

**T.C.
ISTANBUL GEDİK UNIVERSITY
INSTITUTE OF GRADUATE STUDIES**



**HUMAN-INDUCED SEDIMENT TRANSPORT CAUSED COASTAL
EROSION: ALANYA SCALE**

MASTER THESIS

Mulham ABDUL RAZAK

**Civil Engineering Department
Master in Civil Engineering English Program**

MAY 2023

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T.C.
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DECLARATION

I Mulham ABDUL RAZAK as a result of this declare that this thesis titled “Human-Induced Sediment Transport Caused Coastal Erosion: Alanya Scale” is original work I did for the award of the master's degree in the faculty of Civil Engineering Program I also declare that this thesis or any part of it has not been submitted and presented for any other degree or research paper in any other university or institution.
(31/05/2023)

Mulham ABDUL RAZAK



PREFACE

There are many people I would like to show my appreciation to for their help and guidance throughout my research. First and foremost, I would like to thank my advisor Dr. Redan Ghasmlounia and Dr. Murat Aksel. Thank you for being patient with me and for your knowledge and guidance through it all. I would also like to thank my parents for their love and support, especially within my path of graduate studies. I would also like to thank my entire family, for everything they did to get me where I needed to be.

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ABBREVIATIONS

E	: South
g	: Gram
kg	: Kilogram
m²	: Square meters
m³	: Cubic Meters
MF	: Mass of Fines (g)
MI	: Mass of Bowl (g)
Mm	: Millimeter
MS	: Mass of Sand (g)
N	: North

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HUMAN-INDUCED SEDIMENT TRANSPORT CAUSED COASTAL EROSION: ALANYA SCALE

ABSTRACT

Sandy coasts are constantly exposed to rapid coastal change. Projected climate change caused by Changes in sea level rise, wave circumstances, and storm occurrences will increase erosion rates, exposing these areas to increasingly hazardous conditions. For coastal management purposes, it is important to monitor and measure these changes. Erosion of sandy and pebbly beaches and their ecosystems. The loss of sand and gravel is not only due to the rise in sea level and the force of waves resulting from storms, which will intensify due to climate change. There is a new important factor of human intervention and impact on the beaches that must be mentioned and verified as to how the effect is in the long term with the increase in tourism in the coastal areas, especially in areas of a tourist nature. The amount of sediment that each individual transports from the coastal beaches in the Alanya region.

In the experiment, we Collecting samples of sand and gravel from different locations of the coast to be surveyed. Classifying the collected samples by means of sieve analysis. Executing the project by going to the sites of sand samples that were analyzed in different time periods by collecting samples (collecting sand attached to the bodies of people of different sizes in basins Testing). The thesis also answers Identify the eroded beach by relating the average number of locals and foreigners who come to the project area for a year and use the coast with the data collected during the project.

Keywords: *Coastal erosion, Shoreline, Erosion, Sea-level rise, Climate change*

İNSAN KAYNAKLI SEDİMENT TAŞINIMI SONUCU MEYDANA GELEN KIYI EROZYONU: ALANYA ÖLÇEĞİ

ÖZET

Kumlu kıyılar sürekli olarak hızlı kıyı değişimine maruz kalmaktadır. Deniz seviyesinin yükselmesi, dalga koşulları ve fırtına oluşumlarındaki değişikliklerin neden olduğu öngörülen iklim değişikliği, erozyon oranlarını artıracak ve bu alanları giderek daha tehlikeli koşullara maruz bırakacaktır. Kıyı yönetimi amaçları için, bu değişimlerin izlenmesi ve ölçülmesi önemlidir. Kumlu ve çakıllı plajların ve ekosistemlerinin erozyonu. Kum ve çakıl kaybı sadece deniz seviyesinin yükselmesi ve iklim değişikliği nedeniyle yoğunlaşacak olan fırtınalardan kaynaklanan dalgaların gücünden kaynaklanmamaktadır. Kıyı bölgelerinde, özellikle turistik nitelikteki alanlarda turizmin artmasıyla birlikte, uzun vadede etkisinin nasıl olduğuna dair bahsedilmesi ve doğrulanması gereken, insan müdahalesi ve plajlara etkisi konusunda yeni ve önemli bir faktör var. Alanya bölgesindeki kıyı plajlarından her bireyin taşıdığı tortu miktarı.

Deneyde, etüt için kıyının farklı noktalarından kum ve çakıl örnekleri topluyoruz. Toplanan numunelerin elek analizi ile sınıflandırılması. Farklı zaman dilimlerinde analizleri yapılmış kum numunelerinin sahalara gidilerek numune toplanarak projenin yürütülmesi (Havzalarda farklı büyüklükteki insanların vücutlarına yapıştırılmış kumların toplanması Testi). Tez ayrıca, proje alanına bir yıl boyunca gelen ve kıyıyı kullanan yerli ve yabancıların ortalama sayısını proje sırasında toplanan verilerle ilişkilendirerek erozyona uğramış sahili belirleme sorusuna cevap vermektedir.

Anahtar kelimeler: *Kıyı erozyonu, Kıyı şeridi, Erozyon, Deniz seviyesinin yükselmesi, İklim değişikliği*

1. INTRODUCTION

Erosion is among the maximum urgent troubles in coastal regions as it impacts the elegance of the location in phrases of leisure and financial activities (inclusive of solar and seashore recreation, water sports, fisheries, tourism, etc.), in addition to its cap potential to conform to the weather—alternate associated climate events. The growing vulnerability of coastal regions is evident in public spaces Policy plans and techniques. And the maximum current file from The Climate Change Intergovernmental Panel has issued a report on climate change. This problem is extra prominent. Along the coasts of developed and developing countries, climate change will interact differently with people's activities and other factors that cause change, for example. Modifications in the environment and climate and the increases in sea levels can further affect accommodation need. Along the coasts of developed countries. Recreation centers, and the building of infrastructure for renewable energy sources on the coast (Hadley 2009).

This has done a lot of damage to archaeological records, and it will probably keep doing so: If sea levels rise another meter in the next 100 years, many archaeological sites along all of the world's coasts will be destroyed, flooded, or drowned(Fitzpatrick, Kappers, and Kaye 2006). In some locations, Erosion and rising sea levels pose immediate threats to archaeological sites.

Human influence and construction vulnerability are dependent based on the distance from the coast and the type of infrastructure. Different criteria were used to generate vulnerability maps for a variety of coastal zones across the globe through the assistance of utilizing coastal zones Multivariate analysis with computer assistance, numerical models and Geospatial Information Systems (GIS), including pioneering research conducted by Once coastal sensitivity vulnerability determined, accommodation entails adaptation. The changing of infrastructure and housing and a number of land usage may result in the replacement of an agricultural region with a saline marsh and the relocation of human activity along the shore. Stability is the "hold the line" option for defending and maintaining The current shoreline position

will be modified by using strong armour kit structures or Protecting beaches by nourishment. The identification of an effective management approach revolves around understanding the magnitudes and causes of processes of Erosion and legislation regarding financing. Cost-benefit evaluation or response time criterion determines economic factors. Coastal Erosion affects the majority of coastal nations, essentially resulting in a permanent loss.

1.2 Problem Statement

Coastal areas are thought to have the most people living in them, so they are significant and have a lot of economic value(Small and Nicholls, 2003a). Average sea level change, high tides, and other wave events are a result of climate change significantly impact these places, making them vulnerable to fast coastal adjustments (Vos et al. 2019). Because of the high numbers of individuals and numerous development activities in coastal regions, such as increasing tourist and transportation options, coastal Erosion is now seen as a significant problem(Thomas et, al2018). So, it is likely that these areas will face more and more dangerous situations. Because of this, coastal management and development need to keep an eye on and measure these fast changes in vulnerable parts of the coast.

Human actions and natural phenomena contribute to coastal Erosion; waves and currents linked to sediment transport and beach shape are affected by human activity, which in turn impacts coastal dynamics(Pranzini et al. 2018).

Human activities have caused coastal Erosion to worsen in many places over the past few decades. The main reason Coastal loss of sediment is when the system for moving sediment, which is usually in balance in its natural state, is upset. Structures made by humans that affect the way sediment moves will have a harmful effect and cause coastal Erosion.

1.3 Study Objectives Study Questions

This research was conducted as part of a Master of Science thesis to quantify and assess the silt carried by human activity. To factor prospective coastal hazards and their associated impacts into creating a coastal zone management plan for the Alanya coast, it is necessary to define both. The Coastal Zone Management Plan must be

implemented to mitigate the current and future risks posed by coastal hazards. Accordingly, this Coastal Processes and Hazards Definition Study provides the technical data on hazard likelihood from which management actions can be developed, lacking for some decades, within a risk-based framework. The results of this study can aid researchers, policy makers, and others working in the environmental field in pinpointing all the places where soil erosion control measures are n

- To conduct a coastal geomorphology field survey in the subject area.
- To collect available data related to the coastal region of the study area from various areas at the Alanya coastal line.
- To gather the lessons learned from the study site's experience for use by other communities, which the same problem may threaten in the future needed.

1.4 Significance of the Study

When testing dune erosion on natural beaches, it's hard to focus on just one process because it's difficult to rule out things like longshore sediment transport. So, a set up on the beach that keeps them safe could be a solution. This might stop longshore sediment transport from having an effect, but it dramatically cuts the cost of this new research.

This study will give us the information we need to make a new sediment budget. It will also give us a clear picture of where sediment is coming from and where it is going in this system, which can be used in future models of sediment texture and movement in the Basin. This information is essential because it gives a baseline picture of how things are

1.5 Area of Study

Alanya coastal was chosen for the study because it is a popular summer resort on the south coast of Turkey, where many tourists live. Because of where it is and how the weather is, Alanya has summer from May until the end of October, which is almost half the year. The area is essential for Turkish tourism because it has 662 hotels with 190,000 beds and about 3 million visitors annually, about 8% of the total number of visitors to Turkey.

Erosion is getting worse along the coast of Alanya, which hurts tourism, coastal infrastructure, ecosystems, and protected areas. Coastal Erosion is caused by factors including the relative rise in sea level, damage to the coastline, loss of seagrass, extreme weather, the placement of coastal structures, illegal sand mining, coastal squeeze, and other human-made things. Seawalls and even sandbags are put up along the coast to protect the beaches from Erosion. These kinds of actions often cause more significant problems further down the line.



Figure 1.1: Location of Alanya

Source: (Wikimedia, 2017)

2. LITERATURE REVIEW

Coastal

It is the landform formed by the Erosion, and accumulation of water. Coasts; It also covers the beach, gravel reservoirs, swamps, and reeds formed by the water, which has a horizontal and vertical scope that encompasses all kinds of water such as ocean, sea, lake, and stream. Modifications in the landform procedures that form coastline, and dune areas along the coastline is caused by how the sea surface reacts to the amount of sand in the water and how much room there is for the processes that cause these changes to happen (del Valle et al. 2020).

Coastal Erosion

In general, beach erosion activities are caused by aspects that can be contrasted, including comparative a rise in the level of the water, extreme storm occurrences, and alterations to the sediment supply that humans drive. The vast majority of people in the world are most populated regions are coastal, where a unique set of environmental, financial and historic aspects continues to draw residents and spur a variety of migratory patterns (Brown, Keath, and Wong 2009; Seto et al. 2011; Barragán and de Andrés 2015).

It's a naturally occurring phenomenon that's been going on ever since the first land rose from the ocean, and it will continue to do so; many diverse processes contribute to coastal Erosion, but in the broadest sense, it is caused by a multitude of natural and human-made variables that can work singly or in concert(Rangel-Buitrago, Neal, and de Jonge 2020).

2.1 Natural Causes of Coastal Erosion

Trends and fluctuations in the Earth's climate that affect beaches fluctuate from days to short times after a large storm to the subtle but progressive shifts over decades to centuries; global warming, the increase in air and water temperatures, might

accelerate The increase in sea levels and enhance wind severity and wave height, weather -related processes will improve future(Wallendorf et al., 2011).

Fluctuations in sea level and sediment supply due to earthquakes and tsunamis are a fundamental reason for alarm because these phenomena occur on varying spatiotemporal scales, and analyzing them can be difficult; real estate, personal belongings, and public facilities have all been harmedIn some areas, the frequency of extreme weather will increase, altering repercussions such as coastal Erosion, Observation of rising global temperatures, significant loss of ice and snow, and increasing average global sea level indicate a warming climate., and more evidence linking multiple physical impacts to climate change, While the inundation danger is related to sea-level rise, it was acknowledged that Erosion is a significant coastal impact that necessitates predictions Various coastal forces, such as storms and waves (Hemer et al. 2010).

Sea level rise, wave height and frequency, storm tides, flood levels, and river flow are all as a result of climate change (Wang, Feng, and Swail, 2014). As a consequence human involvement and climate impact, storm frequency and intensity are expected to increase, sea levels are expected to increase, and The wave height is expected to change(Stocker et al., 2013).

