Soil erosion and its effects on the transportation and the modern sedimentation in Turkey

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Turkey is one of the countries subjectea to the intense erosion in the World. According to the data, at least more than 50 per cent of the total land of Turkey has been prevailed to the soil and the parent material erosion of several types. The amount of total suspense sediments transported by the rivers are about 380 million tons / year. Europe is 13 times bigger than Turkey and the yearly transported sediments are nearly 320 million tons. The annually average sediment yields of the watershed area of Turkey is more than 600 tons/km^2 or 1600 tons/mi^2. This figure is very high when compared to the other countries and continents of the World. Namely the measured and estimated sediment yields of the contitents such as Africa, Europe and Australia appear to be very low, averaging 70, 90 and 115 tons per square mile/each year, respectively. North America has the lowest with 160 tons per square mile; South America is a moderate sediment producer with 245, and the highest producer of sediment is Asia with 1530 tons/ mi^2. These data clearly indicates that severe or intense erosion, transportation and sedimantation events have been continuing in Turkey.

This article has been prepared in order to explain the erosion, transportation and modern sedimantation in Turkey.

I— FACTORS AFFECTING THE EROSION

The main causes of creating the soil and the parent material erosion will be explained in the following headlines.

1— WRONG LAND—USE

The main economic activities of Turkey are based on agriculture ana cattle-breeding. Especially closed economic system continued from the historical time until recent years, although development in the industrial sectors in Turkey. The natural forests were severly destructed and degenerated by the people who lived in the rural areas to provide timber for bulding their own houses and to supply

fuel for the mines and forests and range lands were converted into agricultural lands to obtain food. Thus the most part of the natural forests and rangelands were converted into agricultural areas because of wrong land use.

The land capability classes of I, II, and III cover an area of 24.8 per cent (or 19 345 569 hectares) of Turkey. As it is known these lands are suitable for safe cultivation without much intensive conservation measures. The land capability the 4th class covers 9.3 per cent of the total land of Turkey. The lands of class V, VI and VII which should definitely be under permenant natural vegetation cover an area of 65.4 per cent of the whole country (Table 1).

Table 1: Results of land capability classification in Turkey(1).

Major land-use suitability	Land capability classes	Area		Total Area	
		Ha	%	Ha	%
Suited for cultivation	I	4 973 162	6.5	26 374 593	34.6
	II	6 705 943	8.8		
	III	7 532 049	9.9		
	IV	7 163 439	9.4		
Not suited for culvitation	V	165 076	0.2	49 750 738	65.4
	VI	10 189 857	13.4		
	VII	36 232 151	47.6		
	VIII	3 163 654	4.2		
Total		76 125 331	100.0	76 125 331	100.0

(1) After DPT, 1976. Lakes are excluded from the total area (after Balcı and Uzunsoy, 1980).

But, actually the land capability of class V, VI and VII which are unsuitable for agriculture, are under agriculture and the most effective mistake in the pratice of land use which contributes to soil erosion hazards, has been the use of V, VI and VII capability classes of land for various agricultural pratices without any soil conservation prevents. About 6.1 millon hectares of V, VI and VII capability classes of land in Turkey have been under misuse or various agricultural practices without conservation measures. Thus, wrong land use system are dominant in Turkey. Soil and parent material erosion in active on the capability classes of V, VI, and VII. due to wong land use and without any soil corservation measures (Table 1, 2 and 3) For example, especially cultivated lands of VI and VII. are subjected to the intense soil erosion and the parent material is exposed due to the intense erosion so that some parts of the lands are converted to VII class land where parent materials are composed of hard limestone, quarzite and cristalline schistes. These lands are seen on the Taurus Mountains and on some paleozoic massive of Turkey.

Table 2: Present land use in Turkey. (After Topraksu, 1975; Balcı and Uzunsoy 1980).

Land - Use Types	Area	
	Hectares	Percent
Cultivated land	27 699 003	35.6
Range and Pasture land	21 170 196	28.0
High and low forests(1)	20 468 463	26.0
Maquis and shrubs	3 298 267	4.2
Urban areas	569 400	0.7
Others (Marshlands, sanddunes)	3 212 175	4.1
Lakes	1 102 396	1.4
T o t a l	77 797 127	100.0

(1) According to Ministry of Forests, it is 20 170 196 Ha.

