NATIONAL STRATEGY AND ACTION PROGRAMME CONCERNING DESERTIFICATION, LAND DEGRADATION AND DROUGHT PREVENT AND CONTROL

1. INTRODUCTION

The climatic data of the last century show a progressive heating of the atmosphere and a reduction of the precipitations, which became limitative factors for the growth, development and productivity of crops from certain geographical region of the country and also strong constraint factors for the allocation and use of the water resources.

In 1997 Romania signed (by law no. 629/1997) " The Convention to Combat Desertification (CCD) ", adopted in Paris on June 17/1994, became operatively on December 26, 1994 and elaborated on the basis of the Resolution United Nations General Assembly 47/188 from December 22, 1992 as following United Nations Conference on Environmental and Development in Rio de Janeiro (1991). The objective of Convention is the desertification combat and the reduction of drought results in those countries experiencing serious drought and/or desertification by efficient measures in every level, for a sustainable development in the concerned areas.

The present strategy follows the decisions CCD and Ministry of Waters, Forests and Environment Protection and represents the synthesis of studies elaborated by Forest Research and Management Institute (FRMI), Research Institute for Soil Science and Agrochemistry (RISSA), National Company "National Institute of Meteorology, Hydrology and Water Management" (NC-NIMHWM), Studies and Designing Institute for Land Improvement (SDILI), National Institute of Research – Development for Environment Protection (NIRDEP), Research and Technological Engineering Institute for Irrigations and Drainage, Baneasa-Giurgiu (RTEID), Research Institute of Life Quality, Research Institute for Grains and Technical Crops Fundulea (RIGTC) and Research and Production Institute for Grass Cultivation, Magurele- Brasov (RPIGC).

1.1. THE DESERTIFICATION, LAND DEGRADATION AND DROUGHT PROBLEMS IN THE NATIONAL AND WORLDWIDE CONTEXT

The apparition and the extension of deserts-like conditions in different world-wide areas is characterised in various ways:

United Nations Conference on Environment and Development (UNCED) defines the desertification as a land degradation in aride, semi-aride and dry and sub-moist areas resultated by action of many factors, among the most important are: the climatic variations and human activity.

Over the fields, the desertification is shown by:

- the reduction of soil areas covered by vegetation, a considerable decrease of fertility and erosion of the soils;
- the progressive increases of sun radiation intensity.

The ***droughts*** represents complex phenomenon with slow manifestation, which affect various components of the environment: hydrological, pedological, vegetal and animal. Consequently it speaks about different types of drought: hydrological, meteorological and agricultural.

Common to many geographical areas, the drought is usually associated with the absence of the precipitations during long time and provokes visible negative effects on the environment, especially on the vegetation, soil and hydrological resources.

While the drought is mainly determined by the time, the site mainly determines aridity. In the same time the lands degradation[*] is very extended in moist areas caused by human factors: erosion caused by water and wind, soil degradation, lost of the natural vegetation.

In the world, after the dates offered by CCD, a third of globe area reverts to the dry lands and from those with agricultural employment 70 % are experiencing serious degradations. Every year it is lost by erosion about 24 billions tons of arable soil and over one billion of people are affected. The annual cost of the desertification is evaluated at about 42 billions USD. Over 110 countries, comprising 5 U.E. countries are affected.

International Information and Reference for Soils Centre (ISRIC) co-ordinates a number of international projects to evaluate the actual stage of lands degradation: the project GLASOD, concluded in 1991 by a world wide map, the AASOD project dedicated to detail the Southern and South Eastern Asia and the SOVEUR project dedicated to detail the Central Europe and Eastern (including Romania). The last project considers the following types of soil degradation:

[*] In this paper the *land degradation* is considered both for semi-arid and dry-semihumid areas, and for the wet areas

- soil pollution (acidification, heavy metal pollution, pesticides pollution, eutrophisation, radioactive pollution);
- water erosion (surface erosion, deep soil erosion and land slides);
- wind erosion (loss of arable soils, dunes forming);
- physical soil degradation (aridity, compactness, crust, taken out of production by urbanisation and other economical activities, induced excess of humidity).

In Romania, over recent ten years the drought has extended as a result of deep transformations (deforestations, destructions of wind breaks and others) over a most important part of national fund, but also on the basis of climatic unbalance. In the same time, the degradations have knew an alarming intensification both in humid areas and semi-arid as well as in dry-subhumid.

The meteorological data acquired for last 100 years in 17 stations situated in southeast of country (Dobrogea, East of Muntenia and South of Moldova) show that these areas are potentially affected by desertification (over the 3 millions ha, where about 2,8 millions ha are crops land, that means about 20 % from national agricultural area). Actually, the drought affects almost all-agricultural land in our country. In the same time the different degree degradation of soil affect about a third of the country. The most important factor is the water erosion and landslides, that cover about 7 millions ha. The areas with most important rate in soil erosion are: Moldova Plateau, Pericarpathian hills between Trotus and Olt, Transylvanian Plateau and Getic Piedmont. The annually soil loss by erosion is evaluated to amount, on the average, at 123 millions tons.

1.2. THE NECCESITY OF ELABORATION OF A NATIONAL STRATEGY AND AN ACTION PROGRAMME

The agreement of our country under CCD is naturally as long as the risks of the desertification, drought and lands degradation have occurred recent times.

The elaboration of a strategy and national action plan represents the obligations of every countries member of CCD to combat desertification and the reduction effects of droughts, the promotion of regional and internal partnership between the governmental and local bodies, non-governmental organisations and landholders.

It is foreseen also establishment of legislative and institutional framework for the strategy implementation.

We mention that Romania subscribe also others international conventions concerning desertification problem, drought and degradation lands (see annex 1).

2. GENERAL PHYSICO-GEOGRAPHICAL CHARACTERISTICS OF ROMANIA AND PECULIARITIES OF REGIONS WITH DESERTIFICATION, LAND DEGRADATION AND DROUGHT

2.1. GEOMORPHOLOGY AND LITHOLOGY

Although Romania's territory is not so vast, it exhibits all the three main relief categories: mountains, hills and plateaus, plains.

Mountain units. The mountains occupy almost a third of the country's total surface. The main units are the Carpathian Mountains, which are of alpine type, and of a height that frequently exceeds 1650 m; in general, they are made up of massive, metamorphic, magmatic and consolidated sedimentary rocks (limestone, conglomerates, etc). Numerous inter-mountainous depressions (over 300) can be included in various geomorphological subtypes (tectonic, tectonic erosive, etc).

Hill, piedmont and plateau units. These relief units are between 1000 and 300 m and occupy 42% of the country's surface. According to their geological structure, height and external surface they may be sub-Carpathian hills, piedmont hills and plateaus.

Plain units. This form of relief occupies about 30% of the country's surface and, in general its altitude is below 200 – 300 m. The most important plain units are:

The Romanian Plain which is the most extensive and occupies the south of Oltenia, the south and southeast of Muntenia; its geological strata are loess, loessial soil and, here and there, sand soil, clay and alluvial soil.

The Western Plain, which is a subsidence plain and made up of heavy sediments; some of its higher parts are covered by loess.

The Danube Meadow and Delta exhibit meadow characteristics; their geological strata are made up of recent alluvial soil and some lacustrine soil; in the Delta, on top of these strata there are river-sea sandy-hills.

The territory of high desertification and drought risk includes the whole Romanian Plain, the south of Moldova along the Prut up to Iassy town, the Dobrudja Plateau, the Danube Meadow and Delta and to a smaller extent, the Western Plain.

2.2 SOILS

Due to the high diversity of pedogenetic conditions, the soil cover of Romania is complex and presents a high spatial variability (fig. 1).

According to the Romanian Soil Classification System (1980) within Romanian territory 10 soil classes, 39 genetical soil types and 500 soil types were identified. The areas occupied by the main soils are given in the table 1.

Table 1

Areas occupied by the main soil classes and genetically soil types in Romania

Soil type (class)	Total	
	%	10^3 ha
Kastanozems	0.8	191
Chernozems, Cambic Chernozems	17.7	4 218
Clay-illuvial Chernozems, Chernozem-like soils, Grey soils, Pseudorendzinas	6.8	1 621
Rendzinas	1.4	334
TOTAL MOLLISOLS	**26.7**	**6 363**
Reddish Brown, Luvic Reddish Brown soils	3.2	763
Clay-illuvial Brown soils, Luvic Brown soils	17.7	4 218
Albic Luvisols, Planosols	4.6	1 097
TOTAL ARGILUVISOLS	**25.5**	**6 077**
Eu - mezobazic Brown soils, Red Soils	6.0	1 430
Acid Brown soils	13.5	3 217
TOTAL CAMBISOLS	**19.5**	**4 648**
TOTAL SPODOSOLS (Feriilluvial Brown soils, Podzols)	**5.2**	**1 240**
TOTAL UMBRISOLS (Acid Black Soils, Andosols, Silicatic - Humic soils)	**0.8**	**191**
TOTAL HIDROMORPHIC SOILS (Humic Gley soils, Gley soils, Slope Black Hidromorphic soils, Pseudogley soils)	**3.2**	**763**
TOTAL HALOMORPHIC SOILS (Solonchaks, Solonetz)	**0.8**	**191**
TOTAL VERTISOLS	**1.6**	**381**
Lithosols	0.4	95
Regosols	3.9	930
Psamosols	1.0	238
Alluvial soils	9.2	2 193
TOTAL UNDERDEVELOPED SOILS	**14.5**	**3 457**
TOTAL ORGANIC SOILS	**-**	**5**
Lakes, Marshes	2.2	524
GRAND TOTAL	**100**	**23 839**

From the above data it results that in Romania three soil classes are predominant: Mollisols - 26.7 %, Luvisols - 25.5 % and Cambisols - 19.5 %. The undeveloped soils have also an important weight - 14.5 %. The other soil classes participate with percents that vary between 0.8 % (Halomorphic Soils, Umbrisols) and 5.2 % (Spodosols).

The soil cover of the areas exposed to desertification and drought from Romania consists of a relatively large number of genetically soil types (table 2), whose vulnerability to climatic drought is different depending on soil texture and other physical soil properties,

mostly on easily available water capacity, on some chemical soil properties, local relief, parent material and drainage.

Table 2

Soils of the drought and desertification affected area

Soil	Area (% from agricultural land of the drought area)	Soil vulnerability to drought	Easily available water capacity (mm)
Soils with good easily available water capacity			
On flat lands (moderately vulnerable to drought)			
Kastanozems	1.0	III	65 - 100
Chernozems	18.8	II	55 - 95
Clay-illuvial and Cambic Chernozems	17	II	50 - 80
Mollic Clay-illuvial Brown Soils	13	II	40 - 70
Grey soils	1.0	II	40 - 70
Reddish Brown soils	4.2	II	30 - 50
On sloping lands (more vulnerable to drought)			
Kastanozems	1.3	I	60 - 90
Chernozems	5.0	I	50 - 90
Clay-illuvial and Cambice Chernozems	3.0	I - II	45 - 75
Grey soils	2.4	I	35 - 65
Soils with smaller easily available water capacity (more vulnerable to drought)			
Lithic Kastanozems	0.1	I	20 - 35
Mollic Eu-Mezobazic Brown soils (brantchog)	1.0	I	20 - 35
Solonetz	1.2	I	40 - 50
Vertisols	2.1	I - II	15 - 30
Lithosols	0.2	I	10 - 20
Psamosols	2.4	I	20 - 40
Lamelar Psamosols	0.4	I	15 - 30
Coarse textured alluvial soils	1.8	II	20 - 40
Soils with shallow ground water (less vulnerable to drought)			
Chernozems, freatic phase	2.0	III	60 - 100
Gley soils	0.4	II - III	20 - 60
Humic-Gley soils	2.7	II - III	40 - 90
Medium textured alluvial soils	8.5	III	70 - 120
Fine textured alluvial soils	5.8	II - III	40 - 90
Other soils	4.8		

Figure 1. Soil map of Romania

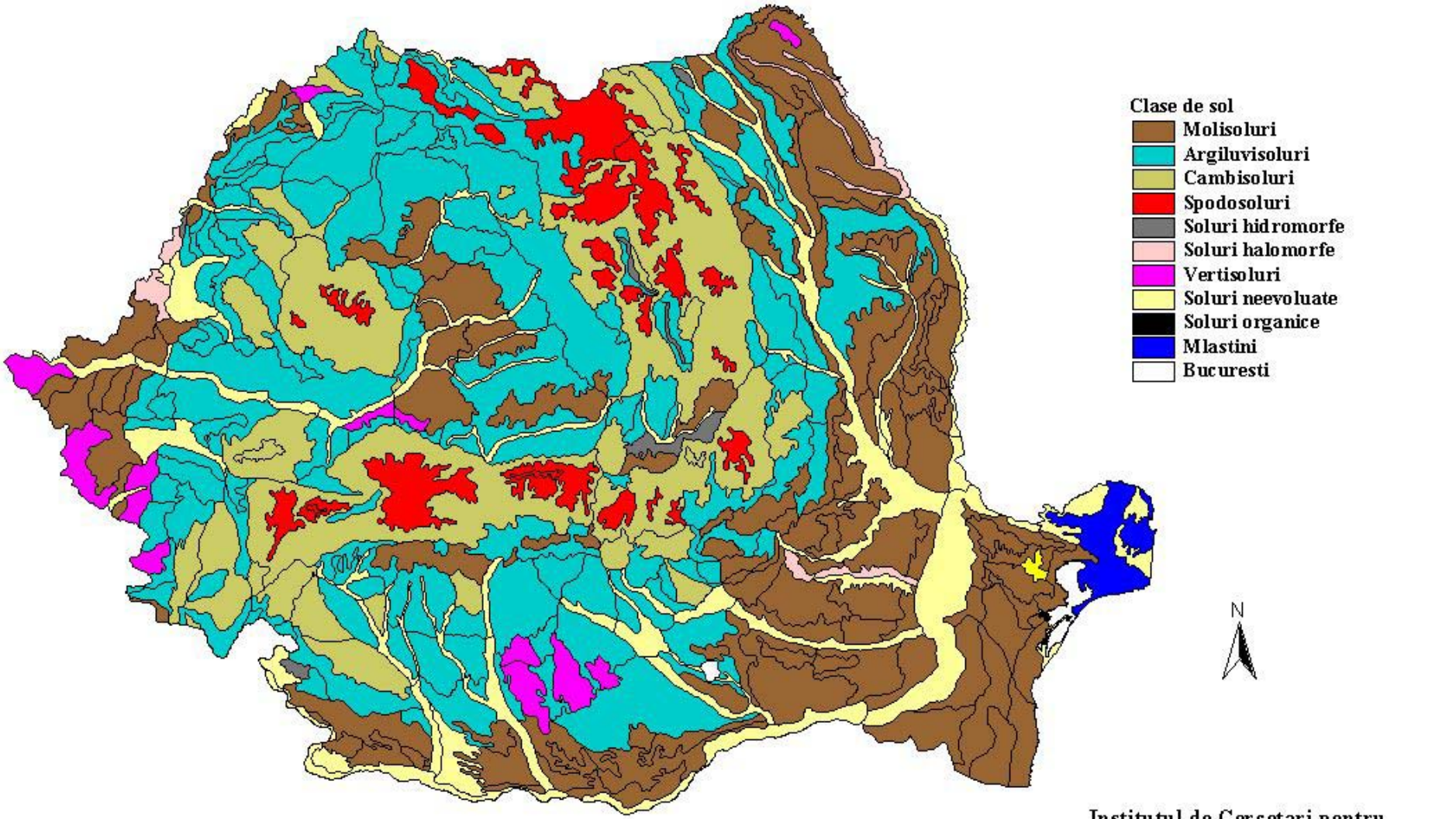


Fig. 1 - Harta solurilor din Romania

2.3 CLIMATE. AGROCLIMATIC RESOURCES

The climatic of our country is influenced by Romania's position on the globe, at half way between the Pole and the Equator Cit is crossed by the 45 (grade) parallel as well as by it's geographic location on the continent, at about 2000 km from the Atlantic Ocean, 1000 km from the Baltic Sea, 400 km from the Adriatic Sea and facing the Black Sea. These peculiarities endow the climate with a temperate continental feature.

The air masses driven towards the Romanian territory in various synoptic contexts evolve within a very wide range, from the Arctic to the tropical (Saharan) ones, which also endows the climate with *a transition feature.*

Also the unsteadiness of the relations between the main pressure centres induces important variations with respect to the preservation of a certain meteorological context. Thus, there may be recorded both long durations of a cyclonic circulation, bringing abundant precipitation and long periods of anticyclones regime - specific to the occurrence and action of the drought phenomenon, or fast passages from the anticyclones regime and vice-versa, with corresponding modifications of the weather state.

Our country's territory stretching over almost 5 (grade) in the latitude results in greater differentiations between the south and the north of the country with respect to temperatures than the expansion over 10 grade in the longitude induces. While the mean annual temperature in the south of the country rises to about 11 grade C, in the north of the country. at comparable altitudes this parameter's values are by about 3 grades C lower.

Between the western and the eastern borders of the national territory the difference reduces to on degree (10 grade C in the west, 9 grade C in the east). In exchange, the differences concerning precipitation are more important (about 700 mm per year in the west and below 400 mm per year in the east).

Our country's relief plays an essential role in the delimitation of the climatic areas and stages. The Carpathians constitute a barrier, which separates the rough climates in the east from those of oceanic - Adriatic type in the west.

Hills and plateaus alleviate in turn the climate extremes in point of the hydrothermal potential.

The large plains and meadows in the south of the country are free corridors for the atmospheric flows, although they stains under a Carpathian - type influence, which alleviates the climate excesses.

Figure 2. Mean annual temperature

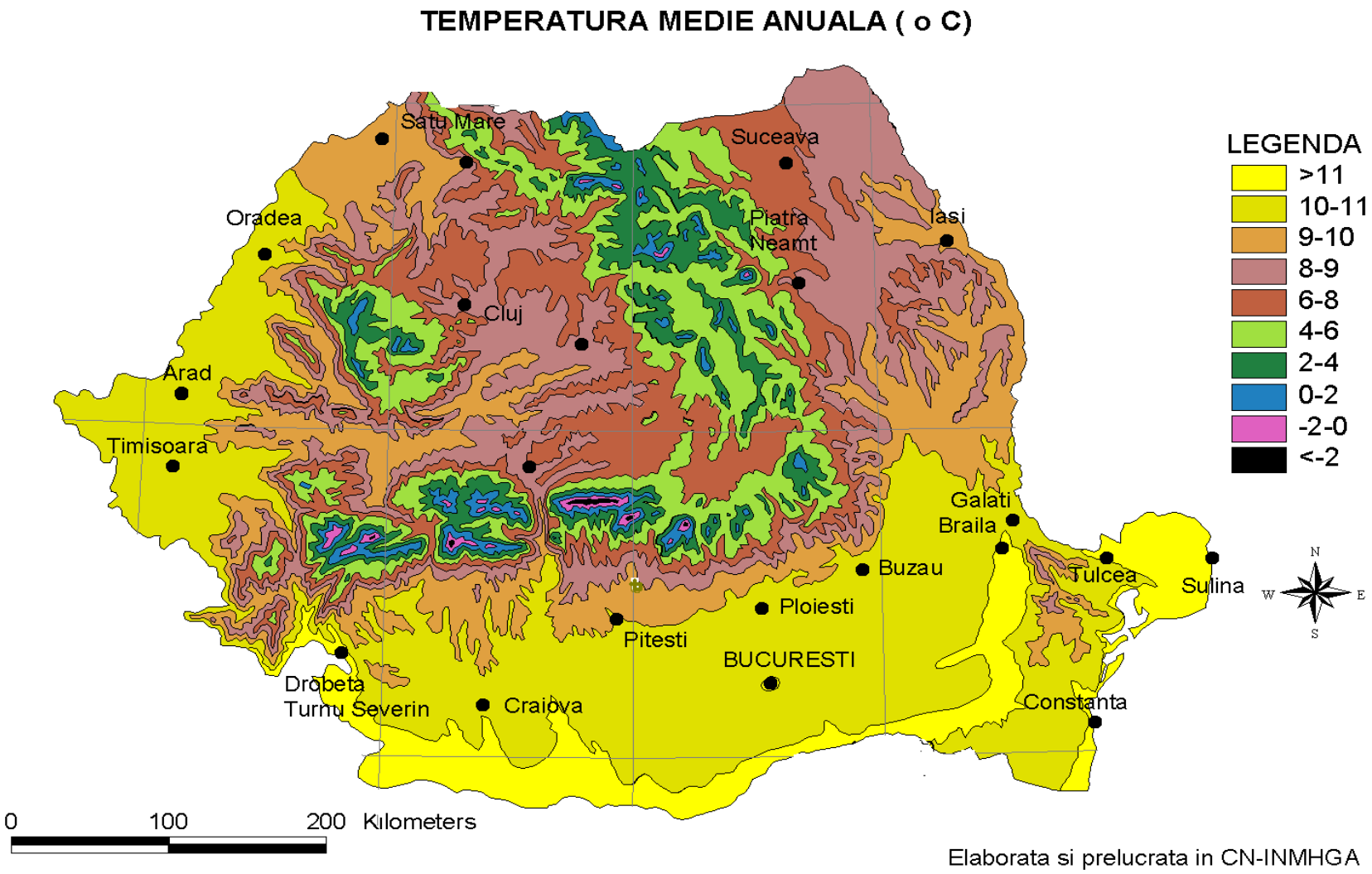
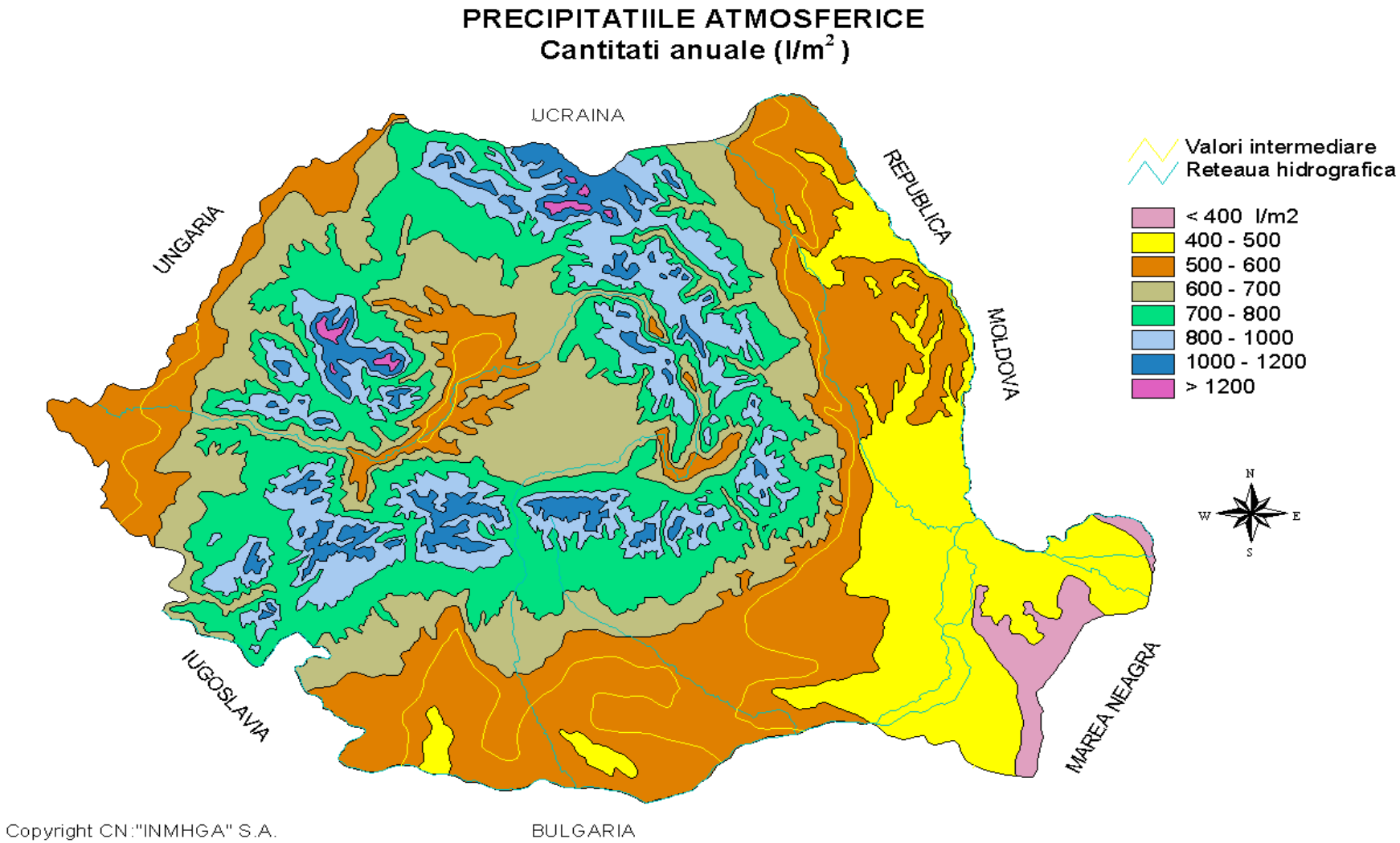


Fig.3. Precipitation (annual l/m^2)



The presence of the Carpathian chain and of the hills and plateaus in the centre of the country however determines the existence of four climatic stages, which differ deeply from the zones climate. The first stage, between 300 and 1400, m has a warm to cool climate (9 grade C; 4 grade C) and wetter (from 600 - 7oo to 1000 - 1000 mm ?); the second stage, between 1400 and 1800 has a cold and wet climate (4 grade C - 2 grade C) and 1000 - 1400 mm; the third stage bears a very cold and also wet climate (2 grade ; O grade C) and 1000 - 1400 mm) while the fourth stage also has a very cold and humid climate (from 0 grade to -2.7 grade C and 1200-1400 mm).

At the country's scale the mean multiannual (100 years) values of the *mean annual temperatures* (fig.2) range between -2.7 grade C at an altitude of 2500 m and 11.4 grade C in the south-east (at Constanta) and the means of the precipitation sums (fig.3) again expressed as multiannually values 9 grade from 385.5 mm and 500.9 mm in the south-east (at Constanta and Calarasi respectively) and between 1000 and 1200 mm of precipitation in the mountain area.

The *aridity index* (R) as a ratio between the sum of the annual precipitation and the potential evapotranspiration (P/ETP) separates the following areas (fig.4): hyper-arid (R<0.05), arid (0.O5<R<0.20), semi-arid (0.20<R<0.50), dry-sub-humid (0.50<R,0.65) and humid R>0.65. From this standpoint the climate in our country falls in the semi-arid areas, in the dry-sub-humid and in the humid ones, with R>0.20.

It is noteworthy that in the high hill and mountain areas the aridity index R is higher than 0.65. In the steppe "islands", R ranges within 0.20 - 0.50 and in the sylvo - steppe "islands" - between 0.50 and 0.65.

