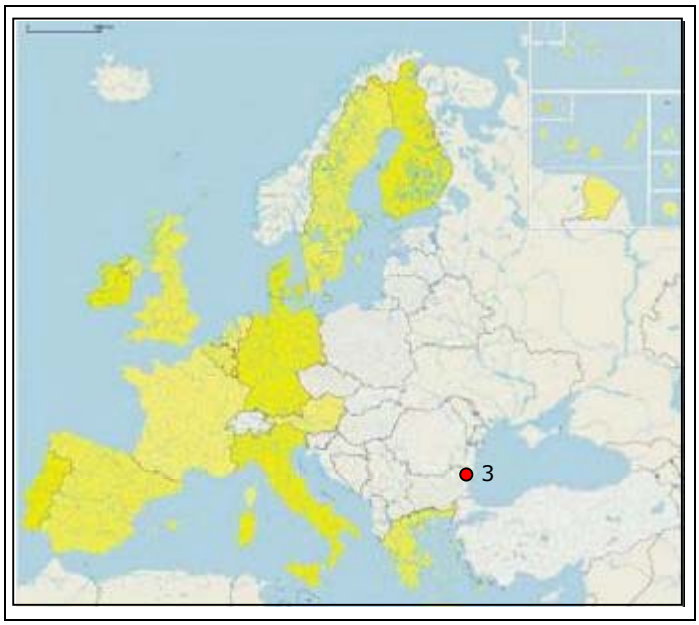
# SHABLA-KRAPETZ (BULGARIA)




Contact:

**Ms. Ivanka GOSPODINOVA**

**Technical Secretary of the Municipality**

Pavno Pole Str. 35
9690 Shabla (Bulgaria)

Phone: +359 057 432 045
Fax: +359 057 432 204

e-mail: obcshabla@infotel.bg

# 1. GENERAL DESCRIPTION OF THE AREA

The area of Shabla community covers the northern-most Bulgarian coastal municipality. It is bordering Romania to the North, the Black Sea to the East, Kavarna municipality to the South and General Toshevo municipality to the West. The area of the municipality is 329.97km$^2$ and constitutes 5.62% of the coastal zone of the country. The population of the municipality is 6,900 in 16 human settlements.

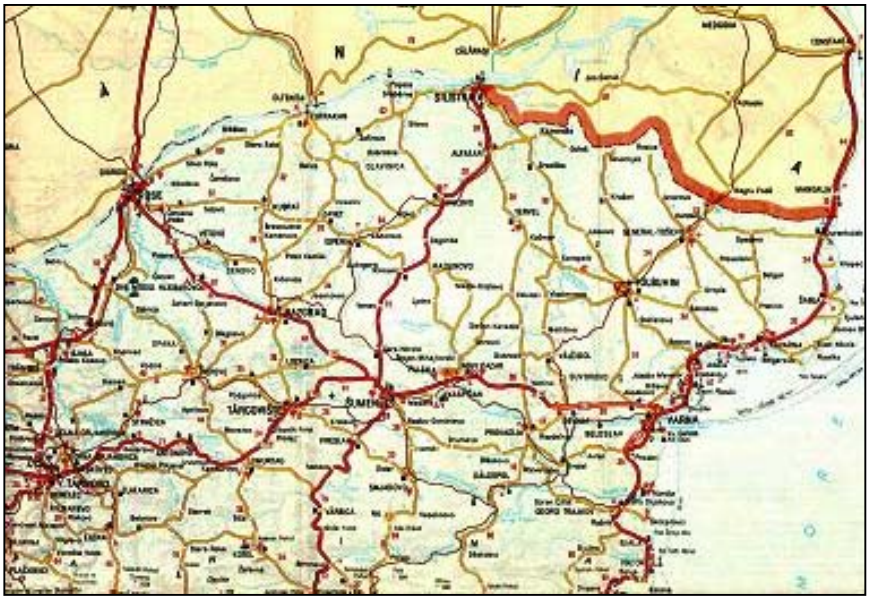


*Fig. 1: Location map of the north-east region of Bulgaria.*

## 1.1 Physical process level

### 1.1.1 Classification

- General: beaches and cliffs
- CORINE: beaches
- Coastal guide: coastal plain

### 1.1.2 Geology

The area is relatively simple from geological view point. Sarmat (Upper Miocene) deposits on top of lower Cretaceous and Vallange deposits. The Sarmat deposits are whitish, cavernous limestone located near the surface. The top consits of loess and loam, with a thickness of from several tenths of centimeters (in the East) to 15-20m in the Western part. In the coastal zone the loess cover is not present and the Cretaceous limestones are directly exposed.

*Fig. 2: The geomorphological structure of the Shabla coast.*

### 1.1.3 Morphology of the coast

The Shabla area is a low plateau, slightly elevated and inclined towards the sea. It is part of the so called Mizian plate. From the Romanian border (Cape Sivribouroun) to Cape Shabla there is relatively low coast with cliff segments formed in loess sediments and huge beach strips like Dourankoulashka and Shablenska Three firth lakes - Dourankoulashko, Ezeretzko and Shablensko - with an elevation of 50-80cm above the sea level are located in "drowned" valleys. From Cape Shabla to Kavarna bay the coast is a high abrasion coast with an active vertical cliff, which gradually increases height from 5-6m at Cape Shabla to 60m by Cape Kaliacra and then up to 120m by the town of Kavarna. There is almost no surface water flow from the area in the summer period.

