and Kakheti. The road leading to Georgia's iconic Tusheti mountain area is currently among the world's most dangerous roads. It is well known, that the Abano Pass in the Tusheti protected area is regarded as a crossroads between Europe and Asia by the USA National Geographic Society (Kvirkvelia *et al.*, 2017). The highest located village in Georgia and Europe is Bochorna (Akhmeta municipality) at 2345 m a.s.l (National Atlas of Georgia., 2018).

The purpose of the study is to process and analyze the statistical data of the census materials (1989, 2002, 2014) available in the study area (in the border regions of Eastern Georgia - Khevi, Khevsureti, Tusheti); Identifying existing some demographic trends based on these materials; Identifying the causes of negative demographic processes; Develop recommendations to address the demographic problems identified in the study; Survey the resulting image on the map using the GIS.

2. Material and Methodology

The various research methods were used: statistical, mathematical, comparative, GIS. The available statistical data was analyzed with GIS software, the data was mathematically calculated, diagrams were created to compare and analyze old and new demographic data. Accordingly, modern demographic processes have been identified.

3. Results

Our intention was to analyze population dynamics in borderline regions (Khevi, Khevsureti, Tusheti) of eastern Caucasus. The results are divided into two parts as follows: 1989-2002 and 2002-2014 periods. Evident for this is in Figure 1.



Figure 1. Percentage changes in the population among 1989, 2002 and 2014

Population change in the study regions was different in different periods. During 1989-2002, the highest rate of depopulation was in Khevi (17.1%) and the lowest in Khevsureti (3.7%). The situation is diametrically different between 2002 and 2014, with Khevsureti population halving (53.6%), which is an alarming result. The 1990s were equally difficult for both the lowland and mountain communities, but since the 2000s the standard of living in the country has been improving, but mainly in the capital and other major cities, and the mountains still have a difficult situation, which is the reason for such a strong wave of migration. Finally, according to fig. 1, the highest rate of depopulation between 1989 and 2014 is observed in Khevsureti (55.3%) and relatively lower in Khevi (40.5%).

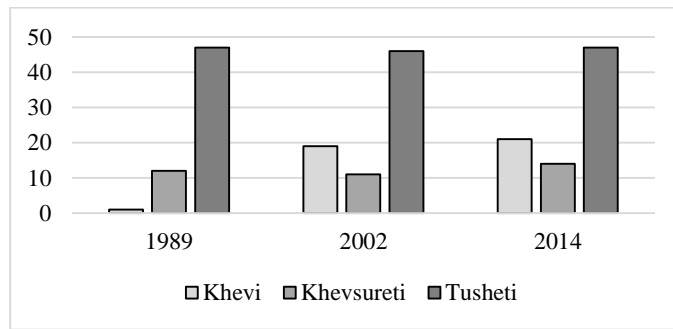


Figure 2. Number of abandoned villages

It should, however, be noted that the process of abandoning of the villages in these regions had been gradually intensified in the 20th century. Accordingly, in the last years of 19th century Tusheti population settled in Akhmeta region. In Zemo and Kvemo Alvani, as well as in Telavi village Laliskuri (Neidze, 2003). As we can see from Figure 2, the number of abandoned villages is stable in Tusheti. There is a particularly high rate of depopulation in the Khevi, and the reason for this is the out-migration of the ethnic Ossetians which left the country and moved to the North Caucasus because of the social, economic and political crisis of the early 1990s. In most of the abandoned villages during this period, the main population was ethnic Ossetians.

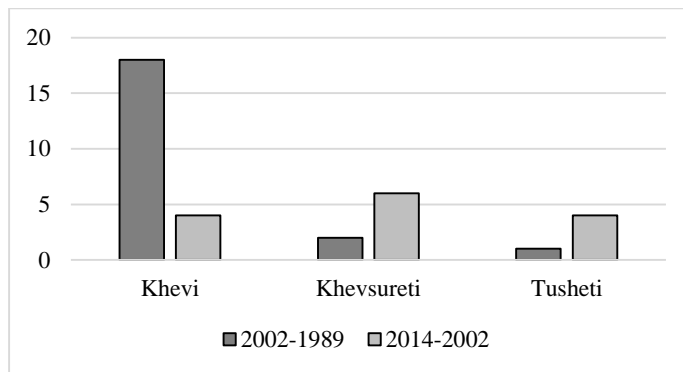


Figure 3. Ratio of abandoned villages among 1989, 2002 and 2014

As illustrated by Figure 3, the number of abandoned villages increased in Khevsureti during 2002-2014 period. Most of the villages are abandoned in Khevsureti from 2002 to 2014, which is largely due to social and economic problems.

Data in Figure 4 suggest that there was a slight positive trend in the re-settlement of abandoned villages in 2002 compared to 1989 (five villages, two villages in Tusheti, three in Khevsureti). The population of these villages is only 1 or maximum 2 people, but the intentions of local community, especially young generation, give us a reason to hope better results for the future census. Gudauri is the only settlement where population increased sharply in 2014 compared to 1989. Gudauri is the most important mountain sports-recreational complex in Georgia. The growing popularity of Gudauri has contributed to an increase in the number of permanent residents.

Analysis of population statistics shows that the eastern regions of eastern Caucasus (Khevi, Khevsureti, Tusheti) face severe demographic challenges. Although all three regions - Khevi, Khevsureti and Tusheti are close to each other and have a more or less complex environment, research has shown that the demographic situation between these regions differs (Figure 5). There is a relatively better situation in Khevi, due to the existence of the old military road here (formerly the Silk Road) and directly to the Russian border crossing point - Larsi. The infrastructure is relatively orderly. With a few exceptions (avalanches), it is connected to the capital all year long, while Khevsureti and Tusheti have been cut off from the rest of the world for almost half a year, power supplies are delayed and often no

first aid is available, impeding the growth of the permanent population in this region. As mentioned above, access to Tusheti is one of the most dangerous in the world (its worth can only be considered as very attractive to wildlife tourists). Protected areas in the region are becoming increasingly popular among both Georgian and foreign tourists, creating additional jobs in the region, which should help increase the number of permanent residents, but still face a number of social and economic issues.

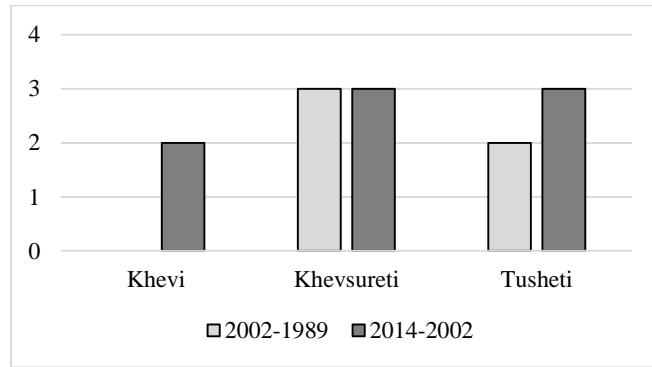


Figure 4. Number of resettled villages

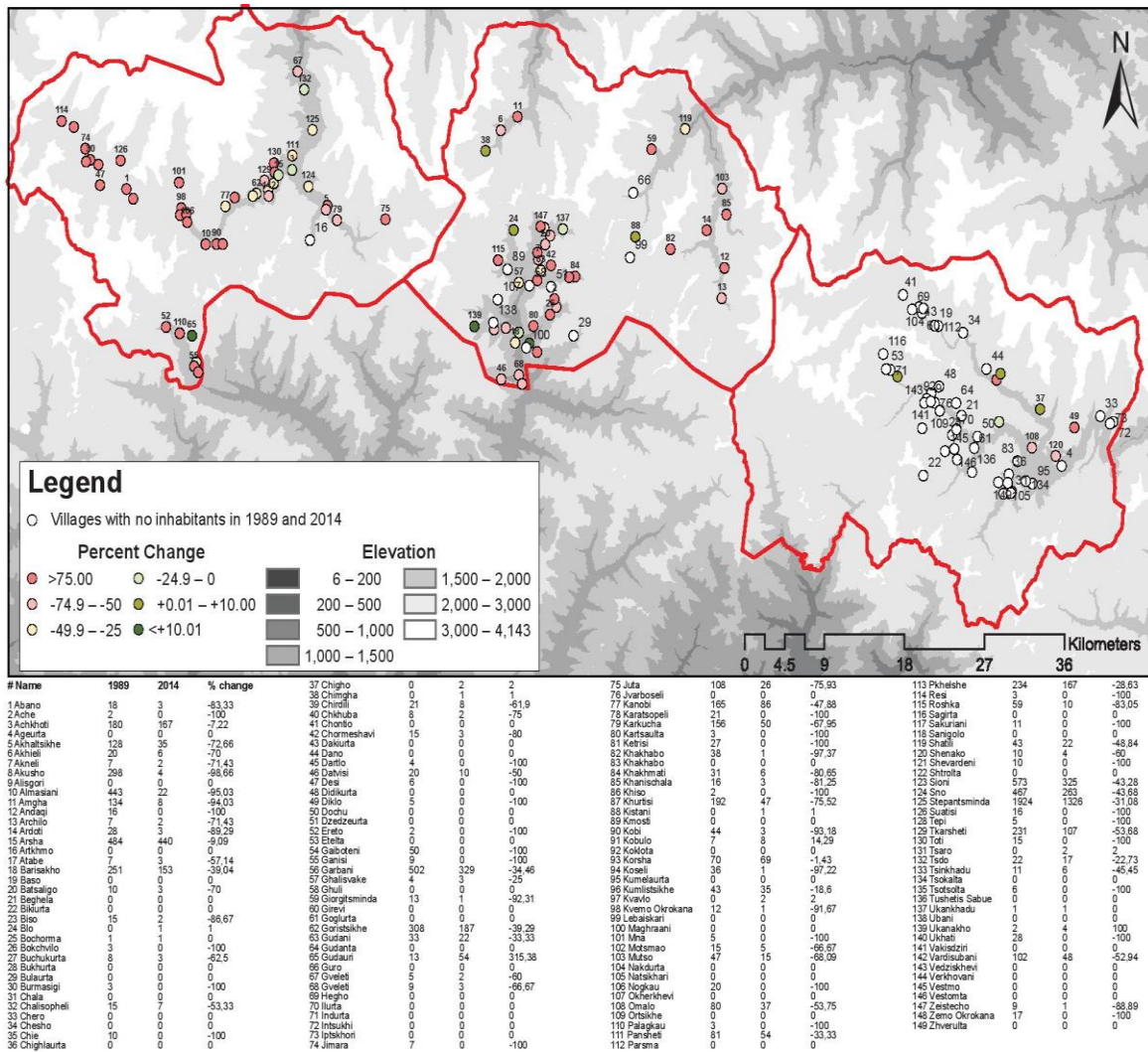


Figure 5. Percent change in population of study area villages between 1898-2014

4. Conclusions

This study shows that the demographic situation in the study region has changed dramatically over the last 25 years. Since the study area is a border area, the preservation of the population in this area is very important. The future of this frontier region depends on the location of indigenous peoples. Tourism plays a major role in this. Recently tourism has had a major impact on locating the population. This was conditioned by the implementation of various local or international projects. For example, Tuscany cooperates with the Czech Development Agency. Meetings with locals employed in tourism are organized by Tusheti Guide; Staff are trained in a foreign language (English); Development of a unified electronic hotel booking system, which already includes several hotels; Organized by Friends of the Association and funded by UNDP (The United Nations Development Program), hotel owners are trained in planning / offering a travel package; The ravine was the basis for the development of cooperative farming. For example, "plant the future" to cultivate berries. EU-funded Family Hotels are being built. For example, one of these is the Green Ship. The Ministry of Education, Science, Culture and Sport has implemented the restoration of Mutso, a culturally significant village in Khevsureti, which is listed as a World Heritage Site. While these good shifts are slowly taking place in the region, priorities need to be selected; Trainings for local communities; Informing tourists about local traditions; Preservation of natural and cultural diversity; Proper use of local culture to improve livelihoods and income; Respect for local traditions; However, it is necessary to regulate roads and other means of communication, for example, in some villages of Khevsureti there is no telephone connection and access. It is necessary to create jobs and encourage young people to return to their homes.

References

- Kohler, T. Elizbarashvili, N., Meladze, G., Svanadze, D., Meessen, H., 2017. The Demogeographic Crisis in Racha, Georgia: Depopulation in the Central Caucasus Mountains. *Mountain Research and Development*, 37(4), 415-424.
2018. National Atlas of Georgia. Stuttgart: Franz Steiner Verlag.
- Kvirkvelia, N., Tsitsagi, M. & Gugeshashvili, M., 2016. Snow Avalanche Terrain Modeling; A case study from Gudauri-Kobi part of Military Road of Georgia. *Journal of Young Researchers*, Volume 4, 21-30.
- Kvirkvelia, N., Tsitsagi, M., Gugeshashvili, M. & Chaladze, T., 2017. Terrain Morphometric Analysis to Support Tourism Development in the Tusheti Protected Area. In: R. Efe & M. Öztürk, eds. *Contemporary Studies in Environment and Tourism*. Newcastle upon Tyne: Cambridge Scholars Publishing, 427-434.
- Löffler, R., Walder, J., Beismann, M., Warmuth, W., Steinicke, E., 2016. Amenity Migration in the Alps: Applying Models of Motivations and Effects to 2 Case Studies in Italy. *Mountain Research and Development* (MRD), 36(4), 484-493.
- Neidze, V., 2003. Tusheti. In: Z. Tatashidze, ed. *Social-economic geography of Georgia*. Tbilisi: Metsniereba, 190-253.

İklim Değişikliğinin ve İklim Değişikliğiyle İlgili Küresel Anlaşmaların Çevre Etiği Bakımından Değerlendirilmesi*

*An Assesment of Climate Change and Global Agreements from the Perspective
of Environmental Ethics*

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Özet: Bu çalışmada temel olarak iklim değişikliği ve ilgili küresel düzenlemeler çevre etiği bağlamında irdelenmektedir. Çalışmanın öncelikli konularını çevre bilinci ve çevre etiği, iklim değişikliği sorunsalı, Birleşmiş Milletler nezdinde kabul edilen uluslararası iklim anlaşmaları ve iklim etiği oluşturmaktadır. Küresel düzeyde uygulanan düzenlemeler çevre etiği yaklaşımları bakımından incelendiğinde ise, BMİDÇS, Kyoto Protokolü ve Paris Anlaşması'nın insanmerkezci bir yaklaşımla hazırlandığı konusunda geniş kapsamlı bir mutabakatın olduğu görülmektedir. Diğer taraftan, iklim değişikliği sorunsalının "kendine özgü" niteliklerini de kullanarak münhasır bir alan olarak ortaya çıkan iklim etiği iklim değişikliği-etik ilişkisinin daha derin bir biçimde incelenmesini sağlamaktadır. Hâkim değer sistemi insan kaynaklı iklim değişikliği gibi küresel çevre sorunları hakkında düşüncelere yön vermek açısından uygun ve yeterli değildir. Bu kapsamda, iklim değişikliğinde kuşaklar arası adalet gibi ciddi bir sorunun çözümü için daha yüksek ahlaki standartlar ve normlar gerekmektedir.