2— OVER GRAZING

In Turkey stock-breeding is generally based on pasture grazing, most common form of it is upland (Turkish name is yayla) grazing. The most of the animals are fed in the stable and fold or penat at the villages during winter. At the beginning of summer or in the late spring animals go to the vicinity of villages and also up to upland areas of the mountains or high lands. In the Aegean and Mediterranean regions of Turkey animals graze in the vicinity of the villages during winter, while the animals go up to the upland areas of the mountains for grazing at beginning of summer. Most of the animals graze within the forest lands and shrubs lands of Turkey. The animals living in the Central, Eastern and the southeastern Anatolia graze on the rangelands, steppe vegetation areas and oak forests. According to the offical statistics in 1979 the population of animals are about 83.8 millions, 55 per cent of this figure consists of sheeps, 24 per cent of goats and 20 per cent of cows and water buffaloere Presently the range and/or pasture lands of Turkey cover an area of 28 per cent of the total land of Turkey.

Although the share of the meadow for one big animal units was 1.79 hectares, today the share is about 0.86 ha. because of increase of animal population. Thus overgrazing system prevails in Turkey

As a general rule, the amount of the over grazing is two-three times according to the normal grazing.

Domestic animals are grazed illegaly on the forest lands throughout Turkey without any control. Grazing is most commonly practiced and is destructive to forest grazing.

Due to over grazing. the natural herb capacity of the pasture lands decrease and the herb species having spiny and bitter increase thus most of the climax herb species disappeared because of the fact that over grazing system has been continuing. For

TABLE 3 : Land use capability classes under present land uses in Turkey (1000 Ha.)
(Modified from Topraksu, 1975, after Balcı and Uzunsoy, 1980).

Types of Presens Land - Use		Land-Use Capability Classes										
		I	II	III	IV	Total	V	VII	VII	Total	VIII	Grand Total
1. Cultivated Land Dry and irrigated farming. orchars	Ha	4 779	5 987	6 229	4 593	21 588	18	3 848	2 245	6 111	—	27 699
	%	6.14	7.70	8.01	5.90	27.75	0.02	4.95	2.89	7.86	—	35.61
2. Range and Pastures	Ha	178	547	826	1731	3 282	104	4 104	14 257	18 465	—	21 747
	%	0.23	0.70	1.06	2.22	4.21	0.13	5.28	18.32	23.73	—	27.94
3. High and Low Forest	Ha	17	172	477	839	1 505	31	2 238	19 694	21 963	—	23 468
	%	0.22	0.22	0.61	1.08	1.93	0.04	2.88	25.32	28.24	—	30.17
4. Urban Areas	Ha	39	53	42	38	172	—	49	56	105	292	569
	%	0.05	0.07	0.05	0.05	0.22	—	0.07	0.07	0.14	0.38	0.74
5. Marshland. sanddunes	Ha	—	—	—	—	—	13	—	36	49	3.164	3 213
	%	—	—	—	—	—	0.02	—	0.04	0.06	4.07	4.13
6. Total	Ha	5 012	6 759	7 574	7 201	26 546	166	10 238	36 289	36 693	3 456	76 695
	%	6.44	8.69	9.73	9.25	34.11	0.21	13.18	46.64	60.03	4.15	98.59
7. Water surfaces	Ha	—	—	—	—	—	—	—	—	—	—	1 102
	%	—	—	—	—	—	—	—	—	—	—	1.41
Total	Ha											77 797
	%											100.00

example, the major part of the pasture lands of Central and Eastern Anatolia were occupied by the species of ***Astragalus, Euphorbia, Verbascum*** etc.

3— DESTRUCTION OF NATURAL VEGETATION (FOREST FIRES)

The forests of Aegean and Mediterranean region having hot and arid summers have been subjected to forest fires. The forest lands which were lost by the forest fires are great in number. For example, the number of 32 156 forest fires took place during the period of 1950-1980. During this period, 1 238 494 hectares forests have been destroyed by the fires. In other words, 6 per cent of natural forest area was lost by the fires. The area of reforestation, afforestation is about 513 498 ha. during the period of 1943-1977. The figures indicate that the forest areas which were lost by fires are more than the planted areas.

The natural balance of the fired areas are largely deteriorated due to intense soil erosion, so these areas were mostly occupied by the herbs and xerophtyte shrubs such as maquis and garriques. This position is clearly seen on the fired forest lands of Aegean and Mediterranean regions.

4— TOPOGRAPHY

Turkey has a very rough and also a high land topography Two main orogenic belts extend on the northern and the southern part of Turkey. The orogenic belts begin at the sea level and rise as high as 3000-4000 metres in short distances. The volcanic mountains and peaks occur on the Central and Eastern Anatolia rising as high as 5000 m (Mont Ararat 5137 m, Erciyes M. 3917 m, Süphan M. 4058 m, and Tendürek 3660 m.) Tectonic basins and corridors extend in various directions bounded by the high mountains. The orogenic belts and volcanic mountains were dissected and deeply cut by the fluvial erosion. Thus very rugged topography was formed due to orogenic, epirogenic movements, and external volcanic activities and the fluvial erosion. The slope of deeply cut valleys located within the orogenic balts is more than 40 per cent.

