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C O N T E N T S

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Research Paper

Spatial Correlations between P-wave Velocities Anomalies, Thermal Waters and Seismicity in Elbasani Zone

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Abstract: A detailed investigation of the earthquake's epicentre distribution, low velocity layers, thermal water sources and b-value beneath Elbasani Zone Albania were studied. In the Elbasani Zone, hot mineral water (thermal waters) spot out from natural springs which have been known since the 19th century. We interpret the 3D seismic velocity structure in the Elbasani zone to understand the factors controlling the genesis of temperature and level of seismicity. A narrow low-velocity zone is imaged within the Elbasani fault zone over a length of ~20 km, which partly penetrates 1-4 km and into 10-14 km depth. The low-velocity zone correlates in space with thermal water sources area, the trending of low seismicity compare to surrounding zones and trending of high b-value. A reactivation of thermal water fracture zone is probably related to the low-velocity anomaly. A comparison of the distribution of thermal water sources shows a relationship between thermal waters and the distribution of low seismicity. From Hidraj to Llinxha and up to Kozan the surface temperature of thermal waters varies from 50^0 to 60^0 and 65^0 Celsius. The b-value of the thermal water zones is high over 1.0 which shows that the accumulation of stress in this area is low.

Keywords: *Seismicity, Thermal Water, Velocity. b-value*

Introduction

The Albanides are found within the Alpine-Mediterranean seismic belt between Dinarides within the north and Helenides within the south and suit portion of the distortion due to the collision of the African plate with the Eurasian plate. The seismicity of Albania is caused by the collision of the African plate with the Eurasian plate. Within the system of this contact collision of the Adria microplate with Albanian orogen impacts longitudinal and transversal fractures interior Albania (Ormeni *et al*., 2013a; Aliaj et al., 210). In Albania there are many springs and wells of thermal waters with a low enthalpy (Fig 1). These water sources have temperatures that go up to 65.5^0C.The Elbasani zone is a particular zone because characterized by great geothermal potential and frequent seismicity (Shatro & Ormeni, 2014). In Albania there are numerous springs and wells of warm waters with a low enthalpy (Fig 1). These water sources have temperatures that go up to 65.50C. The Elbasani zone may be a specific zone since characterized by extraordinary geothermal potential and visit seismicity (Shatro & Ormeni, 2014).

The Elbasani fault zone is expressed by the diaper dome of Dumrea, Quaternary depression of Elbasani, and transversal structure of Labinoti (Shatro & Ormeni, 2014).Analyses of spatial and temporal characteristics of the earthquake activity may supply significant clues for revealing the future seismic hazard along the Elbasani fault zone (Koçiaj, 1986; Sulstarova et al, 2000; Ormeni & Fundo, 2011; Ormeni, 2015b; Ormeni & Daberdini, 2021; Ormeni et al 2022a; Ormeni et al 2023)..The low-velocity layer in the shallow earth's crust can be the promoter of triggering seismic activity in the Elbasani fault zone (Shatro & Ormeni, 2013; Ormeni et al 2023). The geothermal sources of Elbasani area, have medium temperatures varies from 50^0 to 60^0 and 65^0 Celsius. The thermal water comes up from the depths (800-3000 m) in the carbonate or sandy reservoirs. Kruja geothermal area start on the Adriatic coast, Northern of Durresi city, in Ishmi region, continues in Tirana, in Elbasani up to South-Eastern Albanian- Greek border and extends to the Konica district in Greece. Analysis of observed anomalies of P wave velocities in different depth layers allows us to develop our imaginations on the processes occurring inside the Earth (Anderson & Johnson, 1976). The Elbasani fracture zone is

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communicated by the diaper arch of Dumrea, Quaternary garben of Elbasani, and transversal structure of Labinoti (Ormeni *et al*., 2015b; Aliaj et al., 210). Analyses of spatial and temporal characteristics of the seismic activity may supply critical clues for revealing end of the seismic hazard along the Elbasani fracture zone (Koçiaj, 1986; Sulstarova et al, 2000; Ormeni & Fundo, 2011; Ormeni, 2015b; Ormeni & Daberdini, 2021; Ormeni et al 2022a; Ormeni et al 2023). The low-velocity layer within the shallow earth's outside can be the promoter of activating seismic action within the Elbasani blame zone (Shatro & Ormeni, 2014; Ormeni *et al*., 2023)

The geothermal sources of Elbasani area,have medium temperatures varies from 50^0 to 60^0 and 65^0 Celsius. The thermal water comes up from the depths (800-3000 m) within the carbonate or sandy reservoirs. Kruja geothermal zone begin on the Adriatic coast, Northern of Durresi city, in Ishmi village, continues in Tirana, in Elbasani up to South-Eastern Albanian- Greek border and amplifies to the Konica town in Greece. Analysis of watched irregularities of P wave velocity in numerous profundity layers permits us to create our creative energies on the forms happening interior the Earth (Anderson & Johnson, 1976)

Using arguments based on heat flow, Anderson (1976) proposed that the low-velocity zone was due to the presence of a small amount of melt (Schorlemmer et al, 2005). The Elbasani zone is a particular area because has a considerable number of sources of thermal water and presents a different level of seismicity.

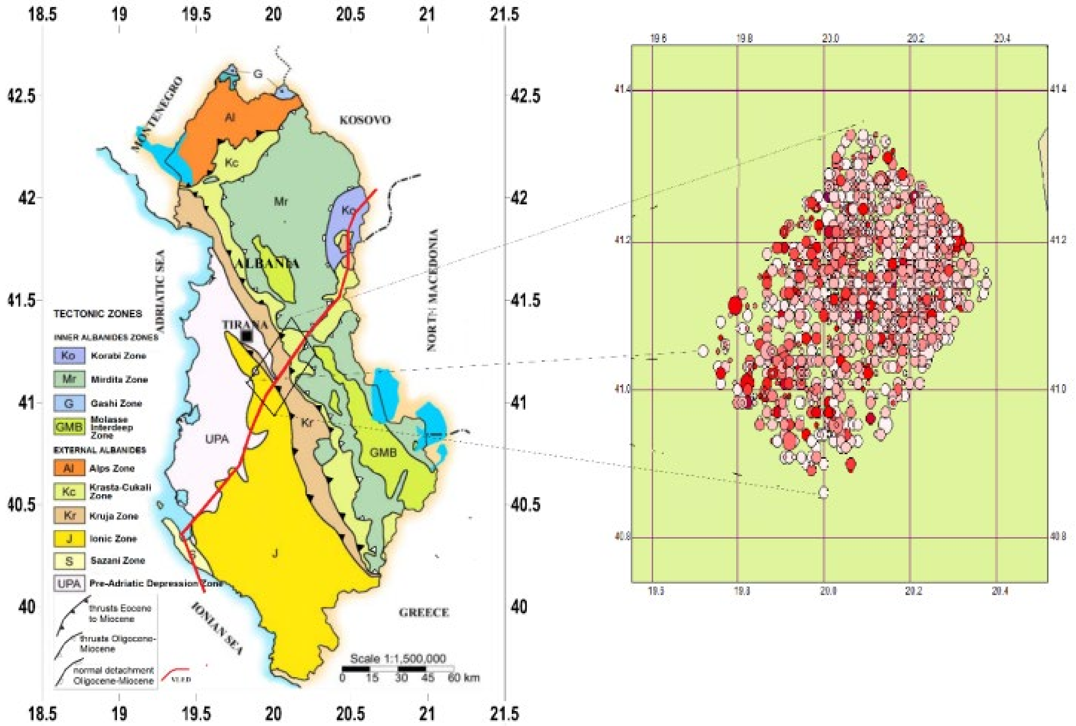

Figure 1. The Albania geothermal map and epicenters distribution of M_L>1.0 earthquakes during 1968-2022 in Elbasani zone.

Data and Methods

These earthquakes were recorded by permanent broadband seismological stations that are part of the Albanian Seismological Network, as well by neighbouring seismic networks AUTH, MSO, INGV and MEDNET (TIR) (www.geo.edu.al, 2023) The procedure uses for earthquake locations have been the program Hypo invers (Klein, 202) of the Atlas package, and the velocity model (Muco *et al*., 2001; Ormeni., 2011). In the Elbasani seizmogenic zone were located 1831 tectonic earthquakes with M_L>1.0, (Fig. 1) (Ormeni *et al*, 2023). From statistical analysis, every year, in the Elbasani fault zone, have occurred two earthquakes with magnitude M_L>3.5 Richter, and one earthquake with magnitude M_L>4.0.

The analysis of low-velocity layers discovered from 3D tomography shows their relation to geothermal energy resources which further develops our knowledge of geodynamic processes in this area. The analysis of low-velocity layers determined from 3D seismic tomography is used for the interpretation of geothermal water sources and features of seismicity (Ormeni, 2011; Ormeni, 2013b).

Low Velocity Layers and Geothermal Energy

The existence of the low velocity layers might be the source of geothermal energy of hot water which has enough high temperature to be used as a source of energy in this zone. This hot sulphur waters pushed by high pressure of gases get on the surface through the tectonic fractures of the zone. Analysis show that the low velocity layers in the Elbasan region are located in the earth's crust, at 2-4 km (Figure 2). At 2-4 km depths the velocity of P waves is reduced from 5.12 km/s to 4.40 km/s, and the difference is ΔV = 0.72 km/s or 14%. It is known that the low-velocity layer are characteristic for sizmoactive regions (Ormeni, 2009; Ormeni et al 2013a). As a result of the high temperature in the lower velocity layers occur melting of materials. Geothermal energy resources in Elbasan area are evaluate as warmer water sources of underground layers, which have a temperature sufficient to be used as an energy source. These thermal springs have low enthalpy and maximum temperature up to 80ºC (Frasheri, 2000). The existence of the low velocity layers might be the source of geothermal energy of hot water which has enough high temperature to generate frequent low seismic activity in this zone (Ormeni et al 2023). Sources of thermo-mineral water of Llixha begin around 12 km south of the city of Elbasan, thermo-mineral water resources of Hidrat appear around 13-14km south of the city of Elbasan and the Shijon thermal water resources appear around 10 km northwest of the city of Elbasan.

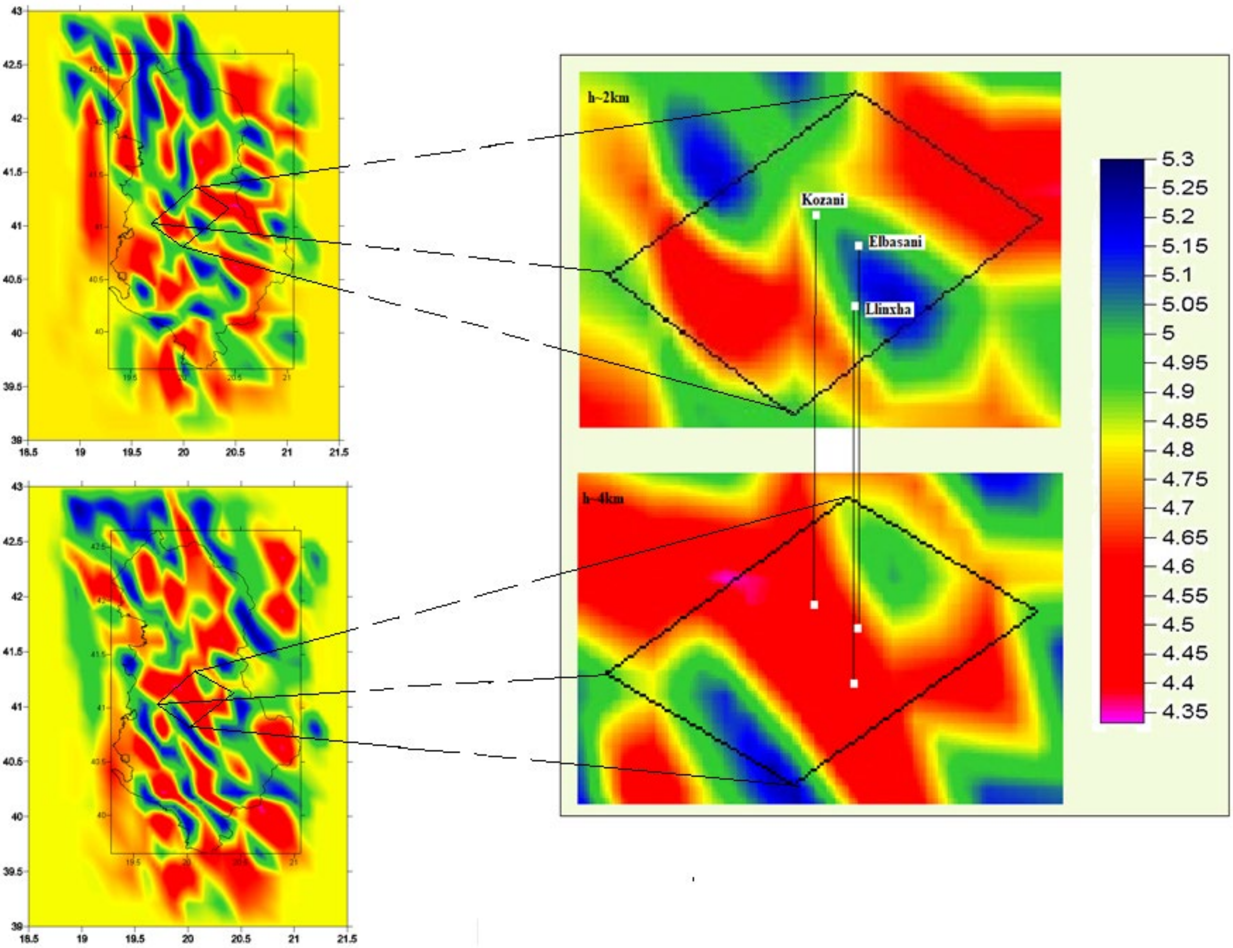

Figure 2. Lateral distribution of low velocities in-depth 2-4 km (Ormeni et al 2023).

Distribution of Seismicity and Thermal Water in Elbasan Zone

Elbasan zone in Albania, represents an earlier deep fracture, with springs of thermal water and which were hit by the frequent earthquakes, being active now. The results of the analysis, based on the parameters of events and some features of seismicity that have occurred in the Elbasan seismogenic zone during period of time five decades, are presented. The goal is to shed light on the correlation between the seismicity of the area and the thermal water.