As a conclusion, the Romanian climate is of the temperate - continental type, with four seasons, and is marked by influences of the steppe climates in the east, byte Adriatic ones from the south-west, by the oceanic ones from the west and north-west, preserving, however, the identity of the Carpathian - Pontic - Danubian climate.

In the territory highly exposed to the desertification and drought hazard

the climate is warm and dry, with mean annual temperatures higher than 10 grade C, the sum of the mean temperatures > 0 grade C is between 4000 and 4300 grade C and the sum of temperatures > 10 grade is between 1600 and 1800 grade C. The sum of the mean annual precipitation is between 350 and 550 mm, of which that from the April - October period is 200 - 350 mm, while the water reserves of the soil over the 0 - 100 cm depth at 31 March is between 950 - 1500 mc/ha, which is equivalent to 95 - 150 mm of precipitation.

Fig. 4. Distribution of aridity index P/ETP

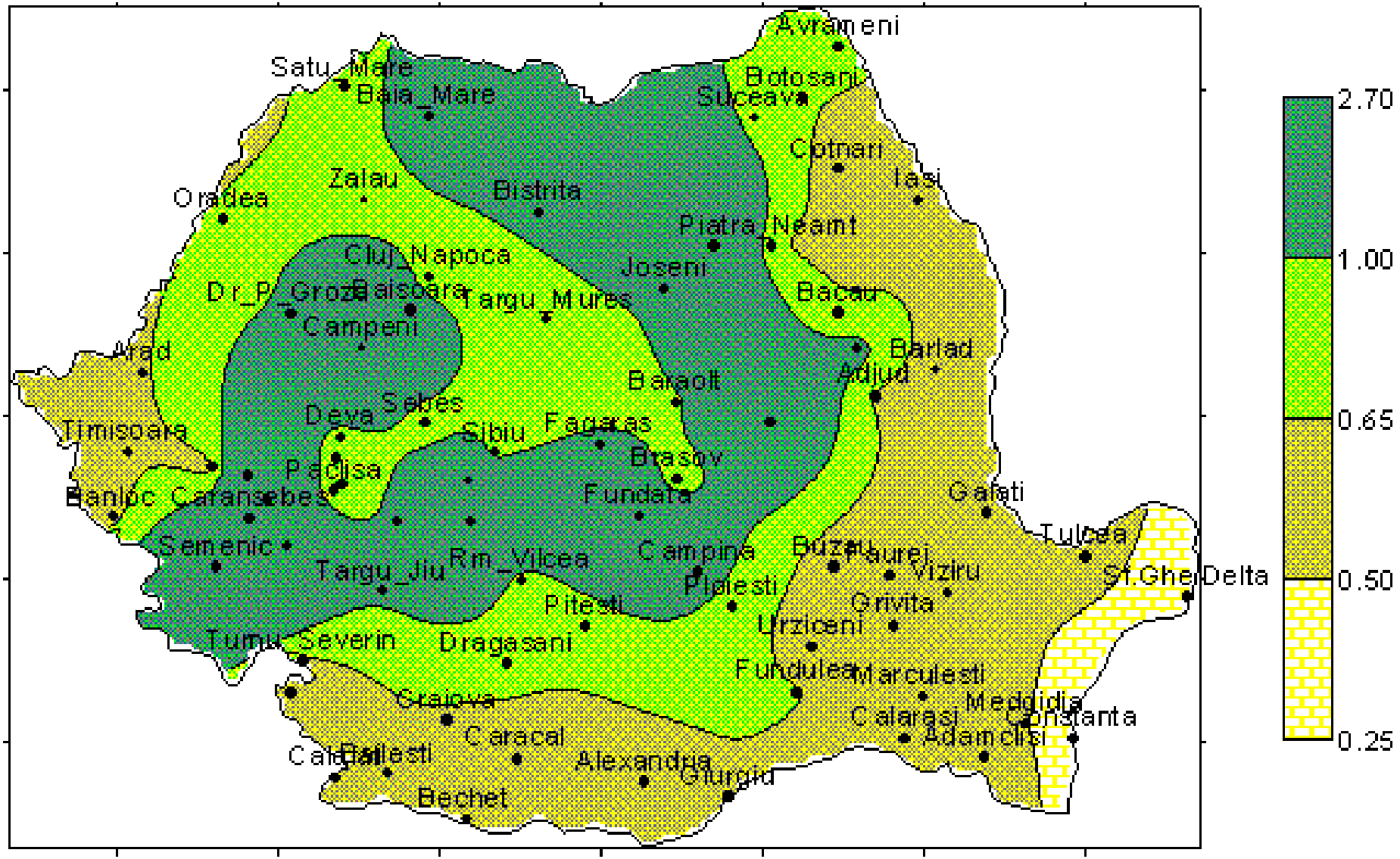
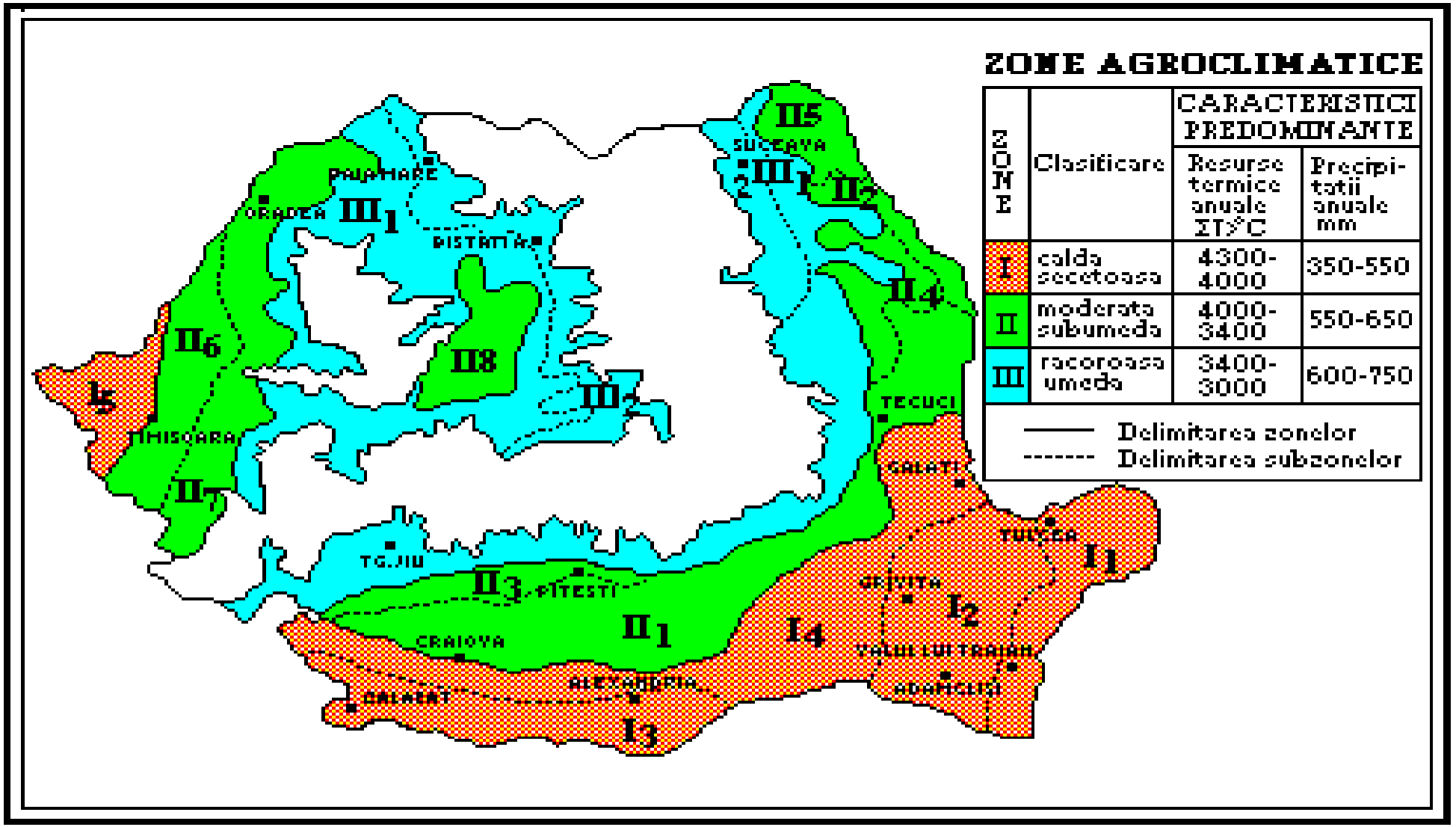


Fig. 5. Agroclimatic zonation

I = warm-dry area II = moderate sub-humid area III = cool-wet area



With respect to the **agroclimatic resources,** three large agroclimatic areas (Fig.5) become evident, with their specific features, whose climatic potential is turned to good account in different ways in agriculture and sylviculture, function of the existing local conditions and economic resources.

From the energetic standpoint, the annual flux is 110-140 K cal/cm2, a level similar to those from the large cereal areas in Europe, North America and Eastern Asia. The thermal potential ranges between 3000 and 4300 grade C, with a ratio of the effective temperature during the vegetation period of 1200 to 1800 grade C.

In the area stretching between the isotherms of 6 grade and 8 grade C, micro and meso-thermal plants may be cultivated (bundle flax, rape, potato, rye, two-row barley).

Between the isotherms of 8 to 11 grade C, the majority of the agricultural plants may be cultivated, whereas in the area with mean annual temperatures higher than 11 grade C - mega-thermal plants (cotton, rice, castor-oil).

From the hydric standpoint, resources vary: in the plain-between 350 and 750 l/m^2, but are unevenly distributed in space and time, which determines large annual fluctuations of the crops. The time periods when the hydric resources ensure efficient turning to good account of the thermal resources represent about 30% of the vegetation season.

In the rest of the time, droughts or precipitation excesses occur.

I = warm-dry area II = moderate sub-humid area III = cool-wet area

The largest fluctuations are recorded in the plain area in the south of the country, with monthly values between 1 and 300 l/m^2 and annual values between 250 and 1000 l/m^2. The droughty and excessively wet periods are grouped over periods of 2 to 4 years and return cyclically. This is also noticeable during the year, through the grouping of the droughty and rainy months.

The territory subjected to a high desertification and drought hazard is situated in the 1st warm and droughty area, which comprises large areas in the Wallachian Plain, Dobrudja and partially in the Western Plain. Within this area, 5 sub-zones are distinguishable, function of the geographic location and of the peculiarities of the atmospheric circulation (Table 3).

Within the area, soil humidity decreases below the minimum level (50% of the Useful Water Capacity), dropping to the withering coefficient (in 1988, 1992, 1993, 1994, 1998, 2000).

Table 3

Agroclimatic resources – 1 ST area / warm - droughty

(mean multiannual values)

1 ST AREA warm–droughty	Sub – zones	THERMAL AND RADIATIVE RESOURCES						
		I-XII	IV-X	V-VIII	XI-III	XII-II	I-XII	I-XII
		Global T (∑Tmed ≥ 0°C)	EffectiveT ∑Tmed ≥ 10°C	Aridity units (∑Tmax ≥ 32°C)	Abs.min T (°C)	Frost units (∑Tmin ≤-15°C)	Solar radiation (kcal/an)	Sun–shine duration (hours/year)
	1	4100-4200	1600	0-10	-28.0 -33.0	1-3	132-136	2350
	2	4200-4250	1600-1800	10-20	-20.0…-22.0	4-6	128-132	2275
	3	4200-4300	1800	30-40	-29.0…-34.0	8-10	124-127	2250
	4	4000-4300	1600-1800	20-40	-30.0…-32.0	20-24	125-128	2200
	5	4100-4250	1400-1500	20-30	-29.0…-30.0	10-20	125-128	2200

1 ST AREA warm–droughty	Sub – zones	HYDRIC RESOURCES							
		Precipitation (mm)				Water supply of soils m^3/ha		Optimum sowing epoch	
		I-XII	XI-III	IV-X	VII	Humidity reserve 0–100 cm m^3/ha 31 III	Humidity deficits 0–100 cm m^3/ha IV-X	Winter wheat	Maize
	1	350-400	150-200	200-250	35-40	1150-1180	4450-4800	15-20 X	13-16 IV
	2	400-450	125-175	275-330	40-50	1200-1300	3850-4500	12-18 X	10-13 IV
	3	450-500	150-200	300-350	45-55	950-1500	2800-4200	15-20 X	9-12 IV
	4	500-550	175-250	250-300	50-60	1150-1400	3300-3850	10-15 X	10-13 IV
	5	550-600	200-300	350-400	65-75	1350-1400	3300-3450	10-15 X	10-13 IV

2.4 VEGETATION

The zonal vegetation unit over Romania are:

According to the altitudinal zonation

- alpine pastures and dwarf shrubs zone
- sub-alpine pastures and dwarf shrubs zone
- spruce forests zone
- broadleaved forests zone.

According to the latitudinal zonation

- oaks forests zone
- forest-steppe zone
- steppe

They have been identified about 800 vegetal associations so far (according Braun-Blanquette classification), as belonging to 41 vegetation classes of boreal and middle Europe, that is: forest associations, grassland associations, wet sites vegetations, aquatic, halophyte associations, arenicols.

Natural and cultivated **herbs associations** cover about 4. 924.000 ha of grassland. Pastures vegetation is laying form alpine to steppe area, is mainly represented by associations based on *Carex curvula, Juncus trifidus, Sesleria sp., Nardus stricta* (in the alpine and sub-alpine zone), on *Festuca rubra, Agrostis capillaris* (in the spruce and broadleaved forests zone), on *Poa angustifolia*, *Chrysopogon gryllus, Festuca rupicola* (in oak forests zone), on *Festuca valesiaca, Stipa sp.* spreaded on zonal soil in silvosteppe and steppe, as well as halophylic associations based on *Salicornia sp., Saueda sp., Bassia hirsuta, Puccinella sp., Limonium gmelini, Festuca pseudovina* and arenicol association on *Festuca vaginata, F. beckeri, Stipa sabulosa*, and grasslands with *Agrostis stolonifera, Agropyron repens, Lolium perene* (in meadows).

Shrubs association in the alpine and sub-alpine zones are composed by *Salix herbaceea, S. reticulata, Pinus mugo, Alnus viridis, Vaccinum sp., Rhododendron kotschyi, Juniperus sp.,* etc.

Forest vegetation (fig. 6) is set in mountain forests (58.5 %), hills forests (27.3 %) and plain and riverside forests (6.7 %), while the whole area of forests fund are 6.249.000 ha (100 %), to what it adds about 328.000 ha of forest vegetation outside the forest fund. Forests are formed by spruce (*Picea abies*), fir (*Abies alba*), beech (*Fagus sylvatica ssp. sylvatica, Fagus sylvatica ssp. moesiaca*), mixtures between beech and fir (and/or spruce), sessile oak

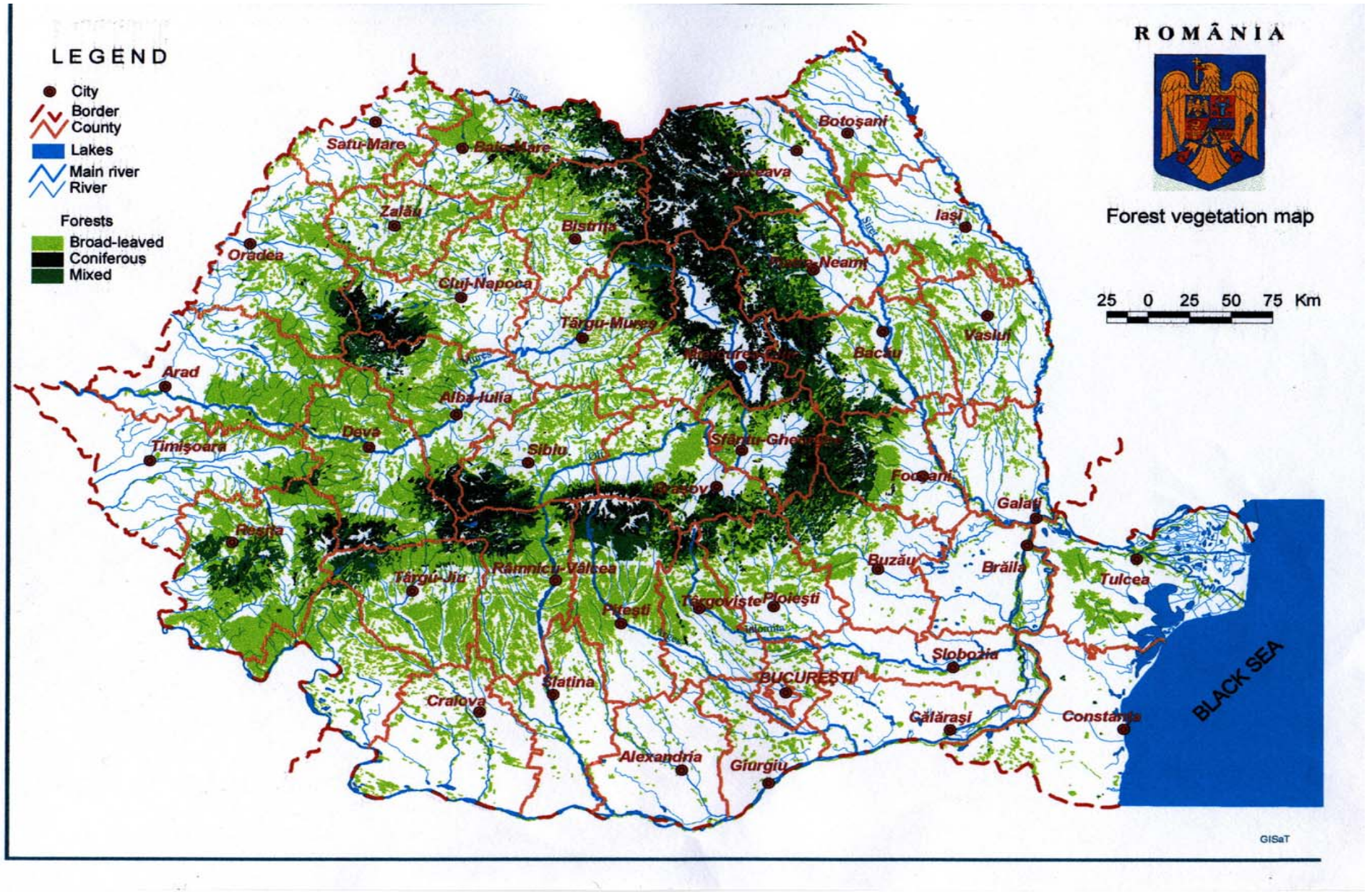
(Quercua petraea ssp. petrea, Q.p. ssp. dalechampii, Q.p. ssp. polycarpa), mixtures among sessile oak and other broadleaved species (*Tilia sp., Carpinus sp., Ulmus sp., Aces sp., Sorbus sp*.), oak (*Quercus robur*) as pure or mixed with other boroadleaveds, Hungarian and Turkey oak (*Quercus frainetto, Q. cerris*), other *oak (Q. pedunculiflora, Q. pubescens*), alder, poplars, wilows (*Alnus incana, A. glutionosa, Populus nigra, P. alba, Salix alba, S. fragilis,* etc.).

In the area under high risk of drought and desertification the grasslands are formed by the following herbs: *Poa bulbosa, Artemisia austriaca, Euphorbia stepossa, Festuca callieri, Thymus zigioides, Artemisia arenaria, Centaurea arenaria,* etc.

Q. pedunculiflora forests cover about 25 000 ha, and those set in Romanian plain and partially in Dobrogea and southern part of Muntenia are the most representative, followed by *Q. pubescens* forests on 21 000 ha layered mostly in northern Dobrogea. Highly representative are black locust forests covering about 174 000 ha, the ones formed by soft wood species (as willow, poplar, alder) on 226 000 ha, lime forests on 30 000 ha and other hard wood (*Carpinus orientalis, marshy Fraxinus sp., Pyrus sp., Fraxinus ornus*) on about 210 000 ha. Also, over this zone it may found natural and artificial shrubs associations based on *Hippophae rhamnoides, Tamarix ramosissima, Salix rosmarinifolia, Amorpha fructicosa* and other xerophytic shrubs set on halic soils in Danube Delta and Danube banks, as well as on the river banks in south of the country.

For all, the forests in this area cover about 1 600 000 ha (that is about 18 %, fig. 7) much under the historical surface of forests (fig.8) in the area, as a consequences of the defforestations with purpose to increase crop land.

Fig. 6 Forest vegetation map



2.5 AQUATIC AND TERESTRIAL FAUNA

Among the large carnivores in Europe, about 60 % of bear (*Ursus arctos*) population, 40 % of wolf (*Canis lupus*), and the most homogenous and vigurous population of about 1. 500 000 pieces of *Lynx lynx* live in Romania. As well, the largest population of *Branta ruficolis* and *Pelicanus crispus* spend the winter in Danube Delta. As sub-endemic species it has to enumerate: *Cervus elaphys montanus, Rupicapra rupicapra carpatica* as a post glacial relict*, Sus scrofa attila, Lepus europaeus* and *Parus montanus transsilvanicus* as localized in mountains regions: Bucegi, Piatra Craiului, Retezat, Pietrosul Rodnei, Rarau-Giumalau, Hasmasul Mare, Fagaras, Parang, Cernei, Almaj, Bihor.

In the area under high risk of drought and desertification, faunistic biodiversity is reduced. As a direct consequence of water missing, game migrates in the area rich both in rivers and forage. We mention the recent extiction of *Otis tarda* in Romanian plain.

The aquatic fauna is located in the 4 000 rivers, with the catchments larger than 10 000 km^2 and a cumulate length of about 60 000 km. From these, about 18 000 km are mountain rivers. Among the species some are rare as *Hucho hucho hucho L.*, *Romanychtys valsanicola* and *Cobitis elongata.* In the dry climate the aquatic fauna is extremly poor because of low flow of rivers.

2.6 LAND USE TYPES

Romania has a total area of 23.839 mil. ha from which in 1997, 14.82 mil. ha are agricultural lands (9.36 mil ha arable lands, ca. 0.28 mil ha orchards, 0.26 mil ha Vineyards and ca. 4.92 mil ha pastures and meadows) and forests ha occupy 6.67 mil. The amount of arable land per capita is of 0.41 ha. The remaining area of 2.35 mil ha represents water bodies, human settlements, roads etc.

The table 4 shows the land-use dynamics in the last ten years.

Table 4

Comparative situation of land resources use
at the end of 1989 and 1998

Land use	Area (10^3 ha)		Difference 1989 - 1999
	1989	1998	
1. Agricultural lands	**15 109**	**14 819**	**-290**
• Arable land	10 108	9 357	- 751
• Pastures	3 000	3 414	+ 414

• Meadows	1 401	1 510	+ 109
• Vineyards and nurseries	268	278	+ 10
• Orchards and nurseries	332	260	- 72
2. Non-agricultural land	**8 641**	**9 020**	**+ 379**
• Forests and other lands with forest vegetation	6 574	6 667	+ 93
• Water bodies and ponds	840	878	+ 38
• Roads and railways	371	396	+ 25
• Houses and courtyards	530	632	+ 102
• Non-productive lands	326	447	+ 121
TOTAL	**23 750**	**23 839**	**+ 89**

One can notice a decreasing trend of the agricultural and arable land, associated with an increase of lands occupied by grasslands (pastures and meadows) resulted mainly following abandonee of some arable lands and some afforestations. At least partially, this is due to the fact that in 1970 - 1980 period, a large area of marginal lands prone to degradation processes has been introduced as arable land.

Desertification affects mostly the south and southeastern part of the country area.

The arable land of that area represents more than 25% of the cropped land from Romania. On can notice the very low weight (8.2%), far from the country average (circa 28%) of lands occupied by forests (table 5).

Table 5

Land use types from the districts (judete) affected by desertification

Land use type	ha	%	Land use type	ha	%
Arable land	2 448 865	61.7	Forests	327 128	8.2
Pastures	310 484	7.8	Water bodies	506 749	12.8
Meadows	8 454	0.2	Roads + houses	179 369	4.5
Vineyards	87 404	2.2	Unproductive	82 639	2.1
Orchards	15 034	0.4	Total non-agricultural land	1 095 885	27.6
Total agricultural land	2 870 241	72.4			
GRAND TOTAL				**3 966 126**	**100.0**

2.7 HYDROGRAPHY AND HYDROGEOLOGY

Romania owns a rich hydrographic network – about 122.000 km of rivers, only 66.000 km of which are held by the 4295 rivers longer than 5 km and with a 10 km^2 surface of the catchment's area. The network's density is 0.49 km/km^2 (between 1 km/km^2 in the mountains and 0 km/km^2 in many plain areas).

Groundwater and unevenly distributed over the country's territory, since 80% of the resources are in the hill and plain areas, as well shaped horizons. In the mountains, resources

are scarce, to be found in alluvial cones, major streambeds and limestone's. However, the annual regeneration of ground waters takes place within the Carpathian area in a share of 80%.

Territories highly hazardous to desertification and drought have in the most part a scarce or very scarce own network. However, large rivers, springing in the mountains or in the hills, cross these territories. They are also crossed by the Danube.

Wet ***territories with spoiled lands*** have, in exchange a dense hydrographic network, where torrential formations frequently develop, because of deforestation's and of the irrational use of agricultural lands and pastures.

2.8 WATER RESOURCES

The total water resources from the interior rivers (15 large basins) is 42.293 million cubic meters – on a multiannual average (17% of which are collected by Siret river, 13.8% by Mures river and 13% by Olt river. The Danube's contribution at the in let into the country is 175.598 mil.m^3. Distributed by seasons, the surface water resources (discharged volumes) are: for the interior rivers: 8252 mil.m^3, 16801 mil.m^3 in spring, 11318 mil.m^3 in summer, 6023 mil.m^3 in autumn; for the Danube, the seasonal distribution is: 40836 mil.m^3, 58798 mil.m^3, 43281 mil.m^3 and 32683 mil.m^3(see annex 2.1).

In circumstances of drought the water resources of the interior rivers are about 9 times smaller, decreasing from 1340 m^3/s to 164 m^3/s, thus endangering the continuity of supplying with water the industry, the agriculture and the localities (see annex 2.2).

Ground water resources are estimated at about 8.300 mil.m^3, 5100 mil.m^3, from phreatic waters and 3200 mil.m^3, from regenerable deep waters.

Should the Danube's water contribution be ignored, Romania is a country with poor water resources.

Therefore, careful management of this resource is compulsory.

The water deficit is acutely felt in ***the territories highly hazardous to desertification and drought***. To compensate this deficit–very large during the droughty spells–, irrigation systems were designed in these areas for some 3 mil.ha., using Danube's water as a main resources and as secondary resources the water from Siret, Olt and other rivers (see annexes 2.3, 2.4).