**Sea Bottom**

The Bulgarian shelf comprises in its northern part a system of underwater sea terraces and smaller underwater sandy banks with drops between banks. The underwater coastal slope is covered mostly by rocky banks overlaid by a dynamic sandy layer. In the coastal zone down to 1,5m depth sandy deposits prevail. Some specific geological and geo-morphological features of the Bulgarian Black Sea coast are important for the purposes of coastal protection:

- Little average declination of the bottom from shoreline to isobath -10 m (Juan, Parlichev, 1979) which are positive factors for the construction of different kinds of coastal protection facilities.
- Availability of large number of rocky banks and reefs near to the shore which are a source for shelly material. These make irregular features which have to be accounted for in the constructions.
- Significant content of shelly component of more than 85% (Popov, Mishev, 1974), of the beaches from Cape Sivribouroun to Cape Shabla which shows the dominating role of the biogenic factor in the coastal sediment budget.
- Shelly beaches are located in the areas of capes and sandy beaches in the areas of bays (Figure 4).
- About 50 years ago very broad beaches (50-60m broad) existed in the area the cliffs were slant and afforested, suggesting that the biogenic factor's role on the coast is large (Parlichev D., 1998).

## Relief and shoreline

The area is plain, uniform and gentle sloped to the SE-E direction with a height from 0 to 100m above the sea level. The territory is part of Eastern Danube plain. From Cape Sivribourun to Cape Shabla the coast is low, with a combination of cliff sections and beach strips with dunes up to 18m high and 600m wide. From Cape Shabla to Tyulenovo village the coast consists of cliffs and gradually increases in height starting from 5-6m. The coast of the Shabla community area lies between the Cape Sivribourun (Bulgarian-Romanian border) and the border of Tyulenovo village. The coast is segmented in two zones - one between Cape Sivribourun and Cape Shabla and the second zone between Cape Shabla and Cape Kaliakra.

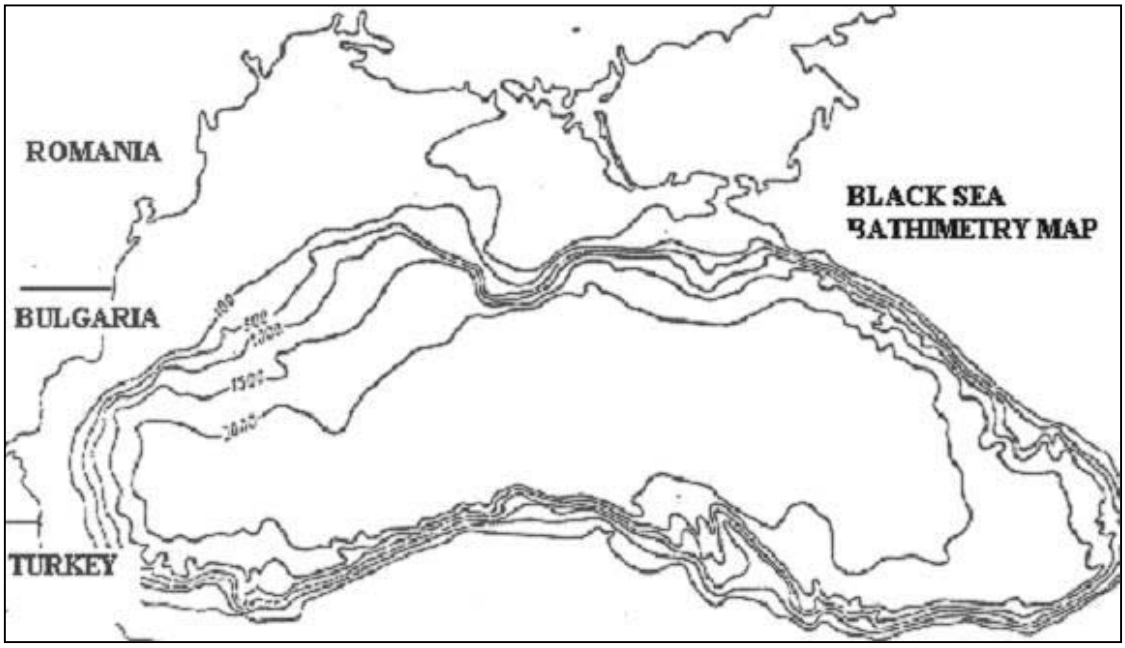



*Fig. 3: Bathymetry map of the Black Sea (Trimonis, 1973).*

The beaches in the area are predominantly plain or with dune structure. They constituted of fine sands and detritus (finely grounded mussel shells), typically about $D_{50}$ = 140 μm. The dunes have a total area of 133ha. The beaches according to the Territorial Management Plan of 1997 have total area of 197.6ha. This ensures the service for 197,000 visitors per day, following the Bulgarian norms of 8-12$m^2$ per visitor.

*Fig. 4: Sandy beaches and dunes covered by grass in Shabla area.*

### Landscape

According to the landscape-typological scheme of the country, the Shabla community area is classified as "landscape of the humus-steppe plains on the loess rocks", as "landscape of beaches and sea shores" and as "landscape of littoral lakes and swamps" (Petrov P., 1974). The territory of the municipality is divided in three major parts:

- Black sea coast around Shabla and the villages Dourankoulak, Krapetz and Ezeretz - huge beaches and dune fields, caves and karst rocky formations at the coast
- The area of freshwater lakes and swamps with unique natural qualities of authentic flora and fauna
- The area with low quality landscapes of rural type

## 1.1.4 Physical processes

The erosion factors include mainly natural driving forces - winds, storms, waves and sea level rise.

### Wind

One of the most important climatic factors influencing the coastal processes is the wind. The average yearly wind velocity in the area is: for Shabla – 3.6m/s and for Kaliakra – 6.7m/s, with anaverage yearly amplitude for Shabla – 2.1m/s and 3.7m/s for Kaliakra. The wind velocity by months and the average yearly wind velocity in m/s are cited in Tables 1 and 2.

