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NATIONAL ACTION PROGRAMME TO COMBAT DESERTIFICATION IN ARMENIA

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Preparation of the National Action Programme to Combat desertification in the Republic of Armenia has been carried out by the Interagency Committee of the Ministry of Nature Protection for compliance to Armenia's obligations of the Republic of Armenia under the United Nations Convention to Combat Desertification.

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Foreword

Combating desertification is one of the global environmental issues of the Earth.

Given the geological-climatic conditions Armenia is also subject to desertification and is greatly damaged, mainly due to land degradation, reduction of biodiversity and biological resources and, as a result, deterioration of social state of population.

So combating desertification is a strategical issue for republic. Mitigation and prevention of desertification is a precondition for sustainable development of the country.

With UNCCD Armenia undertakes a number of international obligations where the priority is given to developing the National Plan to Combat Desertification.

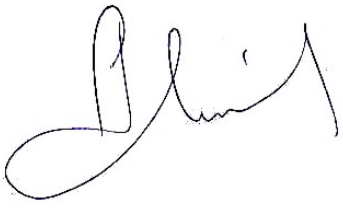
UN CCD being an essential achievement of Rio summit is closely related to UN Conventions on Biological Diversity and Climate Change. Armenia is a member of these Conventions as well. UN CCD is an innovation document, a new achievement in the international law on environmental protection.

I consider developing the National Plan to Combat Desertification in Armenia as a modern task both for ecological and economical development of the country. The witness for its strategical importance is approving the project by RA Government (28.03.2002.), which will encourage effective implementation of environmental measurements in the different fields.

Special significance is given to analysis of ecological and socio economical status of the republic, identification of executive and local authorities, land users role in combating desertification.

Essential scientific significance have the computer-based mappings, where a detailed description of environmental, including state of natural resources and features of desertification processes is represented.

I hope implementing the National Plan to Combat Desertification will facilitate mitigation of nature vulnerability by means of conservation, rehabilitation and sustainable use of natural resources and lead to poverty reduction by improving the socio-economic state of the country.

Minister of Nature Protection  **Vardan Ayvazyan**

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INTRODUCTION

Desertification as a global environmental problem includes the integrity of undesirable and disastrous processes and their consequences. This is the reason why combating desertification includes efficient administration of conservation and rational use of natural ecosystems, their components and natural resources, but also such efforts targeted at mitigation of impacts on violation of ecological balance of the environment, such as social and economic factors. Therefore, efficiency of combating desertification mainly depends upon profound analysis of socio-economic conditions and identification of natural resources potential.

Desertification processes on the territory of the Republic of Armenia, which have been more activated under the conditions of recent years socio-economic crisis and blockade, cover about 80% of the country's territory. By realizing the importance of the issue Armenia took an active participation in the activities of the Inter-governmental Advisory Committee for preparation of the UN Convention to Combat Desertification, and signed it in Paris on October 14, 1994. The National Assembly of the Republic of Armenia ratified the Convention in July 1997.

Formulation of the National Action Programme to Combat Desertification in Armenia is a critical integrated part of the obligations under the UN Convention to Combat Desertification. Hence, the Ministry of Nature Protection of the Republic of Armenia initiated in 1999 preparation of a national action plan to combat desertification in Armenia sponsored by the United Nations Environment Programme (UNEP), Secretariat of Convention (UN CCD), and Armenia office of UNDP .

Proposed project is a guiding document. First part analyses multilateral causes of desertification, second – priorities of strategy actions to combat desertification. Third part represents a number of projects of local significance and the forth – maps of decertified areas of Armenia.
Second part of this project is approved by RA Government (28.03.2002) on the chapters -
" Strategy of actions to combat desertification", "Education and science to combat desertification' and "Public participation to combat desertification'

The National Action Plan would enable country to address resources to environmental policy as a state security task to mitigate and prevent socio-economic consequences of desertification.

The project assumed the framework for tasks and activities of ministries, state territorial and local self-governance, scientific, educational and other organizations.

The National Action Plan is assumed to implement in identified timetable in the framework of annual and perspective socio-economic development projects of republic, according to fields, financing and sources. Whenever possible it will be reflected in RA state budget, appropriate community budgets, as well as agreements to donors and international organizations.

PART I

CHAPTER 1.

NATURAL AND CLIMATIC CONDITIONS IN ARMENIA

1.1. Geographic Description Relief, Vertical Zoning

Geographic Description of the Republic of Armenia. The Republic of Armenia is located in northwestern section of Armenian mountain rangeand occupies major part of the Kur-Arax mountain interfluve. It occupies an area of 29.74 thousand km^2 between the north longitude and $38^0$50' - $41^0$18' of east longitude of $43^0$27' - $46^0$37'. It passes for some 360 km through the northwest to the southeast by approaching 200 km in the widest part. The Republic is 75 km off the Caspian Sea by a direct line, 145 km off the Black Sea, 750 km off the Mediterranean Sea, 960 km off the Persian Gulf.

The extent of the republic's frontier with the neighbouring countries is 1479 km. It is contiguous with Georgia from the north. It is bordered upon Azerbaijan from the northeast, east and southwest and Iran - from the west.

The area of the Republic of Armenia amounting to the small passage of the Armenian mountain range (10%) has a complicated geological composition and multi-form relief. The republic is a typical highland country. The lowest spot is in the north -- on the bank of Debet River at 375 m above sea level, whereas the highest spot is the northern peak of Mount Aragats of 4095 m. Relative altitudes fluctuate from 1500-2000 m to 3700 m. The average altitude of the area amounts to 1850 m. Such a picture of the altitude fluctuation is an important factor in terms of formation of climate and landscape highland zoning.

Relief. There are 4 parts in the Republic of Armenia that differ from each other in terms of relief origin.

1. Section of the plicate and fission-fragmented mountains and intermountain valleys.

It covers the northeastern part of the area basically in the Kur river basin - the Vayots Dzor, Bazum, Pambak, Gugarats, Areguni, Sevan mountain ranges and concavities and valleys therein and is notable by its erosion fragmentation. The highest peak is 3101 m of Tezhler.

2. Volcanic covering sections. The massifs of the Ashotsk, Aragats, Geghama, Vardenis, Syunik and surrounding plateaus.

They are covered by young lava of upper Pliocene and Quaternary. The forms of the relief are soft enough with slight erosion fragmentation. The highest peak is Mount Aragats of 4095 m.

3. Arax streamside plicate and fission-fragmented mountains system: on the left bank of Arax - Urts Yeranosyan, Teksar mountains, the Vayk mountain range and Zangezur mountain range together with its waves (Meghri and Bargushat mountain ranges). This section is intensively fragmented. The highest spot is 3904 m of Mount Kaputjur.

4. The Ararat Valley. It covers the bottom section of the Ararat concavity. It is subject to tectonic lowering and covered by lake and alluvial and pro-alluvial sediments.

The largest inclinations are typical of plicate and fission-fragmented mountains, whereas weak inclinations - to plains and volcanic plateaus.

Volcanism of the Quaternary and human economic activity in the recent times left an indelible track on the Armenian mountain range. Due to the complicated relief, natural landscape changes are notable everywhere in the country. Each and every valley, watershed and mountain peak here has its own landscape. Biogenic elements are represented in the most diverse nature. Similar diversity is conditioned also by the location of the Armenian highland, which is located in the junction of several geographical regions.

Vertical Zoning. There are two major types of highland-zoning landscapes identified in the Republic of Armenia: temperately wet landscapes of weathered or bar mountain slopes and dry landscapes of closed concavities.

The first type is typical of the areas (Gugark, Utik) involved within the highland system of the Small Caucasus, the second one - to the Arax basin's concavities (Shirak, Ararat, Sevan and Vayk, etc.). The forests are dominating within the first-type sample landscapes, whereas the steppes and semi-deserts, - within the second one. Alpine meadow landscapes are spread in the high mountains region in the case of both types.

The shift of the landscape zones within the above types has the following picture (see Table 1).

Thus, natural landscapes typical of Armenian territory are the following: semi-deserts, dry steppes, temperately wet steppes, moderately wet forests and alpine meadows.

There are no typical desert landscape in Armenia, but their counteracts in the form of scratches are found within Ararat valley, basically on the river sediments and tertiary clays. Semi-desert and lowland saline-meadow landscapes are very typical of the mentioned valley. The latter is involved within the original semi-desert zone, but the high level of groundwater caused the existence of wet lowland saline land meadows.

Table 1

Landscape Zoning Structure in the Republic of Armenia

Medium-Arax Type		**Small-Arax Type**	
Landscape zones	**Upper limit of dispersion (m ASL)**	**Landscape zones**	**Upper limit of dispersion (m ASL)**
Desert-and-semi-desert	up to 1250 (1300)	Sub-tropical dry steppe	up to 700 - 800
Dry steppe	up to 1600 (1700)	Dry sparse forests (fragment)	up to 1000 - 1100
Steppe	up to 2300 - 2400	Forest steppe	800 - 2000 (concavity bottoms)
Forest fragments	from 1800 to 2300	Alpine meadows	above 2000 (2200)
Alpine meadows	up to 3700		
Sub-snow	above 3700		

The semi-desert zone goes up to 1300-m high, and lowland meadows - 800-900 m. Wormwood and ephemeral vegetation is typical to semi-deserts, and salt-loving subshrubs - to saline land. The major part of the landscapes in this zone has been turned to the agro-landscapes of heat-loving crops. Within the recent decades saline lands have been intensively desalinated and cultivated.

Lowland wetland landscapes are specially ranked among the semi-desert zone, which also have been subject to reclamation and cultivation.

The semi-desert landscape zone occupies a wide area in the foothills part as well, where the relief is hilly and wavelike with steep slopes here and there. Under the conditions of dry terrestrial climate physical weathering processes are prevailing and causing accumulation of degraded brittle substances and fast mineralization of biomaterial. Springtime downpours, which are typical to the landscape in this zone, wash out these brittle formations and initiate heavy showers.

Due to the dry climate an interesting type of desert and semi-desert landscape, Badlands type free from vegetation cover has been formed in the areas of foothills that border the Ararat Valley from the southeast and in the lowlands that comprise sediment waterproof rocks.

One of the peculiarities of the semi-desert landscapes is the accumulation of gypsum. Farming in this zone is possible only under irrigation.

The steppes are the major type of landscape in Armenia, which are represented in various sub-types: dry, moderately dry, moderately wet and wet.

Dry steppes are met in the lower floor of mountains - within the limits of lower mountains. The major massif is concentrated in the Ararat concavity. This is an intermediate type between the semi-deserts and steppes. They have been mostly formed on the volcanic plateaus up to 1500 m height. Due to a shortage of precipitation the flow is weak. Another contribution to that is the presence of volcanic porous rocks. They have been formed under temperately warm continental climate where a warm dry summer and a cold winter are prevailing. A rainfed farming possibility is too little (agricultural crops need to be irrigated). The dry steppe zone is the mostly fragmented and eroded in the country. Immense territories are not used adequately so far due to lack of irrigation water and stoniness. In the river basins of Azat and Vedi in Vayk dry steppes have been formed on the sediment rocks. They are too fragmented, steep, badlands and bad landed areas are widely spread there.

Moderately dry steppes are shifted by dry steppes by forming a narrow zone on the highland slopes. They are located in large areas at an average height on the lain bottoms of inter-highland concavities (Sisian, Pambak, Sevan, Shirak, etc.). The climate is continental, precipitation is decreasing during the vegetation period, and an active farming requires irrigation.

Moderately wet steppes are mainly spread on the parts of medium volcanic rock floors and sunny slopes of the mountain range surrounding the concavities (Bazum, Virahayots, Pambak, etc.). Climate conditions are favourable for agriculture although large steepness of the relief prevents it. Thus, most of these landscapes are used as pastures and hay meadows.

Within the medium-Arax concavity the upper floor of the medium-height mountains is represented by wet steppe landscapes typical of their round-season precipitation, desalination of soil cover, high quantity of humus, etc. The natural and landscape conditions are favourable for expansion of hay meadows, as well as cultivation of wheat crops.

A unique landscape type has been formed in the lower floor of the high mountains – sub-alpine meadow steppes. They have a double nature in terms of their origin: in the medium-Arax part they are a result of xerophytes of lower alpine meadows; in the Small Caucasus Mountains - the retreat of the forest upper zone. In both cases they are notable by their biological productivity, being mostly used as hay meadows.

The prevailing zone in the Small Caucasus Mountain system is the forest one with the domination of oak-trees, beech and hornbeam. The ration of temperature and humidity in this zone is the most favourable in the country. They mainly occupy so-called circulation (weather-beaten) slopes amounting to some 11.8% of the area in the country. In Northern Armenia (Gugark, Tavush, Lori) the upper limit of the forests does not exceed the point of 2000 m, in some places of Zangezur it approaches to 2300-2400 m. If the forest landscape covers 30% of the whole area in the northern region, in Zangezur -- 20%, then in the Ararat concavity it amounts to 2-3%.

The dry bushy forests, mostly met in the northeast regions and the Meghri valley, are transferred to the shibliak. Wet sparse growth of trees is typical of the slopes adjacent to the subalpine zone. Wet beech forests are spread over the shady (northern) slopes and deep, dark valleys in the forest zone. Moderately wet, sparse growth of trees is of a secondary nature originated in the result of forest degradation. Mountain-forest brown soils, in rare cases also grey soils with weak differentiated genetic horizons are mainly spread.

The Alpine meadow zone covers highland mountain plateaus and massifs above 2000 (2100) m. In its inferior sub-zone lower Alpine meadow landscapes are spread over, and in the upper one - upper Alpine meadows (above 2700-2800 m). This landscape zone is considered a summer-time pasture region. However, they are stony and over-grazed requiring radical reformation. The meadow landscapes in high mountains are formed under cold climate. As a result of low temperature the evaporation tension is essentially decreasing. Meanwhile the surface flow is increasing. The biomass is low due to the lack of warmth.

Snow-like landscapes are formed on some of the highest mountain peaks in the country (Aragats, Kaputjur, etc.) above the alpine zone by means of spots of eternal snow and ice.

1.2. Climate

Armenia's climate is notable by its aridity nature. Armenia's altitude and relief peculiarities have their unique role in the formation of its climate.

Diversity and uniqueness of the republic's climate create big diversity of the climatic conditions by forming sub-districts of local microclimate, which differ from each other by thermal regimes, precipitation quantity and moisture conditions.

Under the conditions of Armenia's complicated and fragmented relief, closeness of the horizon is considerably reducing the duration of sun shining. General cloudiness is also influencing the area's real sun shining.

The measurements and special calculations show that the longest duration of real sun shining occurs in the plain areas, where the mountains do not close the horizon. In terms of real duration of sun- shining many of the areas in the republic, such as the Ararat valley, may be classified to the rank of the Middle Asian sub-tropical zone. In general, real sun-shining duration in the country under warm season amounts to 82-87% of year, meanwhile the average real sun shinning amounts to 58% of possible sun shining for this latitude.

The atmospheric phenomena on the territory of Armenia are basically conditioned by the invasion of predominating western and eastern air masses. Such penetration is frequently broken by penetrations of cold arctic air masses from the northern slopes and southern warm currents towards meridian. Wintertime weather changes in the country are basically connected with the invasion of

cold air masses towards the meridian from the northwest and southeast. In wintertime, major air masses of the medium-latitude anti-cyclones formed in the European part of Russia and Siberia, having 62% frequency, are predominant in the country. Severe air-cooling are occurring due to invasion of those cold air masses and resulting in daily cooling of temperature by 10-12^{0}C. However, southwestern warm currents invading to the republic's territory in wintertime bring with them moisture and warmth.

At the beginning of spring the arctic air currents are going on, which in certain cases are changing the weather by decreasing the temperature and there are heavy precipitation, which are frequently as snow. The repeat of these invasions is equal to 10-12%. In springtime invasion of these cold currents activates cyclone activity from the side of the Mediterranean Sea, the frequency of which is 20-21%.
Major peculiarity of the summer-time circulation is that severe hot continental tropical air masses formed in the Arabic peninsula, Iranian and Anatolian plateaux are invading the country.

Such circulation is predominant in the republic in July-August and causes a high temperature background, particularly in the Ararat valley, Shirak and Zangezur valleys. Such circulation frequency in summer time is equal to 55%. Invasion of tropical air masses to the territory of the republic is viewed all year long, which is resulted in formation of dry continental climate up to the altitude of 1900 m, while a sub-tropical climate with comparatively warm winters is formed in Meghri and Noyemberian. More severe forms express the aridity of the Arax River with average flow across the plains and valleys - cold winters and hot summers. A moderately warm and dry climate is formed in the foothill districts in this area and southern part of Zangezur at the altitude of 1300-15100 m, a moderately cold one -- at the altitude of 1500-2000 m, a highland cold one -- at the altitude of 2000-3000 m.

Thus, medium-latitude continental air masses are basically predominant in the territory of Armenia. Anti-cyclone type weather is predominant in winter and summertime, which is resulted in a cold winter and an arid and hot summer. Local air circulation has a significant impact on weather formation, which is caused by the mezzo- and microcirculation processes that occurs as a consequence of orographic peculiarities. This circulation is mostly due to air mass deformation resulted from the impact of the relief to the air masses movement across the republic's territory.

Wind direction coincides with the ravines and valleys. Western and northern winds are prevailing in wintertime, whereas eastern and southern winds - in summer time. Wind direction is more obvious in the passes, where the wind velocity compared to plain areas is raised by 1.4-1.8 times on the weathered or wind-parallel above 10^0-steepy slopes, wind-parallel valleys with longitudinal tilt, and the wind velocity is raised by 2.0-2.4 times on the peaks of the hills with a relative height of 600 m. High velocity is also viewed on the peaks of high mountains and highland plain plateaus. In the highland zone the highest wind velocity is observed in wintertime, while in the lowland and foothill zone - in summer time. Within a daytime the lowest wind velocity is observed in the morning hours, while in the afternoon - it is being increased. Breezes (in the Lake Sevan basin) and highland valley winds, which are well developed particularly in the Ararat valley and plain areas adjacent to other mountains, are of regular daily process. During warm season the wind blows from the valleys to the mountains in the afternoon, while after 15-16P.M. - from the mountains to the valleys.

Phyones, warm air masses descending from the mountains, are typical of Armenia. They are leading to temperature increase, humidity decrease, snowmelts, etc. During warm season dry,

warm and hot winds are frequently blowing from the southern districts and causing damage to the farming.

Thermal Regime. Armenia's complicated relief, fluctuation of the altitude above sea level, slopes location and steepness make a considerable impact on the distribution of air and soil temperature..

The presence of unversal snow layer is the major factor affecting the spatial distribution character of the republic's temperature in wintertime. Durable preservation of the inversion and rapid snowmelt on southern slopes at small distances create a big temperature discrepancy. There is a lower temperature in the concavity bottoms compared to the adjacent mountain slopes. Average temperatures in January for the same-altitude areas in the republic are fluctuating between 0^0C and 5^0C at the altitude of 500-1000 m, between 1^0C and 6.5^0C -- at the altitude of 1000-1500 m, between 1.5^0C and 12.5^0C -- at the altitude of 1500-2000 m.

In springtime in the highland zone (2100-2200 m) normally covered with snow, the average monthly temperature is not exceeding 0^0C. In the northeast districts average monthly temperature for April in the zone of 400-600 m of altitude is above 10^0C. In the inner districts this process involves the altitudes of 1200-1300 m, while the 1500-2000 m altitudes average temperature is 5^0C.

In the spring-time average monthly values of temperatures on the same altitude are fluctuating between 8.5^0C and 13.5^0C in the zone at the altitude of 500-1000 m, at the altitude of 1000-1500 m - between 5.5^0C and 11.5^0C, and at the altitude of 1500-2000 m - between 1.0^0C and 7.5^0C. The highest temperature is observed in Meghri -- 13.5^0C. If the temperature is higher in summer time in north-southern districts than in the inner district of same altitude, then in April the picture is the opposite. It is explained by the humidity of a high degree and cloudiness in the northeast.

In summer time, depending upon slope location, big differentiation of temperatures is taking place in the country. If the average monthly temperature differentiation in April for the arid northeastern and inner districts at the altitude of 900-1000 m is 3-4^0C, while in July it amounts to 4-5^0C. The highest average monthly temperatures are observed in the Ararat Valley, Yeghegnadzor and Meghri: 25.5-26^0C. The highest average temperature gradient in July is 0.6^0C for each 100 m. The air temperature is below 0^0C in October in the zone above 3000 m.. The temperature is fluctuating between 0^0C and 5^0C in the highland zone (2000-3000 m) concavities, while in the zone below 2000 m -- between 5^0C and 15^0C. The highest average monthly temperature is observed in Meghri (15.3^0C). In the northeastern districts the average temperature compared to the same altitudes in the inner districts is lower by 1.5-20^0C.

The average annual temperatures in the republic's territory are fluctuating within the limits of -2.7^0C (the Aragats highland) +13.8^0C) (Table 2).

The coldest areas in each region are considered the northern slopes then the concavities. The absolute highest temperature in the country is fluctuating between 21^0C and 42^0C, while the absolute lowest degree- between -22^0C and -46^0C (Table 2).

One of the important elements of the thermal resources description is the sum of positive temperatures in the warm season. The sum of high temperatures above 5^0C and 10^0C, characterizing the vegetation period, in the republic's territory is big enough (Table 2). It is decreased depending upon the altitude. The biggest sum of the temperatures is observed in the inner arid districts at the altitude of 800-1000 m, where the sum of temperatures above 5^0C

amounts to 4400-4900^{0}C, while the sum of the temperatures' above 10^{0}C -- 4100-4500^{0}C. It is too low in the highland districts amounting to 670 m and 40^{0}C respectively. The sum of the temperatures above 10^{0}C at every altitude based on each 100 m is decreasing to 220 - 230^{0}C, while the sum of temperatures above 5^{0}C an altitude-based gradient amounts to 220^{0}C. The gradient of temperatures of 15^{0}C and 25^{0}C as the altitude decreases is higher.

Table 2

Spatial distribution of annual average and extreme temperatures, duration of non-frosty season and the sum of temperatures in the Republic of Armenia

Stations	Altitude (m)	Average annual temperature	Term of transition above 10^0			Sum of temperatures		Vegetation season	Absolute temperature	
			Spring-time	Fall	Duration	Above 5^0	Above 10^0		Minimum	Maximal
North-east and Lori-Pambak										
Debedashen	453	11.7	11.04	29.10	200	4111	3711	220	-25	40
Ijevan	732	10.6	18.04	23.10	187	3686	3236	200	-23	37
Vanadzor	1350	7.4	1.05	10.10	161	2807	2417	174	-32	36
Stepanavan	1397	6.6	6.4	9.10	155	2582	2214	149	-34	35
Tashir	1507	5.8	13.05	3.10	142	2376	1956	132	-36	34
Spitak	1552	7.1	3.05	11.10	160	2791	2430	167	-32	35
Chambarak	1861	4.8	25.05	23.09	120	2075	1546	131	-34	31
Internal Arid Districts										
Meghri	627	13.8	25.03	7.11	226	4865	4479	253	-22	41
Kapan	705	11.5	11.04	30.10	201	4036	3641	214	-27	38
Artashat	829	11.1	4.04	28.10	206	4242	3925	196	-32	41
Armavir	861	11.3	6.04	28.10	204	4341	3902	201	-33	41
Yerevan, Agro	942	11.4	7.04	30.10	205	4353	4040	224	-31	42
Areni	1009	11.8	8.04	1.11	206	4414	4082	218	-29	41
Yeghegnadzor	1267	10.8	13.04	29.10	198	4090	3756	219	-30	40
Yeghvard	1317	9.1	20.04	22.10	184	3643	3330	202	-34	38
Gyumri	1556	5.8	4.05	8.10	156	2997	2670	168	-41	36
Sisian	1580	6.6	7.05	8.10	153	2652	2281	147	-37	34
Talin	1582	7.9	29.04	16.10	169	3197	2847	186	-32	36
Artik	1750	5.8	10.05	8.10	150	2662	2267	165	-30	34
Fontan	1798	6.0	10.05	11.10	153	2663	2229	183	-32	34
Aparan	1291	4.3	18.05	28.09	132	2336	1917	134	-41	32
Sevan	1936	4.0	27.05	1.10	126	2210	1759	131	-37	32
Mazra	1940	4.2	24.05	28.09	126	2217	1753	124	-41	32
Martuni	1995	5.6	19.05	7.10	140	2262	1938	145	-31	32
Shurabad	2004	1.8	8.06	16.09	99	1809	1294	89	-46	31
Yangh	2334	2.7	15.06	18.09	94	1763	1270	117	-37	30
Aragats highland	3229	-2.7	29.07	3.08	4	671	40	66	-39	21

Non-frosty season assessment is important for the overall use of area's thermal regime, which is somehow dependent upon average daily temperatures. The non-frosty season in comparatively humid districts in the north-east begin in on average 15 day before a transition to the 10^{0}C season, while in the inner districts - 10 day before. The duration of non-frosty season is also being decreased depending upon the altitude by amounting from 66 days (Aragats highland) to 253 days (Meghri). Non-frosty season in the north-eastern inner districts below 1000 m begins on April 3rd

and ends up on November 14th and continues for 220 days, while in the zone above 2000 m it starts on May 25th to October 21st and continues to some 118 days. It is observed in the medium Arax concavity on April 6th, in Gyumri - on April 30th, while the end of the season is observed as appropriately: on November 2nd, October 14th, October 8th, and continues in the Ararat Valley and Yeghegnadzor -- 212-225 days, in Shirak -- 165-180 days, while in the Lake Sevan basin - 130-145 days. The gradient of the season depending upon the altitude decrease amounts on average to 3-4 days per each 100 m.

Soil temperature. The soil temperature is frequently considered as determining factor, which is a prerequisite for generation of a number meso- and microclimate events in subsoil and soil arable layers.

Both, the rests of the climate elements and the soil temperature are closely connected with the elevation of the area and forms of the relief. In wintertime in Meghri canyon, the warmest district in the republic, soil surface temperature is 0^0. In the northeast humid districts of the 400-700 m altitude zone soil surface temperature is fluctuating between 0^0 and -2^0. In Ararat Valley and adjacent foothill districts up to 1200 m altitudes, as well as in Goris-Kapan, it fluctuates within the limits of -2^0 and -4^0.. The average temperature of snow surface in the highland zone is -14^0.