About 80 per cent of the total area of Turkey is steeper than 8 per cent slope and the slope having more than 40 per cent covers nearly 46 per cent of the lands of Turkey. That is very steep and extremely steep slopes costitute 30 per cent of the whole country (Table 4). This situation indicates the significance of topography in erosion, transportation and flood damages in Turkey. As it is known, the infiltration capacity of the mountainous areas in broad sense is very low due to the steep slopes and in these areas the amount of surface flow or runoff is very excessive and also erosive potentials of runoff derived from the shower rainfall are very intense. The mass movements such as landslides, debris avalances, slope slides are common in places where the steep slopes and natural vegetation were completely destructed. The positions are seen on the steep slopes of the orogenic belt except for the flat lands of Central, south-eastern and the eastern Anatolia.

Table 4: Slope groups in Turkey (DPT, 1976; Balcı, Uzunsoy, 1980).

Slope groups in percent		Area (Ha)	Percentage	
Flat	0-2	9 178 404		12
Gentle slope	2-6	8 039 452	36	10
Moderata slope	6-12	10 596 581		14
Steep slope	12-20	11 478 394		15
Very steep slope	20-30	13 394 964	45	17
Extremely steep slope	> 30	10 483 292		13
Lithosolic land(1)		9 742 069		13
Urban areas		369 400		1
Others		3 212 175	19	4
Water surfaces		1 102 396		1

(1) Rocky and stony areas in all slope groups under bushy vegetation or used as open range land.

5— VEGETATION COVER

As a result of wrong land-use, forest fires, over grazing and the destruction of natural vegetation, the natural vegetation of Turkey was largely destructed and degenerated. From the standpoint of ecological conditions about 70 per cent of the total lands of Turkey (or 54 million hectares) are suitable for growing the forests. But, presently the natural forest lands of Turkey covers an area of 27 per cent (or 20.1 million hectares) of the total land of the country, and which of roughly 54 percent or 11 million hectares are considered to be high forests whereas coppice forest of various quantities cover about 9 million hectares or about 46 per cent of the total forest land.

Most of the part of the forest areas except for Black Sea region forest which is rich in groundflora, has undergone to various erosion hazards. As a matter of fact the erosion continues in degenerated forest areas.

The climax vegetation composition of rangeland/meadows are largely deteriorated especially by over grazing.

The forest which had occupied as much as the 55-55 per cent of Central Anatolia decreased in great extent. As a matter of fact the dry forests cover nearly 7-8 per cent of the total land of Central Anatolia. The shrub formations which cover most parts of the Aegean and Mediterranean region are stabilized because of the destruction of the natural timberlands. Antropogene steppe areas that are widespread on the Central and the Eastern Anatolia were arised as a result of especially oak forests.

The destruction and degeneration of the natural vegetation in Turkey unfortunately continues.

6— PARENT MATERIAL

Another important factors affecting the erosion is the parent material having less cohesive detritus. After soil cover was completely eroded from the original surface, the intensity and progression of the erosion were largely determined by the parent material. If parent material was composed of hard limestone, marble, crystalline schistes and hard volcanic rocks, the erosion would have stopped or have not continued after soil erosion. While, if parent material was composed of less cohesive Plio-quaternary and Neogene deposits, flyches of Cratecous and Eocene, volcanic sand and tuffs and evaporitic deposits containing soluble HCO_3, SO_4, Cl, erosion would have passed or transfered to parent material. These parent materials founding and the slopes consisting of less cohesive deposits which were gullied by the runoff.

The erodibilite intensity of the parent materials in Turkey are summarized as follows (Figure 1):

a) **Highest eroded parent materials:** The parent materials consisting of sandy, silty and gravelly deposits of Plio-quaternary and Neogene, sandstone, siltstone, conglomerate strata beleonging to the Cratecous and Eocene flysh, volcanic sand ana tuff deposits and evaporited deposits of the Oligo-miocene are being largely eroaed by the runoff. For example, the Plio-quaternary deposits which are composed of silt, sand ana gravels extending on the northern edge of Bozdağ mountains and on the southern edge of Aydın Mountains are largely dissected by the deep gullies.

Cratecaous and Eocene flysh widespreading on the middle and the eastern section of Black Sea region and Neogene deposits occuring especially in Central Anatolia; the volcanic sand and tuffs occuring on the Eastern part of Anatolia and partly in Central Anatolia seem to have been intensely eroded.