Fig. 7 Present forest vegetation map of affected area

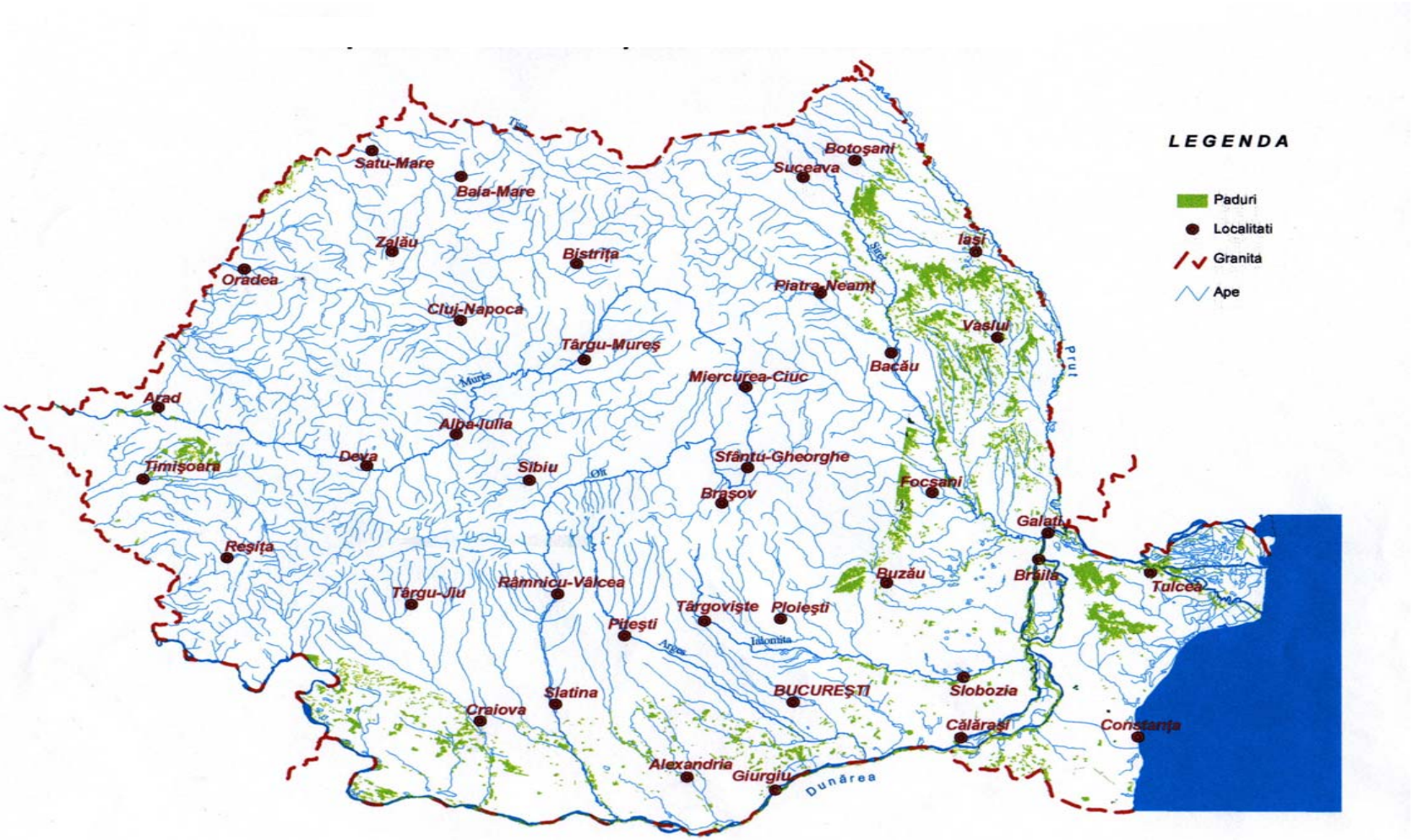
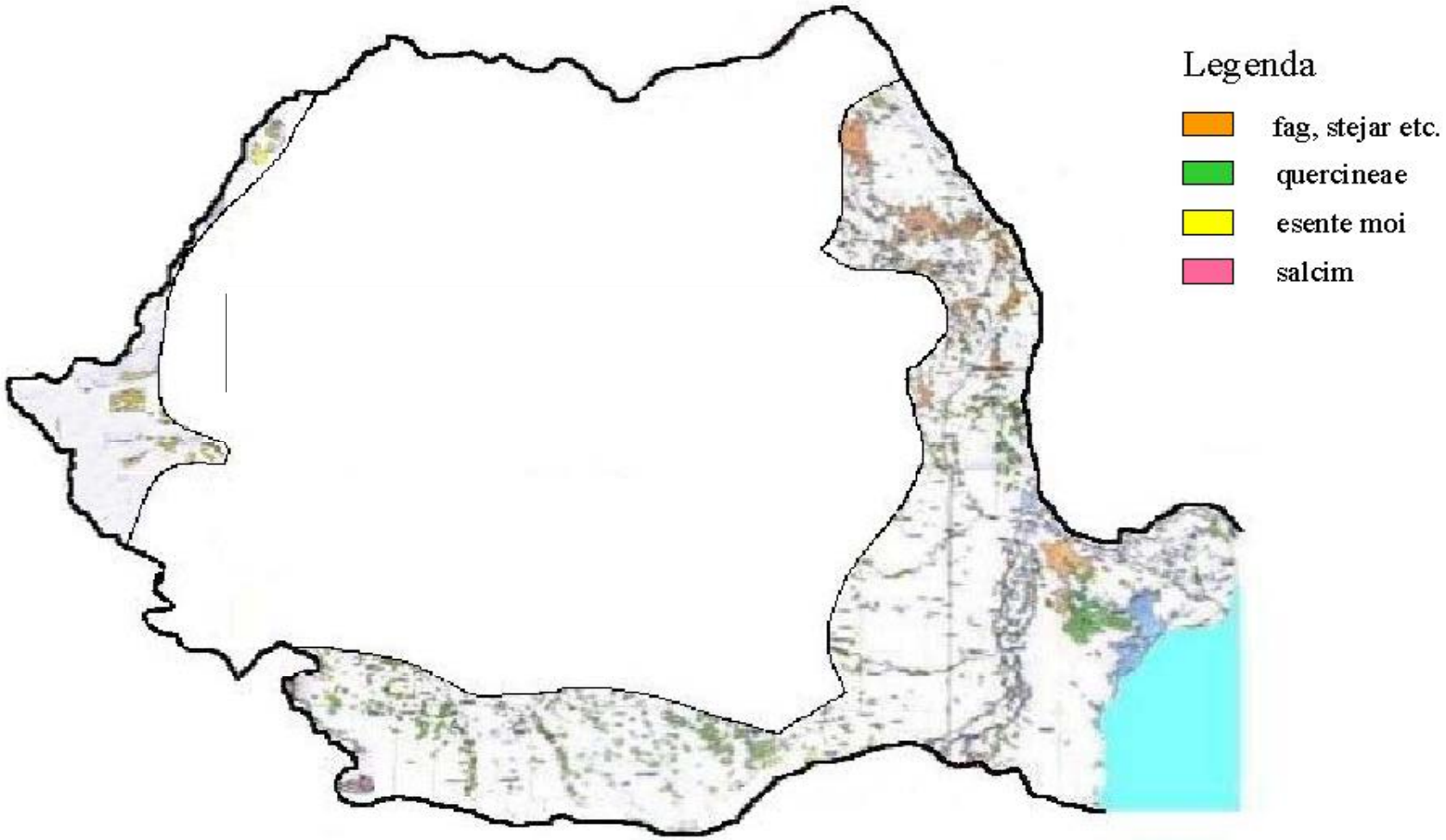


Fig. 8 Forest vegetation map in the 1900 year



2.9 ENVIRONMENTAL COMPONENTS STATE UNDER DROUGHTY CONDITIONS

The state of environmental components is conditioned by the activities that are carried out on the country's territory as well as by trans-boundary pollution.

Air quality. The mean annual concentrations of the main pollutants (SO_2, NO_2, NH_3, powders) are in general below the mean admissible concentrations. There exist exceeding as well, sometimes 2 or 10 higher and mostly around localities with polluting industry.

In 1994, the greenhouse gas emissions of CO_2 amounted to 125,597 Gg, about 70,000 Gg smaller than that in 1989, as result of the reduction of industrial activities. For all this, the CO emissions have increased as result of road traffic development.

At present, specific pollution (pollutants amount per capita) is below the average value registered in EU countries.

The ozone registers decreasing values (8.5% in the last 20 years) in Romania too; its values are comparable to those registered on the regional level.

In general, **precipitation's quality** has not changed substantially in the last 10 years. In the industrial areas of the middle and the south of the country the precipitations are acid. Locally there are also basic precipitations around waste dumps with basic rocks or near industrial units (Timisoara, Piatra Neamt, Cluj) emitting basic pollutants.

Water quality. As compared to 1989, due to the reduction of the polluting industrial activities, water quality has improved considerably. In 1999 the total river length showed the following quality distribution: 53% (in comparison with 35% in 1989) was water quality of category I; 31% (in comparison with 22% in 1989) was water quality of category II; 5% was water quality of category III and the remaining share is degraded water of category D. Highly degraded river sectors are on the Ialomita (downstream Slobozia), on the Prut (downstream Bahlui), on the Dambovita (downstream Bucharest), on the Mures, the Aries, the Sasar, the Aranca, and so on.

The Danube carries pollutants (especially nitrates and phosphates) from countries upstream Romania; thus at the entry in the country its water quality is of category II. Through self-purification the Danube water quality becomes of category I up to confluence with the Ialomita River.

Water quality of lakes belongs to categories I and II.

Ground water is polluted by nitrates and phosphates on about 25% of the country's surface; locally, there are discharges from chemical, petrochemical, metallurgical and oil extractive industry, from oleo ducts/pipelines and manure discharges.

For surface and phreatic water protection there exist 2,770 wastewater treatment plants; more than half of them do not function. Only 18% of the wastewater volume is considered sufficiently treated.

Soil quality. According to their adequacy for agricultural purposes and without the appliance of improving measures, the agricultural lands are classified into the following quality classes: class I – 2.8% of the total area; class II – 24.7%; class III – 20.8%, class IV and V – 51.6%.

At present, Romania's agriculture is characterized by fragmentation of land property and farmland exploitation (Tab. 6).

Table 6

AVERAGE DIMENSION AND STRUCTURE OF FARMLAND EXPLOITATION

No.	Type of farmland exploitation	Average agricultural area (ha/exploitation)	Agricultural area (ha)
1	Individual farms	2,40	3 625758
2	Family associations	95	1 440 000
3	Legal agricultural companies	456	1 752 000
4	Agricultural trading companies and autonomous management companies	1638	1 710 680

The agricultural area includes about 40 million lots owned by about 6 million landowners. The arable area per capita is 0.41ha and the agricultural area per capita is 0.65 ha.

3 FACTORS WHICH GENERATE DESERTIFICATION, LAND DEGRADATION AND DROUGHT

3.6 FACTORS WHICH GENERATE OR INCREASE THE DESERTIFICATION AND THE DROUGHT PHENOMENON

It is obvious that the aridization is determined by two major factors: natural factors, by periodical stress of certain extreme and persistent events like drought, on the one hand and by anthropical factors, by the abuses made by man using the vulnerable and sensitive ecosystems generally from the geographical area and particularly from the arid regions, on the other hand.

However, the interactions between the natural and the anthropical factors are neither very well known nor very well understood.

Climatic anomalies, important for the space - temporal distribution, can determine extensions of the arid episodes, materialized by precipitation decrease, temperature increase and wind speed increase.

Concerning the climatic changes in Romania, comparing the values obtained in the last 100, 50, 20, 15 and 10 years for precipitation and air temperature, it could be noticed a general tendency of decrease of the mean annual precipitation quantities and respectively an increase of the mean annual temperatures in the last 10 years confronted by the last 100 years report (table 7).

The tendency of the precipitation quantities decrease and the temperature increase is materialized at the level of the whole territory of the country (for the plain and hillock area) excepting the eastern area (particularly the seaside one) where the precipitation quantities are very reduced.

During the drought period after 1980 it can be noticed a gradual precipitation increase with daily quantities between 0,1 - 4,9 mm and 5 - 20 mm particularly since 1980 to 1990 during the intervals: April - October, May - August, July - August. The amount of precipitation resulted from daily quantities more than 20 mm, has for the three analysed intervals a sliding means multiannual progress similar to that one of the total amount of precipitation in the respective intervals.

That is why the increase of the daily precipitation amount from 5 to 20 new was made to the detriment of the precipitation more than 20 mm. The sensitive increase of the daily precipitation with quantities between 0,1 and 4,9 mm, namely those ones that are missed because the interceptions and the evapotranspiration at the soil surface, increased the deficit of

water in soil. In the last two decades, there were many years for which the amount of the daily precipitation less than 5 mm exceeded 25% and the territory of the country was frequently affected by droughts (fig.9).

Table 7

Mean Annual Precipitation Quantities in the Last 100 years

Meteorological Station	10 YEARS		15 YEARS		20 YEARS		50 YEARS		100 YEARS		100 and 10 mean difference	
	Pp med	T med	Pp med	Tmed	Pp med	Tmed	Pp med	T med	Pp med	T med	Pp med	Tmed
Grivita	491.3	10.7	458.7	10.6	464.0	10.5	499.4	10.5	-	-		
Calarasi	464.6	11.5	470.1	11.3	471.9	11.3			500.9	11.3	-36.3	+0.2
Bucuresti	594.2	11.4	597.5	11.2	602.0	11.2			592.3	11.0	+1.9	+0.4
Giurgiu	584.1	11.5	553.8	11.4	559.8	11.3	587.5	11.2	-	-		
Caracal	475.2	11.2	477.2	11.1	500.2	11.1	548.2	11.0	-	-		
Alexandria	485.8	11.2	467.4	11.0	485.4	11.0	535.7	10.9	-	-		
Craiova	553.5	11.1	545.1	11.0	560.5	10.9	562.1	10.7	-	-		
Drobeta Tr.Sev.	581.6	11.9	590.2	11.8	616.4	11.7			679.4	11.6	-97.8	+0.3
Timisoara	589.9	11.0	576.4	10.8	583.5	10.8			597.8	10.7	-7.9	+0.3
Brasov	581.7	7.7	565.8	7.5	578.2	7.5			684.7	7.6	-103	+0.1
Tg. Mures	554.0	9.0	546.	8.9	551.8	8.9			605.9	8.7	-51.9	+0.3
Bistrita	661.8	8.4	687.3	8.2	691.3	8.1			683.9	8.2	-22.1	+0.2
Baia Mare	895.8	9.8	901.2	9.6	886.8	9.5			917.7	9.5	-21.9	+0.3
Oc. Sugatag	717.2	8.1	716.6	7.9	730.4	7.8			740.3	7.9	-23.1	+0.2
Iasi	586.1	10.1	589.9	9.7	592.5	9.6			544.7	9.5	+41.4	+0.6
Roman	575.0	9.0	559.7	8.6	549.5	8.6			521.2	8.5	+53.8	+0.5
Galati	494.2	10.9	474.5	10.7	473.0	10.6	474.5	10.5	-	-		
Medgidia	463.5	11.2	447.1	1.0	433.7	10.9	428.2	10.7	-	-		
Constanta	409.9	11.9	406.3	11.6	399.2	11.7			385.5	11.4	+24.4	+0.5

Anthropical pressure determines the overexploitation of the terrestrial natural resources and the extension of the cultivated agricultural surfaces beyond the limits that could maintain the man - environment balance.

The human pressure includes an improper land management, materialized in soil degradation (because of the erosion caused by water and wind, salinity, overgrazing) deforestation and rivers clogging. The salinity is very important in the arid areas, particularly on the irrigated surfaces where the water management is incorrect.

The climatic anomalies superposition with the anthropical pressure of different kinds of manifestation often generates irreversible ecological lacks of balance, the natural “repair” and “regeneration” mechanisms being unable to annihilate the supplementary stress.

Among the anthropical causes which contribute to the increase of the aridization,could be mentioned the pollution and the deforestations.

Pollution

- Among the pollutants established by the protocol from Kyoto in Romania are taken into account the following gas emissions with greenhouse effect: carbon dioxide, nitrogen and methane oxides and afterwards the other gases from the protocol (fluorine hydrocarbons, perfluorinecarbons and hexafluorines of sulphur).
- At present the specific pollution (the pollutants quantity related to the number of inhabitants) is for certain common pollutants below the mean of the UE' s countries from 1990 (and below the mean from 1995 - taking into account the obligations of these countries not to exceed in 1995 the pollutants quantity from 1990). Fig.10.
- The carbon dioxide emission in Romania (the most important for the green house effect) in 1989 was of 194.826 Gg (as reference value) and 1994 of 125.597 Gg. In 1996 the world carbon dioxide emissions were of about 4 t/inh. (U.S.A. -20 t /inh, in the Central Europe and the Western Asia -7,35 - 7,9 t/inh), the USA, in EU and Japan producing 40% from the total quantity; the annual rate of CO2 increase is of l,3%. In Romania in the period 1989-1998 the CO2 / inh quantity decreased from 8,56 to 5,2 + (fig.11), However, CO2 having a high degree of diffusion in the atmosphere, it spreads very quickly, the atmospheric constituant in this gas being quite uniform on the Earth, that makes the green house effect be generalized.

Deforestation

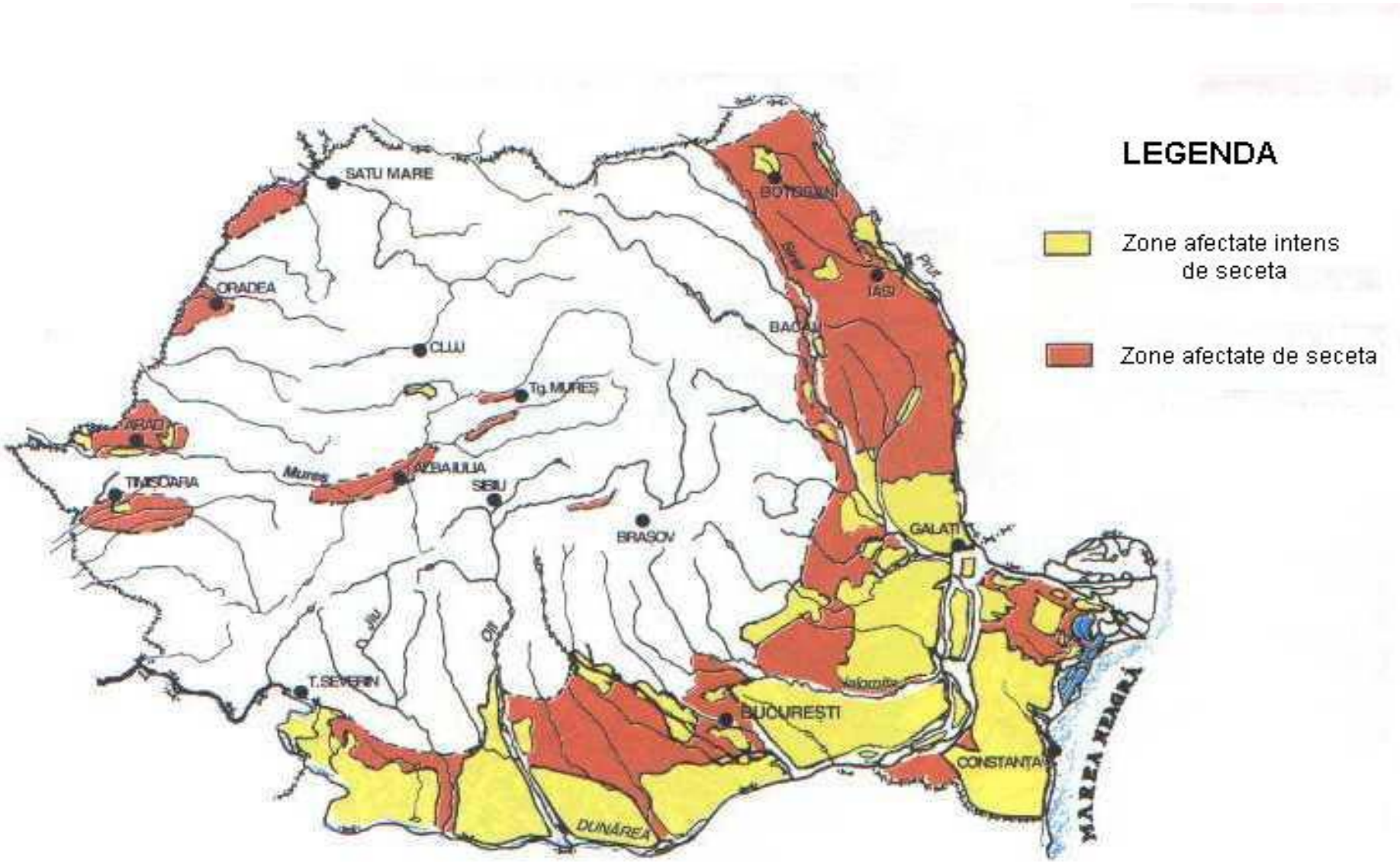
In the prehistoric times, the territory of Romania was covered by forests in a percentage of 79-80%. When the human society developped, the forests surface was gradually reduced. Nowadays the areas covered with forests represent 28% of our territory.

The main cause of the clearings was to obtain arable fields, pastures, development of some trades (obtaining "potash" from the oak wood used in the glass industry).

Important changes in the landscape were made after 1766 when Grigore Ghica's" urbarium who encouraged forests cutting by administrative measures.

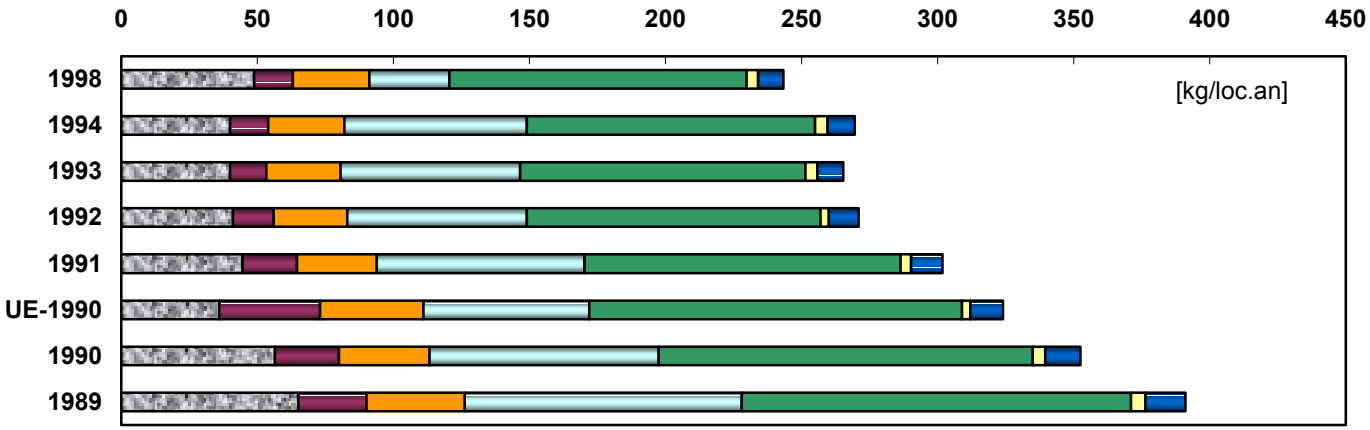
The beginning of the radical changes of the landshifting was marked by the Adrianopol fact signed in 1829 which determined the intensification of the wheat and wood trade. The Romanasi and the Baragan plains were modified in order to obtain better wheat crops and good results in the oak wood exportation.

Fig.9 The areas affected by drought in Romania



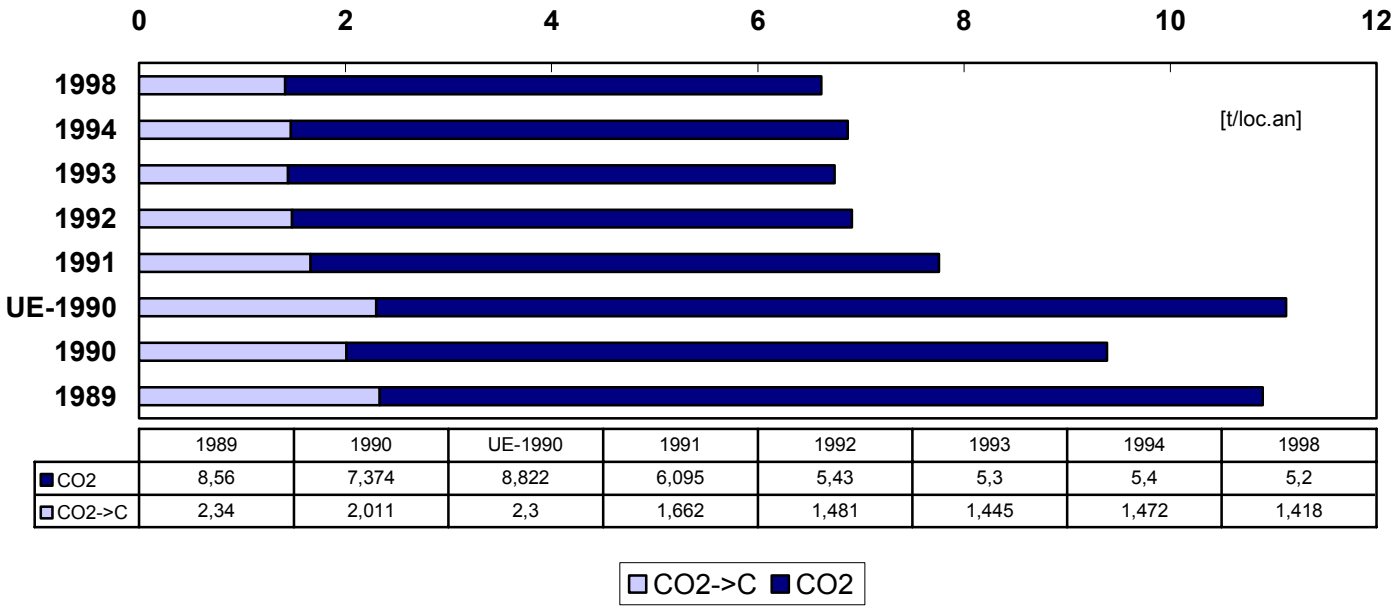
Zonele afectate de seceta in Romania

Fig.10 Gas quantities with green house effect uttered in the atmosphere in the period 1989 - 1990 (kg/inh. year)



	1989	1990	UE-1990	1991	1992	1993	1994	1998
NH3	14,7	12,9	12	11,5	11	9,6	10	9,4
N2O	5,3	4,6	3	3,9	3	4,3	4,6	4,2
CO	143,1	137,5	137	116,2	108	104,9	106	109,2
CH4	101,8	84,2	61	76,4	66	66	67	29,5
COV	36,1	33,3	38	29,2	27	27,3	28	28,1
NOx	25	23,5	37	20	15	13,3	14	14,2
SOx	65,1	56,5	36	44,6	41	40	40	48,8

Fig.11 CO_2 and C (from CO_2) quantities uttered in the atmosphere during the period 1989 - 1990 (kg/inh.an)



	1989	1990	UE-1990	1991	1992	1993	1994	1998
CO2	8,56	7,374	8,822	6,095	5,43	5,3	5,4	5,2
CO2->C	2,34	2,011	2,3	1,662	1,481	1,445	1,472	1,418

The highest clearings were effectuated between 1838 and 1959 during "Caragea's plague' and after it when the people who were living in the plain area found shelter in the woods because of the disease. Afterwards they set these woods on fire. The clearings continued after 1859 so as the afforestation in the Romanian Plain decreased below 25-30%, the ideal percentage for this area (for example in the Vlasia plain, the forests surface decreased from 38% in 1859 to 12% at present).