Anahtar sözcükler: İklim değişikliği, çevre bilinci, Birleşmiş Milletler, çevre etiği, iklim etiği.

Abstract: This study examines the reality of climate change and related global arrangements from the perspective of environmental ethics. Priority fields of the study include environmental awareness, challenge of climate change, international climate agreements concluded before the United Nations and climate change ethics. It is widely accepted that the global climate agreements, namely United Nations Framework Convention on Climate Change, Kyoto Protocol and Paris Agreement have been designed from an anthropocentric point of view, as far as environmental ethics is concerned. On the other hand, climate change ethics, which has emerged as a separate field of study thanks to the sui generis character of climate change, ensures in-depth analysis of the relationship between the climate change and ethics in a multidimensional manner including climate justice and responsibilities to future generations. The prevailing value system (ethos) is not capable of directing global human-induced environmental challenges such as climate change. In this respect, higher ethic standards and norms should be developed to overcome significant matters like intergenerational justice caused by climate change.

Key words: Climate change, environmental awareness, United Nations, environmental ethics, climate change ethics.

1. Giriş

Bilim insanları, çevreci ve siyasetçilerin büyük bir kısmı iklim değişikliğini 21. yüzyılda doğa ve insanlığın karşı karşıya olduğu "en büyük tehdit" olarak görmektedir. Bununla birlikte, bilim insanlarının, ekonomistlerin ve politikacıların tüm teknik cevaplarının altında en derin etik açmaz

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yatmaktadır: Bugünkü nesillerin gelecektekilere karşı sorumluluğu var mı? Varlıkların değeri sadece insana faydası olup olmadığına bakılarak mı belirlenir? Doğanın kendinden menkul bir değeri var mı? Bugüne değin literatürde görece ihmal edilen iklim değişikliğinin etik boyutu, günümüzde büyük önem kazanmıştır. Örneğin, ABD'nin ünlü siyasi simalarından Al Gore 2006 yılında yaptığı bir konuşmada “iklim değişikliğinin siyasi bir sorundan ziyade etik bir mesele olduğunu” ifade etmiştir (Gardiner *et al.*, 2010).

Bu çalışmada, öncelikle iklim değişikliğinin tanımı ve kanıtları ele alınacak, ikinci bölümde ise küresel iklim rejimi düzenlemeleri hakkında bilgi verilecektir. Üçüncü bölümde farklı çevre etiği yaklaşımlarının iklim değişikliğine bakışı değerlendirilerek iklim değişikliğiyle ilgili düzenlemeler bu yaklaşımlar temelinde tartışılacaktır. Dördüncü bölümde ise “iklim etiği” hakkında bilgi verilecektir. Çalışma, sonuç ve değerlendirme kısmı ile tamamlanacaktır.

2. İklim Değişikliği: Tanım ve Problem

2.1 İklim Değişikliğinin Tanımı

“Eğiklik” anlamına gelen, Latince “*klimatis*”, Yunanca ise “*klima*” olarak bilinen iklim, “belirli bir dönem içerisinde ve istatistikî veriler ışığında ortalama hava durumu” olarak tanımlanmaktadır (İKV, 2013). İklim değişikliği ise, genel bir ifade ile “nedeni ne olursa olsun iklim koşullarındaki, büyük ölçekli (küresel) ve önemli yerel etkileri bulunan, uzun süreli ve yavaş gelişen değişiklikler” şeklinde tanımlanabilir (Türkeş *vd.*, 2000).

İklim değişikliği, gezegenimizin tarihi boyunca sürüp giden doğal bir olgu olmasına karşın, 19. yüzyılın ortalarından (Sanayi Devriminden) bu yana, iklimdeki doğal değişimlere ek olarak, ilk kez insan etkinliklerinin de iklimi etkilediği yeni bir döneme girilmiştir. Bu nedenle, iklim değişikliği, Birleşmiş Milletler İklim Değişikliği Çerçeve Sözleşmesi (BMİDÇS)'nde, insan etkisini de kapsayacak şekilde, “karşılaştırılabilir bir zaman periyodunda gözlenen doğal iklim değişikliğine ilaveten, doğrudan ya da dolaylı olarak küresel atmosferin bileşimini bozan insan etkinlikleri sonucunda iklimde oluşan bir değişiklik” olarak tanımlanmaktadır (DPT, 2000).

İklim değişikliği fosil yakıtların kullanımı, arazi kullanımındaki değişiklikler, ormansızlaştırma ve sanayi süreçleri gibi insan etkinlikleriyle atmosfere salınan sera gazı birikimlerindeki hızlı artışın doğal sera etkisini kuvvetlendirmesi sonucunda yerkürenin ortalama yüzey sıcaklıklarındaki artışı ve bunun sonucu olarak ortaya çıkan etkileri ifade etmektedir. Sera gazları, kısaca, atmosferde bulunan ve sera etkisi yaratan kimyasal gaz bileşikleridir. Su buharı (H₂O), karbondioksit (CO₂), metan (CH₄), nitroz oksit (N₂O), ve ozon (O₃) doğal sera gazları sınıfına girerken; endüstriyel üretim sonucu ortaya çıkan hidroflorokarbonlar (HFCs), nitrojen triflörür (NF₃) ve perflorokarbonlar (PFCs) gibi florlu bileşikler ve kükürt hegzaförür (SF₆) ise dolaylı sera gazları sınıfında değerlendirilmektedir.

İnsan kaynaklı iklim değişikliği ile mücadele konusunda iki önemli yaklaşımın bulunduğunu söylemek mümkündür: Azaltım (*mitigasyon*) ve uyum (*adaptasyon*). Bu iki genel yaklaşımdan birincisi, “azaltım”; insan kaynaklı iklim değişikliğinin önüne geçilebilmesi ya da yavaşlatılabilmesi için gerekli tedbirlerin alınmasını hedeflemektedir. İkinci yaklaşım olan “uyum” ise; iklim değişikliğinin potansiyel etkilerine karşı toplum ve ekonomilerin hazırlıklı olmasını hedefleyen uyum politikalarını kapsamaktadır. (Doğan ve Tüzer, 2011).

2.2 İklim Değişikliğinin Bilimsel Kanıtları

1988'de Dünya Meteoroloji Örgütü ve BM Çevre Programı (UNEP) tarafından Hükümetler Arası İklim Değişikliği Paneli (IPCC) kurulmuştur. Küresel iklim değişikliği konusunda çalışmalar yapmak üzere tesis edilen IPCC'nin asıl amacı, insan kaynaklı iklim değişikliği, muhtemel etkileri ve alınması gereken önlemler konusunda halihazırda üretilmiş bilimsel, teknik ve sosyo-ekonomik bilgileri değerlendirmektir (İgci, 2015).

2014 yılında yayımlanan IPCC sentez Beşinci Değerlendirme Raporu'nda³ öne çıkan bilimsel kanıtlar aşağıda özetlenmektedir (Anonim, 2017a):

a) İklim sistemindeki ısınma aşırı olup, 1850'den bu yana gözlemlenen değişiklikler önceki on yıllar ve bin yılda görülmemiştir. Atmosfer ve okyanuslar birlikte 0.85°C ısınmış, kar ve buz miktarları azalmış, deniz seviyesi yükselmiş ve sera gazlarının birikimi artmıştır.

b) Son üç ardışık 10 yıl, 1850'den beri yaşanan en sıcak on yıldır. 1983-2012 ise son 1400 yılın en sıcak 30 yılı olmuştur.

c) Son 20 yılda Grönland ve Arktik buz kütleleri hacim kaybetmeye devam etmiştir.

d) Okyanusların ısınması iklim sisteminde saklanan enerjiyi artırmakta olup, hesaplanan enerjinin %90'ı 1971-2010 döneminde birikmiştir.

e) Troposferdeki karbondioksit sanayileşme öncesi döneme göre %40 artmıştır.

f) Okyanuslar insan kaynaklı salınan karbondioksitin %30'unu soğurmakta, bu da denizlerin asitleşmesine neden olmaktadır.

g) 19. yüzyıldan bu yana gerçekleşen deniz seviyesi yükselme oranı son 2 bin yıldan fazladır. 1901-2010 arası küresel deniz seviyesi 19 cm yükselmiştir.

h) IPCC Dördüncü Değerlendirme Raporu'ndan bu yana iklim modelleri gelişmiştir. Modeller 21. yüzyılın sonlarına doğru, bir senaryo (RCP2.6) hariç, tüm senaryolarda 1.5°C'nin üzerinde artışlar beklemektedir. İki senaryoya (RCP6.0 ve RCP8.5) göre ise ısınmanın her yerde aynı olmamakla birlikte 2.0°C'yi aşması kaçınılmazdır.

i) Sıcak hava dalgaları, sel ve kuraklıklar, aşırı yüksek deniz seviyeleri, tropikal ve ekstra tropikal siklonlar gibi ekstrem olayların şiddet ve frekansları 20.yüzyılın ikinci yarısından beri artmış olup gelecekte de artmaya devam edecektir (Anonim, 2017a).

3. Küresel Düzeyde İklim Değişikliğine İlişkin Düzenlemeler

Sürdürülebilir kalkınma bağlamında kalkınma ile çevre ilişkisinin gerilimli doğası, özellikle ekonomik büyümeyi nihai amaç edinen ve bu doğrultuda "kalkınma stratejileri" izleyen ülkelerin iklim değişikliği riskini arttırdığı düşünüldüğünde iklim değişikliği konusunda izlenecek uzun vadeli ve ortaklaştırılmış stratejiler tasarlamak önemli hale gelmiştir.

Başta enerji ve üretim olmak üzere, iktisadi hayatın pek çok alanında "paradigma değişikliğini (*paradigm shift*)" gerektiren bu stratejiler tüm ülkelerin katılım gösterdiği Birleşmiş Milletler ekseninde yürütülen müzakerelerde oluşturulmaya çalışılsa da, konu, sanayileşmeye geç başlamış ülkelerle çoktan bazı basamakları atlamış gelişmiş ülkeler arasında çevre ve sürdürülebilir kalkınma üzerinden kurulan yeni bir Kuzey-Güney bölünmesine işaret etmektedir. Sera gazı emisyonlarının ortaya çıkışında "tarihsel sorumluluğu" bulunan gelişmiş ülkeler iklim değişikliğine karşı daha kolay önlem alabilirken, az gelişmiş veya gelişmekte olan ülkeler, ekonomik büyüme ve gelişimlerini olumsuz etkileyeceği için, iklim değişikliğini azaltma önlemlerine halihazırda pek sıcak bakmamaktadır. Ayrıca emisyonu azaltmanın yaratacağı maliyetin nasıl paylaşılacağı, hem uluslararası ölçekte hem de ülkesel planda karşılaşılan bir diğer sorun olmuştur (İğci, 2015).

Bu kapsamda, Birleşmiş Milletler İklim Değişikliği Çerçeve Sözleşmesi Sekretaryası nezdinde yürütülen ve Sözleşme'ye taraf ülkelerin yanı sıra pek çok sivil toplum kuruluşu ve iş dünyası temsilcisiyle katılım sağlanan uluslararası müzakerelerde iklim değişikliğiyle mücadelenin kaçınılmaz olduğu konusunda mutabakata varılmıştır. İklim değişikliği konusunda 2016 yılında Marakeş/Fas'ta düzenlenen 22. Taraflar Konferansı'na (COP-22) kadar kaydedilen uluslararası gelişmeler, her biri bir sonrakinin alt yapısını oluşturan üç ana dönem altında incelenmektedir. Bunlardan 1972-1992 arasındaki birinci dönemde, iklim değişikliği konusu uluslararası düzeyde ele alınarak konuyla ilgili

³ IPCC'nin günümüze kadar beş adet Değerlendirme Raporu yayınlanmıştır. IPCC'nin ilk dönemlerinde gerçekleştirilen toplantılarında çoğunlukla, fosil yakıt kullanımına dayalı CO₂ emisyonunun daha çok enerji ile ilgili olup olmadığı tartışılmıştır. IPCC'nin daha sonraki toplantılarının konusunu, CO₂ emisyonunu azaltmaya yönelik bağlayıcılığı olan yasal yükümlülükler, hedefler, azaltım takvimi, finansal mekanizmalar, teknoloji transferi ve gelişmiş ve gelişmekte olan ülkelerin "ortak fakat farklılaştırılmış sorumlulukları" oluşturmuştur.

bilimsel veriler toplanmaya başlanmıştır. 1992-1997 arasındaki ikinci dönemde çeşitli eylem stratejileri geliştirilmiş, 1997-2016 arasındaki son dönemde ise yükümlülük ve mekanizmalar oluşturularak muhtelif önlemler hayata geçirilmeye çalışılmıştır (Ediger, 2008).

Bu bölümde iklim değişikliğine ilişkin üç küresel anlaşma ele alınacaktır.

3.1 BM İklim Değişikliği Çerçeve Sözleşmesi

3-14 Haziran 1992 tarihlerinde Brezilya'nın Rio de Janeiro kentinde toplanan BM Çevre ve Kalkınma Konferansında ("Dünya Zirvesi - *Earth Summit*") imzaya açılan ve 21 Mart 1994 tarihinde yürürlüğe giren **BMİDÇS** hükümetlerarası düzeyde iklim değişikliğine yönelik ilk çevre mutabakatı olması dolayısıyla önem arz etmemektedir. 26 maddelik ana metinden oluşan Sözleşme'nin iki eki bulunmaktadır: Ek-I 'de piyasa ekonomisine geçiş sürecinde bulunan eski Doğu Bloku ülkeleri ile gelişmiş ülkeler (OECD-1992), Ek-II 'de ise yalnızca gelişmiş ülkeler (OECD-1992 ve AB) yer almaktadır (Anonim, 2017b). Bu çerçevede, Ek-I Ülkeleri iklim değişikliğini azaltmak amacıyla, sera gazlarının insan kaynaklı emisyonlarını sınırlandırmak ve sera gazı yutaklarını artırmak yönünde tedbirler almak ve politikalar benimsemek, iklim değişikliğini önlemek için aldıkları tedbirlerin ve izledikleri politikaların neler olduğunu bildirmek, mevcut sera gazı emisyonları ve öngörülen emisyonlarla ilgili elde edilen bilgiyi iletmek ve geçtiğimiz yüzyılın sonunda, insan kaynaklı sera gazı emisyonlarını daha önceki seviyesine geri çevirmek ve bunu gerçekleştirmek için de öncelikle bireysel ya da ortaklaşa olarak 1990 yılı seviyesine indirmekle sorumludur (Bu koşul Ek-I ülkeleri tarafından kısaca "sera gazı emisyonlarını 2000 yılında 1990 yılı seviyesinde sabitlemek olarak yorumlanmaktadır). Sözleşme'nin Ek-II listesinde yer alan sanayileşmiş ülkelerin geliştirmekte olan ülkelere karşı yükümlülükleri ise ulusal bildirimlerini hazırlamaları için maddi yardım sağlamak, iklim değişikliğini önlemek için alacakları tedbirlerin ve izleyecekleri politikaların uygulama maliyetini karşılayabilmeleri için gerekli maddi kaynağı sağlamak ve gerekirse bu ülkelere teknoloji transferi yapmak olarak belirlenmiştir (Dündar, 2005).