Non-climate stresses, such as urbanization and housing, commercial and recreational uses of coastal resources—most notably agriculture, fisheries, and transportation already burden coastal ecosystems. It may be caused by the outright removal or alteration of habitat or by less obvious factors like pollution or the spread of invasive species. Coastal habitats can be negatively impacted by pollution, sedimentation, and nutrient exports from diffuse or point sources. The impact of global warming on these stresses multiplied, resulting in a situation that may be difficult to anticipate, monitor, and control (Zanuttigh and Nicholls, n.d.).

2.1.1 Temporary erosion and continuous erosion

The difference in both the short- and long-term forces that shape the coast as a result of climate change add uncertainty to the existing state of affairs and may have far-reaching consequences for the future of the shoreline; while it is usual practice to predict a rise in the average water surface without alteration to Storm, this assumption is prone to (Ranasinghe, Callaghan, and Steve 2012; Wainwright et al.,

2015; le Cozannet et al. 2019; Jongejan et al. 2016). both-side Erosion can have immediate and long-term consequences, The short-term effects influence the long-term ones, and the area of impact keeps growing; as a result, it is more difficult to determine how far ashore constructions may affect their surroundings and how exactly developers would be held accountable for any harm that may result (Baptista et al.2014).

Different time ranges are involved in the coastal processes and factors that shape coastlines (Cowell et al., 2003; Steve et al., 2002). seasonal and yearly trends in shoreline evolution are governed by the cumulative effects of months and years of Erosion and accretion(Maspataud, Ruz, and Héquette 2009; Miller and Dean 2004). River hazards such as high tides, tidal waves, and cyclone surges flows are all examples of short-term drivers that have significant impacts on both the short- storm and medium-term climate (Vancoppenolle et al. 2010; Splinter et al. 2014; Barnard et al. 2015).

Long-term shoreline alterations are caused mainly by longer-onset factors and processes such factors such as rising sea levels, wind currents, Erosion of natural soil, persistent depletion of river sediment supplies, and longshore transport gradients. (Sallenger, Doran, and Howd 2012; Ashton, Murray, and Arnoult 2001). at least 10–20 years of cross-shore profile data in the study area are Necessary to reliably tell the difference among long-term, progressive Erosion and short-term, fluctuating Erosion (which happens naturally along the coast). The amount of sediment in the active site as a whole can be calculated using the profile data and then plotted against time to highlight erosional or depositional tendencies(van Rijn 2011).

Temporary Erosion is the rapid and sudden wearing away of coastal land due to natural disasters such as storms and flooding. This process often reshapes coastal landforms such as cliffs and dunes, leading to coastal instability and beach erosion. Continuous Erosion occurs over a much more extended period due to the gradual and continuous action of waves and tides on the shoreline. This Erosion causes more subtle changes, such as the gradual retreat of the shoreline, the formation of new beaches, and the gradual reshaping of the coastline. In some cases, these processes may also lead to long-term changes in landforms and other effects such as shoreline

subsidence or coastal marsh erosion. Both temporary and continuous Erosion can affect coastal ecosystems.

2.1.2 Shore sand loss due to increased transportation

Climate-caused Rise in ocean levels, which is resulting from the temperature increases of ocean water, increasingly severe extreme climate events, such as storms and high tides, are forming and transforming the coastlines (Doorga et al. 2021).also, social and economic activities on the coastal line, such as increased Urbanization and the growth of coastal tourism, are making the coasts worse. This makes the coasts more dynamic and unstable (Baird 2003).

Open beaches can see significant changes in the net transport of sediment along and across the coast (Robinet et al., 2018; Vitousek et al., 2017). that takes into account cross-shore transport in both directions, seaward and inland, according to the storm surge circumstances at the time and whether or not excess or an absence of sand was produced relative to the balanced coastline; recent work has expanded on this simple formula (Dean and Houston 2016). Increases in onshore sediment transfer because to wave the imbalance over the nourishment ,Together, these changes cause an accumulation of sand behind the shoreface nourishment region, Sand erosion from the shoreline and move in both cross- and longshore paths will eventually lessen the filtering effects of sand on incoming waves (Sánchez-Arcilla et al.; 2006).

Loss of beach sand because of more traffic is a big problem for coastal areas, as is the amount of dirt that gets washed off the roads and into rivers and streams that flow to the coast. This extra sediment can cause a lot of Erosion along the shoreline, which can cause beaches to get smaller and lose sand. Also, sediment from construction, farming, and other human activities can be moved to the coast, making Erosion worse. Coastal management techniques like building sea walls and dikes, using soil conservation techniques, and controlling runoff can help reduce the effects of more transportation on coastal Erosion and sand loss.

2.1.3 Sand loss by coastal transport

Rising tides typically push sediment inland (Cooper et al., 2020). Coastal sediment loss is predicted to persist in the face of rising sea levels and more frequent and intense storms (Brown and McLachlan 2002). Moreover, annual soil loss due to

water erosion is estimated to be around 970 million tons (Panagos et al., 2016). For this reason, it is crucial to capture the interdependence between Coastal flooding and beach erosion caused by storms when conducting a comprehensive risk assessment (Hillier et al., 2020). Increased Global warming-related sea-level rise will make this a bigger problem. Many coastline protection projects in Sri Lanka have led to the destruction of its once-plentiful recreational beaches as a direct result of rising sea levels and beach erosion (Weerakkody 1997). Although long-embayed beaches often suffer high alongshore fluctuation, there is typically slight net longshore variation in sediment movement (Burvingt et al., 2017).

However, the equilibrium between alongshore and cross-shore sediment transport can be disturbed when beach nourishments create massive nearshore disturbances (Guo et al., 2020). The involvement of humans can complicate sediment transfer on beaches (Vickers 2017).

Sand loss due to coastal transport is a significant problem that many coastal areas face. As waves resume and recede along beaches, they carry sand particles from the shore and deposit them offshore. Combined with the effects of tides and currents, they gradually erode the shoreline and drain beaches over time. Sand loss can be exacerbated by human activities such as coastal developments.

2.1.3.1. Violation and excessive washing

Coastal degradation and Erosion due to violations and excessive Erosion are significant causes of coastal degradation and Erosion. Wetlands being filled in, building too close to the water, and sand mining are all examples of illegal practices. Extreme environmental changes can result from these actions, leading to beach erosion and instability. The increased sediment load in rivers, streams, and other waterways as a result of excessive leachings, such as rainfall runoff, agricultural activities, and sewage discharges, causes Coastal Erosion.

Globally, at least 70 percent of sandy beaches have been affected by Erosion (Guo et al., 2020)or, in a different way, by causing large amounts of sand to become entangled in inlet systems(Steve and Wang, 2003; van Goor et al., 2003). (Rosati, Dean, and Walton, 2013)to determine the whole from seaward to landward range of cross-shore transport borders, taking into account the current whether storm and overflow conditions, overwash and aeolian processes, and climate or not there are

any or not there is a tidal gradient. Where the total sediment transport across long beaches is the amount of sand that is critical to the balance, The research about the future waves will move coastal sediment (Casas-Prat et al. 2016; Rosati, Dean, and Walton 2013) 's is an example of the kind of work being done right now on beaches.

2.1.4 Wind transport to dunes

The Erosion of coastal dunes is exacerbated by wind transport. Dunes are formed when strong winds transport sand from the beach and deposit it further inland. As time passes, the dunes erode because the wind blows more sand away and in different directions. Along coastlines, higher than high tide mark for sand shorelines, coastal dunes form; they are found worldwide, from the northern Arctic to the equator and the southern Antarctic; this illustrates that coastal dunes tend to appear wherever barrier islands or wave-dominated depositional coastal landforms occur (Maun, Martínez, and Psuty 2004). Sandy beaches, in particular, are among the most dynamic regions on the planet and highly vulnerable to storm surges, coastal Erosion, and inundation (Huggett 2016). However, local and regional wind and ocean conditions certainly have a considerably more significant and noticeable effect on the shore and on the stakeholders' perspective (Bustos, Piccolo, and Perillo 2011; Bustos, Perillo, and Piccolo 2009).

Higher rates of land erosion have been linked to increased tropical cyclone activity along the coast of Bangladesh (Kabir et al., 2016; Paul, 2013). This has led to the tropical cyclone being named one of the country's primary drivers of coastal Erosion. The beach and dune systems that form along open sandy coastlines are the first line of defense against the devastation caused by major coastal storms; flooding of low-lying areas and Erosion of beaches due to storm waves are two significant risks associated with coastal storms, Whether occurring separately or together, floods and Erosion represent a severe threat to the world's populated coastlines (Rueda et al., 2017; Mentaschi et al. 2018). It's important to know what causes coastal flooding and beach erosion due to storms and how they change over time so that proper and timely disaster preparation can be done. (UNISDR 2006). As previously discussed, the long-term coastal recession is caused by Cyclone eroding (i.e., Strong waves and water surface elevation (Ranasinghe, Callaghan, and Steve 2012).

Erosion of dunes is caused by extreme events with high amounts of rush, such as tides; on a sandy beach, 0.2 mm of Erosion in a meter is considered maximum dune erosion; In normal circumstances, there are two or three storms, and the surge levels are between 1 and 2 m, annual dune erosion over the sandy North Sea beaches is approximately 50 m³ /m/year, Most sand from degraded dunes is washed up on the beach, where it is subject to transport by cross-shore and longshore currents or recovery by wind forces (van der Wal 2004) Therefore, dune erosion results in an irreversible sand loss that can be made up for only through chemical fertilization (dune restoration).

2.1.5 Offshore sand loss under extreme wave and storm surge conditions

Along several sandy coastlines worldwide, coastal dunes prevent flooding and damage to low-lying regions; 70% of the Gross National Product is generated in flood-prone areas, which are protected, among other things, by dunes (en Milieu 2015). The magnitude of these phenomena can negatively impact the coast, affecting both people and coastal infrastructure; Urbanization along the coast may increase the destructive power of storms by accelerating erosion processes (Barragán and de Andrés 2015a; Gibbs 2015). In general, the rate of retreat is predicted to speed up and spread globally as sea levels rise (Hackney, Darby, and Leyland 2013; Limber et al. 2018).

Predictions of the future climate suggest that storms will have more frequent and severe effects along the coasts (D. J. Griggs and Noguera 2002). The smaller the silt, the more likely it is to be taken up by the wind; this indicates that the wind and the grain size of the soil significantly influence the morphology of a dune (Burger 2010) Off-shelf sediment transport can rise significantly during high-energy activities like storms or river floods (Palanques et al. 2012).

Many coastal localities have a significant problem with offshore sand loss during high waves and storm surges. Sand from beaches can be carried far out to sea by the force of the currents during storms with high waves and surges. This can cause nearshore sand levels to drop and erode beaches. The movement of sand along the coast can also alter the path taken by sediment along the coast, which might alter existing beach formations or even cause the construction of new ones.

2.1.6 Offshore sand loss to canyons

Sediment may enter a cell from rivers and estuaries, erode from cliffs and dunes, be transported onshore from the shelf owing to wave asymmetry, be deposited artificially, or be deposited biogenically as bits of shell and coral. Offshore transportation is hard during storms because of undertow and rip currents caught in local depressions canyons. Mining is the most prominent Sediment particles Lost due to Erosion from a cliff system cannot be recovered there. Sediment particles deposited in a canyon represent a permanent loss of the coastal zone(van Rijn 2011c).Cutting canyons and routing sediment around them at first is most commonly linked to margins that were initially "out of grade" (Fisher et al. 2021). The delta at the shore edge aggressively transfers sand to the deepwater shore and is an essential This leads to an increase in direct feeding, especially during river floods (Porębski and Steel 2003). As a result of the enormous The continental margins are places where a lot of sediment builds up. This is because they get large amounts of both land particles from river discharges and biogenic particles from marine primary producers(Lopez-Fernandez et al., 2013).

It has been known for a long time, and various Contemporary canyons and the deepwater fans that go with them have been documented about,in different detail, as having sent considerable large amounts of sediment to the Deep Basin, according to research (Covault and Graham 2010; Covault et al. 2007) river valley systems can function regardless of water level. While off-shelf and down-slope transport pulses are known to occur, the mechanisms that cause them are not always clear; sediment gravity flows are one example of a process linked with sediment movement(Palanques et al.,2012).

Offshore sand loss to canyons is a severe problem many coastal areas face. Canyons are steep-sided channels carved in the ocean floor by powerful currents carrying sediment away from the shoreline. This process can lead to significant losses of sand offshore, resulting in beach erosion and destabilization of coastal landforms. Additionally, this sediment movement can also affect the down-drift of sand up and down the coastline, leading to changes in shorelines and beaches.