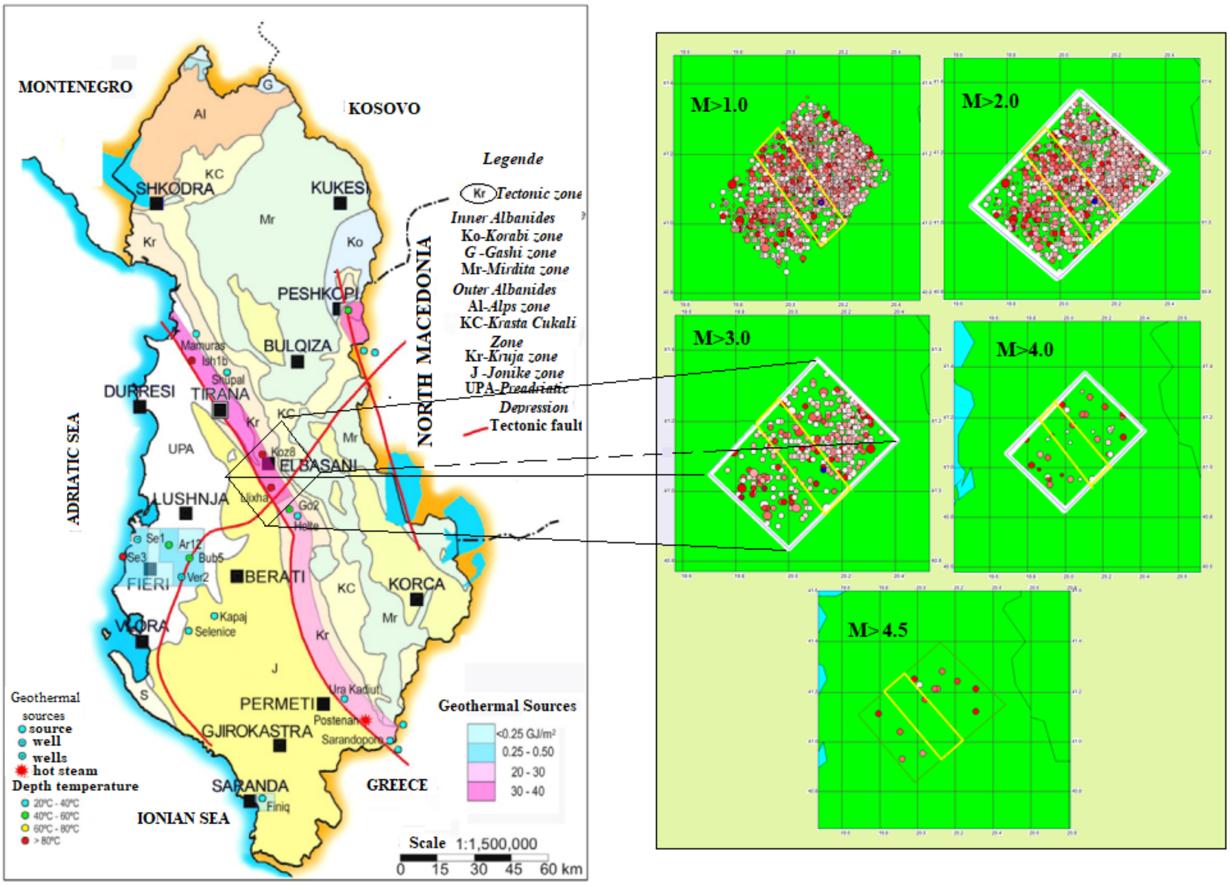

Figure 3. Map of geothermal sources and correlations of thermal water sources to different kind of earthquakes in Elbasan thermal waters.

A comparison of the distribution of thermal and thermal-related springs and wells in Elbasani zone, with the abundance of earthquakes of magnitude M_L>1.0 shows as close a relationship between thermal waters and the distribution of seismicity (Fig 3). It appears that variations in the geothermal gradient influences the stress accumulation capability of the rocks at depth. Thus, areas with abundant thermal waters release stress that generate frequent micro-earthquakes. The distribution of earthquake epicentres in the figure 3, is proportional inverse for earthquakes with M_L>3.0.The high temperatures swelling the rock mass and as a consequence increase stresses which leads to the trigger of micro-earthquakes and small earthquakes.

Distribution of b-value and Thermal Water SOURCES in Elbasan Zone

Figure 4 shows the thermal water sources in this area and distribution of the b-value. The b-value in the zone of thermal water sources ranges from 1.05 to 1.15 (Fig 4). This shows that the accumulation of stress in Llinxha-Kozan thermal water belts low. In the south-western part of Llinxha-Kozan thermal water belt, the b-value is low at0.9 but in other parts is over 1.0. The b-value equal to 1 is normal for our country.

The 'b value' can serve as a proxy, for the accumulation of stress in this area. The b-value is the ratio of small to large earthquakes and Schorlemmer et al., (2005) contend that it's inversely related to the shear stress on the fault (Schorlemmer *et al*, 2005). A higher b value would mean the stress is lower (Ormeni, 2015b; Ormeni *et al*, 2017)) Conversely, a lower b value means the stress is higher, increasing the likelihood of a triggered event. In the southwestern part of the Elbasan zone the b-value is smaller than 1.0 which means the stress is higher, increasing the likelihood of a triggered event. There is a higher b value over 1.1 in the north-eastern of Elbasani zone which means that the stress is lower. In Llinxha-

Kozan thermal water belt the b-value is between 1.0 and 1.1 which means the stress is normal for this area not to be prone of moderate earthquakes in near future.

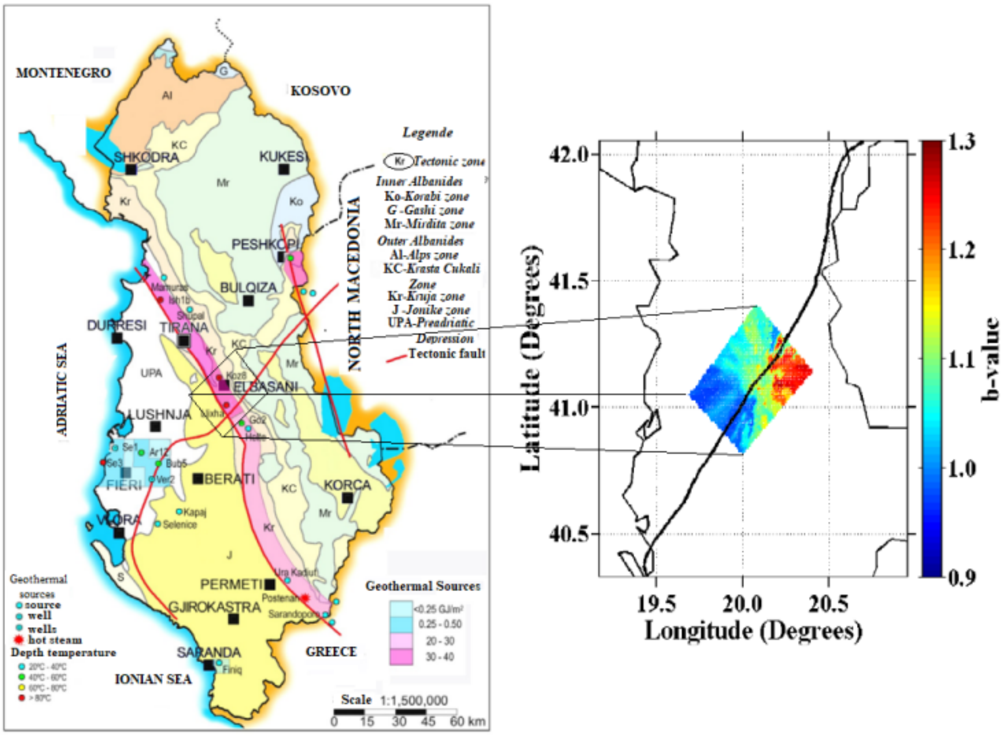

Figure 4. Map of geothermal sources and correlations of thermal water sources to b-value in Elbasani geothermal water

Conclusion

Studying how thermal water zones are distributed and how they relate to seismic activity helps us understand the structure and movement of the Earth's crust. The Elbasani region has not had many earthquakes between 1968 and 2022. Hot thermal water springs can be found in the Kozani to Llimxha area. Slow-velocity layers in the Earth's crust can help generate geothermal energy. The Elbasani area is a special place because it has a lot of underground heat energy and often experiences earthquakes. The low-velocity layer is a common feature in areas that have many small and medium-sized earthquakes. The Earth's crust layer in the Elbasani area has slow-velocity sections at depths of 2-4 km and 10-14 km. High temperatures in the low-velocity layers in this area can create the thermal-water.
As the effect of the pressure of gases, thermal water come to the surface through the lineament of tectonic fractures. The Elbasani zone could be a specific region since encompasses a significant number of sources with geothermal potential and frequent seismicity. Analysis appear a relationship between thermal waters sources locations, low velocity layers, the distribution of seismic parameters. A higher b-value in the thermal water sources zone would mean the stress is lower.

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Research Paper

Behaviour of Sille Stone Against Acid Rain

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Abstract: The structures in which human activities are carried out and we are in at any time are reacting with the increasing acid rain and acids caused by different reasons. Building materials lose their chemical and physical properties as a result of reactions with acids. Sille stone, which has quarries in the Sille district of our Konya province, is a building material that has been used since ancient times. The resistance of this building material, which is still preferred in building construction in today's conditions, against acid rain, although it has been encountered in various historical artifacts carried from different cultures and civilizations until today, was discussed in this study. The pH value of rainwater varies between 5.6 and 6 and shows acidic properties. It has been observed that the pH value of acid rains fell below 5 and decreased to 3 in some places in the world. Sulfuric acid, nitric acid, carboxylic acid and their mixtures, which are frequently encountered in acid rain, were used in this study. 7x7x7 samples were taken from the stone quarries in Sille district. 1 molar concentration of citric acid was prepared in order to examine the behaviour of Sille stone as a result of the reaction of these stones in seasonal acid rains. The samples were kept in natural environment, in water and in acidic environments by varnishing and by without varnishing. In this way, the protected on of stone against acid rains was also analysed.

Keywords: *Acid rain, Nitric acid, Sille stone, Coat protection*.

Introduction

Palta (2020) examined the effect of boric acid on self-compacting concrete. They produced the concrete themselves. 6 samples were obtained by adding a reference sample and 0.5%, 1.0%, 1.5%, 2.0%, 2.5% boric acid by weight to the concrete water, respectively. Diffusion Table, V-Funnel, L-Box, U-Box tests from Fresh Concrete Tests were performed on these 6 samples produced. Compressive strength and bending strength experiments were carried out to compare the changes in the mechanical properties of the obtained samples. Additionally, SEM and XRD analyses were performed to observe structural characterization changes. When SEM images were examined, boric acid accelerated the formation of C-S-H gels by binding C-H to itself over time, and with the effect of this, an increase in compressive strength was achieved over time. Thus, with the addition of boric acid, a new C-S-H gel was formed, and the structure was made more impermeable and durable. With the addition of 2.5% boric acid, the gaps and pores began to increase significantly. Micro crack formation was also observed. As a result of this situation, the increase in compressive strength decreased compared to the control sample. In the XRD analysis, when looking at the XRD peaks, especially after the 0.5% Boric acid additive rate, the dominant peak intensities seen at approximately 30° started to increase effectively. The low peak intensity of 0.5% Boric acid additive ratio can be associated with the decrease in particle size and pores. It can be said in the SEM image of the sample with 0.5% boric acid that the particles are smaller compared to other samples. SEM and XRD analysis results support the increase in compressive strength, especially in the concrete sample with 0.5% Boric acid added. When a general evaluation was made, it was seen that Self-Compacting Concrete could be produced by adding boric acid.

Reddy studied three different regions in the northeastern United States in 1988. The aim of this research is to examine the effects of dry and wet deposition states of acid on stone separately. As a result of the experiments and observations, it was revealed that the stagnation on the stone surface is proportional to the amount of precipitation. In other words, the amount of precipitation that falls on the stone will increase the dissolution on the stone surface proportionally. This research has shown that the result is proportional to the hydrogen ion arriving on the stone surface (Reddy, 1988).

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Charola (1987) have studied limited the pollutants that cause acid rain to only sulphur oxides. He limited the stones he examined to quartz, which is a stable mineral form. As a result of his research, he attributed the deterioration of calcareous stone to two main reasons. The first is the chemical dissolution of calcite, and the second is the damage caused by the salts formed during dissolution crystallising again in the stone pores. The first case explains the deterioration in the surface details of buildings and monuments, and the second case explains the causes of structural damage to the stone.

In 2005, Tecer examined the effects of SO2 and NOx resulting from environmental pollution on carbonate rocks. He examined the results of the effects of air pollutants on historical structures whose main component is $CaCO_3$. Effects of Sulphur Dioxide, Nitrogenizes, Carbon Dioxide, Acid Rain, and Particulate Matters on carbonate rocks are examined in the study.

Bravo (2005) had experiments to observe the dissolution that occurs when limestone is exposed to acid rain. As a result of the studies, it was determined that 85% of the precipitation in this region is acidic and the limestone building material in this region is dissolved by acid rain and as a result, it erodes over time and loses its shape and resistance.

Materials and Methods

Air pollution, which has become one of today's important environmental problems with the rapid increase in industrialization brought about by advanced technology, causes acid rain. Acid rain, or acid deposition, includes any form of precipitation with acidic materials, as sulfuric acid, nitric acid, citric acid which fall from the atmosphere to ground in wet or dry forms. Its shape may be rain, snow, fog, hail or even dust that is acidic form. Its effects directly each part of the planet so our life. It is harmful to aquatic life and vegetation. It effects the human health by causing the important diseases in human body. It also accelerates weathering in stone and metal structures. The aim of this study is related to weathering in stone structures as the stone structures are very popular as they have more advantages with compared to other structural materials. Sille stones are magmatic stones such as granite, kyanite and andesite found in volcanic lands (Tapur, 2019). Although Sille stone is referred to as andesite in many sources, Taşlıgil, in his article written in 2016, mentioned it as trachyte, which is also a stone of magmatic origin and has a silica content of 62% (Taşligil & Şahin, 2016). Sille stone is composed of cinder blocks formed by andesite blocks and andesite tuffs (Kazancı & Gürbüz, 2014). In order to examine the effect of acid rain on the Sille stone, the sample stones are taken from a geological heritage reserve located in the Sille district of Konya as seen in Figure 1. The changes in physical and chemical properties of Sille stone exposed to acid rain were examined. Additionally, it was aimed to reduce this effect and the Sille stones so the stones were covered with stone varnish. The change in strength and chemistry of Sille stones coated by stone varnish compared with unvarnished Sille stones was compared.