3.2 Kyoto Protokolü

BMİDÇS'nin yaptırım gücünün zayıf kalması, bağlayıcı ve daha somut hedefleri haiz farklı bir yasal düzenlemenin uygulanması gereksinimini ortaya çıkarmıştır. Bu kapsamda 1-12 Aralık 1997'de Japonya'nın Kyoto kentinde toplanan 3. Taraflar Konferansında⁴ (COP-3) kabul edilen **BM İklim Değişikliği Çerçeve Sözleşmesine Yönelik Kyoto Protokolü (Kyoto Protokolü)** 16 Şubat 2005 tarihinde yürürlüğe girmiştir. İklim değişikliği ile mücadelede hazırlanan en kapsamlı anlaşma olan Kyoto Protokolü 25 maddelik ana metinden ve Ek-A ve Ek-B olmak üzere iki ek listeden oluşmaktadır. Protokol'ün özünü, Ek-I ülkeleri için bağlayıcılık taşıyan emisyon hedefleri oluşturmaktadır. Bu kapsamda, Sözleşme'nin Ek-I listesinde yer alan ülkeler, Protokol'ün Ek-A listesinde belirtilen altı temel sera gazından karbondioksit, metan ve nitroz oksitinin toplam emisyonunu birinci yükümlülük dönemi olan 2008-2012 için 1990 yılı seviyesinin; hidroflorokarbonlar, perflorokarbonlar ve kükürt heksaflorür gazlarının toplam emisyonunu ise 1995 yılındaki seviyesinin %5 altına çekmekle yükümlüdür. Ek-I ülkelerinden oluşan Ek-B listesi ise 1990 yılına oranla sayısal emisyon azaltım hedeflerini içermektedir. Protokol, Tarafların emisyon azaltma ya da karbon yutaklarını geliştirme girişimlerini, kendi ülkeleri yerine başka yerlerde daha düşük maliyetle gerçekleştirebilmelerine olanak tanıyan üç mekanizmayı (Ortak Yürütme, Emisyon Ticareti ve Temiz Kalkınma Mekanizması) devreye sokmuştur (Anonim, 2017c).

Kyoto Protokolü'nün yerini alacak yeni bir düzenlemenin kabul edilmesi amacıyla 2007 yılında başlayan BM iklim müzakerelerinin 2009 yılında Kopenhag'da gerçekleştirilen 15. Taraflar Konferansı'nda tamamlanması hedeflenmiş ancak taraflar arasındaki derin fikir ayrılıkları sebebiyle 2012 yılı sonrası uluslararası iklim değişikliği rejimini düzenleyecek nihai anlaşmaya varılamamıştır.

⁴ *Taraflar Konferansı (Conference of Parties- COP)*, BM İklim Değişikliği Çerçeve Sözleşmesi'nin en üst karar organıdır. Sözleşme'ye taraf olan bütün ülkelerin temsil edildiği COP her yıl toplanarak Sözleşme'nin uygulanmasını değerlendirmektedir. Sözleşmenin daha etkin bir şekilde uygulanmasını teminen kararların alındığı ve diğer yasal araçların kabul edildiği COP'un temel görevi, taraf ülkelerce sunulan ulusal bildirimleri ve sera gazı envanterlerini gözden geçirmektir.

Bunun üzerine, 2011 yılında Durban’da düzenlenen 17. Taraflar Konferansı’nda Kyoto Protokolü’nün 2013-2020 döneminde de uygulanması hususunda mutabık kalınmış ve 2020 yılı sonrası iklim değişikliği rejiminin belirlenmesine yönelik müzakerelere devam edilmiştir. (Anonim, 2017d).

3.3 Paris Anlaşması

30 Kasım-11 Aralık 2015 tarihlerinde Paris’te gerçekleştirilen 21. Taraflar Konferansı (COP-21) sonunda, 2020 yılı sonrasına yönelik yeni iklim değişikliği anlaşması (Paris Anlaşması) kabul edilmiştir. 22 Nisan 2016 tarihinde New York’ta gerçekleştirilen imza töreninde Paris Anlaşması 175 ülke tarafından imzalanmış ve 5 Kasım 2016 tarihinde yürürlüğe girmiştir (Anonim, 2017e).

BMİDÇS’ye taraf 195 ülke tarafından kabul edilen Anlaşmada, Sanayi Devriminden bugüne kadar 1°C’ye ulaşan yerkürenin ısınmasının 2°C’nin altına indirilmesine ve mümkün olduğunca 1,5°C seviyelerinde tutulmasına karar verilmiştir. Bu çerçevede, 29 maddeden oluşan Paris Anlaşmasının ana temasını; anlaşmaya dahil ülkelerin sunmuş olduğu Niyet Edilen Ulusal Olarak Belirlenmiş Katkıları (*Intended Nationally Determined Contribution-INDC*) oluşturmaktadır. Sera gazı emisyonlarının azaltılmasına yönelik “yol haritası” niteliğindeki söz konusu belgeler, anlaşmaya onay veren ülkelerin taahhütleri olarak kabul edilmektedir (Anonim, 2017f). Esasen bu Anlaşma ile tüm tarafların emisyon azaltımı konusunda yükümlülük alması kabul edilmiştir. Ancak bu azaltım yükümlülüğünde gelişmiş ülkelerin daha fazla azaltım taahhüdü alması ve mutlak azaltım yapması istenirken, gelişmekte olan ülkelerin ise “ortak fakat farklılaştırılmış sorumluluklar” ilkesi gereği mevcut kapasitelerine göre bir azaltım yapması beklenmektedir. Anlaşmada uyum (adaptasyon) güçlü bir şekilde vurgulanmış ve özellikle iklim değişikliğinden en fazla etkilenecek savunmasız az gelişmiş ülkelerin desteklenmesi konusunda taahhütlerde bulunulmuştur (Karakaya, 2016).

“Büyük bir başarı” olarak lanse edilen Paris Anlaşması 2009’da Kopenhag zirvesinin çökmesinin yarattığı şokun aşılması ve Kyoto Protokolü’nün yerini alacak yeni bir anlaşmanın kabul edilmiş olması açısından çok önemli bir dönüm noktasıdır. Ayrıca bu anlaşmayla iklim değişikliğinin ne kadar büyük bir tehdit olduğu en güçlü biçimde ilan edilerek iklim değişikliğinin var olmadığı ya da insan kaynaklı olmadığı tezi çürütülmüştür. Bununla birlikte, Paris Anlaşması’nın en önemli eksiği iklim değişikliğini durduramayacak olmasıdır. Zira Anlaşmanın ekinde yer alan INDC’lerde sunulan ulusal emisyon azaltım hedefleri hem maksimum 2°C sıcaklık artışı hedefini sağlamak için yeterli değildir hem de bağlayıcılık taşımamaktadır. Paris Anlaşması’ndaki bir diğer sorun ise, bu yüzyılın ikinci yarısında (2051-2100 döneminde) karbon nötralizasyonuna ulaşma hedefi konulmasına rağmen bu hedefe nasıl ulaşılabileceğinin belirlenmemesidir (Anonim, 2017g).

4. İklim Değişikliği ve Çevre Etiği

4.1 Çevre sorunları ve çevre bilinci

Çevre sorunları, insanların sonradan oluşturduğu çevrenin doğal çevreye etkileri ile yapay çevrede var olan olumsuzluklar ve her iki çevrede de görülen sorunlardır. Günümüzde insanlığın karşı karşıya bulunduğu çevre sorunları; hava, su ve toprak kirliliği, ışık ve ses kirliliği, asit yağmurları, türlerin ve doğal kaynakların yok olması, kuraklık, açlık, nükleer enerji kullanımının ortaya çıkardığı riskler, kentleşmenin ortaya çıkardığı ve görülme sıklığını artırdığı hastalıklar, ozon tabakasının seyrelmesi ve iklim değişikliğidir (İlhan, 2013).

Bireylerin çevre sorunlarının önemini kavraması ve bu sorunları ortadan kaldırmak üzere önlemler alma bilincine erişmesi ise aşamalı olarak gerçekleşmiştir. Bu çerçevede, insan ve çevre ilişkilerinin avcılık ve toplayıcılık dönemlerine kadar uzanan *ilk aşaması*, insanın çevreyi tanıması ve çevreye uyum sağlama çabası ile geçmiştir. *İkinci aşamada* demirin kullanılması ve işlevsel aletlerin yardımıyla insan doğaya egemen olmaya başlamıştır. Bu dönemde insan, binlerce yıldır doğayla uyum içinde yaşama kültürünü geride bırakmış ve doğaya ve doğadaki varlıklara karşı sınırsız sömürme yaklaşımını benimsemiştir. Esasen bu tutum, insanmerkezci yaklaşımın da temelini oluşturmaktadır: Doğa ve çevre sadece insana yararlı olduğu sürece korunmuş, diğer yandan sınırsızca kullanılmıştır. 20. yüzyılın ikinci döneminde ortaya çıkan ve binlerce insanın yaşamına mal olan çevre sorunları, çevre konusundaki bilinçlenmenin ve önlem alma gereksiniminin ortaya çıkmasına neden olmuş ve böylelikle

üçüncü aşama başlamıştır. Bu dönemde insan, çevreyi bilinçsiz ve acımasızca tükettikçe, bunun sonuçlarının kendisini de etkileyebileceğini acı deneyimlerle öğrenmek zorunda kalmıştır. Bu aşamadan sonra ise çevreyi kendi sağlığını için korumak gereksinimi nedeniyle çevre bilinci ortaya çıkmıştır. *Dördüncü aşamada* bilimsel gelişmelerin de etkisiyle çevre bir maliyet sorunu olarak algılanmaya başlamıştır. Ancak çevresel kaynakların fiyatlandırılmaması (hava, su ve toprağa fiyat biçilememesi gibi) önemli bir sorun olarak ortaya çıkmıştır. Bilinçlenmenin *son aşaması* ile insanın çevre içinde doğal kaynaklar ve diğer canlılar ile bir bütünün parçası olduğu ve çevre sorunları ortaya çıkmadan önlenmeye çalışılması gerektiği ön plana çıkmıştır (Ertan, 2004).

Çevrenin bir sorun olarak insanlığın gündemine girmesinin birkaç on yıllık geçmişi olmakla birlikte, çevre sorunlarının yalnızca insan dışındaki canlıları tehdit eden bir sorunsal olmakla kalmayıp bizatihi insanın varoluşunu tehdit eden bir aşamaya gelmesi kısa sürede gerçekleşmiştir. 1952’de Londra’da hava kirliliği nedeniyle birkaç haftada 4 bin insanın yaşamını yitirmesi çevre felaketlerinin o yıllardaki somut kanıtlarından biri olarak ortaya çıkmıştır. Teknolojik buluşların korunmasında ve geliştirilmesinde yapılan insan hatalarından ortaya çıkan tehlikelere, örneğin 1984’te Hindistan’daki Bhopal gaz kaçağına ve 1986’da Sovyetler Birliği’ndeki Çernobil kazasına insanlık tanık olmuştur. (Eren, 2015).

Son yarım yüzyıla damgasını vuran ve tüm çevreci eleştirmenlerin etkilendiği Amerikalı bilim insanı ve yazar Rachel Carson 1962 yılında yayımladığı ve “tarihin seyrini değiştiren” “Sessiz Bahar (*Silent Spring*)” adlı kitabında çevrenin ve insan bedeninin ekolojilerini birlikte ele almıştır. Pestisit üreticilerinin yol açtığı ve devletin onayladığı çevre tahribatının titiz araştırması ve dokümantasyonunda Carson, sadece çevreyi ve doğal yaşamı etkileyen tahribatı değil, insanların yakalanabileceği ölümcül hastalıkları da incelemiştir. Böylelikle “Sessiz Bahar” modern çevre hareketinin başlangıcı sayılmıştır. Sessiz Bahar’dan elli yıl sonra artık sessizlik sona ermiş ve çevre tahribatına bağlı sağlık problemleri geçmişteki kuşklara karşın nihayet halk sağlığı gündemine girmiştir (Özdağ, 2011).

Diğer taraftan, çevre sorunlarına çözüm arayışında insanın, bu faaliyetleri ne için yaptığını, yaparken neleri bozup yok ettiğini, bozup yok ettiği bu şeylerin ne tür ve ne düzeyde bir değer taşıdığını sorgulaması kaçınılmaz olmaktadır. Felsefeye dayanmayan, yüzeysel, teknolojik çözümlerin tek başına doğadaki bozulma ve yok oluşu durduramadığının görülmesi de böyle bir sorgulamanın kaçınılmazlığını desteklemektedir (İlhan, 2013).

4.2 Çevre etiği

Etik, çeşitli alt alanlara da ayrılarak genişlemekte olup, bu alanların en önemlilerinden biri çevre etiğidir. Bu kapsamda çevre etiği hem bir uygulamalı etik hem de bir meslek etiği dalıdır (Ergün ve Çobanoğlu, 2012).

Çevre etiği ekolojik denge bütünlüğünün korunarak çevreye saygı gösterilmesini gerektiren davranış ve değerlerdir. Aslında çevre etiği, doğaya insanın bakışında köklü değişikliklerin olmasını ve var olandan farklı olarak olması gerekenlerin geliştirilmesini amaçlamaktadır. Çevre etiği; her türlü din ve kültürel değer içerisinde anlam ifade eden, uzun vadeli düşüncülerle çevre-kalkınma dengesinin sağlanmasını zorunlu kılan, her türlü genel ve özel çevre koruma politikaları oluşturmaya çalışan ve son olarak adaletli paylaşımı ve insan doğa ilişkilerinin düzenlenmesini temel hedef edinen bir yaklaşımdır (Kayaer, 2013).

İnsanın canlı ve cansız çevreye karşı davranışlarında neyin iyi, neyin kötü olduğu sorularını soran çevre etiği, esasen, iyi olanı yapmayı, kötü olandan ise kaçınmayı önermektedir. Bu da insanı, çevre ile olan ilişkilerinde sınırlandırma anlamına gelmektedir. Bu durumda, davranışlarında kendinden sonraki nesilleri dikkate almayan, gelecek kuşakların refahlarını azaltan ya da yok eden bir davranış, bugünkü kuşaklara fayda sağlıyor olsa bile iyi bir davranış olarak kabul edilmemektedir (Ergün ve Çobanoğlu, 2012).