***Table 1: Average wind velocity in m/s by months and by direction in Shabla.***

| Directions | I | II | III | IV | V | VI | VII | VIII | IX | X | XI | XII |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **N** | 6,2 | 6,3 | 5,2 | 4,6 | 4,2 | 4,3 | 3,4 | 3,7 | 4,5 | 4,3 | 5,0 | 4,8 |
| **NE** | 4,9 | 4,7 | 5,1 | 4,3 | 4,1 | 3,6 | 3,3 | 3,8 | 4,2 | 3,8 | 4,1 | 4,5 |
| **E** | 3,8 | 4,9 | 3,5 | 3,3 | 3,4 | 3,4 | 2,7 | 3,4 | 3,5 | 3,2 | 3,3 | 4,5 |
| **SE** | 3,8 | 4,5 | 3,9 | 3,9 | 3,4 | 3,0 | 2,8 | 3,3 | 3,1 | 2,1 | 3,4 | 4,1 |
| **S** | 4,8 | 4,5 | 4,2 | 4,1 | 3,6 | 2,9 | 3,3 | 3,3 | 3,3 | 3,1 | 3,9 | 4,4 |
| **SW** | 3,5 | 4,8 | 4,2 | 4,7 | 3,5 | 3,5 | 3,1 | 3,4 | 3,7 | 3,5 | 3,8 | 4,5 |
| **W** | 4,9 | 4,3 | 3,6 | 4,1 | 5,1 | 6,9 | 3,1 | 3,5 | 3,8 | 3,8 | 4,0 | 3,8 |
| **NW** | 6,0 | 4,6 | 4,5 | 4,3 | 4,3 | 3,6 | 3,6 | 3,7 | 4,3 | 3,7 | 4,9 | 5,1 |

***Table 2: Average yearly wind velocity in m/s.***

| Measurement Points | I | II | III | IV | V | VI | VII | VIII | IX | X | XI | XII | Yearly |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Shabla** | 4,7 | 4,2 | 3,7 | 3,8 | 3,6 | 2,9 | 2,6 | 2,9 | 3,1 | 3,3 | 3,7 | 4,3 | 3,6 |
| **Kaliakra** | 8,5 | 8,3 | 7,0 | 5,4 | 5,2 | 4,8 | 5,5, | 5,8 | 6,7 | 7,0 | 7,6 | 8,0 | 6,7 |

The wind frequency for Shabla is presented in Table 3. The periods of calm weather without winds are given in %.

***Table 3: Wind frequency by direction and in calm weather in % for Shabla.***

| Directions | I | II | III | IV | V | VI | VII | VIII | IX | X | XI | XII | Yearly |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **N** | 12,7 | 10,9 | 17,7 | 10,9 | 11,2 | 11,0 | 9,5 | 8,6 | 12,4 | 12,7 | 13,3 | 10,0 | 11,7 |
| **NE** | 7,9 | 9,4 | 16,7 | 15,5 | 14,7 | 14,3 | 13,8 | 17,5 | 12,2 | 15,4 | 14,7 | 9,9 | 13,5 |
| **E** | 2,2 | 3,3 | 4,4 | 5,2 | 4,3 | 5,9 | 6,1 | 4,5 | 7,3 | 6,4 | 7,0 | 4,9 | 5,1 |
| **SE** | 10,4 | 11,1 | 10,3 | 11,5 | 10,5 | 14,7 | 11,0 | 16,0 | 13,3 | 8,9 | 10,9 | 15,0 | 12,0 |
| **S** | 6,9 | 6,5 | 6,6 | 10,7 | 12,9 | 8,3 | 8,0 | 6,8 | 8,4 | 7,9 | 7,4 | 9,1 | 8,3 |
| **SW** | 13,6 | 20,0 | 14,5 | 18,6 | 19,3 | 14,2 | 11,5 | 8,9 | 9,7 | 15,0 | 14,9 | 13,5 | 14,5 |
| **W** | 6,0 | 8,6 | 4,9 | 6,4 | 6,3 | 8,6 | 7,4 | 10,1 | 5,4 | 8,4 | 8,6 | 7,6 | 7,3 |
| **NW** | 40,3 | 30,0 | 25,0 | 21,2 | 20,9 | 23,2 | 32,8 | 27,6 | 31,3 | 25,3 | 23,1 | 30,2 | 27,62 |
| **CALM WEATHER** | 15,5 | 11,6 | 13,8 | 14,9 | 17,2 | 22,4 | 29,1 | 26,7 | 24,0 | 17,4 | 18,1 | 14,9 | 18,9 |

The wind roses clearly show the situation throughout the year , and display the crucial role of winter winds and storms for the coastal erosion.

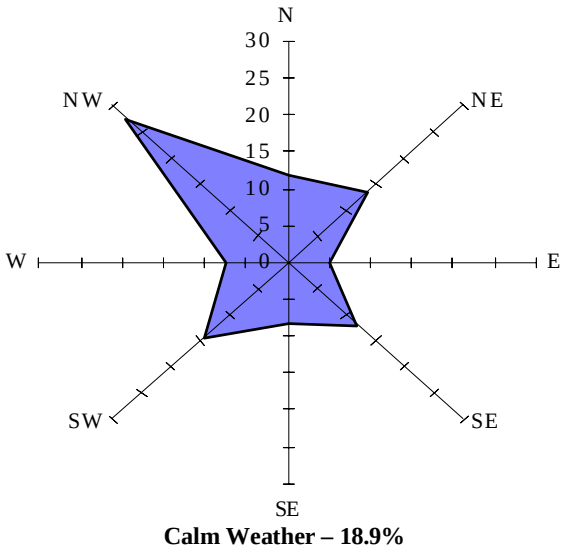



*Fig. 5: Wind Yearly Distribution in %.*

## Waves, Currents and Deposits

The wave activity corresponds to the intensive winds and depends highly on the winter storms. Under the influence of the wave activity and the rough sea shore longitudinal streams are generated with a North-South direction. Observations have shown that although the possibility of sediment transport exists, there are no deposits in the Shabla coast coming from Danube river or from other rivers in the region. The Danube sediments pas the shore several kilometers offshore and does not form beach strips.

The rough sea results in the take up and transformation of the main component of deposits - mussel shells. The processed shells are deposited in the zones with proper geo-morphological conditions and accumulate in forms and bodies. The disturbance of the natural process of the development of these forms leads to seasonal or yearly trends of increase or decrease of the beaches. A tendency of decrease in area and volume per meter exists in Krapetz village, Krapetz - South and Shabla. The relief of the beaches and shoreface was transformed after the intensive storm activities in 1979.