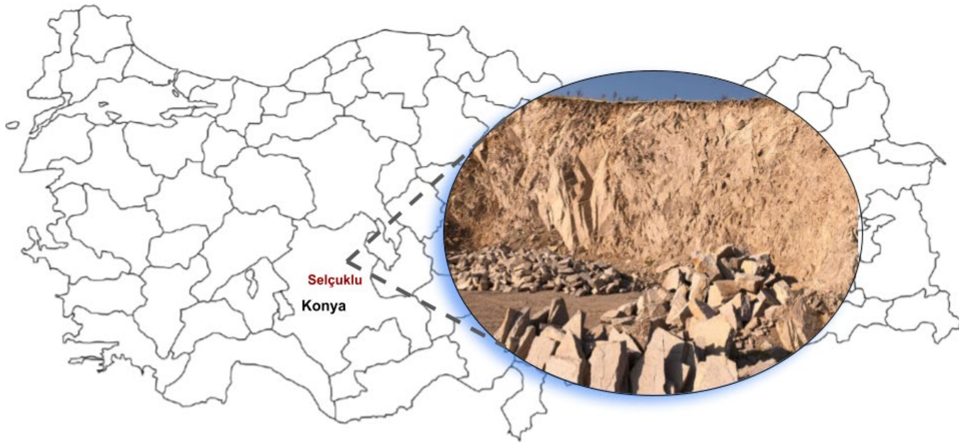


Figure 1. Sille stone Source

In this study, Sille stone samples are kept in water, in nitric acid (HNO_3) prepared as 1 molar, in the atmosphere environment, coated with stone varnish and uncoated for Sille stone for 6 months. Mechanical and chemical changes of Sille stones during seasonal transitions were analysed over a 6-month period.

Used materials

The main material of this study is Sille stone which is stated that the required sample size for the pressure test on TS1926 natural stones should be 7x7x7 cm^3. For this reason, in this study, which will last 6 months, the size of a sample of Sille stone will be a cube of 7x7x7 cm^3. Compressive strength test is performed on at least 5 test samples for each environment (TS 1926) and averaged their results. Additionally, 1 test sample is required for chemical experiments. In this case, 5+1 unvarnished and 5+1 varnished test samples are required for each environment. Tested material are given in Table 1.

Table 1. Tested materials

	varnished	unvarnished
References	5+1	5+1
Nitric Acid	5+1	5+1
Atmosphere	5+1	5+1
Water	5+1	5+1
Total	48	

Discussion and Results

Pressure Test

Compressive strength is the maximum stress that is measured on concrete under the effect of axial pressure load. The compressive strength of the concrete cube test provides an idea about all the characteristics of concrete. By this single test one can judge if the resistance of it is suitable or not to avoid breaking. The reasons why the most commonly used strength is compressive strength; the test applied to determine compressive strength is simpler than the tests applied to determine other types of strength. The compressive strength value has an important role in building designs. If the compressive strength is known, one can have an idea about the other strength values of the samples and make comments.

The pressure test was prepared depending on TS 1926 conditions and its procedure. Test for compressive strength is carried out on a 7x7x7 cm^3 cube. So, Sille stone test samples were prepared as cube samples with dimensions of 7x7x7 cm^3. Before placing the sample on the compression device with adjusted loading speed, it was checked that the surface on which the sample would be placed was clean and smooth. The sample was carefully placed on the testing device in the centre of the loading bed so that the load would act exactly in the middle and axially. After the placement process was completed, loading was started and the maximum force withstood by the sample was measured from the device (Figure 1). The compression test was carried out with the compression device in the civil engineering laboratory of Necmettin Erbakan University.

Figure 1. The compressive strength test of the samples

Firstly, the compression is applied on unvarnished Sille stone, as it was originally removed from the its source and the compression strength was measured as 30.91 MPa. The compression test result of the Sille stone samples, which were varnished and kept for the varnish to dry, was measured as 25.61 MPa as seen in Table 2.

Table 2. Compressive strength of Sille stone, taken from the its source, with and without varnished

	Sample No	7*7*7 Cubic (KN)	Compressive strength (MPA)	Average (MPA)
Unvarnished	1	133,95	27,34	
	2	177,44	36,21	
	3	128,57	26,24	30,91
	4	162,26	33,11	
	5	154,98	31,63	
Varnished	1V	84,93	17,33	
	2V	154,36	31,50	
	3V	109,13	22,27	25,61
	4V	135,54	27,66	
	5V	143,44	29,27	

As can be seen from the Figure 2, the varnish prevents oxygen passing through from surface to insight of the stone. For this reason, the compression strength in varnished samples was lower than in unvarnished samples. As can be seen from the Figure 2, it was observed that the compressive strength is increasing in all environments with compared to the strength of the samples which as first came out of the quarry in varnished samples. This is a sign that the strength of quarried samples increases when exposed to oxygen. Applying varnish prevented oxygen from passing through in it. For this reason, the strength of varnished samples was lower with compared to strength of unvarnished samples.

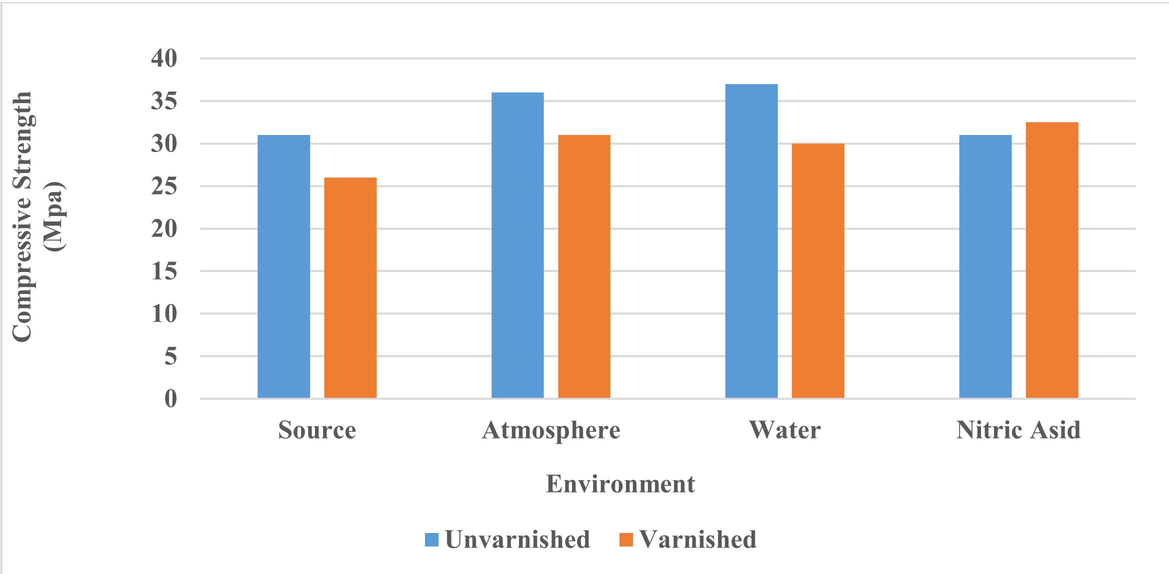


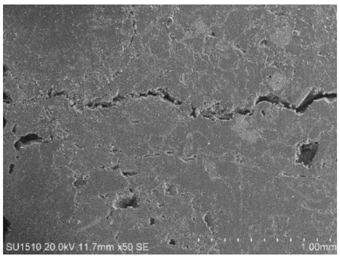
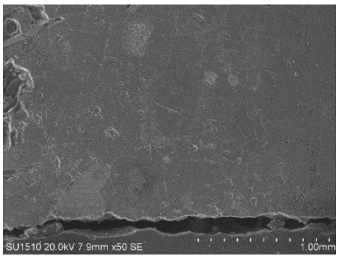
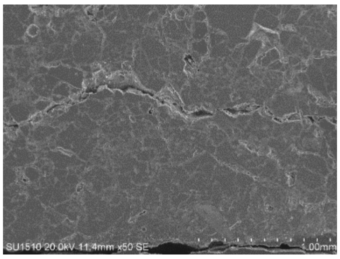
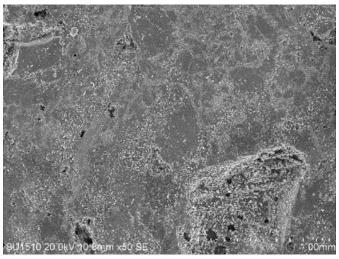
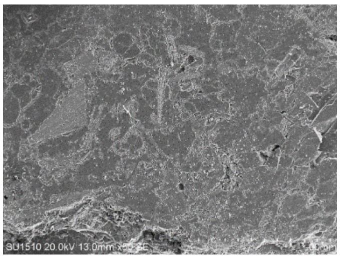
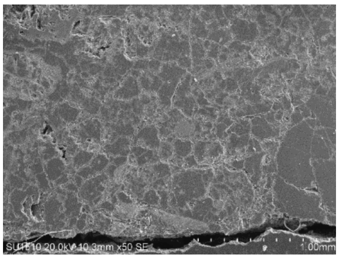
Figure 2. Compressive Strength of samples

Over time, physical and chemical transformation occur in Sille stone. It has been observed that the improvement in mechanical properties is slower in Sille stone samples varnished and kept in atmosphere, water and acid environments. However, it has been determined that Sille stone samples behave more stable over time. The physical transformation of the stone occurs when the quarried Sille stone turns into a lower energy state as the pressure on it decreases. Chemical transformation of the stone is the changes in compressive strength as a result of chemical reactions in Sille stone samples kept in different environments.

SEM analysis

Varnished and unvarnished SEM images of the samples tested in the most applicable atmosphere, water and nitric acid environments are given in Table 4.2. In general, applying varnish to the samples causes the cracks and pores on the material surface. When SEM images are examined, it can be said that the idea that small molecules, which were formed during the transformation, accumulate in the cracks and pores in the material is supported.

Table 2. SEM images of varnished and unvarnished Sille stone

	Varnished	**Unvarnished**
Atmospheric Environment		
Water Environment		
Acidic Environment		

Results

- The transformation began to negatively affect the sample by destroying it, and a decrease in compressive strength occurred in the 6th month.
- It has been observed that the improvement in mechanical properties is slower in Sille stone samples varnished and kept in atmosphere, water and acid environments. However, it has been determined that Sille stone samples behave more stable over time.
- It is thought that not varnishing the stones used in houses and buildings intended to be built using Sille stone at the beginning, but varnishing them after a certain period of time, will be effective in increasing the compressive strength. Determining this period clearly experimentally may be the subject of future studies.
- In order to examine the transformations in the chemical and physical properties of Sille stone in more detail, more detailed findings can be detected and evaluated by selecting a single aging environment and performing strength tests over a longer period of time and at shorter intervals.

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Research Paper

The Effect of Various Energy Dissipator Layouts on Energy Dissipating Along the Stilling Basin

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Abstract: Energy dissipater in the stilling basin is a structure designed to protect downstream of the spillway from erosion and scour by reducing flow energy in the energy dissipation pool. Energy dissipation pool is an important element of hydraulic structures as a transition between the high-velocity flow and the sensitive tail water. The aim of this study is to investigate the energy dissipation ratios of baffle blocks which constructed in Type III stilling basin by using physical and numerical modelling methods. Energy dissipation ratio of the baffle blocks was determined in 3 different layouts as single row, two rows and two rows without end sill are tested. In addition, these experimental studies were tested by numerical study. Results show that, extra added chute blocks help to increase energy dissipating ratio at the energy dissipating pool and so the stilling basin length shortens by shortening the length of the hydraulic jump. The physical study results and the data obtained from numerical modelling are also like each other.

Keywords: *Open channel hydraulics, Spillway structures, Stilling basins, Energy dissipation block, Energy dissipaters, FLOW-3D, Hydraulic Jump.*

Introduction

Spillways are the hydraulic structures that transfer the excessive water safely from reservoir to downstream side without damaging the dam body. A spillway structure generally consists of the approach channel, spillway, aerators and the energy dissipation structure. Approach flow discharging from top of the dam body with high energy can damage the structures on the downstream side of the spillway and by scouring. Energy dissipating structures, reduce the energy of the flow which is coming over the dam body and allow it to pass to the downstream side with lower energy. The basic principle of energy-dissipating structures is to ensure that the hydraulic jump, that formed when flow regime changes from supercritical to subcritical, occurs in the stilling basins (Hager, 1992)

Stilling basin types were first described in by Bradley and Peterka in 1957 and a series of experiments on chute blocks, baffle blocks and end sill were carried out and stilling basins types were classified according to Froude number and flow velocity. Energetic blocks are placed in the scattering pool to allow hydraulic splashing to occur and to increase turbulence. Baffle blocks are placed in the basin to allow hydraulic jump to occur and to increase turbulence, by this way needed basin length is shortening to break energy of flow. Baffle blocks can be used in a single row or in more than one row. It has been suggested by the Peterka (1984) that baffle blocks in the second and subsequent rows should be placed in a staggered manner, the first block should be placed half the width of the block from the wall, and the width of the blocks in the same row and the distance between the blocks should be equal. Some researchers have tried to increase the efficiency by changing baffle and chute block geometries in the stilling basin structure (Pagliara and Palermo, 2012; Bestawy, 2013). Cook (2002) created a numerical model of the spillway and stilling basin constructed within the scope of the Dalles project using Flow-3D and compared the results obtained from the numerical model and the physical model. Amorim (2015) compared the results obtained from numerical model of the stilling basin of the Porto Colombia Hydroelectric power plant with 1/100 scale physical model of the power plant. Nigam et al. (2016) did an overview and worked on hydraulic jump type stilling basins. They dealed with the hydrodynamic design aspect of jump type energy dissipaters by experimentally and analytically along with comparison of various energy dissipaters. Based on the estimating the uplift and hydrodynamic forces on energy dissipaters, although jump type energy dissipators with only one end sill is sufficient

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for higher velocities, it was not recommended to use it for head above 100 meter. Dermawan et al. (2021) was carried out the physical model study by experimentally by bottom lowering of horizontal and USBR II stilling basin. It was expected to represent flow behaviour in the overflow system regarding flow conditions and energy dissipation. After experiments, the amount of flow energy that occurs at each control point is calculated. USBR II is found that, in which has baffle blocs at the toe and end sill, the flow becomes more turbulent with compared to the flat stilling basin that does not have baffle blocks. USBR II it was better than flat stilling basin while discharge is increasing with a higher difference in overflow height.

Flow conditions on overflow systems can result in construction failure, mainly due to the high flow energy. Since the dams require a unique design (site-specific) in topographic conditions, there may be situations where the energy dissipation pool is not sufficient. In such cases, USBR designs may not be enough and additionally energy dissipater blocks can be used to obtain higher energy loss (Kumcu and Kökpınar, 2019).

In this study, the physical hydraulic model test was carried out to increase energy dissipating ratios of various baffle blocks placed in various layouts on USBR III energy dissipating pools. So, the contribution of the baffle blocks in stilling basins located downstream of the ogee spillway to find out energy dissipation ratios which were investigated by physical and numerical modelling methods.