On the other hand, Oligo-miocene evaporited deposits unaerwent largely to chemical erosion. As a matter of fact these deposits which were accumulated under the hot and dry climatic conditions in the closed Oltu-Narman basins contain soluble Cl, HCO_3, and SO_4 in amount of 0.11-4.96 m.e./100 g, 0.05-0.74 m.e/100 g, and 0.28-32.4 m.e./100 g, respectively. These deposits are also rich in clay content. These deposits are being slided along steep slopes till they become saturated with the water. The evaporated sediments are easly being flown in places where at slope degree 50-52 (ATALAY, 1982). Besides that such deposits were easly eroded by the running water, the narrow and deep gullies are being developed along the steep slopes (Figure 1).

b) **Secondly eroded materials:** These parent materials are composed of clayey limestone, and soft limestone of Neogene occuring within the orogenic belt and on the several parts of Turkey, and ophiolites extend as belts within the orogenic ranges, and the agglomerate, sandy and gravelly deposits of Neogene and Eo-

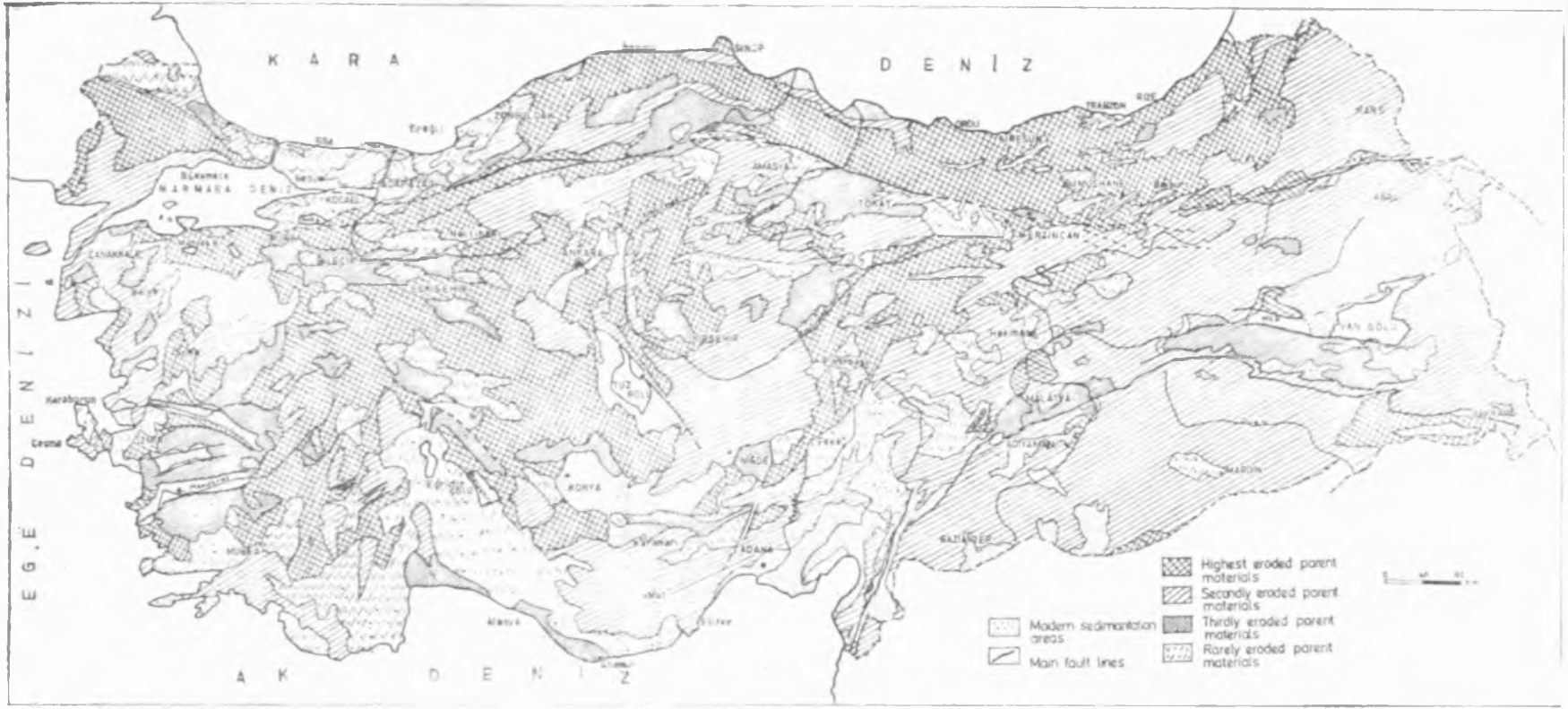

Figure 1 : The map showing resistance of the parent materials against erosion in Turkey (After Atalay, 1978).

cene formations. Some gullies and sheet erosion forms are commonly seen on the parent materials. Weathered ophiolites having strong alkalen reaction are not suitable for growing the dense vegetation and also the slope slidings are also common in places where altered zone of ophiolite occurs.