The soil surface temperature during the warmest season of July in Ararat Valley, Vayk, Meghri canyon is $34\text{-}35^0$, the average soil surface temperature in the north-east lowland humid districts and Goris-Kapan amounts to $28\text{-}29^0$, while at an altitude of 3200 m it amounts to 12^0.

The temperature of the soil arable layer (0-20 cm) depends upon the weather conditions and soil hydrophysical (mechanical composition, colour, volumetric weight, thermal conductivity, etc.) attributes, as well as area's description. Soil temperature in warm districts on a depth of 10 cm in the medium zone is $2.0\text{-}2.5^0$ higher than air temperature, while in the highland zone -- $3\text{-}4^0$ higher. Soil temperature in the north-eastern districts at an altitude of 500-1000 m is $2.5\text{-}3.5^0$ lower than in the inner districts. If by ascending each 100 m in the north-eastern districts the soil temperature on a depth of 10 cm is dropped by $0.3\text{-}0.4^0$, then in the arid districts - by $0.5\text{-}0.7^0$, which is caused by an extreme aridity in these districts.

The average monthly soil temperature on a depth of 20 cm in cold season is dropped by 0.4^0 while ascending each 100 m, whereas in the summer-time - 0.7^0. The lowest temperature in the highland districts is observed in February (-8^0), while in the warm valley districts it is observed in January ($3\text{-}4^0$). The highest soil temperature on a depth of 20 cm is observed in July in Meghri and in the Ararat valley.

Distribution of Air Moisture. Air moisture in different districts may be judged on the values of water vapours elasticity, relative moisture, as well as shortage of water vapour saturation.

Elasticity of water vapour . The highest elasticity of vapour is observed in the humid north-eastern and south districts where it equals to 3.5-4.5 Mb in January, and 16-17 Mb -- in July. The lowest vapour pressure in the republic is observed in the zone above 3000 m.. It equals to 1.9 Mb in January, and 7.4 Mb -- in July.

Relative air moisture. The average annual value of relative moisture is fluctuating within the limits of 56-75% (Table 3), which, as opposed to the other climate elements, has no extremely expressed regularity to be changed depending upon the altitude and is basically dependent upon area's micro- and meso-climatic conditions. The highest relative moisture (75-80%) is observed in the republic's

north-eastern districts: Goris-Kapan, northern part of the Sevan basin, and highland zone. In the Ararat valley it amounts to 60%, in the foothill zone - 65%, upstream river Akhuryan - 70-75%. In the Lake Sevan basin the annual amplitude is 10-20%, while in the Ararat valley and Shirak - 20-35%. Starting from March-April the relative moisture is falling down in the whole territory of the republic, while in the Ararat valley it begins starting from January, in the northeast and Debet river basin - starting from May.

During the warm season relative moisture amounts to its lowest value of the year. It amounts to 32% in August-September in the Ararat valley, while in other districts - about 45%. If relative air moisture falls down below 30%, then similar days are considered as arid. Similar days are observed mostly in the Ararat valley - some 107 days. The biggest number of moist days when the relative moisture at 13:00 P.M. is more than 80% is observed in the highland districts: 152 days, while in the moist foggy districts it amounts to more than 100 days. In respective years the number of dry (less than 30%) and moist (more than 80%) days considerably differs from the said average values.

Average annual values of saturation shortage of air's water vapour are fluctuating in the country within the limits of 1.8 and 9.1 Mb (Table 3). The lowest value of the shortage of air's water vapour saturation is observed in wintertime due to high relative moisture and minimal temperature. In January it amounts to 1.5 Mb on average, while in July and August it approaches to its highest value. During this season the shortage of moisture in the whole territory of the republic fluctuates between 2.1 Mb and 22.6 Mb. Local conditions are influencing the value of shortage of moisture as well.

Atmospheric precipitations. The quantity of annual precipitation in the territory of the republic is changed within large limits (Table 3). In the lowland districts quantity of multiyear annual average precipitation is 200-250 mm, in respective years it falls down to 100 mm and even less, in the highland districts it amounts to 900-1000 mm, while in respective years it approaches to 1300-1500 mm.

While summarizing the analysis of distribution of annual precipitation quantity the following picture is drawn. In the north-western districts above the altitude of 400-1000 m the sum of average annual precipitation is fluctuating between 430-600 mm, while in the inner arid districts at the same altitude it amounts to 250-300 mm. It appropriately amounts to 550-750 mm and 250-550 mm for the altitude of 1000-1500 m, 600-820 and 350-600 mm - at the elevation of 1500-2000 m zone. Judging from this regularity the following is notable: in both of the districts at the elevation of 2500-3000 m zone the annual sum of the precipitation amounts to 750-950 mm (Table 3). It should be noted, that by ascending each 100 m the gradient in the inner arid districts amounts to 20-25 mm, while in the north-east - to 18-20 mm.
According to the observations during vegetation period in April-October the quantity of precipitation in the republic's territory is distributed very unevenly (Table 3), which amounts more then 51% of annual precipitation (in the Ararat concavity) and to 81% (north-east, Lori-Pambak). Within said period the quantity of precipitation in the Ararat valley and Vayk amounts on average to 59% of annual precipitation, in the Sevan basin -- 73%, in Zangezur - 66%. Pursuant to the data hereto in the areas where the dryness of the climate is more expressed the intensity of precipitation is low during the vegetation period. It should be mentioned that the heaviest precipitation in all the districts occurs in April-June.
A quite different distribution picture is in a cold season: during November-March (Table 2), particularly in northeast and in the Lake Sevan basin, where both the quantity of precipitation and the gradient are rapidly falling down. Within that season relatively heavy precipitation is occurring

in the Aparan-Hrazdan (210-25 mm) or some 30-35% of the annual precipitation. The precipitation within the season is mostly snow. Duration of stable snow cover in the country is fluctuating within the limits of 21 (Meghri) to 252 (the Ararat highland) days. The origin of the snow cover and its vertical gradient at the altitudes of 500-1500 m is 2-3 days, while at the elevation of 1300-3000 m zone - 4-5 days per each 100 m uphill.

Snow cover in southern slopes up to 800 m of altitude continues for 23 days later than in the northern slopes, which is 18 days at the altitude of 2000 m. The smallest altitude of snow cover is observed in Meghri and Ararat valley on average 5-10 cm, minimum 0 cm, maximum 20-40 cm (Table 3). The layer of snow cover is also small in the Lake Sevan basin, which is explained by shortage of precipitation. In the republic's area on an average altitude of 500-1700 m while ascending each 100 m the snow layer is increasing by 2-4 cm, while in the above 1700 m snow it approaches to 10-12 cm per each 100 m.

Table 3

Spatial Distribution of the Average Values of Atmospheric Precipitation and Air Moisture in the Territory of the RoA

Stations	Precipitation quantity			Average height of the snow cover			Duration of snow cover	Relative air moisture (%)	Shortage of moisture (Mb)
	Year	4-9	11-3	Average	Maximal	Minimum			
North-east and Lori-Pambak									
Bagratashen	444	333	111					72	5.2
Ijevan	563	434	129	10	28	1	38	73	4.6
Vanajor	586	458	128	17	38	3	72	71	4.0
Stepanavan	683	542	141	19	53	4	73	73	3.5
Tashir	713	556	157	17	37	2	72	75	3.5
Spitak	439	342	97	12	56	2	63	69	4.4
Chambarak	557	421	136	16	37	5	102	74	2.9
New Inner Districts									
Meghri	259	160	99	5	27	0	21	61	9.1
Kapan	544	373	171	10	32	2	34	71	6.1
Artashat	235	140	95	10	44	0	39	65	7.7
Armavir	244	151	93	10	42	0	45	60	8.8
Yerevan, Agro	316	186	130	12	46	0	44	60	8.7
Yeghvard	407	231	176	28	68	0	74	62	7.0
Areni	357	211	146	14	-	-	40	56	9.8
Yeghegnadzor	398	227	171	18	-	-	50	58	8.8
Sisian	365	252	113	12	.34	3	73	68	4.6
Gyumri	477	358	119	26	61	4	96	70	4.7
Talin	435	297	138	24	64	2	82	59	6.6
Artik	516	381	135	22	51	5	95	66	4.8
Fontan	640	391	249	50	79	13	124	66	4.6
Aparan	651	441	210	56	92	10	125	69	4.0
Sevan	556	407	149	36	83	3	136	74	3.2
Mazra	390	281	109	21	35	7	109	69	3.7
Martuni	457	322	135	26	75	2	98	67	3.8
Yangh	488	345	143	64	102	33	160	72	2.9
Shurabad	574	432	142	53	81	17	138	74	2.8
Aragats highland	1065	626	439	166	235	66	252	73	1.8

1.3. Geological Structure

In terms of geological structure Armenia is a part of the Transcaucasus great arched fold and medium-Araxian intermountain lowering. These two geological structural units are included in the Caucasus-Anatolia-Iranian segment of the Mediterranean plicate zone.

Given the time of establishment of geological structural units and accomplishment age of plicate formation some scientists divide the territory of Armenia into the Somkheti-Ghapan complex (unity), Bazum-Zangezur and trans-Araksian zones.

1. The Somkheti-Ghapan complex as a real geosyncline was formed in alpine period. Volcanic, volcanic sedimentary rocks, terrestrial and carbonate ores are involved in the Complex structure .

The Somkheti-Ghapan complex is divided into the Ghapan segment and Somkheti-Ghapan multi-arched plicate zone. The Alaverdi-Shamshadin, Noyemberyan and Lori sub-zones differed by their age, ores composition and structure are identified within the latter.

a. The Alaverdi-Shamshadin sub-zone is composed mainly volcanic-and-sedimentary formations of unique lower Cretaceous period, which are fragmented by inter-igneous rocks of acid composition, within the sub-group composition Alaverdi and Shamshadin multi-arched plicate (anticlinorium) and Ijevan multi-concave plicate.

b. The Noyemberyan sub-zone is composed of carbonate and land-carbonate ores, which are extremely inadequately sited on the lower stratums forming a secondary plicate structure.

c. The Lori sub-zone is rich in volcanic and sedimentary rocks, which are slightly shifted.

2.The Bazum-Zangezur intensively plicate zone is involved in the layer section by land-origin volcanic-and-sedimentary rocks and carbonate ores of Cretaceous period.

The ophiolite sub-zone of Sevan-Amasia and multi-pouted sub-zone of Tsaghkunjats-Zangezur are isolated on the borders of the Bazum-Zangezur zone.

a. The Sevan-Amasia sub-zone is characterized by wide prevalence of ophiolete formation rocks and intensively plicate nature. This sub-zone identifies Amasia, Bazum and Sevan multi-arched placate composed of cretaceous sediments and Palaeogene stratums filled by multi-concave plicate splitting them.

b. The Tsaghkunyats-Zangezur multi-arched sub-zone is characterized by an extremely inadequate dislocation of Palaeozoic and Palaeocene sedimentation and volcanic sediments, as well as wide prevalence of neogenesis molas and land and volcanic-origin stratums of Quaternary period.

3. The trans-Araksian weak plicate zone is divided into the Yerevan-Ordubad and orogenic lowering sub-zones.

a. The Yerevan-Ordubad sub-zone is located in the south of the Bazum-Zangezur zone and is characterized by meogeocyncline type. Land, carbonate, ophyolite, volcanic-and-sedimentary formation stratums, as well as volcanic-origin and land formations of Quaternary period.

Mentioned sub-zone is composed of two structural units: the Yerevan-Ordubad concave fold and Urts-Vayots Dzor arched fold.

The Yerevan-Ordubad concave fold is composed of the second-grade concave folds of the Yerevan, Vedi, Yeghegnadzor, which are divided by the Yeranos, Sovetashen and Martiros arched folds.

b. The orogenic-lowering sub-zone is composed of a number of concave folds (Nakhijevan, Artashat, Sevan-Yerevan, Aragats, Akhuryan, etc.), which are divided by arched folds (Parakar-Yengija, Ararat, Armavir, etc.).

Jagged dislocations, particularly deep breaks that supervise the zone boundaries, sedimentation formations and thickness, magmata nature and inner-born mineralization, are playing an important role. Availability of the largest breaks of Sevan-Akera, Shirak-Zangezur and the Middle Araksian (Yerevan) has been identified by geological, geophysical and geochemical data. They are expressed on the surface by zones of 5-10 cm between the ophyolite coincidence rocks and breaks.

1.4. Soils

The Republic of Armenia is short of land, although notable by its mixed soil cover including the following zones (Tables 4).

1. Semi-desert where semi-desert grey, irrigated meadow grey, alkalised and paleohydromorphic cemented hydromorphic salinated-alkali soils are developed.

The semi-desert grey soils occupy the lower hilly plains of foothill zone of the Ararat concavity at the altitude of 850-1250 m. They are characterised by low capacity of humus horizons /25-40cm/, low percentage (2%) of humus, stoniness, skeleton-type and considerable percentage of carbonates. Below the carbonate horizons the gypsum-clay stratums are represented. Salinity is notable here and there. They have weak absorption-ability, inadequate hydrophysical properties, saturated by soil-alkali grounds.

Irrigated meadow grey lands have been formed in the Ararat plateau areas at the altitude of 800-900 m: under the conditions of joint impact of the subsoil and surface wetting regimes, and a century-old human activity. The capacity of the Profile is 80-120 cm. They are characterized by high percentage of carbonates (3-7%) and low percentage of humus (1.5-2%) earthen and clay-sand mechanical composition. They are normally not saline, although there are areas that are weakly saline and alkali under the impact of mineralised groundwater. They possess adequate hydrophysical properties.

Palaeohydromorphic combined alkalised soils are located on the multi-colour clays met in the surrounding areas of the city of Yerevan. They are characterized by crevices, low capacity, mechanical clay composition, low percentage of humus (0.8-2.6%) and carbonates, alkalinity and plastered nature. They have extremely unfavourable hydro physical properties.

2. Dry steppe soils include only brown soils.

Brown soils are developed in the Ararat concave valley, in the plateaux of Vayk and Zangezur dry steppe zones at the altitude of 1250-1950 m, intermountain valleys and adjacent highland slopes. They are characterized by presence of a medium content of humus (2-4%), stoniness, extremely expressed alluvial-carbonate horizon, which is partly in a cemented state. They have weak basic reaction (pH=7.4-8.5), medium absorption volume saturated by salinated soils (30-35 mg/ekv) and unfavourable hydrophysical properties.

Table 4

Natural Land Zones and Soil Types*

Zones	Provinces/marzes	Soil types	Area		Altitude
			thou ha	%	ASL m
Semi-desert	Aragatsotn, Ararat, Armavir, Kotayk, Yerevan	Semi-desert grey, irrigated meadow grey, palaeo-hydromorphic, combined alkaline saline alkali	152 53 2 29	5.8 2.0 0.1 1.1	850-1250
Sub-total:			236	9.0	
Dry steppe	Ararat, Aragatsotn, Kotayk, Syunik, Vayots Dzor	Brown	242	9.2	1250-1950
Steppe	Aragatsotn, Ararat, Gegharkunik, Lori, Kotayk, Syunik, Vayots Dzor, Shirak,	Black-soil, meadow-black-soil, river-valley-plateau, land-subsoil	718 13 48 18	27.4 0.5 1.8 0.7	1300-2450
Sub-total:			797	30.4	
Forest	Ararat, Aragatsotn, Gegharkunik, Lori, Kotayk, Syunik, Tavush	Forest grey, turf-carbonate, chestnut	133 15 564	5.2 0.6 21.6	500-2400
Sub-total:			712	27.4	
Highland meadow	Ararat, Aragatsotn, Gegharkunik, Lori, Kotayk, Syunik, Vayots Dzor, Tavush	Highland- meadow, meadow-steppe	346 283	13.2 10.8	2200-4000
Sub-total:			629	24.0	
Total:			**2616**	**100**	

***) 358.3 thousand ha are the exits of root rocks, sands, waters, roads and other buildings.**

3. Steppe soils cover black-soil, meadow black-soil, river-valley-plateau soils and subsoil.

Black-soils are developed in the Ararat concave valley, Shirak highland, Lori steppe, Sevan basin, Zangezur plateau and comparatively mild steepness of the mountain slopes in the areas of 1300-2450 m altitude. They are characterised by different percentage of humus (3.5-12%), above-medium absorption-ability (35-55 mg/eq.), high aggregation, mainly neutral, sometimes weak acidic and weak basic reaction (pH=6.0-8.2), as well as with best indicators of material composition and hydrophysical properties. ***Meadow black-soils*** have been formed in the steppe zone within the limits of black-soil dispersion under surface and ground wetting conditions. They are basically spread in the Lori steppes, Shirak plateau and Sevan basin. They are quite close to deashed black soils, and unique hydrological conditions promote the considerable increase of humus (10-13%) and clay in lower stratums. They have weak acidic reaction, the amount of absorbed cations is up to 57 mg/eq.

River-valley-plateau soils have been formed in the river valleys and the coastal areas released from the Lake Sevan water. Arable lands, which have weak ground nutrition or it is nota long time they are deprived of ground nutrition, have weakly developed, mainly stony profile, rich in skeleton. Humus composition is from low to moderate (2-4%), neutral, sometimes with weak basic reaction (pH 6.9-8.1) and various volume of absorbsion (14-35 mg/ekv), where the percentage of absorbed magnesium is essential.

Subsoils have been formed in the Lake Sevan coastal areas as a result of depression of water table. They cover an essential area, characterize sand-clay subsoils and are characterized by mechanical sand-and-clay composition, and low humus percentage (0.3-0.5%).

4. Forest soils cover forest gray, turf-carbonate and forest brown land types.

Forest grey soils have been formed on the slopes in North-eastern Armenia at an altitude of 1800-2250 m.. They are characterized by earthiness as a result of alleviation. There is a high humus percentage (4.8%), an average absorption capacity, from weak to strong acid reaction(pH 4.6-5.9/ and favourable hydrophysical properties.

Forest turf-carbonate soils have been formed on average altitude in plicate mountains of Gugark, Hakhum, Bargushat on mother types rich in carbonate. of. They are characterized by considerable humus percentage (7.5-11%), on upper stratums neutral (pH 7.0-7.4/, and basic reactions in lower stratums /pH 7.8-8.5/, saturated with alkali soils with medium and above medium absorption capacity, clay and clay-and-sand mechanical composition.

Forest brown soils are spread over the Virahayots, Gegark, Pambak and Zangezur mountain ranges at an altitude of 500-1700 m, whereas in the sunny- side dry slopes -- in the areas of up to 2400 m height. Earthiness, considerable stoniness, mechanical clay-and-sand and clay composition, essential humus percentage (4-10%), and medium absorption capacity, as well as carbonate percentage, and adequate physical properties of the middle part of the profile characterize them.

5. Highland-meadow soils cover the highland-meadow and meadow- steppe types of soils.

Highland-meadow soils have been originated on the fragmented mountain slopes and plateaus spread in the area at the altitude above 2200-2600 m ASL, under cold and humid climatic conditions. They have high humus percentage (13-20%), light mechanical composition and fragile structure, absorption ability below medium (15-20 mg/ekv), acid reaction (pH 4.8-5.5) and favourable hydrophysical properties.

Meadow-steppe lands are available at an altitude of 1800-2600 m. They have comparatively high humus percentage (8-13%), neutral or weak acid reaction (pH 5.5-6.8) expanded absorption capacity, medium and low mechanical clay-and-sand composition and favourable hydrophysical properties.

1.5. Hydrology

Rivers. The Republic of Armenia is covered with a dense net of rivers. The network density coefficient is 0.8 km/km^2. Armenian rivers belong to the Caspian Sea basin. Basins of the tributaries of Kur River occupy an area of 700 km^2 (Debed, Pambak, Aghstev, Tavush, etc.), and basins of the tributaries of Arax river - an area of 22790 km^2 (Akhuryan, Kasakh, Metsamor, Hrazdan, Azat, Vedi, Arpa, Vorotan, etc.).

Armenia's rivers have mixed feeding - melting, groundwater, pluvial. Their flow is being considerably changed within a year. During summer-time and fall, when water demand is approaching its maximum, the annual water share amounts to 20-25%, in winter-time - 10-12% of the total flow, whereas in spring-time - some 55-70%.

Lakes. The Republic of Armenia is not rich in lakes. Sevan is the biggest lake in the Caucasus and Armenia. Its square amounts to 1240 km^2. The lake is located at the altitude of 1897 m above sea level. The rest of the lakes in the country (Kari, Akna, and Sev, and etc) are small and mostly located in the highland zones. Arpi and Parz lakes are located at a medium altitude highland zone. Lake Ayghr is a lowland lake fed by the underground waters.

Underground waters. Underground waters in the country are distributed unevenly. These are mostly presented in the form of springs, wetlands, groundwater flows (artesian waters and groundwater).

Springs - outflow only in definite sites by immediately originating river flows.

Wetlands - outflow into the surface of land trenches with extensive squares by frequently bogging up the area, which eventually originate flows, and outflow from the area.

Underground (deep) flows. Underground waters are those that flow away from the area without out flowing into the surface. The level of groundwater is changed for some 1 meter within a year . Underground waters are sometimes closely approaching the earth surface by originating wetlands. Some 1500 km2 area of wetlands and swamps are originated in the Ararat valley under the artesian water pressure and the Arax river floods. The wetlands have been dried out starting from 1953 to 1955 being transferred to agricultural lands. 80 km^2 of swamps have been dried out in the territory of Lake Gilli due to the reduction of lake's water level. Due to inoperative condition of drainage systems the groundwater level in the Ararat valley has been raised again, resulting in soil alkalinity and salinization.

1.6. Flora

Armenian flora has been formed influenced by different floras, summarizing peculiarities of the Caucasian mesophyll and Armenian-Iranian xerophily floras. Here in the northern hemisphere, in addition to the widely-spread plant species there are also endemic and relic species with a narrow and fragmented natural habitats, as well as wild relatives of cultivated plants.

Diversity of Sepsis. of the Armenian flora involves four category groups of taxonomic classification: algae, fungi, moss, and vascular plants.

Algae -- There are relatively few studies of algae in Armenia. The biodiversity of algae is represented by 143 species. . They basically belong to green, diatomic, yellow-and-green and blue-and-green algae.

Fungi - During the study of mycobiota in Armenia some 4200 species of fungi have been identified.

Microscopic fungi involve 125 species of peronosporales (class of *Peronosporales),* major part of which are extremely hazardous parasites that originate many diseases.

The 541 species of land micromycents identified in the republic are occupying an important place in mycobiota, of which the representatives of Fusarium sepsis are particularly spread.

Aquatic fungi, identified in the republic (some 200 species) compose a specific ecological group. The most spread are Achlya, Blastocladia, Anguillospora, Clavariopsis, Saprolegnia, Tetracladium, Trikladia and species of other genus.

Predator fungi (more than 25 species), based on land and vegetation residues, are taking a special place among the micromycents, of which the species of Arthrobotrys genus predominate.

Classification diversity of *macroscopic fungi* is represented by 1182 species on the territory of Armenia. The 284 species out of them are eatable and basically belong to farmers' fungi. The diversity of poisonous fungi amounts to 59 species, out of which the most hazardous for human health are: colourless toadstool (Amanita phalloides), sundrew panther's fungus (A. pantherina), false *Hypholoma fascicular* and *Inocybe* and a number of species of the genus of *Cortinarius.*

Mosses -- There are 290 species known to present in Armenia. The Lake Sevan basin inhabited by 190 species has been studied comprehensively.

Vascular plants - Cover the higher plants group, which includes some 3500 species (about 50% of the Caucasus flora).

Moss-like plants - There are 430 species in overall in the republic spread mainly in the medium mountainous and forest districts.

Bog moss in Armenia is represented by two species, including the major species of Selaginella Swiss (Selaginella Helvetica), which is found in northern Armenia's humid habitats of sub-Alpine meadows.

Horsetail-like plants are represented in Armenia by 6 species, which are spread in relatively humid forest and meadow districts' wetland river valleys, riverbanks, sometimes in sandy areas and bushes. Field, boggy and branchy horsetail-like plants are mainly spread.

Fern-like plants are represented in Armenia by 38 species, of which Cystopexies fragilis, Polyp odium vulgar, Athyrium filix, etc are very typical of Armenia. They are mostly spread in forest area.

Gymnospermae, in Armenia, are represented with extremely poor -- only 9 species. *Gymnospermous* trees found in the republic's decorative nurseries are mostly alien, introduced from other vegetation and geographic regions. The most valuable ones are cypress (5 species) and taxus.

Angiosperm (vegetated) plants' flora is notable by its luxuriant specific and diversity composition of some 3015 species.

Vegetation. Armenia's vegetation diversity is conditioned by availability of a complicated relief of the country's territory, speckled natural and climatic conditions, unique geographical location, peculiarities of natural environment within passed geological periods, and availability of landscape zones (Table 5).
The integrity of country's complicated cartography plicate mountain chains, intermountain concavities, plains and plateaus has a huge impact on flora.

Table 5

Characteristics of Vegetation Zones on the Territory of Armenia

Vegetation zone	Altitude above sea level (m)	Typical plant populations	Typical species
Desert-and-semi-desert	500-1200 (1400)	Halophyll, Gypsophila and psamophyll plants, oshinder-ephemeral, oshinder-cereal, oshider-ohsn and oshan	Salsola ericoides, Salsona cana, Calligonum poligonoides, Artemisia fragrans, Kochia prostrata, Teucrium polium, Poa bulbosa
Steppe	1200-2200	Pinnate-and-sprout grass, wheaten-and-thin, wheaten-and-sprout, barrbery grass, couch-grass, grass-and-wheaten shrubby, tragacanth	Stipa tirsa, S. capillata, S.lessingiana, S. puleherima, Festuca sulcata, Borthriochloa ischaemum
Forest	600-2200 (2400)	Broad-leaved deciduous forests with beech, oak-tree, arid sparse forests with coniferous, (junipers) and deciduous (pistachio-tree, snowball-tree, maple, pear-tree, almond-tree, etc.) species. Grass-and-cereal, narrow-leaved with sprout grass, wheat, butterfly-and-flower grass, cereals, sedge.	Fagus orientalis, Quercus macranthera, Q. iberica, Carpinus betulus, C. orientalis, Fraxinus exelsior, Pinus pallasiana, Platanus orientalis, Taxus baccata
Sub-alpine	2200-2800	Dry cereals (wheat, sprout grass, wheat-and-Koeleria, oats, gold oats, reed-and-grass multi-colored sprout grass, wet wheat-and-butterfly-and-flower, broad-leaved, grass, shrubby and high grass.	Hordeum violaceum, Poa alpina, Dactylis glomerata, Festuca gigantea, poa longifolia, Cephalaria armeniaca, Doronicum oblongilium
Alpine	2800-4000	Cereals-and-grass: wheat, sprout grass, Koeleria, alpine field sorrels, violet field sorrels, grass meadows, peat.	Campanula tridentata, Taraxacum stevenii, Plantago atrata, Festuca varia, Bromopsis variegata, Nardus stricta, Carex tristis

Endemic Species of Flora

From plant-and-geographical point of view Armenia is of a great interest for availability of endemic species. Endemic species of flora in Armenia amount to 106, which comprises only 3% of its overall diversity of species, and 1.5% of Caocasian flora (Table 6 and 7).