Material and Method

While water drops from reservoir to tail of the spillway, it moves from upstream to downstream, it should be used hydraulic energy dissipators, the most common types are energy dissipating pools which are called stilling basin for large structures like spillways, rely on the formation of a hydraulic jump. A hydraulic jump is a sudden rise in the water surface that occurs when the flow regime changes from the supercritical to the subcritical. During the hydraulic jump, a significant amount of energy is absorbed over a short distance. A hydraulic jump causes so much turbulence so it should be kept in the pool so energy dissipators are designed to force a hydraulic jump to occur. There are many various designs of stilling basins depends on combinations of blocks, end sills, and overall geometry to control how the hydraulic jump forms. In Figure 1 the general view of the stilling basin and hydraulic jump formed in the pool are given.

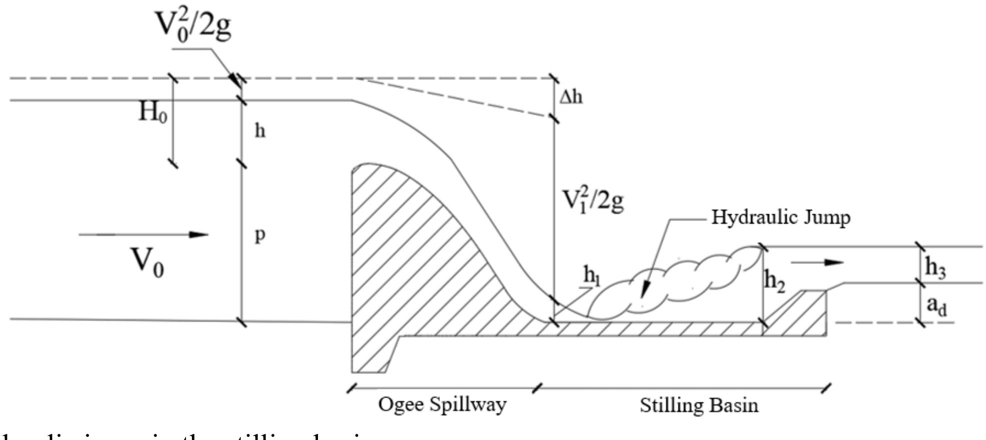


Figure 1. Hydraulic jump in the stilling basin

The definitions of the parameters described in Figure 1 are given below.

h_2 =	Flow depth after the hydraulic jump	V_0 =	Approach flow velocity
h_3 =	Flow depth at downstream	V_1 =	Velocity of the flow before the jump
h =	Flow head over the crest	Δh=	Head of the dissipated energy
p =	Crest height	H_0=	Total water head over the crest
a_d =	End sill height	V_0 =	Approach flow velocity
$V^2/2g$ =	Velocity head		

The relationship between h_1 and h_2 by using the momentum equations during the hydraulic jump is as follows.

$$\frac{h_2}{h_1} = \frac{\sqrt{1+8Fr^2}-1}{2}$$

Hydraulic jumps are classified according to the Froude number as $Fr = \frac{V}{\sqrt{g \times h_1}}$. Depending on the Froude number, jump types are given in Figure 2.

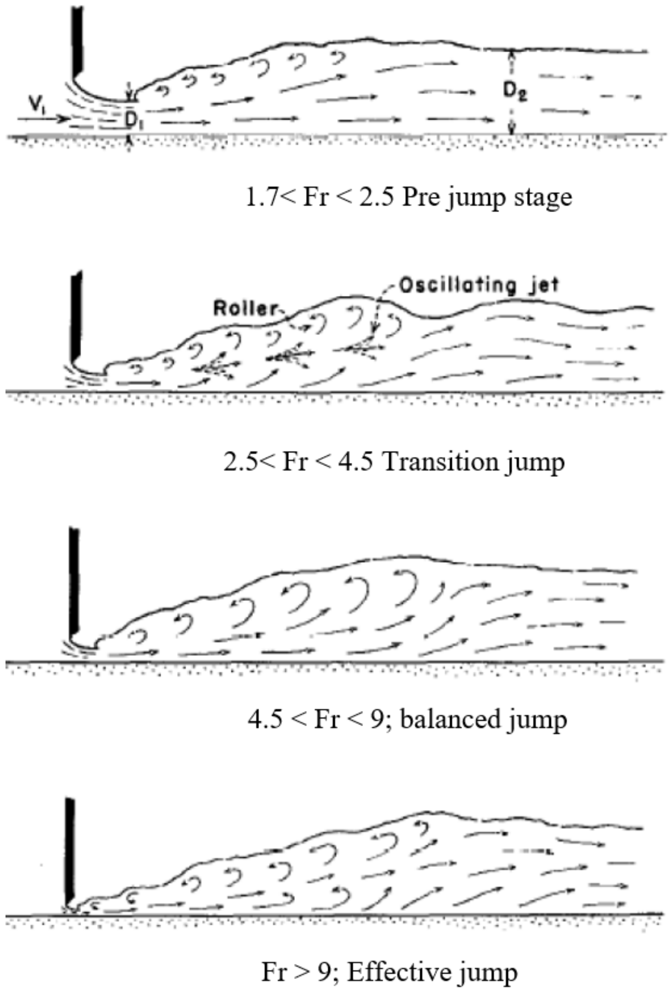


Figure 2. Hydraulic jump types depending on Froude number (Peterka, 1984).

Stilling basin

Flow energy is transferred from kinetic energy to heat energy by hydraulic jump in the stilling basin. These phenomena occur at the stilling basin. Stilling basins are designed depend on the type of the hydraulic jump. Its design instalment parts are including chute blocks, baffle blocks and end sills. Chute blocks are used at the tip of the spillway to form the flow jet at the entrance of the stilling basin. Baffle blocks are placed along the stilling basin depend on the flow. They enable enough energy dissipating amount. The end sill is usually used at the end of the pool for providing to keep local scour at the pool and to make its length is shorter. Flow depth (h_1) and corresponding velocity (V_1) and Froude number (Fr) before the hydraulic jump were calculated, and the highest velocity and the Froude number were computed as 2.75 m/s and 8.83, respectively. Type III stilling basin is used when the Froude number is greater than 4.5 and the flow velocity is less than 18.3 m/s (60 ft/s). Thus, USBR type III stilling basin was chosen, which is suitable for the design in flow conditions where the calculated Froude number, Fr=8.33 is greater than 4.5 and the maximum velocity V_1=2,75 is less than 18.3 m/s (60 ft/s).

Type III stilling basin is designed according to USBR and dimensioning of the basin, baffle and chute blocks are given in Figure 2. Limit values of the study are given in Table 1.

Table 1. Max and Min values used for designing USBR Type III basin.

Min/Max	Q (l/s)	H (cm)	h_1 (cm)	Channel width, B(cm)	V=Q/A (m/s)	$F_r = V/\sqrt{gh_1}$	$\frac{h_2}{h_1} = \frac{\sqrt{1+8Fr^2}-1}{2}$
Min	1.10	1.52	0.26	30.00	1.41	8.83	3.12
Max	39.62	14.40	4.80	30.00	2.75	4.01	24.92

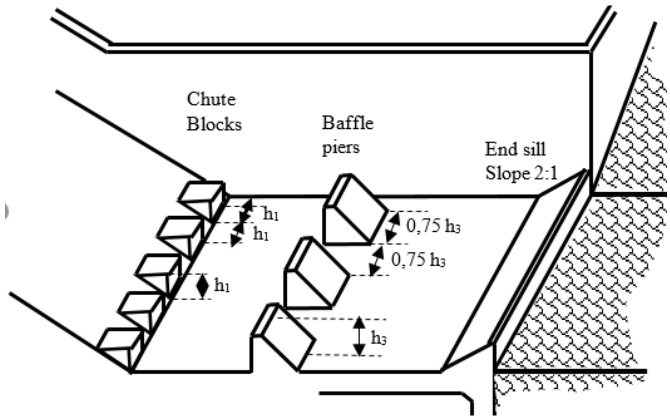


Figure 3. Type III stilling basin (Peterka, 1984)

Experimental setup

Experiments were carried out in a rectangular open channel with a length of 670 cm, a width of 30 cm and a depth of 50 cm. In the experimental setup, flow in the open channel is provided by two pumps, each of which has a power of 7.5 kW, connected in parallel to the system. The water flowing in the open channel system is supplied from two reservoirs. The pumps take the water from the reservoir-1 and convey it into reservoir-2. Then, the water reaches to the reservoir-2 passes through the laboratory flume and is poured back into the reservoir. The total discharge in the channel is equal to the sum of the flows supplied from both pumps. The flow discharge that the pumps will provide is adjusted by the frequency alternative on the panel to which the pumps are connected. The flow through the system is read by electromagnetic flowmeter placed between the pipes after the pumps. Flow depth was measured with a limnimeter with an accuracy of ±1 mm placed in the open channel. The open channel flume is made of 1.2 cm thick laminated glass-walled, which is obtained by combining two 0.6 cm thick tempered glass sheets with a plastic layer placed between them. In the experiments, ogee type profile and stilling basin made of plexiglas. The general view of the experimental setup is seen in Figure 4.

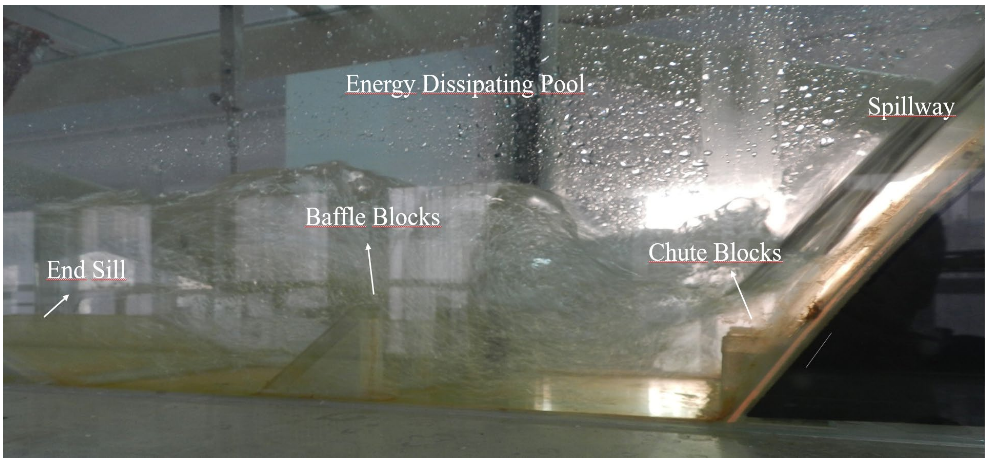


Figure 4. Experimental setup

Experiments are conducted for 7 various discharge values (10, 15, 20, 25, 30, 35 and 39.62 l/s). Stilling basin elements were prepared in accordance with the methods recommended by the USBR and adhered to the open channel with the help of silicone. The flow depths were measured with the help of a limnimeter.

Experimental studies were carried out on physical models for investigating the energy absorption ratios of the energy dissipating blocks placed in the USBR Type III stilling basin. In the experiments, the data obtained by measuring the height after splashing and downstream water level at 7 different flow rates were compared, and the energy dissipating ratios were calculated. In the experiments, trapezoidal energy dissipater was used. The energy block types used were placed in the energy dissipating pool first in a single row, then 2 rows and then 2 rows without threshold, and the flow conditions were investigated. Plan and profile views of the energy dissipating block types are given in Figure 5.

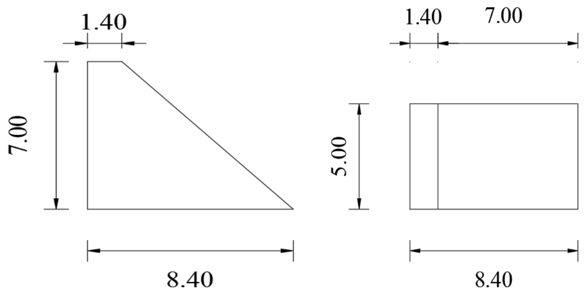


Figure 5. Block types used in the experiments; a) Longitudinal cross-section and b) Top view of the dissipating block types.

Numerical setup

FLOW-3D is a computational fluid dynamics solver, a commercial mathematical computation program that can solve multiple fluid mixtures using the finite difference method. A single fluid-free surface flow solution was used in the analyses. For the VOF (Volume of fluid) method, it is provided to define the fill or void ratio of each mesh cell and to perform pre-debugging by using pre-process. Mesh cells of 5 mm size were used in the analyses, and the mesh block contains a total of 1,536.000 cells. The part where water enters the system (-X side) is defined as the pressure (static water level). Depending on the desired weir load on the weir, the height of this static water level was adjusted and water was allowed to enter at the desired height. The side surfaces and the bottom of the pool were chosen as walls, the downstream part as outflow and the upper part as pressure to represent the atmospheric pressure. To obtain the desired analysis results, Fluid Fraction (filling ratio) and hydraulic data options are marked in the "output" section. The solid model and layer conditions used in the analysis are shown in Figure 6.

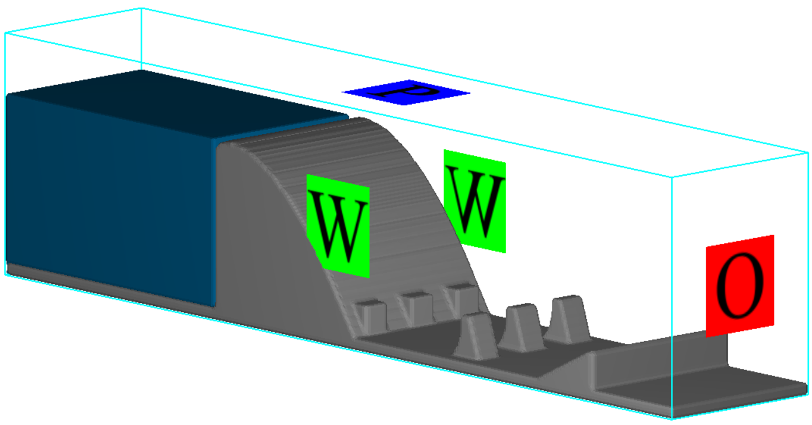
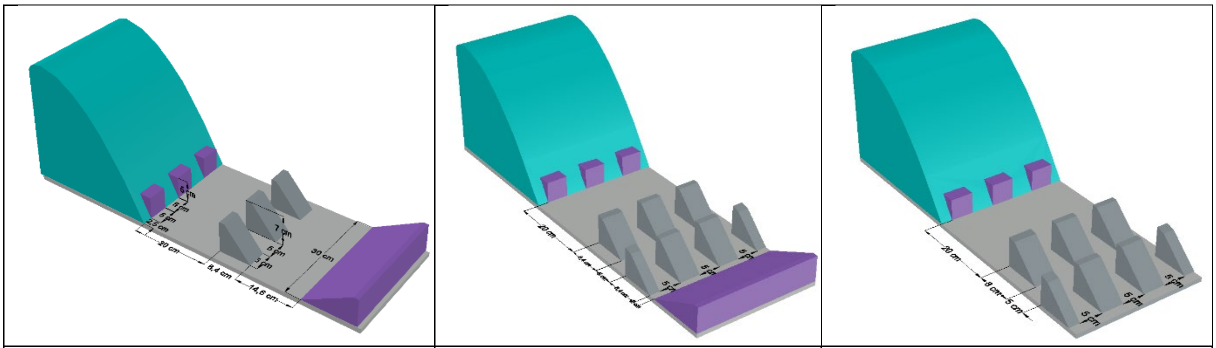


Figure 6. Solid model used in the CFD simulations of single row trapezoidal energy dissipaters

The solid model of a single line, two rows and two rows without end sill energy dissipating pools are given in Figure 7.



a) A single row	Two rows	**c)** Two rows without end sill

Figure 7. CFD models of the tested energy dissipating pool having a) a single row b) two rows with end sill c) two rows without end sill

Results and Discussion

Physical Model

During this experimental study on the open channel, the energy dissipation ratios of baffle blocks having different geometric outlines were investigated with the help of the hydraulic jump created in the flow. The measured depths and velocities of the flow before and after the hydraulic jump formation were investigated, and the energy dissipation ratios were found by computing the total heads of the flow. To determine the amount of energy dissipation and to find the most effective plan shape of baffle blocks were designed as; single row, double row and double rows and compared according to their non-threshold arrangement. The graphs is given in Figure 8.