There is significant influence of the seasonal fluctuations of sea level. In autumn and winter under storm conditions the sea level rises and in summer the level falls. The sea level fluctuations are approximately 10-15cm and they move the zone of wave breaking nearer to the coast during storms. The most dangerous sea level rise result from the wind drive on the water masses, sharp changes in the atmospheric pressure and long-period waves with seismic origin. An unusual and rare level rise of more than 2m was observed in February 1979 (Belberov et al., 1982).

## Global Climate Change and Sea Level Rise

As a result of the global climate change it has been found that the sea level at Bulgarian Black Sea coast rises with 3mm/yr (Markov et al., 1991). In a long-term perspective, the expected sea level rise in 2100 will be not less than 15cm, and the most probable result will

be 48cm (Wigley, Raper, 1991). Following the widely used Bruun rule a rise of the sea level by 1cm leads to a displacement of the coast inland of 30cm (Bruun, 1962).

### 1.1.5 Erosion

The most typical engineering-geo-dynamic processes in this area include:

- Sea abrasion (erosion) - the most important factor for coastal erosion.
- Waves and wind (weathering) erosion of the beach strip and nearby dune fields.
- Landslides, as a result of the sea abrasion and the combined influence of waves and winds.
- Demolition, as a result of the same factors cited above.
- Flat-bottomed erosion.

**Natural and anthropogenic factors for the activation of landslide processes**

The northern Black Sea coast can be divided to two geo-dynamic zones, based on the data for the morphology and geological texture. The gravitational processes and deformations in the two zones have different mechanism of formation, defined by their leading factor of morphogenesis (Stoykov et al., 1998).

The first geo-dynamic zone comprises the coast from Bulgarian-Romanian border (Cape Sivribourun) to the town of Balchik and includes the Shabla Community Area. This coast has the character of a cliff. The first district of the this zone comprises the coastal strip from the Bulgarian-Romanian border to the Cape Shabla. Passive factor for the constant landsliding - demolishing processes are the dusty-sandy loess sediments. The active factor directly dictating landslides-demolishing processes is the abrasion impact of the rough sea (waves). The slope deformations because of the abrasion and the gravity lead to the expansion of cracks and to landslides of huge packages of the coastal cliff which are completely washed away by the sea. The sections of Shabla Community Area coast with such character are the Cosmos Camping, and Krapetz and Shabla shores. The long-term monitoring of this coast shows that the landslide indentations move landward with an average rate of 0,3m/yr, but with a rate of 2m/yr in certain sections (Peichev, 1998). The most active and speedy gravitational processes take place under the influence of extreme stormy situations caused by North-East winds with a velocity of 10m/s and a duration of 80 hours. Typical examples were the powerful storms in the area to the North of Cape Shabla in October 1976 and January 1977 when the coastal line went landward from 3 to 10m (Vassilev, 1978). Around 50,000$m^2$ arable lands were washed away and the demolished and washed away loess reached 250,000$m^3$. There exists a threat for the lighthouse facilities and for some surrounding buildings This example shows that in coastal protection activities are needed against the periodic storms.

The second district of the first geodynamic zone comprises the coastal zone from Cape Shabla to Cape Kaliakra. It is characterized by the vertical cliff built up by steady cavernous Sarmat limestones. Its height starts from several meters (5-7-9m) at Cape Shabla and then increases up to 50-60m at Cape Kaliakra. The dynamics in this district result from two main factors - active influence of the abrasion processes and tectonics. The landslides have a linear-block character and they are located along the length of sub-parallel listric fault structures. The faults have developed because of the existence of clearly defined expansion tensions (Alexiev et al, 1993).

The anthropogenic factors which influence coastal erosion are: construction of ports and navigation channels, some coastal protection facilities. In this area the human activities are negligible, because there are no active economic development activities along the coast.

## Erosion Types and Factors

The main factors for the coastal erosion in the area are natural and they are described briefly:

1) Chronic sea abrasion (erosion) in the area has rates from 0.35 to 1.40m/. In the section between Cape Sivribourun and Cape Shabla the abrasion rate is 0.30m/yr, but in certain sections at Cape Shabla and Cape Krapetz reaches 1.5-2.0m/yr. The total abrasion area is 3,800$m^2$ which leads to decrease of the precious arable agricultural lands in this section. Between Cape Shabla and Cape Kaliakra the abrasion rate is 0.05m/yr and the abrasion area is 1,300$m^2$. The abrasion data for the area is included in the Tables 4 and 5. This data shows that the abrasion rate in this area is among the highest along the Bulgarian Black Sea coast.

From the beginning of 1983 the Institute of Oceanology-Varna has undertaken systematic measurements of the abrasion processes along the Bulgarian Black Sea coast. The Shabla area is divided in five abrasion sections having the total length of 12.5km and the results have shown the following rates of the abrasion with certain approximation:

- Section 1 - Sivribouroun - 10cm/yr
- Section 2 - Kartalbouroun - 8-10cm/yr
- Section 3 - Krapetz - 10cm/yr North of the Cape Posta, 120cm/yr the little bay to the North of the village and more than 200cm/yr to the South of the Krapetz village
- Section 4 - Camping Dobroudzha - 10-15cm/yr
- Section 5 - Shabla - 25-30cm/yr (Vassilev T., 1988)

***Table 4: Abraded Material from Shabla Community Area Coast.***

| № | ABRASION ZONE OF THE COAST | LENGTH (km) | AVERAGE ABRASION RATE(m/yr) | ABRADED AREA ($m^2$/yr) | ABRADED VOLUME ($m^3$/yr) | MASS x $10^6$ (kg/yr) |
|---|---|---|---|---|---|---|
| **1** | **Cape Sivribourun - cape Shabla** | 12,5 | 0,30 | 3796 | 42068 | 61,0 |
| **2** | **Cape Shabla - cape Kaliakra** | 25,8 | 0,05 | 1290 | 22446 | 56,6 |
| **TOTAL** | | 38,3 | - | 5086 | 64514 | 117,6 |