A direct link between the quantity of endemic species and the level of climate aridity is notable in Armenia. Southern and central arid areas in the country are the richest in endemic species.

Overwhelming majority of endemic species in Armenia are neo-endemics or other species formed in the Quaternary and even in Holocene periods.

The species of having a very small natural habitat are growing here, which beside Armenia have 1-2 habitats the adjacent parts of neighbouring countries. For example, highland decorative bellflower of Massalsky (Campanula massalsky) is growing on Armenia's territory only on the slope of Mount Arteni and in Turkey (one nidus) and Cousinia gigantolepis, which is growing in Zangezur and Northern Iran (sub-province of Atrpatakan). Beside, there are some 300 endemic species, which are typical of Armenian-Iranian floristic province, Armenian and Atrpatakan sub-provinces.

Table 6

Family-based Quantitative Distribution of Endemic Species

	Family	Number of species
1.	Asteraceae	26
2.	Rosaceae	24
3.	Scrophulariaceae	8
4.	Fabaceae	7
5.	Brassicaceae	6
6.	Caryophyllaceae	5
7.	Poaceae	4
8.	Boraginaceae	4
9.	Apiceae	3
10.	Grossulariaceae	2
11.	Limoniaceae	2
12.	Orobanchaceae	2
13.	Rubiaceae	2
14.	Campanulaceae	1
15.	Caprifoliaceae	1
16.	Dipsacaceae	1
17.	Euphobiaceae	1
18.	Geraniaceae	1
19.	Hypericaceae	1
20.	Liliaceae	1
21.	Linaceae	1
22.	Malvaceae	1
23.	Polygalaceae	1

Table 7

Quantitative Dispersion of Endemic Species of Flora in Armenia according to Floristic Districts and Vertical Zoning

Floristic districts	Zones				
	lower	Medium	upper	sub-alpine	alpine
Verin Akhuryan	-	2	4	1	-
Shirak	4	18	14	2	-
Aragats	-	4	5	4	4
Lori	1	5	4	2	-
Ijevan	4	16	14	7	3
Aparan	2	12	12	7	1
Sevan	2	16	20	8	2
Gegham	-	13	13	10	7
Yerevan	13	27	18	7	-
Daralagyaz	8	29	22	11	-
Zangezur	6	16	13	8	4
Meghri	2	14	13	6	3

1.7. Fauna

Fauna in the territory of Armenia passed a complicated and long course, which is proved by abundance of fossil materials. The current fauna was mainly formed in the tertiary period (Miocene), when the formation of current plants began and was accomplished with from invaded from the Mediterranean Region. Formation of fauna has been essentially affected by invasion of the Middle Asian deserts, Iranian dry-love species, Frigane, tugaian elements via the Caspian isthmus.

By occupying the north-eastern mountainous massif and being located on the most important way of the world bird migration, Armenia bears the impact of bird kingdoms of different geographic regions by making a cross-road where Asian and European bird representatives are being drown together or inhabit closely.

Species Diversity. Armenia is characterized by its fauna species diversity and endemic nature. There are some 17500 species of land invertebrate and vertebrate animals around the territory of Armenia. However, many species of the republic's fauna are inhabited here at the frontier of their distribution zones, isolated populations apart from the general natural habitat.

Invertebrates. The fauna of invertebrates covers some 1700 species (Table 8). 90% of them account for insects.

Table 8

Distribution of Quantitative Composition of Invertebrate Animals in Armenia Based on Category Groups

Category Groups		Number of species identified
Type	**Class**	
Mollusca		155
	Gastropoda	141
	Bivalvia	14
Arthropoda		16845
	Arachnida	some 2000
	Insecta	14845

Fishes. The 30 species of fish are found in Armenia's aquatic areas, which belong to:

1. Salmoniformes – 5 species
2. Cypriniformes – 22 species
3. Siluriformes – 1 specie
4. Cyprinoformes – 2 species

Amphibious - This class is represented in Armenia’s fauna by 8 species (Table 9). Lake frogs (Rana ridibunda) are most spread, green toad (Bufo viridis). Trans-caucasian frog (Rana macrocnemis) is found in the highland steppe zones. Shelkovnikov's tree frog (Hyla arborea shelkovnikovi) is found in the northern forest zone, and in the south - AsiaMinor's tree frog (H. savigni). The Syrian garlic frog (Pelobates syriacus) is found in the republic's territory, which is endangered species registered by the former USSR Red Book. A small population of triton (Triturus vittatus) has been recently found in the republic's northern part, being completely isolated from its major natural habitat.

Table 9

Diversity of Amphibious in Armenia

Family	Total number of species
Salamanders – *Salamandridae*	2
Toads - Bufonidae	1
Pelobatidae	1
Tree-frogs – *Hylidae*	2
Real frogs – *Ranidae*	2
Total	**8**

Reptiles. In terms of herpetology Armenia is the most interesting area out of the former USSR. Out of the 156 species found in the USSR 53 species (Table 10) inhabit in Armenia, most of which are registered in the Red Book of Armenia.

Table 10

Diversity of Reptiles

Grupps of Category	Total number of species
Land tortoises – *Testudinidae*	1
Lizards – *Sauria*	
Gekkonides – *Gekkonidae*	1
Agamides – *Agamidae*	2
Spindle-shaped snakes – *Anguidae*	2
Scincanes – *Scincidae*	4
Real lizards – *Lacertidae*	17
Snakes – *Serpentes*	
Blind young snakes – *Typhlopidae*	1
Dragons – *Boidae*	1
Colubridae	18
Vipers – *Viperidae*	4
Total	**53**

Birds. Geographic location of the republic, diversity of geological structure, land, climate and plants had been originally a prerequisite for the formation of bird kingdom and its diversity. The Armenian highland is, from one hand contiguous to ornitofauna of East Europe, and, from the other hand - to the one of Asia Minor and Mediterranean countries. This circumstance is mostly contributing to the diversity of the republic's bird kingdom, which amounts to more than 60% of vertebrate animals and is represented by 349 species (Table 11).

Table 11

Bird Diversity in Armenia

Category	Total number of species
Gaviformes	2
Podicipediformes	5
Pelecaniformes	4
Ciconiformes	13
Phoenicopteriformes	1
Falconiformes	35
Anseriformes	28
Galiformes	7
Gruiformes	13
Charadriiformes	62
Columbiformes	8
Cuculiformes	2
Strgiformes	7
Caprimulgiformes	1
Apodiformes	2
Coraciiformes	5
Piciformes	8
Passeriformes	146
Total	**349**

Mammals. - Mammals by their 83 species are placed on the second place after the birds among the vertebrate animals (Table 12).

Table 12

Diversity of Mammals in Armenia

Family	Total number of species
Erinaceidae	2
Talpidae	1
Soricidae	7
Rhinolophidae	5
Vespertilionidae	17
Mollossidae	1
Leporidae	1
Hystricidae	1
Capromyidae	1
Scinridae	2
Muscardinidae	2
Dipodidae	2
Zapodidae	1
Muridae	17
Spalacidae	1
Mustelidae	5
Ursidae	2
Hyaenidae	1
Canidae	3
Felidae	6
Suidae	1
Cervidae	2
Bovidae	2
Total	**83**

Expansion of Animal Kingdom in Armenia

Zoning, typical of Armenia, made its imprint not only on the formation of specific diversity of fauna, but also its geographic expansion. Each and every landscape zone is identified by its unique ecosystems and animal kingdom represented therein. Nevertheless, as opposed to the plant populations, animals in ecosystems of mentioned zones are not considered stable (static) components, since due to high mobility they usually have an extended inter-zone natural habitat of spreading. Many species may be spread in other landscape zones due to seasonal and other migrations, as well as high malleability.

These factors conditioned the rich diversity of vertical spreading of Armenia's animal kingdom (Tables 13, 14, 15).

Table 13

Landscape-based Expansion of Amphibious and Reptiles

Families	Total number	Number of species by landscapes							
		Semi-desert		Mountainous-and-steppe		Forest		Highland Meadow	
		r	e	r	e	r	e	r	e
Salamandridae	2		-	-	-	-	2	-	
Bufonidae	1	1	-	1	-	1	-	1	-
Pelobatidae	1	-	1	-	1	-	-	-	-
Hylidae	2	1	-	-	-	1	-	-	-
Ranidae	2	1	-	2	-	2	-	2	-
Emidadae	2	1	-	-	1	-	-	-	-
Testudinidae	1	-	1	-	1	-	-	-	-
Gekkonidae	1	-	1	-	-	-	-	-	-
Agamidae	2	1	1	1	-	1	-	-	-
Scincidae	2	1	-	1	1	2	-	-	-
Lacertidae	4	-	3	-	4	-	-	-	-
Typhlopidae	17	1	3	10	1	10	-	2	-
Boidae	1	1	-	-	-	-	-	-	-
Columbridae	1	-	1	-	1	-	1	-	-
Viperidae	4	-	1	-	2	-	2	-	2
Total	**61**	**14**	**20**	**21**	**15**	**23**	**8**	**9**	**4**

R - regular (not requiring priority held, satisfactory spread species), E - endangered (extinct, vulnerable, nearly eliminated species)

Table 14

Landscape-based Expansion of Birds

Family-based grouping	Total number	Number of species by landscapes									
		Semi-desert		Mountainous-and-steppe		Forests			Highland Meadows	Extrazonal Landscapes	
		r	e	r	e	r	e	r	e	r	e
Gaviiformes	2	-	-	-	-	-	-	-	-	1	1
Podicipediformes	5	-	-	-	-	-	-	-	-	4	1
Pelecaniformes	4	-	-	-	-	-	-	-	-	-	4
Ciconiformes	13	-	-	-	-	-	-	-	-	8	5
Phoenicopteriformes	1	-	-	-	-	-	-	-	-	-	1
Falconiformes	35	-	-	5	5	7	5	-	-	4	9
Anseriformes	28	-	-	-	-	-	-	-	-	16	12
Galiformes	7	-	1	2	-	-	-	-	2	1	1
Gruiformes	13	-	3	-	2	-	-	-	-	3	5
Charadriiformes	62	-	-	-	-	-	-	-	-	42	20
Columbiformes	8	1	1	-	-	3	-	-	-	3	-
Cuculiformes	2	-	-	-	-	-	-	-	-	1	1
Strigiformes	7	-	-	-	-	3	1	-	-	2	1
Caprimulgiformes	1	-	-	-	-	1	-		-	-	-
Apodiformes	2	-	-	-	-	-	-	-	-	2	-
Coraciiformes	5	2	1	-	-	-	1	-	-	1	-
Piciformes	8	-	-	-	-	2	4	-	-	2	-
Passeriformes	146	18	5	17	2	40	2	6	4	40	12
Total:	**349**	**21**	**11**	**24**	**9**	**56**	**13**	**6**	**6**	**130**	**73**

R - regular (not requiring priority held, satisfactory spread species), E - endangered (extinct, vulnerable, nearly eliminated species)

Table 15

Landscape-based Expansion of Vertebrates

Families	Total number of species	Number of species by landscapes									
		Semi-desert		Mountainous-and-steppe		Forest			Highland Meadow	Extrazonal Landscape	
		r	e	r	e	r	e	r	E	r	e
Hedgehog	2	-	2	-	1	1	-	-	-	-	1
Moles	1	-	-	-	1	1	-	-	1	-	-
Shrews	7	-	4	-	2	1	-	-	2	-	1
Horseshoe-shaped	5	-	2	1	-	1	-	-	-	-	5
Snubs	17	-	10	-	3	-	1	-	-	-	14
Bulldogs	1	-	-	-	-	-	1	-	-	-	1
Hares	1	-	1	1	-	1	-	-	1	-	-
Pigs	1	-	1	-	1	-	1	-	-	-	-
Nutrias	1	-	1	-	-	-	-	-	-	1	-
Rabbits	2	-	1	-	1	-	1	-	1	-	-
Dormouse	2	-	-	-	-	-	2	-	-	-	1
Jerboa	2	-	2	-	2	-	-	-	-	-	-
Zapodidae	1	-	-	-	1	-	-	-	-	-	-
Muridae	17	5	3	11	2	3	1	2	2	4	-
Spalocidae	1	-	1	-	1	-	-	-	1	-	-
Martens	5	1	4	1	4	3	1	1	-	-	1
Bears	2	-	-	-	-	2	1	1	-	1	-
Hyena	1	-	1	-	1	-	-	-	-	-	-
Canis	3	1	-	1	2	2	1	1	1	-	1
Felidae	6	2	1	1	2	1	3	-	1	-	-
Pigs	1	1	-	-	1	-	1	-	-	-	-
Deers	2	-	-	-	-	-	2	-	1	-	-
Hollow horned	2	-	-	-	2	-	1	-	1	-	-
Total	**83**	**10**	**34**	**16**	**27**	**16**	**17**	**5**	**12**	**6**	**25**

R - regular (not requiring priority held, satisfactory spread species), E - endangered (extinct, vulnerable, nearly eliminated or with unclear status species)

Endemic Species of *Fauna.* Study of invertebrates identified some 316 endemic species and above 100 rare and endangered species in Armenia.

The following should be mentioned out of these animals: Phytodrymadusa armenica, Nocarodes armenus, Olophrum aragatzense, Amphicoma eichleri, Cantharis araxicola, Totomyaza araxana, Bombilius schelkovnikovi, Shadinia akramowskii, Gabiella araxena and other species.

The majority of the 53 species of reptiles found in the country are endemic for the Armenian highland and Cuacasian fauna, such as: Triturus vittatus, Eremias arguta transcaucasica, Lacerta.armeniaca, L.unisexualis, L.dahli, L.rostombekovi widely spread in the northern parts of the country, and amphibious L. nairensis, Elaphehohenackeri, Rhinchocalamus satunini, Vipera raddei, Ablepharus chernovi.

There is no endemic species among the bird kingdom in Armenia. Nevertheless, several tens of semi-desert and alpine forms are involved in the groups equivalent to endemic ones and are classified as subject to extinction, vulnerable, eliminated, indefinite status and relict species.

Out of the 83 species of mammals 6 ones are endemic. They are the following: Ellodius lutescens, Meriones vinogradovi, Ovis ommon armeni, Allactaga williamsi, Sicista caucasica, Myotis nattereri araxen.

The following are typical samples of endemic species in Armenia:
Fishes - Salmo ischan Kessler, which is represented in Lake Sevan by 4 sub-species: S.ischan ischan Kessler, S.ischan gegarkuni Kessler, S.ischan danilewskii Jakowlew, S.ischan aestivalis Fortunatov,
- Rutilus schelkovnikovi,
- Alburnoides bipunctatus armeniensis
- Varicorhinus capoeta sevangi,
- Barbus lacerta goktschaicus,
- Blicca bjoerkna derjavini.

Reptiles - Lacerta unisexualis, Lacerta armenica, Lacerta nairensis, Lacerta dahli, Lacerta rostombekovi, Lacerta valentini, Eremias arguta transcaucasika, Vipera Darevsky, Vipera raddei.
Birds - Larius argentatus armeniacus, which have been found in the Lake Sevan basin and along Arx, Hrazdan and Akhuryan Rivers. It is considered as endemic equivalent.
Mammals - Ovis ammon gmelini.

CHAPTER 2.

SOCIO-ECONOMIC CONDITIONS AND NATURAL RESOURCES IN ARMENIA

2.1. Legislation in the Republic of Armenia

The state independence of the Republic of Armenia was declared on August 23, 1990, and on March 2, 1992Armenia became a UN member..
Coming out of the provisions of the Declaration "On Independence of the Republic of Armenia", the Supreme Soviet of RoA adopted a resolution on March 1991, "On Holding a Referendum in the Territory of Armenia" for coming out of the SU membership", according to which a referendum was held on September 21, 1991, and the majority of the population voted for

The Republic of Armenia is a sovereign, democratic, social, legal state. The people exercise its power by means of free elections, referenda, as well as state and local self-governance authorities and officials, envisaged by the Constitution, (RoA Constitution, Chapter 1, Article 1,2).

The RoA Constitution has been adopted on July 5, 1995. It radically reformed the territorial and administrative division in the republic of the soviet period and the overall system of governance.
It defines the basis of constitution, basic rights and freedoms of human and citizens, envisages ----------provisions in respect to President of the Republic, National Assembly of RoA, defines the structure of jury, the principles of its activity, as well as provisions of the principles of activities and the system of territorial administration and local self-governance bodies. The order for adoption of the Constitution, further changes and amendments in it, as well as transitional provisions are also defined.

Since adoption of the Declaration "On Independence of Armenia" a number of laws has been adopted in the Republic of Armenia, which might be grouped based on the span of relations, which can be classified in the following groups:

I. Laws of socio-economic nature regulating relations related to state pension security, invalids social security, insurance, public health care and services, refugee, repressed people, relations regarding the status and privileges veterans of the Great Patriotic War (the laws "On Pension Security of the RoA Citizens", On Insurance", "On Public Health Care and Services", "On Refugees", "On Repressed People", "On Veterans of the Great Patriotic War", "On the Minimum Monthly Salary", etc.).

II. Tax legislation regulating relations emerging in the tax field, particularly types of taxes, amounts of taxes, methods and terms of payment, tax privileges, relations connected with taxpayer's rights and obligations (laws "On Profit Tax", "On Value Added Tax", "On Excise Tax", "On Property Tax", On Taxes", etc.).

III. Judicial and legal laws regulating issues related to the status of judges, prosecutor's offices' employees, advocates, as well as relations emerging in the field of criminal procedure, civil procedure, particularly laws "On Judicial Structure", "On the Status of a Judge", "On Prosecutor's Office", etc.

IV. Legislation for regulation of relationship emerging from governing system, particularly, law "On Local Self-governance", RoA President Decrees "On State Governing in Provinces", "On State

Governing in the City of Yerevan", "On Identification of the Government Structure and Activity Order", "On the Central Bank", etc.

V. Legislation for regulation of relations emerging in the field of finances, particularly, laws "On Budgetary System", "On Financial Leveling", "On Banks and Banking Activity", "On the Central Bank", etc.

VI. Laws for regulation of relations emerging in the field of education, culture, particularly, laws "On Education", "On Protection and Use of Historic and Cultural Monuments and Historic Environment", etc.

VII. Laws for regulation of relations emerging in the field of defense, internal affairs and national security ("On Defense", "On Martial Law", "Population Protection under Emergency", etc.).

VIII. Laws for regulation of relationship emerging from human and civil rights. ("On Public Organizations", "On Child's Rights", "On Freedom of Conscience and Religious Organizations", etc.).

RoA Environmental legislation: According to the Article 10 of the RoA Constitution the state shall ensure environmental protection and reproduction, and wise use of natural resources.

It should be mentioned that until the adoption of the Constitution in 1995 the RoA Supreme Council had adopted "The Principles of Environmental Legislation in the Republic of Armenia" in 1991. This law for the first time has essentially identified the state policy principles in the field of environment.

"Principles of Environmental Legislation in the Republic of Armenia", laws "On Specially Protected Natural Areas", "On Atmospheric Air Protection", "On Environmental Impact Examination", "On Environmental and Nature-use Fees", "On Fauna", "On plants' protection and Carantine" "On Flora", and "On the Rates of Environmental Fees".

The following codes are acting in the Republic of Armenia: "Forest Code", "Water Code", "Land Code", "Code on the Interior".

There are also acting RoA laws which regulate individual environmental provisions, particularly law "On Local Self-governance" which envisages the competence of a community leader in the field of environment and nature protection, law "On Drugs", which regulates environment-related issues while elimination of expired drugs, the RoA law "On Energy", which regulates environmental issues related to the rules for energy sector, laws "On Urban Development", "On Budgetary System", "On Ensuring Sanitary and Epidemiological Safety for the RoA Population", "On Population Protection under Emergencies", "On State Agrarian Inspections".

As to the enforcement for violation of environmental requirements and standards envisaged by the Republic of Armenia legislation, it is regulated by individual articles of the "Republic of Armenia Civil Code", "Code on Administrative Offences", and "Criminal Code". Hence, offences against environmental protection are regulated by the RoA Civil Code chapter 11 on obtaining ownership right and chapter 13 on other property rights, chapter 26 on obligations and regulation of these obligations, numerous articles of chapter 60 on liability for damage indemnity. More than 40 articles of the RoA Code on Administrative Offences envisage enforcement instruments to comply with the requirements of legislation in the field of environment and nature-use.

Appropriate articles of chapter 6 of "Economic Crimes" of the RoA Criminal Code adequate sanctions are envisaged for violation of combating against plant diseases and pests, illegal fishing and other hunting or violation of their rules, illegal deforestation, depletion of young plants, violation of underground exploitation rules, cases of illegal circulation of hazardous and other wastes.

As to the by-laws in the field of environmental protection and nature use, then they are mainly represented by the RoA resolutions. Starting since September 1990 some 140 resolutions have been adopted to regulate relations emerging from forests, land, water, atmosphere, specially protected natural areas, bioresources and underground protection.

Departmental standard acts are an important part of the RoA environmental legislation. After adoption of resolution No. 13 "On Departmental Standard Acts Registration" various "instructions", "orders" (8 acts in all) have been adopted by the Ministry of Nature Protection and duly registered by the Ministry of Justice. These acts regulate relations emerging from commercial fishing, environmental and nature-use fees, special water use, geological survey of the underground and extraction of mineral resources.

The legislation ensuring environmental protection in the Republic of Armenia is being developed in the following directions of sustainable use of natural resources and nature conservation:

The RoA National Assembly has ratified 12 environmental conventions which are related to the issues of environmental impact assessment, biodiversity, climate change, air pollution, disposal of hazardous substances, ozone layer protection, combat desertification.

2.2. The Population and Settling Characteristics

Actions to combat desertification in Armenia are first of all conditioned by human factor and aimed at improvement of socio-economic situation in the country, increase in population living standards.

To attain the aim one should take into account country's demographic history, indices and characteristics of development and formation of population in provinces, urban and rural areas, as well as the overall settlements system. These factors are of a great importance in the conditions of land scarcity.

Population in the Republic of Armenia

The population in the Republic of Armenia as of 1 January 2000 amounted to 3803.4 thousand people, of which 2535.7 thousand people or 66.8% resided in the country's urban areas, whereas 1267.7 thousand people or 33.2% -- in the rural areas. 48.6% of the population was males, 51.4% -- females (last census has been carried out in 1989) (Tables 16 and 17).
The population in the Republic of Armenia is almost mono-ethnic -- 96% are Armenians, 4% -- Yezdies, Curds, Russians, Ukrainians, Assirians, Greeks and other ethnic minorities.

The Armenians are one of those nations the majority of which, as the fate decree, are living outside the country (some 5 mln Armenians are currently living in 66 countries).

Table 16

Population Number in Provinces

As of January 1, thousand of people

RoA Provinces	1996	1997	1998	1999	2000
Republic of Armenia	3766.4	3780.7	3791.2	3798.2	3803.4
Yerevan	1249.4	1250.0	1249.7	1248.7	1248.2
Aragatsotn	162.5	164.0	165.4	166.7	167.5
Ararat	305.0	307.8	309.0	310.0	310.8
Armavir	315.5	317.9	319.6	321.1	322.3
Gegharkunik	272.5	274.5	276.3	277.6	276.6
Lori	392.4	393.3	393.8	394.1	394.4
Kotayk	325.9	327.2	328.5	328.9	329.4
Shirak	358.3	359.4	360.8	361.8	362.3
Syunik	161.9	162.6	163.1	163.6	163.9
Vayots-Dzor	68.3	68.6	68.9	69.1	69.2
Tavush	154.8	155.4	156.1	156.6	156.8

Table 17

Distribution of the Permanent Population on an Age Group Basis in the RoA

As of January 1

	Thousand of people			Percentage from the total population number		
	1997	1998	1999	1997	1998	1999
Total population	3780.7	3791.2	3798.2	100	100	100
including: on an age basis						
years 0-14	1035	1003.9	966.1	27.4	26.5	25.4
15-64	2439.1	2466.8	2500.9	64.5	65.1	65.9
above 65	306.4	320.5	331.2	8.1	8.4	8.7
Total population number on an age basis						
below labor age	1107.9	1075.9	1040.2	29.3	28.4	27.4
labor age	2122.0	2184.3	2338.3	56.1	57.6	61.7
above labor age	550.8	531.0	419.7	14.6	14.0	11.0

Population in Urban Areas. Out of 48 towns/cities in the Republic of Armenia 45 (93.7%) are small (up to 50 thousand people) and medium (50-100 thousand people) towns/cities inhabited by 35.6% of the urban population (Table 18).

Table 18

Classification of Urban Settlements Population Based on Population Number

Settlements group thousand people	Settlements number	Population	
		thousand people	%
below 2	3	3.8	0.1
2-5	2	6.6	0.3
5-10	8	55.7	2.2
10-20	13	174.7	6.9
20-50	16	475.2	18.7
50-100	3	190.3	7.5
100-200	1	172.9	6.8
200-500	1	211.5	8.3
above 500	1	1249.7	49.2

The most populated towns/cities (having 100 thousand residents and above) are the following: Yerevan, Gyumri, Vanadzor inhabited by 1633 thousand people or 64.3% of the total population in the country.

The small towns are on the number-based first place -- 42 towns. On a population-number basis this group is on the second place -- 716 thousand people (average density: 14.7 thousand people) including: 16 town accommodating 20-50 thousand people and average population number is 13.4 thousand, towns inhabited by less than 10 thousand people (13 towns) and average population number of 5.1 thousand people.

Almost half (49.2%) of the urban population in the country is concentrated in the city of Yerevan, which is not favorable, both from the urban development and strategy point of view.

The other half of the population is distributed as below:

- big towns/cities (100-250 thousand people) - 15.1%
- medium towns/cities (50-100 thousand people) - 7.5%
- small towns/cities (below 50 thousand people) - 28.2%

Rural Population.