In 1921, the agrarian reform reduced the forests surface in Romanian with about 1.000.000 ha.

In the areas with a high degree of aridization the forests surface is very reduced (1.607 ha, bellow 18%) represented by different kinds of oak (mesophile, submesophile and xerophile oaks).

At present, the mean afforestation percentage in the plain area is of 7%, for the hill area of about 27% and in the mountain area of about 60%. It can be mentioned that, in the plain, hill and mountain area, the forests has no uniform distribution that determine the amplification of the land degradation and water courses with torrents.

The albedo increase after the deforestations in these territories determined a supplementary heating of the adjacent air masses, the decrease of the air humidity and big losses of water in soil. The drought phenomenon, as a natural phenomenon proper to the steppe and forest steppe climates, became more frequent affecting also the crops.

3.7 FACTORS RESPONSIBLES FOR LAND DEGRADATION

Both soil and land degradation, as well as the drought phenomenon and occurrence of the desertification in some regions of Romania are strongly linked with the bad natural resources management: vegetation, climate, soil and water. Soil and land degradation has mainly human (anthropic) causes, while in the drought and desertification case the main role is played by climate factors. From this reason, although geographically those two phenomena overlap, the area of land degradation occurrence is by far larger than that of areas affected by drought and with desertification risk.

The causing factors of anthropic soil and land degradation are described in the following:

Anthropic (human) factors. The main anthropic (human) factors considered as being responsible for the land degradation in Romania are given in the table 8. From this table it results that the agriculture occupies the first place. However, it worth to emphasize that the agriculture "*per se*" doesn't represent the main cause of the degradation processes, but the bad

management of the agricultural lands, and the advanced deforestation of the country area. Indeed, taking into account physiographic peculiarities of the Romanian territory (with more than 67 percent sloping lands, climate, geomorphology, surface lithology and soil favourable to water erosion). The decrease of the forested lands represents the main cause of soil and land degradation. Moreover, within 1965-1985 period one pressed strongly to extend the agricultural (mostly arable) lands, by embanking large areas in the Danube Flood Plain and Danube Delta, and also by cutting down wind breaks, being taken for cropping soils with high degradation risk.

The decrease of the forested area from ca. 80 % at the beginning of the millennium to 28 percent at the time being (below the European average of cca 33 percent and significantly below the optimum, taking into account the physiographic and climate conditions) has been one of the main causes that worsened the soil and land degradation processes.

Table 8

Causing factors of anthropic - induced degradation of Romanian soils

Causing factor	Extent	Location	Degradation type	Aprox. Age of start (years)
1. Deforestation and removal of natural vegetation (converting forest into agricultural lands)	Forest and forest - Steppe zone	Mountain and hilly region, partially in plain region	- Soil erosion (mainly by water)	$> 1.5 \times 10^3$
			- Loss of nutrients and organic matter	1.0×10^2
2. Miss leaded agricultural management (lock of erosion control measures, excessive or insufficient use of chemical fertilizers and biocides, too frequent use of heavy agricultural machinery, bad management of irrigated areas)	Practically on agricultural land as a whole	Hilly and plain region	- Water and wind erosion	$> 1.5 \times 10^3$
			- Terrain deformations (land slides gulling)	$> 1.5 \times 10^2$
			- Soil compaction, structure destruction	0.5×10^2
			- Decrease of humus and macro - nutrients content	1.0×10^2
			- Pollution by biocides	0.3×10^2
3. Overexploitation of forestry for domestic use (fuel wood, construction, trade)	Locally	All regions, but mainly within the mountainous and hilly ones	- Water and wind erosion	Unknown
4. Over-grazing and trampling by livestock	Locally	All regions, but mostly in Forest and Forest - Steppe zones	- Water and wind erosion	1.5×10^3
5. Industrial activities (industries, power generation, infrastructure development, waste handling, traffic, etc.)	Locally	All regions	- Pollution of different kinds (point source or diffuse)	$\geq 1.0 \times 10^2$
6. Intensive commercial exploitation, road constructions, urban development	Locally	All regions	- Loss of bio productive functions of soil	$\geq 1.0 \times 10^2$

3.8 DESERTIFICATION AND SOIL DEGRADATION PROCESSES – AS FACTORS OF INTENSIFYING DROUGHT

Soil degradation from the regions exposed to drought has an amplifying effect upon the edaphically drought (table 9).

Table 9

Desertification and soil degradation processes that amplify edaphically drought

Type of process	Consequences
Water erosion	- increase of surface runoff - decrease of soil water holding capacity, following the partial or total destruction of the soil mantle - decrease or destruction of soil capacity to provide a normal support for development of vegetation cover - silting of natural emissaries and flooding risk increase - increase of the albedo of the ground surface and evapotranspiration intensification
Wind erosion	- removal of the humus rich upper horizons and reducing soil capacity to store water and to ensure vegetation cover development. - exposure of sandy substration and increase of wind erosion intensity - albedo increase, surface soil temperature increase, evapotranspiration intensification - covering with sandy deposits of arable lands or crops; filling-up with sands of irrigation or drainage channels
Soil compaction	- rootable conditions worsening - increase of erosion risk following decrease of soil permeability and increase of surface runoff - decrease of soil water holding capacity by diminishing soil porosity - increase of evapotranspiration - increase of the albedo
Crusting	- reducing surface soil permeability - intensifying evapotranspiration - increase of the albedo
Salinisation	- intensifying of edaphically drought following soil-water osmotic pressure increase above that of cultivated plants - toxic effect of salts accumulated in soil - intensifying of evapotranspiration by surface crust development and soil albedo increase
Sodication	- clay dispersion and development of dense and impermeable soil horizons - toxic effect on plants of high alcalinity - severe reduction of soil permeability and easily available water capacity - increase of surface runoff - increase of the albedo and of evapotranspiration

Water erosion is a strong amplifying factor of drought in Dobrogea (the main region of Romania subjected to desertification), and also in the Barlad Tableland and Getic Piedmont. Wind erosion has a significant worsening effect upon drought mainly in the areas with sandy soils from south and southeastern part of Romania (Oltenia, Baragan, Tecuci Plain).

Soil compaction and crusting act mainly in the plain region from the south and western part of the country, where those processes are largely widespread.

Soil salinisation and sodication act as drought intensifying factors within areas with salt-affected soils from Eastern Romanian Danube Plain (Baragan) and within the plain from the western part of the country.

3.9 DROUGHT AS FACTOR OF AMPLIFYING SOIL DEGRADATION PROCESSES

In the relationship between desertification, drought and soil degradation, there is the reverse of medal, that is the amplifying of soil degradation during drought periods (table 10).

Table 10

Desertification and soil degradation processes induced or triggered by drought periods

Process	Amplifying cause
Water erosion	- severe drying of the soil surface and weakening the resistance of soil structural aggregates to raindrop impact - increase of rain torrentially and of their erosion power - increase the risk of rill and gully erosion
Wind erosion	- excessive drying of the soil surface and weakening the cohesion between particles
Crusting	- dispersion of the structural aggregates during heavy rains
Salinization	- increase of evapotranspiration from ground water and intensification of salt accumulation within the soil profile

4 EFECTS OF THE FACTORS RESPONSIBLE FOR DESERTIFICATION, LAND DEGRADATION AND DROUGHT

2.1. LAND DEGRADATION TYPES AND THEIR LOCATION

According to SOVEUR methodology, in Romania were identified 13 human-induced degradation types and the so called "stable lands" without apparent degradation. The kinds of degraded land, their extent and location are shown in the table 11 and fig. 12, respectively.

Table 11

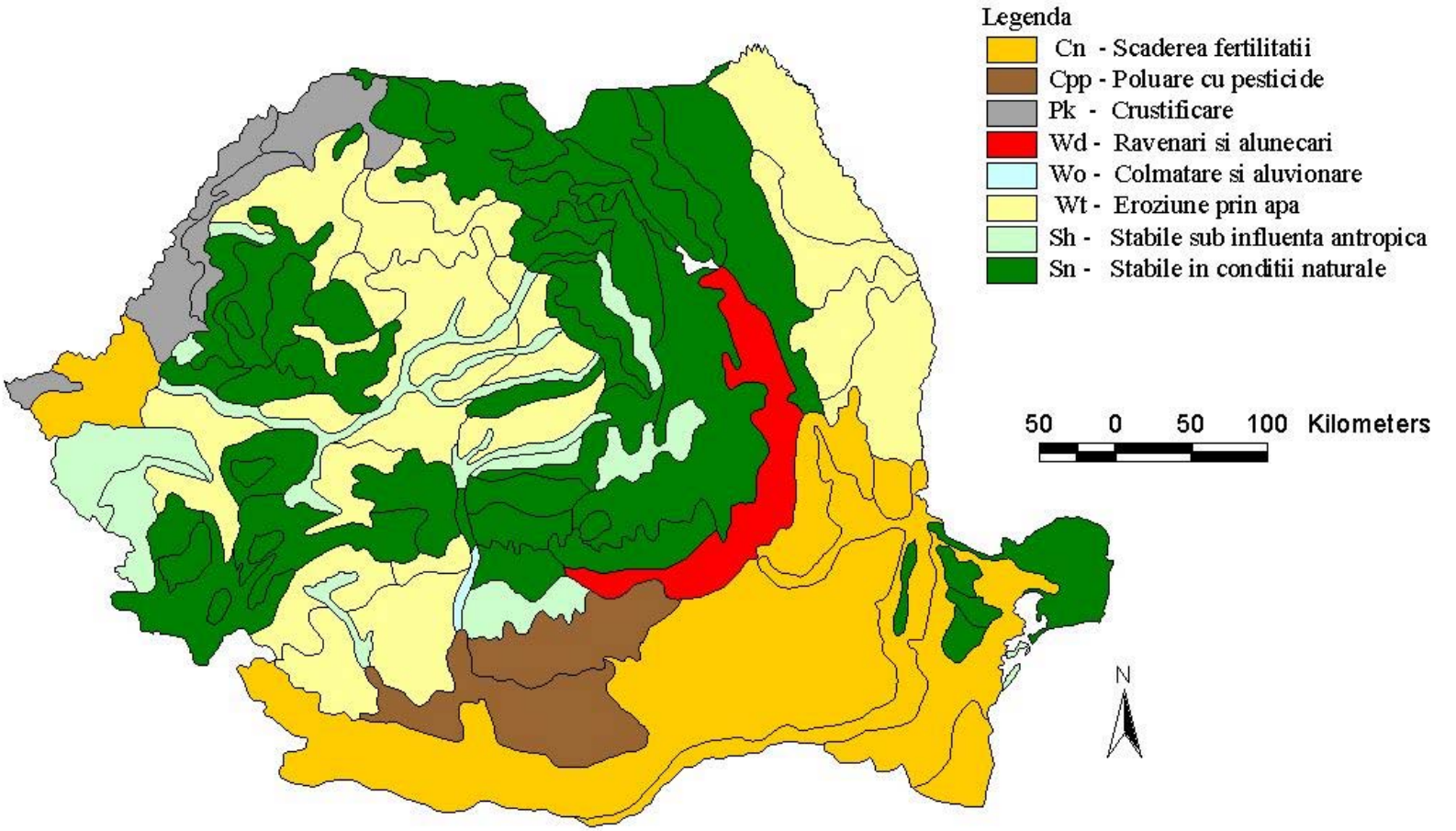
Types of human-induced soil degradation

Nr. crt.	Degradation type	Location	Area[1)]	
			10^3 ha	% from total area
1	Water erosion (sheet and gully erosion)	Hilly and table land region, pericarpathian hills	6 300 (gulling 1376.10^3 ha)	26.4
2	Landslides	Hilly and table land region, pericarpathian hills	702	2.9
3	Wind erosion	Sandy areas from Romanian Plain and Danube Delta	378	1.6
4	Silting /colmatation	Inland river flood plains, Danube Flood Plain and Danube Delta	950	4.0
5	Soil compaction	Agricultural lands as a whole, but predominantly within the plain region	1 344	5.6
6	Crusting and sealing	Almost all salty, salty loamy and clayey loamy soils	2 300	9.6
7	Aridification	Locally within the Danube Flood Plain	362	1.5
8	Soil removal through surface mining, excavation	Mostly within surface coal mining areas from Oltenia	15	0.1
9	Pollution with urban and industrial wastes	Periurban areas, coal power plants, mining areas	18	0.1
10	Salinisation (mostly natural)	Eastern Romanian Danube Plain, Western Plain, Moldavia Tableland	614	2.6
11	Chemical pollution (generally of moderate intensity)	Industrial, mining areas	900 (+ weak pollution ca. 3641.10^3 ha)	3.8
12	Loss of soil fertility by organic matter and nutrients depletion	Eastern Romanian Danube Plain, Dobrogea, Southern part of the Western Romanian Danube Plain	3 342	14.1
13	Acidification	Agricultural lands from the external part of the forestry zone	841	3.5
14	Stable land in natural condition	Forested land, some grassland, Danube Delta	7 182	30.2
15	Stable land under human influence	Some areas of plains and tableland regions, outside the irrigated areas	1 240	5.2
16	Lands without natural vegetation	Rocky land, alpine peaks	141	0.6

1) Some degradation types overlap, so the total percent may be 100%.

Fig. 12 Human induced land degradation map of Romania

(Cn=fertility diminishing, Cpp=chemicals pollution, Pk=krust, Wd=Gullies and Landslides, Wo=Silting, Wt=water erosion, Sh=Stable under human pressure, Sn=Stable under natural conditions)



The soil degradation processes affect more than 1/3 from the country area as a whole. From these processes, the most important is **water erosion** that together with **landslides** occupies more than 7 mil. ha. The regions with the high percent of eroded soils are: the Moldavia Tableland, Pericarpathian Hills (Subcarpathes) between Trotus and Olt rivers, the Transilvania Tableland and the Getic Piedmont. The amount of soil material lost by erosion, at the whole country level, rise to 126 mil. tons per year.

One can say certainly that all kinds of degradation processes and of limiting factors of agricultural production are to be found in the area with dry-subhumid climate, as well as in that affected by drought, although their proportions may be different if compared with those which refers to the country area as a whole.

Wind erosion occurs with higher intensity only in sandy areas from Baragan, Oltenia, Tecuci Plain and the marine levees from Danube Delta. On loess-covered area from Baragan and Dobrogea wind erosion of lower intensity is admitted.

Silting and colmatations are characteristic to the non-embanked sectors of flood plains and to some areas from river plains where the watercourses were not regularised.

Human-induced soil compaction and crusting are by far the most important kinds of physical deterioration of Romanian soils. Strong or moderate soil compaction occurs on ca. 1.3 mil ha and is due mainly to the weight and/or frequent use of machinery, mostly when the soil is too dry or too wet. The last one is mainly a consequence of a too large area of arable land per tractor. The soil compaction is recorded especially on clayey-sandy and salty- loamy soils, but also on clayey loamy, loamy and sandy loamy soils from the dry and subhumid regions of the country. Crusting and sealing occur on 2.2 mil ha, mostly on salty and loamy soils, with low organic matter content, with top soil structure destroyed following of intensive and repeated tillage works made at unsuitable soil moisture condition, with scarce vegetation cover that allows a maximum raindrops impact.

Aridification. This process is relatively new in Romania and is estimated at 0.4 mil ha, although it may be more extensive. According to present day methodologies, it is taken into consideration only for areas where an excessive lowering of ground water table (over drainage) took place. Aridification is a controversial subject because the effect of climate change is not known yet.

It seems that in this category should be included the majority of soils with low water holding capacity, on which the negative effect of drought periods is strongly amplified: skeletal soils, shallow soils, coarse sandy soils, salt affected soils, strongly eroded soils from the regions with dry climate of Romania.

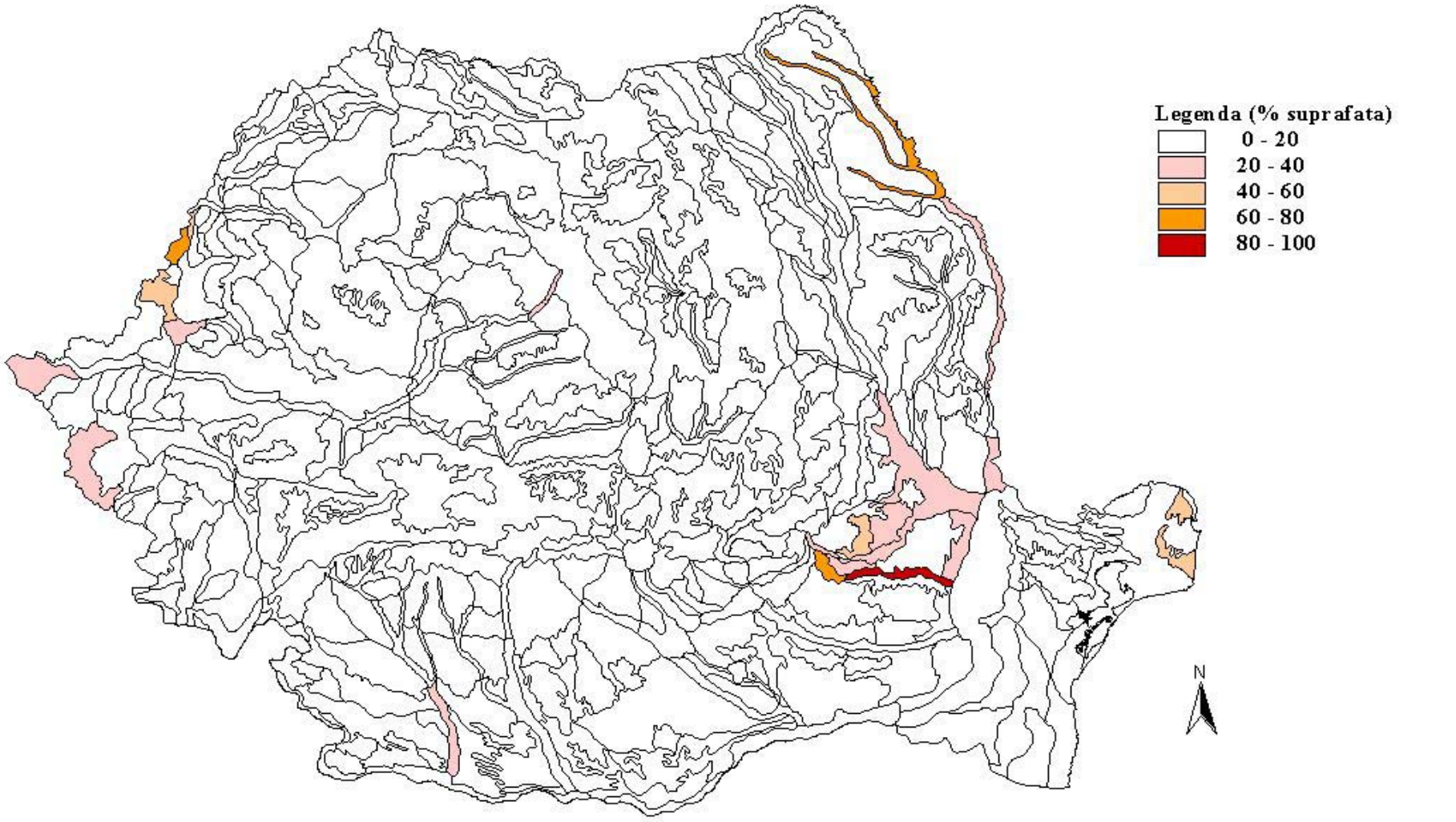
Salinisation. This is a primary natural process in Romania, but in a large measure intensified by some land improvement works, mistakenly applied, e. g. embankment, drainage and irrigation. At the time being salinisation and sodication affect ca. 0.6 miles ha, and occur mainly in the eastern part of the Romanian Danube Plain and in the Western Plain (fig. 13).

Chemical pollution is a consequence of biocides and of other organic contaminants use. Moderately polluted soils occupy 0.9 mil ha, while the low pollution ones extend over 3.6 mil ha. Although very localised (0.05 mil ha), *oil and salty water pollution* has a strong impact in the areas of occurrence. *Heavy metal pollution* (Cd, Pb, Zn, and Cu) is of point source type and occurs in four main areas: Zlatna, Baia Mare, Copsa Mica and Valea Calugareasca. It is due mainly to industrial activities.

Once with the removal of native vegetation, forest or grasses, by agricultural use, on notice a **significant decrease of organic matter content,** sometimes only in few years, down to half from initial amount. After being stabilised at this new level, although the existing data are doubtful, the process extends and is considered as being a serious threat for the soils of the plain region of the southern part of the country (ca. 3.3 mil ha). The main cause is considered to be the negative balance between the applied fertilization and the nutrients exported by crops. There is also the opinion that drought could play an important role. This process has more negative effects as much as it is inscribed on a general adverse fertility status of the soil resources of the country, expressed (Dumitru et all, 2000) by: low - extremly low humus reserve (8.6 mil ha from which 5.3 mil ha arable land), moderate and strong acidity (3.4 mil ha from which 1.87 mil ha arable land), high alkalinity (0.22 mil ha from which 0.13 mil ha arable land), low - very low content of available phosphorus and potassium (6.3 mil ha and respectively 0.7 mil ha from which 3.3 mil ha and respectively 0.31 mil ha arable land), low amount of available nitrogen (ca. 5.1 mil ha from which 3.0 mil ha arable land), trace element deficiency especially zinc (1.5 mil ha arable lands).

Lands without apparent degradation (so called stable lands) occupy a little more than 1/3 of the country area. They are represented mostly by forestlands from the mountain regions and wetlands from Danube Flood Plain and Danube Delta (7.2 mil ha). The stable lands under agricultural use are considerably less extended (1.2 mil ha) and were identified practically only in the Western Plain.

Fig. 13 Salt affected soil map of Romania



4.2 VARIATION TENDENCY OF THE HUMIDITY RESERVES IN SOIL (1970-2000)

The increase of the climatic variability in the last decades, the intensification of the extreme events (drought, intense heat, humidity in excess) and their negative consequences which make us pay more attention to the interpretation annual the use of the climatic resource in agriculture.

At present, the agriculture of our country is not too developed to face the increase duration, intensity and frequency of the climatic restrictive conditions, that is why the agricultural production presents frequent fluctuations every year. Thus, in the warm and extremely droughty years of the last two decades was registered a dramatic decrease of the crops level (40-66%) or even their total destruction, particularly in the plain areas in the south.

The evaluation of the plants water feeding degree during the vegetation period was made taking into account the different accessibility limits of the water in soil favourable or unfavourable for the normal development of the vegetation processes. Thus, in spring for the sowing corn, the necessary humidity from the arable soil layer is of 20-45 mm (accessible humidity of 40-90% from the useful soil water capacity - CAv).

If the accessible humidity content for this layer decreases below 5 mm, the germination and springing processes are stopped. During the vegetation period, the proper water feeding limit is of 70-100 % from Cav, and below these limits, taking into account the plants growing stage; this limit could be sufficient or the water stress begins to be materialized (0-50% from Cav), extreme severe and moderate pedological drought.

In Oltenia and the western Muntenia, the pedological drought enhances since the end of June to the autumn period. Thus, on 30th of June, the accessible humidity reserves of 0-100 cm profile, present only proper and satisfactory values in a relative small percentage, 44-47% from the cases and the extreme, severe and moderate pedological drought occurs in 15-20% from the cases.

In the agricultural areas in the southern part of the country, there is a tendency of the drought phenomenon persistence after 1980 (reserves less than the 50% limit standard from Cav) and its enhancing in the last two decades (i.e.1988, 1992, 1993, 1994, 1998, 2000) when the humidity reserves decreased till the withering coefficient limit. This fact proves that since the beginning of June the corn needs frequent irrigations till middle August when the interval with maximum water request ends, for the addition of the big deficits of water in soil being necessary 1.440-2.200 mc water) ha.

In the south of Moldova, also with a big vulnerability to drought because of the critical precipitation in the summer time, the water accessible to plants has reduced values less than 35% from Cav (severe and extreme droughts in 19% from these years). Insufficient conditions are registered in 22% from these years, the rest having a good or sufficient feeding.

The analysis of the presented data shows that at the end of the 1970-1980 interval with a sufficient soil humidity regime sufficient there is a tendency of decrease and maintenance of the insufficient reserves taking into account the plant needs during the maximum consumption period for all the analysed areas reaching the highest point in 2000 with a long and intensive period of drought which began in May (the humidity content decreased till the withering coefficient limit) with a wide territorial extension.

In August, when the previous accumulated reserves finished because of the consumption by evapotranspiration, could be noticed an increased frequency of the years with extreme, severe and moderate droughts till 78 - 90% of the years in the agricultural areas from Moldova, Oltenia and Banat and after 1980 there is an enhancing risk tendency for big deficits of water in soil taking into account the plant needs.

The desertification and drought strong risk areas of Romania are situated in the I-st zone (fig. 5) where the diminution of the soil humidity was under the minimum moisture content (50% of available moisture holding capacity) in several years (1988, 1992, 1993, 1994, 1998, 2000).

4.3 DECREASE OF THE WATER RESOURCES MOBILIZABLE AT THE SOURCE

From the point of view of the water resources during the 1982-1993 period, there were registered 7 years with hydrological drought: 1983, 1985, 1987, 1989, 1990, 1992 and 1993, the years: 1992, 1993 being characterized by a special severity of this phenomenon particularly for the hydrological basins in the south of the country. In these areas the annual rivers flow represented less than 50% from the multianual value and for the plain areas even less than 30%.

The ground water levels also registered decreases of about 200-300 cm below the normal values.

- Surface waters

The strongest influences of the drought phenomenon enhancement can be felt in July when the med of water in agriculture is at the maximum level.

The probable values of the water supplementary need in the conditions of the climatic changes anticipated at the main observational stations in July, are the following:

- Craiova - 31,6 mm/month
- Tr.Magurele - 41,5 mm/month
- Marculesti - 38,2 mm/month

The increase of the water need is due to the supplementary evapotranspiration during the vegetation period, which can reach the limit of 42-61 mm in July. Up these conditions, the supplementary water need during the vegetation period could reach 85 - 125 mm.

Thus among the probable effects of the climatic changes upon the irrigation systems functioning, can be mentioned:

- increase of the water requests for irrigation with about 1.000 mc/ha/year at a mean efficiency of the irrigation systems of 50%:
- a return time with less than 30% in July that supposes the increase of the watering equipments need, the verification of the pumping station capacities, the verification of the transport through channels and pipes, the adjustment of the crop plan and the crop rotation to the present conditions.