***Table 5: Abrasion Data for Shabla Community Area Coast.***

| № | ABRASION ZONE OF THE COAST | TIME PERIOD | NUMBER OF ABRASION POLYGONS | TOTAL LENGTH (m) | ABRASION RATE (cm/yr) | | |
|---|---|---|---|---|---|---|---|
| | | | | | Min | Max | Average |
| **1** | **Cape Sivribourun** | 1983-92 | 11 | 612 | 1 | 30 | 15 |
| **2** | **Cape Kartalbouroun** | 1983-94 | 6 | 272 | 6 | 23 | 11 |
| **3** | **Dourankoulak** | 1989-92 | 3 | 447 | 16 | 23 | 19 |
| **4** | **Cape Krapetz** | 1983-97 | 17 | 1222 | 9 | 166 | 43 |
| **5** | **Camping "Druzhba"** | 1985-94 | 7 | 375 | 9 | 15 | 12 |
| **6** | **Cape Shabla** | 1983-94 | 8 | 1142 | 15 | 164 | 43 |
| **7** | **Cape Kalkantepe** | 1987-94 | 9 | 532 | 2 | 24 | 14 |
| **8** | **Topola** | 1986-92 | 2 | 90 | 10 | 13 | 11 |
| **AVERAGE DATA** | | 10 years | 8 | 586 | 8 | 57 | 21 |

2) Chronic flat-bottomed erosion **-** in this area there are not enough observations and measurements of this type of erosion although it is a factor in the processes along the Shabla coasts.

3) Chronic wave and wind erosion of the beaches and dunes.

4) Periodic storms - maximum rate of the cliff abrasion was fixed to 7m/yr after the storm in 1979.

5) Longshore currents with a resulting energy component in the direction North-South because of the wave activity.

6) Surface and linear erosion with maximum cliff washing away rate of 0.18m/yr; the yearly rates are stable, and for a section of 13km long of cliffs and active destruction area of 0.182km$^2$ of eroded materials are 149.3m$^3$/yr measured from 1986 until today.

7) Earthquakes and seismic activities **-** the effects on the area are not so significant because they are influencing the erosion process for relatively short time in and after the earthquakes. The impact on the area is high, but fortunately such events are not happening very often.

## 1.2 Socio-economic aspects

### 1.2.1 Population rate

The municipality is small and has a population of 6,900. This means a low population density of 21.2 inhabitants per km$^2$; for Bulgaria, the average rate is 81 inh/km$^2$. There are 15 villages and one town in this municipality.

### 1.2.2 Major functions of the coastal zone

Summarized information for the yearly economic activities of Shabla municipality is given in Table 6 based on the data for the years 1993-2002.

***Table 6: Economic activities in the area.***

| Sector of Economy | Fixed Assets (Million €) | Sales Income (Million €) | Total Income (Million €) |
|---|---|---|---|
| **Industry** | 14,4 | 4,1 | 4,2 |
| **Construction** | 4,6 | 1,6 | 1,8 |
| **Agriculture** | 52,4 | 65,7 | 78,4 |
| **Transport** | 3,6 | 2,1 | 2,1 |
| **Commerce** | 6,8 | 1,6 | 1,9 |
| **Tourism and Recreation** | 3,1 | 1,3 | 2,3 |
| **Housing and Domestic Services** | - | - | - |
| **Total** | 84,9 | 76,4 | 90,7 |

- **Water Supply Network***:* the Shabla municipality has 57km of intercity water supply network, 80km intracity water supply network, and one waste water treatment plant in Shabla town.
- **Industry***:* local small scale oil production - up to 50tons/day of oil with specific gravity of 938kg/$m^3$ from an oil field on land and under the sea of about 50$km^2$. Small light and food industry enterprises.
- **Agriculture and Forestry***:* agricultural fund – 25,800ha of arable lands, 2,400ha are meadows and pastures. Forests - over 1,747ha, mainly artificially planted for the protection of the agricultural land (about 80ha of the forests are protected forest areas). Main economic sector – agriculture, stock-breeding and field-farming.
- **Tourism and Recreation***:* resort formations - 3 camping sites, one school resort camp and 7,409 beds registered in private lodgings. Hunting and fishing tourism is developed in the area. There are perspectives for the development of rural and environmental tourism (Private) and an environmental training and information center already functions in the municipality. The perspectives of the tourism are planned in the fields of cultural and historic heritage, rural tourism and underwater tourism.
- **Medical Care and Medical Treatment***:* in this municipality there are 4 medical establishments and a number of general practitioners cabinets..

*Fig. 6: Small Hotel and Camping Fish Restaurant in Shabla Municipality.*

- **Transport**: transport infrastructure consists of 308km first class roads, i.e. 27%, 12.5% - second class roads, and 68% are the fourth class roads, one airport for

agricultural operations, bus central station, border crossing point Dourankoulak to Romania. The total density of the road network is 34.9% - relatively low one because of the low level of urbanization and predominantly rural type of development. About 40km of railroads and connections with the national rail-road network. Important international road I-9 or E-87 is the coast-longitudinal part of the old route North-South or so called Varyag route from Istanbul to Scandinavia.

- **Urbanization - Safety of People and Investments***:* main urbanization axes is a part of European corridor 1-9 "North-South" - international; road E-87. This axes "cuts off" an Eastern zone with resort, recreation and entertainment functions. The relatively low urbanization level has positive and negative aspects. Positive factors are that not very huge amounts of capital are endangered by erosion, but their value is still significant by the national and local point of view. To receive some impression about the capital under potential threat we have to know that the investments in tourism, recreation, fisheries - hotels, camping sites, restaurants, different kinds of buildings in the endangered shore sections have been.
- **Fisheries and Aquaculture-Exploitation of Renewable Natural Resources***:* fisheries are developed for the supply of the local population and tourists only. There are no aquaculture enterprises in the area. Some conflicts exist between the interests of local fishermen and the restrictions imposed on the fishing in protected areas.
- **Nature Conservation***:* two very valuable protected areas are established here - Dourankoulak lake as natural beauty - wetlands area - protected as a RAMSAR Convention object with 350ha and Shabla protected area of 510ha including Shablensko and Ezeretzko lakes. The total protected area is over 1000ha.