Villages inhabited by 1001-3000 people compose the major percentage (35.1%) of the rural communities in the country versus the smallest one of 4.1% of the communities inhabited by less than 100 people (excluding 10 non-populated communities, table 19). Population number therein amounts appropriately to 46.1 and 0.2% out of the total population number in rural areas.

The so-called large settlements inhabited by more than 3000 people are 96 in number. They are inhabited by some 37% of the total population in rural areas.

Based on the settlements dimensions the Province of Gegharkunik is on the first place where the 20 out of 87 are inhabited by more than 3000 people which amounts to 65% of the province's rural population.

This number in the Province of Kotayk amounts to 52%, in the Province of Ararat -- 38.8% in the Province of Armavir -- 35.3%. In the Province of Syunik there is no rural settlement inhabited by 3000 and above people. Similar settlements are small in number in the Provinces of Vayots Dzor (13.7%), Shirak (20.2%) and Lori (24.8%).

The average level of population density in the provincial settlements of Armenia amounts to 1324. As one can see, the average density data on a province basis vary within large limits. In the villages of the Province of Syunik, for instance, the average density amounts to 409 persons or by 5 times lower compared to the Province of Ararat (2080). This indicator is lower than the in-country average (1324 people) in the Provinces of Aragatsotn, Lori, Shirak, Syunik and Vayots Dzor, whereas it is higher in the Provinces of Ararat, Armavir, Kotayk, Gegharkunik.
There are 6 "super big" (inhabited by above 8000 people) rural settlements.

The analysis of the rural settlement population data shows extremely low density in the highland, borderland areas, particularly in the Provinces of Syunik and Vayots Dzor compared to the rest of regions in the country. It is mainly explained by the low socio-economic unfavorable conditions there and, as a result, an intensive migration to other areas (Table 20).

Table 19

Rural Population Quantitative Data

Rural communities based on population number	Provinces										
	Tavush	Armavir	Aragatsotn	Shirak	Ararat	Vayots Dzor	Kotayk	Gegharkunik	Syunik	Lori	Total
Uninhabited communities	-	1	-	-	-	-	-	3	6	-	10
inhabited by below 100 people (residents)	-	-	1	7	-	-	1	-	16	1	26
inhabited by 101-200 people (residents)	1	1	6	10	2	2	1	4	24	9	60
inhabited by 201-500 people (residents)	9	4	35	28	2	16	4	20	30	28	176
inhabited by 501-1000 people (residents)	15	12	35	32	14	8	13	16	19	21	185
inhabited by 1001-3000 people (residents)	24	62	27	34	56	14	27	26	11	38	318
inhabited by below 3001-5000 people (residents)	8	10	5	3	15	-	9	11	-	5	66
inhabited by 5001-10000 people (residents)	1	4	2	1	4	1	5	8	-	3	29
inhabited by above 10000 people (residents)	-	-	-	1	-	-	-	-	-	-	1
Total	58	94	111	116	93	41	60	87	106	105	871

Table 20

Major Indicators of Population Natural Movement

Provinces	Population number (thousand people)		Birth rate		Mortality		Natural growth		Infant (aged 1 year and lower) mortality	
	1998	**1999**	**1998**	**1999**	**1998**	**1999**	**1998**	**1999**	**1998**	**1999**
Total in the Republic of Armenia	3791.2	3798.2	43929	39366	23985	23210	19944	16156	678	580
Yerevan	1249.7	1248.7	12877	11610	8555	8241	4322	3269	231	205
Aragatsotn	165.4	166.7	2241	2130	961	949	1280	1181	34	25
Ararat	309.6	310.0	3613	3292	1753	1731	1860	1560	56	44
Armavir	319.6	321.1	4097	3481	1742	1679	2355	1802	55	42
Gegharkunik	276.3	277.6	3960	3395	1640	1505	2320	1890	58	52
Lori	393.8	394.1	4062	3804	2583	2525	1479	1279	57	54
Kotayk	328.5	328.9	3659	3145	1705	1608	1954	1537	47	52
Shirak	360.8	361.8	4456	3874	2363	2220	2093	1654	71	54
Syunik	163.1	163.6	2005	1930	1124	1098	881	832	20	17
Vayots-Dzor	68.9	69.1	906	743	416	381	490	362	12	7
Tavush	156.1	156.6	2053	1962	1143	1173	910	789	37	28

As the table shows within the recent years the birth rate (4563 people less) and natural population growth (3763 people less) declined in the country both in the capital city and all the provinces. The number of marriages has also decreased (1997 - 12521, 1998 - 11365).

Inter-state Migration and its Rationale

Inter-state migration at its unprecedented scope and consequences is the most significant event of the demographic processes in the modern times.

Until early 1980s Armenia benefited from the positive balance, i.e. population number in the country kept increasing not only due to natural growth but also at the account of migration flows.

Starting from 1980s a gradual growth of the emigrating population number was notable, which resulted in the deterioration of the migration flows proportions in favor of emigrating population. Some 10 thousand people started to leave Armenia every year (Table 21).

Table 21

Inter-state Migration of Population in Armenian in 1980-1987

Thousand people

Years	Incoming	Outgoing	Migration growth (+, -)
1980	38.6	47.0	-8.4
1982	39.7	47.3	-7.6
1984	45.3	56.3	-11.0
1986	54.9	66.6	-11.7
1987	60.3	70.7	-10.4

The years of 1989-1990 were an exception when the negative migration balance have been changed to a positive one due to the flow of refugees and forced migrants into Armenia.

The overwhelming majority 84.2% of the emigrants left for the Russian Federation, 8.8% -- to Ukraine, 1.9% -- to the United States.

There are 350 thousand refugees and equal categories in the country.

In-country Migration

The description of the in-country migration in Armenia was notable by population movement from a village to a city, which was resulted in a high enough level of population urbanization in Armenia. In early 1960s half of the population used to reside in the urban areas, and the other half -- in the rural areas. 30 years later the proportion between the urban and rural population equaled to 69 per cent and 31 per cent (Table 22).

A population movement from the highland settlements towards lowland areas used to be taking part, particularly to the Ararat valley, as well as a population flow from the borderland and remote countryside small settlements towards the republic's larger cities, particularly Yerevan.

Table 22

Urban and Rural Population Ratio in the RoA in 1990-1998

Years	Population percentage (percent)	
	Urban	***Rural***
1990	69.1	30.9
1991	69.5	30.5
1992	68.9	31.1
1993	68.1	31.9
1994	67.7	32.3
1995	67.5	32.5
1996	67.3	32.7
1997	67.0	33.0
1998	66.9	33.1
1999	66.6	33.4

As the table data show starting from 1992 the rural population ratio increased in the republic. It is an exceptional event in the Armenian demographic history in the 20th century, which is explained by the impact of two powerful socio-economic factors.

1. Decline of economy and industrial production, in particular, started in the transition period, many businesses, institutions and organizations were completely (or almost completely) shutdown resulted in labor market critical situation.
2. On January 22, 1991 the RoA Law "On Agricultural and Agricultural Collective Farms" has been adopted. The agricultural lands started to be privatized.

In similar situation part of the rural population lost its drive for residence in the republic's cities versus a great number of former village residents who resided in cities, considered it ecumenically reasonable and desirable to return to their home villages, to become landowners and establish their own farms.

Population Movement from the Borderland and Remote Backcountry Settlements to the Deeper Part of the Country and its Consequences

As a result of rapid development in Armenia within the recent 80 years an essential discrepancy risen between the central and backcountry districts. 2/3rds of the republic's population, most of the towns/cities, more than half of the labor resources are concentrated on the 20% of the so-called Central agglomeration (Yerevan and its influence zone). Meanwhile there is a constant outflow from the backcountry districts (Syunik, Tavush, etc.).

The analysis of socio-economic situation in the Armenia's borderland and backcountry settlements shows that the economic potential in these districts have essentially declined. The sown areas have

been decreased, subsidiaries of the businesses ceased to be operated. The fighting operations, natural disasters and physical and moral amortization caused inoperative or essential damage of economic infrastructures -- housing fund, facilities, roads, water pipelines, sewage systems. Due to non-reconstruction within the several years the socio-cultural objects are in an inoperative state.

In the settlements mentioned above a significant decrease of the population has taken place, decline in birth rate and youth outflow. The analysis of the factual data obtained from the provinces proves among those villages are 174 borderland and 138 highland communities. The number of the migrants therefrom within the recent decade amounted to some 72 thousand people.

2.3. Territorial Division, Settlements

According to the RoA Constitution administrative and territorial division and overall public administration system has been radically reformed in Armenia.

Before adoption of the RoA law "On Administrative and Territorial Division" (November 7, 1995) the territory of the Republic of Armenia has been divided into 37 regions. Since 1995 it is divided into 11 provinces (marzes) including the city of Yerevan having a status of province (Table 23). There are 48 cities and towns and 952 villages in the Republic of Armenia out of which 8 are part of urban communities, while the rest of the villages -- part of 871 rural communities.
The 10 out of the former urban-like settlements (Ani pemza, Azatamut, Aragats, Argel, Arzni, Ayrum, Gagarin, Nor Kharberd, Dzoraget, Pemzashen) have acquired a status of rural settlements, the 17, such as Agarak, Akhtala, Aparan, Berd, Dastakert, Yeghegnadzor, Talin, Tumnayan, Shamlugh, Chambarak, Maralik, Martuni, Masis, Neyemberyan, Vayk, Vardenis and Vedi -- a status of towns, while the town-like settlement of Nubarashen has become a district of the city of Yerevan.

Table 23

Provinces and Provincial Centers in Armenia

Province name	Area km^2	Provincial Centre	Distance from Yerevan (km)	Number of urban communities	Number of rural communities
City of Yerevan	227	Yerevan	-	12[x]	-
Aragatsotn	2753	Ashtarak	20	3	111
Ararat	2086	Artasahat	29	4	93
Armavir	1242	Armavir	48	3	94
Gegharkunik	5348[xx]	Gavar	98	5	87
Lori	3789	Vanadzor	120	8	105
Kotayk	2089	Hrazdan	50	7	60
Shirak	2681	Gyumri	116	3	116
Syunik	4506	Kapan	316	7	106
Vayots Dzor	2308	Yeghegnadzor	119	3	41
Tavush	2704	Ijevan	137	4	58

[x] **District communities**
[xx] **Including Lake Sevan**

Demographic and socio-economic characteristics: Formation and development of the overall settling system on the territories of cities, as well as country are conditioned by:

- peculiarities and traditions of historical development;
- the level of economic development;
- economic and territorial development policy conducted in the country;
- prevailing production orientation of population residing in a certain settlement;
- Military purposes.

Given the real conditions, purposeful and functional significance of the areas, as well as location of settlements and profile of the areas in the Republic of Armenia the following might be distinguished:

The Capital City of Yerevan. State governance bodies of republic-wide significance, mostly important cultural and educational institutions are concentrated here. An estimated evaluation of the people engaged in the registered economy sector (under the conditions of concealed unemployment and self-employment) is above 60 per cent.

Provincial Centres. These are multi-functional big, medium, sometimes small towns/cities, where the territorial governance bodies of province-wide significance are concentrated. As a rule the ratio of able-bodied population employed in the field of transport, industry, construction and other non-agricultural sectors amounts to some 50 per cent.

Communal Centres. High development of organizational-and-trading, economic, administrative-and-cultural functions of local-wide significance are typical to these settlements. Communal Centres that are towns are, as a rule, administrative and servicing centres of region-wide significance.

Resort (Cultural) Settlements. Until 1990 annual number of resting people in these settlements, as a rule, amounted to some 50 per cent of the permanent population. The number of population employed in the fields of industrial production and transport is relatively lower, meanwhile the number of people employed in the health care sector is high enough (above 10 per cent).

Limited land resources in the country have a definite impact on the territorial and settlements development.

An essential number of towns/cities have almost exhausted or already exhausted land resources allocated to them and, consequently, possibilities for further development. The most important ones among them with the above than 90 per cent of built-up areas are Aratashat, 98.9, Armavir, 94.9, Artik, 93.3, Ashtarak, 93.1, Sevan, 90.9, Tashir, 91.7, Echmiadzin, 91.2 per cent, etc.

The built-up part of the city of Yerevan amounts to 15885 ha, or 80 per cent of the total land area, which is also a serious cause for concern.

Analysis of the characteristics typical to the status of settlements and other functional areas in the RoA on the basis of urban development and economic appropriation level presumes the following division of the area of the Republic of Armenia to the following zones:
- intensively appropriated - slightly appropriated - recreation and environmental
- unfavorable for settling.

Intensively appropriated zones include the city of Yerevan, flat parts of the Kotayk, Aragatsotn, Armavir, Ararat, provinces, valleys of the Hrazdan, Kasakh rivers, the central flat part of Shirak Province --, in the Province of Gegharkunik -- coastal zone of Lake Sevan, in the Province of Lori -- valleys of the Tashir, Dzoraget, Pambak rivers, in the Province of Vayots Dzor -- narrow valleys of the Arpa river, in the Province of Syunik -- valley of the Vararak river, narrow valleys of the Vorotan, Vokhchi, Meghri rivers. These zones amount to 24.3 per cent of the RoA territory, where 88.0 per cent of the population is concentrated (99.2 per cent of the urban population), population density amounts to 400-553 people/km^2.

Slightly appropriated zones cover mainly the mountainous slopes adjacent to the intensively appropriated zones up to 2000 m of altitude. The slightly appropriated zones in the RoA amount to 33.4 per cent, where only 12.0 per cent of the population is residing, population density fluctuates between 22 and 82 people/km^2.

Recreation and environmental zones are the forests, specially protected natural areas, areas of recreation significance.

Unfavorable for settling zone covers areas above 2100 meters (39% of the territory of the country).

The Problems in the High Mountainous and Boundary Settlements in the RoA. The list of settlements located in mountainous and high mountainous conditions involves 13 urban and 363 rural settlements, including on the basis of altitude zones:

- 1700-2000 m – 8 towns/cities and 202 villages
- 2000-3000 m - 5 towns/cities and 161 villages.

The number of boundary settlements amounts to 487.
The length of the RoA boundary is 1448km, including:

- with Georgia - 196 km
- with Azerbaijan - 930 km
- with Turkey - 280 km
- with Iran - 42 km.

Within the recent decade a considerable decline of economic potential and social infrastructures has taken place in the 138 high mountainous and 174 boundary communities out of the mentioned high mountainous and boundary settlements.

This is conditioned not only by transition difficulties, which is typical to all the states formed after the collapse of former USSR, but also peculiarities in the Republic of Armenia, such as many blockades, earthquake consequences, immigration, etc.

A serious damage to the housing fund has been imposed due to the military actions and natural calamities. More than 1500 dwelling houses have been damaged or destroyed. The number of people not provided with apartments and dwelling houses amounts to 13643 people, or 24.7 per cent of the populations in the settlements of the same category, including 7693 - in the Province of Gegharkunik, 3478 - in the Province of Tavush, 610 - in the Province of Syunik, 313 - in the Province of Shirak, 85 families - in the Province of Lori.

The 53 out of these settlements have no drinking water pipes, while 147 water pipes are out of order and are in an acute need for capital repairing. About 148 buildings of community schools failed to be repaired during the last decade, while 15 villages lack any school buildings.

The network of inter-community and inner-community roads of total length of 9.5 thousand kilometers in 161 communities is in an obsolete state.

93 villages are free from elementary medical care services. No telephone communication services are available in more than 110 villages. More than 90 villages lack any objects of culture.
Land plots in boundary and high mountainous areas are used incompletely due to inadequacy of equipment, fact of mine-strewn agricultural lands, lack of irrigation water, seeds and a number of other reasons.

All these facts taken separately and in general are predetermining the continuos attempts of the population to leave those areas and further desertification of these areas.

2.4 General Trends of Economic Development

The processes aimed at introducing liberal market economic relations made a significant impact on economic development in the country within 1990-1999. A rapid drop in GDP output (above 53%) has been registered in 1990-1994 and it showed up growth only in 1994. The biggest drop in GDP production has been registered in 1992 (42 percentage points), which exceeded by more than 6 times similar indicator in the CIS. The 1999 GDP level approached only 60% of the 1990 GDP level (Table 24).

In 2000 GDP per capita amounted to AMD 293.7 thousand and raised compared to 1999 by 10.1%, whereas within the same period of time the US$ exchange rate raised by 1.2%, which meant that GDP per capita amounted to 554.0 versus US$ 500.9 in 1999.

The economy showed up recovery since 1994. GDP growth in the country has been mostly ensured due to change of products and services output in the following five basic economic sectors (industry, agriculture, construction, trade, transportation), which in 2000 ensured above 80% of GDP output (Table 25).

Table 24

	Ruble				**Dram (AMD)**						
	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
GDP in actual prices, bln	10.1	16	62.5	853.1	187.1	522.3	660.3	798.5	951.9	989.1	103.2
mln US$			323.7	492.2	643.3	1286.5	1957	1600.8	1885.4	1855.7	194.6
GDP growth rate compared to previous year, percentage	94.5	88.3	58.2	91.2	105.4	106.9	105.8	103.1	107.2	103.1	106.4
GDP per capita, thousand			17	228.6	49.9	138.9	175	210.9	250.9	267.3	293.7
US$			**87.8**	**131.9**	**171.7**	**342.2**	**423.2**	**422.8**	**496.9**	**500.9**	**554.0**

Table 25

GDP Growth Rate Based on Basic Sectors

(percent)

	1991	1992	1993	1994	1995	1996	1997	1998	1999
Total GDP	88.3	58.2	91.2	105.4	106.9	105.8	103.1	107.2	103.1
Industry	96	40.3	108.8	115.2	102.6	101.6	101.1	97.4	105.2
Agriculture	98	91.3	94.2	105.8	104	102	96.1	113.1	101.3
Construction	75.6	14.7	79.7	91.6	94.2	130.6	101.4	111	100.4
Trade	79.4	31.4	86.7	111.2	173	112.5	105.2	106.1	107.7
Transportation	79.2	42	30.2	94.3	109.6	102.8	110.2	108	81.3

During the formation period of liberal economy conditions that lead to domination in the country were formed of the private sector in the economy. Since March 1995, privatization of enterprises

has started through open joint stocking sine 1995. It was the major type of privatization of enterprises.

The private sector development dynamics within the period of formation of liberal economic relations in the country is characterized below (Table 26).

Table 26

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Total GDP, %	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Specific gravity of private sector in GDP composition, %	11.7	32.7	36.7	46.2	49.7	51.7	63.3	67.9	74.5	79

Private sector portion in the filed of agriculture and trade amounted to appropriately: 98% and 97%.

Some institutional movements have taken place in formation of the sources of capital investments to cover significantly more resources of state budget and population. It should be also noted that the scope of foreign investments has been rapidly decreased among the capital investments. The decline of specific weight of foreign investments in the scope of capital construction is conditioned by the reduction of loans, by 3 times, received through state governance system. Starting from 1974, Armenia used to be an importing country -- generated national income used to fully satisfy in-country needs, and the difference in accounts with the rest of the republics used to be positive. Since 1988 the republic has been consuming more than producing.

Due to the 1988 disastrous earthquake the republic lost more that 1.5 bln Rubles of national income, which resulted in exceeding by 14% in consumption of reserves versus national income.

Starting from 1994 a sustainable growth of output has been registered in the country by simultaneous growth of individual business resulted in average living standard growth among the population.

Within the recent years the trend of RoA's foreign trade has been shifted from the CIS countries to other countries. If in 1993 foreign trade carried out with other countries amounted to 28%, then in 1999 it amounted to 79,6%. Whereas, exportation scope to the CIS countries decreased by some 2 times as opposed to 3 times increase of the importation scope.

Although a 101.4% industrial growth has been recorded in 2000, however compared to 1990 a notable recession in production took place in the whole country and its individual sectors. It was particularly big in 1992 when production volumes used to be decreased by some 2 times compared to the previous year. This had its objective and subjective reasons, such as:

- blockade of the railway,
- break-off of economic relations among the enterprises after the collapse of the USSR,
- a severe energy crisis in the country that resulted in forced outage of many enterprises.

Significant reforms in banking system and liberalization of financial system started in the country in 1994. However, a financial crisis started in Russia in August 1998 made a significant impact to the economics in the republic, which was resulted in recession in the rate of industrial production volumes and the scope of exportation of goods. It definitely influenced financial activity of the business entities in the country, which within recent two years acquired a trend for stability.

On the edge of end 1990 and beginning 1991 wholesale, retail and purchase prices were increased, setting free and new tariffs for transportation and communication services were applied. However, these changes failed to overcome cost-recovery mechanism for price-formation. Total index for tariffs of goods and services rendered for public at consuming market in 1991 versus 1990 amounted to 274.1%.

Deepening of the energy crisis, which became more acute in November-December 1992 were resulted in recession in all the sectors of economy.

The year of 1993 was the year of monetary reform, which made its critical impact on a rapid growth of consumer lines prices and services tariffs, as well as on the growth of inflation rate. In the course of 1993 an unprecedented growth of prices and tariffs index by 110 times took place.

In 1996 under the conditions of strengthening of liberalized economic relations a definitely stable price level was established in the republic. An outstanding example of the latter was the fact that a significant inflation of ruble in Russia in 1998 failed to significantly influence the consumer lines prices and services tariffs. In December 1998 compared to 1997 a deflation phenomenon were noted -- Inflation Price Index decreased by 1.3%. The IPI amounted to 100.4% in 2000, which is 1.6% less than last year's same index (102.0% in 1999).
Privatization of collective farms has been initiated in the republic since 1991 to be continued to present. As of January 1, 1999 350 thousand agricultural farms and agricultural collective farms have been formed based on some 1000 former collective farms, soviet farms inter-farm and other agricultural companies. The newly established farms have provided with 447,000 ha of agricultural lands, which is 64.1% of the agricultural lands (excluding pastures) available in the country.

Recession in gross agricultural production ceased in 1994. In 1999 gross agricultural production amounted to the 98% level of 1991. Gross agricultural product as compared to the previous year decreased by 2.5% caused by reduction of production rate in plant growing due to the draught. The 74% of specific gravity of private sector in the gross agricultural production amounted in 1991 increased to 99% in 1999.

After privatization areas under agricultural crops used to decrease by more than 20%. Within that period acreage under wheat increased by more than 30%, whereas areas under potato -- by some 43%. The major part of areas under agricultural crops has been generally decreased at the account of forage plants, the acreage of which decreased by more than 3 times in 1998 compared to 1991 by amounting to 69,200 ha in 1998 versus 213,000 ha -- in 1991. Such decrease of areas under forage crops served a major reason for recession in the cattle breeding sector.

Big institutional changes occurring in the economy made their influence on the operation of transport. Since 1992 the volume of cargo transpiration handled by transport of general use rapidly decreased. Since 1993 the trend for decrease of cargo transportation volumes has been slowed down due to rapid increase of air transportation mainly caused by a rapid growth of cargo volume imported by foreign philanthropists. Thus, cargo transported by air in 1993 was by 2.8 times more than in 1992 due to railway transport blockade. The volume of cargo imported to the republic by air transport within the same period increased by 2.2 times. However, 128 thousand tones of cargo were delivered by air transport and gradually decreased by approaching only 16 thousand tones of cargo in 2000. Decrease of air cargo transportation volumes is explained by an essential increase of the tariff for transportation of 1 tone of cargo by air transport and decrease of cargo imported by foreign philanthropists.

Since 1992 railway blockade made a negative impact to the railway operation. Therefore, the volume of railway cargo transportation amounted to 29.1 mln tones in 1991, and it amounted to 7.5 mln tones in 1992 by decreasing by 4 times compared to 1991. The 2000 indicator amounted to 20% of the 1992 level.

Within 1991-2000 communication services have been rapidly decreased. In 1992 long-distance and international telephone services has been increased by 6.5% compared to 1991. Same indicator in 1993-1995 decreased compared to 1992 due to energy crisis, failure of telephone stations. However, thanks to further technical reformation it keeps to be raising -- by 3.3 in 1998 compared to 1995.

2.5. Social Security Issues

Exiting setting of population social security. Population's living standard has been declined under the existing situation of transition from a centralized planned economy to a market economy. The population is split into polar shares based on the income rate, the majority of population has become extremely poor. Unemployment rate, as well as number of employees under forced outage and non-reimbursable leave, migration rate are being increased. Population reproduction has been declined.

There is an extremely limited possibility for formation and establishment of effective relations that are typical to developed countries under the conditions of inadequate rate of growth of individual sectors, gross domestic product, national income and slow growth of the state budget revenues, existence of expanded scope of shadow economy.

Existing system of provision of pensions is funded on the basis of generation solidarity principles, which means that pension rates are due to insurance contributions made by employees.

Existing number of contributors to the system of pensions is slightly above the number of pension-receivers which causes serious problems for timely payment and increase of the pensions.

If under former planned economy compulsory insurance contributions used to be sufficient to secure high ratio of average salary and average pension rates, then under existing phase of a transition to market economy reduction of the share of legal economy and expansion of the scope of shadow economy resulted in decrease of the taxation basis to provide compulsory insurance contributions.

Resolution of the issues of socially vulnerable groups of population, particularly disabled and aged people has acquired a particular significance under the transition period.

Living standards of disabled people are lower than average population's in the republic.

Social policy aimed at disabled people is mostly structured on the basis of direct monetary contributions -- pensions, allowances, and monetary reimbursements instead of privileges. Similar approach does not take into account the possibilities of preservation of independent vital activity of the disabled people, their abilities and needs. It fails to orient the society and disabled people towards personal development and use of potential. It fails to contribute to their integration within the society.

Medical and social rehabilitation including actions aimed at person's medical, employment, psychological and social rehabilitation is of an extremely importance of social security service for disabled people.
During the development and implementation of social security strategy a specific attention is required for the children fallen into the risk group: particularly vagrant children and those deprived of parents'

Families lead by female-mothers are primarily subject to poverty among the most socially vulnerable groups. The number of similar families in the country is some 55 thousand taking care of 64 thousand children. Out of them: 23841 (38%) are the children of single mothers, 11124 (17%) -- of divorced people, 28831 (45%) -- of families lost their male bread-winners. Among others this is another reason for the majority of children cared in the orphanages to be the children of incomplete families.

The number of operating kinder gardens in the republic is 5 under the Ministry of Social Security, 2 under the Ministry of Education and Science, 1 under the Gjumry's mayors office, and 3 non governmental, where about 1000 children are brought up.

Within the recent years there has been observed a growth trend of delivery to the asylums of children having in total two parents, which is caused by the fact that the families had appeared to be in heavy social conditions. In case of failure to implement purposeful preventive programmes this trend may be transformed into a social regularity.