➢ Ground waters

Especially in the last 35 years it was noticed a perturbation of the water resources recycling as combined effect (by superposition in time) of the climatic and anthropical factors upon the ground waters, more obvious in the case of the phreatic aquifers.

The analysis of these variations pointed on the following aspects:

- the general tendency of the piezometrical levels evolution is that of decrease, in 1995 being reached the lowest share,
- during the period 1965-1981 the piezometrical levels excluded the multi-annual mean, mainly because of the re-feeding aquifer with the water come from irrigations, but also due to some amounts of annual precipitation which exceeded the mean values,
- during the period 1981-1991 it was registered an evolution stability at high shares, with a light tendency of decrease (or return),
- during the period 1991-1995 the general variation tendency of the piezometrical levels was of enhanced decrease, because of the relative poor precipitation, a higher mean annual temperature and the destruction of the irrigation systems.
- The water quality evaluation for the phreatic aquifers in Romania, in 1999 printed on the following:

- the omnipresent chemical compounds whose values exceed the values exceptional admitted, are NH4- and NO2-
- another indicators which exceed the values exceptionally admitted, with a percentage bigger than 30% from the measurements / indicator member, are: total hardness (Mures and Prut hydrographical basins); constant wastes (Prut hydrographical basin); organic substances (Banat and Prut hydrographical basins); magnesium (Prut hydrographical basin); iron (hydrographical basins: Banat, Olt, Vedea-Arges, Ialomita, Prut and Danube); manganese (Siret and Prut hydrographical basins); sulphates (Prut hydrographical basin).

Concerning the depth aquifer horizons, these ones could be affected by the consequences of a long range drought period by overexploitation. Besides the quantitative impact, the indirect impact of this irrational measure of resources management may reflect in the quality deterioration of the extracted water.

4.4 ECOLOGICAL, ECONOMICAL AND SOCIAL EFFECTS OF DESERTIFICATION

4.4.1 Decreasing of the yields and of their quality

A prime effect of the drought and aridity phenomena is the decreasing of the yields down to zero. This fact and the opportunity of the irrigation result from table 12.

The mean yield damages in the no irrigated fields are smaller for the winter crops (wheat, barley), sunflower, rape, sorg hum (known as more tolerant species to drought) and much greater for the complete season crops (sugar beet, soya bean, maize)..

The successive droughts superimposed to the heat days may lead too much drastic decreasing of the yields, to 80 – 90% from the mean annual yield.

It is obvious that the irrigation has a special importance in these conditions both for the yields ensuring and for the improvement of the environment conditions.

Table 12

YIELDS MULTIANNUAL MEAN (1970 – 1990) BY COMPARISON TO DROUGHT PERIODS IN THE IRRIGATED AND NON-IRRIGATED FIELDS

No.	Experimental field	Crop	Yields – to / ha				Yield increase (%) towards the no irrigated fields	
			No irrigated		Irrigated			
			M*	D**	M*	D**	M*	D**
1.	Maglavit (1976 - 1990)	soya	1,3	0,4	3,7	3,0	185	750
		maize	6,5	2,6	11,7	12,0	182	460
		sugar beet	27,4	12,0	67,9	60,0	248	500
2.	Caracal (1970 - 1990)	soya	1,8	0,9	3,3	3,2	83	355
		maize	6,6	0,8	11,2	9,0	70	1125
		sugar beet	44,4	20,0	66,1	40,0	149	200
3.	Valul lui Traian (1969 - 1990)	soya	1,2	0,2	3,2	2,8	266	1400
		maize	4,2	0,3	11,6	11,4	280	3800
		sugar beet	31,3	11,3	69,9	58,0	223	513
4.	Braila (1969 - 1990)	soya	1,5	0,4	2,7	2,8	80	700
		maize	6,0	-	10,9	-	80	-
		sugar beet	37,5	-	69,9	-	80	-
5.	Cosmesti (1970 - 1990)	soya	1,6	0,4	3,3	2,4	106	600
		maize	5,9	0	11,2	7,3	90	7300
		sugar beet	21,5	7,2	64,4	40,5	200	560
6.	Arad (1970 - 1990)	soya	1,8	-	2,6	-	44	-
		maize	6,5	3,7	11,7	13,0	80	350
		sugar beet	37,7	-	53,6	-	42	-

*M=multiannual mean on the whole period
**D= mean on the drought periods

4.4.2 The limiting of cultivation of some plant species

Because of the repeated droughts as well as the lowering of the groundwater level and wind speed intensifying, the water balance of the area is strongly changed to have negative influence over the growth and development of herbaceous and woody plants. In this way it were vanished about 60 000 ha of riverside forests. Also about 50 000 ha of oak forests on high clayey soil are facing difficulties in the regeneration processes.

Meanwhile the non-irrigated fields are suitable only for some tolerant drought species (Sorghum, Sudan grass, sun flower, etc).

On salt polluted soils the spectrum of suitable plants is reduced to halophytes and some vegetables (but only in area under irrigation) and possibly rice.

On sandy soils, the no irrigated crops is available only for a small number of agricultural and forestry species

4.4.3 Forests decline

The forests decline has both a geographical-spatial and ecophysiological perspective. The spatial perspective consists in the reduction of forests area and in the lowering of their percent for some type of landscapes (mostly for the plain and hilly regions). The

ecophysiological perspective is expressed by defoliation-discolouration of leaves, both of them are generated by different causes (pollution, droughts, bed management) that lead in the end to the trees die.

According the forest health monitoring that has started since 1990 the resinous are less affected than broadleaved species. Among the species the strongest affected are: *Quercus pedunculiflora, Q. frainetto, Q. robur* and *Robinia pseudacacia.* Among broadleaved species the beech is the less affected.

Results regarding the health state of trees on altitude gradient suggest the increase of damaged trees percentage at hilly and plain regions (table 13).

Tabelul 13

HEALTH AND DAMAGE TREES PROPORTION (%) ACCORDING WITH THE ALTITUDE FOR ALL SPECIES BETWEEN 1994-1999

Altitude (m)	Class of defoliation									
	0-1					2-4				
	1994	1995	1997	1998	1999	1994	1995	1997	1998	1999
0-250	45,8	48,8	53,0	61,5	58,1	25,3	25,9	21,4	17,6	19,7
251-500	46,1	51,7	57,8	67,7	66,8	23,7	22,5	16,3	12,6	13,2
501-750	47,8	50,7	61,3	66,6	66,2	20,1	20,5	12,1	10,9	11,2
751-1000	46,6	54,1	64,3	67,6	67,1	17,2	17,3	10,7	10,8	10,7
1001-1250	51,8	58,5	67,0	72,2	68,7	15,9	15,5	10,0	7,7	9,6
1251-1500	53,4	62,9	70,7	75,3	68,7	14,5	13,2	7,9	6,9	6,6
>1500	49,2	57,1	62,9	71,8	65,8	14,1	18,4	12,9	9,3	11,7

The physiological decline is reflected by decreasing of growth (both diameter and height), and consequently by a tree volume decreasing (fig. 14).

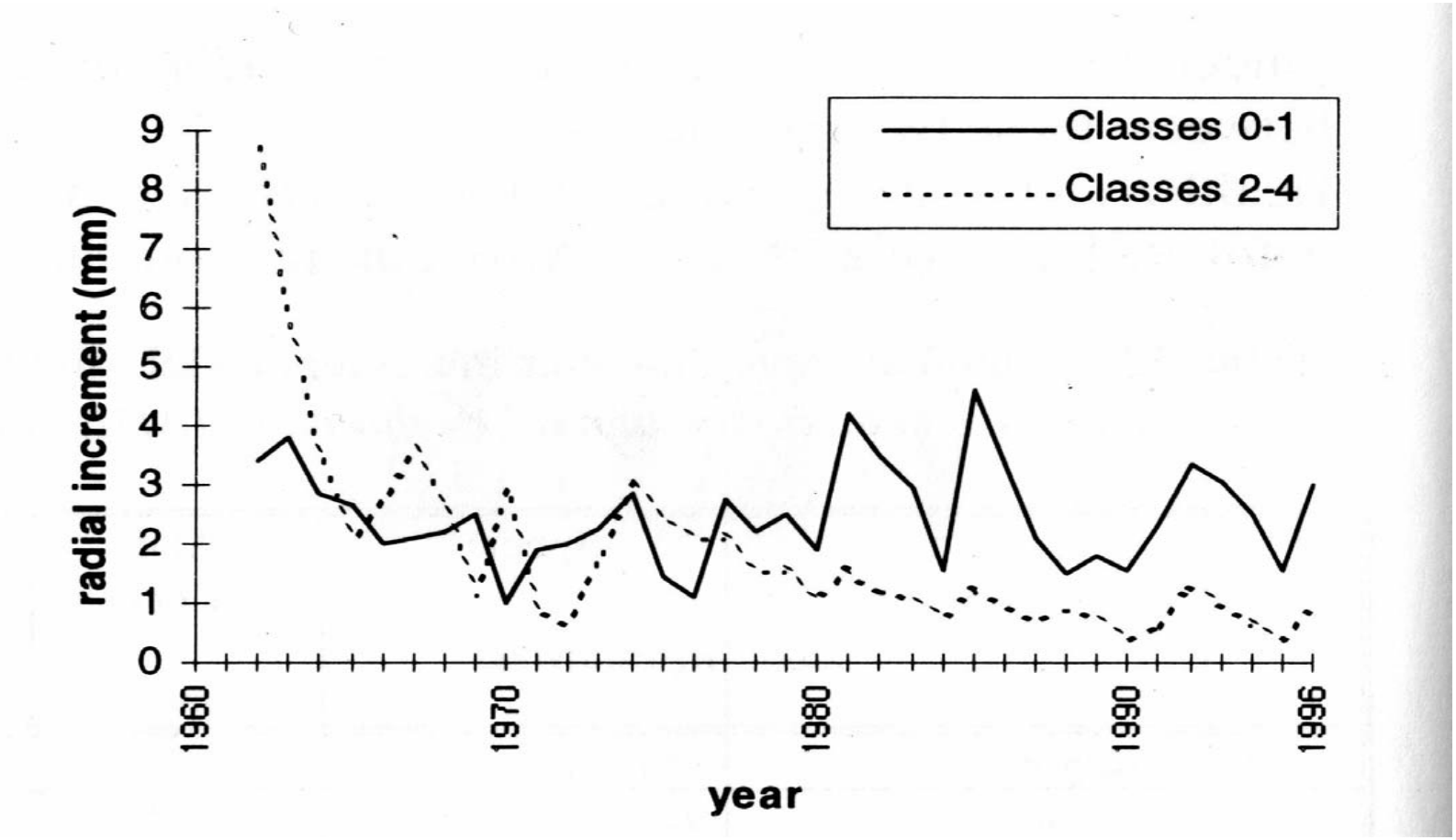
4.4.4 The pastures degradation

The surface of the permanent pastures from the plain lands is very small in the present (13% from the total of the pastoral fields), being maintained, in fragments, especially on the narrow meadows, on the broken landforms, sands and salt affected soils. The common steppe pastures provides animal food during at the most 2 month per year. Starting from June, the vegetation looks burnt and blunt, unable to feed the animals. On the other hand, the compaction due to early and excessive grazing damaged the soil structure. They became fallows and the weeds have overrun them, as effect of their neglect. A similar situation occurs in the former common pastures affected by excessive grazing or water or wind erosion.

4.4.5 Decrease of soil resources amount and change of their quality

The combined effect of desertification, drought and land degradation are reflected in the diminishing of the area of farmland soils and the decrease of the quality of those remained under agricultural or forestry use. Estimative this effect is shown in the table 14.

Fig. 14 Radial increment for Quercus sp. (1960-1996)



The socio-economic consequences of soil and land degradation processes are expressed by the fact that in 1990 - 1999 period the agricultural land area decreased by 0.290 mil ha, and that of the arable land by 0.751 mil ha. Moreover, the area of abandoned lands increased by 43 percent amounting to 0.450 mil ha.

Table 14

The effect of desertification, drought and land degradation on the soil resources of Romania

The intensity of land degradation	**10^3 ha**	**%**
Excessive and strong degraded lands, practically withdrawn from agricultural and forestry use	2 451	16.7
Lands with moderately to strong degraded soils, partially used as arable land with risk of extending degradation; they may be used as grasslands and timberlands of low productivity	5 248	35.8
Lands with weak degraded soils, used as arable lands, grasslands or timberlands, with diminished productivity	6 946	47.5
TOTAL	**14 645**	**100**

Changes of soil properties. The direct influence of drought takes place mainly by an increase of aridity of the soil moisture regime. This fact has as consequence the decrease of the weight of liquid phase and lowering or even stopping of the majority physical, biological, biochemical and chemical processes, whose development depend on water.

Changes of physical properties: porosity decrease, hard setting, soil compaction and bulk density increase; water holding capacity decrease; soil permeability decrease (sometimes significantly); structure breakdown and increase of water/wind erosion risk; widening and deepening of cracks in vertisols or other clayey soils.

Changes of chemical and mineralogical properties: decrease of the organic matter content; diminishing of nitrification rate and of nitric forms of nitrogen; increase of pH and amplifying of the risk of trace elements deficiency, reducing of phosphorus availability following the retrogradation in the crystalline lattice of clay minerals; increase of the salinisation risk in irrigated areas and in areas with shallow ground water; recarbonatation of some chernozems; increase of the risk of contamination/pollution with heavy metals; formation of the clay mineral palygorskit (typical for desert conditions).

Changes of biological properties: decrease of the soil capacity to produce biomass; decrease of the faunal activity (earth worms, burrowing animals).

4.4.6 Reduction of biodiversity

In the area under desertification, it has occurred periods of biodiversity reduction as well as recovering ones. At the beginning, the steppe and forest steppe area were rich in biodiversity. Plant species of the grassland and steppe brushes, forests, river side brushes and meadows (about 300 species), marsh ecosystems, aquatic, halophytic (about 1000 species), to what it was added a high number of primary and secondary consumers, are a short tableau of the primitive biodiversity. As a consequence of the human interventions by deforestations and creating of croplands, the biodiversity suffered a strong decrease. Anyhow, some increase of the biodiversity in such areas was achieved over the last half of century, by forest belts and windbreaks creation and reforestations of sandy areas. The strong reduction of biodiversity was done by chemical and mechanized agriculture over the span 1970-1990. After 1990, the land tenure reform, have given a real possibility to increase the biodiversity on agricultural land, due to land non-utilisation.

While the soil degradation occurs, by different type of erosions, exigent to fertility plant species disappeared with the consequence of biodiversity reduction.

4.4.7 Impact of desertification, land degradation and draught on human communities

The steppe and forest-steppe soils from high risk desertification and draught areas may be classified as frail areas, confronted with demographic and economic problems, with natural risks, which generate a range of dysfunctions.

The large proportion of rural population, of a large number of people living from agriculture, may generate high food insecurity if draught occurs. Among the counties with high rural population quotas are Calarasi (60.3%), Giurgiu (69.9%), Ialomita (58.7%), Olt (60.5%), Vrancea (61.1%) etc.

The lover density of population in the counties with highly agricultural economy such as Tulcea – 80.9 inhabitants/sq. km, Mehedinti, 65.9 inhabitants/sq. km, Ialomita – 68.5 inhabitants/sq. km, Teleorman – 80.0 inhabitants/sq. km, Vrancea – 80.6 inhabitants/sq. km, Giurgiu – 84.3 inhabitants/sq. km, creates problems of people employment in agriculture. There also are counties with higher densities than the average country level (94.4 inhabitants/sq. km): Iassy – 151 inhabitants/sq. km, Galati – 143.9 inhabitants/sq. km, Bacau – 113.1 inhabitants/sq. km, Constanta – 195.7 inhabitants/sq. km.

There are large differences between counties in the number of agricultural equipment and machinery, the average being 58 ha/tractor.

Regarding the areas fitted for irrigation, the following aspects can be observed:

- low proportion of areas fitted for irrigation is some country such as Bihor (2.5%), Satu Mare (2.1%);

- in other counties (Constanta, Dolj, Galati, Olt, Tulcea) the existing systems are deteriorated and they need to be restored.

If we consider the income from agriculture, in most areas from the analysed area, the income come preponderantly from plant production (Calarasi, Ialomita, Arad, Braila, Giurgiu, Teleorman etc.), while the number of counties with high animal production per inhabitant is low (Bihor, Calarasi, Ialomita, Timis).

In both situations, the plant and animal production can fluctuate largely according to the situation of climacteric parameters.

Poverty is the most serious dysfunction of the areas running high risks of desertification and draught. The poverty line in draught affected areas is an indicator of economic and social regress of the involved communities.

The following indicators are taken into consideration by poverty analysis in rural areas:

- proportion of occupation in agriculture, below the average of rural areas;
- lower proportion of active persons (compared to the average);
- the degree of village dispersion in poor communes;
- deficient infrastructure, mainly concerning the running water, sewage system etc.
- household endowment, below the average for rural areas

The draught has a significant contribution to the indicators mentioned above. There is also a low degree of consciousness of the state of facts and noninvolvement in actions for the prevention and alleviation of soil desertification and degradation. This explains why the areas with spots of poverty display a stressed degradation of soils.

The investigations conducted in order to assess the level of community poverty in our country show that poverty occurs mainly in rural areas. It was determined that the poorest communities are mostly in steppe and forest steppe areas. The proportion of the poorest communes, of the overall county communes, is particularly high in the following counties: Vaslui – 84.5%, Botosani – 79.4%, Teleorman – 53%, Iassy – 47.1%, Galati – 33.9%, Calarasi – 31.3%, Giurgiu – 30.4%, Braila – 20.5%.

Rural poverty must also be accounted by the frequency and high duration of draught with a direct impact on agriculture, the main activity of the inhabitants. In these areas, the income from agriculture is lower, which makes the households poorer.

Currently, the pressure of population on the agricultural areas, particularly in the areas with higher density of population, is increasing, under the conditions in which this sector of activity plays the role of an occupational buffer for the population unemployed in industrial areas undergoing reorganization. The phenomenon forced agriculture to absorb the excess of labour force, which caused a large-scale under-occupation and a low labour marginal productivity.

The only category of inhabitants of rural areas for which the poverty risk is low consists of retired persons from non-agricultural branches. Their households run low poverty risks because they can add to their pension, agricultural income form the land they possess.

The physiological density in the rural areas, as ratio between the number of inhabitants and the agricultural and arable area, shows that in the east and north-eastern counties, the human pressure exceeds the country average. At the same time, the south and western areas, with larger (agricultural and arable) areas, the values of physiological density are considerably lower.

4.4.8 Increase of the conflicts of interests

- Conflicts enhancing:
  - Between the water uses;
  - Management conflicts;
  - Political conflicts;
  - Other social conflicts (scientific, environmental).

Defined as those activities using water during the production process, water uses often get into contradiction or even in conflict. The most obvious contradictions are, for instance, those between the energetic use, requiring more water in wintertime to produce electric power and agriculture, whose water requirements are greater during the vegetation period (spring-autumn). Resolving these conflicts is sometimes difficult, despite existing computation methodologies.

The situation worsens when the resource is scarce. In this sense, certain authors consider that it is not the water that is scarce, but water as a market product. Almost often this definition skips over the connections established between the various physical, technical, financial and other aspects, which make water become or become not a resource for the user.

Lately, it is for this reason that the notion *of water resources apt to be mobilised* has been used ever more frequently.

These may be defined as being those usable resources obtained as a result of a confrontation between the economic and the social factors. In other words, the resource apt to be mobilised is the result of an arbitration and not only of economic computations.

If water amounts are limited – as happens in drought circumstances –, competition will intervene between users.

Actually, competition will not take place in the domain of water, but in either the field of the market mechanisms or in that of the public arbitration.

5 IDENTIFICATION AND DELIMITATION OF THE AREAS AFFECTED BY DESERTIFICATION, LAND DEGRADATION AND DROUGHT

5.1 IDENTIFICATION OF THE AREAS WITH A HIGH RISK TO DESERTIFICATION AND DROUGHT.

This identification was made taking into account the correlation between the aridity index calculated by the precipitation reference to the potential evapotranspiration and Palfay aridity index, which takes into account the frequency of the droughty years. It was considered that the affected areas contain the territories in which the respective index (precipitation / evapotranspiration) is below 0,65 (table 15, fig.15) and those ones with a severe sensitivity drought for which Palfay index is of 6-8 (the frequency of the drought years being of 40-63%). These territories are placed in the southern and eastern side of the country characteristic most of it for the forest steppe and steppe but also for the quercineae forests area in the high plains. In the western side of the country, the territories with a risk to aridization cover surfaces comparatively restricted.

Table 15

ARIDITY AREAS ACCORDING TO RELATION: (UNEP-1992)

No.	**Climatic areas**	Aridity index R = P/PET
1	Hyperarid areas	**R < 0,05** The human activity is very restricted, only around the oasis
2	Arid areas	**0,05 ≤ R ≤ 0,20** Grazing is possible but with a big susceptibility to the annual climatic or water resources variation
3	Semi-arid areas	**0,20 ≤ R < 0,50** Constant grazing, agriculture very susceptible to inter-annual climatic variability
4	Dry/subhumid	**0,50 ≤ R < 0,65** Agriculture cold develop over wide surfaces in areas with precipitation
5	Humid climate - humid - cold	**R ≥ 0.65**

The areas with the most severe drought intensities are the sondy lands in the district of Dolj, the lands with heavy soils in the south of the district of Teleorman, the lands in the districts of Ialomita, Braila, Galati, Tulcea and Constanta (fig.16).

5.2 IDENTIFICATION AND DELINEATION OF ZONES AFFECTED BY LAND DEGRADATION

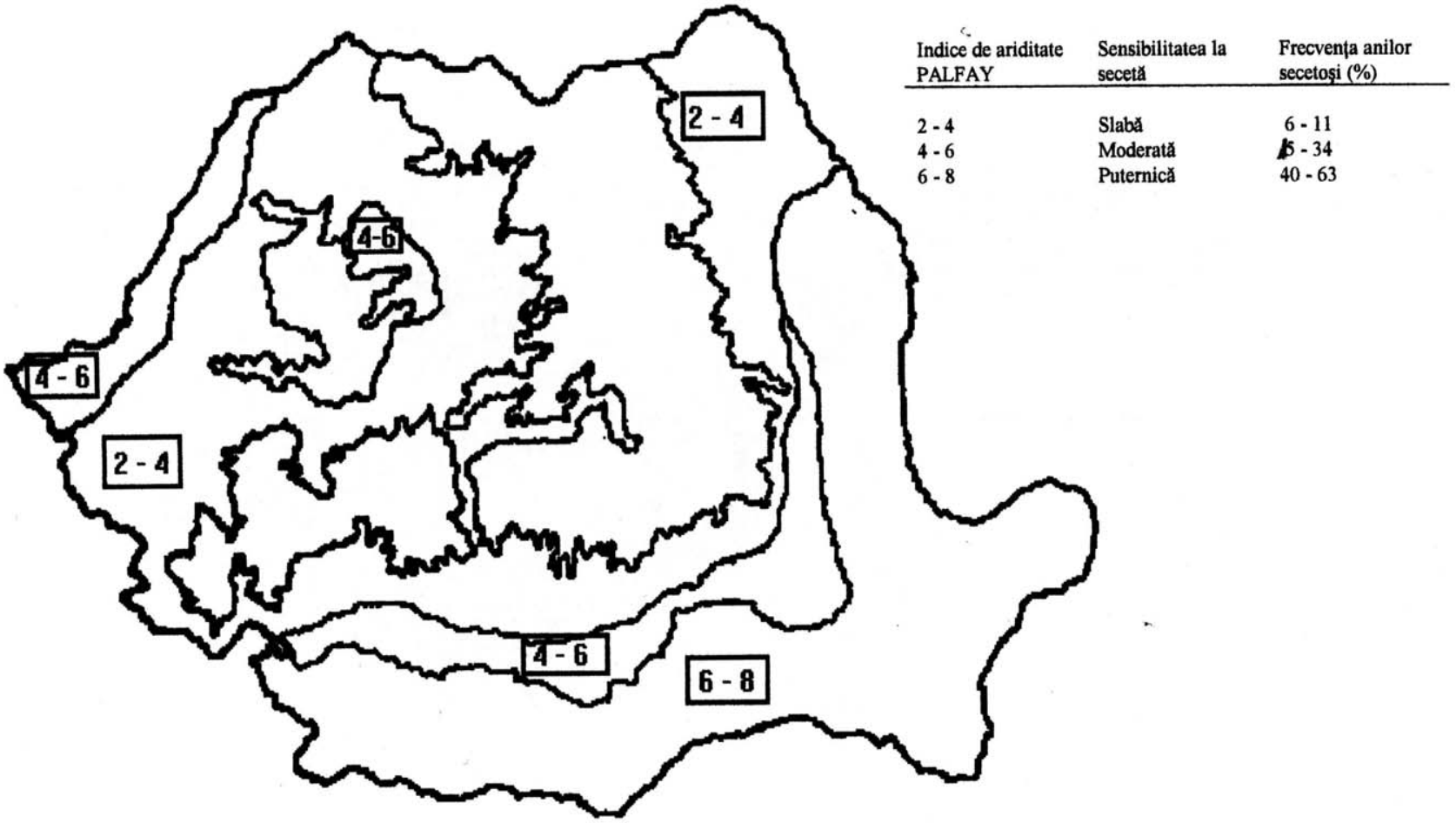
The zones of Romania within which degradation lands have been produced in the past or are producing in the present, mostly by water erosion and landslides are shown in fig. 17.

The total area of these terrains is of about 7 mil ha, from which the largest part is to be found within Getic Piedmont, Southern Pericarpathian Hills, Somes Tableland, Transylvania Tableland, Moldavian Pericarpathian Hills, Moldavian Plain and Moldavian Tableland, Dobrogea.

From the total area, the excessive erosion associated with gulling and landslides occurs on ca. 2.078 mil ha and the moderate to strong on ca. 4.924 mil ha. Soil degradation from humid and subhumid zones takes place also because of chemical pollution (moderate to strong on ca. 0.90 mil ha and weak on ca. 3.640 mil ha), as well as by stripping works for surface mining, by waste disposal, roads construction, human settling (towns and villages), development (ca. 0,1 mil ha).