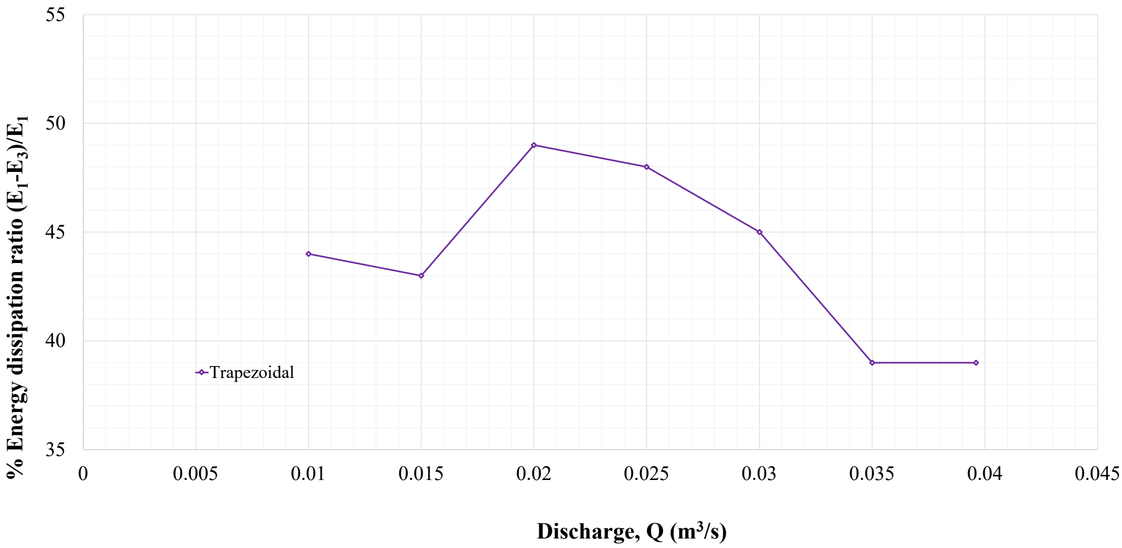


Figure 8. Energy dissipating ratios of the single row energy dissipaters

When the energy dissipation ratios of the single row energy dissipater blocks are examined in Figure 8, it is seen that the highest absorption rate is obtained at 20 l/s, which corresponds to almost 50% of the total head of the flow.

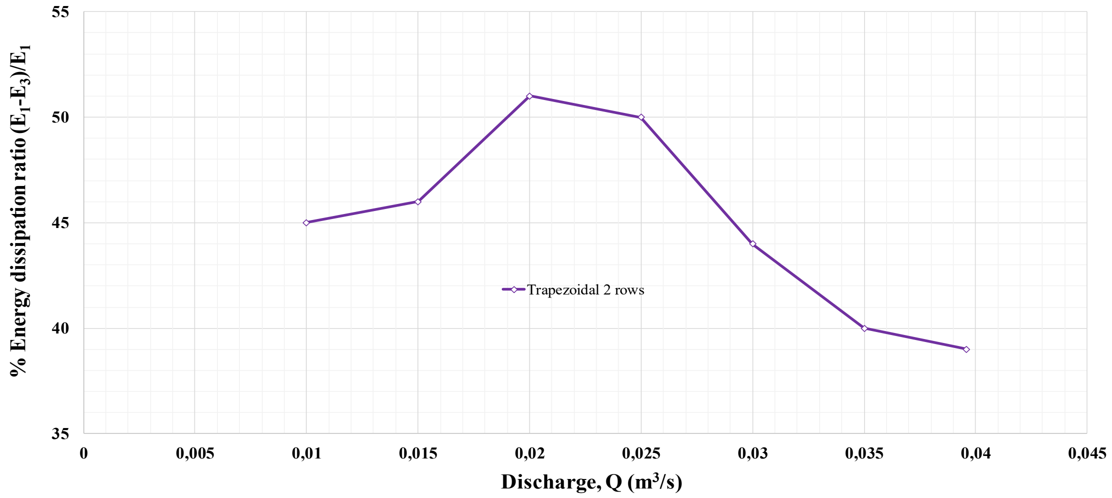


Figure 9. Energy dissipating ratios of two rows energy dissipaters

When the energy damping ratios of the two-row energy breaker blocks are examined in Figure 9, it is seen that the highest damping rate decreased by 51% with 20 l/s, which corresponds to almost 50% of the design flow. In the design flow, it was observed that the highest energy breaking rate belonged to the T-section energy breaker block plan and reached 39%.

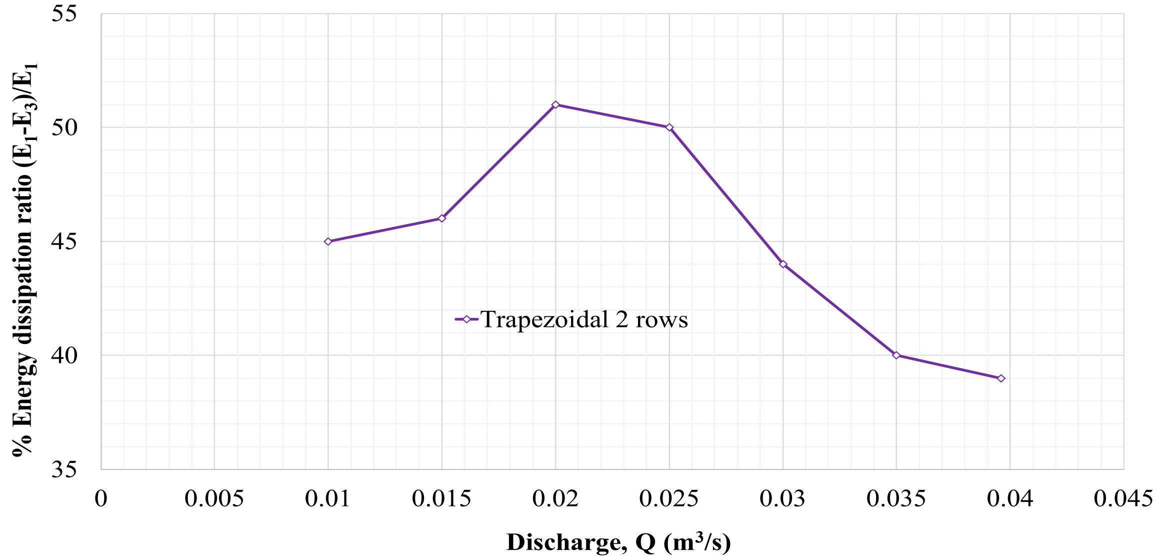


Figure 10. Energy dissipating ratios of the two rows without end sill energy dissipaters

When the energy dissipation ratios of the two rows of without end sill energy dissipation blocks are examined in Figure 10, it is seen that the highest energy dissipating rate is reduced by 51% with 20 l/s, which corresponds to almost 50% of the design flow. The effect of Fr number on energy dissipation is also important and it is shown on Figure 11. Energy dissipation rate reaches its maximum for the design type of 2 – lines with end sill. It means that the extra added chute blocks cause to rise the energy dissipating ratio on the stilling basin. When the Fr number various between 4,5 to 5, energy dissipating ratio reaches 51%.

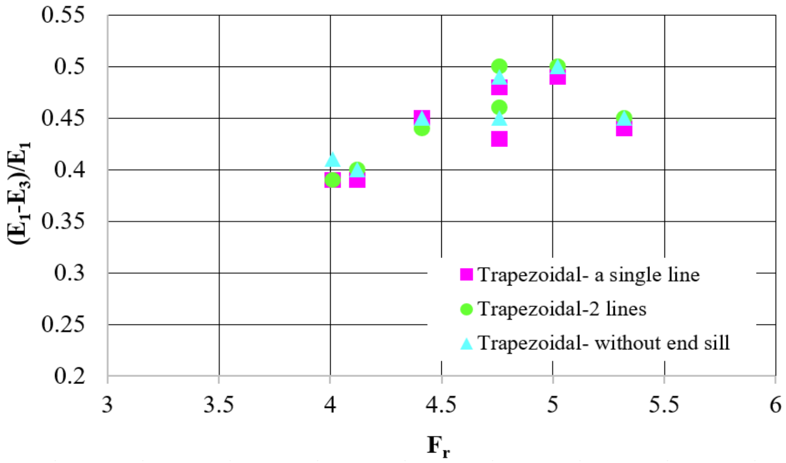


Figure 11. Variation of energy dissipating ratios by Fr

Mathematical Modelling

The experimental setups of the single row energy reduction blocks used in the experimental study were tested with the FLOW-3D mathematical method at the design flow rate, and the data on the hydraulic properties obtained are given in Table 2. When this table is analyzed, the energy breaking blocks with Trapezoidal cross-sections have energy breaking percentages is almost 39%.

Table 2. The results of mathematical modelling of the single row energy dissipating block

Type	h_1 (m)	V_1(m/s)	E_1 (m)	h_3 (m)	V_3 (m/s)	E_3 (m)	$(E_1$-$E_3)/E_1$	Fr_1	Fr_2
Trapezoidal	0,0480	2,75	0,4338	0,2495	0,53	0,2638	0,39	4,01	0,34

Comparison of Physical and Mathematical Model Results

Experimental setups of single row energy breaker blocks were tested physically at seven different flow rates and with the FLOW-3D mathematical method at the design flow. When the energy dissipation rates of the energy dissipating blocks are analysed in Table 3, the experimental study results and the FLOW-3D results have almost the same values.

Table 3. Energy reducing rates obtained by mathematical modelling for the single row energy dissipating block at design discharge

	Physical modelling			Mathematical Modelling		
Block	h_3 (m)	V_3 (m/s)	$(E_1$-$E_3)/E_1$	h_3 (m)	V_3 (m/s)	$(E_1$-$E_3)/E_1$
Type	0,2485	0,53	0,39	0,2495	0,53	0,39
Trapezoidal	0,2515	0,53	0,39	0,2500	0,53	0,39

Conclusions

A series of experiments were carried out to investigate the similarities and differences of the dissipating ratios of the different layout of energy dissipating blocks placed in the USBR Type III energy dissipating pool, the experimental study, and the mathematical model. The findings are given below:

- In the two-row threshold energy dissipating blocks design, the highest dissipating ratio was obtained at the design flow rate.
- In all experimental setups, the highest dissipating ratio was obtained at 20 l/s flow rate and the lowest dissipating ratio was obtained at the design flow rate.
- Energy dissipating blocks shorten the distance of the hydraulic jump and so shorten the length of the pool.
- The experimental study results and FLOW-3D results had almost the same values.

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Research Paper

A New Paradigm for in-Situ Conservation, other Effective Area- Based Conservation Measures; Case of Karacadag Steppes

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Abstract: Protected areas are the most important cornerstones in the protection of natural resources and biodiversity. At the same time, they provide benefits to residents and are also instruments that contribute to the implementation of international agreements. They are known by a multitude of names in different countries and are governed according to both nationally and internationally accepted agreements and/or approaches. The International Union for the Conservation of Nature (IUCN) has created a classification system that identifies six categories of protected area according to their management objectives to create a common understanding for each category. While the protected areas are an essential and continually growing approach to conservation, there is difficulties to applicate universally for the conservation of biodiversity. Therefore, apart from national and regional protected areas, various tools and networks also contribute to the effective in-situ conservation of natural resources and biodiversity. 'Other Effective area-based Conservation Measures' (OECMs) have been recognized as an important opportunity to achieve this aim. The OECMs has the potential to promote a new model for conservation that fosters inclusive approaches and equitably governs land, forests, freshwater and oceans to achieve long-term conservation, as well as social, economic, and cultural wellbeing. In the October 2023, total 870 number of OECMs in the world. For Türkiye, a case study was carried out and an OECMs assessment report prepared for Karacadağ Steppes in the scope of "Conservation and Sustainable Management of the Türkiye's' Steppe Ecosystems Project " that was implemented between 2017-2022 by the FAO and the Ministry of Agriculture and Forestry. It is the first case for Türkiye and introduced the OECM approach to the policy agenda as well.

Keywords: *Protected area, Nature conservation, OECMs, Karacadag-Sanliurfa*

Introduction

Protected areas are an essential and continually growing approach to conserve biodiversity and the natural environment. In addition to conserve natural values, these areas are also supported to increase nature awareness, rural development, reduce the possible effects of climate change, strengthen cooperation opportunities with many different partner groups and gaining experiences in nature. The most widely accepted definition of a protected area was developed by the International Union for Conservation of Nature (IUCN) in 2008: A clearly defined geographical space, recognized, dedicated, and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values. (Dudley, 2008). This brief definition encompasses four critical facets: spatial, set aside, long-term and nature. In application, the term 'nature' has been broadly interpreted to include landscapes and seascapes where human activities have considerably altered the original state, but where natural values are still considered as conservation targets (Boucher *et al*., 2013).

Although protected area classifications and management approaches vary from country to country, protected area management categories classified by IUCN; Ia. Strict nature reserves, Ib. Wilderness areas, II. National parks, III. National monuments, IV. Habitat/species management areas, V. Protected landscapes/seascapes, VI. Protected areas with sustainable use of natural resources (Dudley, 2008) are most widely accepted categorizations. Even if many protected areas do not appropriate gracefully into these definitions, still they are the most effective tools for protecting biodiversity. In addition to conserve biodiversity and natural values, protected areas also promote many other environmental, social, and economic benefits. For instance, the functions of protected areas include strengthening social welfare, protecting local security, and providing multi-scale economic benefits (Naughton-Treves and Holland,

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2005). The value of protected areas is well known. In addition, their role in climate change mitigation and adaptation is understood. Due to these benefits, protected areas are becoming increasingly important (Dudley *et al*., 2011).