At present the major part of the socially vulnerable population in the republic are the aged people, which is a sufficiently large number. People aged above 60 years amount to 20% of the total population in the country, while 10% of the latter are single persons in need of social support and service.

Growth of aged people among the population depends upon the emigration of the able-bodied part of the population -- youth, which is also a consequence of unfavorable socio-economic situation (low pension and welfare, lack of employment, etc.).

There are two citizen apartments operating in the republic's social security system to take care of 450 pensioners. There is a large number of people willing to settle down at the citizen apartments .

In addition to stationary form of social care there is a department of home services for aged people operating in the pensioners' services centre. Its employees serve more than 900 pensioners living in the city of Yerevan. On August 1, 1998 new home services were established, such as medical, legal, psychological, as well as a confidence telephone.

There is privilege of free medical aid under the state order for individual groups of population including invalids, the World War II veterans and others, which also fails to be fully performed.

There are some 20000 veterans of World War II living in the country, including 9000 disabled veterans having the same problems as the aged people and invalids.

Unemployment in the country. There is a tense situation around the population employment. There is a continued deepening of discrepancy between the supply and demand in the labour market. The situation is not affected by the small and medium business development so far. Non-repayable financial means granted to an unemployed to encourage self-employment, re-training of

occupations of highest demand in the economy, supplementary guarantees provided to the invalids are not yet resulted in expected outcomes.

According to other estimations the number of real number of unemployed by about 2 times exceeds the number of those who are registered. It is difficult to estimate the number of unemployed among the rural population, because they are considered as employed due to land privatization.

The 94.8% of the unemployed population is concentrated in the urban settlements, including 27.9% -- in Yerevan, 17.2% -- in Gyumri and 8.8% -- in Vanadzor.

There is a continued high unemployment rate among refugees. Studies of the State Service for Labour and Employment prove that unemployment rate among the refugees is higher than the average rate of registered unemployed.

National and regional employment programmes. State policy Employment programmes in the republic and separate provinces/marzes have the following trends:
a/ elaboration of instruments to encourage small and medium enterprises and businesses,
b/ provision of financial support unemployed people to establish private business and to secure self-employment,
c/ providing employment for citizens and refugees non-competitive in the labour market; ,
d/ provision of extension and training programs to unemployed people according to the demands of economy, establishment of training centres,
e/ involvement of refugees in the preparation and implementation of active employment policy programmes,
f/ organization of paid volunteer works.

Analysis of Inter-relation between the Rural and Urban Families Poverty and Environmental Issues. Analysis of anthropogenic factors that contribute to the desertification shows that there is a direct relationship between desertification and heavy socio-economic situation in the republic related to formation of market and new economic relations, as well as population impoverishment caused by demographic processes.

After land privatization there are currently some 350 thousand farms. It caused absolutely new socio-economic and legal conditions, which under absence of appropriate environmental measures contributed to the privatized lands degradation and fertility abatement.

Absence of any preparatory phase for privatization, i.e. no ensuring small farm formation, training of peculiarities of land use and cattle-breeding, small agricultural machinery, no definite action programmes for revaluation of land cadaster land quality conservation and improvement, resulted in impoverishment of rural population. As a result ageing of rural population has been also observed, as well as discrepancy of female and male population quantity related to large-scale flows of migration to major cities in the republic and overseas of the economically active population (basically males), particularly young labour force. This fact causes a difficult problem both for implementation of social programmes and those to efficiently combat desertification.

A lot of organizations have conducted qualitative and quantitative assessment on population's poverty, however the biggest and comprehensive ones are were the surveys of the World Bank and National Statistical Service fulfilled in 1996 and 1999. While selecting the assessment indicators of welfare for the survey the priority was given to more stable and reliable data used in international practice.

As a rule the population tends to hide its revenues, then consumption indicators, which include the price of consumed food, (purchased, grown and prepared in own farms, received as a present or as a salary in the form of food), the price of procured industrial products and services. There is no official consumption rate in the republic, which can serve as poverty line. A concept of "A poverty food and general line" is used for the definition of poverty line. For the determination of food line the price of food consumption against actual consumed food per person (according to UN WFP for not wealthy countries it will satisfy about 2100 K.K.) is considered. The general poverty line was defined by actual consumption rate, which is the price of consumed food multiplied with the coefficient of expenditures for goods and services. According to these survey data, no changes has been in the poverty during these years, specific gravity of poor population (relative poverty) was grown by 0.35% (general poverty line), specific gravity (with 5 percentage point,: 28-23%).

The view of poverty in Armenia obtained from the overall survey is the following.:

Table 27

	Households			**Population**		
	Total	City	Village	Total	City	Village
Not poor	50.33	47.39	54.86	44.95	41.73	49.24
Poor	30.53	33.03	26.69	32.14	35.10	28.21
Extremely poor	19.14	19.58	18.45	22.91	23.17	22.55

It is obvious that urban population is more subject to poverty than rural is. This is explained by the unequal conditions of rural population. Their activities and economic conditions depend on elevation of rural settlements.
Rural settlements are divided into three levels of height:

I level –up to 1300 sea level, where 39% of rural population is settled,
II level-from 1301 to 1700m, 26% of population,
III level-1701m, 35%.
The living standards of rural population, according to the location of communities, are presented below.

Table 28

	I level	**II level**	**III level**	**Total**
Poors	42.35	54.39	57.99	50.76
Extrimly poors	16.37	24.86	28.28	22.55

More favorable and efficient conditions for agricultural development, and consequently for living conditions of rural population are priority issues. Depending on the altitude of the laceration of the community the living standards are decreasing. In the poverty programme adopted by the Republic of Armenia is based upon the principle of social justice as the foundation for state social support policy, while the principle of addressing system -- for the allocation. Starting from January 1, 1999 family benefit system has been established (involving more that 1 mln people), which substituted former state welfare system, which used to cover some 300 thousand children of 26 groups, as well as 170 thousand citizens who were compensated against privileges.

The government of the Republic of Armenia has allocated an amount of 21.15 bln Armenian Drams (AMD) (about US$40 mln) to execute the payments under family benefit system aimed at poverty alleviation by providing about AMD 7500 per each family, which is essentially exceeding the resources allocated to the former state welfare system. The allocated amount in the state

budget in consequent years was reduced gradually and an amount of 19 bln AMD was allocated in 2000, in 2001-17 bln. Besides the estimated amount for 2002 is also reduced.

The "Paros" system (formerly used for distribution of humanitarian aid) has been set within the family benefit system as an instrument for neediness assessment by prior improvement of both data collection tools and testing methods, and procedure for neediness assessment.

State policy for poverty alleviation policy within the recent years included continuity of humanitarian food and fuel –energetic relief projects as well.

2.6. Industry

History of Industry Development and Major Trends.

Before 1920s major products of Armenia's economy used to be generated from agriculture. The industry used to be represented by few isolated enterprises.

Armenia is one of the industrially backward countries in the world.

Since 1920s Armenia underwent an essential activity in industrial development. As energy-consuming chemical and metallurgical sectors of industry were developed in Armenia. The following large enterprises, factories and complexes were established to produce calcium carbide, caustic soda, chlorine, hydrochloric acid, chloroprene rubber and latex, nitrogen fertilizers, glass, chemical fiber and plastic.

The capital city of Yerevan, Vanadzor became large centres of chemical industry. Chemical factories have been established in Alaverdi, Echmiadzin and Sevan.

Large enterprises of mining chemistry, mining, and metallurgy were established in Alaverdi and Zangezur.

The non-ferrous metallurgy in Armenia became one of the major trends. The ferrous metallurgy started to be developed in Armenia in 1970s. Yerevan clean ferrous, Charentsavan "Central Fusion" plants were established. Having an old history of non-ferrous metallurgy, Armenia became one of the most important republics in the USSR. Since 1980s Armenia has been importing big quantities of chemical and non-ferrous metallurgy, such as synthetic rubber, carbonates (acetic acid, formic acid, propion acid) molybdenum and copper concentrates, vehicle tires, etc.

Thanks to availability of highly qualified staff and adequate raw material less metal-consuming and more labour-consuming machine-building, electric engineering were developed in Armenia. Radio electronic and electronic industries were developed in a particularly rapid rates. Mathematical machinery, mobile electric plants, electric generators for alternating power, and wires, cables, electric valves, chandeliers and luminaries, various electric measuring instruments, automobiles, autoloaders, etc.

Machine-building specialized on boring, milling, grinding, metal-cutting, stone-processing and other machine-tools construction. The number of enterprises involved in production of compressors and pumps, pressers, carpentry, clocks and watches, precision machinery stones,

artificial corundum, instrumental artificial diamond, jeweler's diamond making was increasing. There was a wide network of workplaces for population.

Major centres of electric engineering and machine-building industries were Yerevan, Gyumri, Vanadzor, Armavir, Charentsavan, Stepanavan, Gavar, Echmiadzin and Dilijan.

The constructional materials industry has been developed based on various-type construction materials in Armenia.

Armenia produces such construction materials as multi-coloured tuff, granite, basalt, marble, etc. In addition to being a construction material, Armenian pumice-stone is used in different sectors of industry as grinding material, filter, etc.

Glass, china, refractory brick production (Tumanyan, Yerevan, Byureghavan, Armavir, Arzni) has become widely developed.

Light industry has a significant specific gravity by producing, particularly, cotton, wool fabric and silks, knitted goods, socks, cloths, shoes, leather fancy goods, carpets and other consumer lines at more than 70 large enterprises.

Food industry is also a developed branch in Armenia. Its products are diverse: meat and diary products, wine, brandy, beer, mineral waters -- "Jermuk", "Arzni", "Dilijan", "Hankavan", "Sevan" -- canned fruits and vegetables, cigars, cigarettes, confections. Essential oil (geranium) manufacturing has been established.

Within the recent decade after the collapse of the USSR and based on comprehensive crisis Armenian industry suffered from a deep recession, a number of large and small enterprises were shutdown. Those enterprises suffered particularly severe, which used to import raw material from foreign countries by railway, as well as those ones, the products of which supplemented or were a part of the enterprises' production complexes of the former USSR republics and Russian Federation area. Migration of an essential part of the population from Armenia has created a prerequisite for desertification of areas. A comprehensive unemployment makes its deep trail on the map of Armenia by contributing to the expansion of desertification.

Volumes of the Use of Natural Resources in the Field of Industry, Non-ferrous metallurgy, industrial chemistry and construction materials industry are the branches that use non-renewable natural resources. .

In 2000 the non-ferrous metallurgy includes the copper and molybdenum, black copper, ferousmolibdenium production, aluminum processing and gold enterprises. Kajaran and Agarak mines enrichment enterprises for copper and molybdenum operate in Armenia, which produce copper and molybdenum concentrates. On the basis of Kapan copper mines a Kapan enrichment plant is operating.

Manufacturing of aluminum in Armenia was shutdown in 1984 to ensure clean air basin in Yerevan. At present there are only re-processing shops based on imported aluminum to produce various foil and aluminum constructional profiles.

The Alaverdi copper chemical factory has been shutdown, sulfuric acid; refined copper manufacturing has been fully liquidated. There is an operating section with a small capacity (ten

times less than formerly) for generating black copper under flame method without decontamination equipment for sulfuric and other gases.

Gold industry in Armenia includes gold mines at Zod and the Ararat gold recovery plant which served a basis for the establishment of "Armgold" amalgamation in 1976 by involving the Vardenis' Zod mine, Ararat gold recovery plant and Sevan-Shorzha-Zod railway (122 km), which connects the Ararat plant to the Zod mine.

Tailings accumulated within many years of operation at the tail storages which contain essential quantity of gold and silver and already passed energy-consuming process of mechanical treatment, are currently used by an Armenian-Canadian joint venture, which is going to reduce accumulations at the tail storages and there would be no need for allocation of new areas to install tailings. Almost all the studies of tail storages show a perspective of their further recycling by using contemporary technologies. Actions are being taken to increase non-ferrous metals manufacturing on the account of re-treatment scrap, wastes and ore not formerly used and difficult to be treated.

Manufacturing of construction materials in Armenia basically started in 1926. Manufacturing of non-mineral construction materials comprise construction sand, road metal, and sand and gravel mixture and quarry stone. They are generated due to mechanical treatment of volcanic rocks (granite, basalt, etc.) and sedimentation rocks (dolomite, sand stone, etc.) mines at open pits. In 1986 there were 92 mines of construction stone, 15 mines of sand and gravel, 2 machined mines of sand used in concrete and silicate structures. The "Armenian Non-Mineral Rocks" trust produces light concrete filler out of remnants from mining of volcanic slag, stone-like pumice and tuff stone. The Armenian construction materials output in 1960 amounted to 1.826.000 cu m, in 1965 -- 3.257.000 cu m, in 1970 -- 6.139.000 cu m, in 1975 -- 7.100.000 cu m, in 1980 -- 9.059.000 cu m, in 1985 -- 10.085.000 cu m. In 1990 production volumes has been essentially decreased.

Armenia is also rich in construction materials reserves of decorative natural stones.

Glass production has a special place in Armenia, particularly, for tare bottles. There are factories in Arzni, Armavir, Gyumri, Bryuureghavan, where perlite is used.

2.7. Agriculture

After collapse of the Soviet Union Armenia used to be a comparatively developed country in agriculture, possessing a big scientific potential in the field of both fundamental and applied studies. The agriculture in the country used to annually produce 200.000 tones of vine, 200.000 tones of fruits and berries, 550.000 tones of vegetables, 300.000 tones of cereal crops.

There used to operate numerous re-processing factories to sale their products around the huge area of the USSR.

Obviously, the agriculture of that period of time used to have both advantages and disadvantages, which by nature were typical of the Soviet planned economy. Strictly regulated agricultural policy failed to support growing of local traditional crops, and negatively impacted nature, particularly, land condition. Improvement of efficiency frequently resulted in failure of the other valuable characteristics of the products.

Extensive land-use development forced to use as arable land even rather steep slopes by violating natural ecosystem, generating land erosion and wash-up of fertile soil.

Same extensive development in the field of cattle breeding originated over-grazing of animals, which resulted in pasture and land degradation.

Unjustified rural roads and routing of animal transpiration, construction of water storage reservoirs supported to origination of new centres for land erosion.

However, forest areas, forest-protective and field-protective zone expansion, mountain slopes forest-planting were paid a particular attention.

Big scientific potential enabled scientific research institutes to conduct studies at international level, both on land erosion and agricultural agrarian engineering development and generation of new types of plants.

Within that period of time agriculture used to be more or less procured with mechanization aids and toxic chemicals and fertilizers. The cattle-breeding complexes were relatively on equal shares using the pastures. Due to operation of seed-breeding farms and stations, the farms were provided with qualified seeds and seedlings.

Same as in the rest of the USSR a peasant in Armenia failed to be considered as the landowner, being separated from the outcomes of his/her own work, and failed to treat land as his/her own feeder. He/she had minimum income to afford his/her own life and did not see any legal ways to improve it. It leads to numerous infringement of land-use. Animal grazing in the forests, haymaking in reserves, water pollution and ruthlessly use were a regular operations.

Unfortunately, once gained independence Armenia, from one hand, lost many positive sides of the Soviet economy, and, from the other hand, being in transition period, failed to obtain the advantages of market economy so far.

Instability of economic situation in former neighboring USSR republics, blockade of transportation roads, economic and energy crisis resulted in a rapid drop in population living standard and its mass migration from the republic. It had a heavy influence on all the layers of population. Due to inflation and rapid decrease of state funds to cover scientific research the republic lost an essential part of its scientific potential, the volume and deepness of the research dropped, particularly, in the field of agricultural applied studies.

The harshness of the adopted decisions , without predicting of the consequences, caused a big damage to the agriculture.

Rapid privatization of lands, including orchards and vineyards were full of serious mistakes, which were resulted in serious consequences. Logistical procurement, maintenance and consumption issues failed to be identified. Products sale and re-processing facilities were shutdown. Neither crediting nor insurance institutions were established.

Small sizes of land plots, their fragmentation and inadequacy of necessary measures lead to generation of small subsistence farming, which were mainly involved in affording self-sufficiency. Only 4.7% of the farms are integral, and the rest is fragmented composed of two or more land plots. Therefore, manual labour is prevailing in the field of farming. Similar farms fail to serve a

basis for provision of high production . It should be added by a rapid raise in water tariffs increased fuel and lubricating material prices. Break-off of existing trading relations was resulted in shutdown of many factories involved in agricultural products processing. It generated over-production of products and rapid abatement of their prices. In many cases, a produced product fails to cover its own cost. Consequently, serious changes took place in the structure of agricultural areas, which threatens to the existence of traditional crops, primarily, fruitful plants and vine, as well as to the loss of conventional knowledge. According to official data some 60% of the vineyards and less than half of the fruitful plantations remained. Instead of that cereal crops, particularly wheat acreage have been increased by 32%. However, it failed to lead to an essential increase of wheat production due to decrease of soil fertility (mainly due to incompatibility of germination conditions, lack of required farming equipment, constraints of adequate knowledge and experience and other reasons). Besides, types of cereals obtained as a part of humanitarian relief are frequently inefficient to grow in local conditions, which fail to justify labour and expenditure invested in their production.

Crop rotation is not applied anywhere in the country, which is decreasing soil fertility and generates escalation of weathering processes. Seed stuff production is also in a miserable situation in Armenia. Instead of 120 formerly operating seed farms, only 35 are working currently. Moreover, the quality of their products fails to comply with the general requirements. Therefore, the farmers buy untested seeds and obtain low yield. Desperate situation of the farmers cease to preserve the fruitful tree and bush species in their farmland that have been sustained by many generations, which have specific characteristics. It threatens to the loss of local sorts and diversity valuable for selection.

After liquidation of the collective and Soviet farms and privatization of agricultural lands in Armenia due to lack of funding the plant protection system almost ceased its existence. Within the recent years, plant protection is carried out on the account of the farmers.

As an ancient agrarian country, Armenia has extensive resources of local cultivated plant sorts. First of all these are the sorts of century-old selection made by the people. It is known, that Armenian highland is the motherland of origin of numerous sorts of mainly fruit-and-berry plants and vine. Great variety of conditions, vertical zoning and fragmented relief resulted in generation of forms and sorts diversity centres independent from each other. These sorts are usually well fitting local conditions. They are notable be their record productivity, but do not suffer from unfavorable conditions or diseases and pests.

It is necessary to note the high flavoring characteristics of the sorts of fruit-and-berry plants (apricot-tree, peach-tree), cultivated vegetable crops and melons and gourds, table vine sorts and provisional raw material for Armenian wines and brandies. Besides, all local species are important raw material for selection. While mentioning the old sorts of cultivated plants, the achievement of contemporary selection should also be mentioned. The 112 sorts out of the 246 sorts circulation in Armenia are new and extremely valuable selective sorts.

There are rich collections of various sorts of cultivated plants available at the research institutions and selection station under the Ministry of Agriculture. Unfortunately, due to a rapid reduction of financing their major part has been destroyed.

Armenia's flora is rich in fodder plants, the protection of which in natural habitats and their introduction to cultivation is an extremely important issue for cattle-breeding development. Armenia's fodder plants belong mainly to two families: cereals and legumes. Representatives of

legumes as forage plants have special significance. They fertilize the soil by nitrogen (it has a special value for Armenia); their seeds are rich in proteins, notable by dry resistance and sustainable towards pests and diseases.

Representatives of cereals amounting to some 300 species in Armenia's flora are mostly prevailing plants of arable lands and hay-fields.
Specific gravity of the cattle-breeding products has been decreased within the gross agricultural product in the country.

Presently, due to economical hardship, the stock of cattle and small cattle has been rapidly decreased.

As of January 1, 1991 the stock of cattle in Armenia amounted to 640.000, sheep and goats -- 1.989.000, pigs -- 311.000, horses --6.600.

As of January 1, 1999, it appropriately amounted to: cattle -- 469.000, sheep and goats -- 546.00, pigs -- 86.00, horses -- 11.300 heads.

A rapid decrease of the stock of sheep and pigs is notable, while the horses' one increased by 172%. This is a result of market relations, which is explained both by consumption and high prices for agrarian equipment.

Drop in cattle stock number has negatively affected on the productivity of natural feed holdings.

Major sources of forage in the country are hay-fields and pastures, which occupy some 60% of the agricultural value lands. Only 5% of the pastures are improved, the rest are degraded due to different-level over-grazing, land strengthening and erosion. In general ration between the cattle stock, pastures, and hay-fields has become almost perfect (ideal) for a mountainous country. However, as a result of break-off of the system of collective and Soviet farms the cattle-breeding complexes have almost disappeared. Under absence of cooperation and finances, the small farms fail to drive their droves to the remote summer pastures, and use only feed holdings next to the villages. Therefore, the latter are under a big load (by prevailing on average the load of the recent decades) and subject to degradation. All the processes concurrent to the over-grazing are strong enough here: land depletion is activated, a shift in floristic composition is taking place, i.e. weed, bur and toxic species are starting to prevail over more valuable fodder plants. Remote feed holdings (in alpine and partly sub-alpine and steppe zones) because of absence of grazing are recovered within the recent years; their state is notably recovered.
Of the total land of the republic, about 47% is the agricultural lands. The area of arable lands and perennials amounts to 550.7 000 ha at an altitude of 400-2450m ASL.

In 1991 according to the RoA Supreme Council Decision "On Agrarian and Agrarian Collective Farms" initiated the land privatization process in the country.

Total of privatized lands in the republic amounts to 457,700 ha or 66.4% of cultivated or hay-fields.

An average area of one privatized farm amounts to 1.4 ha, of which 1.04 ha of arable land, 0.12 ha of perennial plantation and 0.24 ha of hay-fields.

Recent-years reality showed that due to failure or high operation of irrigation system or high prices of their operation and maintenance, cultivated lands have been rapidly decreased.

The fact of decrease of fertility of lands in Armenia is becoming more obvious when the Soviet-period and current cultivated lands areas and fertility indicators are compared (Table 29).

Table 29

Crops	Area (thousand ha)				Yield (t/ha)		
	1986	1992-94	1999	2000	1986	1992-94	1999
Cereals	133.2	189.5	175.7	190.0	2.4	1.5	1.7
Vegetables	18.0	21.9	20.9	20.5	31.8	20.0	21.5
Melons and gourds	3.9	2.8	4.2	3.5	16.3	14.1	21.0
Potatoes	20.3	30.6	32.0	32.0	13.0	12.6	12.9
Fruits	52.1	33.5	20.7	20.7	3.8	3.1	4.3
Vine	25.7	25.1	15.2	15.2	8.1	6.5	7.6
Tobacco	3.8	0.5	0.8	2.6	2.9	2.8	2.3
Forage	267.1	134.0		122.0	10.2	8.9	

According to the results of preliminary assessment, it is anticipated that cultivated land area would face more decrease particularly due to failure to form a consumer market, unfavorable situation of the irrigation system and its high operation costs and other reasons.

Limited capacity of individual farmers in 1999 lead to reduction of arable lands use by 134,000 ha which amounted to 27%. Areas under orchards and vineyards versus those under vegetables and potatoes have been significantly reduced.

Limited dimension of consumer market forced the land users to reduce orchards and vineyards, which formerly used to gain great profits by substituting them by easier sold and safe diversity: wheat and potato. From the other hand, an essential decrease of crop productivity is notable, which is one of the forms of development of desertification phenomena.

2.8 Energy Sector

Armenia used to traditionally import primary energy resources from other republics of former USSR. Some 95% of the energy carriers used to be imported from Russia, Azerbaijan and Turkmenia, whereas only 5% of the demand were covered by the republic's own sources (mainly only hydropower). Mined coal, grey coal and peat had local significance and played no essential role in the general energy balance. The portion of the small hydropower plants in the hydropower generation amounted to 8-10%, or 1% of the general power generation. This situation used to be a direct effect of the integration policy run in a centralized planned country. Faults of such policy made their most heavy impact during the severely critical period of time (1992-1995).

Hydropower Resources.

Armenia's hydropower potential is theoretically estimated in 21.8 bln kWh/year, including 18.6 bln kWh/year of the big and medium rivers, and 3.2 bln kWh/year of the small ones. There are some 200 rivers in the country. Up to different estimations a technically available potential varies within the limits of 7-8 bln kW/h, i.e. some one third of the assortment, which was somehow lower than both the regional and Russian indicators (Azerbaijan - 37%, Georgia - 48%, Russia - 57%). However, it concurs with the continental indices (Asia - 36%, Europe - 38%). Technically

available potential of the two larger rivers: Hrazdan and Vorotan are practically applied. The potential of the second comparatively large group: Pambak-Dzoraget-Debed is not applied (except for Dzora Hydropower Plant of 26 MW/h. There are 17 hydropower plants operating on small rivers with the annual capacity of some 120-130 kW/h (including Dzora Hydropower Plant). Design electric energy generation by power plants of the two cascades (in case of irrigation regimes operation of the Sevan-Hrazdan cascade) and small hydropower plants amounts to 1500 GW/hr, or 20% of technically available potential.

Armenia's technically available hydropower potential is estimated at 3200 GW/h. Similar generation is possible by operating two existing hydropower plant complexes -- the Sevan-Hrazdan and Vorotan ones, and by constructing another four new large hydropower plants. Besides, the RoA Ministry of Energy has formulated "Small Hydropower Plant Development Scheme" which covers all the hydropower plants -- 325 in number with general established capacity of 257MW and annual average power generation of 770.0 mln kW/h.

Implementation of the economically feasible hydropotential would enable satisfaction of the 50% of the existing demand, which would protect Armenia from energy crisis, and, consequently, secure economic development and raise stability of reforms underway, strengthen political position of the state.

Organic Fuel Reserves.

Geological exploration and survey has been undertaken in Armenia to discover organic fuel reserves. Mines of coal, combustible slate, peat, bitumen, bituminous sands, as well as gas traces have been discovered. In general, a brief information on the use of Armenia's underground organic fuel reserve is the following;

Explored reserves of coal and combustible slate amount to 17-18 mln. t;

Some 6 mln t of explored reserves of slate in the Dilijan deposit, 128 mln t of prospective reserves;

Prospective coal reserves in the Ijevan deposit are some 100 mln t;

Prospective oil and gas layer reserves are available in the republic's provinces of Armavir and Ararat.

Thus, reserves of a number of deposits of coal and combustible slate might be qualified as commercial.

New and Renewable Energy Resources.