c) **Thirdly eroded materials:** The parent material consists of the phillite, clorite-serizite schistes, talc schistes belonging to epimetamorphic schistes. The parent materials become wrinkled and swollen or puffed when they are saturated with water. The swollen lands are gullied by the running water. These erosion forms are seen on the steep slopes of Sultan mountains, Ilgaz and Bitlis mountains.

d) **Fourthly eroded or rarely eroded materials:** The Paleozoic massive of Turkey such as Istranca, Menderes, Bitlis, Kırşehir etc. are less eroded than those of above mentioned parent materials. In addition, hard limestones belonging to the Paleozoic and Mesozoic are rarely subjected to erosion because of the fact that karstic features are also common and have been cracked very much.

7— CLIMATIC FACTORS

The climatic factor affecting the erosion is rainstorm or intense rainfall. The rainfalls when occured late spring and early summer become very hazard because of the fact that the vegetation cover is not dense. The soil cover is commonly shallow and generally eroded in Turkey. Overland flow occurs on the hillsides during a rainstorm when infiltration and storage capacity of the soils and parent materials are exceeded.

Annual precipitation varies from 250 mm to 2500 mm in Turkey. Annual precipitation is less than 400 mm in Central and SE Anatolia whereas in Black Sea region and Mediterranean region it is above 1000 mm. The rainfalls of which the erosive potential is very high; fall in Mediterranean and Black Sea coastal strips yearly precipitation amount is high. Lower potentials are seen in Central, Eastern and SE Anatolia where annual precipitation is less than 400 mm. As a general rule, Mediterranean region has the highest erosive potentials, this is followed by the Black Sea, Aegean, Thrace, Marmara, the SE and Central Anatolia (GÜÇER 1972). The distribution of erosive potentials in Turkey by months also veries with the amount of rainfalls. In Turkey June is the month which has the highest erosive potential, this is followed by May.

The erosive season for Black Sea coastal strips is autumm, inland parts of Black Sea region have an erosive season in early summer. In Marmara region erosive season is autumm on the Anatolian part, and early summer in Thrace same with the inland part of Black Sea region. In Aegean region erosive season is winter in coastal parts and late spring and early summer in the inland parts. Erosive season for Central Eastern and the south-eastern Anatolia regions is generally spring and early summer.

The effects of the erosive potential also depend on the vegetation cover, infiltration capacity of the soil and the parent materials, and slope degree of topography and so on. Although the erosive potential is high in Mediterranean region, erosion does not occur where the parent material is composed of hard and limely limestone. In the semiarid regions of Turkey erosion is seen on the slopy areas in spite of fact that rainfaal intensity is low. For example, the gullies and rill erosion types forming on the steep slopes of Central Anatolia reflect the importance of the erosion.

Rain drop erosion on the other hand is also an active in Turkey. The action of raindrops on the soil particles is most easly understood by considering the momentum of a single raindrop falling on the sloping surface. This erosion is being continued where vegetation cover was destructed and degenerated. Coarse material or coarse textured soils occuring on the flat and undulating area of Anatolia reflet the intensity of raindrop erosion.

The wind erosion is also seen in the semiarid regions of Turkey. The erosion is being affected where the fine sand and silt materials of the plio-quaternary deposits was outcropped due to the soil erosion. The fine materials are being carried away from the original surface by the winds.

As a result, according to the erosion surneys (Topraksu, 1975), more than 70 percent of the total land of Turkey has been subjected to water erosion (Table 5). Severe and very severe erosion is seen on the steep slopes of the Central Anatolia and on the orogenic belts in places where natural vegetation was completely destrueted. Gully erosion or bad-land topography also widespreads on the Neogene sedimentary formations which were occured in the Central Anatolia and the flysches formations of the upper Mesozoic and Eocene locating within the orogenic belt, and also on the evaporitic sediments, accumulated in the tectenic basins sach as Oltu-Narman, Kağızman-Iğdır and Kelkit valley. On the other hand, moderate erosion is active on the cultivated lands of III, IV and V capability classes and partly destructed forest lands. Slight and non eroded areas only common on the flat lands of Turkey and densely covered with humid forest formations locating the Marmara and Black Sea region.

II— TRANSPORTATION and SEDIMENTATION IN TURKEY

The material which derived from the water erosion is being transported by the fluvial agents. Transported materials are being accumulated on the flood-plain and in the lake and dam reservoirs and in low slopy areas of the mountains.

The amount of the total sediments transported by the rivers, stream and creeks into the seas, closed basins and bordering states of Turkey is not less than 380 million tons. The amount of transported sediments by the rivers into the seas are as follows: 128 million tons into Black Sea, 45 million tons into Aegean Sea, 40 million tons into Mediterranean Sea, and 10 million tons into Marmara Sea.