According to statistics updated in September 2023 by Protected Planet, the most reliable protected area data source at the global level, there are 266,985 protected areas in terrestrial areas (including inland waters) worldwide, and these protected areas cover 16.02% of all terrestrial areas. The number of protected areas in marine ecosystems is 18,431, and the ratio of these protected areas to the total marine area is 8.17% (https://www.protectedplanet.net, 2023). However, while the number and size of protected areas increases, biodiversity loss continues unabated in globally (UNEP-WCMC, 2017). Still, the existing global system of protected areas is inadequate in several ways. (i) protected areas are still incomplete, and do not cover all biomes and critical species; (ii) protected areas are not fulfilling their biodiversity conservation objectives; (iii) participation of local people in establishment and management of protected areas is inadequate; and (iv) protected areas in developing countries are poorly funded (Dudley, *et.al.* 2005).

Very important steps have been taken at the global level since 1972 towards today strengthening the existing global protected areas system and reducing biodiversity losses. This process is summarized in figure 1.

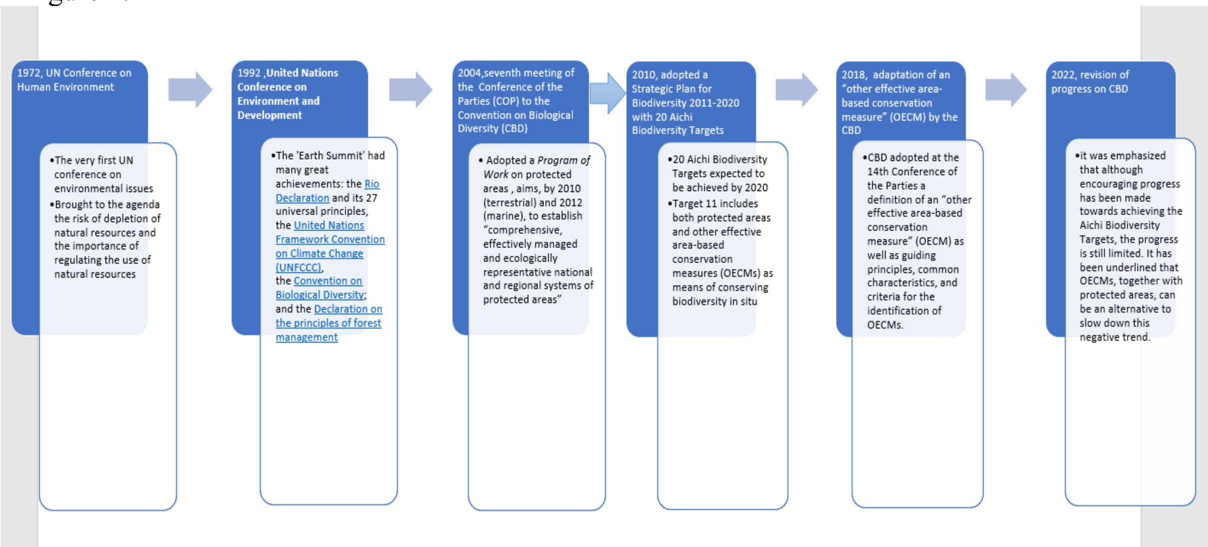

Figure 1. Global initiatives to strengthen protected area systems since 1972

The 1972 UN Conference on the Human Environment which was the very first UN conference on environmental issues, held in Stockholm, brought to the agenda the risk of depletion of natural resources and the importance of regulating the use of natural resources to better protect resources and ecosystems. Although the 1972 Stockholm Declaration laid out the fundamental principles for sustainability resource governance, the pressures on the environment were continued at an increasing rate. Since Stockholm, numerous multilateral agreements have developed a range of operational guidelines, targets, and standards. Some intergovernmental frameworks, such as the Convention on Biological Diversity (CBD) is one of the main initiatives to focus on sustainable management of the natural environment (Bansard and Schröder, 2021). Despite efforts since the 1970s, current trends in natural resource use are unsustainable and continue to have potentially devastating consequences. So much so that it has required new decisions to be taken to produce more permanent solutions and reduce biodiversity losses.

The seventh meeting of the Conference of the Parties (COP) to the Convention on Biological Diversity (CBD) in 2004 taking impetus provided by the Millennium Development Goals, the Plan of Implementation of the World Summit on Sustainable Development and the Durban Accord and Plan of Action from the Vth World's Parks Congress, adopted a *Program of Work* on protected areas one of the most ambitious environmental strategies in history. The Program aims, by 2010 (terrestrial) and 2012 (marine), to establish "comprehensive, effectively managed and ecologically representative national and regional systems of protected areas" (Dudley *et.al*., 2005). By 2010, it was seen that the targets set in 2004 were far behind and that the current protected area system was insufficient to protect natural resources and biodiversity or to create comprehensive, effectively managed, and ecologically representative national and regional protected area systems.

In 2010, Parties to the Convention on Biological Diversity adopted a Strategic Plan for Biodiversity 2011-2020 with 20 Aichi Biodiversity Targets expected to be achieved by 2020. Target 11 includes both protected areas and other effective area-based conservation measures (OECMs) as means of conserving biodiversity in-situ (IUCN WCPA, 2019). Under the Strategic Plan for Biodiversity 2011-2020, Aichi Biodiversity Target 11 states: By 2020, at least 17 per cent of terrestrial and inland water areas and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well-connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscape and seascape (CBD, 2010). Parties to the Convention on Biological Diversity (CBD) recognized early in the CBD's Strategic Plan (2011-2020) that 'other effective area-based conservation measures' (OECMs) offer a significant opportunity to contribute to the effective in-situ conservation of biodiversity (UCN-WCPA Task Force on OECMs, 2019).

In 2018, this situation was remedied when Parties to the CBD adopted at the 14th Conference of the Parties a definition of an "other effective area-based conservation measure" (OECM) as well as guiding principles, common characteristics, and criteria for the identification of OECMs (CBD/ COP/DEC/14/8). Decision 14/8 defines an OECM as: A geographically defined area other than a Protected Area, which is governed and managed in ways that achieve positive and sustained long-term outcomes for the in-situ conservation of biodiversity with associated ecosystem functions and services and where applicable, cultural, spiritual, socio–economic, and other locally relevant values (CBD, 2018).

In 2022, the progress in the implementation of the Convention and the 2011-2020 Biodiversity Strategic Plan and the achievement of the Aichi Biodiversity Targets were reviewed, and it was emphasized that although encouraging progress has been made towards achieving the Aichi Biodiversity Targets, the progress is still limited (CBD, 2022a). However, at the global level, biodiversity losses continue to be depleted at an irreversible rate and sensitive ecosystems continue to be fragmented. Even current conservation efforts and initiatives cannot slow down the rate of change in our natural environment. Climate change is accelerating this change even further. A key problem is the mismatch between the artificial 'economic grammar' which drives public and private policy and 'nature's syntax' which determines how the real world operates. Biodiversity conservation is more than an ethical commitment for humanity: it is a non-negotiable and strategic investment to preserve our health, wealth, and security (WWF, 2020). Unfortunately, many efforts and initiatives that have continued until today have not been able to prevent human destruction of nature. On the other hand, major disaster, or turbulent situations in the region, such as Covid 2019 or natural disasters such as major fires and floods, may reveal new ideas, processes, and transformation opportunities. OECMs, together with protected areas, can be an alternative to slow down this negative trend. OECMs can support contributions to conservation globally by bringing together more stakeholders and encouraging more equitable partnerships in global conservation efforts.

In doing so, OECMs will contribute to the conservation of biodiversity in many ways, such as: conserving important representative ecosystems, habitats, and wildlife corridors; supporting the recovery of threatened species; maintaining ecosystem functions and securing ecosystem services; enhancing resilience against threats; and contributing to improved management and restoration of areas that could usefully support long-term in-situ conservation of biodiversity. OECMs can contribute to ecologically representative and well-connected systems of protected and conserved areas, integrated within wider landscapes and seascapes (IUCN-WCPA Task Force on OECMs, 2019). OECMs are intrinsically important as local social-ecological systems. They form integral parts of national biodiversity strategies, underpin sustainable economies, and contribute to global biodiversity targets and the Sustainable Development Goals (Marnewick, *et.al*., 2020).

The Convention on Biological Diversity's (CBD) '2050 Vision' aims to achieve, by 2050, a world that is 'living in harmony with nature.' Yet biodiversity is threatened globally to an extent never before witnessed in human history. The *Global Assessment of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services* (*IPBES Global Assessment*) found that a sustainable global future for people and nature remains possible. However, this can only be achieved if we fundamentally redesign our economic, social, and governance systems (Lim, 2021).

The total number of protected area records in the October 2023 release of the World Database on Protected Areas (WDPA) is 287,359, comprising 275,357 polygons and 12,002 points and covering 244 countries and territories. The total number of other effective area-based conservation measures (OECMs) in the October 2023 release of the WD-OECM is 870, comprising 734 polygons and 136 points and covering 9 countries and territories (https://www.protectedplanet.net, 2023). The number of OECMs will be increased, however, most countries have not yet provided data to the World Database on OECMs, therefore, the current statistical data is seeing low. It is expected that OECMs will complement protected areas and deliver effective conservation of biodiversity.

Türkiye signed the CBD in 1992 and approved it with Law No. 4177 dated 1996. CBD parties are making efforts to implement the meeting decisions. Consequently, the National Biodiversity Strategy and Action Plan (2007-2017) was prepared by the Government of Türkiye, and then updated the national biological strategy and action plan to cover the years 2018-2028, including the 2011-2022 BD strategic plan and Aichi targets, in line with the CBD COP10/2 meeting decisions (MoAF, 2019). Türkiye, which has carried out many studies on the protection of biological diversity at the national level since 1992, carries out its studies on the protection of biological diversity by updating its national biological diversity strategy and action plan and with both protected areas and specific species conservation programs. In Türkiye, biological

diversity and natural-cultural landscapes are protected with several categories such as national park, nature park, nature reserve, wildlife development area, wetland of national and international importance, special environmental protection area, and conservation forest. The ratio of protected areas to the country's surface area in Turkey is around 10% (Yenilmez Arpa *et.al*., 2022). However, the problems experienced at the global level and the pressures on natural values and biological diversity continue without slowing down. The current protected area system is not sufficient to protect the country's rich biodiversity. No serious steps have been taken yet regarding the implementation of initiatives that will support in-situ conservation in protected areas such as OECMs. There is only one case on OECM but only assessment report was prepared for Karacadağ Steppes in the scope of "Conservation and Sustainable Management of the Türkiye's' Steppe Ecosystems Project " that was implemented between 2017-2022 by the FAO and the Ministry of Agriculture and Forestry. It is the first case for Türkiye and introduced the OECM approach to the policy agenda as well.

Material and Method

Study area

The proposed Karacadağ Steppes OECM lies predominantly in Şanlıurfa Province, as shown in Figure 2, but this volcanic mountain range extends eastwards into Diyarbakır Province and covers a fraction of Mardin Province to the south-east.

The entire mountain range and its predominantly steppe vegetation is proposed as a Natural Site by the Ministry of Environment and Urbanization under the 2863 Protection of Cultural and Natural Assets Law. The proposed Natural Site overlaps with the mountainous part of the proposed Karacadağ Steppes OECM, as shown in Figure 3.

The Karacadag steppes is also one of the Key Biodiversity Areas (KBAs) – the sites of global importance for biodiversity conservation- which have been 313 KBAs in Türkiye (Eken, *et.al*., 2016). Site details of Karacadag KBA is given in Table 1.

Table 1. Site overview of Karacadag KBA (Key Biodiversity Areas Partnership, 2023)

Global KBA criteria: **Year of assessment:** 2017 **National site name:** Karacadağ **Central coordinates:** Lat: 37.68 Long: 39.83 **System:** Terrestrial **Altitude (m):** 850 to 1,981 **Area of KBA (ha):** 135,696 **Protected area coverage (%):** 0	**Rationale for qualifying as KBA:** This site qualifies as a Key Biodiversity Area of international significance because it meets one or more previously established criteria and thresholds for identifying sites of biodiversity importance (including Important Bird and Biodiversity Areas, Alliance for Zero Extinction sites,and Key Biodiversity Areas) KBA identified in the CEPF Ecosystem Profile of the Mediterranean Hotspot (2017). Taxonomy, nomenclature and global threat category follow the 2016 IUCN Red List.

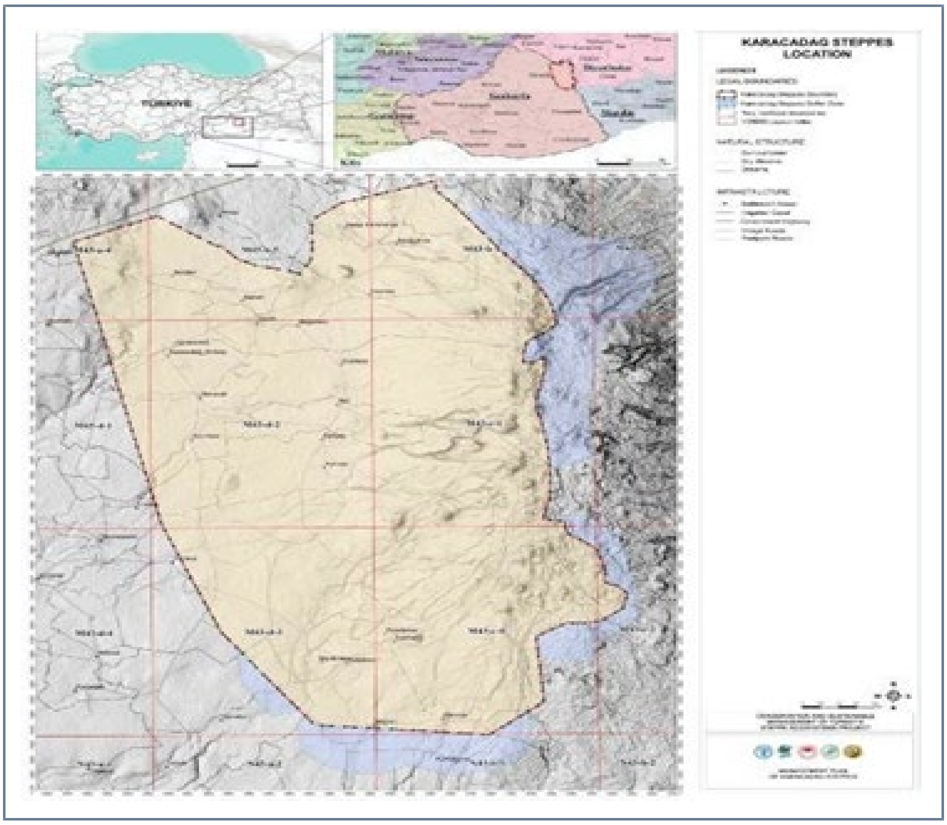

Figure 2. Location of Karacadağ Steppes (60,000 ha), a potential OECM, in South-eastern Anatolia (FAO-MAF.2022a**).**