Armenia's territory is endowed by a significant potential of solar energy. Annual value of solar flow on 1 m^2 of horizontal surface amounts to 1720 kWhr/m^2 (average European is 1000 kWhr/m^2). Solar radiance in the Sevan basin might be considered as a record one -- 2800 hours. On an annual basis a direct radiation portion on the whole territory is also significant -- some 65-70% which is typical enough in terms of concentration collectors application.

The curve on Figure 1 describes distribution of solar exposure of 1 m^2 of horizontal surface on the Armenia's territory.

Figure 1

Distribution of horizontal surface solar exposure

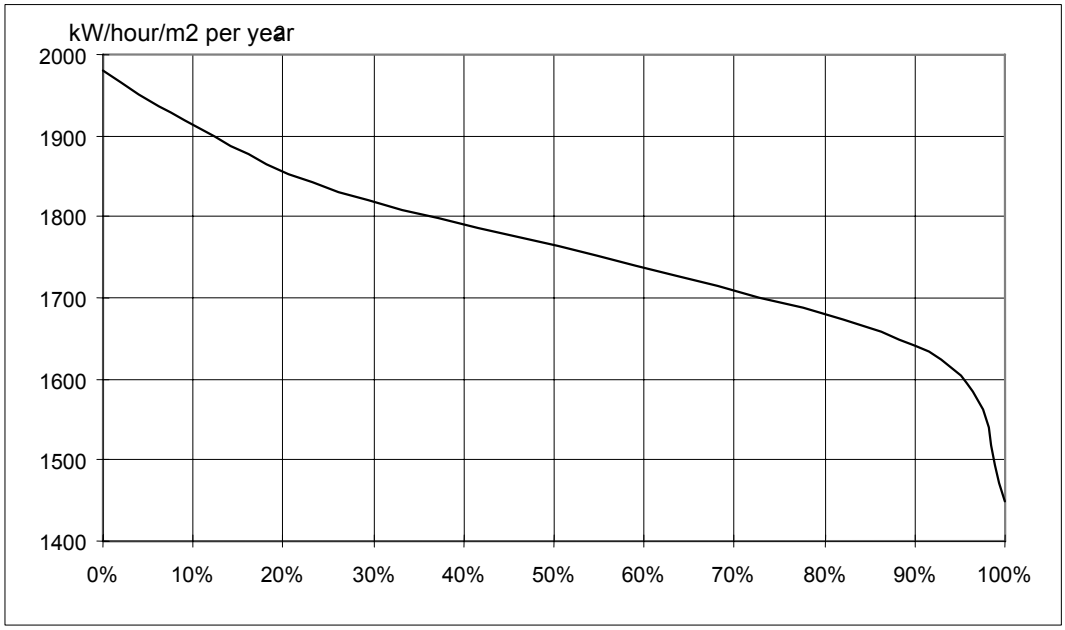

Figure 1 shows that one quarter of the Armenian territory is provided with annual intensity of 1850 kWh/m^2 of energy reserves.

Use of these reserves is considered beneficial for individual power consuming groups by using photoelectric converters.

As to the use of solar energy by flat solar collectors for hot water supply purposes, then this field might be perspective enough in case of state (even temporary) financial support.

Formulation of Armenia's hydro-meteorological database provides a rough evaluation of the wind reserves.

Theoretical potential is estimated at 10.7 GWh, whereas the technically available one -- some 1.6 GWh in case of 15%-capacity efficiency of use. The Pushkin and Sisian mountain passes and Mount Aragats have been selected for network wind energy equipment. The annual average wind flow duration in these districts amounts to 5200 hour/year when the lowest wind speed is 5-6 m/sec.

Feasible potential of the network installations is characterized as 15-20 MW and 40-50 GWh/year.

Armenia has significant reserves of geothermal energy, and prospects in terms of power and heat generation. According to different specialists it is considered completely feasible to produce 150-200 MW capacity of electric energy in case of low prime cost of kWh at US¢5.

Use of geo-energy reserves for heat-supply purposes is considered as more perspective. In terms of territory, the central volcanic zone is considered perspective. Geological survey there enabled to discover prospective geothermal and ore-thermal deposits (Jermaghbyur, Sisian, etc.).

Policy Analysis.

Energy is one the economy sectors, which defines the level of economic development and population social welfare.

The energy sector in the country involves power; gas and heat supply systems together with their production, transportation, distribution, construction, assembly, regulation, maintenance, service, communication and other units.

The following companies are involved within the republic's electric energy system:
Three thermal power plants of 1756 MW of setting power capacity and 1600 Gcal/hr of thermal capacity and annual power generation capacity of 9 bln kWh. The plants have been operated within the period of time of 1963-1974.
The Sevan-Hrazdan and Vorotan cascades' capacity is appropriately 556 and 404 kWh and 480 mln kWh (under irrigation regimes) and some 1 bln kWh of generation capacity. The cascades' power plants have operated in 1936-1966-1989.
The Armenian Nuclear Power Plant of 815 MW of setting capacity and up to 5.6 bln kWh generation size. Operated in 1976-1980. It has been shut down in 1989. In November 1995 its Unit # 2 has been re-started to produce 6 bln kWh of power.
Small hydroelectric in total number of 25 of 62 MW setting capacity and up to 120 mln kWh generation capacity.

The electric energy system involves developed transportation and distribution networks. Total length of the high-tension lines amounts to 4600 km, number of high-tension substations -- 133. Some 2700 km length is the medium-tension (35 kW) lines, 278 medium-tension substations, 27400 km of total length distribution networks 8600 low-tension substations are a lower component in charge of direct distribution of energy and supply to the consumer.

The electric energy system used to generate 15.5 bln kWh of energy in 1980s, whereas some 6.0 bln kWh of energy within the recent years.

The gas supply system is a network of highway and net of circular distribution gas pipelines, which involves regulation, protection, storage and other equipment and management services.

The system might be fed in three directions: Georgia - Alaverdi, Azerbaijan -Ijevan, and Azerbaijan - Karabagh - Goris.

It is only the first one that is operated currently which due to excessively inadequate amounts of the operation and maintenance expenditure displays obvious features of gradual distraction. In a technically regular state Armenia's system is in the position to accept annually up to 16 bln m^3 of natural gas, which is 2.2 times higher compared to the highest consumption in the 1980s and 12 time -- compared to 1998 supply.

The gas-transportation system in Armenia involves 1980 km-long main gas\ pipelines 11650 km-long distribution networks of different pressure, 60 gas-distribution stations, 1730 gas-regulation points, and 1670 electrochemical corrosion protection stations.

Residual oil is another major resource to secure energy system operation. It is supplied by railway in a complicated and costly route followed in the recent years. The complex involves a developed storage facilities of 358 thousand tons capacity attached to the power plants and the Gyumri boiler-house.

Under the existing state of infrastructure the complex is in the position to provide electric energy exchange with the neighboring countries. An electric energy exchange is currently performed with the Islamic Republic of Iran, and export -- to Georgia. Armenia's favorable geographic location makes it valid to run an "all azimuth" energy policy to contribute to the inner- and inter-regional energy exchange development.

2.9. Land Resources

The land resources distribution in Armenia per provinces and land types is the following (Table 30):

Table 30

Land Resources Distribution in Armenia Per Provinces and Land Types

(thousand ha)

Provinces	Total	Agricultural land types	Arable land	Perennial plantations	Hay-fields	Pasture	Forests and shrubbery	Other lands
Syunik	450.5	194.3	48.3	2.7	9.6	133.7	57.0	199.2
Gegharkunik	407.1	240.1	95.3	1.8	35.6	107.4	16.0	278.9
Lori	378.9	192.2	48.4	4.5	39.4	99.9	90.0	96.7
Aragatsotn	275.6	136.7	56.2	7.7	4.1	68.7	7.5	131.4
Tavush	270.4	98.6	27.8	6.8	15.0	49.0	123.9	47.9
Shirak	268.0	165.7	84.5	0.5	16.8	63.9	2.5	99.8
Vayots Dzor	230.8	75.9	20.6	3.3	4.6	47.4	6.5	148.4
Ararat	209.9	99.1	30.0	11.8	2.9	54.4	9.5	101.3
Kotayk	209.5	99.8	40.6	7.6	10.9	40.7	20.0	89.7
Armavir	124.2	80.7	40.4	13.6	0.2	26.5	1.0	42.5
Yerevan	21.5	8.3	2.2	3.3	-	2.8	-	13.2
Total	2846.4	1391.4	494.3	63.6	139.1	694.4	333.9	1249.0

***Without aquatic area of Lake Sevan**

According to the 1997 land balance the land fund in Armenia is divided into categories and land types per functional use (Table 31).

Table 31

The Republic of Armenia Land Fund Per Categories and Land Types (accordion to exports)

(thousand ha)

Categories	Total land area	Agricultural land types	Arable land	Perennial plantations	Hay-fields	Pastures	Other lands: forests, bushes, buildings, etc.
TOTAL	**2974.3**	**1391.4**	**494.3**	**63.6**	**139.1**	**694.4**	**1582.9**
Agricultural function lands	551.0	509.0	368.0	54.0	66.0	21.0	42.0
Settlements Lands	66.0	8.4	4.0	2.3	0.1	2.0	57.6
Industry, transportation, communication and other lands	95.0	7.5	1.3	0.5	1.6	4.1	87.5
Environmental, health, recreational, sport and historical and cultural land	230.0	4.3	0.3	0.1	0.3	3.6	225.7
Forest fund lands	352.0	18.1	0.5	1.8	3.1	12.7	333.9
Water fund lands	20.0	-	-	-	-	0.1	19.9
Reserve fund lands	1660.3	844.1	120.2	5.1	67.8	650.9	816.3

The percentage of distribution of land fund is the following: agricultural lands amount to 18.5%;
settlements lands amount to 2.2%, including 90% of buildings and attached facilities;
industry, transportation, communication and other lands - 3.2%;
environmental, health, recreational, sport and historical and cultural area - 7.7%;
forest lands - 11.8%;
water fund lands (excluding Lake Sevan's aquatic area) - 0.7%;
reserve fund lands - 55.8%.

The root ores exits, sands, waters and other areas out of the Land fund's 2974.3 thousand ha amount to 358 thousand ha (12% of the total).

On May 2, 2001, the National Assembly adopted a new "Land Code" according to which the land fund in Armenia is classified as for their significance: Agricultural significance, Settlements, Industrial, underground use, for other production, Energetic, transport, communication, communal infrastructure objects, Special protected areas, Special importance, Forest, Water,Reserve funds.

2.10. Water Resources

One of the priorities to combat desertification in Armenia is adequate calculation of water resources, allocation and protection from pollution. Some 200 thousand people live in water scarce districts, which prevent the economic development depending on access to water. Annual stock of surface water in the republic amounts to 6250 mln m^3, and approved stock of operated underground water - 1200 mln m^3.

Rivers in Armenia are mountainous, mostly small water-scarce and are dried out in summer-time. The annual mean flow amounts to 7.187 bln m^3 (Table 32) in water-scarce years it accounts for 5.3 bln m^3. Geographic location of the republic is such that almost all the rivers are flowing outside its borders.

Table 32

Major Rivers Characteristics of in Armenia

	Rivers	**Length**	**Watershed basin area**	**Flow**
		Km	Km2	1 mln m3/year
1	Akhuryan	186	2784	358
2	Metsamor	38	2240	834
3	Hrazdan	141	2565	710
4	Azat	56	952	217
5	Vedi	58	998	64
6	Arpa	128	2306	732
7	Vorotan	178	2476	716
8	Vokhchi (with Norashenik tributary)	86	1341	366
9	Kasakh	89	1480	235
10	Debed	92	3895	1120
11	Aghstev	133	2480	359
12	Lake Sevan basin		4750	265
13	Kur River tributaries		810	168
14	Meghri and Araks Rivers tributaries	36	664	103
15	Total		29741	6247
Additional flow from Araks River				940
Total:				**7187**

The lakes are highland and small enough, except for Lake Sevan (Table 33)

Table 33

Major Indicators of the Lakes in Armenia

#	Lake names	Location (Province)	Altitude ASL (m)	Volume (mln cu m)	Surface of mirror (km^2)
1	Sevan	Gegharkunik	1897	33400	1240
2	Arpi	Shirak	2020	100	22
3	Kari	Aragatsotn	3200	0.36	0.12
4	Ayghr	Armavir	856	0.31	0.16
5	Sev	Syunik	2658	11.6	1.92
6	Kaputavan	Syunik	3286	0.47	0.10
7	Akna	Kotayk	3030	2.5	0.50
8	Parz	Tavoush	1334	0.08	0.03

One of the major problems of conservation and efficient use of water resources in the republic is the protection of Lake Sevan, the freshwater of which is considered as the only source of drinking water in the future.

Lake Sevan occupies an area of 1240 km^2 and is located at 1897 m above sea level. Within the recent 50 years, its level has dropped by some 20 meters. The water has been used for energy and irrigation purposes. The Arpa-Sevan tunnel has been constructed and put into operation in 1981 to divert some 300 mln m^3 to Lake Sevan. The Vototan hydrotechnical facility is under construction to maintain the lake's level to divert 165 mln m^3 of water to Lake Sevan.

In order to satisfy the need for irrigation water 75 water storage reservoirs have been constructed of 986,0 mln m^3 of total capacity. The Mantash water storage reservoir is the only reservoir constructed for drinking and commercial water-supply purposes. There are 10 water storage reservoirs with total capacity of 396 mln m^3 are currently under construction. Data on the water storage reservoirs of volume of 10 mln m^3 and above see in Table 34.

Table 34

#	Name of reservoir	Watershed	Useful volume (mln m3)	Water availability
1	Akhuryan	Akhuryan	510.0	permanent
2	Spandaryan	Vorotan	218.0	permanent
3	Aparan	Kasakh	81.0	permanent
4	Tolorsi	Vorotan	80.0	permanent
5	Azat	Azat	60.8	permanent
6	Joghaz	Aghstev	43.0	permanent
7	Karnut	Akhuryan	28.0	permanent
8	Her-Her	Arpa	23.0	permanent
9	Hakhum	Debet tributary	11.2	permanent
10	Geghi	Vokhchi	11.5	permanent

The underground waters in Armenia are allocated in an uneven way and their stock is accounted to 4.017 m^3/sec. Some 70% of the water resources flow to the Ararat valley the water stock of which is located on the depth between 40 and 300 m. The upper water layer (up to 40m deep) is mainly used for drinking and industrial purposes. Underground water level is fluctuating within a year by about 1 meter.

The average water balance in Armenia " According to Integrated Water Resources Management Programme" is as follows:

Table 35

Inflow		**Outflow**	
Component	Mln cu m/annually	Component	Mln cu m/annually
Precipitation	17,600	Evaporation	11,475
River inflow		River outflow	
Boundary rivers	940	In-country rivers	6,250
		Boundary rivers	940
Underground inflow	1,193	Underground outflow	1,068
Total inflow	**19,733**	**Total outflow**	**19,733**

2.11. Biological Resources

One of the peculiarities of biological resources in Armenia is the fact that major percentage of its specific composition are the species used in different fields of human activity.

Bioresources involve the genetic resources, organisms, their parts and products, populations or biotic components of ecosystems of actual or perspective use or value for men.

Plant resources

Armenia's flora is rich in useful species. According to historical data some 2000 species of herbal, eatable, colouring, tanning, technical and commercially valuable, other wild useful plants have been used for different purposes in Armenia within centuries.

Wild plants in Armenia based on function of use could be grouped in the following way:

a) *Eatable and flavouring plants* are represented by 282 species of flowered plants, which are used both in a fresh and processed state. Many of them (hornbeam, paster, lily, damsons, etc.) due to being excessively used by population have become rare or endanger. Some 10 species out of some 300 species eatable mushrooms found in Armenia are used by population.

b) *Fodder crops* - Grasslands in Armenia are identified by wide diversity of plant populations. Natural feed holdings are occupying some 834,000 ha, including 140,000 ha of hay-fields, 694,000 ha of pastures. Each landscape zone is identified by plant populations typical of it (Table 36).

Table 36

#	Landscape zone	Plant populations in feed holdings	Forms and terms of use
1	Semi-desert	Oshinder-ephemeral, oshinder-cereal, oshider-oshan and oshan groupings	Used in spring, fall and winter mainly for hay-making and livestock grazing
2	Steppe	Pinnate-and-sprout grass, wheaten-and-thin, wheaten-and-sprout, barrbery grass, couch-grass, grass-and-wheaten shrubby, tragacanth groupings	Used in spring, summer and fall for animal grazing and hay-making
3	Meadow	Motley grass and cereals with narrow-leaved motley grass, wheat, with butterfly flower motley grass, cereals and sedge	Used for hay-making and spring, summer and fall grazing of animals
4	Forest-and-meadow	Butterfly flower and cereal, sedge and bushy	Used for hay-making and spring, summer and fall grazing of animals
5	Sub-alpine	Dry cereals (wheat, sprout grass, wheat-and-Koeleria, oats, gold oats, reed-and-grass multi-colored sprout grass, wet wheat-and-butterfly-and-flower, broad-leaved, grass, shrubby and high grass.	Used for hay-making and summer grazing of animals
6	Alpine	Cereals-and-grass: wheat, sprout grass, Koeleria, alpine field sorrels, violet field sorrels, grass meadows, peat.	Used only in summer for livestock grazing. Term of use: 80-100 days

c) *Timber resources* - use of tree-species timber is carried out for fuel, construction various small tool-making and domestic purposes. According to the last population census of forest resources (1993) total timber resources of forest fund amounts to 41.74 mln. Cubic m., and annual regeneration 354,000 cubic m. Forest's total is 0.54 and the bonitet is III-7.The oak-tree, beech, hornbeam timber are of particular value.

Some 40% (120 species) of the Armenia's dendroflora specific composition as wild fruitful species has large application in canned food production. And as a sustainable stock, it is of commercial value for obtaining fruit and berry plants.

d) *Herbs* are also of large specific gravity in Armenia's flora (some 10%). The most significant are Crataegus, Rhamnus, Juniperus, Berberis, Rosa, Hypericum and representatives of other genus. Some herbs (antaram, mint, thyme, mald, loshtak) are picked in big quantities.

e) *Melliferous species* (some 350 species) include Acer, Onobrychis, Medicago, Tilia, Trifolium, etc. Lake Sevan basin, Talin and Meghri Districts are important honey-making areas.

f) *Decorative plants* are mostly the trees, bushes, and numerous decorative grasses (some 300 species), which are currently used for decoration of punches and wreaths of flowers.

g) *Volatile-oil-bearing plants* (some 120 species) belong mostly to the genus of Thymus, Helichrysum, Artemisia, etc.

h) *Paint-bearing plants* involve some 120 species including Euphorbia, Rhamus, Sambucus, Rubia and a number of other genuses.

Vitamin-bearing plants (some 130 species), herbs-containing (some 60 species) and resin-bearing (60 species) plant species are also of a particular significance. The tragacant gases are particularly rich in natural resins.

Animal resources.

Wild animals in Armenia are mainly used for hunting, fishing and pharmaceutics purposes.

Hunting resources. Some 20 species out the 83 vertebrate species found in Armenia may be an object for hunting, such as Caucasian tribal deer, striped deer, bezoardic goat, Armenian moufflon, brown bear, roe, wild boar, river otter, nutria, marten, black grouse, wolf, fox, wild (forest) cat, hare, etc. However, most of the listed species due to unregulated use and impact of other negative factors are mostly prohibited game, since they are registered by national and international Red Books.

In specific terms, birds as a hunting object are richer. Out of the settled birds the following species are found in the republic: Caucasian grouse**,** ular, partridge, black-and-blue pigeon, ptarmigan, black parpar, black snipe, big diver, cackling duck, grey duck, etc.

Out of the summer nest-making birds the following are hunting objects: quail, forest pigeon, turtle-dove, *mrgahav*, grey crane, beautiful bustard, black-winged stilt, avoecet, woodcock, snipe, grey goose, multicoloured goose, etc. Flying game birds are big in number.

In general, out of game birds representatives of the following groups are available in Armenia: hen-like (3 species), pigeons (4), thrusts (5), cranes (2), bustard (3), snipes (30), pottered (2), looms (2), gooses (23), paddle-fish (2), long-lagged (4) and passerines (7), totally 91 species. However, not all are subject to hunting due to registration by the national Red Book.

Within the recent decade, no inventory of animal stock has been carried out in the country, except for accounting of some of the hunting animals as a basis for the Ministry of Nature Protection to issue permits for licensed hunting.

Fish stock. Water basins in Armenia are rich in valuable fish species. Local valuable fish species are the following: in Lake Sevan - the *ischkan* (*Salmo ischkan)*, *khrami carp (Varicorhinus capoeta)*, barbel, and in the rest of water basins - trout, barbel, river *khrami carp,* cat-fish, Arax's *yendaberan.* Due to unregulated use and deterioration of ecological conditions of natural habitats stock of the most of the fish species have been drastically decreased, individual species are endangered and registered by national Red Book. In order to supplement the fish stock in the country starting from 1930s whitefish, different *carps* have been acclimatized in different dams (natural and artificial) in the country. They are presently major fishing species.

The 90 per cent of the commercial fishing is carried out in Lake Sevan by accounting to some 2000 tons in individual years. Before the reduction of water level, the *Sevan's ischkan (Salmo ischkan)*, Sevan's *khrami carp (Varicorhinus capoeta sevagni)* used to be major fishing species before drop of water level, and whitefish *(Coregonus lavaretus sevanicus),* silver carp *(Carassius auratus)*.

Amateurish fishing is allowed in all the rivers and lakes except for specially protected areas.
Pharmaceutics reserves. Major animal species used for preparation of different pharmaceutical preparations are Cheiroptera (23 species), excrement of which is used in pharmaceutics, badger, oil of which is used in fold medicine, poisoning snakes (Armenian adder, **Gyurza**), poison of which is used for pharmaceutics purposes to cure epilepsy, haemophilia, cancer, bronchial asthma, etc.

Genetic Resources.
The Armenian Plateau is one of the centres of origin of endemic genera of tame animals and crops. The archaeological studies revealed that still during the Neolite period local fast horses, cattle, sheep and pigs were breed in Armenia. Old Armenian cuneiform inscriptions refer to the agricultural animals breed now in the country.

Endemic coarse-hair genus of sheep were known in the 9th century BC which by means of folk selection were improved and breed to the Mazekh, Bulakh, Karabakh ones.

Numerous authors refer to that Armenian Plateau used to be one of the centres of origin goat tame. Out of the endemic genera the Cylicia fine-fleeced goat were particularly known. The Karabagh genus of horses is also local in the Armenian Plateau.

The age of ethno-botanical materials in the Armenian Plateau starts since the 8th millennium BC. The age of excavated carbonized remnants of crops and their allies is dated to the 5th millennium BC. According to archaeological and botanical studies, different species of wheat, barley, rye, millet, oats, bean, lentil, pea, haricot, sesame, watermelon, vine, apricot, quince, plum, cherry, pomegranate, oak, peach, apple, and ethereal and other plants were cropped on the territory of Armenia.

Wild allies of crops in Armenia are mainly represented by the following groups:

Cereals - Wheat (Triticum) - The tree out of the four wild wheat species known in the world grow here: T. boeticum, T.urartu and T.araraticum. The last two ones were first found in Armenia, which are characterized by great inner-specie diversity -- above 110 of diversity.

Aegilops - A close tribe to wheat, the species of which participated in generation of solid and soft species groups: 9 species were found in Armenia with rich inner-specie diversity.

Secale - A wild annual (S.vavilovii) and wild perennial (S.montanum) species are growing in Armenia.

Hordeum - 8 wild species were found with great inner-specie diversity. The two-row wild (H.sponteanum) and wild (H.bulbosum) species are of particular interest.

Cereals and legumes - 3 species of Phaseolus, 2 species of Lens, 3 species of Pisum, wild species of Faba were found in Armenia.

Food plants mainly belong to Fabaceae andPoaceae families. Out of the Fabaceae family 10 species of Medicago, 30 species of Onovrychis and Trifolium, 36 species of Vicia and species of other tribes, ecotypes and forms are spread. Out of the Poaceae: Agropyron, Arrhenatherum, Dactylis, Festuca, Lolium, Pleum, Bromus and other species, ecotypes and forms are grown and cropped.

Fruit-and-cheery - Since the ancient times people used their variety by including in cropping. There are 3 apple-tree species, 17 species of pear-tree, 11 species of hawthorn, 4 species of plum-tree, 4 species of almond-tree. There growing in a cropped, wild or run wild state of the following: Armeniaca, Persica, Cydonia, Mespilus, Ceassus, Juglans, Corilus, Pistaca, Dospyros, Punica, Elaednus, Ficus carica, Fragaria, Rubus, Ribes and othpecies, sorts, ecotypes and forms.

Vegetables, melons and gourds - Except for the cropped species Beta, Spinacea, Daucus, Coriandrum, Saturea, Asparegus, Allium and other species, ecotypes and forms are growing in wild state.

Ethereal - Except for the cropped species Linum, Cannabis, Camelina, Sinapis, Brassica, Lallemantia, Carthamus, Papaver and other species, ecotypes, forms are growing.

2.12. Mineral Resources

The territory of the Republic of Armenia is rich in mineral resources. According to archaeological data mines of copper, gold, iron and a number of other mineral resources were known even in ancient times, and some of them were even partly exploited.

Up to 1920s only several metal mines and mine manifestations were known in the Republic of Armenia, which were extremely weak explored. Since 1930s a number of mine, manifestations of metal and non-metal mineral resources were found in Armenia. The copper, molybdenum, gold and silver, lead and zinc, iron, aluminium, perlite, benthonite clays, table salt mines have industrial value.

Metal Mineral Resources. Among the metal mineral resources in the Republic of Armenia the copper-and-molybdenum mines are the most important ones, which are mainly located in the republic's south-eastern part: under the conditions of the Zangezur mountain range limits (Kajaran, Agarak, Dastakert, Lichk, Shikahogh, etc.).

Relatively not large copper-and-molybdenum mines are known also in the republic's area central part (Yelpin, Vardenis) and northern part (Hankavan, Teghut).

Out of mentioned mines only Kajaran and Agarak mines. The Kajaran copper-and-molybdenum mine is the largest one among the metal mineral resources mines in the republic, which unites several mining districts.

Next important group of found metal mines in the republic are the pyrites mines. They are represented by the sulphur-and-pirates (Tandzut), copper-and-pirates (Alaverdi, Shamlugh, Kapan, etc.), pirates and multi-metal (Akhtala), pirates-and-gold multi-metal (Shahumyan, Khalaj, etc.) formation types.