2.1.6.1. Erosion downstream of accumulated forms

Erosion downstream of accumulated forms is a common problem many coastal areas face. Accumulated forms are often the result of sediment being carried downstream from upstream locations due to floods or other natural processes. These accumulations can lead to the Erosion of soil and destabilization of coastal landforms downstream, resulting in beach erosion and the reshaping of shorelines.

Produce significant storms in the fall and winter due to water moving toward the coast and low air pressure. These phenomena are linked to substantial waves and a noticeable rise in sea levels along the coast (Palanques et al., 2012). Therefore, it is essential to know the many mechanisms through which wind interacts with the ground surface; mechanisms of wind erosion include deflation and abrasion because of to the stormy weather of the windstorm; deflation is the elimination of loose, fine-grained particles, abrasion is the Erosion of bedrock the grinding action of wind-borne sand particles (Paris et al., 2019).

A significant mechanism for the transport of water and suspended particles from the shelf to the deep slope occurs during the coldest years when this thick shelf water overflows and cascades down the slope (Palanques et al., 2012).

2.1.7 Sand loss on coastal ledges

Erosion of beaches, especially in exposed coastal areas, is a significant physical effect of sea level rise that will make coastal infrastructure more susceptible to storm waves (Titus 1985). To clarify, this does not imply that sea-level rise causes Erosion; instead, it demonstrates that higher seas make it possible for Higher-energy, shorter-period storm waves will strike the coastline further inland and transport sand offshore (da Silva and Duck 2001). Waves can cause damage to a sandy construction on multiple scales. In many ways, these levels of impact are split into distinct regimes based on a mix of wave forcing (expressed by the runup limits) and resistance as characterized by the dune's geometry (Sallenger Jr 2000). Investment of \$13 million in Barbados' coastal beaches, Due their significance to the tourism industry, beaches may suffer from Erosion due to rising sea levels, Storms and the diminished availability of sediment due to climate change and human alteration of rivers and coastlines could amplify the adverse effects (Phillips and Jones 2006).

Coastal ledges are rocky formations found along the shoreline of bodies of water. These features can be important habitats for marine life, providing shelter and food for various species. However, coastal ledges are also vulnerable to Erosion and other forms of degradation. One of the critical threats to coastal ledges is coastal flooding, which can cause significant Erosion and damage to these formations.

2.1.8 Climate change and sea level rise

Coastal areas are in danger from many dangers and impacts related to sea level rises, such as the increase of temporary flooding, The flooding of land and groundwater, and the saltwater intrusion of water sources below and above ground (Magnan et al., 2022). Several weather stations have measured temperatures on land since the late nineteenth century, and ships and, more recently, satellites have recorded temperatures in the oceans. These records indicate temperatures over a large portion of the Earth. These records are now indispensable for establishing the timeline of rising global temperatures from their earliest occurrence around the year 1900 to the latest record-breaking temperature spikes (J. E. Hansen and Sato 2012).

Rising sea levels are an effect of global warming, and they may present significant environmental and socioeconomic concerns, particularly in coastal areas; several negative consequences on marine ecosystems and services are caused by SLR, including an increase in the severity of impacts from extreme sea level events and coastal hazards (Nevermann et al.,2022). Coastal areas are particularly vulnerable because of the potential impacts of extreme sea level occurrences and land subsidence on ecosystem services, environments, land use,and structures (Davtalab et al., 2020; Nicholls and Cazenave, 2010). From the likely Field projections of sea level rise from post-IPCC studies, a value of 1.1 m by 2100 was picked for this evaluation; since scientific understanding in this field is constantly evolving, it will be necessary to periodically update risk assessments and regulations to account for new information about the future sea-level rise(DCC 2009).Hurricanes, extreme rains, and meltingolar ice sheets have all contributed to rising sea levels, but warming temperatures are also to blame (Melillo, Richmond, and Yohe, 2014).

One of the most obvious signs of climate change is the rise in sea level. Over the past few decades, this trend of progressively rising sea levels is predicted to continue. By

the turn of the century, scientists predict that sea levels will have risen at least 1.5 meters worldwide

2.1.8.1 Impacts of climate change

The effect of climate change on extreme weather events has raised concerns about how vulnerable, adaptable, and resilient coastal communities are. (Chust et al., 2010; Mulder, Hommes, and Horstman, 2011; Luo et al., 2015; Bagdanavičiūtė, Kelpšaitė, and Soomere 2015) Extreme occurrences, Coastal Erosion has increased in recent years due to climate change and global environmental change-related increases in its severity and frequency(H. Zhang and Sheng 2015). As a result of climate change, sea levels are also increasing; due to global warming, ice sheets and glaciers are melting, which is raising sea levels; this has the potential to have devastating effects on coastal populations and environments; the study concluded that Climate change is already affecting the world, and these effects will only worsen in the future. (Hansen et al., 2007).

Coastal Erosion is affected by climatic due to water surface rise and changes in the severity and With inclement weather and severe natural phenomena; therefore, Global warming consequences typically exacerbate existing difficulties in coastal regions (Masselink and Russell 2013).Even though these interactions haven't been studied yet in coastline eroding, Knowing that even slightly rises in sea level can have a major effect on extreme climate-related decline occurrences is useful (Toimil et al., 2017). Coastal Erosion seems to have been exacerbated by the Climate Change phenomenon, as it has substantially grown over the past two decades (K, Zhang, 2004; Mulder, 2011b). Twenty to ninety percent of the current world littoral wetland area is anticipated to be destroyed by the year 2100, depending on various global warming and associated factor scenarios (Masselink and Russell, 2013). Erosion damages are not restricted to agricultural soils. Still, they also impacts on quality of water and sand transport, directly affecting reservoir storage and water resource availability (le Bissonnais et al., 2002).

2.1.8.2 Relative sea level rise

Recent efforts have zeroed in on the specific implications of significant wave events and the sea-level rise in the context of climate change, both of which pose significant threats to coastal areas and carry significant risks(Vitousek et al. 2017; Ng et al.

2014a). As the oceans rise, the frequency and intensity of wave impacts, and hence the energy transferred to the cliff face, is predicted to increase, leading to increased Erosion (Trenhaile 2010; Hackney, Darby, and Leyland 2013b; Limber et al. 2018b).

Changes in the short-term mean sea level can cause damage, but how much damage can be done depends on how the weather changes at different scales, how deep the water is near the shore, and how the land is shaped (Masselink, Hughes, and Knight 2014; Stockton et al. 2007; Jiménez et al. 2012a) Many coastal communities will experience this phenomenon with increased velocity resulting from increasing sea levels brought on by climate change (Li et al. 2015; Awange et al. 2018). Combined with the effects of sea level rise, coastal areas will be more vulnerable to threats in the years and decades to come(N, Li et al., 2018).

Tidal flooding and hurricane storm surges are becoming a bigger problem in coastal areas, and sea level rise is one of the reasons why. Sea level rise has already caused a loss of real estate value in recent years(McAlpine and Porter, 2018).undertook a worldwide examination changes regarding the amount of energy is flowing, finding that most coastal locations of the southern temperate zone have seen an increase of up to 30% in the 1-in-100-year return threshold, while the Northern Hemisphere has shown a decreasing trend(Bricheno and Wolf 2018).

2.2 Human Causes of Coastal Erosion

The human system includes artificial features such as harbor walls, buildings, roadways, groins, and breakwaters; when energy, sediment supply, and resistance are all altered, sandy beaches return to their pre-disturbance state as an equilibrium landform in the coastal system, The shape of beaches is affected by the force of storms, waves, and tides, the amount and location of deposited sediment, and the presence of things like coral reefs, bedrock, and artificial structures(Change 2014).

The destruction of dunes and excavation of coastal bluffs are examples of human activity in this region (Ogorodov and Kokin 2012; Rachold et al. 2005). The inherent risk of coastal Erosion is evaluated utilizing various information sources, including the ecological and physical features of the coast, human occupation, and the patterns of the coast now and in the future((McLaughlin and Cooper 2010; Ng et al. 2014b). It has only been in the last half-century when the populations of the world's

coastlines have recorded values that are close to 3percent of the average growth rate needed each year for cities; As a result of climate change, it is thought that almost 30 percent of homes along low coastlines, if they are within 200 meters of the water, could lose a lot of property due to Erosion over the next 50 years scenarios that are currently being considered(Gracia et al., 2018) These development activities include manufacturing and other forms of industry(Barragán et al. 2015b; Rumson et al. 2017).

Erosion along the shore can have widespread repercussions, including adverse effects on human life, agricultural practices, natural resource availability, and biodiversity (Boruff et al., 2005; Kaliraj et al., 2015). There is a relationship between human populations and activities and coastal environmental processes, which can lead to coastal hazards; the current tendency has been continuous migration toward the ocean and increased Urbanization along the shoreline(Small and Nicholls, 2003). It is typically accepted that the consequences of urbanization significantly impact coastal alterations; nevertheless, Even though this is the case, it shouldn't mean that the impacts of global warming and variability aren't important (Mentaschi et al., 2018b). Throughout history, people have chosen to make their homes in coastal locations because of those natural resources that are necessary for both survival and commercial expansion(Özyurt and Ergin 2009).An association between human activities and coastal Erosion might exist either directly or indirectly(Paalvast and van der Velde 2014). Because of the vast population concentrated around the coasts, coastal ecosystems have been touched and altered the most worldwide (Rachold et al., 2005b).

Although tourism benefits coastal towns, the inflow of tourists in coastal areas harms their natural attractiveness. Unless effectively managed, population growth and additional services to support it would degrade vital habitats and biodiversity. The convergence of these phenomena is anticipated to be worsened by global warming, sea level rise, and ecological adaptation.

Approximately 20% of the world's population, or 1409 million people, live within 25 kilometers, and 40% of the world's population, or 2818 million people, live within 100 kilometers of the shoreline (Rangel et al. 2018).

2.2.1 Intervention to coastal structures

Concrete structures that provide protection can reduce Erosion of the landmass behind them, but this cuts off the sediment supply to locations further downdrift. Other structures in a river system, such as dams, which were constructed, for example, in connection with the generation of hydropower, restrict the flow of the discharged water. As a result of the decreased velocities and turbulence caused by the dams, which will allow particles to settle, the dams will also operate as sediment sinks. Because of this, the amount of fluvial silt discharged from the dam will be lower than what is found in the water that is coming into the dam (Finkl 2016). For instance, due to coastal Erosion and rapid Urbanization over the past half-century, the amount of damage to infrastructure along the Catalan Coast has increased by forty percent (Jiménez et al., 2012b).

There is a correlation between the extent of Coastal Erosion along heavily populated coastlines and a more significant severity and recurrence of extreme events; These events may have been caused by interdecadal processes, climate variability ,or global climate keep changing (Jiménez et al., 2012b; Masselink et al., 2016). The use of complex structures is not always the best option, and the detrimental effects of these structures have been identified as a significant issue along a great number of beaches all over the world (Griggs, 2005; Charlier et al., 2005; Pranzini et al., 2013 Pilkey and Cooper 2014; Rangel et al.,2018b).

2.2.2 Shore spurs and similar structures

Complicated structures have significant challenges in many locations and are losing their viability as a result of the expensive and ongoing maintenance they need, as well as any enlargements in width and height that are required to keep up with the rising risk of coastal Erosion; challenging constructions are not sustainable, In addition to this, the presence of such constructions has a considerable impact on the natural adaptability of any shoreline (Temmerman et al., 2013). Even though these efforts are not always successful, the natural beauty of the beach and the biological environment are not negatively affected as much by these measures; because of this, the practice of using soft engineering principles has become increasingly popular in coastal defense planning (Anthony et at,2011; Hanley et al., 2014; Elko et al., 2021).

Approximately half of the world's coastlines have some form of a coastal cliff, which is a feature that is significant both geomorphologically and socially (Young and Carilli 2019). On the other hand, the development of urban areas and population growth on dynamic coastal landforms puts the local inhabitants and infrastructure at an increased risk of being affected by natural disasters (Cutter and Finch 2008).

The use of complex structures is not always the optimal answer, and the detrimental effects of these structures have been identified as a significant issue along a great number of beaches all over the world (Griggs, 2005b; Charlier et al., 2005b; Pranzini and Williams 2013b; Pilkey and Cooper 2014b; Rangel et al., 2018). It is counterintuitive to observe that the typical defense structures (rigid, inflexible structures) installed to mitigate coastal hazards negatively affect coastal ecosystems (Cooper, O'Connor, and McIvor, 2020; Gittman et al., 2016).