Genel olarak çevre etiği, insanlar ile doğal çevreleri arasındaki ahlaki ilişkilerin sistemli olarak incelenmesidir. Çevre etiği, ahlak kurallarının insanların doğal dünya karşısındaki davranışlarını yönettiğini ve yönetmesi gerektiğini varsaymaktadır. Bu nedenle, bir çevre etiği kuramı bu kuralların neler olduğunu, insanların kimlere ve nelere karşı sorumlulukları bulunduğunu açıklamak ve bu

sorumlulukların neden haklı olduğunu göstermek zorundadır. Doğaya karşı sorumlu olmak, yalnızca doğadaki insan dışındaki varlıklarla olan ilişkiyi ifade eder gibi görünse de sosyal, sağlık ve felsefi açılardan bu konularda hassasiyetleri olan, sonuçlarından doğrudan veya dolaylı etkilenen diğer insanlara karşı bir sorumluluğu da içermektedir (Yıldız, 2016).

Çevre etiği konusunda sorumluluğun “kim için” ve “ne için” duyulması gerektiği hep sorulmakla birlikte, bu soruya yanıt bulmakta güçlük çekilmektedir. Doğal çevrimin bozulmasını önlemek, doğanın dengesini yeniden kurmak, insanlığın çıkarlarını korumak ve ilginin ağırlık odağını bireyden uzaklaştırarak tüm canlıların korunmasını ön plana çıkarmak “sorumluluk” konularına dahil edilmektedir (Keleş vd., 2015).

Etik düşünürleri, çevre ile ilgili iki değer tanımlamaktadır. Birincisi, bir canlının ya da doğal yapının insana faydası olduğu için değeri olmasıdır. “Araçsal değer” olarak tanımlanan bu değerlendirme genellikle ekonomik çıkarlara dayanan, geleneksel Batı etik düzeninin bir uygulamasıdır. İkinci değer ise, bir varlığın insanlara faydası olsun veya olmasın kendine özgü değerinin olmasıdır (Akkoyunlu Ertan, 1998). “İçkin/içsel değer” olarak nitelendirilen bu değerlendirme daha ziyade yeni etikçiler tarafından kullanılmaktadır.

İnsanmerkezci (Antroposentrik), Canlımerkezci (Biosentrik) ve Çevremerkezci (Ekosentrik) olmak üzere başlıca üç çevre etiği yaklaşımı bulunmaktadır. Bunlara gelişmeye devam eden yeni etik yaklaşımı da eklenebilir.

4.2.1 İnsanmerkezci yaklaşım ve iklim değişikliği

Canlı ve cansız varlıkların temel işlevlerini insana dayandıran bu yaklaşım, bitki ve hayvan topluluklarının insanlara sağladıkları yarar için değerli olduklarını (“araçsal değer” taşıdıklarını) ileri sürmektedir (Akkoyunlu Ertan, 1998). Ünlü sofist düşünür Protagoras’ın “*insan her şeyin ölçüsüdür*” sözü ile en net şekilde ifade edilebilecek insanmerkezci yaklaşıma göre, insan türler hiyerarşisinin en üstünde yer almakta ve doğadaki her şey insana göre konumlandırılmaktadır. Doğa, insan için kullanılacak, dönüştürülecek ve yararlanılacak bir kaynak deposuna indirgenmektedir. Çevrenin korunması da yalnızca araçsal değerleri bakımından korunması gereken varlıkları kapsamaktadır (Ak, 2013). Bu çerçevede, ekolojik sorunlar, insan için yarattığı olumsuzluklar, tehditler ve tehlikeler ölçüsünde bir politika sorunu olarak görülmektedir.

Çevre sorunlarının giderek artması ve insanmerkezci yaklaşımın insan-canlı-doğa ilişkilerini açıklamakta yetersiz kalması üzerine “yeni insanmerkezci yaklaşımlar” ortaya çıkmıştır:

- **Aydınlanmış İnsanmerkezcilik:** Ünlü mikrobiyolog Rener Dubos’a göre insan, yaşamın kısa bir döneminde doğanın sadece bir tapıcısı ve onun eylemlerinin edilgin bir seyircisidir. Oysa insan, doğaya biçim verirken insan olur. Bu yaklaşım insanın doğayı çıkar gözetmeden ve salt kendisi için sevmeden onu etkin biçimde kontrol edemeyeceğini savunmakta ve insanın doğaya yaratıcı olarak müdahale etmesini önermektedir (Ertan, 2004).
- **Zayıf İnsanmerkezcilik:** İnsanmerkezci yaklaşımı, “güçlü insanmerkezci” ve “zayıf insanmerkezci” olmak üzere iki türe ayıran Bryan G. Norton, bu ayrımı, “insan çıkarı”nın iki anlamı arasında yaptığı ayrımı dayandırmaktadır. Bu çerçevede, “hissedilen yeğleme”; bir kişinin geçici olarak doyurabileceği bir ihtiyacı ya da arzusunu ifade ederken, “düşünceli yeğleme”, kişinin ihtiyacını ya da arzusunu, ussal olarak benimsediği dünya görüşü ile tutarlı olup olmadığına da dikkat ederek tartması sonucunda ifade ettiği yeğlemedir. Norton, hissedilen yeğlemeleri sorgulamadan kabul eden güçlü insanmerkezci yaklaşım içinde, doğaya zarar veren davranışları eleştirme olanağı bulunmadığını savunmaktadır. Buna karşın, hissedilen yeğlemelerin bir dünya görüşüyle tutarlılığının tartıldığı zayıf insanmerkezci yaklaşım, doğaya zarar veren davranışların ve bunların dayandığı değer sistemlerinin eleştirilmesine olanak tanıyabilmektedir. Bu nedenle zayıf insanmerkezci yaklaşımın doğanın korunabilmesi ve doğaya zarar veren davranışlara izin veren değer sistemlerinin eleştirilebilmesi için iyi bir temel sağladığı düşünülmektedir (İlhan, 2013).
- **Modern İnsanmerkezcilik:** W. H. Murdy’ye göre, evrim sürecinde insan çevreyi değiştirebilme yeteneği bakımından diğer türlere göre daha çok gelişmiş olup, dünya

egemenliğini elde etmiş tek tip ve evrim süreci içinde ortaya çıkmış en son egemen tiptir. İnsan bu egemenliği yeryüzünün yapısını köklü bir şekilde yeniden düzenleyerek ele geçirmiştir (Şakacı, 2011). Murdy, insanların sergilediği büyük yok etme potansiyeline vurgu yapmakta ve ekolojik destek sistemine bağımlı olma olgusunun insanları bu kırılğan gezegeni tahrip etmeme konusunda dikkatli olmaya yöneltmesi gerektiğine dikkat çekmektedir. Murdy'e göre, insanlar insan olmayanlar ve doğal dünyanın geri kalanına, bu varlıkların insanlara yarar sağlamanın bir gereği olarak değer vermelidir (Şakacı, 2011).

- **Teknomerkezcilik:** Doğanın ve çevrenin acımasızca sömürülmesinin de ideolojisi olarak Batı toplumlarında ortaya çıkmış ve daha sonra bütün dünyaya yayılmış bu görüş, “çevreye resmi tavır alışı” anlamına gelmektedir. Bu yaklaşımın başlıca temsilcisi olan David Pepper'a göre; bu görüşün temel bileşeni, klasik bilim ile onun beslediği bakış açıları ve inanışlardır (Ertan, 2004). Doğayı insanın sınırsız kullanımına açık bir kaynak deposu olarak gören bu yaklaşımda bilim ve ona dayanan teknoloji insanın doğa üzerindeki egemenliğinin kurulmasında kullanılan başlıca araçlardır (Çüçen, 2011).

İnsanmerkezci yaklaşım açısından “iklim değişikliği” yalnızca insanın refahını etkilediği ölçüde bir sorun oluşturmaktadır. Doğal kaynakları sadece “insan” yararına sınırsızca kullanmayı amaçlayan bu görüş meseleye yalnızca “siyasi” açıdan bakarak “çözüm” üretecektir. Her ne kadar aydınlanmış insanmerkezcilik, modern insanmerkezcilik ve zayıf insanmerkezcilikte insanın doğaya karşı tavrı biraz daha yumuşatılmış olsa da özünde “insanın öncelikli ve en değerli varlık” olduğu gerçeği değişmemektedir.

Mevcut uluslararası iklim rejimini değerlendirmek için öncelikle konunun ilk kez düzenlendiği (BMİDÇS'nin kabul edildiği) 1992 Rio Konferansını ele almak gerekmektedir. Bu konferansın sonunda kabul edilen Rio Bildirisi'nin 1. maddesine göre; “insanlar, sürekli ve dengeli kalkınmanın merkezindedirler. Doğa ile uyum içerisinde, sağlıklı ve verimli bir biçimde yaşama hakları vardır.” Ancak sürekli ve dengeli kalkınmayla sağlıklı ve verimli yaşama hakkının birlikte ele alınması çevre hakkı açısından belirsiz bir durum yaratmaktadır. Sürekli kalkınma, dengeli bile olsa, çevreyi sürekli tehdit edecektir. İnsanların, belli hakları ve yükümlülükleri olan nesnelere olarak görülmediği bir yaklaşımla kaleme alınan Rio Bildirgesi, insan varlığına, doğayla uyumlu sağlıklı yaşam hakkını tanımaktaysa da, bu hakka üretim yönelimli mantığın bakış açısına göre yer vermektedir. Bu çerçevede, Rio Konferansı'nın insanmerkezci bir çevre anlayışını benimsediğini söylemek yanlış olmayacaktır (Sezer. Tarih belirtilmemiş).

BMİDÇS gibi Kyoto Protokolü de salt insan bakımından değerlendirmeye öncelik veren düzenlemeler içermektedir. Söz konusu hukuki belgeler canlı ve cansız varlıklar arasında ve/veya canlıların kendi aralarında adalet ve hakkaniyete dayalı bir etik anlayışına sahip olmadığı gibi, sınıfsal açıdan farklılıkları da dikkate almamaktadır (Algan, 2008).

Her iki belgenin de “sürdürülebilir kalkınma”yı hedeflemesi söz konusu düzenlemelerin “insanmerkezci” niteliğinin bir diğer göstergesidir. Zira “sürdürülebilir kalkınma” kapsamında doğal kaynakların korunması yalnızca gelecek kuşakların refahlarının korunması adına istenmektedir. “Gelecek kuşaklar” ile kast edilen ise, yalnızca insan neslidir. Bu çerçevede, “sürdürülebilir kalkınma”, “insanmerkezciliğin yeni bir görüntüsü olarak” da nitelendirilmektedir (Ergün ve Çobanoğlu, 2012).

İklim değişikliğine yol açan sera gazı emisyonlarının azaltılması ve iklim değişikliğinin etkilerine uyum sağlanması alanlarında gelişmekte olan ülkelere sanayileşmiş ülkelere iklim dostu teknolojilerin transferinin sağlanması ve söz konusu teknolojilerin bu ülkelere geliştirilmesinin hem BMİDÇS (Madde 4) ve hem de Kyoto Protokolü'nün (Madde 10) önceliklerinden biri olması, teknomerkezci anlayışın göstergelerinden biri olarak da yorumlanabilir. Aynı yaklaşım Paris Anlaşması bakımından da geçerlidir (Madde 10).

BMİDÇS ve Kyoto Protokolü ile aynı anlayışla düzenlenen Paris Anlaşması da yukarıdaki değerlendirmelere büyük ölçüde uymakta olup, diğer etik yaklaşımlara yakın tarafları ilgili kısımlarda açıklanacaktır.

4.2.2 Canlımerkezci yaklaşım ve iklim değişikliği

İnsanmerkezci yaklaşıma tepki olarak diğer canlı varlıkların da değerinin ve dolayısıyla hakkının olduğunu savunan canlımerkezci yaklaşım, insanmerkezci yaklaşımın “sadece insan” tezine şiddetle karşı çıkmaktadır. Bu yaklaşım, bitki ve hayvanların hatta tüm canlıların önemli ve hak sahibi olduğunu ve insan ihtiyaç ve taleplerinin karşılanmasının ötesinde içkin değer taşıdığını savunmaktadır (Kayaer, 2013). Bu kapsamda öne çıkan canlımerkezci yaklaşımlar şunlardır:

- **Yeryüzü Etiği:** İnsanların yeryüzünün hakimi yerine yeryüzünün birer üyesi olarak görülmesi gerektiğini savunan Aldo Leopold canlı varlıkların ahlaksal haklarının var olduğunu ileri sürmektedir. Leopold’un “Yeryüzü Etiği (*Land Ethic*)”, çevre merkezci etik anlayışının da temelini oluşturmaktadır. Bu durumda insan, doğal yaşamda ayrı ve üstün bir yaratık olmayıp, çevresel varlıklar insanlara sağladığı faydalar nedeniyle değil, kendi öz varlıkları için korunmalıdır (Kayaer, 2013). Leopold’dan sonra Henry David Thoreau, John Muir, Edward Abbey ve Terry Tempest Williams’ın katkılarıyla “Doğal yaşam alanlarının ve biyolojik çeşitliliğin korunması, biyotik topluluğun içsel olarak değerli bireylerinin yaşam haklarına saygı duyulması, toprağın ve toprağın barındırdığı canlıların sağlığı için insan yaşamında fedakarlıklar yapılması gerektiği ortaya çıkmıştır” (Akkoyunlu Ertan, 2015). “Yeryüzü etiği” yaklaşımı kapsamında iklim değişikliği olgusu değerlendirildiğinde; bu yaklaşımın doğayı kişisel çıkarlar için yok etmenin ve sınırsız büyümenin önünü açan ülkeler için uyarı olarak kaleme alındığını ve çevre sorunlarının küresel bir tehdide dönüştüğü günümüzde bu yaklaşımın dünya üzerindeki tüm türlerin uyumlu ve huzurlu bir yaşamı paylaşarak geleceğe taşınmasını amaçladığını söylemek yanlış olmayacaktır.
- **Gaia Yaklaşımı:** James Lovelock ve Lynn Margulis tarafından geliştirilen yaklaşıma göre dünyanın varlığının devamı canlı organizmaların işbirliği yapmasına bağlı olup, dünyayı yaşam bulunmayan Mars Gezegeni’nden ayıran canlıların biyosferi değiştirmesidir. Bu yaklaşım, diğer canlı formlarının da insanlarla aynı ve eşit haklara sahip oldukları tezini ortaya koymaktadır. Buna göre canlı türlerinin ekonomik olmayan değerinin ötesinde varlığının değeri kendinden menkul sayılmalıdır. Çevreye ve çevre politikalarına bu bakış hakim olmalı, biyolojik çeşitliliği insan çıkarı gözetilmeksizin korumaya ve geliştirmeye çalışılmalı, hem eğitsel, hem hukuksal hem de uygulamaya yönelik alanlarda çaba ve çalışmalar sürdürülmelidir (Kayaer, 2013). Gaia yaklaşımının öncüsü James Lovelock iklim değişikliğini Toprak Ana’nın sınırları içinde yaşayan uygarlığın sistemsal bir başarısızlığı olarak görmektedir. “Yeryüzüne önem vermediğimiz takdirde, o da şüphesiz bizleri artık hoş görmeyecek şekilde kendi önlemini alacaktır. İnancı olan insanların Yeryüzüne tekrar bakıp, buranın kutsal bir yer olduğunu ve Tanrı’nın bir parçası olduğunu hatırlayıp buraya nasıl saygısızlık edildiğini görmeleri gerekmektedir” (Hulme, 2016). Diğer taraftan, Gaia yaklaşımına göre, “insan kaynaklı sera gazı emisyonlarının artışında dahi, gezegenin iklimi sabitleyebilecek kendi kendini düzenleyen mekanizmaları” bulunmaktadır (Jamieson, 1992). Söz konusu yaklaşım çerçevesinde mevcut iklim rejimine bakıldığında ise, iklim değişikliğine ilişkin düzenlemelerin liberal siyaset kuramını esas aldığı, küresel iklimin bir “kaynak” olarak görüldüğünü ve temel etik sorunun “bu kaynağın kullanılması ve paylaşılmasına ilişkin haklar ve söz konusu kullanımdan kaynaklanan fayda ve yüklerin dağıtımı” olduğunu belirtmekte fayda bulunmaktadır (Barry *et al.*, 2013).