A number of gold mines (Sotk, Meghradzor, etc.) were found and explored in the republic, which are extremely different in terms of geological structure and conditions of origin.

There are also smaller mines and non operating mine manifestations of iron in Abovyan, Hrazdan and Svarants, chromate in Shorzha, manganate in Sarigyugh, Sevkar, antimony in Amasia, mercury in Khosrov, Vardenis, arsenic in Salvard.

Non-Metal Mineral Resources. The area of Republic of Armenia is also rich in non-metal mineral resources, which are widely applied in businesses: chemical industry (barite, sulphur pirates, stony salt), construction (rocks of andesite row, granites, volcanic tuff, volcanic slag, limestone, travertine, pumice, perlite), oil industry (benthonite clay).

Different-type and different-colour volcanic tuff, andesite, basalt, volcanic slag, limestone, perlite, pumice, benthonite and refractory clay, travertine, etc.).

The following are the major non-metal mineral resources mines:

1. Artik Tuff Mine is located in the Province of Shirak by occupying an area of some 220 sq km, tuff stone layer capacity -- 6-7 m.

Origination of the mine is conditioned by a Quaternary period volcanic activity.

2. Anipemza Pumice and Tuff Mine. The largest mine of pumice and pumice tuff in former USSR. It is located in the Province of Shirak by occupying an area of some 2 sq km, maximum capacity of productive layer is 20-25 m, including 5-6 m of tuff and 15-20 m of pumice.

3. Aragats Perlite Mine is located in the Province of Aragatsotn and originally related to the activity of Arteni volcano. The "Perlite" plant in Aragats is operated by its raw material. Perlite is used as filling material for light concrete, heat insulator and raw material for glass.

4. Sarigyugh Benthonite Clay Mine is located in the Province of Tavush. The mine has been originated as a consequence of reformation of volcanic and fission-fragment rocks of acidic composition.

In the form of powders, it is used in oil industry as absorber in oil-and-soap, food, synthetic substances, paper, textile and other industries.

Tumanyan Refractory Clay Mine is located in the Province of Lori. It is exploited in an open method and feeds by raw material the Tumanyan plant of refractory materials.
Avan salt mines are located in Yerevan. The group of salt layer is comprised of sequence of clay and stony salt layers. The capacity is about 700m. The capacity of exploited layers is fluctuating from 10 to 15m. The reserves of stony salt amounts to 25 mln t. The mine is exploited through mine wells, then the created empty holes are used as cave treatment holes.
Jrvedz gypsum-clay mine is located in Yerevan. The content of gypsum fluctuates in the limits of 10-60%. Yerevan gas factory is operating based on it.

Small mines of coal, shale oil, turf, obsidian, agate, carbuncule, which are operated slightly or at all.

Mineral Waters. The territory of the Republic of Armenia is rich in an important part of the mineral resources -- mines of fresh underground waters and mineral waters.

Major sources of feeding of underground waters are precipitation and water vapours condensed in land grounds in the mountain massifs. In some districts lakes, water storage reservoirs and surface flow waters are also contributing to the feeding. Highland mountain ranges, mountain plains and mountain massifs are the areas of groundwater feeding, while intermontane concavities, foothill steep plains and river valleys are major areas for accumulation and unloading. The andesite-and-

basalt lavas and their fission-fragmented options (slag) are playing an exceptionally important role in the field of origination of underground waters. Due to strong chinky nature and porosity they are easily absorbing 70% of precipitation, which at different horizons of lava blanket or at the contact of lavas and old rocks of the foundation are forming strong water flows. These waters are outgoing to the earth surface in the form of springs. They involve the Goght-Garni, Akunk, Arzni, Gyumush, Sarukhan, Shaki and a number of other springs.

Major reserves of pressure waters in intermontane lowlands are located in the Ararat and Shirakartesian basins: in the lake sediments and lava.

Mineral waters saturated with deep gases are formed in the deep fragmented fractures described in the republic's geological structure (1.3), which are outgoing to the earth surface in the form of hot and cold springs. Major part of the mineral waters is saturated by carbonic gas, which serves a reason for observing the country as an area of spread of carbonic mineral waters.

Major mines of mineral waters in Armenia are the mines of Jermuk hot (like Karlsbad), Hankavan and Lichk (like Yessentuki), Arzakan and Bjni (like Vichi) warm, and Dilijan cold (like Borzhom), Ararat and Tatev (like Narzan) warm waters. Sulphate Narzan-like mineral waters are known in the Ijevan district. In the suburbs district of Yerevan there are minerailized saline-and-alkaline waters: Arzni, Getamej, Avazan.

2.13. Specially Protected Natural Areas

The system of Specially Protected Natural Areas (SPNA) in Armenia has been formed since 1958.

According to the law "On Specially Protected Natural Areas" (1991) SPNAs in the republic are classified are classified to state preserves, state sanctuaries, national parks, and nature monuments. There are presently 3 state preserves (Khosrov, Shikahokh, Erebuni), 23 state sanctuaries and 2 national parks (Sevan National Park and Dilijan) operating in Armenia. Total surface area of the protected areas amounts to 311 thousand ha, which is some 10% of the republic's territory. 60% of the specific composition of flora and fauna is protected there. Protected areas in land landscapes amount to some 6%, which is extremely insufficient for a country with a rich landscape and biological diversity under anthropogenic pressure. Specially protected natural areas except for Sevan National Park are mainly forest landscapes.

State Reserves. According to the existing legislation "State preserve is a special environmental area with aesthetic characteristics, and representing an environmental, scientific, natural and historic value, where the natural development processes are going on without a direct involvement". Human activity in the preserves is limited only to scientific research. According to this definition the state preserves in Armenia are considered as protected areas of IUCN "I a" class (IUCN 1994).

1.Khosrov Reserve. Established in 1958, located in the southern location of the Geghama highlands, and on the north-eastern slopes of the Urts and Yeranos mountain chains, in the basins of Azat and Khosrov rivers within the limits of 1400-2250 m of altitude, and occupies an area of 29196 ha. The landscapes of dry sparse growth of trees, frigate and semi-desert landscapes and their unique flora and fauna populations of the central Armenia are protected there.

The reserve's flora comprises 1686 plant species, which is about 50% of Armenia's total flora. 146 of them are registered in RA and the former USSR Red Books. Wild relatives of crops are preserved here. Fruit trees are represented by wild pear and malus, plum, cherry, sorbus, crataegus, almonds etc., and among cereals rye is preserved here. Sparse forests of junipers and oak-trees, mountainous lichens, formations of mountainous steppe and wormwood semi-dessert are also conserved here. Mammals are represented here with 55 species, including brown bear, wild boar, wild cat, Armenian mouflon, lynx, wild goat, wolf, fox, leopard and etc). 142 species of birds, 33 reptiles and 5 species of a number of amphibians and fish are represented here.

No registration of non-vertebrates has been conducted. Arachinda is represented with tarantula, some species of scorpion, cross spider, and various species of tick. Crustacea includes daifa and cyclop, stiffening –a number of species of small mare, as well as various species of orthoptera. A number of butterflies are known here which are registered in the former Red Book.

2.Shikahogh Reserve. Established in 1958, located in the southern part of the republic - in the basins of the Tsav and Shikahogh rivers. It occupies an area of 10 thousand ha ranging of an altitude of 700-2400 m. The oak and hornbeam forests and plant and animal population typical of them are the conservation objects.

Due to forest mosofile nature of vegetation, Caucasian boreal elements are well presented here. Prevailing tree species are oak-trees, carpinus, mixed with the population of taxus, eastern beach, walnut etc. On the upper boundaries of forests (2400-2600m), mixed populations of subalpine oak-trees, birch, mountain ash and junipers grow here. Relict and rare species of ferns grow in the reserve. Various species of snowdrop, iris, tulip, colchicum and meringue are frequently met here. A number of endemic species grow here: Zangezur pear, Takhtanjyan raspberry, mixed tulip, etc. About 70 plant species are registered in the Red Book. Registration of fauna species for the reserve has not been conducted yet. Cheeiroptera is presented with night bat. Bird species registered in the Red Book are as follows: Caspian turkey, griffon vulture, black vulture and white head vulture, etc. Mammals include badger, hare, coypu, wildcat, chamois, wolf, fox, hedgehog, greater horseshoe bat, wild boar, brown bear, lynx, leopard, wild goat and moufflon.

3. Erebuni Reserve. Established in 1981 is located on the border of the Kotayk and Ararat provinces, in the surroundings of Yerevan. It occupies an area of 89 ha. The mountainous xerophyte endemic and unique natural complexes are being protected there. The conservation is focused on wild cereals genetic fund. Despite its small territory, it has rich and diverse vegetation, with 293 plant species. Plant population mainly includes annual cereals: (*Aegilops cylindrica, Secale vavilovii, Triticum araraticum, T. boeoticum,* and *T.urartu)*. There are more than 100 wheat subspecies here. Some rare and endangered plants, registered in the Red Book also can be met here: (Iris *reticulata, Rhizocephalus orientalis, Hohenackeria excapa* and *Cundelia tournefortii*);

The representatives of fauna include 17 reptile species (Vipera *lebetina, Malpolon monspesscullanus, Mabuya aurata,* and *Eumeces schneideri)*, amphibians (Rana *ridibunda, Bufo viridis, Hyla savigni)*, 50 species of birds (including quail, partridge, turtle dove, falcons, harriers, and little owl); mammals include fox, weasel, marten, wolf and badger.

1. Sevan National Park. Sevan National Park is the only one in the republic. It has been established in 1978. It includes the mirror of Lake Sevan and bottom grounds released due to water level lowering. It occupies an area of 150.1 thousand ha, including 24.8 thousand of land area.

There are 1600 species of high-category plants accounted in the territory of Sevan National Park and its buffer zone. Due to the reduction of water level the released land, areas (some 17,000ha) are covered with artificial forests, which represent mixed populations of pine, poplar, conifers, sea buckhorn, and some other trees and scrubs. Junipers, rose hips, mountain ash, and other species of scrubs grow in the protection zone, where the number of astragalus and *dactylis* is quite high, including a number of rare and endangered species. Natural residue woodlands of oak, carpinus, acer, and juniper species together with entangled populations are well preserved here.

Fauna in the National Park is represented with two major groups: terrestrial and aquatic, which include 34 mammals, 267 birds, 3 amphibians, 17 reptiles and 9 fish species. 19m drop of Lake Sevan level within last four decades, as well as artificial dry up of 10 ha wetlands had a very bad negative impact on the fauna of the lake's basin, which is specifically expressed with fish and birds. Birds in the park's territory, registered in the Red Book are as follows: big heron, small heron, mallard, shelduck, flamingo, whooper swan, white headed duck, greylag goose, Armenian gull and stilt. Reptiles include rock lizards *(Lacerta unisexualis, L. nairensis, L. rostombekovi, L. armeniac*a) and snakes *(Natrix natrix, Coronella austriaca, Vipera erivanensis).* Amphibians - green toad *(Bufo viridi*s) and frog *(Rana ichchan*i); Fish species include rare and endangered Sevan trout, barbel, 'kogak' and carp.

Sevan National Park is an environmental scientific-research institution to ensure conservation and supervision of use of natural complexes of Lake Sevan and its basin. It co-ordinates and supervises recreation and tourism development, as well as contributes to the conservation of the historic and cultural monuments in the territory of the park.

The park is divided into 3 functional zones:

- reserve,
- recreation,
- commercial.

It has a protective zone, which includes the areas between the watersheds adjacent to park borders and the lake basin.

The park's territory covers 4 preserves of total area of 3700 ha, 10 sanctuaries starting from 500 m long from the rivers mouths, as well as an area of 7200 ha of recreation zone, including 3000 ha of land area.

Lake Sevan is the object of protection, as well as its watershed basin, unique and endemic animal and plant populations.

2. "Dilijan" Reserve. From 1958 to 2002, it had a status of a state reserve, since 2002- National Park. It is located in the northern part of the country, on the slopes of Pambak, Areguni, Miapor, Gugarats mountain chains, in the basins of Aghstev and Getik rivers by occupying an area of 27995 ha. It is located within the limits of an altitude of 1000-2300 m. The Caucasus-like mesophyll forests, beech and oak-tree populations, a unique yew grove, rare forest fauna and unique historic and architectural monuments are being protected there.

The flora of the park includes 900 species, of which 35 are registered in the Armenian and former USSR Red Book, including unique orchid, iris, *fritillaria,* etc. Prevailing tree species are beach, oak, *carpinus,* along with walnut, malus, pear, pine, *tilia and* birch in the upper borders. Conicera, cornel, berberies, bewa and rose hip are met in the woodlands. Reloct species of *Taxus bacata* can

also be met in the territory of the National Park. Fauna of the National Park is represented with five species of fish, amphibians-4, reptiles-4, birds-147 and mammals-43. Fish species include forel, Cura caboose and Cura barbel etc. Bird species include Caucasian grouse and Caspian snowcock, golden eagle and vulture) Mammal include Caucasian mole, badger, weasel, beech marten, lynx, wild cat, squirrel, wild boar, roe deer, and otter.

Sanctuaries. The sanctuaries have been established yet in 1950-1970s.
According to the RoA law, "On Specially Protected Natural Areas" state sanctuaries are those permanently or temporarily dedicated areas, where the conservation and reproduction of natural complexes representing a reference, scientific, historic and cultural, commercial value and their elements is ensured. Any activity that contradicts to the sanctuary objectives is prohibited on the territory of sanctuaries.

The sanctuaries are empowered with the function of conservation of natural complexes in Armenia and their particular components, improvement and reproduction of plant and animal genetic fund, as well as ensuring the balance between economic, and natural and ecological relations.

The following are registered sanctuaries in the country:

1.Akhnabat yew-tree grove. Established in 1958 on an area of 25 ha. It is located in the northeast of Armenia on southeastern slopes of Miapor mountain chain, in the Basin of Getik River, on an altitude of 1400-1800 m above sea level. A unique Protection yew-tree grove is under conservation there.

2.Maple grove. Established in1958 on an area of 60 ha. It is located in the south of Armenia on the bank of Tsav and Shikahogh rivers on an altitude of 700-800 m. The maple grove, the only natural maple grove in the Caucasus that had been preserved since older times, is the object of conservation.

3.Bear's nut sanctuary. Established in 1958 on an area of 4000 ha. It is located in the north of Armenia, in the Basin of Khachaghbyur River in the Tavush province, on the northern slopes of the Ijevan mountain chain, on an altitude of 1500-1800 m. Bear's nut and yew groves are the conservation objects.

4.Sparse growth of junipers. Established in 1958 on an area of 3310 ha. It is established on the southern slopes of the Areguni and Sevan mountain chains, on an altitude of 2000-3000 m. The conservation object is the sparse growth of junipers (Juniperus) composed of diverse relic juniper species, such as Juniper Polycarpicae (J. polycarpos), Juniper Stinking (J. foetidissima), Juniper sabina (J. sabina) and Juniper Long-leafed (J. oblonga).

5.Myrtle Rose-tree sanctuary. Established in 1959 on an area of 1000 ha. It is located in the north of Armenia on the northern slopes of Pampak and Tsaghkunyats mountain chains in the Provinces of Kotayk and Lori on an altitude of 1900-2200 m. The conservation objects are the specie of relic Caucasian myrtle rose-trees (Rhododendron caucasicum) and other related rare species.

6.Aragats Alpine sanctuary. Established in 1959 on an area of 300 ha. It is located on the upper top of the Mount Aragats massif on an altitude of 3200-3500 m. The conservation object is the glacier Stony Lake, adjacent alpine meadows.

7.Meadow valleys sanctuaries. Established in 1959 on an area of 5000 ha. It is located in the northern slopes of Pambak mountain chain, on an altutude of 1900-2000 m. The conservation objects are extremely degraded mesophyll forests and fauna typical to them, such as roe (Capreolus capreolus), grey bare, Caucasian grouse (Tetrao mlokosiewicsi), etc.

8.Gyulagarak sanctuary. Established in 1958 on an area of 2590 ha. It is located in the Bazum mountain range's Karhank-jur river valley, in the southwest and northeast slopes, on an altitude of 1300-1850 m. The conservation object is the relic pipe-tree forest.

9.Gorovan sand. Established in 1958 on an area of 200 ha. It is located in the Ararat concavity, on the left bank of Vedi river, in the foothills of Urts mountain chain, in a direct neighbourhood to one of the parts of the Khosrov preserve, on an altitude of 1100-1200 m. The conservation objects are animals typical to the sand desert and typical psamophyll plants.

10.Banks pipe-tree sanctuary. Established in 1958 on an area of 400 ha. It is located in the Marmarik river basin, on the northern slopes of Tsaghkunyats mountain chain, on an altitude of 1800-2000 m. The conservation object is the planting grove of pipe-tree banks (Pinus banksiana) specie.

11.Herher sparse growth of trees. Established in 1958 on an area of 6140 ha. It is established in the Basin of Herher River, a tributary to Arpa River, on an altitude of 1600-1800 m. The conservation object is xerophyte mountain and steppe vegetation represented by juniper (Juniperus) sparse grows of trees, *spnduk* (Pyrola) and tragacanth gases massifs.

12.Jermuk sanctuary. Established in 1958 on an area of 3865 ha. It is located in Vayk on the upper flow of Arpa flow, on an altitude of 2000-2500 m. The conservation objects are the oak forests composed of the oak's large-anther (Quercus macranthera) specie and a number of endemic tree-species, and the animals, such as moufflon, Besuarian goat, wild boar and bear.

13.Jermuk mineral waters sanctuary. Established in 1983 on an area of 7000 ha. It is located in the upper flow of Arpa River. The conservation objects are feeding basins of mineral water hot sources.

14.Arzakan and Meghradzor sanctuary. Established in 1971 on an area of 14500 ha. It is located in the Korayk province, in the basin of Daralik and Marmarik rivers, on an altitude of 1600-2100 m. The conservation objects are roe, Ussurian striped deer, brown bear, Caucasian grouse and other forest animals.

15.Ijevan sanctuary. Established in 1971 on an area of 7800 ha. It is located in the northern Armenia - in the Basin of Aghstev River, on an altitude of 900-2100 m. The conservation objects are forest animals and plants.

16.Gandzakar (Upper Aghdan) sanctuary. Established in 1971 on an area of 6800 ha. It is located in the northern Armenia - in the Basin of Paytajur River, a right-bank tributary to Aghstev River. The conservation objects are forest animals.

17.Getik sanctuary. Established in 1971 on an area of 6000 ha. It is located in the northeastern Armenia - in the Basin of Getik River, on an altitude of 1500-2700 m. The conservation objects are forest animals.

18.Yeghegnadzor sanctuary. Established in 1971 on an area of 4200 ha. It is located in Vayk - in the Basin of Yeghegis River, a right-bank tributary to Arpa River. Although the sanctuary has been established to protect animals, the Yeghegis river canyon represents a unique interest in terms of botanical point of view. A number of endemic or rare species are growing in the canyon, which are registered by the former USSR and Armenian Red Data Books. Such as, Smyrniopsis Armenian (Smyrniopsis armena), diverse species of cornflower (Centaurea arpensis, C. phaeopappoides), etc.

19.Hankavan sanctuary. Established in 1981 on an area of 3400 ha. It is located in Marmarik River's upper flow, on the slops of Tsaghkunyats mountain chain. The conservation objects are feeding basins of mineral waters.

20.Vordan karmir (Armenian worm's red, red worm) (Porphyrophora hamelii Brandt). Established in 1987 on an area of 200 ha. It is located in the Ararat concavity, amongst the villages of Argavand, Arazap and Soviet. The conservation object is the halophyte desert with the cereal specie of coastal worm-grass (Aelurotus littoralis), on which the Armenian *vordan karmir* is populated. The Ararat *Vordan karmir* is an endemic insect, which almost three millenniums ago were used to extract red painting material - carmine in the Armenian highland territory. Out of 11000 ha of the area formerly occupied by the insect only 217 ha have been preserved due to the development of the alkali soils in the Ararat valley. Vordan karmir has been registered by the former USSR Red Data Book.

21.Beghakar sanctuary. Established in 1989 on an area of 2790 ha. It is located in the Syunik province's extreme south - on the southern slopes of Zangezur mountain chain. There are endemic, rare species registered there, such as tulip Sosnovski (Tulipa sosnovskyi), Kurdish king crown (Fritillaria kurdica), etc. The species of oak-tree Araksian (Quercus araxina) and a number of rare orchids are found in the oak sparse growth of trees. Rare species of *khazez* unique (Allium paradoxum) and goose-leek (Gagea lutea) are found in mostly mesophyll forests. The local endemic of dandelion Takhtajani (Scrophularia takhtajanii) has been described there.

22.Goris sanctuary. Occupies an area of 1900 ha. It is located in southern Armenia - Zangezur, in the river basins of Vorotan and its tributary Vararakn, on an altitude of 1400-2800 m. It has been established to conserve the fauna (species of roe, Ussurian striped deer, brown bear, wild boar, Causacian grouse) in this region.

23. Sev Lich Reserve. From 1987 to 2001, it had the status of State Reserve, now it is a sanctuary. It is located in the south of Armenia, in the pseudo-crater part of the Syunik volcanic highland's Mount Big Iskhanasar southern foothill, on the borderline of Armenia and Azerbaijan on an altitude of 2658 m and covers an area of 240 ha. Protected areas are the watershed of highland volcanic origin and plant and animal populations adjacent to it. Vegetation in the lake surroundings is mainly represented with meadow populations. Sevan trout is introduced in the lake.

Nature Monuments.

According to the RoA law "On Specially Protected Natural Areas" nature monuments are exclusive or typical natural objects representing a scientific, historic and cultural values.

Great differences of the origin, age and formation related and other characteristics for landscape complexes in Armenia and their individual components created a rich diversity of wildlife and inorganic nature. Many of them have international significance and are considered as international references.

Age-old relic tree-species might be ranked among the wildlife nature monuments, such as broad-leafed maples (surroundings of village Tsaghkavan, Tsav river valley, Meghri), Judas's tree, etc.

The examples of inorganic monuments are recent volcanic formations found in Azat, Arpa, Hrazdan river valleys representing basalt columnar and radial formations, as well as original volcanic cones in the Geghama and Vardenis mountain massifs, unique formations of relief weathering (natural land pyramids in Goris and various fascinating formations), numerous highland small lakes, mineral and freshwater springs, waterfalls, slides, etc.).
Nature monuments are not yet officially registered in the republic. There are no by-laws. Their inventorization and passport-system works are not yet finished.

2.14. Recreation

The Situation of Different Sectors of Recreation and Use of Natural Resources. From the viewpoint of recreation resources, the Republic of Armenia is a sufficiently rich country.

The geological-and-geographical location and landscape diversity of Armenia, its favorable climatic and resort conditions, mineral waters, forests, natural and historic-and-cultural monuments have been serving grounds for large-scale development of recreational sector.

These resources have an important role for the country's socio-economic development. Recreation as an independent sector of Armenia's economy, which has been formed only during recent decade. In the years preceding the independence, it had already approached to the high level of development and become a valid system, which is witnessed by its technical capacities (Table 37).

Table 37

Type of rest objects	Number (units)	Capacity (thousand of people)
Sanatoriums and sanitary prophylactic centres	31	6.4
Rest homes, resorts, sports centres	128	26.3
Tourist centres	19	5.2
Pupils' camps	102	60.6
Total	280	98.5

High level of development of the recreation sector is a witness for formation of dense constructed highly industrial recreation zones in individual areas in the country, such as Tsakhkadzor, Marmarik valley, Dilijan, Jermuk, Arzni resorts, Lake Sevan coastal zone -- tourist centres, rest homes, etc. Major nature-use sector in mentioned zones was recreation industry, which became also major business for local population. After the Spitak disastrous earthquake in 1988 and following well-known events in the region, part of the mentioned objects is used to shelter home-less people and refugees.

All these essentially disorganized the recreation system in the republic.

Recreation resources in Armenia are identified by the following:

- rich diversity of natural resources,
- uniqueness and high values of sanitary utility,
- high density of diverse resources territorial spread,
- harmonized concurrence of natural resources and historical-and-cultural values.

Favorable conditions of the following natural resources play a great role for recreation development:

- landscape diversity of highland zoning,
- climatic conditions,
- water resources, including rich mineral resources,
- relief geological and geodesic favorable conditions,
- flora and fauna resources,
- rare natural objects (monuments of nature).

Natural landscape diversity of highland zoning:
Complete diversity of all natural zones in the country are met on the profile of only 30-40 km in the country, which are observed from the tropics to the poles -- by their unique recreation resources and the conditions of their use. There are many formations of natural landscapes of typical, unique and relic views, which represent high-value objects for popular scientific and aesthetic tourism.

Climatic Conditions: Climatic conditions in Armenia are classified among the world's high-grade recreation resources. Solar (up to 2700/2800 hours/year), clear days (up to 150-200 days/year), sanitary mountainous air full of various ethereal materials, possibilities for concurrence of different altitude zones weather types created ample prerequisites for all types of tourism and rest.

By many of their climatic conditions: air temperature, relative humidity, equivalent effective temperatures, level of suitability of weather types, etc. many sanatoriums in Armenia, such as Jermuk, Arzni, Hankavan, Stepanavan, Goris, Sevan, Martuni, Tavush, Yeghegnadzor, Meghri, etc. are interior to no well-known tourist centre in the world.

Climatic conditions in Armenia are favourable also for winter sports, tourism and rest. Centres for these purposes may be established in Tsakhkadzor, Sevan basin, Aparan, Lori, Zangezur, Tavsuh, Ashotsk.

Water resources:
Water resources play an important role in Armenia both for rest (medicinal and ttherapeutic) and tourism (scientific-and-popular and aesthetic).

The following provinces are mostly rich in mineral resources: Vayots Dzor, Kotayk, Tavush, Gegharkunik and Lori. Mineral waters in the Province of Shirak fail to be used yet.

Geological survey of the mineral waters reserves is going on and they are currently found but not estimated, which have great potential in Gegharkunuk, Kotauk and Lori.

Medicinal mineral waters are different based on their value. The Jermuk and Hankavan waters are used for treatment of intestinal-gastric and support-motive system diseases, the Arzni, Lichk and Hankavan waters are used to treat cardiac-vascular and neural system diseases.

Sanatoriums were established based on the "Jermuk", "Arzni" and "Hankavan" waters and these waters may have wide market outside the country (Table 38).