2.2.3 Ports established on the coast

The information serves as the foundation for additional Planning a project to nourishment the beaches thus to achieve a balance in the coastal resources at both the regional and municipal levels, this procedure aids in promoting cooperative coastal management efforts between government agencies and the engineering and scientific community; complex engineering solutions, such as groins and seawalls, or peaceful solutions, like sand bypassing or beach nourishment, can be used to treat the downdrift erosion phases, With such a wide range of coastal environments, both hard and soft solutions appear to have certain limitations (J Andrew G Cooper and Pilkey 2012; Luo et al., 2015b).

Wave diffraction and changes in sediment movement are caused by coastal structures, including offshore breakwaters, jetties, and groins, which frequently cause deposition and downslope Erosion; because the mangroves' natural erosion buffer is eliminated when they are destroyed and turned into aquaculture, Erosion is also a result of this (Anthony and Gratiot 2012; Saengsupavanich 2013). Ports, navigational channels, and jetties all have an impact on sediment flow patterns, as can the hurried (and unregulated) Construction on dunes as an aspect of the growth of littoral regions (Anthony et al., 2014; Saengsupavanich et al., 2009).

The human engineering technique (seawall, groin, jetty development) only affects a limited, bounded section of the shore (Komar 2000). As a result of the unlawful

construction of over 200 jetties and groins, Erosion and accretion have worsened in the areas of Flic-en-Flac, Le Morne, Grand Bay, and Mahebourg (Ragoonaden 1997).

2.2.4 Entry piers at tidal inlets and estuaries

The emphasis was on the function of hydrodynamic pressure Changes in cross-shore structures. coastal sediment flux by introducing an area, which changes the wave field by reflection; The difference along the shore in wave formation between the shadow region and the nearby region generates a near-shore circular current that flows towards the structure (van Rijn 2011a; Bodge and Rosati 2003).exposing the coastline to more giant waves, A jetty is a perpendicular-to-the-shore coastal construction that prevents longshore material from transportation at river entrances and inlets, Literature has identified its adverse effects (Leont'yev 2007; Kamphuis 2020).

The updraft edge of the breakwater undergoes soil is transferred because the structure intercepts the shoreline sediment movement(Garel et al., 2015; Thiruvenkatasamy and Girija, 2014). Negative experiences outweigh favorable ones in installing complex structures as coastal erosion prevention measures due to processes acting at a large spatial scale (>100 km; (Pilkey and Young, 2009; Neal et al., 2018; Rangel et al., 2018c Williams et al., 2018).

The period of the water level change, the variations permit waves to contact a cliff, tensional, compressive, and hydraulic shear pressures are exerted on the cliff face, causing quarrying of blocks and mechanical abrasion While sediment and stones are present(Sunamura 1992; Rosser et al., 2013; Kline, Adams, and Limber 2014; Young et al., 2016). Consequently, the process below base of cliffs is caused by both wave movement and damage by human activity by tools. Erosion processes are usually restricted to the Tides zone (A S Trenhaile 2004; Walkden and Hall 2005).

As predicted by other writers, our findings show that the rate of coastal Erosion will depend mainly on the quantity of energy provided to the cliff and the frequency with which water levels surpass critical thresholds (Alan S Trenhaile 2010b; Hackney et al., 2013c; Limber et al., 2018c). Seawalls make it easier to stop beach erosion by By spreading tidal power away from the wall and decreasing the amount of sediment ingestion(Griggs et al., 1994).

2.3. Literature Search Result

Human activity in coastal zones increases the coastal Erosion as well as the effects on vulnerable ecosystems along the coastline such as the change of sediment transport due to the use of sea territory for anthropogenic functions. These functions have a significant role in non-climate change factors that impact coastal Erosion exposed to these functions and their effects.

However, these functions also cause a considerable variety in coastal erosion rate and process. This diversity in coastal erosion rates influenced by different anthropogenic activities, in combination with climate change, is the reason for unpredictable changes in the coastal landscape. The unpredictability of the landscape is an argument for a need for protection measures or an adaptation strategy in the form of spatial planning.

Although projects have been developed and measures have been taken for the types of coastal Erosion mentioned above, based on various researches, there is no literature on this subject for coastal Erosion caused by sediment transport by the human body, but for the first time, calculations will be made by us and coastal Erosion will be examined as a result of sediment transported by foot.

3. MATERIALS AND METHOD

3.1 Experiment

This study is being carried out in the Alanya District of Antalya province. The sand samples taken from the coasts in different locations were classified by sieve analysis in Alanya Alaaddin Keykubat University, Rafet Kayış Engineering Faculty, Civil Engineering Department, Civil Engineering Laboratory. Sieve trays, digital scales, oven, sieve series, shaker, Basin, air temperature and moisture meter were used in the experiment. The grain diameters of the sand samples whose sieve analyses were performed were determined, and their locations were determined with the global mapper program. The aim is to classify the coastal beach according to grain diameters and show it on the map.

After these stages, we went to three points determined on the coastline. Three times each, the sand spilt from the feet, which had never been washed, was taken into the sample cups, and then the same process was repeated three times on the carelessly washed feet, and the sand grains remaining on the feet and in some parts of the body were taken into the sample cups. The collected samples were dried a little in the sun, and their wetness was removed. Afterwards, the samples were taken into small containers, and firing was carried out. The number of grams in a full dry state was measured and noted.

The experiment was done with the help of the Excel program and Geographic Information System (GIS) is a very useful and essential instrument due to its unique features and capabilities. This system is capable of simultaneously accumulating, storing, and analyzing multiple parameters and requires little time to provide and present geospatial data. Other characteristics of GIS include low cost, high computing accuracy, the use of complex analytical functions, editing capabilities, and rapid data updating features, modeling, and reporting in multiple formats. By utilizing this instrument for aquifers, hydrogeological, and groundwater pollution cases, a database, groundwater level maps, groundwater base maps, investigation,

and zoning of pollution regarding these resources can be prepared for their management, as needed. Excel software was utilized for the statistical analysis of measured parameters in this study. This work avoids describing and presenting all of its phases.

3.2 The Guidelines Grain Size Analysis for the Soil Grains

The purpose of soil classification is to provide the geotechnical engineer with a way to predict the behavior of the soil for engineering projects. There are numerous soil classification systems in use, but this section will only discuss the three most prevalent systems (Carrier III 2003). Using soil classification systems allows for a greater comprehension and illustration of soil particle characteristics. Several soil classification systems use particle size distribution and Atterberg limits to classify the soil. These systems are frequently supplemented by non-standardized classification of other soil properties, such as consistency and cementation (Bowles 1992). A fundamental analytical method with broad applications in the earth and archaeological sciences, Size of particles or grains is a fundamental characteristic or physical property of particulate samples, sediments, and sedimentary minerals (Folk 1980; Friedman and Sanders 1982).

A series of standard sieves of square mesh, including cover plate and bottom pan. Two recommended sieve stacks (having successively smaller mesh sizes) are as shown in table

This classification system separates soils into two main groups: coarse-grained soils (more than 50% by weight of soil particles retained on No. 200 sieve) and fine-grained soils (50% or more by weight of soil particles pass the No. 200 sieve). The coarse-grained soils are divided into gravels and sands. Both gravels and sands are further subdivided into four secondary groups as indicated in Table 3.1.

Table 3.1: Standard Sieves of Square Mesh

Typical Sieve Stack		Alternative Sieve Stack	
Sieve No.	Opening, mm	Sieve No	Opening, mm
Lid		Lid	
4	4.75	4	4.75
10	2	10	2
20	0.85	20	0.6
40	0.425	40	0.3
60	0.25	60	0.15
140	0.106	140	0.07
200	0.075	200	
Pan		pan	

Sieve analysis is a practice or procedure used to assess the particle size distribution of a granular material. Size distribution is often of crucial importance to the way the material in use performs. Sieve analysis can be performed on any type of inorganic or organic granular material including sand, crushed rock, clay, granite, coal, soil, a wide variety of manufactured powders, grains and seeds, down to a minimum size depending on the exact method. As a simple particle size determination technique, it is probably the most popular.

Sieve analysis determines the grain size distribution curve of a soil sample by passing it through a stack of reducing mesh sieves and measuring the weight remaining in each sieve.

Major Divisions	Subdivisions	USCS Symbol	Typical Names	Laboratory Classification Criteria	
Coarse-grained soils (More than 50% retained on No. 200 sieve)	Gravels (More than 50% of coarse fraction retained on sieve No. 4)	GW	Well-graded gravels or gravel-sand mixtures, little or no fines	Less than 5% fines ^a	$C_u \geq 4$ and $1 \leq C_c \leq 3^c$
		GP	Poorly graded gravels or gravelly sands, little or no fines	Less than 5% fines ^a	Does not meet C_u and/or C_c criteria listed above ^c
		GM	Silty gravels, gravel-sand-silt mixtures	More than 12% fines ^a	Minus No. 40 soil plots below the A-line
		GC	Clayey gravels, gravel-sand clay mixtures	More than 12% fines ^a	Minus No. 40 soil plot on or above the A-line
	Sands (50% or more of coarse fraction passes sieve No. 4)	SW	Well-graded sands or gravelly sands, little or no fines	Less than 5% fines ^a	$C_u \geq 6$ and $1 \leq C_c \leq 3^c$
		SP	Poorly graded sands or gravelly sands, little or no fines	Less than 5% fines ^a	Does not meet C_u and/or C_c criteria listed above ^c
		SM	Silty sands, sand-silt mixtures	More than 12% fines ^a	Minus No. 40 soil plots below the A-line
		SC	Clayey sands, sand-clay mixtures	More than 12% fines ^a	Minus No. 40 soil plot on or above the A-line

Figure 3.1: Unified Soil Classification System

Source: (Robert, 2004)

3.2.1 Apparatus

- For sieves, a Pan, and a lid.
- Sensitive scale to 0.1g.
- mortar and pestle.
- oven.
- Mechanical vibrating sieves.

Sieve numbers 4, 10, 20, 40, 60, 140, and 200 are generally used in most standard sieve work. Identify different soil types. The group symbols are made up of two different uppercase characters. G stands for gravel, S for sandy soil, M for mud, C for clay, and O for organic. The first letter signifies what type of material it is (Folk 1980).

3.2.2 Procedure

Collect a representative sample of oven-dried soil. Samples having particles larger than sieve size No. 4 (4.75 mm) should be about 500 grams. For soils containing larger particles of size greater than 4.75 mm, larger weights are required.

Break up or crush the soil sample into individual particles using a rubber mortar and pestle. (Note: the idea is to break the soil into individual particles, not to break the particles themselves.)

Determine the mass of the sample with an accuracy of 0.1 grams (W).

3.3 Determination of Weights of Existing Samples

Sand samples, previously taken from different locations, were first noted in the laboratory and then dried by drying at 100°C for 24 hours. After noting the dry weights after the firing process, the sand samples were subjected to sieve analysis, and it was noted how much sand and gravel remained in each sieve.

Table 3.2: Coordinates and Wet-Dry Weights of Existing Sample

Number	Coordinate (N)	Coordinate (E)	wet Weight (g)	dry weight(g)
1.	36° 35' 32,3	31° 50' 25,1	313,3	312.7
2.	36° 35' 08,3292''	31° 51' 50,1588''	306,1	303.8
3.	36° 36' 16,9''	31° 47' 27,2''	315,8	296.2
4.	36° 33' 37,854''	31° 56' 08,8588''	315,3	314.6
5.	36° 34' 06,942''	31° 54' 36,9648''	314,1	312.9
6.	36° 34' 44,8086''	31° 52' 54,228''	313,4	311.2
7.	36° 35' 43,6''	31° 48' 41,2''	275,7	265.6
8.	36° 35' 44,0''	31° 48' 41,2''	315,1	313.7
9.	36° 34' 43,3632''	31° 52' 53,0688''	306,1	303.5
10.	36° 34' 07,9608''	31° 54' 37,89''	302,2	298.9
11.	36° 36' 17,4''	31° 47' 27,5''	306,4	306
12.	36° 33' 37,633''	31° 56' 08,412''	310,6	307.4
13.	36° 33' 29,0448''	31° 57' 49,9428''	303,1	301.2
14.	36° 32' 45,7764''	31° 59' 0,13525''	304,2	302.4
15.	36° 33' 28,1448''	31° 57' 50,3568''	300,8	294.8
16.	36° 32' 43,5408''	31° 58' 59,5668''	299,3	296.8
17.	36° 35' 09,528''	31° 51' 49,188''	303,5	303.2
18.	36° 35' 44,0''	31° 48' 41,2''	306,3	305.3
19.	36° 52' 23,25''	32° 05' 40,19''	300,3	298.4
20.	36° 52' 20,89''	32° 05' 36,94''	300,6	293.2
21.	36° 52' 89,79''	32° 04' 39,24''	300,1	289
22.	36° 52' 87,74''	32° 04' 37,72''	300,4	298
23.	36° 53' 74,36''	32° 03' 00,03''	300,3	291.8
24.	36° 53' 68,01''	32° 02' 96,14''	300,3	270.8
25.	36° 54' 30,26''	32° 01' 45,62''	300,5	298.4
26.	36° 54' 29,03''	32° 01' 44,10''	300,4	292.1
27.	36° 55' 60,70''	31° 96' 88,12''	300,3	299.9
28.	36° 55' 55,16''	32° 96' 85,00''	300,5	276.9
29.	36° 54' 72,66''	31° 98' 22,65''	300,1	299.2
30.	36° 54' 67,63''	31° 98' 19,53''	300,5	294.9

3.4 Processing of Existing Samples on the Map

He coordinates of the sand samples in the laboratory were determined by marking where they were taken from with Google Earth (The data that were previously sampled, subjected to sieve analysis and classified were also marked on the map).