BMİDÇS’nin 1. maddesinde “iklim değişikliğinin zararlı etkileri”, “iklim değişikliği sonucunda fiziksel çevrede veya biyotada ortaya çıkan ve doğal haldeki veya yönetim altındaki ekosistemlerin bileşimi, kendilerini onarma yeteneği ve verimliliği veya sosyo-ekonomik sistemlerin çalışması veya insan sağlığı ve refahı üzerinde önemli zararlı etkileri olan değişiklikler” olarak tanımlanmaktadır. 2. maddede yer verilen *Sözleşmenin amacı* ise “Sözleşme’nin ilgili hükümlerine göre, atmosferdeki sera gazı birikimlerini, iklim sistemi üzerindeki tehlikeli insan kaynaklı etkiyi önleyecek bir düzeyde durdurmayı başarmaktır. Böyle bir düzeye, ekosistemin iklim değişikliğine doğal bir şekilde uyum sağlamasına, gıda üretiminin zarar görmeyeceği ve ekonomik kalkınmanın sürdürülebilir şekilde devamına izin verecek bir zaman dahilinde ulaşılmalıdır”. Bu kapsamda, her iki maddede de

“ekosistemler”e atıf yapılmakla birlikte, asıl vurgu “insan sağlığı ve refahını korumak”tır. Kyoto Protokolü’ne bakıldığında ise bu yaklaşımdan bir adım daha geriye gidilerek doğal kaynaklara ve/veya ekosistemlere herhangi bir hükümde yer verilmediği görülmektedir.

Diğer taraftan, Paris Anlaşması’nda canlımerkezci etiğe daha yakın bir yaklaşımın sergilendiğini belirtmek gerekmektedir. Anlaşma’nın “dibace” bölümünde “*Okyanuslar dahil olmak üzere tüm ekosistemlerin bütünlüğünü sağlamanın ve bazı kültürler tarafından Toprak Ana olarak kabul edilen biyolojik çeşitliliği korumanın önemine dikkat çekerek ve iklim değişikliğiyle mücadele için eyleme geçerken “iklim adaleti” kavramının bazıları için önemine dikkat çekerek*” ibaresi yer almaktadır. İlk kez “iklim adaleti” ve “toprak ana” gibi kavramların anlaşma metnine girmesi büyük önem taşımaktadır (Anonim, 2017g).

4.2.3 Çevremerkezci yaklaşım ve iklim değişikliği

Çevremerkezci yaklaşım bütün yaşam biçimlerinin (bitkiler, hayvanlar ve diğer ekosistem üyelerinin) eşit haklarının olduğunu savunmaktadır. Bu kapsamda insanın herhangi bir önceliği ya da farkı bulunmamaktadır. Çevremerkezçiliğin bu temel perspektifi doğayı potansiyel kaynak olarak gören anlayışa ideolojik bir karşı çıkış niteliğindedir (Akkoyunlu Ertan, 1998). Bu görüşe göre, insan kendisini doğadan ayrı ve önemli bir varlık olarak görmekten vazgeçmeli ve doğadaki tüm varlıklara empati ve özen ile yaklaşmalıdır.

Teknoloji konusunda sorgulayıcı bir bakış açısına sahip olan çevremerkezçilikte doğa üzerinde sömürü ve yıkıma neden olan teknolojiler çevre sorunlarının nedenleri olarak görülmektedir. Buna karşılık, insan etkinliklerinin doğaya uyumlu olmasını sağlayan teknolojilerin kullanılması desteklenmektedir. Ekolojik sorunlar insanla ilgili bir çerçeveye sıkıştırılmamakta, “içkin değeri” olan doğadaki varlıkların iyi oluş koşullarının bozulması olarak” ele alınmaktadır. Bu çerçevede başlıca çevremerkezci yaklaşımlar aşağıda özetlenmektedir:

- **Derin Ekoloji:** İsveçli bilim adamı Arne Naess “derin ekoloji- sığ ekoloji” ayrımını ilk olarak 1972 yılında Bükreş’teki “Üçüncü Dünyanın Geleceği Konferansında” dile getirmiş ve 1973 yılında yayımlanan bir makalesinde derin ve sığ ekolojiler arasındaki farklılıkları ortaya koyarak derin ekolojinin ilkelerini belirlemiştir. Naess, bu makalede, ekolojik düşüncede iki sınırlı çevreci hareketin olduğunu, bunlardan birinin daha çok bürokratlar tarafından ortaya konulan ve nüfus ve kaynak sorunlarıyla ilgilenen klasik çevrecilik olduğunu, diğerinin ise doğaya bağlı, kültürümüzde derin ve temel değişimi öneren ve o dönemde pek fazla bilinmeyen derin ekoloji hareketi olduğunu savunmuştur. Bu yaklaşımda insanlar doğaya karşı veya üstün değil doğanın bir parçası olarak görülmekte, kaderi de doğa üzerinde egemenlik kurma ve denetleme olarak değil insanın bilinçli olması ve düşünme yeteneği taşımasıyla belirlenmektedir. Naess dışında Gary Snyder, Bill Devall ve George Session derin ekolojiye en çok katkı yapan isimler olarak anılmaktadır. Derin ekolojinin ortaya çıkmasında Aldo Leopold’un, Rachel Carson’un ve diğer ekolojistlerin ekoloji alanında yaptığı çalışmaların katkısı bulunmaktadır (Yaylı ve Çelik, 2011). Bununla birlikte, bu yaklaşım insanmerkezçiliğe şiddetle karşı çıkmasına rağmen, doğanın korunması için yapılması gerekenleri yine insanlara yüklemektedir. İnsanı merkeze alan tutumun doğayı ikincilleştirdiği sorununun ancak doğa bir hukuk öznesi olarak kabul edildiğinde aşılacağını savunsa da özne olmanın sınırları insan tarafından belirleneceği için kendisiyle çelişkiye düşmektedir (Maltaş, 2015). Derin ekoloji yaklaşımı açısından değerlendirildiğinde iklim değişikliği milyarlarca canlının refahını olumsuz etkilediği için “kötü”dür. İnsanları koruyacak bir yöntem bulunsa dahi diğer canlılar iklim değişikliği nedeniyle mağdur olmaya devam edecekleri için bu durum değişmeyecektir (Anonim, 2017h). Diğer taraftan, derin ekoloji, daha önce de belirtildiği üzere, “tutarsız” ve “idealist” olduğu yönünde eleştirilmiş olup, bu yaklaşımın iklim değişikliğine ilişkin etik tartışmalara herhangi bir katkıda bulunmadığı da ileri sürülmektedir (Tiili, 2015).
- **Doğa Hakları:** Roderick F. Nash’ın “Doğa Hakları” isimli kitabı, çevremerkezci yaklaşımın ortaya konduğu ve geliştirildiği yayınlardan biridir. Nash, bu çalışmada, amacının, ahlakın doğaya karşı insan ilişkilerini de içermesi gerektiği düşüncesinin tarihi ve önemini ortaya

koymak olduğunu belirtmektedir. Nash, insan dışındaki çevreyi de kapsayan doğanın bütünlüğüne haklar tanıyan yaklaşımı savunmaktadır. Doğanın parçası olan bireye değil, doğanın bütününe haklar tanıyan yaklaşımıyla Nash etik yayılcı geleneğin temsilcisidir (Ertan, 2004).

- Doğa hakları düşüncesine önemli katkılarda bulunmuş ve Amerikan mahkemelerinde ağaçların haklarını savunan raporuyla doğa hakları mücadelesinde önemli bir başvuru kaynağı olmuş çevremerkezci hukukçu **Christopher D. Stone**'a göre, çocuklara, kadınlara, kara derililere, kızıl derililere, mahpuslara, akıl hastalarına ve hatta canilere sırasıyla belirli haklar tanınmasından sonra, sıranın ağaçlara ve belki genel olarak doğaya gelmesi, insanlık tarihinin gelişim çizgisinin mantıksal bir sonucudur. Bu çalışması ile Stone, doğal varlıkların hakları düşüncesini açıkça savunan ve bu düşüncesini mahkeme dosyalarına taşıyan ilk düşünür olmuştur (Ertan, 2004: 101). 1972 yılında yayınladığı "*Should Trees Have Standing? Towards Legal Rights for Natural Objects?*" adlı makalesinde, hukukun zaman içindeki gelişimini ele almakta ve ormanlara, okyanuslara, nehirlere, tüm diğer doğal varlıklara ve bir bütün olarak doğaya yasal haklarının verilmesini savunmaktadır (Anonim, 2007ı). Stone, 1972 yılında yazdığı makaleyi 35 yıl sonra güncelleyerek iklim değişikliği ve okyanusların korunmasını da incelemiş ve bu çalışması ile ağaçların, okyanusların, hayvanların ve bir bütün olarak çevrenin neden haklarla donatılması ve doğadaki bu sessiz unsurların gelecek kuşaklar için korunması gerektiğini ortaya koymuştur (Anonim, 2017i).

Çevremerkezci etik anlayışa göre "tüm canlı varlıklar, bunların yaşam ortamları, doğal ve yapay nitelikteki tüm cansız değerler" in korunması gerekirken, uluslararası iklim rejiminde (özellikle BMİDÇS ve Kyoto Protokolü'nde) "insan"ın korunmasının hedeflendiği görülmektedir. Bununla birlikte, Paris Anlaşması'nda, seleflerinin aksine, "çevresel bütünlük"e de atıfta bulunmaktadır (Madde 4.13 ve Madde 6.1). Ayrıca, yine diğer iki düzenlemeye kıyasla, "uyum (adaptasyon)"a daha fazla önem verilmektedir. Bu çerçevede, 7. maddede "...ekosistemleri" göz önünde bulunduran ve "ekonomik çeşitlendirme ve doğal kaynakların sürdürülebilir yönetimi dahil olmak üzere çeşitli yöntemlerle sosyo-ekonomik ve ekolojik sistemlerin direncinin artırılmasına yönelik" politikaların izlenmesi öngörülmektedir. "Kayıp ve zararlar" ile ilgili 8. maddede de "toplulukların, geçim kaynaklarının ve ekosistemlerin dirençliliği" alanında işbirliği yapılması öngörülmektedir (Anonim, 2017j).

Çevremerkezci etiğin çevreyi tüm öğeleriyle dikkate aldığı göz önünde bulundurulduğunda, Paris Anlaşması'nda iklim değişikliğinden farklı düzeylerde etkilenen kesimlere yer verildiği ve görece daha "kırılgan ve etkiye açık (*vulnerable*)" paydaşlar arasında ayırım yapıldığı görülmektedir. Bu kapsamda, yine 7. maddesinde, özellikle uyum konusunda yürütülecek faaliyetlerin "ülkeye özel, toplumsal cinsiyete duyarlı, katılımcı ve tamamen şeffaf bir yaklaşım takip etmesi, mevcut en iyi bilim ve uygun durumlarda geleneksel bilgiye, yerli halkın bilgisine ve yerel bilgi sistemlerine dayanması gerektiği" kabul edilmektedir. Bununla birlikte, Paris Anlaşması'nın kabul edildiği 21. Taraflar Konferansında "mavi bölge" olarak adlandırılan alanda yer alan diplomatlar, devlet başkanları ve ünlü çevrecilerin müzakereleri yönlendirmesine karşın "yeşil bölge" olarak nitelendirilen kısımda bulunan yerli halkların ve sivil toplum kuruluşlarının sınırlı söz hakkına sahip olduğu ve süreçten dışlandığı da ileri sürülmektedir (Anonim, 2017k).

4.2.4 Yeni Etik Yaklaşım ve İklim Değişikliği

Yukarıda bahsedilen etik yaklaşımların yanı sıra, yeni etik yaklaşımı kapsamında farklı görüşler sunulmaktadır:

- **Toplumsal/Sosyal Ekoloji:** Murray Bookchin "çevre"yi "I. Doğa" ve "II. Doğa" olmak üzere ikiye ayırmaktadır. Bookchin'e göre, "yapay çevre"yi ifade eden II. Doğa'da eşitsizlikler ve hiyerarşi hakimdir. Çevre sorunlarının asıl sebebinin oluşturduğu bu hiyerarşinin ortadan kaldırılması, bunun yerine özerk, küçük, yerel ve doğaya saygılı topluluklardan oluşan anarşist bir toplumun kurulması gerekmektedir. Bu kapsamda kapitalizm ile mücadele etmeden daha özgür, daha demokratik ve ekolojik bir toplum kurma şansımız yoktur (Anonim, 2017l). Mevcut

liberal kapitalist bakış açısından değerlendirildiğinde çevre değerleri birer iktisadi kaynak olmaktan öte bir anlam taşımamaktadır. Bookchin'e göre dünya kıtlık sonrası çağına girmiştir. Teknolojide herkesi rahat geçindirecek potansiyel olup, teknolojik gelişmenin ortaya çıkardığı kirlilik teknolojinin akıllıca kullanılmamasından kaynaklanmaktadır (Tont, 1997). Toplumsal ekoloji açısından değerlendirildiğinde, küresel hale gelmiş çevre sorunları yumağı acilen çözüm beklemekte olup, bu sorunların çözümü mevcut sistemle gerçekleşemez. Zira mevcut sistem bizzat sorunların kaynağıdır. “*Dişinizi fırçalarken muslukları kısın, daha az su tüketen “eko-çamaşır ve bulaşık makineleri vb.” tercih edin, tasarruflu ampuller kullanın, toplu taşıma araçlarına binin*” gibi söylemler mevcut sistemin kendini daha fazla yaşatması için toplumun ilgisini başka yöne çekmeye yöneliktir. Biyosferik krizin ise tek bir çözümü vardır; o da toplumun ve ekosistemin bağına yayılmış, doğanın ve insanın yaşam alanını her geçen gün daraltan kanserli sistemi bünyeden söküp atmaktır (Çelik ve Gülersoy, 2016).