Fig. 15 Map of Palfay aridity index

(2-4: low; 4-6: moderate; 6-8: strong)



Indice de ariditate PALFAY	Sensibilitatea la secetă	Frecvenţa anilor secetoşi (%)
2 - 4	Slabă	6 - 11
4 - 6	Moderată	15 - 34
6 - 8	Puternică	40 - 63

Fig. 16 Drought intensity areas according to palfay index corrected by soil properties, relief and ground water

(0-2: very low; 2-4:low; 4-6:moderate; 6-8: strong; 8-10: very strong; 10-12: excesive)

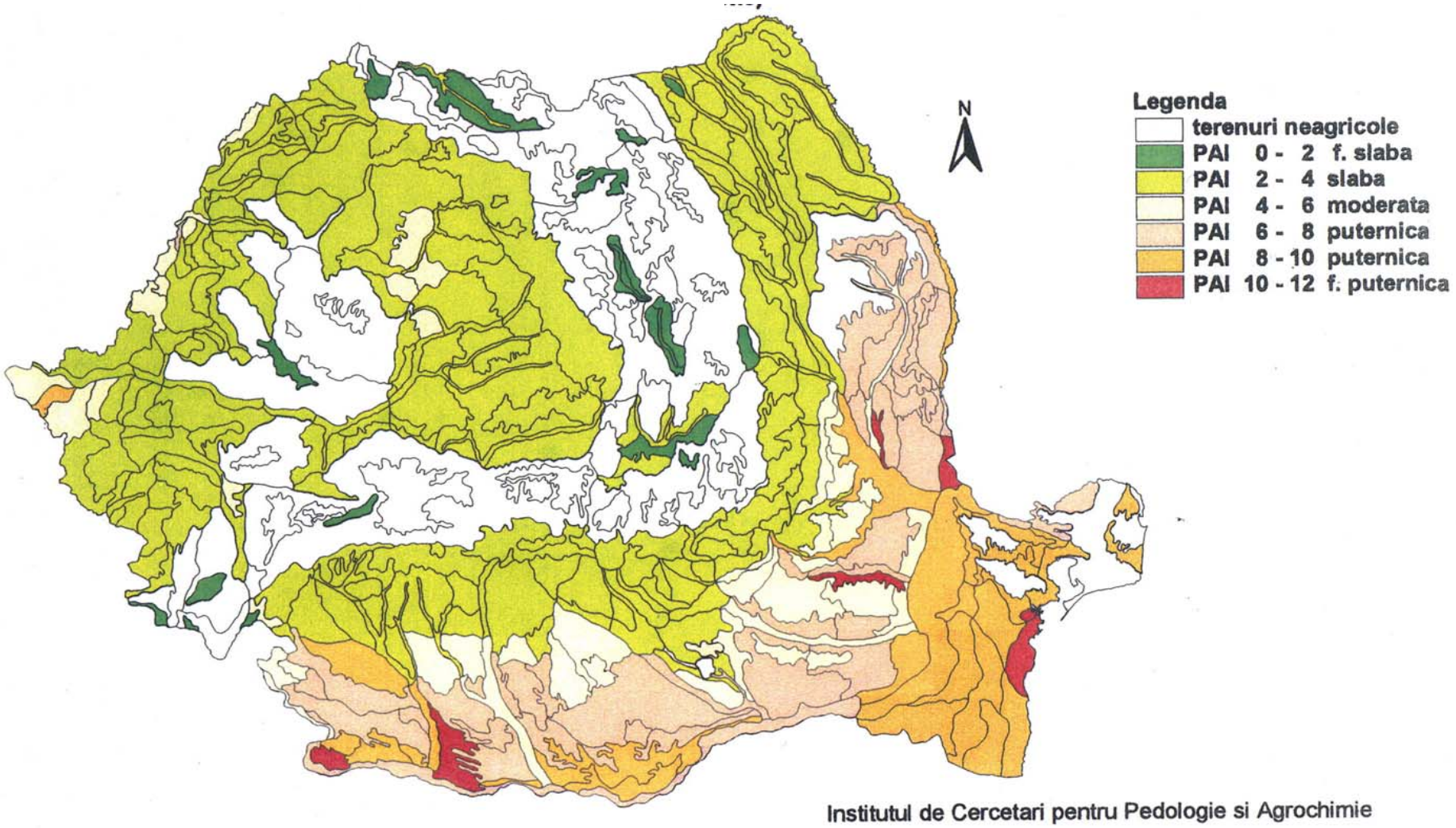
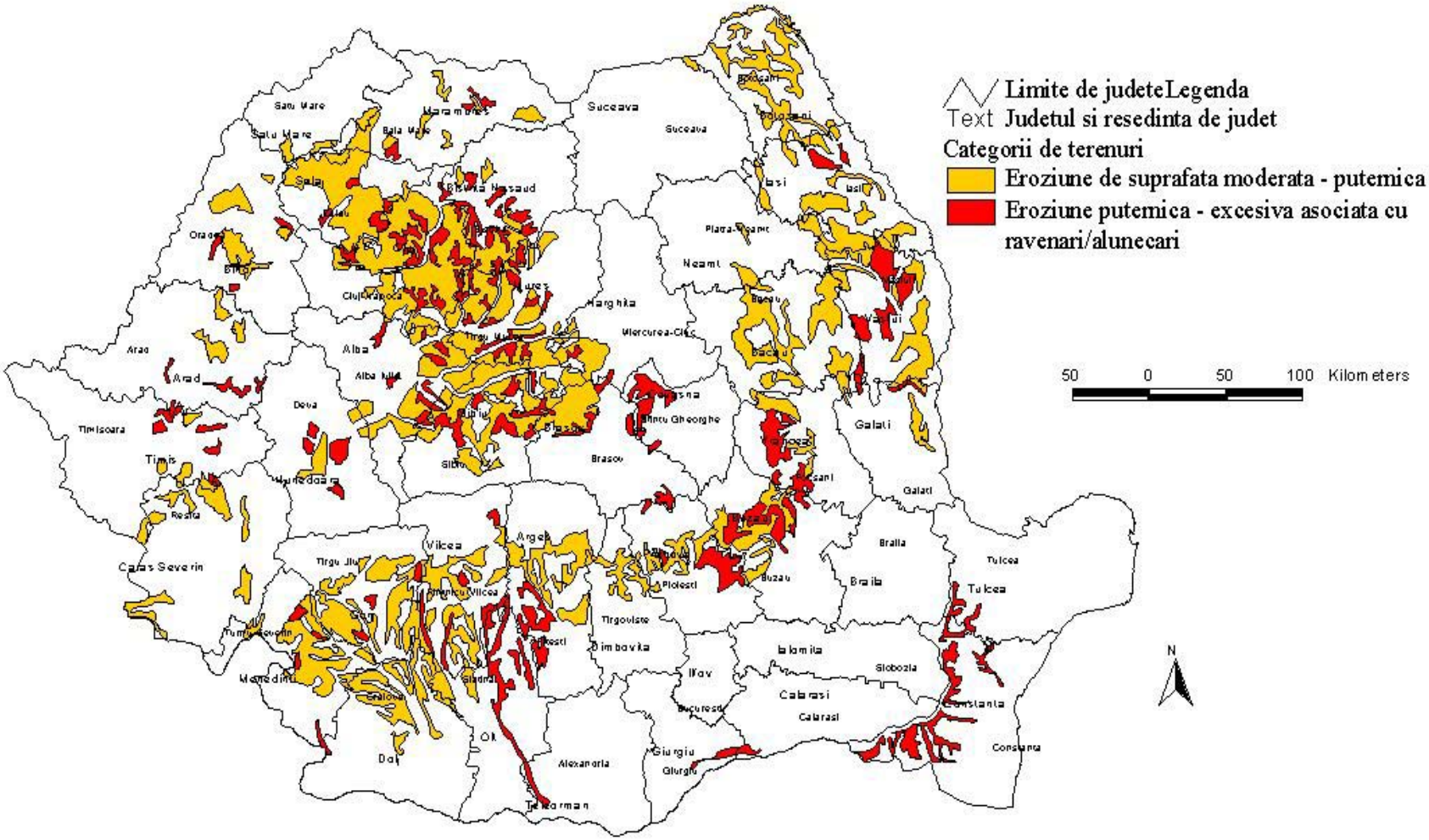


Fig. 17 Map of Romanian lands affected by water erosion (yellow) **and landslides** (red)



6. THE STRATEGY OF DESERTIFICATION, LAND DEGRADATION AND DROUGHT PREVENT AND CONTROL

5.3 GENERAL PRINCIPLES

The basic principles of the elaboration of the strategy were as follows:

- *Agricultural and forestry sustainable development*
- *Biodiversity conservation and natural resources*
- *The prevention and reduction risks in natural hazards occurrence*
- *The improvement of quality of life, especially by rural development in the areas exposed on desertification, lands degradation and drought*

5.4 THE GENERAL AND SPECIFIC OBJECTIVES OF THE STRATEGY

The general objective based on two distinct matters:

- the prevention and combat of desertification, drought and lands degradation in those territory exposed on desertification;
- the prevention and combat lands degradation in moist areas. It was considered that the lands degradation in moist areas because by accenting degradation process in this lands can grow true desertification nucleus.

Started with the necessity of solved the desertification problems the strategically objective was classified into 6 priority axis:

- the development and improvement legislation
- institutional development
- human resources ensuring
- the technical- scientific basis development
- the rural development in the areas exposed on desertification and lands degradation

Table 16

General and specific objectives for desertification, land degradation and drought prevent and control (2001-2020)

General objective 1: Desertification, drought and lands degradation prevention and control in the areas under desertification
General objective 2: Lands degradation prevention and control in the wet areas

1 st priority axis	**2 nd priority axis**	**3 rd priority axis**	**4th priority axis**	**5 th priority axis**	**6 th priority axis**
Improvement and perfecting of legislation	Capacity building	Human resources	Development of scientifically and technical potential	Rural development in the area under desertification risks	Rural development in the wet areas under land degradation
Specific objectives					
1.1 Improvement of water use legislation 1.2 Perfection of legislation on soil protection 1.3 Improvement of legislation on bad lands reclamation and halting of torrential phenomenon 1.4 Promoting of legislation framework to combat drought and desertification	2.1 Setting of institutional framework for implementing the strategy and actions plan 2.2 Setting of special offices for environment survey in the area under change 2.3 Setting up of water use associations 2.4 Development of pedology and agrochemie in the area under change	3.1 Universities graduates in the field of combat desertification and implementing the strategy and actions plan 3.2 Permanent contact with local people 3.3 development of partnership with local people to implement the strategy and actions plan 3.4 ONGs involving 3.5 Creation of new jobs complementary to traditional farming activities	4.1 Building of special scientific teams for the problems of drought, land degradations and desertification 4.2 Research approach of droughts, desertification and land degradation prevention 4.3 Building of informational system on drought, desrtification and land degradation 4.4 Identifying of areas under risks of desertification and land degradation	5.1. Water supply for rural development 5.2 Completion of energy resources by alternative way 5.3 Improving the local climate for prevention of droughts, land degradation and combat desertification 5.4 Improving of soil 5.5 Prevention and combat wind and rain erosion of soil 5.6 Re-use of abandoned crop land 5.7 Improving of degraded pastures 5.8 Diversifying of farming yield 5.9 Maintaining and preserving the biodiversity 5.10 Drought and desertification trends monitorisation	6.1 Anti erosional improving of crop fields 6.2 Prevention and combat the rain erosion, land slides and other types of land degradation 6.3 Re-use of abandoned crop field by improve of fertility 6.4 Improving of soil 6.5 Improving of degraded pastures 6.6 Cadastre and monitoring of soil degradations

6.3 THE POLITICS FRAME

6.3.1 The land use management

The strategy concerning the objectives, measures and actions in the territory arrangement in our country is rediscovered in European Chart, too.

- **Fundamental objectives:**

- the balanced socio-economical development of the regions to hold under controls the crowded areas and the areas development in decline.
- the amelioration of life welfare, the territory arrangement to meet the improvement work conditions, cultures, relations, equipment and others.
- the responsible administration of natural resources and environmental protection
- the rational territory use

- **The particularly objectives :**
  - The rural areas development, the creation of acceptable conditions of life, especially in the poor areas;
  - The check of urban areas growth, by soil occupation plans and by economical activity development to improve life conditions
  - The frontier areas need a coordination policy of the neighbouring states to open the frontiers for common use of infrastructure facilities and to facilitate a regional development
  - The mountain areas – by ecological, economical, agricultural, forest roles, social and cultural, also by natural resources
  - Structural insufficient stability of living areas that needs a special help
  - Declined industrial areas with slowly economical activity caused by industrial reconversion and wear mono-structural equipment which needs special support program
  - The seacoast areas and the islands need balanced development and a check urbanisation, following the objectives dictated by environment protection.
  - The territory management needs to be elaborated according local, regional and national necessities.

6.3.2 Sustainable management of the natural capital

The sustainability of the natural capital in the area under desertification must start from "*agroforestry"* and suppose the balanced relations between agricultural and forestry ecosystems.

The political and socio- economical premises concerning natural capital are:

- the environmental protection actions and measures must occupy important place in all national programs of economical development
- to establish the responsibilities of states institutions and of other organizations for a sustainable development
- non government organizations implication in all decision levels to aware the environment protection

The effects of droughts, soil degradations and desertification are reflected in natural capital degradations (natural, part-natural, artificial ecosystems). For the attenuation of these effects it must to take into account the politic framework by:

- the soil degradation and overexploitation
- the replacement of some forests ecosystems with others
- the degradation and overexploitation of water resources
- the diminution of food resources from domestic and wild animals through conserving and amelioration of natural ecosystems
- the promotion of specific agrotechnical measures for extending areas under aridity
- the overloading of traditional energy resources (wood, coal)

Also it must to be considered:

- the encouragement of extending of small area experience accumulated in the alternative energy sources to all the country
- the wind power resource mapping
- the setting of a scientific-technical center to encourage the use of alternative energy

6.3.3 Biodiversity conservation

Biodiversity conservation is conditioned by human factors due to activities, which lead to soil and water erosion, air pollution, pesticides and chemical manures use, the industrial and domestic wastes depositing, the deforestations and excessive grazing. The negative impact reduction of economical activities must to achieve the following objectives:

- the industrial and energetic units modernization
- the legislative measures for the pollution reduction
- the forests conservation trough the proper forest management
- the state control of chemicals used in agriculture and forestry

- For the biodiversity conservation and increase the resistance to desertification is imposed:
  - the protected areas extension
  - the phytocenosis rehabilitation with local species
  - the protection foresights implementation over the biodiversity in –situ and ex-situ on international Conventions where Romania subscribe.
  - the moist areas restoration and extension
  - the regional and bilateral international cooperation in biodiversity protection

6.3.4 Sustainable development in forestry and agriculture

The forest and agricultural ecosystems are basic components of natural capital.

- *The actions which answer of a sustainable agriculture are :*

➢ building of a agricultural exploitation framework to eliminate economical and ecological damages

➢ exploitation trough lands amalgamation and association

➢ gradual restriction of the arable fields on the slope over 12 % and with degraded soils, either trough conversion of other agricultural employment or trough afforestation

- the agricultural systems development in following directions :
- dry-farming systems in absence of irrigation areas
- systems with limitated irrigation in water deficit resources areas
- intensive agricultural systems in areas provided with sufficient water resources to irrigate
- application of composted organics manure
- introduction of the protection management through optimum pesticides utilisation
- creation of complex agro-zootechnical systems
- ecological reconstructions of bad lands, degraded trough industrial activities (mining, sterile waste dumps, petroleum and salty waters pollution, heavy metal pollution a.o.) on basic principle that the pollutants pays)
- low productive soils amelioration (sands, salty, affected by moist and/or low acidity) just in case of economical and strategically justification)

- races and hybrids of plants creation with great drought resistance
- plantation of protection forests belts in affected areas
- perfection and extension insurance system of crops.

- *The actions designed to answer of a sustainable forestry are:*
  - integrity assurance and sustainable development of forest capital as well as the extension of lands area with forest vegetation
  - institution of the concept of sustainable management
  - stability assurance and functional efficacy rise of forest ecosystems
  - reconstruction of the forest affected by decline
  - to sustain the forest owners for durable management of forests
  - representative forest ecosystems integration in the national network protected areas
  - durable management of game and piscicultural resources
  - development of forest services and produces, others than the wood
  - adapting the forest administration and checking forest regime in conditions on different property forms
  - public, lands holders and the political society awareness about the importance of national patrimony forest

6.3.5 Sustainable water resources management

The water absence in semidry and dry submoist areas has become a chronic phenomenon with negative effects of economical nature in agriculture, vegetable crops, zootechnics, forestry and fisheries. The effects also are felt in potable water supply, transportations, electric power producing, people health and know amplification, particularly, over dry periods. For the sustainable development of affected areas it must to take into account in the planification of water resources for irrigation, the normal and dry conditions to eliminate short crises.

In that sense it is impose to:

- Setting up of the diagnosis indices (aridity indices, precipitation amount, groundwater level, water volume in the lakes, river discharges)
- Setting up of the particular moment of crisis starting
- Setting up of the responsibilities of institutions
- Continuous people information

6.3.6 The regional cooperation

To know the time and space evolution of the environment factors, and hydrical factors particularly, we need data and information from very large areas, which pass beyond the frontiers. Consequently, it results a straight importance of states cooperation in region on problems concerning the prevention and combat desertification.

So, it must have in view:

- collection, analysis and change of pointed out data and information for the sake to have under systematic observation the lands degradation in the affected areas and for a good understanding of processes that occur in desertification and drought
- cooperation on monitoring of desertification, lands degradation and drought
- development of joint research programme to establish the causes that produce such phenomena and the measures required to prevent and combat them.

6.3.7 Socio- economical measures

- The socio-economical purposes of actions in the areas exposed to desertification, lands degradation and drought, are considering:
  - compensation by the state from budget resources of agriculture losses caused by damaging climatic phenomenon
  - economical diversification in rural zone, by active support in developing non-agricultural activities. In this way a initiation of developing programme, stimulating small and middle industries, developing services and infrastructure could be suitable
  - legislation improvement to protect forest-steppe areas, under desertification, lands degradation and drought risks
  - evening school establishment for adults in rural zone to help population for cover the gaps in general education, especially ecological education
  - educative programme elaboration and ecological education books for children in the pre-university education
  - ONG's stimulation to protect the environment, struggle against pollution and drawing them in short and medium programme
  - educative activity intensification by the joint efforts of Local Councils, Police, The Forests Properties Association and zonal mass-media
  - inclusion in the local developing programme of a measures chapter to combat desertification, lands degradation and drought

- assurance systems promotion against the risk factors by aware the rural people, the assurance offer diversifications
- capacity building of local public administration concerning the management in drought field, on desertification and lands degradation, informational support assurance and technical assistance
- preventing and combating desertification, drought and lands degradation in areas with desertification risks
- preventing and combating lands degradation in moist zones

➢ The strategic objectives were grouped according 6 main axe priorities, as follows:

- legislative development and perfecting
- institutional development
- human resources (training for specialists and partnership with civil society)
- development of scientific and technical potential
- the land-shaft reorganization and rural development in zone with desertification risks
- the land-shaft reorganization and rural development in moist zone with degradation land risks

6.4 MEASURES TO PREVENT AND CONTROL DESERTIFICATION LAND, DEGRADATION AND DROUGHT

6.4.1 Prevent and control measures for desertification and drought

- ***Scenarios to determine possible areas with drought***

The medium or long-term hydrological forecasting programme is one instrument to foresee drought; the study of the multi-annual data shows the effect of drought on ground water level. Drought forecasting is useful for the elaboration of programme for integrated use of water resources: surface, phreatic and groundwater.

- ***Environmental components protection under droughty conditions***

➢ Air Pollution under droughty conditions

The few national studies on climate change have not made clear the complex problems of this issue and have not convinced the scientific world and the decision taking factors that it is important to know its long-term consequences. There should be taken measures to limit greenhouse gas emissions and to adapt oneself to future climate change.

The impact of climate change on agricultural ecosystems may happen in future decades, but it is doubtful because of the uncertainly of future weather forecasting as well the lack of knowledge about key-biophysical processes (CO_2 direct effect on plants and complex interactions between CO_2 and water balance elements) in farm yield growth and development.

Taking into consideration the Kyoto Protocol, Romania has committed itself to reduce greenhouse gas emissions by 8% in 2008 – 2012 in comparison with the values of 1989. Some market operating systems including those for transferable marketing permits and the common appliance of the protocol provisions are now to be adopted.

- Qualitative protection and quantitative management of water resources under droughty conditions

In this period of climate change and desertification tendency, water resources get reduced and water flows get modified. All this must be put in relation with the growth of water demand, which will make the water shortage even greater, i.e. the water supply and management systems get vulnerable. Under these circumstances, it is absolutely necessary to limit ground water pollution mainly by making the polluting units equip themselves with technology for wastewater treatment before discharge, for wastewater self-monitoring and intervention in case of accidental pollution.

The areas that should be protected in the near future (5 – 10 years) are situated in the Getic and western piedmonts as well as in the Transylvanian Depression and the Moldavian Plateau.

Water is a limited natural and vulnerable resource conditioning the maintenance of natural systems integrity and the development of the socioeconomic systems. The greater the tendency of desertification, the greater the necessity for a qualitative management of water resource. The following measures also limit the drought impact:

- change of operation rules for reservoirs, conjugated operation of ground and surface water resources as well as change of water supply priorities;
- conservation and improvement of water use efficiency in domestic life (reduction of water consumption; repair of sanitary installation defects), in agriculture (use of waste water, reuse of drained water, irrigation at night) and in industry (water recycling and re- utilization);
- changes of the present technology, especially in agriculture (growing of crops that require small water quantities or that can use drained water; rehabilitation and modernization of irrigation systems including self-acting supply of water demand) and industry (bringing in some technology using air as cooling or cleaning device;

utilization of some technological systems to limit water and soil pollution in relation to emission quantity and consumption);

- quantitative estimation and forecasting of water resources, i.e. water demand under the conditions of climate change and desertification tendency;
- maintenance of the minimal flows downstream the hydro-technical works, which will protect water quality, aquatic ecosystems and those neighbouring river courses, ensure water demand of the downstream uses and ground water supply.

➢ Prevention and fighting against land degradation caused by soil chemical pollution

The degradation of the drought-stricken lands or threatened with the desertification is entranced by the change of physical, chemical and biological features of the soil as a result of its chemical pollution. Generally, for ensuring thee soil protection it is emissions resulting from anthropic activities; some measures necessary to prevent and combat the soil degradation generated by chemical pollution will be mentioned below:

- to complete methodologies for remaking the degraded soils due to the mining activity, particularly in those areas where the drought also affected the land (Oradea, Tr. Severin, Deva);
- to limit the industrial waste storage surface and develop ecological storages for ensuring the protection off both soil, and ground and surface waters against diffusion pollution;
- to enforce the self-monitoring within the economic units which generate an intensive pollution by heavy metals or other dangerous substances for the soil, including liquid leakages (resulting from urban activities, chemical, petrochemical, metallurgical industries, etc.), mainly in the areas affected by drought (Bacau, Tulcea, Govora, Tg. Mures, Tr. Magurele); preventive or operational control measures taken by thee environmental protection bodies;
- to make a new analysis of the soil pollution sources and level on the occasion of issuing new environmental protection authorizations; consequently, for those antropic activities likely to pollute a certain area, comprehensive investigations (physical, chemical and biological analyses of the soil samples, risk studies) are compulsory; according to these analyses recommendations and measures that should be taken on long or short term.

- ***Rehabilitation and development of the irrigation systems***

Irrigation when is rationally applied, represents the main measure regarding the soil humidity deficit control. If we relate to the present arranged area, our country has a very

important patrimony, from this point of view (fig. 18). But the realities prove that 3.2 mil arranged hectares, the area that could be actually irrigated is very small, due to different causes (lack of watering equipment, advanced wear and curtail of pump stations equipment, lack of mobile pump sets, deterioration and theft of automatic elements, deterioration of pipe networks from irrigation plots).

The main problem to be solved by the rehabilitation action of irrigating systems is *the increase of global systems efficiency.*

This implies *the increase of water distribution and water transport efficiency, increase of pump systems efficiency and increase of land watering efficiency in the field.*

Within the global efficiency, that regarding *water transport and water distribution systems (sewer and pipe network) is the most important.* The main cause of water transport and water distribution efficiency is the lack of water by infiltration. From ICITID researches made on irrigating systems changes, the volume lost due to infiltration represents 50% from the water volume of the system.

- In these conditions, the necessity *to stuff the irrigation channels* becomes compulsory, taking into account the important water volumes, which could be saved.

In order to develop the irrigating systems, the following will be taken into account:

- Re-launching of irrigation use and, at least, the rehabilitation and modernization of all areas where these would prove to be viable;
- Promotion and encouragement of irrigations under large management types of agricultural farms from viable areas;
- Efficiency of exploitation works and irrigation maintenance in viable areas;
- Assurance, by progressive investments, of rehabilitation works (modernization of 1.3 mil ha which are comprised in actual irrigation systems, economically viable);
- Assurance of progressive investments in order to arrange new irrigation areas.

- ***The forest belts and passages***

The most efficient way for desertification prevent and control is setting up of the network of forest belts and passages. For this targets the following are to be done:

- *Setting up of the forest belts* for 300, 500, 1000 ha agricultural land, the forest belt surface being of 2-5%. For small farms of 30, 50 or 100 ha the border forest belts are suitable.

The distances between the main forest belts must be of 250-400 m, and between the secondary forest belts of 500-1000 m.

The main species recommended for the drought areas are: *Robinia pseudacacia, Quercus pedunculiflora, Gleditsia triacanthos, Ulmus pumila, Tilia tomentosa, Fraxinus sp., Acer campestre* etc: in the sub-humid areas the recommended species are: *Quercus cerris, Populus alba, P. nigra.* The recommended shrubs are: *Acer tataricum, Crataegus monogyna, Sambucus nigra, Prunus padus.* The fruit trees are also suitable for these areas, the recommended species are: *Prunus cerasifera, Prunus avium, Cydonia oblonga* etc.

The crop lands suitable for forest belts setting up are in the steppe and forest-steppe area from the following districts: Mehedinti, Dolj, Olt, Teleorman, Giurgiu, Calarasi, Buzau, Braila, Galati, Vaslui, Iasi, Botosani, Constanta and Tulcea.

The main long-term targets is the forest belts setting up for only 1 million ha, situated in the most exposed area to desertification. (it means 67-70 thousands of km).

- *Setting up of the forest belts near the* 6000 km *lines of communication,* the forest belts surfaces being of 18000 ha.
- *Setting up of the protective forest belts near the* 4000 km *irrigation channels* , made of 3 rows of *Populus sp* or *Salix sp.* The *Populus x canadensis* R_O-16 is recommended. The forest belt surface will be of 2000 ha.
- *The recreative forests* will cover 9000 ha.
- *The forest passages* between any kinds of forest belt, woods etc. are compulsory to be of a rectangular shape. For the first 10 years 100 ha have to be take into account.
- *The common pasture rehabilitation* situated in the affected areas must be equipped with summer houses (made by trees) for the animals and with eolian watering places.

- ***Hydrological system improvement in dammed water areas***

To exploit the dammed precincts, must be act only in a complex way – *hydromeliorative works (draining and irrigation) and agro-pedo-meliorative works.*

The hydrological conditions improvement *must take into account the fact that many factors act over dammed areas, in this way determining changes in the ground water evolution due to dammed river fluctuations, water flow from the terrace and rainfalls.*

In this way, terraces from the Danube river meadow are, mostly, arranged with irrigation systems, *the water from evacuating* network acting over them also.