Calculation for sample No 9

The dimensions of the remaining particle in the quantity of soil contained in each sieve are smaller than the mesh apertures on any of the sieves put above this one in the sieving hierarchy. Furthermore, the smaller mesh apertures of any of the sieves listed below are insufficient for their size (Bowles, 1992). We have shown a table for the ninth sample table (3.3) only to illustrate the calculation procedure for an experiment Determination of Average Grain Diameters of Samples, as an alternative to the calculation tables for the remaining samples the mass retained is calculated using Equation

$$\text{Mass retained (g)} = MR = MF - M \quad (3.1)$$

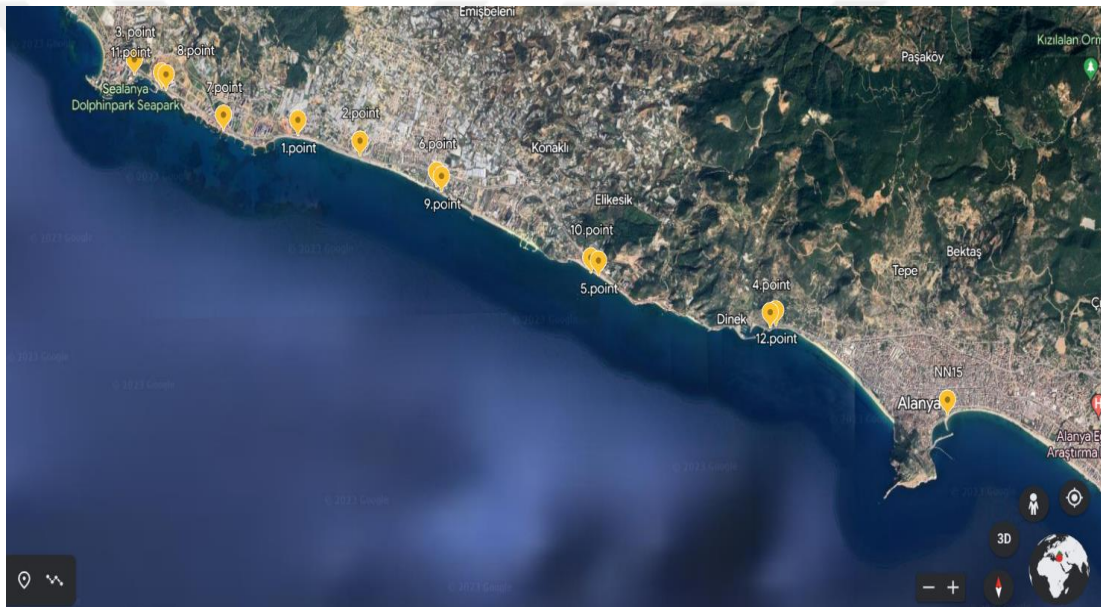


Figure 3.2: Marked On the Map of the Existing Samples

Percent of mass retained is then calculated,

$$\text{Percent of mass retained (\%)} = P_R = \frac{M_R}{M_S} * 100\% \quad (3.2)$$

Using the values of percent of mass retained, the percent passing is calculated,

$$\text{Percent passing (\%)} = P_P = 100 - P_{PR} \quad (3.3)$$

where:

MF mass of fines (g), MI mass of bowl (g), MS mass of sand (g)

Table 3.3: Calculation for Sample No 9

SIEVE NO.	Sieve opening mm	Mass retained (g)	Percent of mass retained	Mass passing	Percent passing
4	4.75	17.3	16.31%	49.5	89.39%
10	2.36	32.2	71.14%	215.9	28.86%
20	1	183.7	83.49%	253.4	16.51%
40	0.425	69.7	23.16%	70.3	76.84%
60	0.30	0.6	0.20%	0.6	23.16%
120	0.15	0	0.00%	0	0.00%
200	0.075	0	0.00%	0	0.00%
PAN	PAN	0	100.00%	303.5	0.00%

3.5 Sieve Analysis of Existing Samples

With the data obtained, the percentages of how much passed through which sieve and how much remained were determined. As a result of sieve analysis calculations, granulometry curves for each sample were drawn with the help of excel program.

With the data obtained, the percentages of how much passed through which sieve and how much remained were determined. As a result of sieve analysis calculations. granulometry curves for each sample were drawn with the help of an Excel program. Each sample has a distinct color, which appears in Figure (3.3) and varies from sample to sample. The dimensions of the samples are computed, and the total result of the lines indicates the quality of the soil. The analysis results from taking soil samples are presented in detail. According to the sieve study, the soil samples range from moderately sandy (figure 3.3) to very sandy (figure 3.3). Mixed grain, silt, and sand (mostly sand, some coarse) Sand, coarse grain, loose silt, fine silt, and sand make up the bulk of samples 1–30. In the soil .test it is shown that the Alanya coastal soil of the study area is mainly sandy. Stability and breakdown are easy. Figure (3.3) shows the Alanya coastal point are soil is ‘‘coarse sands’

Table 3.4: Sieve Analysis Result Remaining %

Openness	Mm	4.75	2.36	0.6	0.425	0.3	0.15	0.075	Sieve No.
Remaining %	1. Sample	43%	44%	49%	64%	81%	100%	100%	100%
Remaining %	2. Sample	2%	4%	68%	87%	91%	98%	100%	100%
Remaining %	3. Sample	1%	9%	100%	100%	100%	100%	100%	100%
Remaining %	4. Sample	2%	2%	50%	80%	92%	100%	100%	100%
Remaining %	5. Sample	4%	23%	90%	98%	99%	100%	100%	100%
Remaining %	6. Sample	5%	8%	26%	53%	74%	95%	97%	100%
Remaining %	7. Sample	16%	19%	23%	26%	30%	83%	100%	100%
Remaining %	8. Sample	21%	21%	59%	83%	94%	100%	100%	100%
Remaining %	9. Sample	16%	71%	83%	23%	0.2%	100%	100%	100%
Remaining %	10. Sample	1%	1%	7%	41%	69%	99%	99%	100%
Remaining %	11. Sample	0%	0%	69%	96%	98%	99%	99%	100%
Remaining %	12. Sample	37%	62%	89%	93%	95%	100%	100%	100%
Remaining %	13. Sample	0%	4%	63%	91%	97%	100%	100%	100%
Remaining %	14. Sample	0%	1%	13%	44%	72%	100%	100%	100%
Remaining %	15. Sample	0%	1%	81%	98%	100%	100%	100%	100%
Remaining %	16. Sample	2%	2%	7%	51%	82%	100%	100%	100%
Remaining %	17. Sample	3%	11%	47%	73%	87%	97%	99%	100%
Remaining %	18. Sample	3%	5%	14%	45%	73%	95%	97%	100%
Remaining %	19. Sample	38%	75%	87%	94%	99%	99%	100%	100%
Remaining %	20. Sample	0%	0%	4%	55%	81%	100%	100%	100%
Remaining %	21. Sample	10%	15%	32%	69%	83%	97%	99%	100%
Remaining %	22. Sample	1%	11%	94%	99%	99%	100%	100%	100%
Remaining %	23. Sample	1%	2%	7%	49%	74%	96%	98%	100%
Remaining %	24. Sample	0%	2%	33%	53%	64%	97%	100%	100%
Remaining %	25. Sample	5%	10%	23%	56%	72%	98%	99%	100%
Remaining %	26. Sample	5%	33%	98%	100%	100%	100%	100%	100%
Remaining %	27. Sample	2%	3%	7%	29%	55%	98%	99%	100%
Remaining %	28. Sample	0%	0%	2%	46%	71%	99%	100%	100%
Remaining %	29. Sample	0%	4%	52%	90%	97%	100%	100%	100%
Remaining %	30. Sample	0%	1%	56%	91%	94%	99%	100%	100%

Table 3.5: Sieve Analysis Result Passing %

Openness	Mm	4.75	2.36	0.6	0.425	0.3	0.15	0.075	Sieve No.
passing %	1. Sample	56.51%	56.19%	50.56%	36.39%	18.64%	0.03%	0.00%	0.00%
passing %	2. Sample	98.26%	96.18%	32.42%	13.17%	8.79%	1.51%	0.10%	0.00%
passing %	3. Sample	99.22%	90.68%	0.03%	0.00%	0.00%	0.00%	0.00%	0.00%
passing %	4. Sample	98.47%	97.77%	50.13%	20.47%	8.20%	0.22%	0.13%	0.00%
passing %	5. Sample	95.59%	76.64%	10.00%	2.40%	0.96%	0.06%	0.03%	0.00%
passing %	6. Sample	94.89%	92.48%	74.45%	46.82%	25.93%	4.69%	2.51%	0.00%
passing %	7. Sample	83.62%	81.02%	76.84%	74.47%	70.41%	16.87%	0.11%	0.00%
passing %	8. Sample	79.34%	78.87%	40.55%	16.80%	5.80%	0.45%	0.13%	0.00%
passing %	9. Sample	89.339%	28.86%	16.51%	76.84%	23.16%	0.00%	0.00%	0.00%
passing %	10. Sample	99.50%	99.36%	92.87%	59.25%	30.78%	1.41%	0.64%	0.00%
passing %	11. Sample	100.00%	99.97%	31.41%	3.66%	1.96%	1.21%	0.72%	0.00%
passing %	12. Sample	63.31%	38.19%	11.39%	7.45%	4.85%	0.46%	0.13%	0.00%
passing %	13. Sample	99.80%	95.72%	37.38%	9.23%	2.56%	0.13%	0.10%	0.00%
passing %	14. Sample	99.74%	99.34%	87.50%	56.12%	27.81%	0.46%	0.10%	0.00%
passing %	15. Sample	100.00%	99.36%	18.66%	1.63%	0.20%	0.03%	0.00%	0.00%
passing %	16. Sample	97.74%	97.74%	92.72%	49.23%	17.59%	0.17%	0.03%	0.00%
passing %	17. Sample	97.36%	89.48%	52.80%	26.52%	13.29%	2.64%	1.45%	0.00%
passing %	18. Sample	97.05%	94.96%	85.62%	55.03%	26.86%	4.65%	2.52%	0.00%
passing %	19. Sample	62.49%	24.99%	13.06%	6.31%	1.20%	0.51%	0.11%	0.00%
passing %	20. Sample	100.00%	99.79%	95.96%	44.57%	19.01%	0.34%	0.03%	0.00%
passing %	21. Sample	90.28%	85.28%	68.19%	31.11%	16.91%	2.67%	1.25%	0.00%
passing %	22. Sample	98.69%	89.34%	6.02%	1.41%	1.18%	0.20%	0.03%	0.00%
passing %	23. Sample	99.14%	97.91%	93.20%	51.10%	25.58%	4.05%	2.23%	0.00%
passing %	24. Sample	100.00%	98.34%	67.12%	47.37%	35.72%	2.63%	0.15%	0.00%
passing %	25. Sample	95.24%	90.05%	77.25%	44.30%	27.82%	2.48%	0.84%	0.00%
passing %	26. Sample	94.86%	67.04%	1.51%	0.03%	0.00%	0.00%	0.00%	0.00%
passing %	27. Sample	98.27%	96.67%	93.34%	70.75%	44.56%	2.00%	0.80%	0.00%
passing %	28. Sample	100.00%	100.00%	97.62%	54.33%	28.84%	0.58%	0.00%	0.00%
passing %	29. Sample	99.73%	95.62%	47.76%	9.54%	3.08%	0.13%	0.13%	0.00%
passing %	30. Sample	99.87%	98.95%	43.80%	8.63%	5.73%	0.54%	0.10%	0.00%