BM'nin iklim değişikliğiyle mücadele yöntemlerinin de kapitalist sistemi güçlendirdiği yönünde tartışmalar sürmektedir. BMİDÇS ve Kyoto Protokolü'nün hükümleri gereği sera gazı emisyonlarının azaltılması amacıyla uygulanan Emisyon Ticareti, Temiz Kalkınma Mekanizması ve Ortak Yürütme gibi mekanizmaların iklim değişikliğiyle mücadeleye beklenen olumlu katkıyı yapmadığı ve ülkeler arasında adaletsiz işbirliklerine yol açtığı ileri sürülmektedir. Naomi Klein, “*This Changes Everything: Capitalism vs the Climate*” adlı kitabında kapitalizm hakkında konuşulmaksızın iklim değişikliğinin ele alınamayacağını savunmaktadır (Hemaadri, 2017). BM nezdindeki uluslararası iklim değişikliği müzakerelerinde “iklim kapitalizmi” söylemi de bu değerlendirmeler sonucunda yaygınlaşmıştır (Talu, 2015). Öyle ki, Venezuela Cumhurbaşkanı Hugo Chavez Kopenhag'da gerçekleştirilen 15. Taraflar Konferansı'nda “*İklim kapitalist bir banka olsaydı, zengin ülkeler onu çoktan kurtarmışlardı*” demiştir. Bu çerçevede, iklim rejiminin toplumsal ekolojinin ilkeleriyle bağdaşmadığını söylemek yanlış olmayacaktır.

- **Eko-feminizm:** “Feminist ekoloji” kavramı ilk kez 1974'te François d'Eaubonne tarafından kullanılmıştır. Rosemary Ruether'in önderlik ettiği bu yaklaşıma göre, kadın ve doğa yüzyıllarca aynı kaderi paylaşarak hor görülmüş ve aşağılanmıştır. Bugünkü çevre sorunlarının çoğu, özellikle kadınların sezgi, bakış ve sentez yapma kabiliyetlerinin toplumlar tarafından göz önünde bulundurulmamasından kaynaklanmaktadır. Erkek-egemen bir toplumda var olan baskı hem çevreye hem de kadına yönelik olduğundan, çevrenin ve kadının erkeğin baskı ve egemenliğinden kurtulması gerekmektedir (Tont, 1997). Eko-feminizm-iklim değişikliği ilişkisinde öncelikle kadınların açlık sınırının altında yaşayan insanların tahmini olarak %70'ini oluşturmaları sebebiyle iklim değişikliği ve çevresel bozulmanın karşısındaki en savunmasız grup durumunda olduğunu belirtmek gerekmektedir. Ayrıca yaşam alanlarının tahrip olması, tarım arazilerinin yok olması (ya da iklim değişikliği ile artık üretim yapılamayacak hale gelmesi) ve tüm bunların genel sonucu olarak yoğun göçlerin başlaması gibi öngörülebilecek genel sorunlardan ilk etkilenecek olan toplumsal özne yine kadınlardır (Anonim, 2017m). Bununla birlikte, birincil doğal kaynak yöneticileri olarak özellikle çevresel adaptasyonu yönetme konusunda iyi donanımlı olan kadınların bu nitelikleri ya toplumda saygı görmemekte ya da karar alma süreçlerinde dikkate alınmamaktadır (Anonim, 2017n). Her ne kadar Paris Anlaşması'nın bazı bölümlerinde (Dibace 5. Paragraf, Madde 7.5 ve Madde 11.2) “toplumsal cinsiyete duyarlı ve toplumsal cinsiyet eşitliğini gözetin” bir yaklaşım/süreç izlenmesi gerektiğine ilişkin ibareler yer alsada, mevcut iklim değişikliği rejiminde de özellikle “kadınlar ve toplumsal cinsiyet eşitliği”ni hedefleyen bir düzenleme bulunmadığını söylemek mümkündür.
- **Ekosozyalizm:** Bünyesinde pek çok farklı akımı barındıran bu hareketin temellerini Marksist ilkeler oluşturmaktadır. Bu yaklaşıma göre, çevre bunalımının sebebi, kapitalist üretim biçimi ve onun uzantısı olan yapılarıdır. Dolayısıyla sorunun çözümü, kapitalizm yerine işbirliğine dayalı, insan gereksinimlerini gidermek üzere ekolojik olarak doğru teknolojilerin kullanıldığı

bir toplumsal düzenin kurulmasıdır. Bu yaklaşım, esasen, insanmerkezci bir yaklaşımla insan dışındaki varlıklara sadece araçsal bir değer atfetmektedir; insan, hem doğanın bir parçasıdır hem de doğadan ayırılır: O, bilinçli olması dolayısıyla doğanın ayrıcalıklı bir parçasıdır. Hümanist anlayışa sahip bu yaklaşıma göre hayvanlardan farklı olan insanın yaptığı her şey doğaldır: Kibri, açgözlülüğü, saldırganlığı, aşırı rekabetçiliği ve merhametsizliklerinden dolayı suçlu olmayan insan, kirletici de değildir. Doğanın bileşenleri ve işleyişi hakkında bilgi sahibi olunması doğaya egemen olma mücadelesinde insanı başarılı kılmaları bakımından önemsenmektedir. Böylece ekolojik korumacılık, insanmerkezci ve faydacı bir bakış açısından hareketle savunulmaktadır (İlhan, 2013). Ekosozyalizm'in uluslararası alandaki sözcülerinden ve ekosozyalist manifesto yazarlarından Michael Löwy, "Ekosozyalizm" isimli kitabında ekosozyalist etiğin başlıca unsurlarını irdelenmiştir. Bu çerçevede, iklim kriziyle mücadelede bireysel davranışların etiği değil, toplumsal bir etik üzerinde durulması gerektiği ve bireyin doğa ile kurduğu ilişkide farkındalık ve dönüşüm önemli olmakla birlikte temel iddianın kapitalist/ticari ekonomik ve toplumsal yapıların değiştirilmesi olduğu ifade edilmektedir. Ayrıca, iklim kriziyle mücadelenin eşitlikçi bir etik üzerinden şekillendirilmesi ve Kuzey ile Güney ülkeleri arasındaki eşitsizliğin, Kuzey'in Güney'e olan iklim borcunun ve hali hazırda var olan toplumsal/sınıfsal eşitsizliklerin dikkate alınması gerektiği belirtilmektedir. İklim değişikliği en çok iklim değişikliğinden en az sorumlu olan yoksulları ve yoksul ülkeleri etkilediği için zenginliğin gezegen düzeyinde yeniden dağılımı ve kaynakların ortak geliştirilmesi önem taşımaktadır. Ekosozyalizm "kötünün köküne inmeyi" hedeflemesi dolayısıyla iklim krizinden çıkışı paradigma değişikliğinde, yeni bir medeniyet modelinde ve devrimci dönüşümde görmektedir. İklim krizi hem gelecek nesiller hem de diğer canlı nesilleri için risk taşımaktadır. Bu anlamda ekosozyalizm mevcut üretim ve tüketim tarzı ve insanın doğa ile kurduğu ilişki dönüşümsüz ekolojik krize radikal bir çözümün de gerçekleşmeyeceğini savunmaktadır (Anonim, 2017o).

5. İklim Etiği

5.1 İklim etiğinin tanımı ve kapsamı

Yeni bir uygulamalı etik dalı olarak ortaya çıkan iklim etiği, iklim değişikliğini temelde etik bir sorun olarak görmektedir. İklim etiği, iklim değişikliği ile ilgili sorunlara eklenen bir konu olmaktan ziyade iklim değişikliğiyle ilgili sorunlara karşı geliştirilen makul tüm politikaların önemli bir parçasıdır. Kendine özgü bir görünüme sahip olan iklim etiği, gelişim açısından henüz başlangıç aşamasındadır (Demirci, 2013).

İklim etiği ile uğraşan akademisyenler, iklim değişikliğinin çözülmesi zor birçok etik sorun ortaya çıkardığına işaret etmektedir. Bu açıdan Stephen Gardiner, iklim değişikliğini mevcut ahlak teorilerini ve ilkelerini sarsan "mükemmel bir ahlaki fırtına" olarak nitelemektedir (Demirci, 2013).

İklim değişikliğinin azaltılması (mitigasyon), iklim değişikliğinin etkilerine uyum (adaptasyon), iklim mühendisliği, gelecek nesiller, iklim yükümlülüklerinin tahsisi, iklim adaleti, din ve iklim gibi konular iklim etiğinin belli başlı ilgi alanlarını oluşturmaktadır.

5.2 İklim etiğine ilişkin başlıca çalışmalar

İklim etiği ile ilgili en önemli çalışmalardan biri 2004 yılında Buenos Aires'te gerçekleştirilen 10. BMİDÇS Taraflar Konferansı'nda çeşitli üniversiteler ve sivil toplum kuruluşları tarafından kurulan "İklim Değişikliğinin Etik Yönleri İşbirliği Programı (*Collaborative Program on the Ethical Dimensions of Climate Change*)"dır. Bu Programın yayınladığı "İklim Değişikliğinin Etik Boyutlarına İlişkin Beyaz Kitap"ta cevapları tartışılan dokuz temel soru ise şunlardır:

- İklim değişikliğinin sonuçlarından etik olarak kim sorumludur?
- İklim değişikliğine karşı tedbir almak ve bu tedbirleri uygulamak sorumluluğu kimindir?
- Önlenemeyen hasarların karşılanmasından kimler sorumludur?
- Özgün iklim değişikliği politikalarının amaçlarını hangi etik kurallar yönlendirmelidir? Atmosfere ilişkin hedefler nasıl belirlenmelidir?

- İklim değişikliğinin tolere edilemeyen etkilerini önleyebilmek için insanlar, kurumlar ve hükümetler arasında sera gazı emisyonlarının azaltılmasında sorumluluğun paylaştırılabilmesi için hangi etik kurallar izlenmelidir?
- Bilimsel belirsizlik karşısında iklim değişikliği kararları alma ihtiyacının etik önemi nedir?
- İklim değişikliğine karşı harekete geçmemek veya harekete geçmeyi ertelemek için gerekçe olarak gösterilen ulusal maliyet etik olarak geçerli midir?
- Karar almada adil bir şekilde temsil edilmeyi sağlamak için hangi kurallar izlenmelidir? (Algan, 2008).

Bu alandaki bir diğer önemli çalışma BM Eğitim, Bilim ve Kültür Kurumu (UNESCO) tarafından 1998 yılında kurulmuş bir danışma organı olan Bilimsel Bilgi Etiği ve Teknoloji Dünya Komisyonu (*World Commission on the Ethics of Scientific Knowledge and Technology-COMEST*) tarafından 2010 yılında yayımlanan “**Küresel İklim Değişikliğinin Etik Etkileri (*The Ethical Implications of Global Climate Change*)**” adlı rapordur. 2009 yılında gerçekleştirilen UNESCO Genel Konferansı’nda kabul edilen karar gereğince, iklim değişikliğiyle ilgili etik prensipler bildirisinin hazırlanması konusunda bir çalışma başlatılmıştır. Bu çerçevede, COMEST tarafından hazırlanan rapor 2010 yılında gerçekleştirilen UNESCO Yürütme Konseyi’ne sunulmuştur. Söz konusu rapor, “ortak fakat farklılaştırılmış sorumluluklar” kavramıyla etik prensipler arasında ne şekilde bağlantı kurulacağı ve buna bağlı olarak etik prensiplerin nasıl yorumlanacağı konusunda önemli güçlükler işaret etmiştir. Rapor, ayrıca, bu konuda UNESCO tarafından rehber ilkeler benimsenmesi gerektiğini de tavsiye etmiştir. Mesele, müteakip UNESCO Yürütme Konseyi ve Genel Konferans toplantılarında çetin tartışmalara konu olmuş, sonuç olarak iklim değişikliğiyle ilgili etik prensipler geliştirilmesine yönelik ilave adımlar atılmasının yolunu açacak ilke kararı 190. UNESCO Yürütme Kurulu toplantısında alınabilmiştir (Özkaya, 2013).

UNESCO, 22. BMİDÇS Taraflar Konferansı öncesinde 20-24 Eylül 2016 tarihlerinde Rabat-Fas’ta gerçekleştirilen bir toplantıda dünya çapında çevre alanında çalışan 24 uzmandan “**İklim Değişikliğine İlişkin Etik İlkeler Deklarasyonu (*Declaration on Ethical Principles in Relation to Climate Change (2017)*)**”nu hazırlamasını istemiştir. Bağlayıcılığı bulunmayan söz konusu Deklarasyonda yer alan başlıca etik ilkeler; “bugünkü ve gelecek nesillerin çıkarlarının korunması”, “kirleticilerin yol açtıkları zararları tazmin etmesi”, “yaşam ile yeryüzü arasındaki karşılıklı bağımlılığın tanınması” ve “bilimsel bilginin paylaşılması yükümlülüğü”dür. Deklarasyon 7-29 Kasım 2017’de gerçekleştirilen UNESCO 39. Genel Konferansı’nda kabul edilmiştir. (UNESCO, 2017).

6. Tartışma ve Sonuç

Günümüzde üzerinde durulan önemli konulardan biri olan “çevre etiği”, insanoğlunun çevreye “bir sorumluluk” duygusu içerisinde bakmasını gündeme getirmiştir. Bu sorumluluğun “insanmerkezcî” bir etik anlayışından, gelecek kuşakların da bu dünyadaki diğer doğal canlılar ve yapılarla yaşayabilmeleri adına “çevremerkezcî” bir etik anlayışına doğru evrildiği görülmektedir (Değirmen ve Dönmez, 2016). Çevre etiğinin geçirdiği bu dönüşümde, yaşanan küresel çevre sorunlarının büyük bir etkisi olmuştur. Bu kapsamda, çağımızın en önemli çevresel tehdidi olarak addedilen iklim değişikliği de gerek bir “olgu” ve gerekse “düzenlendiği hukuki araçlar” seviyesinde pek çok çevre etiği yaklaşımı tarafından değerlendirilmiştir.