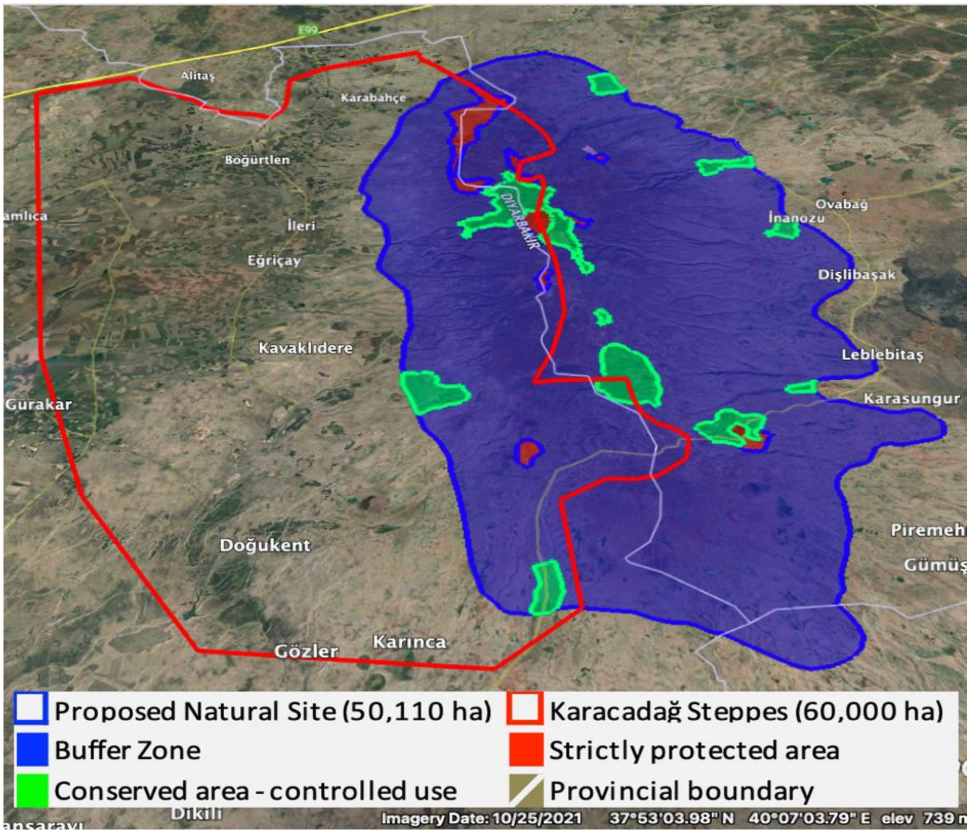

Figure 2. Karacadağ Steppes (60,000 ha), potential OECM site, and the overlapping proposed Natural Site

Şanlıurfa Province (1,941,343 ha) lies almost entirely within the potential steppe zone, 39% of which remains steppe (761,688 ha) and steppe forest (1,714 ha). Karacadag is high critical and vulnerable area regarding to wild crop of cultivated agricultural species (Figure 4) (FAO- MAF.2022b).

Site-level methodology (Marnewick, et all., 2020) which was drafted by IUCN World Commission on Protected Areas for identifying other effective area-based conservation measures (OECMs) of Karacadag has been implemented. The site-level methodology assists potential OECMs to be identified and individual sites to be assessed on a case-by-case basis. For those sites that do not yet meet all criteria, the methodology also helps to identify the characteristics of the site which would need to be strengthened for an area to qualify as an OECM. The methodology for identifying OECMs consists of three steps, which should be followed sequentially.

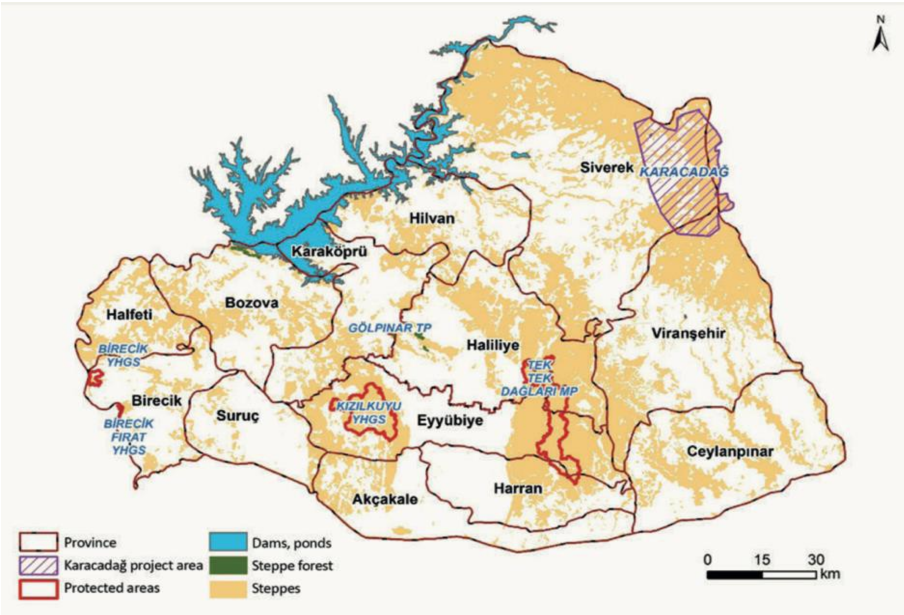

Figure 4. Distribution of protected areas (Tek Tek Mountains NP Park; Kızılkuyu , Birecik and Sanliurfa Birecik Fırat WRs) with respect to Şanlıurfa Province's remaining steppe (761,688 ha) and steppe forest (1,714 ha) (FAO-MAF, 2022b)

- **Step 1: Screening** uses basic information on a site to determine if it is a potential OECM.
- **Step 2: Consent** confirms that the governing authority and other rights-holders have agreed to the assessment going ahead.
- **Step 3: Full assessment** uses further criteria to confirm that the site meets the definition of an OECM.

Step 1 and 2 can be carried out in any order or combined. Step 1 and 2 should be completed before step 3 is implemented (IUCN/WCPA 2022). Step 1 contains the four-step screening tool, directly linked to the definition that enables a determination of whether a site is a 'potential OECM', Step 2 provides for the legitimate governance authority to clearly state whether consent to an assessment has been given and Step 3 contains full assessment uses further criteria to confirm that the site meets the definition of an OECM (Marnewick, *et all*., 2020; and IUCN/WCPA 2022). These steps including the sub-details of each step of the method is given in Figure 5.

Due to not having a protection status yet, "IUCN Category VI: Protected area where natural resources are used sustainably" (Dudley, 2008) has been considered for Karacadağ steppes within the scope of Türkiye's Steppe Ecosystems Conservation and Sustainable Management Project. A management plan for Karacadag steppes was developed in line with the primary management objectives of Category VI.

OECM assessment for Karacadağ steppes was carried out in the last years of the implementation period of the GEF-supported project, *Conservation and Sustainable Management of Türkiye's Steppe Ecosystems.* A comprehensive baseline surveys on biodiversity and socio-economic situation, land management plan, grazing management plan, multi-species action plan, monitoring program and public awareness and training activities were carried out Therefore, there was a lot of data to facilitate the evaluation process, and the stakeholders were sufficiently informed about the importance of the Karacadağ steppes. Due to having both updated and wider information on the potential Karacadag OECM, Screening (step 1) carried out both with a desk exercise and also participatory meetings with experts. A full assessment has been conducted in close cooperation with both planning team and an international expert on biodiversity and protected areas together with project coordinator.

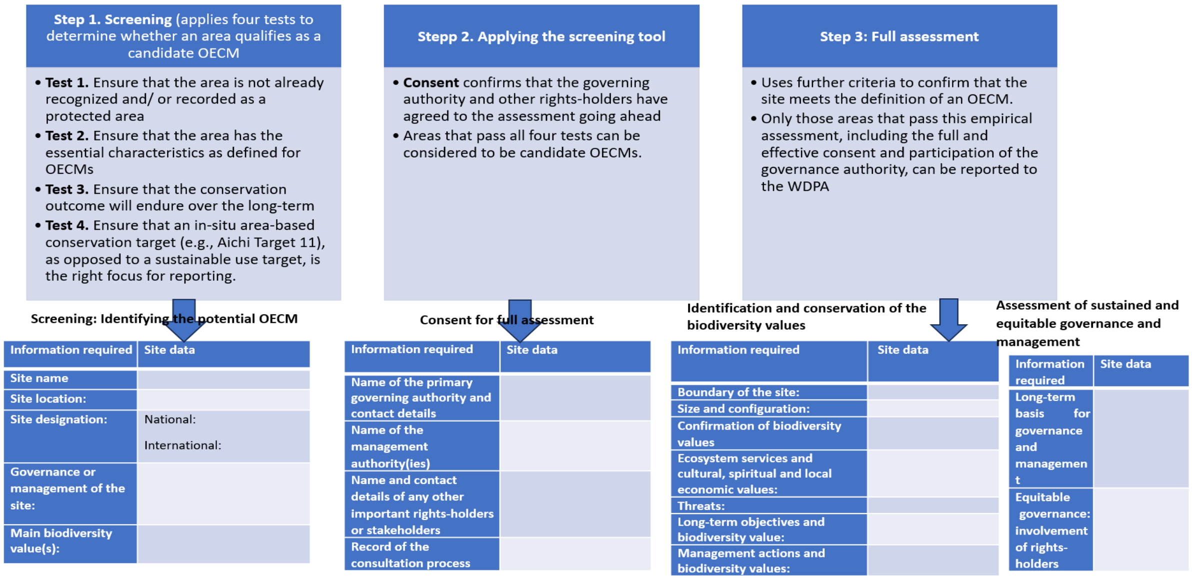

Figure 5. A 3-step methodology and sub-details

Research Findings

Şanlıurfa province is one of the most important areas in Türkiye in terms of steppe ecosystems, and the natural vegetation in this province consists mostly of steppes (FAO and MAF. 2022b). "The Conservation and Sustainable Management of Turkey's Steppe Ecosystems Project" which was implemented between 2017-2022 with the aims of mainstreaming the conservation of Türkiye's steppe biodiversity in production landscapes and strengthening the conservation of steppe ecosystems in three pilot areas in Şanlıurfa is instrumental in highlighting the importance attached to the steppes. The project carried out collaboratively by the Food and Agriculture Organization of the United Nations (FAO) and the Ministry of Agriculture and Forestry General Directorate of Nature Conservation and National Parks (GDNCNP), General Directorate of Plant Production (GDPP), and General Directorate of Forestry (GDF) with the financial support of the Global Environment Facility (GEF) (Yenilmez Arpa, 2022).

Steppe areas represent ecosystems that are very rich in biodiversity and serve as a very important insurance for the conservation of the environment and food security of humanity. At present, the wild relatives of many cultivated species still exist in the steppes. In other words, steppes are important gene centers that contribute to the achievement of food security for the future. Şanlıurfa steppes, as part of the "Fertile Crescent" region, give a summary of the agricultural history of humanity and host a very important cultural and scientific heritage that enables us to re-evaluate the preparatory stages of transition to agriculture (FAO and MAF. 2022b).

Conservation and Sustainable Management of Turkey's Steppe Ecosystems Project aiming at conserving and strengthening Turkey's steppes is one of leading works on steppes. In addition to surveying, planning, monitoring and awareness-raising efforts of the project, which is implemented in three pilot areas in Şanlıurfa, the project also aims at to support conservation of the steppe biodiversity either in protected areas or outside. Karacadag Steppes, unlike the other project demonstration sites, currently has no conservation designation. However, the Karacadag steppes are the gene center of wheat and many legume species, and the last refuge for many other species. Wild relatives of specially cultivated species are still found in the Karacadağ steppes. On the other hand, grazing and livestock farming are the most intense activities in the Karacag steppes. One the one hand, a balance needs to be struck between protecting genetic resources, on the other hand, and supporting sustainable livelihood opportunities.

In line with significance, land ownership and the current land use structure of the Karacadag steppes, it was proposed an alternate in-situ conservation approach except the protected areas. Main outline of three steps which include of the methodology for OECM assessment for Karacadag is summarized based on the original assessment report and briefly given in below tables consequently (Table 2, Table 3 and Table 4 and Table 5) [1].