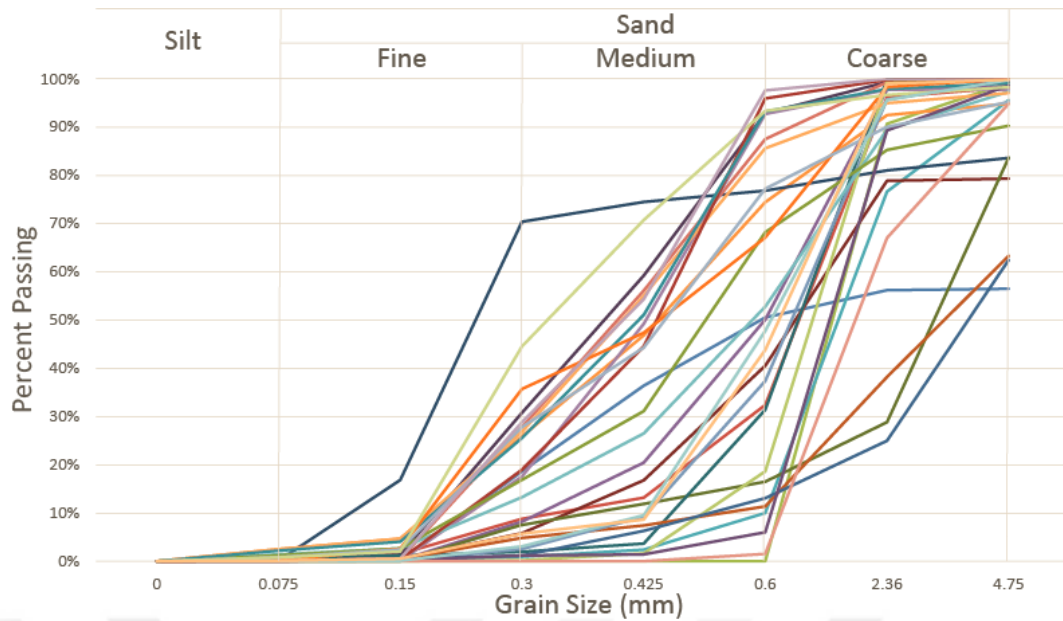


Figure 3.3: Sieve Analysis Test

3.6 Determination of Average Grain Diameters of Samples

With the data obtained, the percentages of how much passed through which sieve and how much remained were determined. As a result of sieve analysis calculations, granulometry curves for each sample were drawn with the help of excel program

Table 3.6: Sieve Analysis D50 Data

Sample number	D50(mm)
1.	0.6 mm
2.	1.0 mm
3.	1.5 mm
4.	0.5 mm
5.	1.5 mm
6.	0.4 mm
7.	0.3 mm
8.	1.1 mm
9.	6.8 mm
10.	0.8 mm
11.	1.0 mm
12.	3.4 mm
13.	1.0 mm
14.	0.4 mm
15.	1.3 mm
16.	0.4 mm
17.	0.6 mm
18.	0.4 mm
19.	4.0 mm

Table 3.6: (Cont.) Sieve Analysis D50 Data

Sample number	D50(mm)
20.	0.5 mm
21.	0.8 mm
22.	1.8 mm
23.	0.4 mm
24.	0.5 mm
25.	0.5 mm
26.	2.0 mm
27.	0.3 mm
28.	0.4 mm
29.	1.1 mm
30.	1.1 mm

3.7 Plotting Coordinates on the Map with Grain Diameter

After the granulometry curves were obtained in these samples, their coordinates were noted in the text document together with the samples in three columns (x and y coordinates in one column and sample d50 diameters in a third column). However, since the Global Mapper application gave an error in the coordinate order in degrees, minutes seconds (it shows the different locations), the coordinates were first converted to decimal

Table 3.7: Coordinate Data Encoded for Glo

X	Y	Z	X	Y	Z
31.840306	36.592306	0.6	32.053694	36.522089	0.5
31.863933	36.585647	1.0	32.043924	36.528979	0.8
31.790889	36.604694	1.5	32.043772	36.528774	1.8
31.935794	36.560515	0.5	32.030003	36.537436	0.4
31.910268	36.568595	1.5	32.029614	36.536801	0.5
31.881730	36.579113	0.4	32.014562	36.543026	0.5
31.811444	36.595444	0.3	32.014410	36.542903	2.0
31.811444	36.595556	1.1	31.968812	36.556070	0.3
31.881408	36.578712	6.8	31.982265	36.547266	1.1
31.910525	36.568878	0.8	31.981953	36.546763	1.1
31.790972	36.604833	1.0	31.968350	36.555512	0.4
31.935670	36.560454	3.4	32.002917	36.541665	0.1
32.054019	36.522325	4.0	32.007165	36.543082	0.9

Then, by importing this notebook with Global Mapper, coordinates were opened in the program. Since the sample diameter was entered in the Z column, a color scale

and average height curve distribution of the samples was obtained. Thanks to this distribution, the grain diameter analysis of the sampled coastline length was performed. With this analysis, it was determined where there was sand and gravel of which grain diameter.

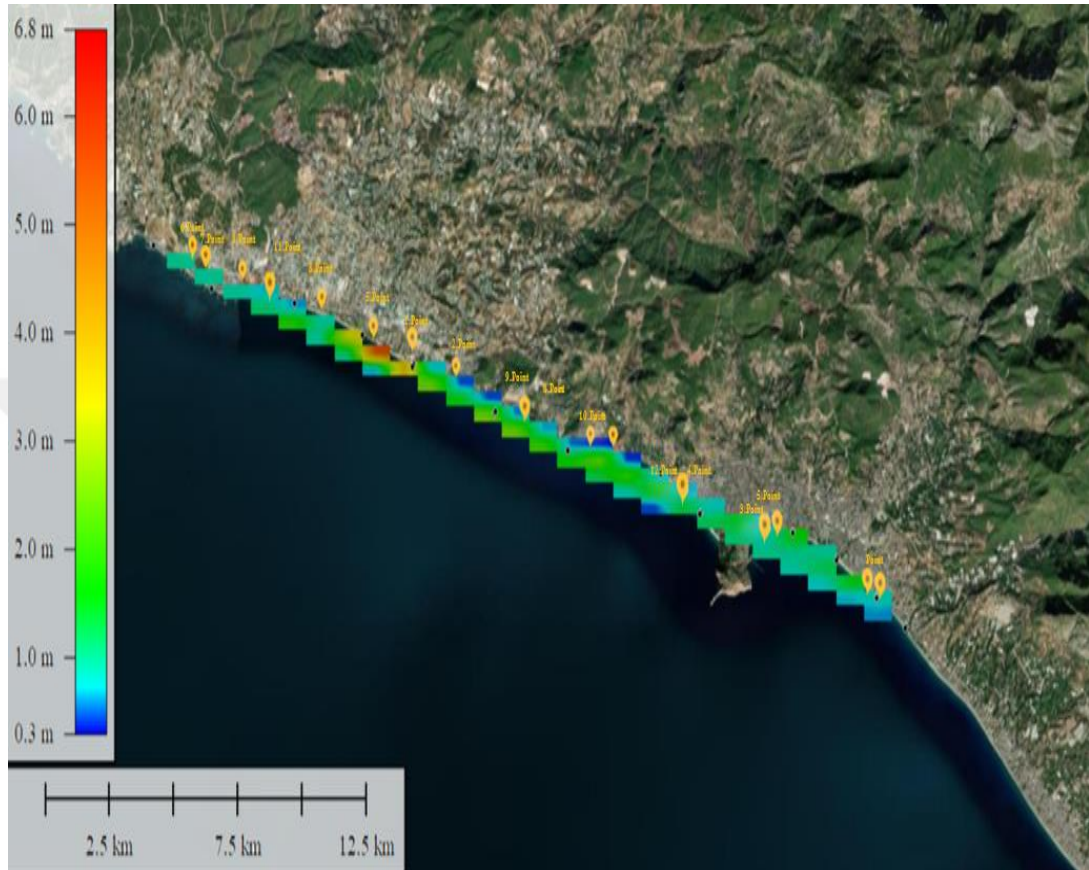


Figure 3.4: Coordinates Engraved On the Map According To D50 Radii

3.8 Experimenting at Three Points Selected from the Map

The experiment was carried out in three different positions in terms of grain diameter. The experiment was carried out by two people with foot numbers 36-37 and 41-42. The experiment was done as follows.

- First of all, three locations are predetermined

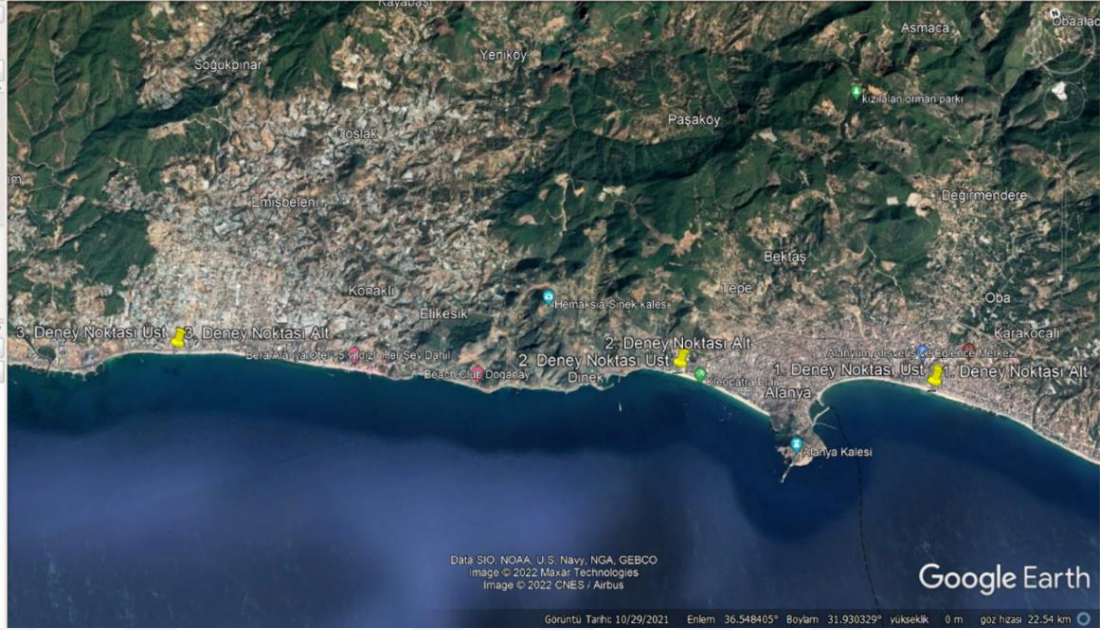


Figure 3.5: Experimental Locations

- The locations of these points and the current air temperature and humidity are noted. current data of test locations
- On the beach, the feet are put into the sea and then the sand is accumulated by walking vertically along the beach. The routes are given in the pictures;

Table 3.8: The Data for Experiments in the Three Different Positions

EXPERIMENT	1. POINT		2. POINT		3. POINT	
For the upper part						
LOCATION	36.53574 7	32.0325	36.5556 69	31.9688 87	36.5923 76	31.8407 50
in	26.9°C		33.8°C		35.7°C	
out	29.6°C		31,7°C		38.2°C	
wetness	36%		19%		14%	
FOR DOWN						
LOCATION	36.53541 13	32.0321 97	36.5555 60	31.9687 40	36.5921 88	31.8407 85
in	25.5°C		30.50°C		37.5°C	
out	26.1°C		25.4°C		24.2°C	
wetness	44%		39%		12%	