Bu çerçevede, insanmerkezcî yaklaşım açısından bir “olgu” olarak bakıldığında “iklim değişikliği”, insanın refahını etkilediği ölçüde bir sorun olarak görülmekte ve yalnızca “siyasi” açıdan “çözüm” üretilmesi hedeflenmektedir. Her ne kadar aydınlanmış insanmerkezcilik, modern insanmerkezcilik ve zayıf insanmerkezcilik ile insanın doğaya karşı tavrı biraz daha yumuşatılmış olsa da özünde “insanın öncelikli ve en değerli varlık” olduğu gerçeği değişmemektedir. Canlımerkezcî yaklaşım kapsamında iklim değişikliği olgusu değerlendirildiğinde; Leopold’un, yeryüzü etiği yaklaşımının, doğayı kişisel çıkarlar için yok etmenin ve sınırsız büyümenin önünü açan ülkeler için uyarı olarak kaleme aldığını ve çevre sorunlarının küresel bir tehdide dönüştüğü günümüzde bu yaklaşımın dünya üzerindeki tüm türlerin uyumlu ve huzurlu bir yaşamı paylaşarak geleceğe taşınmasını

amaçladığını söylemek yanlış olmayacaktır. Gaia yaklaşımının öncüsü James Lovelock ise iklim değişikliğini Toprak Ana'nın sınırları içinde yaşayan uygarlığın sistemsel bir başarısızlığı olarak görmekte ancak insan kaynaklı sera gazı emisyonlarının artışında dahi, gezegenin iklimi sabitleyebilecek kendi kendini düzenleyen mekanizmaları bulunduğunu savunmaktadır. Çevremerkezci yaklaşımın ana kuramlarından “derin ekoloji” açısından değerlendirildiğinde iklim değişikliği milyarlarca canlının refahını olumsuz etkilediği için “kötü” olup, insanları koruyacak bir yöntem bulursa dahi diğer canlılar iklim değişikliği nedeniyle mağdur olmaya devam edecekleri için bu durum değişmeyecektir. Yeni etik yaklaşımlar kapsamında ise “toplumsal/sosyal ekoloji”, küresel hale gelmiş çevre sorunlarının çözümünün mevcut sistemle gerçekleşmeyeceğini savunarak kapitalist sistemin varlığını sorgulamaktadır. Benzer bir biçimde, “ekososyalizm” mevcut üretim ve tüketim tarzı ve insanın doğa ile kurduğu ilişki dönüşümsüzün ekolojik krize radikal bir çözümün de gerçekleşmeyeceğini savunmaktadır.

Küresel düzeyde uygulanan düzenlemeler çevre etiği yaklaşımları bakımından incelendiğinde ise, BMİDÇS, Kyoto Protokolü ve Paris Anlaşması'nın insanmerkezci bir yaklaşımla hazırlandığı konusunda geniş kapsamlı bir mutabakatın olduğu görülmektedir. Her ne kadar 2015 yılında kabul edilen Paris Anlaşması seleflerine kıyasla “daha canlımerkezci ve çevremerkezci” gibi görünse de bu hususları destekleyecek hükümler içermemektedir. Paris Anlaşması'nın toplumsal cinsiyet eşitliğine yaptığı vurgu da yeni etik yaklaşımların ilkelerine uygun olduğunu iddia etmek için yeterli görünmemektedir.

Bu noktada, yeni gelişmeye başlayan iklim etiğine dikkat çekmek gerekmektedir. İklim değişikliği sorunsalının “kendine özgü” niteliklerini de kullanarak münhasır bir alan olarak ortaya çıkan iklim etiği iklim adaleti, iklim yükümlülüklerinin tahsisi ve gelecek nesillere karşı sorumluluk gibi boyutları ile iklim değişikliği-etik ilişkisinin daha derin bir biçimde incelenmesini sağlamaktadır. Her ne kadar “iklim değişikliğinin olumsuz sonuçları konusunda bilimsel bir oydaşma bulunmadığı ve bilimsel belirsizliğin sürdüğü” ve “iklim etiğinin ulusal ekonomilere olan maliyetinin yüksekliği ve gelecekte daha az maliyetli teknolojiler bulununcaya kadar önlem alınmasının ertelenebileceği” gibi gerekçelerle iklim değişikliğiyle mücadelede atılacak adımlara ket vurulmaya çalışılsa da, yapılan bilimsel çalışmalar söz konusu argümanları büyük ölçüde çürütmüştür.

Bu kapsamda, hâkim değer sisteminin insan kaynaklı iklim değişikliği gibi küresel çevre sorunları hakkında düşüncelere yön vermek açısından uygun ve yeterli olmadığını vurgulamakta fayda görülmektedir. Özellikle iklim değişikliğinde kuşaklar arası adalet gibi ciddi bir sorunun çözümü için daha yüksek ahlaki standartlar gerekmektedir.

Kaynaklar

- Ak, S. 2013. *Yeşil Tüketim Yaklaşımı Ekseninde İslami Çevrecilik*. Yayımlanmamış Yüksek Lisans Tezi, Ankara Üniversitesi Sosyal Bilimler Enstitüsü, Ankara.
- Akkoyunlu Ertan, K. 1998. Çevre Etiği. *Amme İdaresi Dergisi*, Cilt 31, Sayı 1, Mart 1998, 125-139 (http://www.todaie.edu.tr/resimler/ekler/66fc4e7dedc9e51_ek.pdf?dergi=Amme%20Idaresi%20Dergisi) (03.04.2017).
- Akkoyunlu Ertan, K. 2015. Leopoldcü Düşünce ve Yeryüzü (Toprak) Etiği. *Memleket SiyasetYönetim (MSY)*, Cilt 10, Sayı 23, Ocak 2015, 1-20.
- Algan, N. 2008. İklim Etiği. *Mülkiye Dergisi*, Cilt: 32 Sayı: 259 (2008), 191-204.
- Anonim 2017a. Meteoroloji Genel Müdürlüğü, <http://www.mgm.gov.tr/kurumsal/haberler.aspx?y=2014&f=ipccsentez> (Erişim tarihi: 01.04.2017).
- Anonim 2017b. Çevre ve Orman Bakanlığı (mülga), http://iklim.cob.gov.tr/iklim/Files/Mevzuat/BM_iklimcerceve.pdf (Erişim tarihi: 02.04.2017).
- Anonim 2017c. Çevre ve Orman Bakanlığı (mülga), http://iklim.cob.gov.tr/iklim/Files/Mevzuat/kyoto_protokol.pdf (Erişim tarihi: 02.04.2017).
- Anonim 2017d. US Climate Action Network, <http://www.usclimatenetwork.org/resource-database/briefing-paper-international-climate-change-negotiations-in-warsaw/> (Erişim tarihi: 02.04.2017).
- Anonim 2017e. United Nations Framework Convention on Climate Change, http://unfccc.int/paris_agreement/items/9485.php (Erişim tarihi: 02.04.2017).

- Anonim 2017f. TMMOB Elektrik Mühendisleri Odası, http://www.emo.org.tr/ekler/da03ea094d73850_ek.pdf?dergi=1021 (Erişim tarihi: 10.04.2017).
- Anonim 2017g. Sabancı Üniversitesi İstanbul Politikalar Merkezi, <http://ipc.sabanciuniv.edu/new/cop21-ardindan/> (Erişim tarihi: 22.05.2017).
- Anonim 2017h. Love of Wisdom, http://loveofwisdom.weebly.com/uploads/9/0/1/4/9014354/deep_and_shallow_ecology_explanations.pdf (Erişim tarihi: 06.04.2017).
- Anonim 2017ı. *İkibin Elli Dergisi*, <http://www.ikibin50dergisi.org/18/insanin-cevre-hakkindan-doganin-haklarina-ekolojik-anayasa.html> (Erişim tarihi: 06.04.2017).
- Anonim 2017i. *Rights of Mother Earth*, <http://www.rightsofmotherearth.com/should-trees-have-standing> (Erişim tarihi: 06.04.2017).
- Anonim 2017j. *United Nations Framework Convention on Climate Change*, http://unfccc.int/files/essential_background/convention/application/pdf/english_paris_agreement.pdf (Erişim tarihi: 07.04.2017).
- Anonim 2017k. Carnegie Council for Ethics in International Affairs, https://www.carnegiecouncil.org/publications/ethics_online/0113_ (Erişim tarihi: 07.04.2017).
- Anonim 2017l. <http://www.ekoloji.org/index.php?option=content&task=view&id=96&catid=35&Itemid=53> (Erişim tarihi: 07.04.2017).
- Anonim 2017m. *Gaia Dergi*, <https://gaiadergi.com/ekolojik-emperyalizm-sorunlari-kadin/> (Erişim tarihi: 07.04.2017).
- Anonim 2017n. *Terra Biyogen Ekoloji Grubu*, <https://terraekoloji.org/2015/06/16/ekofeminizm-nedir/> (Erişim tarihi: 07.04.2017).
- Anonim 2017o. *Yenidüzen Gazetesi*, <http://www.yeniduzen.com/yasadigimiz-felaket-82928h.htm> (Erişim tarihi: 10.04.2017).
- Anonim 2017ö. United Nations Educational, Scientific and Cultural Organization., <http://www.unesco.org/new/en/social-and-human-sciences/themes/comest/ethical-principles/questions-and-answers/> (Erişim tarihi: 23.05.2017).
- Barry, J., Mol, A. P. J., Zito, A. R. 2013. Climate change ethics, rights, and policies: an introduction. *Environmental Politics*, 22:3, DOI: 10.1080/09644016.2013.788861, 361-376 (<http://dx.doi.org/10.1080/09644016.2013.788861>) (10.04.2017).
- Çelik, M. A., Gülersoy, A. E. 2016. Kaos Ortamında (Çağında) Mekân-İnsan Etkileşimine Bütüncül Bir Bakış: Ekolojik Toplum Paradigması. *FLSF (Felsefe ve Sosyal Bilimler Dergisi)*, 2016 Güz, sayı: 22, ISSN 1306-9535, 163-183 (<http://www.flsfdergisi.com/sayi22/163-183.pdf>) (07.04.2017).
- Çüçen, A. 2011. *Derin Ekoloji*, Uludağ Üniversitesi Fen Edebiyat Fakültesi Felsefe Bölümü, Bursa, (<http://blog.aku.edu.tr/ometin/files/2011/12/derinekoloji.pdf>) (05.04.2017).
- Değirmen, N., Dönmez, E. 2016. *Çevre Etiği Açısından Türkiye’de Katı Atık Sorunlarının Değerlendirilmesi*, ISEM2016, 3. Uluslararası Çevre ve Etik Sempozyumu, 4-6 Kasım 2016, Alanya, 259-266.
- Demirci, M. 2013. İklim Etiği ve Özdeşlik Sorunu. *Uludağ Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*, Cilt/Vol. XXXII, Sayı/No. 2, 2013, 225-248.
- Doğan, S., Tüzer, M. 2011. Küresel İklim Değişikliği ile Mücadele: Genel Yaklaşımlar ve Uluslararası Çabalar. *Sosyoloji Konferansları Dergisi*, Sayı (44) 2011, İstanbul, 157-194.
- Devlet Planlama Teşkilatı Müsteşarlığı (DPT). 2000. *İklim Değişikliği Özel İhtisas Komisyonu Raporu*, Sekizinci Beş Yıllık Kalkınma Planı, Ankara.
- Dündar, A. K. 2005. *Avrupa Birliği ve Türkiye’de İklim Değişikliği Politikalarının Yenilenebilir Enerji Kaynakları Açısından Değerlendirilmesi*. Yayınlanmamış Yüksek Lisans Tezi, Ankara Üniversitesi Sosyal Bilimler Enstitüsü, Ankara.
- Ediger, V. Ş. 2008. Küresel İklim Değişikliğinin Uluslararası İlişkiler Boyutu ve Türkiye’nin Politikaları. *Mülkiye, Yaz/2008*, Cilt: XXXII, 133-158.
- Eren, M. 2015. Çevre Sorunları Karşısında Sorumluluk Etiği. *Kelam Araştırmaları 13:1 (2015)*, 439-452.
- Ergün, T., Çobanoğlu, N. 2012. Sürdürülebilir Kalkınma ve Çevre Etiği. *Ankara: Ankara Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, 2012, 3(1) DOI: 10.1501/sbeder_000000041, 97-123 (<http://dergiler.ankara.edu.tr/dergiler/49/1637/17527.pdf>) (03.04.2017).
- Ertan, B., (2004).2000’li Yıllarda Çevre Etiği Yaklaşımları ve Türkiye. *Yönetim Bilimleri Dergisi (1:3) 2004 Journal of Administration Sciences*. 93-108.
- Gardiner, S. M., Caney, S., Jamieson, D., Shue, H. (2010). *Climate Ethics: Essential Readings*, Oxford University Press.
- Hemaadri, SR, (2017). Climate Change and Sinking Ethical Endeavours, *J Pol Sci Pub Aff* 5: 231, DOI: 10.4172/2332-0761.1000231, 1-5 (<https://www.esciencecentral.org/journals/climate-change-and-sinking-ethical-endeavours-2332-0761-1000231.pdf>) (10.04.2017).
- Hulme, M. 2016. *İklim Değişikliği Konusunda Neden Anlaşmıyoruz?*, İstanbul: Alfa, Birinci Basım.
- İğci, T. 2015. *İklim Değişikliği Politikalarının Avrupa Birliği ve Türkiye’de Sanayi Sektörüne Olası Etkileri: Maliyetler ve Rekabet Edebilirlik Bakımından Değerlendirme*. Yayınlanmamış Yüksek Lisans Tezi, Ankara Üniversitesi Sosyal Bilimler Enstitüsü Ankara.
- İktisadi Kalkınma Vakfı (İKV). 2013. *2020’ye Doğru Kyoto-tipi İklim Değişikliği Müzakereleri- Avrupa Birliği’nin Yeterliliği ve Türkiye’nin Konumu*, İktisadi Kalkınma Vakfı Yayınları, Yayın No: 268, İstanbul, Aralık 2013, ISBN: 978-605-5984-61-8, <http://www.ikv.org.tr/images/files/Kyoto.pdf> (01.04.2017).