As a result, the hydrological system improvement in dammed areas is directly related to operating of hydro-ameliorative works, whose role is, mainly, to reach this purpose.

- ***Slope terracing***

Terracing will be taking into account only on the stable lands, without landslides or earth movements.

The main targets of this action are the water flow diminishing on the slope.

Cavities for afforestation are frequently use, are able to hold important amounts of water also. The needs for the present proposed action are of 5000- 6700 cavities/ha almost.

- ***The promotion of the alternative and drought resistant crops and of the special soil management***

The crops assortment will be adapted to the water assurance conditions, taking into account the economical needs of the basic products (cereal, technical and forage crops, leguminous plants, vegetables etc.). Alternative crops more tolerant to the water deficit will be promoted for the drought conditions:

- sorghum or winter barley instead of maize
- pea instead of soya bean
- rape and sunflower as drought resistance oleaginous plants
- Sudan grass and perennial crops (lucerne and perennial herbs)
- the maize, soya, bean, sugar-beet and vegetables will be cultivated particularly under irrigated conditions

The crop rotation and the cropping system will provide the water accumulation and conservation in the soil, the improvement of the soil physical, chemical and biological properties, and the avoidance of the spreading of the pathogenic agents, pest and weeds.

Minimum tillage system and tillage alternation will be promoted in order to maintain the plant remnants on the topsoil and the water accumulation and conservation in the soil and to decrease the water and wind erosion and to save fuel.

The outfit of tractors, agricultural machinery and equipments must be assured for tillage in the optimum period.

The soil fertility will be improved using predominantly the organic fertilisation with manure, compost or green manure, annual and perennial leguminous plants and a minimum quantity of chemical fertilizers.

Plant breeds and hybrids with a short period of vegetation, more tolerant to drought and heat will be cultivated.

The plant growing methods (plant density, row distance, seeding period, weeding, plant protection treatments) will be adapted to the soil water storage, precipitation prognosis and water providing by irrigation.

The integrated measures for weed and pest control will be taken into account.

The following measures will be promoted *in the case of the pastures*:

- regulation of the animal loading according to pasture productivity,
- spring grazing will begin only after the dry of the topsoil and the plants are above 10cm height; the grazing season will end a month before the soil freezing,
- grazing interdiction in the rainy days,
- alternative lawn use (1-2 years as pasture, 1-2 years as hayfield);
- summer houses for animals;
- reseeding (only on the plain surfaces) of the degraded pastures (with productivity below 1 to / ha dry matter or pastoral value below 25) with mixtures of drought resistant species (Sudan grass, sorghum, Italian millet, forage maize etc.)
- the amendment with phosphogypsum (5-8 to / ha every 8 years) is recommended on the low-moderate salty soils with plant associations of *Festuca valesiaca* or *Puccinelia limosa*; in addition to the land amendment, the land improvement measures are compulsory on the pastures of *Salicornia europaea – Suaeda maritima* with more than 15% exchangeable sodium;
- the temporary lawns on the sands are profitable only under irrigation, after the entirely soil melioration for deflation control (shelter-belts), levelling and fertilisation.

- ***Ecological rebuilding of the dry woods***

The forests affected by drying due to the log-term droughts and to the human activities also, are situated in the lower part of Romanian territory especially and in the other sandy areas etc., covered with xerophyllous species of *Quercus*.

The main measures take into account are:

- Land surveying and evaluation
- Afforestation seedlings for the affected areas
- Specific technologies concerning tillage, afforestation and taking care of the new forests.

The decline forests measures for their rehabilitation are:

- Improving of the pest control activities
- Special techniques for attention
- Better composition and structure regarding the new conditions

- ***Water resources management drought in case of drought***

Water resources management in the areas in danger of drought, contains:

a) Request management and water resources re-assignment in order to obtain a more efficient water use. This is the reason why the establishment of a prices system which could control the efficient water use by introducing new technologies and modifying some structural works, is of a great importance:

b) Stimuli and facilities use for an efficient water consumption;

c) Special measures consisting in:

- Improvement and coordination in the water resources management;
- Improvement of the performance and exploitation parameters of the accumulation lakes and generally of the water management works;
- Conjuncture use of the ground resources;
- Use of the inter-basin derivations;
- Re-use of the purified waters for necessities which allow it (cooling waters, waters for domestic use);
- Acknowledgment of the environment and the ecosystems with water needs;
- Settlement of the water right.

Alternative solutions:

In the areas the most vulnerable to extended drought it is important to take certain measures with a difficult hierarchy. The solutions generally consist in a series of options of an institutional, scientific, technical, social and political nature, which have to be assumed at the local, regional and central level. It is important to mention that these measures should be taken before the drought signs.

Among these measures it is worth mentioning the following:

a) Protection and execution of new accumulation lakes in those areas far from the water sources or where the ground water reserves are reduced;

b) Evaluation of the interconnection possibilities of the structures endowed with another water supply systems;

c) Evaluation of the available waster volumes and extension of the existent accumulation lakes capacity, whose keeping possibility was reduced;

d) Measurement of the water flow discharges and determination of the accumulation lakes keeping capacity; determination of the initial point of the water keeping action and the rational water use during the drought period;

e) Promotion of some prospecting programs by drillings in order to determine the stocking capacity of the ground water in the adjacent alluvial layers:

f) Build galleries and wells big in diameter in order to intercept the phreatic layer;

g) Use of the long-range meteorological forecasts in order to determine the starting point of the water keeping measures;

h) Interconnection of certain water supply public systems with another ones, which have available source and the capacity to face the drought conditions;

i) Build immediately certain temporary (permanent water supply systems through the pipes for the communities in danger of a water penury;

j) Provide possibilities for the water transport by auto-cisterns and railways for the water supply of the communities, which live in desperate conditions because of the lock of water.

A series of special measures have to be taken in the activity sectors:

- In agriculture:
  - Adequate countering measures;
  - Establish a water price structure so as to encourage its efficient use;
  - Informational and educational services for the users in order to obtain an efficient water resources use;
  - Name a co-ordinator who has the obligation to control the efficient waster use;
  - Encourage certain water management measures at the farms level among which we could mention.
  - Tight channels;
  - Systems of water re-use;
  - Change the transport channels with big water losses with pipes or channels properly endowed;
  - Use of the sprinkler systems;
  - Land levelling;
  - Soil treatment;
  - Detect and repair all the areas with losses in the irrigation systems:
  - Use first of all the purified for irrigation anywhere it is possible.
  - Stimuli for efficient water use, including different services like: educational programs, demonstrative projects, financial stimuli and also reduction of tones, lower interest credits, subsidies for braying equipments, water taxes reduction.
- In municipalities:
  - Name a co0ordinator for the problems of the efficient water use;
  - Draw up a plan of the efficient water use;
  - Stuff and population training and participation to the efforts of the efficient water use;
  - Implementation of a water losses reduction programs.
- In the improvement of the water supply systems:
  - Water use countering;
  - Introduce alternatively certain un-drinking water distribution systems;
  - Make sure that the hydrants are tight closed.
- In equipments change

Use of toilets with reduced water consumption or diaphragm introduction; showers with reduced discharge cooling water quantity reduction at the specific equipments;

➢ In the landscape domain:

- Lawns watering during the colder day periods and when the wind is not blowing;
- Use of deep roots tress;
- Sprinklers use for lawns watering;
- Sensors for the humidity detection;
- Soil lest and organic substances addition;
- Diminishing the use of the grass beds and uses the common natural? grass;
- Use of bushes and garden plants to reduce the evapotranspiration;
- Diminishing the fertilizing substances, which need water.

- ***Improvement of the supplementary water resources***

Projection and execution of new accumulation lakes, channels and feed pipes in the areas far from the water sources where the ground water reserves are reduced. In this case it is works to keep building the Siret - Baragan channel with a total length of 189 km. The cost of this work is of about 800 mil

USD. The channel efficiency consists in reducing the danger of the land aridization. It will also provide water to irrigate a surface of 519.000 ha in the Northern and Central Baragan a severe drought area, trying to avoid the periods with a lower crop or the lack of crops, obtaining in this way mean supplementary crops of 2 t cereals/ha/year that represent l mil/years, equivalent with 100 mil USD/years. This fact makes possible the initial investment recovery in about 10-12 years.

6.4.2 Measures for controlling land degradation

- **Eroded soils**

Taking into account the extent of areas affected by water erosion (6.30 mil ha), prevention and controlling this phenomenon represents one of the most important objectives of this strategy.

The first action consists of an inventory of control erosion works (2.2 mil. ha), and selecting those areas where these works could be covered in condition of economical and ecological efficiency or in aim to save some national strategic interests.

According to the degradation intensity, in the conception of this strategy, there are two main kinds of measures:

➢ Rehabilitation measures.

This category comprises the agricultural lands with intense erosion processes but which are not completely destroyed and can be recovered for agricultural use after an

improvement period. The measures which would to be applied consists of: withdrawn from cropping, sodding and used as grassland for a period of 10 years, and applying works that will diminish substantially the erosion rate. These works could be made on contractual basis with the farmers which have to receive subsidies for partial recovery of the losses from their profit resulted by an economically less efficient system introduction, but with high efficiency in soil protection. The implementation of these measures has to be done at minimal cost. The area of lands of this category is circa 3.0 - 3.5 mil. ha.

- Ecological reconstruction measures.

In this category enter the lands with excessively eroded soils that not have chances of rehabilitation for agricultural use.

The ecological reconstruction is achieved through afforestation and sodding, accompanied by adequate works to allow vegetation install (Fig.19). The exploitation regime is that of a reservation of two kinds. The first one allows timber or grass harvesting according to a program that permit normal development of the soil - plant system. The second type is that o a reservation with severe restrictions. In this category could be included a land area of 1.5 - 2 mil. ha.

The rehabilitation and ecological reconstruction of lands with eroded soils requires special laws, which should allow to elaborate a program of implementation, financed from public funds.

- **Landslides**

The measures for preventing and controlling landslides are complex and various. They depend on the landslide type, geological and lithological conditions and especially on the hydrological and geomorphological land peculiarities.

The main measures are: interception (capture and drainage) of ground water (in some cases also of the surface runoff) from the area affected by landslides (and sometimes from up-hill) forest planting to stabilize the terrain and improve of the biological drainage. Special consolidation works where buildings, roads, highways, railways, bridges or other objectives of economic or social interest are to be protected.

The rehabilitation and ecological reconstruction measures are principally the same as for the eroded soils, with the difference that in this case the terrain and soil non-uniformity is very high.

The area affected by landslides is of about 0.702 mil ha.

- **Salt-affected soils**

In this problem, the first condition is to change the politics concerning the melioration of the salt-affected soils (circa 0.64 mil ha) putting the accent on the prevent of the salinization (extension and intensification) on good soils, and on the development of adapted technologies specific for weak salty soils, but not to promote special melioration works of saline and sodic soils, works that are very expensive, difficult to be maintained, with doubtful ecological efficiency and certainly without economical efficiency. Otherwise, in Romania the quasi-totality of salt affected soils (Solonchaks and Solonetz) are "natural" ones and represent well-individualised ecosystems, very stable and with a specific ecological value. Such terrains can be (and really they are) used as such: for grasslands (pastures), for recreational spaces for cattles, fishponds, some tourist activities etc.

In the case of weak-moderate salt affected soils, which are used for agriculture, the main melioration measures are the following:

a) In the case of salty soils: irrigation on drained ground to remove the soluble salts. The work is accompanied by gypsum application when sodium (bi) carbonate is present or exchangeable sodium occurs in the soil adsorptive complex.

b) In the case of sodic (alkaly) soils: application of gypsum and deep loosening to improve the soil permeability; when soluble salts are present (simultaneous with gypsum application), irrigation for salt leaching is applied. In all cases artificial drainage (tile or open one) is required.

During the melioration period salt tolerant crops or ameliorative ones are used (barley, sun flower, lucerne, a. o.)

- **Sand and sandy soils (sandy dunes)**

Like in the precedent cases, the first step consists of reanalysing the politics of improvement, melioration and use of sands and sandy soils (0.439 mil ha), in the sense of going back to the strategy promoted at the beginning of the XX-th century, that is of afforestation of sandy soils from the dry zone, where the danger of wind erosion is very high, and keeping for agricultural production only some limited areas (provided with irrigation), according to the necessities of supplying the market with specific products, especially early vegetables.

The main measures for melioration of sandy soils or of sands, cropped or used as grasslands are as following:

- Protection against wind erosion, by keeping the ground surface as much as possible covered with vegetation all year around (but especially during dry

season), forestry wind breaks, irrigation to moisten the soil surface, and where it is possible, use of synthetic conditioners for soil structure development and stabilisation;

- Increase of organic matter content, green and/or organic manure;
- Improvement of water holding capacity by increasing the silt and clay content, objective that can be achieved by incorporation of loamy, loamy - clayey materials (e. g. loess material).

- **Compacted soils**

Further prevention of physical degradation of anthropical compacted soils and of those affected by structure degradation, crusting, sealing a. o. through adequate cropping technologies as follows: types of agricultural machinery which would avoid compaction of arable layer and of subsoil, increase of tractors stock for making possible tillage operations at optimum soil moisture content, decrease of the number of field works, introduction of new tillage systems, inclusive – within suitable zones and in conditions of weed control by specific means – of minimum tillage systems, introduction of long-term crop rotation with protective and ameliorative plants, etc. Taking again of periodical deep loosening and deep ripping works on terrains with deep primary compaction of pedogenetic origin (circa 1 mil. ha)

- **Acid soils**

Correction of soil acidity over circa 2.3 mil. ha agricultural land (1.6 mil. ha arable land; 0.634 mil ha pastures and meadows, 0.101 mil ha vineyards and orchards) by periodical liming, according to agrochemical soil analyses.

- **Soils with low organic matter and macronutrients content**

Increase as much as possible of organic matter (humus) reserve of soil, on circa 7.7 mil. ha agricultural land, from which 4.3 mil. ha arable land, through applying de organic fertilizers (manure), crop rotation with ameliorative plants, increase of plant roots biomass by advanced agricultural technologies, enhancing some biological activities in soil.

Achievement of a positive balance of nutrients in soil by adding chemical and natural fertilizers, according with the requirements of durable agriculture, the results of periodically soil and plant analyses and with the peculiarities of different crops.

- **Polluted soils**

The measures of preventing and controlling soil pollution are taken depending on: the source and the nature of pollution, the distance from the pollution source, the genetic soil types and the geomorphological characteristic of the area.

- For soils polluted with heavy metals and sulphur are taken into consideration the measures that allow immobilization in soil of heavy metals and prevent their translocation in plant: liming, mineral and organic fertilization, a favourable macronutrients balance, pH 6-6.5;
- For soils polluted with oil residues and salty water one recommend a complex set of works which includes: agropedological meliorative works, removal of water excess, ameliorative cropping technologies, biological measures and in extreme cases even the removal of top soil and replacing it with a non-polluted earthy material if it is too strongly polluted;
- Soils polluted with fluorine require the following ameliorative measures: dilution of the pollutant by its mixing with non contaminant materials with a high adsorptive capacity, like clays and aluminium oxides; reducing fluorine mobility by liming and keeping a pH between 5.5-7.0.
- Terrains degraded by mining activities require ecological restoration through levelling of mine dumps covering with earthy material, chemical and mineral fertilization, manuring and correction of soil acidity;
- For the cinder-dump originating from thermoelectric plants, technologies of technical and biological restoration are applied; the terrains polluted with cinders from thermoelectric plants are improved through measures specific for controlling the pollution with heavy metals, sulphur and soluble salts.

6.4.3 Making population aware and educating it

Currently, this activity is quasi absent. The following are considered necessary for the future:

- Organization of conferences in rural areas on subjects of desertification, draught and soil degradation
- Publishing brochures, leaflets and other illustrative documents presenting the effects of desertification, draught and soil degradation and the measures that can be taken at the local level to alleviate the socio-economic consequences of these processes

- Involvement of radio and TV stations, of mass media in general, in the actions of dissemination and education of the importance of preserving, protecting and improving the soil resources.
- Facilitate the access of population to data and information on the means of preventing and controlling the effects of draught, involving the bodies of the local state administrations, the non-governmental organizations and the specialists in agriculture or environmental protection.
- Develop and implement local, regional or national programs for desertification control and/or alleviation of draught effects, involving the population and the local communities.
- Study ecology in preschool and elementary education.

6.4.4 Scientific research and education development

In Romania, the research programmes concerning desertification, land improvement and drought are promoted, through the specialised institutions.

The drought phenomena increasing and desertification tendency on a large area impose the necessity of cooperation between the specialised institutions of our country and a regional and international co-operation

The specialist training must be done in the agronomical, land improvement and environment protection universities.

The post-university training courses must take into account also.

The main targets are:

- Setting up of the research teams for desertification, land degradation and drought prevent and drought
- Setting up of the research programme for desertification, land degradation and drought prevent and drought
- Setting up of the National Informational System for desertification, land degradation and drought monitoring

The secondary targets are:

- People evolution and structure in the affected areas
- Birth rate in the affected areas
- Sustainable development indicators evolution

6.4.5 Economic activities support, especially of the ecological agriculture and forestry

Taking into account that the main population affected by desertification, land degradation and drought is working in rural areas, the main field of activities that must be developed are the agriculture and forestry, according to the ***agroforestry*** concept.

The following are considered necessary:

- Complex networks setting up (from goods production to sale);
- Financial support for means of production and agricultural equipments acquiring;
- Tourism and service network development in affected areas;
- Stimulating of the connected activities (apiculture, sericiculture, pisciculture etc.)

In order to assure the background of an ecological agriculture development is necessary to promote the ***dry farming*** technologies: The best biological quality of the yields may be obtained avoiding the use of the chemicals.

The local forest species promoting is the key of better results of afforestation due to their adaptation to the climatic conditions. Special attention must be taking into account to the shrubs (inside the forest belts), a source of forest fruits and flowers also.

6.4.6 Financial fund for realisation of the strategic objectives

Because the problem of desertification, land degradation and drought is of national and worldwide interest, on short, medium and long term, the financial support must be obtained from the national and local budgets and from external sources

The financial priorities must be according to the present strategy (cap.5.2, table 16).

The costs are presented in the Action Programme (cap. 7).

6.5 LEGISLATIVE FRAMEWORK

Combating the desertification, drought and land degradation might be only efficient if an adequate legislative and institutional framework able to regulate and follow up the polluting economic activities, existed.

Any economic activity should be regulated by environmental protection standards and norms.

No economic activity should affect the supporting capacity of the ecological system where this develops.

The existing main documents related to or regulating the issues referring to the desertification, land degradation and drought prevention and combating are the following:

– **L 58/1994**- To ratify the Convention concerning the biological diversity signed at Rio de Janeiro on 5 June 1992 (Of. J. no 199/ 2 August 1994)

– **L 137/1995** - Low of Environmental Protection (Of. J. no 304/ 29 December 1995)

– **L 7/1996 -** Low of Cadastral Survey (Of. J. no 61/ 13 March 1995)

– **L 26/1996**- Forestry Code (Of. J. no 93/ 8 May 1996)

– **L 51/1996**- To approve GO 25/1995 for implementing and financing research-development activities (Of. J. no 134/ 27 June 1996)

– **L 103/1996** - Low of hunting fund and game protection (Of. J. no 235/27 September 1996)

– **L 107/1996** - Low of water (Of. J. no 244/ 8 October 1996)

– **L 137/1996** - To approve GO 33/1995 related to measures for collecting, recycling and re-introducing in the productive circuit all kind of reusable waste (Of. J. no 264/ 28 October 1996)

– **OM 125/1996** - To approve the Procedure regulating the economic and social activities having an environmental impact (Of. J. no 73/ 11 April 1996)

– **HG (GD) 168/1997** - For service and product regime that could endanger the life, health, work security and environmental protection (Of. J. no 85/ 8 May 1997)

– **OM 201/1997** - To approve the procedure authorizing the activity of picking, capturing and acquiring plants and animals which belong to the wild flora and fauna within our country in order to marked them on the domestic and foreign markets (Of. J. no 92/16 May 1997)

– **OM 399/1997** - To approve the methodology for implementing , keeping and managing the water cadastral survey of Romania (Of. J. no 111/4 June 1997)

– **HG (GD) 329/1997** - To adopt some measures for removing the effects of natural calamities which have damaged in November 1995 the national forestry fund and afforested pastures in Covasna, Harghita, Mures and Bistrita Nasaud counties

– **OM 615/1997** - To approve the Procedure of issuing the agreement of crossing the dam dykes and other water development works protecting against floods, and Technical Guide for designing and developing works for crossing the dykes, dams and other developments made to protect against floods (Of. J. no 241 bis/15 September 1997).

– **OM 449/1998** - To approve the methodology for certifying physical and legal persons that may perform field studies, draw up technical and economic documentation and develop land reclamation works in the forestry field (Of. J. no 268/17 June 1998)

– **L 107/1999** - To approve OG (GD) 81/1998 for some measures necessary to improve and afforest the degraded lands (Of. J. no 304/21 June 1999)

– **L 141/1999** - To approve OG (GD) 96/1998 for regulating the forestry regime and managing the national forestry fund (Of. J. no 355/27 July 1999)

– **OM 264/1999** - To approve the Forestry Technical Norms for managing the forest vegetation existing beyond the national forestry fund (Of. J. no 233/25 May 1999)

– **L 1/2000** - To re-constitute the property rights on farming and forestry lands required according to the Low 18/1991 and Low 169/1997 (Of. J. no 8/17 January 2000)

– **L 73/2000** - Concerning the Environmental Forestry Fund (Of. J. no 207/11 May 2000)

– **L 159/2000** - For completing the Low of Environmental Protection 137/1995 (Of. J. no 512/22 October 2000)

To improve the present legislative framework the following are necessary:

- To promote normative documents concerning the drought and desertification combating
- To improve the legislation related to the water management
- To complete the legislation on the soil protection
- To improve the legislation regarding the degraded soil improvement and torrential phenomena removal
- To review and up-date the methodological norms concerning the forest-pasture development works (simultaneously with the necessary fund ensuring)

6.6 INSTITUTIONAL FRAMEWORK

- The main institutions involved in actions concerning desertification, land degradation and drought prevent and control are:
  - Ministry of waters, forests and environment protection (MAPPM)
  - Research institutes of MAPPM
  - Environment protection agencies
  - Forestry inspectorates
  - Forestry manager's offices
  - Ministry of Agriculture and Food (MAA)
  - Academy of Agricultural and Forestry Sciences "Gh. Ionescu Sisesti" (ASAS)
  - National Society of Land Improvement
  - National Company Romanian Waters
- The civil society has also:
  - 25 NGOs involved in these actions
  - Universities
  - Soil Science and agrochemistry offices
  - Cadastral survey and land planning offices
  - National Society for Soil Conservation (SNRCS)
  - Romanian Organisation for Soil Tillage (ORCLS)

6.7 REGIONAL AND INTERNATIONAL CO-OPERATION

A co-operation exists at both European and regional level in order to conserve and protect the soil resources. Thus, Romania co-operates to form a database for the European soils, having contributed with a digital map representing the Romanian soils at a 1:1,000,000 scale expressed in FAO legend, and to develop a database of soil profiles within the European countries.

Regionally, Romania co-operated to the following:

- SOVEUR project initiated by FAO concerning the vulnerability to pollution classification of the soils within the Central and East-European countries;
- INCO-COPERNICUS project: Action concerning the sub-soil compacting in the Central and East-European countries;
- FAO project: Rehabilitation of polluted soils in Romania;
- INCO-COPERNICUS project: A simulation model with spatial distribution for the physical and agro-physical state forecast of the soil - SIDASS
- INCO-COPERNICUS project: Water and soil management for the agricultural output in urban areas – SWAPUA

In order to understand better the importance of the soil, water resources, vegetation, etc. particularly within the drought-stricken regions or in those presenting a desertification tendency, as well as to act for their sustainable use, involving of the Government, communities, land owners, etc., are necessary. Moreover, regional and international co-operation are needed in the fields of environmental protection, soil and water resources conservation.

For this reason, the parties agree, depending on their own capabilities, to integrate and co-ordinate the collecting, analysis and change of relevant data and information to ensure a permanent control of the land degradation in the damaged regions and better understand and assess the drought and desertification phenomena and their effects.

For knowing the state and evolution of the environmental factors generally it is necessary to gather data and information on very large areas, which go beyond the state limits. Consequently a co-operation among countries that belong to the same region is very important.

6.8 MONITORING OF THE AREAS AFFECTED BY DESERTIFICATION, DROUGHT AND LAND DEGRADATION

6.8.1 Creating the database and the Geographic Information System

In aim to a unitary and permanent monitoring of areas with desertification risk, land degradation and drought, the following requirements have to be fulfilled:

Creation and management of an unitary database that has to contain all data concerning the environmental objective will be achieved by a special department especially create in the frame of institutes involved (preferably, INMH)

Initiating and developed of a Geographic Information System (GIS) able to manage the database, aiming to emerge some thematic maps concerning the desertification, land degradation and drought.

Cooperation between the specialised institutes aiming to create and developed the database and GIS.

Free access of all institutes involved in elaboration of this strategy to use the database and GIS.

6.8.2 Monitoring

Mainly, the monitoring concerning combating desertification, land degradation and drought has to be aligned to the integrated environmental monitoring that emphasize the followings:

The necessity to know the qualitative evolution of the environmental components, in aim to establish and impose protection measures, conservation, reconstruction and checking the efficiency of the applied measures.

The necessity to select and grouping data, their correlation with information originating from other sources (remote sensing, ecological zoning, pedological zones, population health state).

The necessity of obtaining information comparable with those at regional and global scale (world climate, Ozone layer, river Danube and Black Sea protection)

The necessity to know and evaluate quickly the effects in cases of anthropic accidents or incidents having environmental impact.

The necessity of developing knowledge base aiming to establish and fundament actions of environmental protection, ecological reconstruction, etc.

Taking into account the complex nature of desertification, drought and land degradation processes, their early warning and monitoring require a permanent watching of changes intervened in the majority of the environmental components and of territorial ecosystems:

To record the above mentioned changes, a set of specific indicators are used, concerning the climate, soil, water, vegetation, biodiversity and demographic pressure.

An indicator defined as being a parameter or a derived value from other parameters that provide information about a phenomenon (OECD, 1993, EEA, 1998). In this sense the indicators must not be confused with the primary data from which they are derived. The indicators represent a quantified information that helps us to explain how the things change in

time and their spatial variability. In general, the indicators simplify the reality with the aim to allow quantification of complex phenomena, thus that information can be communicated.