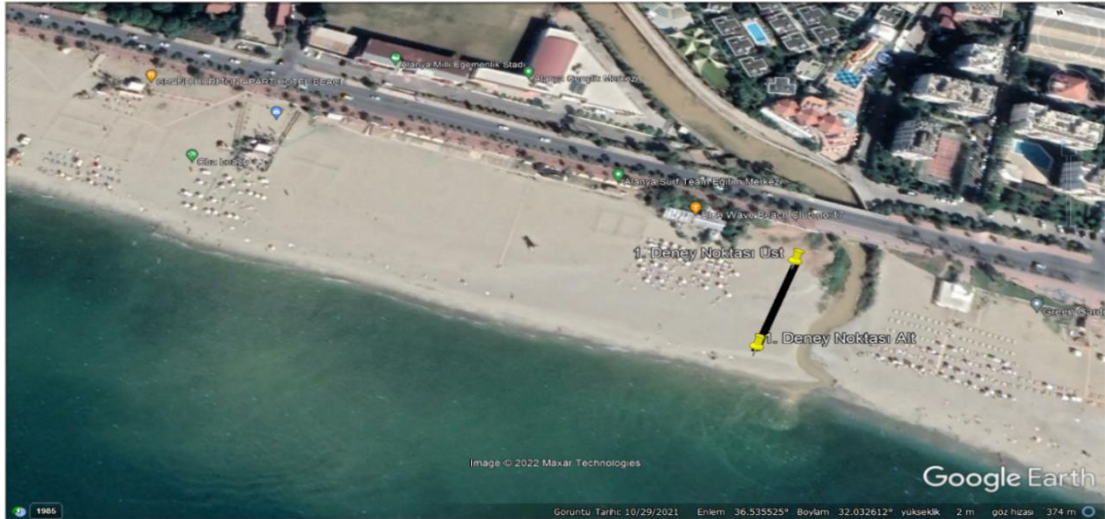


Figure 3.6: The Route of the 1st of the Test Locations

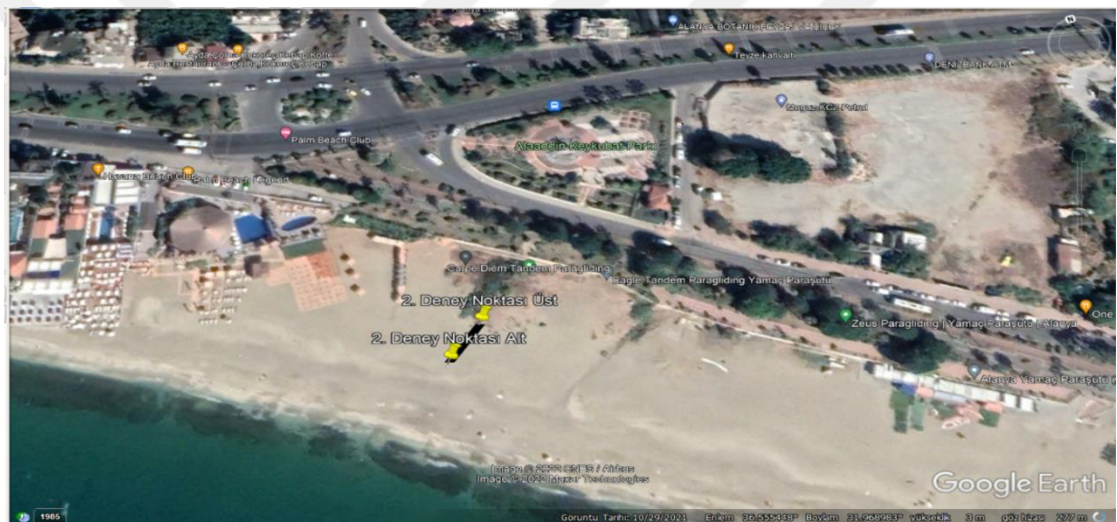


Figure 3.7: The Route of the 2nd of the Test Locations



Figure 3.8: The Route of the 3rd From the Places Where the Test Was Carried Out

- It was cleaned by washing the sands from the feet on the tray.



Figure 3.9: Sand Collected On Feet



Figure 3.10: Discharging the Sand Collected From the Feet Into the Tray

- It was taken by washing it with the help of water on a piece of cloth to remove the sand from the tray.
- This process has been completed three times and applied to both people.
- The same process was performed on the feet that were washed irregularly (to wash the feet irregularly, 3-4 holes were drilled in the cap of a pet bottle and thus, irregular washing was performed).
- The same procedure was applied to the unevenly washed foot three times and for two people.
- The operations were performed in the same way in all three locations.



Figure 3.11: Samples Collected Standing During Fieldwork

3.9 Measuring Masses of Collected Sediments by Drying

In order to be able to measure the sediment samples of human origin collected from the marked locations during the experiment, they were cooked in the oven at 100 ° C for 24 hours and the moisture was completely dried. After drying, each one was measured and noted on a precision scale. Detailed table of sand masses accumulating on feet

Table 3.9: Detailed Table of Sand Masses Accumulating in Feet

1. EXPERIMENT POINT	
Shoe size male (41-42)	Shoe size female (36-37)
samples for unwashed feet	
1) 15,8 gr	1) 8,6 gr
2) 19,3 gr	2) 13,6 gr
3) 31,5 gr	3) 17,5 gr
samples for sloppy-washed feet	
1) 1,2 gr	1) 0,5 gr
2) 0,6 gr	2) 0,6 gr
3) 0,6 gr	3) 0,9 gr
2. EXPERIMENT POINT	
Shoe size male (41-42)	Shoe size female (36-37)
samples for unwashed feet	
1) 41,8 gr	1) 49,1 gr
2) 42,1 gr	2) 41,4 gr
3) 62,3 gr	3) 45,6 gr
samples for sloppy-washed feet	
1) 2,7 gr	1) 2,8 gr
2) 2,9 gr	2) 3,2 gr
3) 9,7 gr	3) 5,5 gr

Table 3.9: (Cont.) Detailed Table of Sand Masses Accumulating in Feet

3. EXPERIMENT POINT	
Shoe size male (41-42)	Shoe size female (36-37)
samples for unwashed feet	
1) 40,3 gr	1) 17,6 gr
2) 15,7 gr	2) 23,3 gr
3) 20,7 gr	3) 13,8 gr
samples for sloppy-washed feet	
1) 4,0 gr	1) 2,3 gr
2) 1,8 gr	2) 3,3 gr
3) 2,4 gr	3) 1,6 gr