Table 5: Water and Wind erosion in Turkey.

WATER EROSION										
	Land capability classes							Total		
Erosion classes	II,	III,		IV,	V,	VI,	VII			
	Ha			%	Ha		%	Ha		%
Slight erosion	—			—	—		—	—		—
Moderate erosion	13	780	260	17.70	1	812	490	2.33	15 592 750	20.04
Severe erosion	2	077	265	2.68	26	257	668	33.75	28 334 933	36.42
Very severe erosion		1	930	0.00	13	219	273	16.99	13 221 203	16.99
Total	15	859	455	20.38	41	289	431	53.07	57 148 886	73.45
WIND EROSION										
Slight erosion		159	259	0.20		6	405	0.01	165 664	0.21
Moderate erosion		168	460	0.22		62	581	0.08	231 041	0.30
Severe erosion		2	439	0.00		61	946	0.08	64 385	0.08
Very severe erosion		—		—		4	823	0.01	4 823	0.01
Total		330	158	0.42		135	755	0.18	465 913	0.60

DEFINITIONS	
Slight erosion :	25 percent of plough layer is eroded
Moderate erosion:	25-75 percent of plough layer is eroded
Severe erosion:	75 percent of plough l5er and 25 percent of sub-soil is eroded
Very severe erosion:	25-75 percent of sub-soil is eroded

(Modified from references, Topraksu, 1975 and DPT, 1976; after Balcı and Uzunsoy, 1980).

Suspense sediment yields of the rivers are aboundant These figures indicated that the sediments transporting by the rivers are very excessive in Turkey, that is, main Turkish rivers transport as much sediment as the main rivers of World do. For example, tha Europhate transports almost as much sediment as Nile river. and Yeşilırmak carries nearly as much sediment as Caroni river in Venezuella.

Annual average sediment yields of the river watershed of Turkey is more than 1500 tons/square mile or nearly 600 tons/km^2. The sediment yields of main river watersheds are as follows: Tigris 1085, Kızılırmak 929, Ceyhan 992, Susurluk 898, Murat 727, Gediz 582, Büyük Menderes 519, Yeşilırmak 1521 and Tortum river 2536 tons/year/km^2.

Much of the sediments transported by the rivers were originated from the parent material erosion. We say that sediments derived from the unconsolitated and/or less cohesive deposits are more than soil erosion. For example, the highest sediment

producer is Yeşilırmak with 4187 tons per sq. mile. In the basin much of the sediments are originated from the gullies areas that developed on the flysch formation of the upper Cartaceous and Neogene formations. The materials which derived from the parent material erosion increased the suspense load and bed load of the Yeşilırmak (Green river). On the other hand, the most part of the transported material by the Gediz and Büyük Menderes river were originated from the erosion of Plio-quaternary deposits occuring in the watershed. As a matter of fact, the plio-quaternary deposits located on the southern part of Gediz and the northern part of Büyük Menderes river basin These deposits were deeply dissected by the gullies. The considerable mass movements are being occured on the slopes of the gullies and river valleys which cut these deposits, and the materials derived from the mass movements are being accumulated into the river valleys, the materials are being carried away by the torrents that occured after the rainstroms.

Transporting materials by the Tortum river were mostly resulted from the parent material erosion wich were composed of flysh of Eocene-Mesozoic and Oligo-Miocene evaporite deposits.

It can be said that the material, transported by the rivers both suspense and bed-load are very excessive either parent material erosion or soil erosion.

MODERN SEDIMENTATION

The sediments transported by the fluvial agents are being accumulated or the flood plain, into the reserviors of lakes and dams, and deltaic plains and on the foot of the mountains. Acutual modern setimantation areas is about 200.000 hectares. The modern or young dejection fans and/or cones are clearly seen common on the flood-plain of tectonic basins and deltaic plains and on the foot of the mountains. For example, in the tectonic basins or corridors such as Gediz, Büyük Menderes, Küçük Menderes and Bakırçay basin the dejection fans or cone are widespread between the rivers which drain the basin and the mountains. The modern sedimantation area extending on the southern of the Gediz basin between Turgutlu and Salihli town is about 1015 hectares. Young dejection fans located between Akwşehir-Eber lakes and Sultan Mountains cover an area of 1336 hectares. (ATALAY 1977). The southern and southwestern section of lake Burdur basin the flood and modern sedimantation area is seen. The reservoirs of the Sille Ana Altınapa dam areas have been subjected to accelerated sedimantation. The amount of accumulated sediment in the Sille dam was estimated to be about 150 000 m^3 during the period of six years. and in this reservoir the amount of deltaic sediment is about 100 000 m^3. It is estimated that 220 000 m^3 sediments are carried into the Çubuk I dam reservoir located in the vicinty of Ankara, each year by the streams. The acculumated sediment in the Çubuk I dam reservoir is considered to be 4 million tons during the period of 18 years. Due to the fact that Çubuk I dam resorvoir capa-

city has been decreased, Çubuk II dam was constructed. In the Sarıyar dam which was established on the Kızılırmak subjected to intense sedimantation.
In this reservoir the amount of accumulated sediments is about 65 million m^3/ year, according to Lacourly.