- İlhan, D. 2013. *Türkiye’de Benimsenen Çevre Etiği Yaklaşımları: Gönüllü Çevre Kuruluşları Örneği*. Yayımlanmamış Yüksek Lisans Tezi, Gazi Üniversitesi Sosyal Bilimler Enstitüsü, Ankara.
- Jamieson, D. 1992. Ethics, Public Policy, and Global Warming. *Science, Technology, & Human Values*, Vol. 17, No. 2 (Spring, 1992), 139-153 (http://www.jstor.org/stable/689781?seq=1#page_scan_tab_contents) (10.04.2017).
- Karakaya, E. 2016. Paris İklim Anlaşması: İçeriği ve Türkiye Üzerine Bir Değerlendirme. *Adnan Menderes Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, Cilt: 3, Sayı: 1, 2016, 1-12.
- Kayaer, M. 2013. Çevre ve Etik Yaklaşımlar. *Siyaset, Ekonomi ve Yönetim Araştırmaları Dergisi*, 2013, Yıl:1, Cilt:1, Sayı:1, 63-76.
- Keleş, R., Hamamcı, C., Çoban, A. 2015. *Çevre Politikası*, Sekizinci Baskı, Ankara: İmge.
- Maltaş, A. 2015. Ekoloji Ekseninde İnsan-Doğa İlişkisi ve Özne Sorunu. *KMÜ Sosyal ve Ekonomik Araştırmalar Dergisi* 17 (29), 2015, 1-8.
- Özdağ, U. 2011. Sessiz Bahar’dan Sonra Ses Getiren Elli Yıl: Kadın, Çevre, Sağlık. *Edebiyat Fakültesi Dergisi*, Cilt 28, Sayı 2, (Aralık 2011), 179-199.
- Özkaya, S. Y. 2013. İklim Değişikliği ve Etik Prensipler. *Uluslararası Ekonomik Sorunlar*, Mayıs 2013, Yıl: 13, Sayı: 46, 123-132.
- Sezer, Ö. *Küresel Konferanslar ve Çevre Sorunları: Çevre Kalkınma ve Etik Açısından Eleştirel Bir Değerlendirme*, 761-780 (<http://www.ayk.gov.tr/wp-content/uploads/2015/01/SEZER-%C3%96zcan-K%C3%9CRESSEL-KONFERANSLAR-VE-%C3%87EVRE-SORUNLARI-%C3%87EVRE-KALKINMA-VE-ET%C4%B0K-A%C3%87ISINDAN-ELE%C5%9CET%C4%B0REL-B%C4%B0R-DE%C4%9EERLEND%C4%B0RME.pdf>) (10.04.2017).
- Şakacı, B. K. 2011. *İnsanmerkezcilik ve Çevremerkezcilik Ekseninde Derin Ekoloji Yaklaşımının Çözümlemesi ve Eleştirisi*. Yayımlanmamış Doktora Tezi, Ankara Üniversitesi Sosyal Bilimler Enstitüsü, Ankara.
- Talu, N. 2015. *Türkiye’de İklim Değişikliği Siyaseti*, Ankara: Phoenix Yayınevi.
- Tiili, K. 2015. *Naessian deep ecology, political action and the climate crisis*, Master’s thesis of Philosophy, Faculty of Humanities. University of Oslo, Spring semester 2015, (<https://www.duo.uio.no/bitstream/handle/10852/46071/Tiili-Master-thesis.pdf?sequence=1>) (06.04.2017).
- Tont, S. A. 1997. *Sulak Bir Gezegendeki Öyküler*. TÜBİTAK Popüler Bilim Kitapları 44, Ankara.
- Türkeş, M., Sümer, U. M., Çetiner, G.,(2000). “Küresel İklim Değişikliği ve Olası Etkileri”, *Çevre Bakanlığı, Birleşmiş Milletler İklim Değişikliği Çerçeve Sözleşmesi Seminer Notları*, ÇKÖK Gn. Md., Ankara.
- United Nations Educational, Scientific and Cultural Organization (UNESCO). 2017. *Declaration on Ethical Principles in Relation to Climate Change (2017)*, SHS/BIO/PI/2017/2, France, 2017.
- Yaylı, H., Çelik, V. 2011. Çevre Sorunlarının Çözümü İçin Radikal Bir Öneri: Derin Ekoloji. *Selçuk Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, 26 / 2011, 369-377 (<http://dergisosyalbil.selcuk.edu.tr/susbed/article/viewFile/175/159>) (05.04.2017).
- Yıldız, M. 2016. *Doğa Koruma ve Ormancılıkta Kamudaki Karar Vericilerin Çevre Etiği Algısının Uygulamalı Etik Açısından Değerlendirilmesi*. Yayımlanmamış Doktora Tezi, Ankara Üniversitesi Sosyal Bilimler Enstitüsü, Ankara.

MAKALE KABUL KOŞULLARI VE YAZIM KURALLARI

- Dergide çevrebilimleri alanında yapılmış özgün araştırmalar ve derlemelerden (tarama yazıları) oluşan "Denetimli Makaleler"in yanısıra "Araştırma Notları", "Konferans Notları", "Kitap Tanıtımı"ve yabancı dilde yayımlanmış olan özgün araştırmaların "Çeviriler"i yayımlanır. Dergide yayınlanacak eserler Türkçe ya da İngilizce olarak yazılabilir.
- Dergiye gelen eserin basımı öncesinde hakem görüşleri alınır. Gönderilen makalenin dergide yayınlanabilmesi için Editörler Kurulu tarafından hem bilimsel içerik, hem de şekil bakımından uygun görülmesi ve hakemler tarafından kabul edilmesi gerekir. Yayınlanması uygun bulunmayan eser yazarına/yazarlarına geri gönderilir.
- Dergide yayınlanacak eserin daha önce hiçbir yayın organında yayınlanmamış ya da yayın hakkının verilmemiş olması gerekir. Buna ilişkin yazılı bildirim, makale ile gönderilmelidir.
- Eser, Microsoft Word programında hazırlanarak Dergipark sistemi üzerinden çevrimiçi olarak yüklenmelidir (<https://dergipark.org.tr/aucevrebilim>).
- Makale Microsoft Word programının yeni versiyonunda, A4 normunda, sayfa kenar boşlukları üst 3cm, sol 2,5cm, sağ 2,5cm, alt 4cm olarak ayarlanarak, 11 punto Times New Roman karakteri ile, tek satır aralığı kullanarak ve iki yana yaslı olarak hazırlanmalı, paragraf arası verilmemeli, paragraflarda ilk satır girintisi ise 1.25cm olarak yazılmalı, metin içerisinde tablo ve şekiller dahil koyu karakterlere yer verilmemeli, şekil, çizelgeler ve Kaynaklar bölümü dahil 20 sayfayı geçmemelidir.
- Eser başlığı baş harfleri büyük, ortalanarak koyu (bold) ve 14 punto, yazar adları 12 punto, Özet ve Abstract iki yana yaslı 9 punto ile yazılmalıdır.
- Yazar adı/adları açık olarak yazılmalı, ünvan kullanılmamalı, adres bilgileri 11 punto ve italik olacak şekilde bir alt satırda yer almalıdır. Başlık ile yazar isimleri arasında 1,5 satır aralığı bulunmalıdır. İki ya da daha fazla yazarlı makalelerde, yazarların soyadları üzerine rakam konularak, adres bilgileri alt satırda ve tek satır boşluğu bırakılarak yer almalıdır.
- Yapılan çalışma bir kurum/kuruluş tarafından desteklenmiş ya da doktora/yüksek lisans tezinden hazırlanmış ise, başlığa yıldız koyularak ilk sayfanın altına dip not olarak verilmelidir.
- Özgün araştırmalar; Özet, Abstract, Giriş, Materyal ve Yöntem, Bulgular, Tartışma, Sonuç, Teşekkür (gerekirse), Kaynaklar şeklinde düzenlenmelidir. Derlemeler Giriş, uygun başlıklar altında Ana Metin ve Sonuçlar olmak üzere üç bölümden oluşabilir, yayınlanmasında Ankara Üniversitesi Çevrebilimleri Dergisinin Yayın İlkeleri uygulanır. Özet, 200 kelimeyi aşmayacak şekilde, çalışmanın amacını, nasıl yapıldığını, sonuçları ve sonuçlar üzerine yazar(lar)ın yaptığı değerlendirmeleri içermeli ve en fazla 7 adet anahtar kelime kullanılmalıdır. Giriş, çalışmanın önemini, amacını ve konu ile ilgili daha önce yapılmış temel araştırmaları kapsamalıdır. Materyal ve Yöntem, çalışmanın tekrarına olanak verecek şekilde yeterli bilgi ve kaynakları içermelidir. Bulgular, şekil ve çizelgelerde verilen bilgilerin tam olarak anlaşılmasını sağlamalıdır. Tartışma bölümünde sonuçlar, önemi vurgulanarak daha önce yapılan çalışmalarla karşılaştırılmalıdır. Sonuç bölümünde ise, bulgulardan ulaşılan son değerlendirmeler verilmelidir.
- Makaledeki şekil, harita ve fotoğrafların bilgisayar kayıtları, uygun çözünürlükte olmalı, makalede metin içerisine yerleştirilmelidir. Çizelge başlıkları çizelgenin üstüne, çizelge kaynağı ise altına verilmelidir. Çizelge ve şekil açıklamalarında sadece ilk kelimenin baş harfi büyük, diğerleri küçük harflerle yazılmalıdır. Çizelge içerisindeki metinlerde de aynı kural geçerlidir. Tüm tablolar “Çizelge”; tüm grafik, harita ve çizimler “Şekil” olarak adlandırılmalıdır. Şekil adları şeklin altında verilmelidir. Tüm şekil ve çizelge adları 9 punto, Times New roman karakterinde olmalı, numaralandırmalardan sonra nokta verilmelidir.
- Metin içerisinde atıfta bulunulan kaynaklar, yazarın soyadı ve yayın yılı sıralamasıyla parantez içerisinde verilecektir (Akpınar, 2000). Aynı yazarın aynı tarihli birkaç eseri varsa alıntılarda yıldan sonra a,b,c... şeklinde numaralandırma yapılacaktır (Akpınar, 2002a). Birden fazla esere

atıfta bulunuluyorsa referanslar alfabetik sıra ile verilmelidir (Avcıoğlu, 2002; Oğuz, 2004; Uslu ve Kiper, 2005).

- Sözlü görüşmeler ve yayınlanmamış eserlere (Yüksek Lisans ve Doktora Tezleri hariç) ait bildirimler, kaynak olarak kullanılmamalıdır.
- Kaynaklar listesi ilk yazarın soyadına göre alfabetik olarak düzenlenmeli ve Times New Roman karakterinde 9 punto olarak yazılmalıdır. İki veya daha fazla yazarlı eserlerin bildiriminde son yazardan önce “ve” bağlacı kullanılmamalıdır.

Dergi:

Somuncu, M.2004.Dağcılık ve Dağ Turizmindeki İkilem: Ekonomik Yarar ve Ekolojik Bedel. *Coğrafi Bilimler Dergisi*, 2 (1):1-22.

Kitap:

Keleş, R. 1996. *Kentleşme Politikası*. İmge Kitabevi Yayınları: 803, Ankara.

Kitabın bir bölümü:

Hamamcı, C. 1997. Çevrenin Uluslararası Boyutları. s: 395-412. Editör: R. Keleş. *İnsan Çevre Toplum*. İmge Kitabevi, Ankara.

Bildiri kitabı:

Karadeniz, N., Özbek, H. ve Gül, S. 2000. Ülkemiz Koruma Alanlarında Yönetim Planı Süreci. *2000’li Yıllarda Yaşadığımız Çevre ve Peyzaj Mimarlığı Sempozyumu. Bildiriler Kitabı*: 177-184, 24-26 Mayıs 2000, Ankara.

Yazarı belirtilmeyen kurum yayınları:

Anonim 1997. *Ulusal Çevre Eylem Planı: Arazi Kullanımı ve Kıyı Alanlarının Yönetimi*. Devlet Planlama Teşkilatı Yayını, Ankara.

İnternet sayfaları:

İnternet sayfasına atıfta metin içerisinde Anonim ya da Anonymous ve erişim tarihi olarak verilmeli (Anonim, 2005), Kaynaklar bölümünde ise sayfa adresi de verilmelidir.

Anonymous 2007. Explore Europe’s changing landscape.

<http://www.eea.europa.eu/highlights/explore-europe2019s-changing-landscape>.

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- The following types of papers are accepted to be published in Ankara University Journal of Environmental Sciences: research papers, review papers, technical notes, conference notes, book reviews, and translations of research articles. Papers must be written either in Turkish or English.
- All submitted manuscripts are subjected to scientific and editorial review by the editorial board and qualified *ad hoc* reviewers. Rejected manuscripts are sent back to the corresponding author.
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- The manuscript should be uploaded via the web platform of Dergipark (<https://dergipark.org.tr/en/pub/aucevrebilim>).
- The paper size must be A4 with margins: top=3 cm., left= 2.5 cm., right= 2.5 cm., and bottom= 4 cm. The text has to be written in Times New Roman; font size 11 pt; and justified with single line spacing in Microsoft Word. Paragraph indentation should be 1 cm. and 6 pt clear line must be left between paragraphs. Do not use bold characters within the text, figures and tables except headings. The manuscript should not exceed 20 pages, including references.
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- All figures, maps and photographs must be in high resolution for quality printing. They must be placed within the text and separate copies should be sent. Table titles should be written above the table and the reference should be written below the table with 9pt. Name of the figures should be written below the figure with 9pt.
- When referring within the text, author last name(s) and year of publication must be written separated with a comma within brackets (Akpınar, 2000). For two authors, use “and” between the last names, and for three authors use “*et al.*”. More than one reference from the same author(s) in the same year must be identified by the letters "a", "b" etc., placed after the year of publication (Akpınar, 2002a). Multiple references should be written in alphabetical order, separated with a semicolon (Avcıoğlu, 2002; Oğuz, 2004; Uslu and Kiper, 2005).
- Interviews and unpublished works (except postgraduate theses) should not be cited.
- Reference list must be written in alphabetical order according to first author last name, in 9 pt. For multiple authors, “and” should be used before the last author name. Indentation must be “hanging” by 1.25 cm.

Journal article:

Karadeniz, N., Somuncu, M. 2003. Approaches for Preservation of Mountainous Areas in Turkey Case Study: Kaçkar Mountains (Turkey). *Montagnes Méditerranéennes*, 17, 89-90.

Book:

Lynch, K. 1960. *The Image of the City*. The MIT Press: 194, USA.

Chapter of a book:

Somuncu, M. 2011. Sustainable Development in the Eastern Black Sea Mountains: Present State and Perspectives. Editor(s): Zhelezov, G., *Sustainable Development in Mountain Regions: Southeastern Europe*, Springer, London-New York, 215-226.

Papers in conference proceedings:

Somuncu, M., İnaner, H., Çiçek, İ. 2004. An Example of Geological and Geomorphological Heritage to be Protected: Gölcük Caldera (Isparta-Southwestern Turkey). *Proceedings of 5th International Symposium on Eastern Mediterranean Geology*, Thessaloniki-Greece, Volume 1, 427-429.

If no author is available:

Anonymous 1997. *National Environmental Action Plan*. State Planning Organization, Ankara.

Web pages:

Web pages should be cited as Anonymous with year of access within the text (Anonymous, 2005), URL should be given in reference list.

Anonymous 2007. Explore Europe's changing landscape.

<http://www.eea.europa.eu/highlights/explore-europe2019s-changing-landscape>.

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