### 1.2.3 Land use

The land-use includes the prevailing role of agriculture and forestry and relatively small urban use for housing, tourism, fishing and transport. The land-use plan approved in 1997 establishes main ICZM principles. According to Bulgarian legislation and traditions this is the most effective tool for territorial and coastal management. The development of the municipality is planned in two directions - environmentally clean agricultural production on the onde side and coastal tourism, recreation and medical treatment with a priority of the existing rich stocks of medical muds and hydro-mineral resources on the other side. Based on this strategy two functional zones have been formed:

- *Zone 1* - North-East from the town of Shabla - a zone for tourism and medical treatment.
- *Zone 2* - "Dispersed" objects connected with the sea - North-East from Dourankoulak village, around Krapetz village and around the Cape of Shabla.

### 1.2.4 Assessment of capital at risk

This evaluations are approximate, especially when it comes to quantitative components of the coast and natural and environmental values. As an example we have tried to calculate the components of the local capital at risk and the real and possible losses of capital about Shabla area. Table 7 show a very rough estimate of the capital at risk.

The main problem in the definition of the capital at risk is that there are a lot of conditions and factor to be accounted for in the estimate. First of all the prices - the standard of living is a variable factor and the economic development and political changes have lead to a

constant increase of prices. Some of these will change again in the near future as the country is preparing to become member of EU. There are also fluctuations in income from tourism varying from year to year, with a dependence on the management and tax systems. It is especially difficult to evaluate a number of elements which are under threat like:

- Human life.
- Loss of beaches and dunes, which could not be sold in the country being exclusive public property.
- Loss of rocky coastal cliffs.
- Monuments of culture and history.
- Parts of protected areas.
- Lakes, limans, wetlands.
- Harmful changes of the landscape.
- Loss of natural resources.
- Loss of living resources.
- Loss of biodiversity.
- Loss of future economic activities - tourism, services, fisheries, oil production.
- Loss of intellectual values - culture, history, local habits and traditions.

In such cases there is a need of a complex evaluation system. The problem in such cases is to estimate both qualitative and quantitative characteristics of the coasts, of their natural and man-made components.

***Table 7: Description of the Shabla area Capital at Risk in Million €.***

| № | TYPE OF CAPITAL | TOTAL PRICE | YEARLY LOSSES | FUTURE INCOME LOST-10yr | REMARKS |
|---|---|---|---|---|---|
| **1** | HOUSES | 15,0 | 0,5 | 10,8 | |
| **2** | FISHERMEN'S HOUSES | 8,8 | 0,3 | 3,6 | |
| **3** | BOATS/EQUIPMENT | 4,6 | 0,6 | 6,5 | |
| **4** | LIGHT SUMMER HOUSES | 12,3 | 0,9 | 10,6 | |
| **5** | SECOND HOMES | 1,4 | 0,1 | 0,6 | |
| **6** | SMALL HOTELS | 3,6 | - | 4,5 | |
| **7** | RESTAURANTS, CAFES | 5,8 | - | 3,6 | |
| **8** | ROADS | 3,8 | 1,4 | 2,4 | |
| **9** | INFRASTRUCTURE OBJECTS | 1,6 | 2,5 | 4,6 | |
| **10** | PORTS INCOME | - | 0,04 | 4,0 | |
| **11** | AGRICULTURAL LAND | 60,0 | 0,1 | 20,0 | |
| **12** | BEACHES/DUNES | ?20,0 | - | - | |
| **13** | ROCKY CLIFFS | ?15,0 | - | - | |
| **14** | HISTORIC/CULTURAL HERITAGE | ?10,0 | - | - | |
| **15** | LAKES/SWAMPS/WETLANDS | 10,5 | 1,5 | - | |
| **TOTAL** | | 172,4 | 7,94 | 71,2 | |

# 2. PROBLEM DESCRIPTION

Coastal erosion is one of the most important problems , because Shabla municipality's coast is the most actively exposed part of the Bulgarian Black Sea coast . Because of its geological character it is vulnerable and suffers constant significant losses of fertile land and natural beauty. Two cases will be discussed about this community area - Cape Shabla coastal protection and cape Krapetz coastal protection schemes. Many characteristics of the erosion sites are similar.

## 2.1 Eroding sites

*Cape Shabla* is one of the symbols of this community with its specific lighthouse, more than 250 years old, picturesque bay, two traditional fishermen's villages - North and South, and the oil production trestle. Erosion is threatening excellent beaches in *Krapetz bay*, the village at the coast, the coastal lands and parcels used for recreational purposes, for agriculture, for infrastructure services, the landscape values. The erosion process consists of abrasion, demolition and landsliding of the cliffs and dilution of the material and washing it into the sea.

## 2.2 Impacts

The negative impacts of the erosion have significant influence on:

- Fishing - all this craft here is under constant threat of material loss and technical problems which are stopping and hindering the work of the local fishermen.
- Tourism - sites are used for tourists lodgings all the year.
- Commerce and services connected with fisheries - restaurants, hotels, camping sites, all the tourism infrastructure.
- Agriculture - loss of fertile land and the crops.
- Loss of valuable coastal areas, protected by environmental and other legislation.
- Landscape diversity loss.
- Infrastructure suffers the loss as direct expenses and brings troubles to users (like the threat of the III class road Shabla-Tyulenovo-Kavarna).
- Significant local and national capitals are under threat of total or partial loss.
- In general directly or indirectly all the wellfare of local population is threatened, as is the comfort of the tourists.

# 3. SOLUTIONS / MEASURES

## 3.1 Policy options

The policy option used in the both cases is a combination of hold the line and managed realignment in some sections of the coast. Mainly hard measures with certain use of soft measures are used .