Intense flooding and sedimantation is being continued in the tectonic basins of Eastern Anatolia. On the edge of the tectonic basins of the Eastern Anatolia such as Muş, Erzurum, Pasinler-Horasan, Erzincan large dejection cones extend as far as the central part of the basins. The fine materials derived from the ophiolitic lands of the mountains are being spread on the plain and the agricultural areas.

On rare occasions, floods may extand across the plain surface and reach the lowermost portion of the basin surface. The transported load containing silt, sand, gravel and dissolved salt are being spread hard-looking pans are forcmed on the plain surface by on the basins. the fine grain materials derived from the ophiolits especially serpantine and peridotite. The hard surface formed by torrent is common on the northern part of the Erzincan plain. The new dejection fans extand both on the northern and the southern section of the Muş plain.

Lake basins are modern sedimantation are of Turkey. Accelerated sedimantation is being continued in the Lake Tortum which is one of the landslide lakes of Turkey. The amount of deposited sediment was estimated to be 2.5 million tons each year. It is assumed that the expansion of lake delta or the filling of the lake is ahout 15-20 metres/year.

Some part of the agricultural lanas locating on the flood plains are mostly affected by the flood and siltation. As a general rule, ground water levels rise as far as the top soil due to flooaing. Permanant and stagnant water level resulted in the decrase of the agricultural products. The insoluble alkaline and salty material are carried from the bottom to the top soils by the capilarite.

Some of the saline and alkaline material remain in the subsoil and topsoils agricultural productivity decreases due to salinity and alkalinity. The position is seen where the ground water level is high in the flood-plain such as Küçük Menderes and Çukurova (Cicilean plain).

The undrained and/or excess water lands cover an area of 2 775 115 hectares or 3.6 per cent of Turkey.

Özet

Türkiye'de toprak erozyonu ve bunun taşınma ve birikme üzerindeki etkileri

Türkiye, aşınma, taşınma ve birikme olaylarının en şiddetli olarak hüküm sürdüğü ülkelerin başında gelmektedir. Nitekim, ülkemiz arazisinin en az yarısında çeşitli derecede erozyon aktif halde devam etmekte ve akarsularımız vasıtasıyle bir yılda ortalama olarak taşınan yüzer haldeki katı madde miktarı en az 380 milyon tonun üzerindedir.

I— EROZYONU OLUŞTURAN FAKTÖRLER

Türkiye'de erozyonu oluşturan belli başlı faktörler şunlardır:

1- Yanlış arazi kullanma: Arazi kabiliyet sınıflarına göre ülkemizde tarıma uygun olan I., II., III. ve IV. sınıf araziler 26 374 593 hektar olup, ülkemiz yüzölçümünün % 34.6 sını oluşturmaktadır. Oysa ülkemizde tarıma uygun olmayan V., VI, ve VII. sınıf arazilerde tarım yapılmaktadır, bu arazilerin toplamı 6 111 176 ha. olup, ülkemiz arazisinin % 12 sini oluşturmaktadır. Tarıma uygun olan ve fakat su ve toprak koruma tedbirleri alınması gerekli arazilerde de yeterli tedbir alınmamaktadır.

2- Aşırı hayvan otlatma: Devlet İstatistik Enstitüsü'nün 1979 verilerine göre ülkemizde 83.6 milyon hayvan bulunmaktadır, bu hayvanların yaklaşık olarak % 55 ini koyun, % 24 ünü keçi, geriye kalanı büyük baş hayvanlar teşkil etmektedir. Ülkemizde bir büyük baş hayvan birimine düşen otlak alanı ise 0.86 nhektar civarındadır. Oysa, normal şartlar altında bir büyük baş hayvana 2 hektara yakın otlak alanı gereklidir. Bu duruma göre, ülkemizde otlakların ot verim kapasitesinin en az iki-üç misli üzerinde hayvan otlatılmaktadır.