- **Monitoring of zones affected by desertification and drought**

Monitoring of these zones should use a range of indicators as follows:

- Climatic indicators:
  - base indicators – which are derived from some climatic data;
  - complex indicators – that are obtained through combination of base indicators with other data types: climatic, agricultural, socio-economic, soil degradation etc.
- Pedological indicators:
  - soil moisture and soil temperature regimes, especially during the plant growing period; soil water balance and its components (runoff, infiltration, evaporation, useful consumption etc.);
  - water and wind erosion, and the elements necessary to use erosion mathematical models (pluvial erosivity, soil erodability etc.);
  - soil salinity, soil sodicity;
  - natural drainage of the area;
  - frequency and duration of flooding;
  - soil structure degradation, crusting, sealing, compaction;
  - equilibrium between organic matter input/output, level of microbial biomass, and the amount of residual organic matter;
  - basic chemical properties: organic matter content and its composition, microbial carbon content, C/N ratio, macronutrients (N, P, K) content, soil reaction (pH).
- Hydric indicators (water):
  - rainfall aggressiveness (precipitation amount, frequency and intensity, USLE index of pluvial erosivity);
  - evapotranspiration;
  - surface runoff infiltration;
  - natural drainage at the area;
  - water resources: quantity, seasonal and annual dynamic, and its trend;
  - frequency and duration of floods.
- Agricultural indicators:
  - annual variation of yields;
  - crop behaviour during growing season.

- Forestry indicators:
  - evolution of health state of forests
  - dynamic of forest resource area
  - damages caused by biotic and abiotic agents
  - changes in quantity and value of non-woody forestry products
  - area of natural and semi-natural secular forests and of strictly protected forests, and of those with special regime of management
  - dynamic of the area of forests with special protective functions (of waters, soil, climate protected areas, recreational areas etc).
- Biological indicators (of vegetation and biodiversity)

These indicators are by far the most sensitive and easily observable of the desertification, drought and soil degradation processes.

a) Vegetation and microbiological indicators:

- seasonal and annual dynamic of the primary vegetation's biomass (NDVI index) using satellite data from NOAA/AVHRR SPOT, VGT, a. o.);
- root/aerial biomass ratio of vegetation cover;
- degree and type of land cover;
- percent of abandoned lands;
- microbiological activity from soil, number and micro-organisms types;
- aridification of natural vegetation (structure, composition spatial distribution, biological types);
- fire-risk of forests.

b) Indicators concerning biodiversity status

Indicators of ecosystems quantity

- percent of auto-regenerating areas, that corresponds to natural and semi-natural ecosystems, and the percent of strongly modified areas following human activities;
- percent of auto – regenerating areas of each kind of ecosystems from the total area;
- extension of natural and semi-natural areas upon size classes (100 - 1000; 1000 - 10.000 ha).

Indicators of biodiversity quality of ecosystems:

- species distribution and quantity face to a reference level;

- indigenous species number in percent face to a reference level;
- total percent of forested areas;
- percent of agro-ecosystems areas from natural zones;
- percent of endemic resources;
- percent of coastal and marine areas having important biological resources.

Indicators of threatened and/or extinct species and of habitat:

- number of threatened or extinct species as percent from groups used as bio-indicators;
- number of threatened habitats as percent from total.

➢ Indicators of demographic (human) pressure

Indicators concerning losses of habitat:

- % of auto – regenerating areas converted yearly to agricultural production, to urban use or to other intensive uses;
- % percent of river-bed significantly affected by dams or regularisation.

Indicators of over-exploitation:

- total amount of harvested biomass face to the exploitation levels estimated as supportable;
- the average size, weight, age per species unit, for animals that browse, reported to the reference year;
- size of the agricultural area lost in the last 10 years, owing to erosion as % from the area converted to agricultural production in the same period at nation-wide level;
- unsuitable agricultural practices (kind, intensity).

Indicators of exotic species:

- total number of exotic species as % from a particular taxonomic group;
- relative biomass of exotic species as % from a particular taxonomic group.

Pollution indicators:

- average quantity of a substances group, strongly harmful to biodiversity as compared with soil, water and air standards established by the European Commission in 1988.

- **Monitoring of areas with degradation soils**

➢ Monitoring of areas affected by water-erosion

- multiplying of existing observation plots (agricultural and forestry) in aim to cover all bio-climatic zones and soil types. A special attention will be paid to the areas where this processes acts with maximum intensity: Hills adjacent to Carpathian Bend, Barlad Tableland, and Transylvanian Tableland.

➢ Monitoring of land-slides

- implementation of monitoring points within areas with active dynamic of land slides that is in areas with marly-clayey and sandy-clayey lithological substratum from Pericarpathian Hills, Barlad Tableland and Transylvanian Tableland.

➢ Monitoring of wind-erosion

- starting the monitoring in sandy dune areas from Oltenia and Baragan (Eastern part of the Romanian Danube Plain). Monitoring points will be also installed within areas with soils developed on loess from the steppe-zone (Kastanozems and Chernozems). On those soils wind-erosion in not studies yet.

➢ Monitoring of salt-affected soils

- monitoring of the soil salinity and soil sodicity dynamics. At the time being this activity is already organised within Braila Plain and Lower Siret Plain. Nowadays is taken into account to extend it in Southern Oltenia and the Western Plain.

➢ Monitoring of polluted soils

- developing and perfecting of monitoring areas with soils polluted by heavy metals and acid rains (Baia Mare, Copsa Mica, Zlatna, Valea Calugareasca) or by oil and salty water, within the frame of the existing agricultural and forestry monitoring system of soil quality (16x16 km grid).

➢ Monitoring of soils vulnerable to compaction

- developing and perfecting of a special monitoring within areas with soils developed on loess or other silty materials, soils with an non-equilibrated texture a. o. within the frame of national system of agricultural and forestry monitoring (16x16 km grid).

- **Organisation of desertification and drought monitoring**

➢ Network type

On appreciate that the present day agricultural and forestry soil quality monitoring network (16x16 km grid) may take successfully the function to monitor also desertification, drought and land degradation. But there is the condition to extend it and to improve its density having as base the present day national grid (4x4 km) of forestry monitoring system. Also it appears necessary to install some supplementary observational points in the areas with serious

ecological problems like those from the zone subjected to desertification: areas with shallow or skeletal soils from Dobrogea (on green schist, limestone, granites), areas with strongly eroded soils from Dobrogea and Southern Moldova, areas with salt affected soils from Eastern Romanian Danube Plain (Calmatui Valley, Ianca Valley, Lower Siret Plain) and from Western Plain, embanked areas from Danube Flood Plain and Danube Delta, areas with sandy soils from Romanian Danube Plain and Danube Delta.

In aim to implement such a complex monitoring system the following urgent measures are considered to be taken:

- sharing the tasks among the all involved institutes;
- elaboration of a unitary methodology that has to be accepted by decision-makers factors according to the existing methodologies in this field of interest.
- providing the necessary funds for procuring equipment, programmes, training personnel etc.;
- the special department created in this aim will gather and integrate all data concerning the monitoring of the environmental factors from the zones with high risk to desertification, drought and land degradation.

Working team:

- **Forest Research and Management Institute:**

Ing. George Man
Dr. ing. Nicolae Geambasu
Dr. ing. Constantin Rosu
Dr. ing. Nicolae Donita
Dr. ing. Ion Catrina
Ing. Stefan Taina

- **Research Institute for Soil Science and Agrochemistry:**

Dr. ing. Ion Munteanu
Dr. ing. Andrei Canarache
Dr. ing. Mihai Dumitru
Fiz. Sorina Dumitru
Dr. Mihai Toti

- **National Company "National Institute of Meteorology, Hydrology and Water Management":**

Dr. Ion Sandu
Dr. Paul Tuinea
Dr. Anton Geicu
Dr. Petruta Tuinea
Dr. Gabriel Nedelcu
Drd.ing. Elena Mateescu
Hidr. Radu Murafa
Hidr. Simona Rusu
Ing. Doina Dragusin
Ing. Ionel Nita
Ing. Emil Radu
Dr. ing. Ion Tecuci
Drd.ing. Elisabeta Oprisan
Dr.ing. Romeo Amaftiesei

- **National Institute of Research – Development for Environment Protection:**

Prof.dr.doc.ing. Simion Hancu
Dr.ing. Patricia Mocanu
Ing. Dan Paduraru

- **Studies and Designing Institute for Land Improvement:**

Dr. ing. Codreanu Mateiu
Ing. Danut Maria

- **Research and Technological Engineering Institute for Irrigations and Drainage, Baneasa-Giurgiu:**

Dr. ing. Gheorghe Cretu
Dr. ing. Nitu Ion
Dr. ing. Nicolae Grumeza

- **Research Institute of the Life Quality:**

Dr. soc. Maria Moldoveanu
Geogr. Dumitru Chiriac
Geogr. Cristina Huma

- **Research Institute for Grains and Technical Crops Fundulea**

Prof.dr.ing. Gheorghe Sin
Dr.ing. Marian Verzea
Dr.ing. Ion Picu

- **Research and Production Institute for Grass Cultivation, Magurele- Brasov:**

Dr. ing. Teodor Marusca
Dr. ing. Mircea Neagu
Dr. ing. Vasile Cardasol

Table of Contents

ROMANIA - NATIONAL ACTION PROGRAMME CONCERNING DESERTIFICATION, LAND DEGRADATION AND DROUGHT CONTROL

(2001-2020)

Specific objective / Action	Involved institutions	Human resources	Time of realisation			Dimension of action	Costs[1] (thousands $)		Costs of financial support (thousands $)		
			short	medium	long	Quantities	Annual	Total	Internal		External
									Budget	Other sources	
1	2	3	4	5	6	7	8	9	10	11	12
1. Priority axis: Legislation improvement											
1.1.Legislation improvement concerning the water management							**27**	**27**	**27**		
1.1.1. Supplement of the water law	MAPPM	3	*				12	12	12		
1.1.2. Promotion of regulations concerning the facilities for irrigation water users	MAA	3	*				10	10	10		
1.1.3. Promotion of regulations concerning the irrigation management transfer to the Association of Irrigation Water Users (AIWU)	MAA	2	*				5	5	5		
1.2.Legislation improvement concerning the soil protection							**20**	**30**	**30**		
1.2.1. Promotion of the Soil Protection law	MAA, MAPPM	4	*				10	20	20		
1.2.2. Promotion of the Agricultural land merging	MAA	2	*				10	10	10		
1.3.Legislation improvement concerning the degraded land improvement and torrential phenomena ending							**10**	**10**	**10**		
1.3.1. Revision and supplement of the land improvement law no. 84/1996	MAPPM, MAA	3	*				10	10	10		
1.4.Promotion of standard acts concerning the desertification and drought effects control							**24**	**48**	**48**		
1.4.1. Promotion of laws concerning the desertification and drought effects prevent and control	MAPPM, MAA	4	*				6	12	12		

1	2	3	4	5	6	7	8	9	10	11	12
1.4.2. Promotion of regulations concerning economical facilities for some activities from the action programme for desertification, land degradation and drought control	MAA, MF	5	*				6	12	12		
1.4.3. Promotion of regulations concerning the grazing	MAA, MAPPM	4	*				6	12	12		
1.4.4. Revision of the methodological standards concerning the forest-pastoral management planning	MAA, MAPPM	4	*				6	12	12		
1.5. Development of the ensuring system for drought and desertification areas											
1.6. Legislation improvement concerning the Plan on National Territory Management							**12**	**24**	**24**		
1.6.1 Bringing up-to-date of the law no.117/1997 concerning the approval of the management on National Territory Arrangement, section 2 APA - promoted by MLPAT							6	12	12		
1.6.2. Law project correlation for PNTA, section V, natural risk areas, promoted by MLPAT							6	12	12		
Total priority axis 1							**93**	**139**	**139**		
2. Priority axis: *Institutional development*											
2.1.Establish of the institutions necessary for the implementation of the national strategy and action plan concerning the desertification, land degradation and drought prevent and control							**200**	**4000**	**2000**		**2000**
2.1.1. Establish of the National Committee for desertification, land degradation and drought prevent and control	MAPPM, MAA, MF	15	*				100	2000	1000		1000
2.1.2. Establish and financial support for an operative department inside the actual structures for prevent and control of the desertification, land degradation and drought, between 2001-2020	MAPPM, MAA, MF	15	*	*	*		100	2000	1000		1000
2.2.The law for the establishment of the Association of Irrigation Water Users (AIWU)	MAA	2	*				**5**	**5**	**5**		

1	2	3	4	5	6	7	8	9	10	11	12
2.3.Extension of the system of Associations of Irrigation Water Users (AIWU) related to the actual working irrigation systems							**18**	**60**	**60**		
2.3.1. Establish of 10 experimental AIWU		3	*				12	12	12		
2.3.2. Development of the AIWU network		1	*	*			6	48	48		
2.4.Development of the soil science and soil testing agency and of the forest research units from the areas affected by desertification and land degradation							**1200**	**6000**	**4000**		**2000**
2.4.1. Endowment and modernisation of the soil science and soil testing agency and of the forest research units		40	*				1200	6000	4000		2000
Total priority axis 2							**1423**	**10065**	**6065**		**4000**

3. Priority axis: Human resources											
3.1.Specialists for the implementation of the measures and actions of the specified objectives	MEN, MAPPM, MAA						**120**	**2400**	**1400**		**1000**
3.1.1. Specialists training in education units		100	*	*	*		120	2400	1400		1000
3.2.Permanent informing of the population and authorities concerning the national strategy and plan of action and the realisations concerning desertification, land degradation and drought prevent and control	MAPPM, MAA, TV						**250**	**5000**			**5000**
3.2.1. Mass-media use, organisation of scientific meetings			*	*	*		200	4000			4000
3.2.2. Publication of papers and folding concerning the experience in this field		5	*	*	*		50	1000			1000
3.3.Development of the partnership between the population and local authorities for a better development of the actions concerning desertification, land degradation and drought prevent and control	District Councils, Prefect's Offices, Mayoralty						**30**	**600**	**600**		
3.3.1. Promotion of meeting and permanent informing			*	*	*		20	400	400		
3.3.2.Involving of the local population in the action of the programme			*	*	*		10	200	200		

1	2	3	4	5	6	7	8	9	10	11	12
3.4.NGO involving in execution of some programme actions, especially for the information and popularisation			*	*	*		**50**	**1000**	**200**		**800**
3.5.Setting up of the complementary activities for agriculture and forestry (units for agro-forestry products processing, service units, agro-tourism)	MAA, MIC, ANAT	7	*				**68**	**340**	**220**		**120**
Total priority axis 3							**518**	**9340**	**2420**		**6920**

4. Priority axis: Development of the scientific basis for research, planning and information											
4.1.Setting up of the special research and planning teams for desertification, land degradation and drought prevent and control at the specific institutes (ICAS, ICPA, INMH, ICIM, ISPIF, ICITID, ICCV, ICPCP etc.); financial support for their equipment	MAPPM, MAA	30	*				**250**	**500**	**500**		
4.2.Research programme scientifically prove and preparing for the control and prevent of desertification, land degradation and drought on the basis of the specific institutes proposals	ANSTI, MAPPM, MAA						**160**	**3200**	**2000**		**1200**
4.2.1. Research programme for desertification, land degradation and drought prevent and control			*	*	*		160	3200	2000		1200
4.3.Organization of the national information system for desertification, land degradation and drought	MAPPM, MAA						**515**	**13100**	**4700**		**5600**
4.3.1. Designation of an institute for the system management			*								
4.3.2. Providing of the financial support for the informational system and its function			*	*	*		200	4000	2500		1500
4.3.3. Interconnecting with the information provider			*								
4.3.4. Data base and GIS setting up for the desertification and land degradation areas		5	*	*	*		200	4000	1000		3000
4.3.5. Publishing of the informing reports (permanent action)		2	*	*	*		15	3100	200		100
4.3.6. Change of information with other countries		20	*	*	*		100	2000	1000		1000

1	2	3	4	5	6	7	8	9	10	11	12
4.4.Elaboration of studies for desertification and land degradation areas	MAPPM, MAA, other institutes						**900**	**4500**	**3400**		**1100**
4.4.1. Studies concerning the actual level of the environmental parameters		50	*				500	2500	2000		500
4.4.2. Demographic and social studies for these areas		20	*				200	1000	700		300
4.4.3. Economical studies in these areas		20	*				200	1000	700		300
4.5.Land management planning and elaboration of projects for the national strategy and action programme implementation for desertification, land degradation and drought prevent and control	MAPPM, MAA, MLPAT and co-ordinated institutes						**15000**	**285000**	**85000**	**100000**	**100000**
4.5.1. Land management of the affected areas			*				1000	5000	5000		
4.5.2. Elaboration of projects for the national strategy and action programme			*	*	*		14000	280000	80000	100000	100000
Total priority axis 4							**16825**	**306300**	**95600**	**100000**	**107900**

5. Priority axis: Rural development and landscape reorganisation in the areas with risk for desertification, land degradation and drought											
5.1.Ensuring of the water resources for the affected area development	MAPPM, MAA						**101950**	**824900**	**209500**	**4000**	**611400**
5.1.1. Repairing of the working irrigation systems		5					1200	9900	5500		4400
5.1.1.1. Realisation of some experimental plots			*			*4000 ha*	*300*	*900*	*500*		*400*
5.1.1.2. Preparing, management planning and execution of the reparations for the working irrigation systems			*	*		*1300000 ha*	*900*	*9000*	*5000*		*4000*
5.1.2. Supplement of the irrigation system							100000	800000	200000		600000
5.1.2.1. Further building of the Siret-Baragan channel			*	*		*189 km*	*100000*	*800000*	*200000*		*600000*

1	2	3	4	5	6	7	8	9	10	11	12
5.1.3. Complex management of the rivers; dissilting of the present accumulation lakes and building of new others especially for local purposes			*	*	*		100	*2000*	2000		
5.1.4. Ensuring of underground water for local needs							350	7000	1000	2000	4000
5.1.4.1. Drilling			*	*	*		*200*	*4000*	*1000*	*1000*	*2000*
5.1.4.2. Development of water distribution networks			*	*	*		*150*	*3000*		*1000*	*2000*
5.1.5. Implementation of the economization measures for the management of water resources, including thread water use			*	*	*		300	6000	1000	2000	3000
5.2.Supplement of the present energetic resources using alternative resources of energy (eolian, solar, biogas) in the favourable areas	MAA		*	*	*		**350**	**7000**	**2100**	**2200**	**2700**
5.3.Improvement of the local climate in order to prevent and control the drought effects	MAPPM, MAA						**14520**	**290400**	**189400**		**101000**
5.3.1. Setting up of crop and protective forest belt networks							4320	86400	55400		31000
5.3.1.1. Setting up of protective forest belts for settlements and lines of communication			*	*	*	20000 ha	1200	24000	14000		10000
5.3.1.2. Setting up of protective forest belts for crop lands			*	*	*	50000 ha	3000	60000	40000		20000
5.3.1.3. Setting up of protective forest belts for irrigation systems			*	*	*	2000 ha	120	2400	1400		1000
5.3.2. Ecological reconstruction of the declining woods from the desertification risk areas	MAPPM						6600	132000	84000		48000
5.3.2.1. Reconstruction of the robinia woods from the steppe and forest-steppe			*	*	*	50000 ha	3000	60000	40000		20000
5.3.2.2. Reconstruction of the woods from the water meadows with alternative hydrological conditions						40000 ha	2400	48000	30000		18000
5.3.2.3. Reconstruction of the oak woods (Quercus pedunculiflora and Q. pubescens)						20000 ha	1200	24000	14000		10000

1	2	3	4	5	6	7	8	9	10	11	12
5.3.3. Extension of the wood surfaces in the desertification and drought affected areas (especially in Dobrogea, South of Moldavia, Baragan)	MAPPM		*	*	*	60000 ha	3600	72000	50000		22000
5.4.Promoting of agricultural techniques for the improvement of the soil properties, maintaining and improving of their productivity potential	MAA						**2600**	**50300**	**30300**		**20000**
5.4.1. Promoting of special crop rotations for soil improvement			*				50	150	150		
5.4.2. Setting up and implementation of the most favourable system for irrigation, fertilisation and tillage for soil conservation			*				50	150	150		
5.4.3. Prevention of the soil salinisation; improvement and use of the salted soils	MAA		*	*	*	50000 ha	2500	50000	30000		20000
5.5.Prevention and control of the water and wind erosion and of other land degradation processes	MAA, MAPPM						**15250**	**308960**	**218760**	**3000**	**87200**
5.5.1. Extention and intensification of the actions for management planning of the torrential hydrographic network			*	*	*	500 km	2500	50000	50000		
5.5.2. Protective forest cultivation on the surfaces with strong erosion			*	*	*	100000 ha	7500	150000	100000		50000
5.5.3. Afforestation of the surfaces with deep erosion			*	*	*	15000 ha	1500	30000	20000		10000
5.5.4. Ecological reconstruction of the declining woods from the river meadows			*	*	*	2000 ha	200	8000	6000		2000
5.5.5. Protective forest and crop cultivation on the sandy surfaces			*	*	*	15000 ha	1275	25500	15500		10000
5.5.6. Rehabilitaion of the sliding and broken down lands							2025	40500	25500		15000
5.5.6.1. Afforestation			*	*	*	*15000 ha*	*1275*	*25500*	*15500*		*10000*
5.5.6.2. Pastures setting up			*	*	*	*20000 ha*	*750*	*15000*	*10000*		*5000*
5.5.7. Rehabilitation of the anthropic degraded lands (discovered lands, waste dumps, artificial slopes, polluted lands etc..) by afforestation, sodding or other methods			*	*	*	1500 ha	150	3000		3000	

1	2	3	4	5	6	7	8	9	10	11	12
5.5.8. Antierosional management planning of the broken crop lands (Dobrogea, Moldavia etc.)							100	1960	1760		200
5.5.8.1. Setting up of experimental stations of the owners associations in order to execute antierosional works in the crop land; ensuring of the financial support for their activity			*	*	*		*80*	*1600*	*1600*		
5.5.8.2. Extention of the agricultural engineering for antierosional exploitation, using different facilities			*	*	*		*20*	*360*	*160*		*200*
5.6.Revaluation of the abandoned lands with low fertility							**3850**	**77000**	**50000**	**5000**	**22000**
5.6.1. Afforestation in the forest deficit areas, in the broken lands and on the slopes over 20°			*	*	*	60000 ha	3600	72000	50000		22000
5.6.2. Setting up of the pastures in the common pasture deficit areas			*	*	*	10000 ha	250	5000		5000	
5.7.Degraded pastures improvement in the desertification risk areas and rational grazing	MAA		*	*	*	**600000 ha**	**15000**	**300000**	**100000**	**100000**	**100000**
5.8.Yield diversification using new crop species, breeds and hybrids better adapted to drought							**40**	**200**	**200**		
5.8.1. Promotion of new crop species, breeds and hybrids assortments for each crop area			*				20	100	100		
5.8.2. Promotion of animal races adapted to the specific area			*				20	100	100		
5.9.Conservation and improvement of the biodiversity in the desertification risk areas							**640**	**12500**	**5500**		**7000**
5.9.1. Setting up of green passages between the woods from the desertification risk areas			*	*	*	2000 ha	120	2400	400		2000
5.9.2. Reconstruction of the wet areas of the inland river meadows, Danube meadow and Danube Delta	MAPPM, MAA		*	*	*	20000 ha	500	10000	5000		5000
5.9.3. Conservation and development of the reservation network in the desertification risk areas	MAPPM		*				20	100	100		
5.10. Desertification tendency monitoring							**850**	**4300**	**2700**		**1600**
5.10.1. Present monitoring accommodation to the desertification problem	MAPPM, MAA						850	4300	2700		1600

1	2	3	4	5	6	7	8	9	10	11	12
5.10.1.1. Monitoring methodology establishing			*				100	100	100		
5.10.1.2. Setting up of a special monitoring network			*				600	1200	600		600
5.10.1.3. Performing observations and setting up of the monitoring data base (using an unitarian soft)			*	*	*		150	3000	2000		1000
Total priority axis 5							**155050**	**1875560**	**808460**	**114200**	**952900**

6. Priority axis: Rural development and landscape reconstruction in the land degradation risk wet areas											
Antierosional management planning of the crop land affected by degradation	MAA						**140**	**360**	**2160**		**600**
6.1.1 Setting up of experimental stations of the owner associations in order to execute antierosional works in the crop land and ensuring of the financial support for their activity		12	*	*	*		120	2 400	2000		400
6.1.2. Extension of the agricultural engineering for antierosional exploitation, using different facilities		4	*	*	*		20	360	160		200
6.2.Prevention and control of the water and wind erosion, sliding and other land degradation processes	MAPPM, MAA						**66415**	**1328300**	**787300**	**11000**	**530000**
6.2.1. Extension of the torrents rectify works			*	*	*	4500 km	22500	450000	300000		150000
6.2.2. Afforestation of the strong-excessive eroded lands			*	*	*	560000 ha	33600	672000	372000		300000
6.2.3. Afforestation of the deep eroded lands			*	*	*	65000 ha	5850	117000	67000		50000
6.2.4. Afforestation of the sliding lands			*	*	*	45000 ha	3375	67500	37500		30000
6.2.5. Ecological reconstruction of the declining woods from the river meadows			*	*	*	6000 ha	540	10800	10800		
6.2.6. Landscape rehabilitation and antropic degraded lands improvement (discovered lands, waste dumps, polluted lands etc..) by afforestation, sodding or other methods			*	*	*	5500 ha	550	11000		11000	
6.3.Revaluation of the abandoned crop lands due to their small fertility	MAA, MAPPM						**5270**	**80400**	**55400**		**50000**
6.3.1. Afforestation of the slopes over 20°			*	*	*	67000 ha	4020	80400	40400		40000
6.3.2. Grass setting up (pastures or hayfields) by sodding of the slopes over 20 °			*	*	*	50000 ha	1250	25 000	15000		10000

1	2	3	4	5	6	7	8	9	10	11	12
6.4.Physical and chemical soil properties improvement	MAA						**100**	**1960**	**1760**		**200**
6.4.1. Setting up of experimental stations for establishing and implementation of the solutions for soil structure improvement, compactation reducing, crust forming limitation, humus content and nutrients improvement, soil reaction amendation		8	*	*	*		80	1600	1600		
6.4.2. Extension measures of the results		4	*	*	*		20	360	160		200
6.5.Degraded pastures improvement and melioration	MAA		*	*	*	**850000 ha**	**42500**	**850000**	**150000**	**500000**	**200000**
6.6.Cadastral survey and monitoring of the land degradation phenomenon	MAPPM, MAA						**600**	**2900**	**2500**		**400**
6.6.1. Present monitoring systems accommodation to the degraded land problem							500	900	500		400
6.6.1.1. Monitoring methodology establishing			*				*100*	*100*	*100*		
6.6.1.2. Setting up of a special monitoring network for the degraded lands			*				*400*	*800*	*400*		*400*
6.6.2. Performing observations and setting up of the monitoring data base (using an unitarian soft) for degraded lands			*	*	*		100	2000	2000		
Total priority axis 6							**115025**	**2263920**	**999120**	**511000**	**781200**
GENERAL TOTAL							**288934**	**4465324**	**1911804**	**725200**	**1852920**

[1] It rests with the decisional authorities to separate the funds on the programme realisation period