Table 2. Step1. Screening: Identifying the potential OECM (OECM – Karacadag,, 2022)

<table>
<tr><th>Information required</th><th>Site data</th></tr>
<tr><td>Site name</td><td>Karacadag Steppes</td></tr>
<tr><td>Site location:</td><td>South-Eastern Anatolia Region, Şanlıurfa Province, Karacadağ Mountain (extinct volcano)</td></tr>
<tr><td>Site designation:</td><td>National: Proposed Natural Site (50,110 ha).
International: Karacadağ identified as a Key Biodiversity Area (135,696 ha)</td></tr>
<tr><td>Governance or management of the site:</td><td>Governance is subject to a protocol comprising a partnership between the Şanlıurfa Governorship, Ministry of Agriculture and Forestry 3rd Regional Directorate of Nature Conservation and National Parks, Şanlıurfa Regional Directorate of Forestry and Sanliurfa Provincial Directorate of Agriculture and Forestry, who are responsible for implementing and monitoring the Şanliurfa Steppe Conservation Strategy and Action Plan (FAO-MAF 2022b).
The aforementioned partners collaborate closely with stakeholders to implement the Karacadağ Steppes Management Plan</td></tr>
<tr><td>Main biodiversity value(s):</td><td>Karacadağ Steppes is located in the Mesopotamium part of Southeastern Anatolia. Karacadağ Steppes is likely to be representative of the following ecosystem types, requiring further assessment of ecosystem threat status once the typology has been applied to Türkiye:
<table>
<tr><th>ID</th><th>Karacadag Steppes: Potential Ecosystem Types</th></tr>
<tr><td>T3.2</td><td>Seasonally dry temperate heath and shrublands</td></tr>
<tr><td>T4.4</td><td>Temperate woodlands</td></tr>
<tr><td>T7.1</td><td>Annual croplands</td></tr>
<tr><td>T7.2</td><td>Sown pastures and fields</td></tr>
<tr><td>T7.4</td><td>Urban and industrial ecosystems</td></tr>
</table>
Biodiversity in Karacadağ Steppes is rich in flora and fauna species, with many recorded for the first-time during surveys undertaken in 2019. Agricultural biodiversity also features prominently in Karacadağ Steppes. Notable is the presence of two wild relatives of modern wheats: wild Emmer (Triticum dicoccoides), progenitor of Durum wheat (Triticum turgidum ssp. durum) and Bread wheat (T. aestivum); and wild Einkorn (Triticum boeoticum), progenitor of domesticated Einkorn (T. monococcum) (FAO-MAF, 2019).
Karacadağ is also renowned for its cultivars of rice (Oryza sativa L.) that have developed disease, pest and other resilience over centuries of cultivation. Karacadağ Rice has been patented under Türkiye's Comminique on Official Geographical Indication and Traditional Product Name" (2018/34); and its traditional production and related practices are proposed for recognition as a Globally Important Agricultural Heritage System (GIAHS). In 2021, a total of 3,352 deciares (3.352 ha) of Karacadağ rice was produced by 11 villages in the Şanlıurfa part of the proposed OECM; and a further 7,838 da were produced by 20 villages in the neighbouring province of Diyarbakir (FAO-MAF, 2022c). (FAO-MAF 2022c)
Other wild relatives of grains and legumes include Aegilops speltoides var. ligustica (white wheatgrass), Pisum sativum sativum var. arvense (fodder pea), Lens culinaris orientalis (wild lentil) and the endemic Cicer echinospermum (wild chickpea): all distributed in stony steppes, field edges and forest clearings. In order to support conservation of wild-crop relatives of cultivated species, multi-taxa action plan has been developed in the GEF supported project (FAO-MAF, 2022d).</td></tr>
</table>

[1] *The tables have been adapted from OECM assessment for Karacadag steppes, 2022 that was prepared in August 2022.*

Table 3. Step 2. Consent for full assessment (OECM – Karacadag, 2022)

Information required	Site data
Name of the primary governing authority and contact details	Republic of Türkiye Ministry of Agriculture and Forestry, 3rd Regional Directorate of Nature Conservation and National Parks
Name of the management authority(ies)	Şanliurfa Governorship
Name and contact details of any other important rights-holders or stakeholders	Republic of Türkiye Ministry of Agriculture and Forestry, Şanlıurfa Provincial Directorate of Agriculture and Forestry
Record of the consultation process	Meetings which were held to prepare Sanliurfa Steppe Conservation Strategy and Action Plan Meetings and trainings on alternate grazing demonstrations program. Meetings and deeply interviews to draft Karacadag management plan.

Documentation of consent must include any conditions agreed with the parties, such as specific requirements for participation, or review before finalization. Therefore, the Karacadağ Steppes Management Plan is due to be formally endorsed by community representatives (i.e. mukhtars).-village heads) in the knowledge of the site's nomination for OECM status. A copy of the Management Plan, signed off by partners and village mukhtars, will be included with this Site- level tool for identifying OECMs. After completing the requirements in the first two steps, the Karacadağ steppes were subjected to a full assessment in the 3rd step according to the OECM criteria.

The first two steps determined that the Karacadag steppes are likely to have significant biodiversity values. Cooperation and communication were ensured with the relevant authorities, stakeholders and parties regarding the Karacadag steppes becoming OECM. Step 3 focused on verifying all significant biodiversity values based on available information. In addition, the governance and sustainability of the existing biodiversity values of the area and the threats to the area were comprehensively evaluated. The comprehensive evaluation results are summarized in **Table 4** and **Table 5**.

Full assessment includes identification and conservation of the biodiversity values and assessment of sustained and equitable governance and management. After completing the assessment, the result of the assessment, with documentation, has been communicated to the General Directorate of Nature Conservation and National Parks. Documentation of the assessment process and results, including supporting data, have been securely stored for future reference and submitted to the Ministry of Agriculture and Forestry to report through the World Database on OECMs (WD-OECM) by the governing authority.

Table 4. Step 3: The full assessment: recognizing an OECM of Karacadag - identification and conservation of the biodiversity values ((OECM – Karacadag,, 2022**)**

Information required	Site data
Boundary of the site	The boundary of the candidate OECM has been defined based on characterizing the landscape, using such variables as vegetation altitudinal zones, morphology, land cover, land use and visual features. Natural and cultural heritage attributes of the landscape have been assessed, for example its geology, topography, hydrology, climate, biogeography, biodiversity, agrobiodiversity, socio-economy and cultural features including spiritual wildness. Landscape characterization was followed by analyses of its regulating, provisioning, and supporting services; and by a sensitivity analysis that informed its zonation. The Management Plan provides full details. The boundary of the candidate OECM has been mapped using a GIS, considering (includes) sections of three provincial boundaries that determine its eastern border. The boundary has not been demarcated on the ground
Size and configuration:	Candidate Karacadağ Steppes OECM is 60,000 ha. The site's configuration is informed by a GIS analysis of ecosystem services. It is further informed by a landscape sensitivity GIS analysis of current land use/cover. The geographic scope of the vision is holistic, with 9 important biological and agricultural hotspots of diversity identified as core areas totaling 9,807 ha, surrounded by a much larger buffer area of 50,193 ha that comprises a mosaic of traditionally grazed pastures and cultivated areas.

Confirmation of biodiversity values	A wealth of scientific information, including fresh biodiversity and socio-economic survey data and cultural knowledge, has been gathered, collated and analyzed to inform the Karacadağ Steppes Management Plan, as part of the GEF-funded *Conservation and Sustainable Management of Turkey's Steppe Ecosystems Project* (GCP/TUR/061/GFF
Ecosystem services and cultural, spiritual and local economic values:	ecosystem services and cultural, spiritual and local economic values have been assessed, informing the site's configuration and its zonation for conservation management purposes
Threats:	None of the activities outlined in the Karacadağ Steppes Action Plan are intended to threaten the site's biodiversity; rather, a majority of them are designed to directly reduce pressures on and threats to ecosystems, species and crop wild relatives.
Long-term objectives and biodiversity value:	The vision and long-term objective, outlined in the Management Plan for Karacadağ Steppes. The **vision** for Karacadağ Steppes is: *A highly recognizable Karacadağ where biodiversity is protected, especially the genetic resources and geological formations in steppe ecosystems, together with the traditional life and production culture. Sustainable grazing and holistic rural development are ensured and managed by the stakeholders.*
Management actions and biodiversity values:	Management activities focus on: restoring and maintaining the ecological (and cultural) integrity of the entire candidate OECM; protecting biological and genetic diversity within the core zones; sustainably managing pastures in support of native wild plant species and crop wild relatives as well as local livelihoods; sustainably managing agriculture areas in support of local livelihoods; investing in local settlement plans to support livelihoods through improved conservation awareness and best practices in agriculture and animal husbandry; promoting equity and equal opportunities within communities; and monitoring implementation of the Management Plan in order to apply adaptive measures as appropriate

Table 5. Step 3: The full assessment: recognizing an OECM of Karacadag - assessment of sustained and equitable governance and management ((OECM – Karacadag,, 2022)

Information required	Site data
Long-term basis for governance and management	The long-term governance and management of the candidate Karacadağ Steppes OECM is documented in its Management Plan, which will be implemented from 2023 onwards as part of the *Şanlıurfa Steppe Conservation Strategy and Action Plan*.
Equitable governance: involvement of rights-holders	The participation and engagement of local communities in the equitable governance of the candidate OECM is an evolving process. While there has been some consultation with local communities during the management planning process the approach has been top down, exacerbated by limitations and restrictions introduced.

Conclusions and Discussion

Türkiye is party to the CBD and its 2011-2020 Strategic Plan, committing to a vision of living in harmony with nature by 2050 through halting the loss of biodiversity; and ensuring that by 2020 ecosystems are resilient and continue to provide essential services to secure the planet's variety of life and human well-being. Among the 20 ambitious targets set to achieve this vision is Aichi Target 11: to conserve at least 17% of land and inland water and at least 10% of coastal and marine waters through ecologically representative, effectively, and equitably managed, and well-connected systems of PAs and 'other effective area-based conservation measures.' Aichi Target 11 is one of three targets under Strategic Goal C: improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity, while the other two targets relative to the conservation of threatened species (Target 12) and genetic diversity of cultivated plants and farmed or domesticated animals and their wild relatives (Target 13). All these three targets are applicable to Karacadag Steppes (FAO-MAF 2022a).

The Government of Türkiye (GoT) is keen to explore the 'other effective area-based conservation measures' (OECM) model for Karacadağ Steppes, under the provisions of Decision 14/8 adopted by the Conference of the Parties (COP) 14 to the Convention on Biological Diversity (CBD) in November 2018 (CBD, 2018).

The total number of other effective area-based conservation measures (OECMs) in the October 2023 release of the WD-OECM is 870, comprising 734 polygons and 136 points and covering 9 countries and territories (https://www.protectedplanet.net, 2023). For Türkiye, only one case was carried out and an OECM assessment report was prepared for Karacadağ Steppes in the scope of "Conservation and Sustainable Management of the Türkiye's' Steppe Ecosystems Project " that was implemented between 2017-2022 by the FAO and the Ministry of Agriculture and Forestry. It is the first case for Türkiye and introduced the OECM approach to the policy agenda as well.

The 2050 Global Deal and 2030 mission for Nature of CBD is a world of living in harmony with nature where "by 2050, biodiversity is valued, conserved, restored and wisely used, maintaining ecosystem services, sustaining a healthy planet and delivering benefits essential for all people.". The mission of the Framework for the period up to 2030, towards the 2050 vision is: To take urgent action to halt and reverse biodiversity loss to put nature on a path to recovery for the benefit of people and planet by conserving and sustainably using biodiversity and by ensuring the fair and equitable sharing of benefits from the use of genetic resources, while providing the necessary means of implementation (https://www.cbd.int/gbf/vision/).

In 2022, the fifteenth meeting of the Conference of the Parties (COP 15) was held in Kunming-Montreal and the Global Biodiversity Framework (GBF) was adopted. Since 1992, hundreds of meetings held and uncountable decisions were agreed. No matter how many decisions are taken to protect biodiversity and natural resources at the global level, it does not seem possible to provide effective protection without reducing or eliminating the human-induced impacts that will reduce these losses. Even the strengthening of protected area systems or alternative in-situ protection tools such as OECM are not strong enough to stop this extinction.

Without doubt, The Global Biodiversity Framework (GBF), which was adopted during the fifteenth meeting of the Conference of the Parties (COP 15) will be the pathway. However, the evidence is unequivocal – nature is being changed and destroyed by us at a rate unprecedented in history. The 2020 global Living Planet Index shows an average 68% fall in populations of mammals, birds, amphibians, reptiles, and fish between 1970 and 2016 (WWF-2020).

The implementation of the Kunming-Montreal Global Biodiversity Framework will be guided and supported through a comprehensive package of decisions also adopted at COP 15

This package includes a monitoring framework for the GBF, an enhanced mechanism for planning, monitoring, reporting, and reviewing implementation, the necessary financial resources for implementation, strategic frameworks for capacity development and technical and scientific cooperation, as well as an agreement on digital sequence information on genetic resources (CBD, 2022b).

As indicated by the Kunming-Montreal Global Biodiversity Framework, all Parties should set national targets to implement it, while all other actors should be compatible to support conservation of nature.

On the other hand, there should be support mechanism to implement of GBF because the full implementation of the framework will require the provision of adequate, predictable and easily accessible financial resources from all sources on a need's basis. In addition, it further requires cooperation and collaboration in building the necessary capacity and transfer of technologies to allow Parties, especially developing country Parties, to fully implement the Framework (CBD, 2022b).

Biodiversity is declining at different rates in different places, still natural resources and biodiversity elements are overconsumed, water and soil are polluted, land and sea use changing including habitat loss and degradation, species are overexploitation, Invasive species and disease are increasing and also effects of climate change.

in 2022, the United Nations General Assembly recognized that everyone, everywhere, has the right to live in a clean, healthy and sustainable environment, meaning that for those in power respecting this is no longer an option but an obligation (WWF, 2022)

All this unconstructiveness experienced at the global level are experienced, perhaps even more intensely, in Türkiye. Although the number of protected areas is relatively increasing today, it cannot be said that management effectiveness has increased. This situation was clearly demonstrated in the study assessing the management effectiveness of Turkey's protected areas, conducted in 2022.

The current protected area system and the inadequacy of the number of protected areas and the shortcomings in management are not sufficient to protect species and values that are rich in biodiversity but also under threat. For this reason, assessments to determine priority areas and species for conservation need to be completed urgently and protected with the necessary conservation

approaches.
According to the 2022 RAPPAM assessment, to increase the management effectiveness of Türkiye's Protected areas need;
- strengthening site management units locally-on-site
- making regulations on the use of protected area revenues
- management planning, participation in planning processes should be brought to the fore and especially implementation plans should be made urgently in a way that focuses on the protection of resources, not on usage.
- elimination of status confusion
- establishment of monitoring and evaluation system
- Paying special attention to improving the economic and social situation of the local people

(Yenilmez Arpa, *et.al,* 2022)
For the development of the **Protected Areas System**;
- Creation of protected areas network
- Strengthening protection legislation
- Elimination in conflict of protection categories
- Elimination of authority confusion
- Establishing an effective monitoring and evaluation system
- Inclusion of unrepresented ecosystems in the existing protected areas system
- Achieving international standards by participating in an international protected area network system
- Ensuring a continuous and innovative perspective in personnel training
- Taking care that managers have an understanding of protection issues and corporate culture (Yenilmez Arpa, *et.al,* 2022).

Major measures need to be taken by everyone, both at the national and international levels. There is a need not only for protection but also for change that will reverse all these negativities.
In- situ conservation efforts such as protected areas and OECMs are main tools to contribute biodiversity conservation and natural resource management together with support food security and sustainable development. However, these efforts need to be increased further.
Although the Karacadag OECM assessment is a first effort in Türkiye, the idea and approach regarding with OECM has taken its place in Türkiye's political agenda and institutional works.
In-situ conservation of biodiversity is "fundamental" to stemming biodiversity loss (CBD, 1992). Protected areas and OECMs are the primary means of achieving in-situ conservation under CBD decisions. Therefore, in order to achive global decisions which have been agreed in the scope of CBD convention site-level tool for identifying other effective area-based conservation measures (OECMs) is very important. This approach can be an important tool for Türkiye as well. One hand, the potential OECM sites can be listed according to the previous baseline study works which have been conducted by the General Directorate of Nature Conservation and National Parks for 81 Provinces, on the other hand, serial trainings and informative meetings/workshops can be arrange on applying of the methodology.

The Karacadag is a one but very important first step to understand of applying the methodology. Decision-makers are key persons to apply the OECM. For this, the technical team who are responsible to follow the CBD behalf of Türkiye, they should take an immediate action to inform for decision-makers. In addition, especially wider participatory meetings by leadership of DKMPGM, should be arranged with participation of academicians, NGOs and also local level government authorities such as Governorship, Municipalities.

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