3- Doğal bitki örtüsünün tahribi: Ülkemizde orman yangını, tarla açma, usulsüz ve kaç kesimler sonucunda doğal orman alanlarımız devamlı olarak gerilemiştir. Örnek olarak 1950-1980 yılları arasında çıkan orman yangınları sonucunda 1 238 494 hektar orman alanı yanmıştır. başka bir ifade ile ormanlarımızın % 6 kadarı orman yangınları ile yok olmuştur. 1943-1976 yılları arasında ağaçlandırma yapılan alan ise 513 498 hektardır. Bu duruma göre, yan ıla kaybettiğimiz ormanlar, ağaçlandırma ile yerine getirilememiştir.

4- Topoğrafik faktörler: Ülkemiz arazisinin % 80'inde eğim, % 8 den, % 46 sında eğim % 40 dan fazladır. Eğimin fazlalığı, yüzeysel akışa geçen sularla ve yağmur damlası erozyonu ile toprakların aşınmasını kolaylaştırmıştır.

5- Bitki örtüsü faktörleri: Türkiye'nin ekolojik koşulları dikkate alındığında ülkemizin % 70'inin ormanlarla kaplı olması gerekmektedir. Oysa, çalı halinde olan bozuk koru ve baltalık alinde olan orman alanlarımızda dahil tüm ormanlar, ülmiz yüzölçümünün % 27 sini kaplamaktadır. Erozyonlaşmada, toprak ve topoğrafyanın menfi etkilerini dengeye getiren orman örtüsünün tahribi aşınmanın artmasına sebep olmuştur.

6- Ana materyal faktörleri: Ülkemizde jeolojik temeli oluşturan çeşitli ana materyallerin aşınmağa karşı az direnç göstermesi, erozyonun şiddetlenmesini sağlamıştır. Nitekim, doğal vejetasyon örtüsünün tahrip edildiği Neojen, Pliyo-kuvaterner kumlu-milli depoları, Kretase ve Eosen flişleri, tuzlu, alkali ve jipsli evaporit kökenli depolar ile volkanik kum ve tüflerin bulunduğu alanlar, aşınmanın şiddetli ve aktif olarak devamettiği birinci derecede erozyona uğramış ve uğrayan alanları oluşturmaktadır; bunu kireçli kumtaşları, çimentosu zayıf konglomera ve aglomeralar ve ofiyolitler (yeşil kayalar) takip etmektedir. Üçüncü derecede aşınmağa uğrayan arazilerimizi, hafif metamorfik şistler özellikle fillat ve kloritli-serizitli şistlerden ibaret yapılar oluşturmaktadır. Aşınmağa karşı direçli olan arazileri ise gnays, mikaşist, kuvarsit şist gibi kuvvetli metamorfikler ile kristalize kireçtaşları meydana getirmektedir.

7- İklim faktörleri: Türkiye'de erozif potansiyeli yüksek olan yağışlar, Akdeniz bölgemizde düşmektedir; bunu Karadeniz, Ege, Trakya-Marmara, Güneydoğu, Orta ve Doğu Anadolu'daki yağışlar takip etmektedir. Yıl içinde haziran ve mayıs ayında düşen yağmurların aşındırma gücü fazladır. Akdeniz ve Karadeniz bölgesinin bitki örtüsünden mahrum eğimli yamaçlara düşen yağışlar, erozyonu şiddetlendirmekte ve sellerin meydana gelmesine sebep olmaktadır.

II- TAŞINMA VE BİRİKME DURUMU

Ülkemizde çok şiddetli olarak devam eden erozyonun doğal sonucu olarak akarsular ve seller tarafından çok aşırı katı malzeme taşınmakta ve özellikle sellerin yayıldığı alanlarda da birikme olayları çok hızlı şekilde devam etmektedir. Nitekim, genel bir değerlendirme ile, akarsularımız tarafından taşınan en az 380 milyon ton olan süspansa yükün 128 milyon tonu Karadeniz, 45 milyon tonu Ege, 40 milyon tonu Akdeniz, 10 milyon tonu Marmara denizine, geriye kalanı ise komşu ülke topraklarına, göl havzalarımızı ve kapalı havzalara taşınmakta ve birikmektedir. Tortum gölü rezervuarına bir yıla taşınan süspanse madde 2.5 milyon ton kadardır.

Belli başlı akarsu havzalarımızın yıllık ortalama sediment verimi ton/km^2 olarak şöyledir: Dicle 1085, Kızılırmak 929, Ceyhan 992, Yeşilırmak 1521, Tortum 2536. Bütün Türkiye sathı dikkate alındığında ortalama olarak bir yılda bir km^2 lik alandan taşınan malzeme miktarı 600 tonun üzerindedir.

Türkiye'nin genel erozyon durumu ve akarsularda taşınan malzeme miktarı dikkate alındığında ülkemizde toprak aşınmasından çok jeolojik yapı veya ana madde aşınması ve taşınması hüküm sürmektedir.

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