## 3.2 Strategy

### 3.2.1 Approach related to the problem

In Bulgaria different solutions were used to fight coastal erosion. The tendency for the last ten years is that the local managers were forced to develop tourism as one of the best options for coastal development. The managers needed to seek complex and multifunctional solutions to ensure multiple effects from the inevitable investments on coastal protection. The strategy adopted consists on using mainly hard measures with certain use of soft measures.

### 3.2.2 Issues concerning threat to life and property

For coastal municipalities one of the main risks is the erosion and disasters connected with the sea, so the emergency planning includes all the necessary measures before and after a disaster - technical measures, financial measures, health care, support for the suffering people, accommodation measures, evacuation. Insurance system in the country is traditional. There is a significant chang, but people and organizations are relatively slow to adapt to free market economy and the new role of the insurance schemes. The risk of erosion is relatively high, and the insurance schemes are not flexible enough. The financial support of the people after a disaster could come as grants from a specialized national fund for disasters, from the municipal disaster funds, and from disaster loans supplied by a banking system.

## 3.3 Technical measures

### 3.3.1 Type of measures/ technical details

For Cape Shabla site a plan and a construction project was ordered by the municipality to work out a comprehensive urban plan of the fishermen villages including coastal protection facilities and one small port (for fishermen and yachts) and the necessary infrastructure:

Cape Shabla Coastal Protection - North

- Rocky embankment protection dike with L=200m (Stage I).
- Low jetty with L=40m (Stage I).
- Construction of a high pier with L=110m (Stage I).
- Concrete wall with L=105m (Stage II).
- Berth with L=125m (Stage II).

Cape Shabla Coastal Protection - South

- Rocky embankment protection dike with L=250m.

Shabla Fishermen's Village - South

- Shabla Port - planned for 113 boats, 44 yachts and 6 motor cutters for local tourism trips.


*Fig. 7: Cape Shabla Coastal Protection Scheme and structure of the barrier pier.*

In the case of Krapetz bay the project includes the coastal protection facility and a small port for fishermen, yachts and local tourism purposes.

Krapetz Bay Coastal Protection (Stage 1)

- Concrete wall with L=560m - built in two sections: I-with L=375m and II-with L=185m.

Krapetz Bay Coastal Protection (Stage 2)

- Dike with L=258m.
- Concrete wall with L=258m.

- Jetty 1 with L=85m to be constructed for its use as a berth to serve local fishermen's village of Krapetz and their boats.
- Jetty 2 with L=31m.

Krapetz Bay Coastal Protection (Stage 3)

- Dike with L=693m.

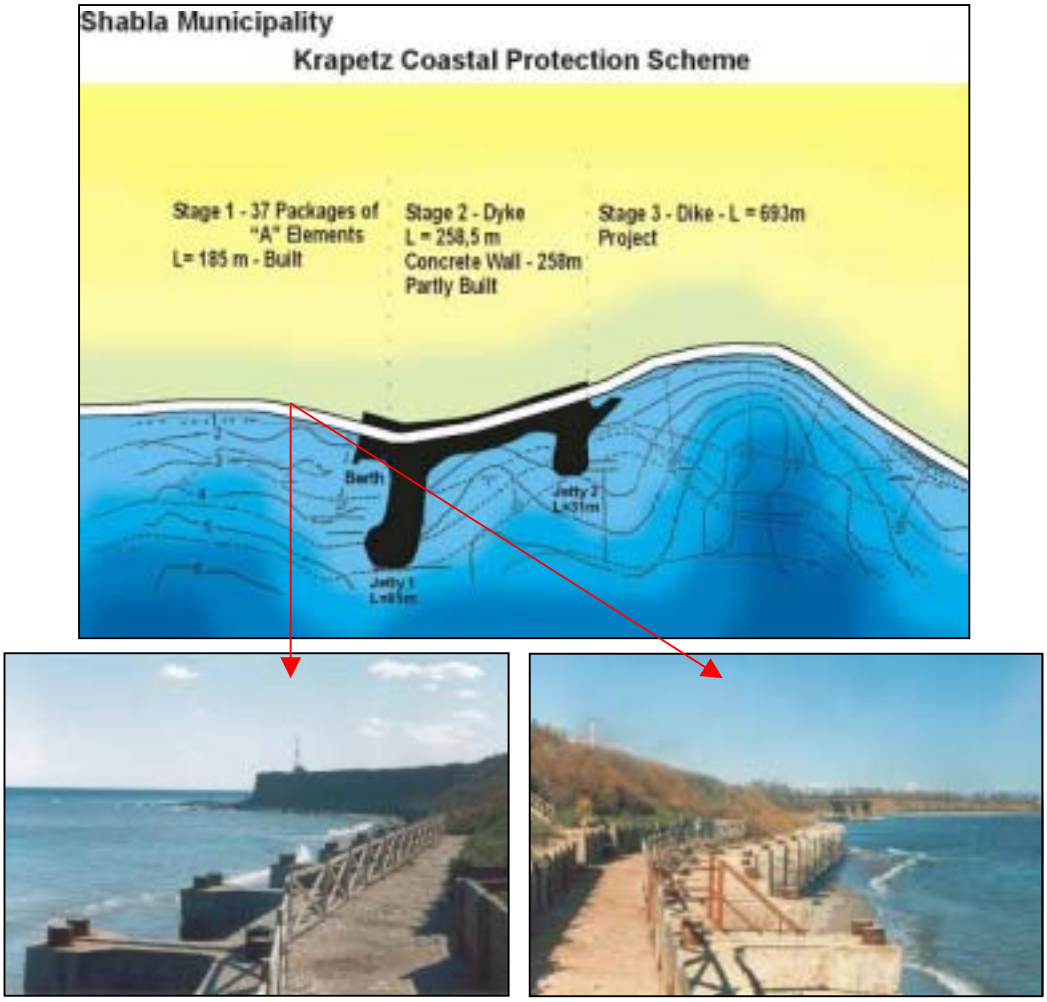



*Fig. 8: Cape Krapetz Coastal Protection Scheme and structure of the protection facilities.*

### 3.3.2 Costs

Different sources, procedures, and factors influence the investment processes. For example, Table 8 gives the investments from the Ministry of Regional Development, which is responsible for mitigation of landslides, but in certain periods the financing of coastal erosion could come from other state agencies, enterprises or other sources. For example, the protection of agricultural lands would be funded by the the Ministry of Agriculture.