3.10 Standing Mass Graphs According to Dimensionless Unit Feet Number

1. Test Point Samples for Unwashed Foot

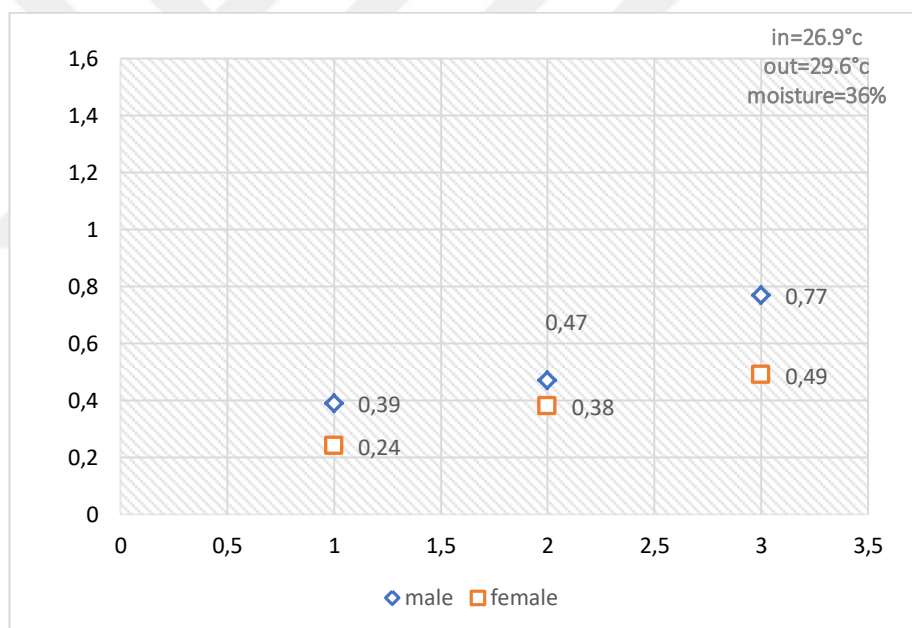


Figure 3.12: 1st Sample Test Point for the Unwashed Foot

1. Test Point Samples for Sloppy Washed Foot

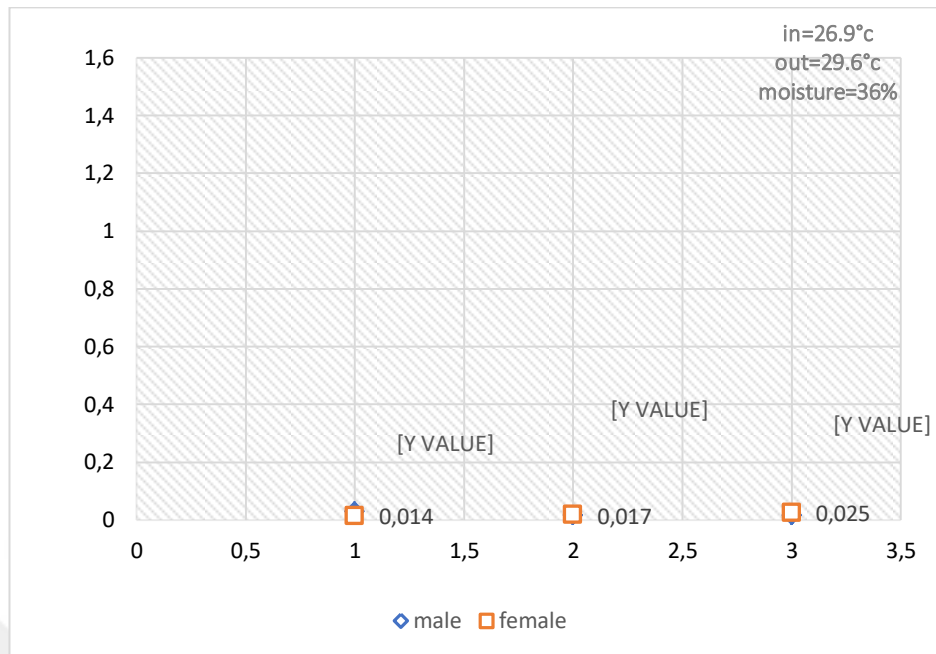


Figure 3.13: 1st Sample Test Point for Sloppy Washed Feet

2. Test Point Samples for Unwashed Foot

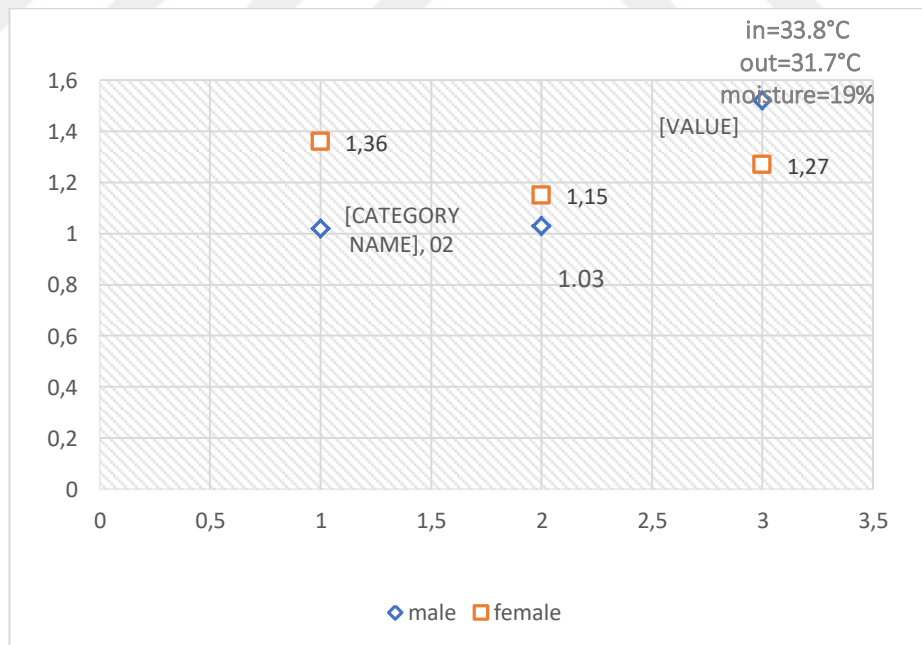


Figure 3.14: Samples for the 2nd Test Point Unwashed Foot

2. Test Point Samples for Sloppy Washed Foot

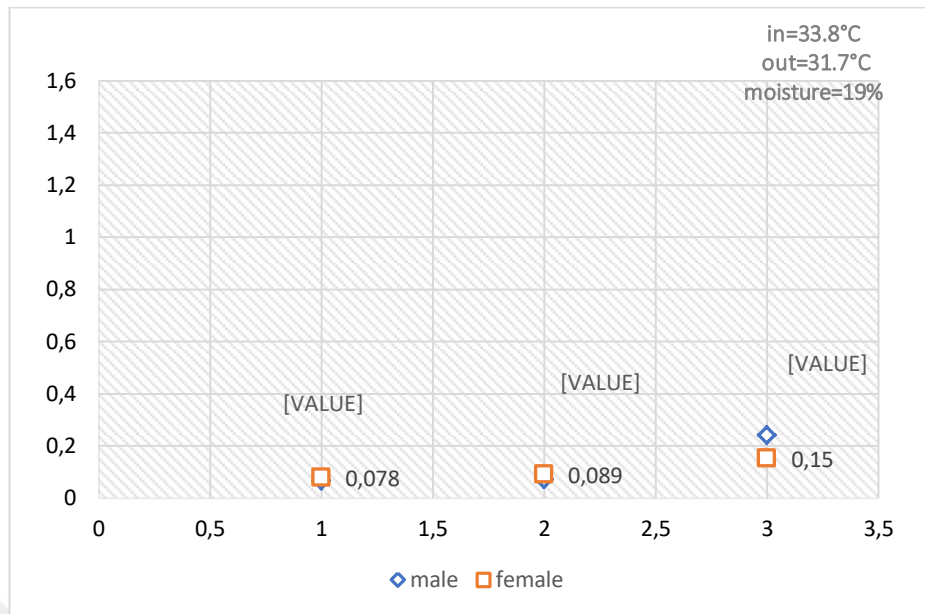


Figure 3.15: Samples for Feet That Have Been Washed Poorly At the 2nd Test Point

3. Samples for Test Point Unwashed Foot

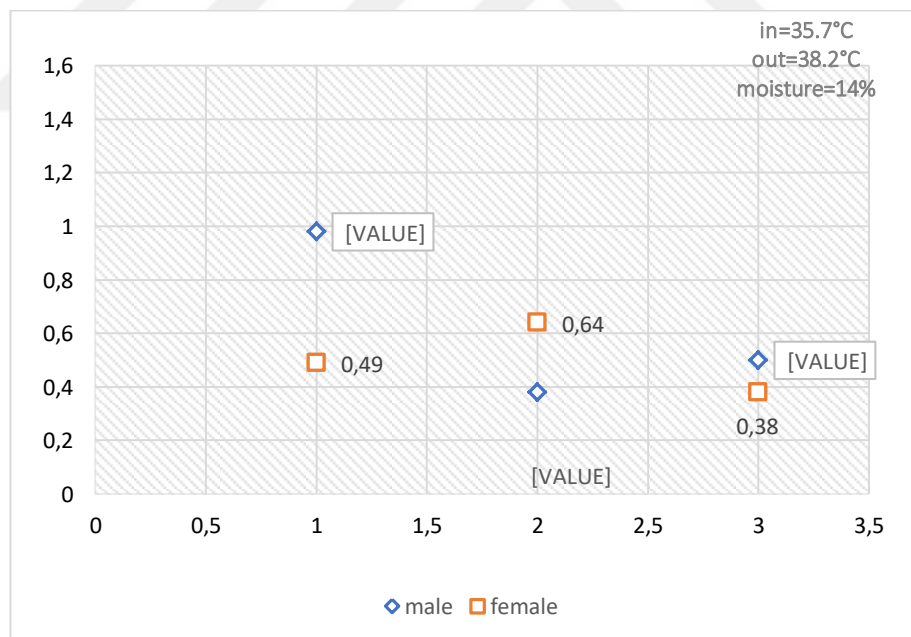


Figure 3.16: 3rd Test Point Samples for Unwashed Feet

3. Test Point Samples for Sloppy Washed Foot

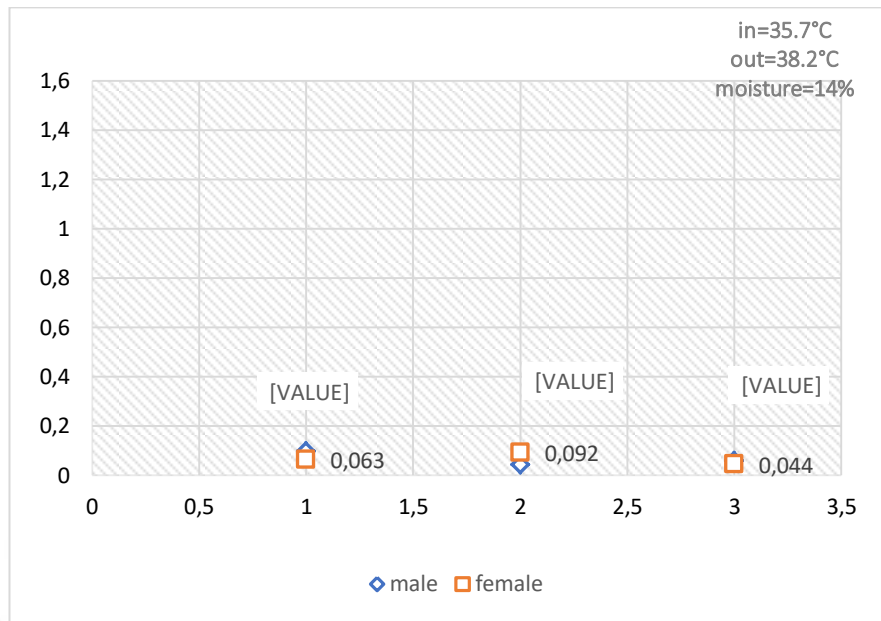


Figure 3.17: 3rd Test Point Samples for Sloppy Washed Feet

3.11 Table of Total Number of Persons Entering the Beach by Month

The number of tourists coming to Alanya throughout the year for the year 2015 (the latest official data is available this year) from the official site of the Alanya District Governorate was determined and noted by distinguishing the months of the holiday season. Some of these tourists are noted in the table below, assuming that each person takes a holiday for five days and goes to the sea or the beach five times in total, since some of them take a holiday for a month, some for a week or a few, and some for a day. Among the local people of Alanya, half of Alanya's population goes to the sea and the beach every weekend, and as a result, the data in the table below is obtained by assuming that a total of two hundred thousand local people set foot on the beach every month.

Table 3.10: Total Number of People Entering the Beach by Month

Months	Number of Tourists	Number of Days They Take Vacation	Number of Indigenous People Entering the Sea	Number of Days They Entered the Sea	Total Number of People Entering the Beach
April	652.000	5	200.000	4	4.060.000
May	1.388.037	5	200.000	4	7.740.185
June	1.642.032	5	200.000	4	9.010.160
July	2.036.137	5	200.000	4	10.980.685
August	1.952.730	5	200.000	4	10.563.650
September	1.585.690	5	200.000	4	8.728.450
October	1.087.683	5	200.000	4	6.238.415

3.12 Amount of Erosion Sand at Best and Worst Cases

In Table (3.11) below, the Amount of erosion sediment is shown in the best and worst cases. The two cases are calculated together for the three samples in the washed and unwashed cases, as shown.

Table 3.11: Amounts of Sand Exposed To Erosion

	1. SPOT UNWASHED	2. SPOT UNWASHED	3. SPOT UNWASHED
THE WORST POSSIBILITY	44.14 ton	77.96 ton	56.18 ton
THE BEST POSSIBILITY	13.78 ton	58.47 ton	21.78 ton
	1. Spot Washed Sloppy	2. Spot Washed Sloppy	3. Spot Washed Sloppy
THE WORST POSSIBILITY	1.66 ton	13.76 ton	5.62 ton
THE BEST POSSIBILITY	0.80 ton	3.78 ton	2.46 ton
	FOR UNWASHED FOOT	For Sloppy Washed Feet	
WORST CASE	77.96 tons*40(average leg size) =3118 tons	Worst case	5.62 tons*40 (average leg size) = 225 tons
BEST CASE	13.78 tons * 40 (average leg size) = 551 tons	Best case	0.80 tons*40 (average leg size) = 32 tons

4. CONCLUSION AND RECOMMENDATIONS

4.1 Conclusion

Within the scope of the project, the coastline and what the coast is and how it was formed were tried to be expressed. The causes of natural and artificial erosion of the coast, i.e. man-made, were briefly expressed and explained. Apart from known natural and artificial erosions, the subject of "Tourism Induced Erosion with Standing Sediment" was discussed under the sub-title of human-induced coastal erosion as an erosion type that can be put into artificial erosions, but not encountered in any source that has been tested and measured before.

Within the scope of this subject, samples were taken from the locations specified in the report and the d50 radii of these samples were determined by sieve analysis. The aim here is to determine where and what type of sand is available by taking a look at the average radius scale of the coastline.

This process was completed by passing the collected sand samples through sieve analysis and determining the d50. Its coordinates were entered on the map, as described in the report, indicating the d50 radii. Then three different locations were determined, each with a different type of sand. By going to these designated locations, walking from the seaside to the upper part of the coast (this route is shown in detail in the report with photographs), the sand, gravel, etc. sediments collected while standing were washed on the tray and taken into the sample containers. Another remarkable thing here is that the amount of sand adhering to the body is higher on the coasts with smaller grain diameters. The same procedure was performed three times in all three positions. The same application was made by washing the feet carelessly. The reason for this is that it does not carry sediment by leaving the sea, the coast, like everyone else.

The samples collected from this experiment after the measurement were dried in the oven at 100°C for 24 hours to remove their wetness. Thus, the sands were dried in order to be able to measure accurately. At the end of 24 hours, each sample was

measured separately and noted how many grams they were. Again, these are given in detail in the report section. A dimensionless distribution was obtained by dividing all the results obtained after these measurements by the foot number of the person concerned.

The number of tourists coming to Alanya in the last months of the tourism season, which is official via the internet, is multiplied by 5, assuming that they have an average of 5 days of vacation, and assuming that half of the number of local people swim an average of 4 days a month, during each month (the months when tourism is active and swimming is possible). The average number of people entering the sea was calculated. By adding up the months calculated during the tourism season, how many tourists came in a year was also calculated and noted. By multiplying this result by the dimensionless results obtained by dividing the samples by the foot number, the amount of sand eroded per month was calculated. The calculations are also given in detail in the report. For each point, the samples of both people for the unwashed and carelessly washed feet were shown in a common graph, and the best and worst possibilities were determined and calculations were made according to these.

Considering the worst and best possibilities of each location and evaluating the best and worst possibilities of them, 77950 kg to 80 tons of sand at the worst, 13750 kg to 14 tons of sand at the best case, 13750 kg to 14 tons of sand with unwashed feet cause coastal erosion. is happening. This situation was calculated at very low levels on sloppy washed feet. Namely, at worst, 5610 kg of sand is eroded by transporting 800 kg of sand at best. As it can be understood from here, there is a big difference between the feet that are washed, even if it is sloppy, and those who leave the shore without being washed. These are the results calculated according to the dimensionless foot number.

It is known that the average foot size is 38 for women and 42 for men. From this, it can be said that the average foot number of both genders is 40. If the results found are multiplied by 40, it can be said that there is unwashed sediment from 550 tons to 3200 tons. This situation ranges from 32 tons to 225 tons on sloppy washed feet. Thanks to the studies carried out within the scope of all this project, it has been determined how much tourism-based sediment transport is.

As it can be understood from here, the difference between the amount of sediment carried by the unwashed foot and the amount of sediment carried by the poorly washed foot is obvious.

However, even with poorly washed feet, there is an annual risk of coastal erosion of up to 200 tons. The reason that affects coastal erosion so much should not be ignored. Human-induced sediment transport should be prevented by placing fountains at the coastal endpoints as close as possible.

4.2 Recommendations

Coastal erosion is a big natural problem that needs to be managed and planned for carefully. Here are some suggestions for how to deal with and stop beach erosion:

- 1) **Shoreline Protection Structures:** Building seawalls, groynes, breakwaters, and revetments along the shore can help lessen the damage caused by waves and stop erosion. But these structures should be built and put in place in a way that has the least amount of bad effects on the areas and ecosystems around them.
- 2) **Beach nourishment** is the process of adding sand or silt to beaches that have been worn down by erosion. This helps keep or repair the beach's natural shape and protects against erosion. It's important to get sand in a sustainable way and think about how much it will cost to keep up in the long run.
- 3) **Dune Restoration:** Dune sand dunes protect the land behind them from erosion by soaking the energy of the waves. By restoring and improving dune systems with methods like planting vegetation and stabilizing dunes, we can stop erosion and protect coastal habitats.
- 4) **Managed Retreat:** In some cases, it may be necessary to think about managed retreat, which involves letting natural coastal processes happen and slowly moving human infrastructure away from the eroding shoreline. This method needs long-term planning, participation from stakeholders, and thought about how it might affect communities and ecosystems.
- 5) **Coastal Planning and Zoning:** Putting in place good coastal planning and zoning rules can help control growth along the coast and stop people from doing things that make erosion worse. This could include setback standards, limits on hard

infrastructure near the water, and rules for building in a way that is good for the environment.

- 6) Erosion Research and Monitoring: It is important to keep an eye on shoreline erosion rates and processes on a regular basis so that decisions can be made in an informed way. Putting money into study and data collection helps people learn more about how the coast works, find places that are vulnerable, and come up with good ways to stop erosion.
- 7) Public Education and Awareness: Teaching people about coastal erosion, what causes it, and how it might affect them can help them feel like good stewards and act in a responsible way near the coast. Campaigns to educate people, get the community involved, and reach out to people can help spread sustainable practices and help protection efforts.
- 8) Adapting to climate change means being aware of how climate change affects shoreline erosion and putting adaptation plans into plans for managing the coast. This could mean that erosion control methods need to take into account rising sea levels, stronger storms, and other climate-related factors.
- 9) Collaboration and Partnerships: Coastal erosion is a complicated problem that needs government agencies, local communities, scientists, and other interested parties to work together. Encourage partnerships so that people can share their knowledge, skills, and resources in order to handle erosion well.
- 10) It's important to remember that the specific advice may change based on the area, the environment, and how bad the erosion is. It is important to talk to coastal experts, engineers, and environmental experts when coming up with site-specific and long-lasting ways to stop erosion.

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