***Table 8: National Investment Program for Landslide Coastal Fortification.***

| **NATIONAL INVESTMENT PROGRAM IN LANDSLIDE COASTAL FORTIFICATION AT THE BLACK SEA COAST FOR THE PERIOD 1999 - 2003** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **№** | **MUNICI-PALITY** | **HUMAN SETTLE-MENT** | **OBJECT - DISTRICT** | **YEARLY INVESTMENTS IN Million €** | | | | | **TOTAL** |
| | | | | 1999 | 2000 | 2001 | 2002 | 2003 | |
| **1** | **SHABLA** | Krapetz village | Coastal Fortification - Krapetz Village | - | 50 | 75 | 75 | 50 | 250 |
| **2** | **SHABLA** | Shabla town | Shabla Coastal Fortification III Stage-Fishermen Village North, I Stage | 50 | 50 | 50 | 50 | 50 | 250 |
| **3** | **SHABLA** | Shabla town | Shabla Coastal Fortification III Stage - Fishermen Village South, I Stage | - | - | - | 50 | 50 | 100 |
| **4** | **SHABLA** | Shabla | II Stage-Working Phase Project | 0,6 | 0,8 | 0,4 | 0,2 | 1,2 | 3,2 |
| **Total per Year** | | | | 50 | 100 | 125 | 175 | 150 | 603,2 |

# 4. EFFECTS AND LESSONS LEARNT

## 4.1 Effects related to erosion/ neighbouring regions

For Cape Shabla, the erosion process has stopped and it is really holding the line. The negative effects on the coast in neighbouring sections have not been observed. The supporting expenses are very small now, but if the project is not built to the end the expenses will increase and the nature will destroy the protection fully in 5 to 10 years.

Fortunately for Krapetz, the existing wall is located directly before the village and the effects are clear - the erosion stopped, the roads and houses near to the shore are safe and a small park has been developed. There is no change in the quality of the beach before the wall, and not serious changes in the sea bottom near the beach. The direct results reached after the dikes have been built are the following: the shoreline stopped its landward movement, the landslides stopped their activity near shore and there are no more losses of fertile agricultural land.The problem proceeds on the unprotected part of the bay, where the erosion process is very active and losses of the fertile land posse a significant threat for the local community.

## 4.2 Effects related to socio-economic aspects

In both cases, the effects in socio-economic aspects are the following:

- Increased safety of the people.
- Safety of the investments mainly in tourism, housing, fisheries, industry.
- Increased safety of the environmental values.
- Safety and decreased loss of infrastructures.
- Decreased loss in tourism and fisheries.
- Increased standard of living of the local population.
- Threat for the fishermen's boats decreased.

Of course the aesthetics of such the facility are far from the natural beauty of the area. But there has to be a compromise between the natural beauty and the coastal protection facility.

## 4.3 Relation with ICZM

The problem of coastal protection here is treated in a best possible way and in harmony with all the interests at the coast and with the participation of all the stakeholders. For Shabla municipality was developed a Danish-Bulgarian ICZM Planning project in 1992, followed by the Bulgarian ICZM Program supported by the Bulgarian government . Also
the Black Sea Environmental Programme developed an ICZM component. The Shabla municipality was involved in all these programs and projects and it has now up-to-date territorial management plan where all the future developments and sectoral strategies are balanced.

## 4.4 Conclusions

### Effectiveness

- The protection is effective. However, parts of it are in the process of further construction, and the final results have yet to be evaluated.
- The main goals have been reached - losses of the shore stopped, the risks for the people and for the capital investments have decreased.
- The interests of local community are adequately protected.
- The positive effect has been reached showing the advantages of the adopted protection strategy.
- Certain direct economic results as economy of the expanses for restoration of damages has been reached.

### Possible undesirable effects

- Negative effects are connected with the aesthetics because the concrete walls and the stony dikes are not compatible with the normal natural landscapes in this area.

### Gaps in information

- Necessity of permanent monitoring of the environment and the effects of the coastal protection measures and facilities - The finances for the monitoring activities lack.

# 5. REFERENCES

**Bulgarian ICZM Report, BSEP (1996-97).**

**International Project " ICZM of the Shabla Municipality" (1992).**

**International Scientific Conference "Mineral and Recreational Resources of the Bulgarian Black Sea Coast" (1988).** Varna, Bulgaria, 17-19 September**.**

**Marinski, Y. *et al.* (1998).** *Protection and Long-term Stabilization of the Slopes of the Black Sea Coast*, Academic Publishing House, Sofia.

Proposal of the Shabla Municipality for Coastal protection. Investments to the Ministry of Regional Development of Bulgaria, Dobrich, 11.11.2000.

**Shabla Land-use Plan and GIS (1995).**

**Shabla ICZM Plan (1994).** Draft version.

**Shabla Pilot project for environmental management, PHARE - Tacis Project (1995).**

**Shabla Municipality (1990-2002).** *Shabla Coastal Protection*. Projects and Documentation.

**VIG Engineering Co. (1997).** *Territorial Management Plan of Shabla municipality*, Vol. 3, GIS, Final project, Sofia, April 1997.

П. Петров - Райониране на България на ландшафтно - типологична основа, 1974 г.

Черно море - сборник, Издателство "Г. Бакалов", Варна, 1978.

НЦТРЖП - ЗРП на северно рибарско селище на нос Шабла, Община Шабла, 1994 г.

УАСГ - сектор за проучване и проектиране, Застроителен план на южно рибарско селище на нос Шабла, Община Шабла, София, 1996 г.

Община Шабла - Работен проект на обект Брегоукрепване на къмпинг Космос, с. Дуранкулак, Геозащита-ООД, Варна, 2001 г.