It should be noted, that surveyed reserves of mineral waters in the republic amount to 274.6 l/sec. Some 100 l/sec is currently used. It makes obvious the possibilities available in Armenia for rest and tourism development. According to the experts' estimation, in case of rational use of existing

Table 38

Sanitary Resources

No.	Mine of mineral water	Estimated reserves, thousand m^3	Value	Factors assisting the use	Factors limiting the use
1	2	3	4	5	6
1	Jermuk	1.469	Drinking, medicinal, bottling	Large quantity of water, favorable climatic conditions	Territorial deficit
2	Arzni	1.649	---"---	Large quantity of water, favorable climatic conditions	---"---
3	Hankavan	3.957	---"---	---"---	---"---
4	Bjni Including districts of Bjni Solak Karashamb Arzakan	2.296 0.898 0.348 0.320 0.730	Drinking, medicinal, bottling	Favorable climatic conditions, resort zone	
5	Lichk	3.403	---"---	Large quantity of water, Territotial availability	
6	Tsovagyugh	0.187	Drinking and sanitary	Territotial availability	Constraining conditions of the "Sevan" National Park and the lake
7	Arpa	0.430	Drinking and medicinal, bottling	Territorial availability	Complicated engineering and geological conditions
8	"Sayat Nova"	0.580	Drinking and medicinal	---"---	----
9	Sevan	2.807	---"---	Large quantities of water, Territorial availability	
10	Vanadzor-Meghrut	1.937	---"---	Large quantities of water, favorable climate	Constraining conditions of the "Sevan" National Park and the lake
11	Kataghbyur	0.423	Drinking	Favorable climatic treatment conditions	In-town location
12	Dilijan	0.165	Medicinal	Favourable forest climatic conditions	
13	Ijevan	0.665	Drinking and medicinal, bottling	Water reserves, availability of forest	Strict area deficit, complicated geological conditions
14	Laligyugh	0.211	Medicinal	---"---	---"---
15	Ghukasyan (Ashotsk)	1.615	Medicinal, bottling	Large reserves of water	Cool climatic conditions
16	Vedi	0.725	Drinking and medicinal	Territorial availability	Hot climatic conditions

waters, it is possible to create in Armenia (provided, if there is adequate economic basis) an up to 50,000-bedroom sanatorium system.

Availability of workplaces in the mentioned sites is mainly related to recreation sector services. Together with the recession in social situation within the recent years the number of people under treatment and rest and, consequently, workplaces have been reduced.

High mountainous lakes, rivers and cool freshwater springs are also notable for their cognitive and aesthetic great values.

Lake Sevan and all its natural reserves take a special place among the recreation resources in Armenia. They are the following: lake's water, 28 tributary rivers, frontal entrance to the 48-kilometer underground water-pipe of Arpa-Sevan next to the village of Tsovinar, a distributary river Hrazdan and a unique underground hydropower plant, rare abundance of solar days, coastal zones and beaches, forests, craters of extinct volcanoes, wild species of flora and fauna, ancient historical and architectural monuments, etc.

Favourable Relief Geological and Geodesic Conditions. Armenia's complicated structure and relief development are important resources for cognitive scientific and aesthetic tourism. Many geological striping, extinct volcanoes and their individual forms are world-famed and important objects of international scientific tourism: Vokhchaberd, Artsvakar Ertech, Pambak, Karashamb and other striping, volcanic and slag cones, basalt columnar separators, earth pyramids, etc.

Biological Resources. The Armenian Plateau is notable by its great biological diversity with a domination of endemic and relic plants and animal species. Here is the home for many of the crops, such as wheat, rye, apricot-tree, peach-tree, etc. Unique populations of flora and fauna for many years became subject for studies by the international scientific community. Armenia became a centre for the field-related scientific tourism.

Sanitary and medicinal climate of the Armenian forests, eatable, decorative and medicinal plants, fruits, wild fowl, rare and endemic plants and animals of cognitive scientific decorative value, monuments of nature make up the forest recreation resources.

Rare Objects of Nature (Monuments of Nature). Be characterizing Armenia as "an open-air museum" one takes into account the monuments of nature, which are marvellous sites not made by hands and having great cognitive scientific and aesthetic value. Bearing exceptional scientific, historical, cultural and aesthetic characteristics, these monuments are attractive both from the cognitive scientific point, as well as from the point of aesthetics and nature studies and research. Presently some 600 monuments have been found in the country. Monuments of nature play a certain role for development of a new form of recreation -- ecological tourism.

Historical-and-architectural Monuments. Armenia has a 3-4 millennium state, rich history and culture. Heritage of Armenian people, created within millenniums, can be met in every step. The followings are ranked among the world human heritage: Haghpat, Sanahin, Goshavank, Echmiadzin, Geghard, Noravank and many other monastery complexes, as well as the Hellenic style temple of Garni, medieval fortresses of Amberd, Lori Berd, and many others.

Armenia is a classical example of ancient medieval and modern civilizations, culture, art, science, literature and history.

Collections of Armenia's museums, galleries are world-famed, and the museum of old manuscripts is unique in the world being an attractive sight for tourists arriving from all over the world.

Thus, brief description of recreation resources shows that the Republic of Armenia has its rich reserves and, if there is adequate investment, it is possible to create a highly developed multi-sector recreation industry and international tourism, which would become one the leading and main sectors of economy in Armenia by all the socio-economic and ecological parameters.

2.15. Economic Mechanisms of Nature Use

Natural resources have been used by human society from immemorial time. Survival of human society is conditioned by two indissoluble parts of nature use and environmental protection, which objectively assumes provision of a continuos and simultaneous relation between natural resources use and protection, which in its turn requires registration of a co-ordinated approach in the observed field:

- maintaining the balance of interaction – and coexistence of human society and natural resource ecosystems,
- improvement of environmental purposeful of use of natural resource potential and production and technical basis for harmonized combination of the processes of efficient (rational) resource use and resource saving,
- establishment and development of a viable legal system for obligatory implementation of environmental actions (programmes) envisaged by the legislation at the account of nature users financial resources and other material investments.

United harmonized action of rational nature use and environmental protection is necessarily assuming availability of appropriate management system, which ensures in-country operation of viable system of checks and balances for state and public supervision and regulation of nature use and environment under high public awareness, perfect legislation, prevalence of law and order.

Environmental economic mechanisms are playing a significant role in regulation of nature use and environment sectors.

The first steps in application of environmental economic instruments in the field of environment has been taken still in the Soviet period, when the Armenian SSR State Planning Committee, Ministry of Finances and State Nature Protection Committee approved in 1986 and put into application damage calculation and recovery mechanism.

The process of application of economic instruments in the field of nature use and environment has been actively developed in particular since independence - when the RoA Supreme Council adopted on July 9, 1991 the RoA Principles on Nature Protection. Its Article 5 defines major definitions and elements of economic mechanisms to ensure environmental protection. The next step in the field were the introduction of paid nature use or so-called "polluter pays" principle (RoA Cabinet Decision No. 448 of September 8, 1993 "On Definition of the Rates Of Natural Resources User's Charges and Environmental Fees").

In further years given the leading experience available in this field, this mechanism has been gradually improved mainly by the efforts of the specialists at the RoA Ministry of Nature Protection and RoA Ministry of Economy (RoA Cabinet Decision No. 221 of June 25, 1997 "On Definition of Rates for Natural Resources Use, Environmental Emission of Hazardous Substances and Establishment of Payment Order"). However, the experience has shown that application of

economic instruments in the field of nature use and environment required legislative solutions. Proceeding from the above mentioned in the end of 1998 corresponding specialists at the RoA Ministry of Nature Protection, RoA Ministry of Finance and Economy have prepared a RoA draft law "On Nature Use and Environmental Rates", which has been adopted by the RoA National Assembly on December 30, 1998.

In order to ensure application of the mentioned law the RoA Government and corresponding ministries have adopted a number important decisions and other legal acts, such as:

- RoA Decision bearing a law force of December 31, 1998 "On the Rates of Environmental Fees",
- RoA Government Decision No. 864, December 30, 1998, "On the Rates of Nature User's Charges",
- RoA Government Decision No. 419 of June 10, 1999 "On Measures to Ensure Application of the RoA Law "On Environmental Fees and Nature User's Charges"",
- RoA Decision No. 340 of May 25, 1999 "On Definition of Rates for Actual Volumes Of Environmental and Nature Use Objects", and a number of other by-laws and standard acts.

On April 19, 2000, Armenian National Assembly has adopted a law "On the Rate of Environmental Fees".

Economic Mechanism (Instruments) for the Use of Land Resources

The nature and types of land resource use in Armenia are based on forms of land tenure and are regulated by the “Civil Code’ and “Land Code” of RA. Property right of citizens and legal entities for land plots is based on the privatization, heritage, purchase, donation, and other transaction of state communal lands and juridical facts.

Land plots are given for use by the owner on permanent use and for leasing. The leasing period of state and community owned lands could not exceed 90 years, except for agricultural significance lands, where the leasing period is determined for 25 years. The leasing right of state and community owned lands are provided through competitive bidding and public bargain. Allocation of lands without competitive bidding is defined by the government. The lands not belonging to the citizens, legal entities or communities are considered as State ownership. The lands located within the boundaries of the community are considered as community lands or city lands, except the lands belonging to the state, citizens, legal entities and other proprietors. The lands out of the boundaries of the community, lands allocated to the community and obtained by them can also be considered as community lands.

State and community owned lands are allocated with the propriety right and use, and the allocation order is defined by the Government of RA. Land privatization of state and community owned lands is realized by provision of land ownership right to the citizens and legal entities. State and community lands are alienated for the use of purposes not prohibited by the law. Alienation of land plots is based on land zoning, usage schemes and main layout of settlements.

State ownership lands are alienated by;

- transferring proprietary right without reimbursement,
- directly selling it,
- auction:

State and community owned lands are provided with proprietary right, without reimbursement for agricultural activities, as homestead gardens, for construction of individual houses and for services in accordance with the provisions set forth in the Land Code of RA (article 64).

The use of lands, provided for agricultural activities without compensation, is forbidden for other purposes. Direct sale of state owned lands is fulfilled in accordance with Land Code of RA (article 66). The price of the direct sale of plots is defined by rate of cadaster price of that plot. Cadaster prices of lands according to their significance, is confirmed by the Government of RA.

The sale of state owned lands, excluding the events specified in the Land Code of RA, are fulfilled with auction, whereas the start price of the auction cannot be less than the 30% of the plot's cadaster price. State owned lands are provided for permanent use, without compensation and bidding to:

- State and community institutions and organizations;
- Charity NGO's and funds;
- Condominiums;
- For the events envisaged by the law and legal acts.

State and community owned lands within the administrative boundaries is provided for permanent use by the head of the community (in city Yerevan by the Yerevan mayor), agricultural lands may be provided to land user for permanent use only after the harvest of the agricultural yield.

Expenditures for the realization, improvement and reclamation of perennial plants and seedlings, as well as expenditures for forest plantations and environmental measures are subject to compensation, the order of which is specified by the Government of RA.

The allocation of lands located out of community administrative boundaries, for permanent use is provided by the marzpet/head of province/ in accordance with the order specified in the law.

State and community owned lands are leased based schemes of land zoning and use, and in accordance with the main layout of the settlements. State and community owned lands, located within the administrative boundaries of the communities, are given for lease by the community authorities (by Yerevan mayor in Yerevan).

State owned lands located out of the administrative boundaries of the communities are leased by the marzpets.

State and community owned lands located within the administrative boundaries of the communities are leased by competitive bidding.

Land plots are leased to:

- citizens of RA;
- RA and foreign legal entities;
- foreign citizens, individuals without any citizenship, individuals having a with special lodging status in Armenia;
- foreign states and international organizations.

The events of land lease without any competitive bidding are specified by the Government of RA. Circulation of land plots is implemented with the contracts and transactions awarded in accordance

with specifications set forth in the Civil Code and Land Code, through transfer of its right from one person to the other.

Land plots, not subject to transfer to citizens or legal entities by the articles of 60 and 62 of the Land Code, cannot be circulated.

Circulation of land plots provided for agricultural production is limited. They may be transferred from one person to the other if the event is allowed by the Land Code.

Circulation of land plots provided to citizens or legal entities for permanent use or for use should be in accordance with Civil Code and Land Code.

Landowner or the tenant (with the agreement of the owner) has the right to invest the land plot or the lease right in statutes capital of the legal entity. Investment rate is defined by the parties agreement based on the licensed assessment report.

State governance or regional self-governance authorities do not have the right to invest the land plots or the right of its permanent use in the statutes capital of legal entities.

Land plots belonging to citizens or legal entities with proprietary right can be sold or procured without changing its purpose and functional significance.

Other specification of sale and procurement of land plots are specified in the Civil Code.

Land use in RA is with payment. The pay for land use is defined in the form of land tax, which is levied in accordance with the legislation of RA. The law "On land tax" was adopted on 14 February 1994, and is effective since April 1 of the same year. The law has to ensure the application of economic instruments in the sphere of land use. Land tax is an obligatory pay levied into state of community budget. The rate of land tax does not depend on the results of economic activities of the payers, and is defined by fixed payment rate per one square of the land plot, on annual basis.

Taxation objects for land tax are the followings:
- for agricultural lands-net income estimated by the evaluation of land cadastre;
- for non-agricultural lands-estimated price of land cadastre.

Taxpayers are the landowners, permanent and temporarily land users of state owned lands. Cadastre data of Armenian state lands are confirmed and indexed by the Government of RA.

The rate of land tax for agricultural lands (including the ones provided for construction of houses, pomology and homestead gardens /summer houses/) is defined as 15% of estimated net income given by the land cadastre.

Land tax for non-agricultural lands is as follows:
a) land tax for industry (including mines and territories destroyed by production activities), transport, communication, radio broadcasting, television, for defense purposes, territories occupied by gas pipelines, as well as water fund lands is defined by cadastre zones (not useable)
and the estimated price given by the cadastre as follows:
- inside the settlements –1%;
- out of settlements-0,5%;

b) rate of forest fund lands (excluding agricultural land types involved in them) is determined according to the cadastre area zone unused lands average cadastre valuation cost's 1%;

c) land tax rate for the rest of non-agricultural value lands is determined by the cadastre area zone for unused lands with average cadastre evaluation cost's 1%;

There are a number of discounts for land tax. Budgetary institutions and organizations, as well as state reserves and sanctuaries, national parks, botanical gardens and lands of historical and cultural value, except for the lands leased out and given for service use, are exempted from this payment.

In order to explain the role of land tax as an economic instrument regulating rational land use mechanism in Armenia it is significant to assess how to ensures those major tasks, for which target tax type is called upon, particularly as:

1. A source of the RoA state and community budget replenishment.
2. A source for accumulation of measures needed to solve environmental concerns in the field of land use.
3. An economic instrument to stimulate rational land use.

Economic Mechanism for Water Resources Use

Water use economic mechanisms in the RoA are regulated by:

- RoA Water Code (adopted on 23.03.1992, No. ÐÜ-0533-1-Ðú-14);
- RoA Law "On Environmental Fees and Nature User's Charges" (adopted on 28.12.1998, No. Ðú-270);
- RoA Cabinet Decision No. 864 of 30.12.1998 "On Rates for Nature User's Charges" and other by-laws.

According to the law, "Water use is the use of water objects both surface and underground waters by population and to meet commercial needs".

Water users in the RoA may be bodies of public administration, enterprises, organizations, institutions and citizens.

Water objects are provided for use to meet domestic, health, industrial, fishery, and other state and public needs. Water objects may be used for one or several purposes.

In case of provision of water objects for simultaneously several purposes water supply for public may not be limited in favor of other water users.

Water objects are provided for use:

- Split water use - by state water use title,
- Special water use - by special water use permit.

General water use is carried out without any permit. State sanitary control and supervision to regulate water use and protection, compliance with the bodies providing fish stock conservation, as well as human life protection in waters, rational use and protection of waters are obligatory in case of general water use.

In case of carrying out general water use local state administration bodies define the sites in an appropriate area where it is prohibited to swim, boat, take water for drinking and domestic purposes, wash animals, etc. Special water use is paid in the RoA.

Water use relations are governed by made contracts stipulating water use volumes, terms, charges and other conditions. All the water users are obliged to pay for water obtained in an order and tariffs approved by the RoA cabinet.

Water objects are provided for permanent or temporary use (short-term - up to 3 years, and long-term - from 3 to 25 years). There is term specified for general water use.

Charge for water use is defined by the RoA Law "On Environmental Fees and Nature User's Charges" and is calculated for accountable period based on water volume directly taken from natural water springs for use purposes, except for fisheries, which is calculated based on 5% of total volume of used water.

Economic Mechanisms for Use of Biological Resources

Use of biological resources in the RoA is regulated by a number of legislative acts, such as:

- RoA Forest Code,
- RoA Law “On Animal Kingdom”,
- RoA Law “On Plant Kingdom”.
- RoA Law "On Environmental Fees and Nature User's Charges"
- RoA Law "On Rates of Environmental Fees and Nature User's Charges"
- A number of other by-laws.

1.Forest Use. The following types of forest use is allowable to be carried out in the Republic of Armenia forests:

- timber procurement,
- secondary forest use (stub) procurement,
- indirect forest use (hay-making, animal grazing, bee-hive installation and bee-keeping, wild fruits, nuts, mushrooms, herbs and technical raw materials collection and procurement),
- forest use for hunting needs,
- forest use for scientific research purposes,
- forest use for cultural and recreational purposes.

Forest fund areas are duly provided for temporarily use for short terms of 5 years and long terms from 5 to 10 years. Their users may be the RoA enterprises, organization and cities/towns.

Forests have environmental significance in Armenia. The forestry in the Soviet period used to be maintained at the account of state budget for the prevailing share (97-98%). Under the RoA state budget limited capacity funding of the system have been significantly changed. The state is in the position (or considers it expedient) to finance 25-30% of the required minimum costs. The remaining part the forestry should be provided at it own account generated from environmental fees and sale of forest indirect products.

Despite the above mentioned the forest management has been done in the RoA in former principle, i.e. timber production is not considered as the principal task. Mainly maintenance and sanitary felling is carried out in the forests. According to Trans-Caucasus Afforestation Service design, drafted before 1992 the felling site fund amounted to 60 thousand cubic meters. However, proceeding from general energy crisis the population has been forced to seek for relatively affordable other energy carriers and the fuel wood in itself became the cheapest and easily accessible good among the energy carriers available in Armenia. Consequently, the RoA cabinet officially approved the "Winter" programme to increase timber procurement volumes. Timber

sales in 1993 approached to 206 thousand cubic meters, in 1994 - to 120 thousand cubic meters, in 1995 - to 150 thousand cubic meters, in 1996 - to 120 thousand cubic meters, in 1997 - to 90 thousand cubic meters, in 1998 - to 64 thousand cubic meters, in 1999 – 36.7 thousand cubic meters, in 2000 – 65 thousand cubic meters. Sale prices of natural timber have also been changed in the referred years (Table 39).

Table 39

Timber sale prices in 1990s

Years	Timber procurement price per 1 cubic meter in Drams
1994	360
1995	1650
1996	2550
1997	4000
1998	4640
1999	4914
2000	6650

An expert's assessment proves for current yearly burning of 0.5 mln cu meters of wood in Armenia, out of which only 10-12% is accounted.

According to the RoA Law "On Environmental Fees and Nature User's Charges" use of timber, as well as other bioresources is paid in Armenia, and the RoA Cabinet Decision No.864 defines the rate for their use (Table 40).

Timber rate has been defined based of tree species and depending upon the type of use, the size of cross-section of fallen tree, and the distance from the forest frontier to the felling site.

Table 40

Forest tree species	Distance (km)	Rate (Dram)			
		Construction timber without rind up to tree trunk cut (cm)			Fuel wood with rind
		Above 25	13-24	3-12	
Beech	Below 10	3.640	3.220	3.220	700
	10-25	2.800	2.520	2.520	630
	25-40	2.520	2.240	2.240	560
	Above 40	2.240	1.960	2.960	420
Oak-tree, ash-tree	Below 10	3.920	3.640	2.800	700
	10-25	3.080	2.800	2.240	630
	25-40	2.520	2.240	1.680	560
	Above 40	1.960	1.680	1.400	420
Hornbeam, maple, elm	Below 10	1.260	1.120	840	700
	10-25	1.120	980	840	630
	25-40	980	840	700	560
	Above 40	840	700	420	420
Other tree species	Below 10	980	840	700	420
	10-25	700	700	560	280
	25-40	560	560	420	350
	Above 40	420	420	280	210

2.Commercial Fishing. Fishing in Armenia was amateurish and commercial purposes for ages. Amateurish fishing is permitted everywhere except for the state reserves. Commercial fishing is performed in Lake Sevan. It accounts for more than 90% of fish caught in the republic. Major fish species in Lake Sevan before drop of the water level used to be *ischkan* trout and *the khrami carp*, while today - *sig* and *crucian carp.* Former fish catching in Lake Sevan performed by state organizations has been substituted by new licensed fishing providing possibility to involve

different ownership forms introduced in Armenia in 1996. This is implemented on the basis of licenses issued by and contracts made with the RoA Ministry of Nature Protection.

3.Plant use for commercial purposes. Major part of plants in Armenia for times was considered as an object of economic activity. According to historical data more than 2000, species of various plants (some 60% of flora) have been used for different purposes.
The public is currently actively using the following species:

- 14-15 species out of some 50 species of wild fruits and cherries,
- 25-30 species out of 850 species containing tanning material and paints,
- 4 species (dog-rose, sea-buckthorn, juniper and almond-tree) out of 270 species of the essential oil plants,
- more than 52 species as herbs.

Despite the fact the Ministry of Nature Protection has recently prepared a new order for herbs collection (by means of issuing permits) which is being applied, it is impossible so far to supervise the collection of mushrooms, fruits and plants on behalf of individual persons on the whole territory of Armenia. Current heavy socio-economic situation of the certain part of population this nature methods is oftentimes becoming the only remedy to mitigate somehow the living standard.

According to the information provided by the Ministry's Bioresources Conservation Division 30.3 t of herbs have been procured in 1998, and 3.3 t - in 1999.

State statistics provides no information on unregulated collection of plants. However, the examination might lead to a conclusion that huge damage is caused to the biodiversity that by increasing is assuming disastrous sizes. Those semi-steppe, steppe and meadow landscapes biocenisis rich in herbs, eatable and decorative species are particularly suffering.

Economic mechanism for use of mineral resources.
Mineral resources have been used by humankind since time immemorial. Output of material values (irrespective to social structure) the output and types of mineral resources extracted (mined) from the interior are simultaneously added in parallel of the increase of production..

Interior use is currently taking and essential part of gross domestic product in almost all the world, particularly developed, countries.

The mineral and raw material basis available in each country determines production infrastructure, its scale and development directions in a given country.

Mines of mineral resources have been known in Armenia since historical times. They have been used not only to meet local needs but also served for goods exchange.

417 mines of solid mineral resources (ferrous, non-ferrous and noble metals, facing and constructional stones, filling materials, constructional materials production, semiprecious stones) and other multi-purpose raw materials discovered to-date on the RoA territory is registered by the state balance. The 135 (the number of legal users is referred) out of them are presently exploited. The rest of 282 mines (including 15 metal mineral resources mines) are registered by the state balance as explored reserve objects (mines).

The RoA Interior Code, "Order on Use of the Interior for Mineral Resources Mining Purposes" approved by the RoA Cabinet Decision No. 374 of August 5, 1994 regulate interior use, including mining of mineral resources in the RoA.

According to the above-referred code the interior might be used in the RoA for the following activities:

- geological survey,
- mining of mineral resources,
- exploitation of mineral resources other than mining of mineral resources.

The enterprises that contain appropriate sector of activity in the charters could be interior users on equal grounds. Interior use by foreign and international enterprises, as well as private citizens is fulfilled in an order established by the Republic of Armenia legislation.

Interior exploitation is paid subject to licensing and contracting. The size of charge for interior use is determined in the order established by the Republic of Armenia Cabinet. In case of exploitation of mineral resources, the charge is retained based on the type and volume of mined raw material.

Use of interior is as a rule a temporarily. The terms of use are defined by a corresponding contract made on a basis of a license. Interior is provided for mineral resources extraction purposes by specially authorized state bodies for interior use and conservation, which issue a permit (license). Licensing of mineral resources extraction without due approval of the preserves is forbidden.

Based on issued permits (licenses) contracts are made with the RoA Ministry of Nature Protection, which is the main legal instrument to define the relationship between the parties while use of interior.

Interior use contracts for mineral resources exploitation purposes are stipulating the following:

- obligations of parts,
- terms and conditions for use of the interior,
- size of fee and its payment method,
- reimbursement procedure of the socio-ecological and other negative damages consequences, proceeding from use of interior.
- reimbursement procedure of cost of interior user in case of advance termination of use of interior at the initiative of provider,
- other terms determining inter-relationship of parts.

Contracts are subject to registration by specially authorized state bodies.

Programmes of industrial enterprises involved in mineral resources extraction for technical operation, as well as oil, gas and groundwater mines rules and mining activities are approved by appropriate organizations by specially authorized bodies in the field of interior use and conservation.

While processing of mineral resources mines and reprocessing of mining raw material the following requirements should be ensured:

- application of those most effective and environmentally safe methods for extraction of primary and associated minerals, which exclude deterioration of mines, extra-standard losses and depletion of mineral resources, as well as selective processing of reserves;

- exclusion of deterioration of operated and adjacent mines, as well as conservation of empty spaces originated from extraction of reserves of mineral resources conserved in the interior;
- in parallel to the extracted and temporarily unused mineral resources, conservation and registration of industrial waste containing mineral components;
- execution of geological survey and mark-shadiering, as well as filing corresponding geological and technical documentation;
- registration of the state and movement of mineral resources, their losses and depletion and state reporting, as well as complex use of raw mineral and empty spaces;
- extraction of mineral components leading to complex reprocessing of mineral raw material;
- protection of employees and public life and health safety, other objects of the interior and environment, building and facilities, preparation of accidents elimination and approval.

Economic mechanism for use of specially protected natural areas.

SPNA protection is carried out by the institutions having a status of a budgetary institution. Since entering into force of the RoA law "On State Budgetary System in the RoA" in 1997 their operational costs are exclusively covered by the state budgetary resources.

Budgetary assignments to this sphere within the recent years are characterized by the following indicators (Table 41):

Table 41

(mln. Drams)

Names of units	1995	1996	1997	1998	1999	2000
1. "Sevan" National Park	11.1	16.0	19.6	65.0	47.0	20.8
2. Preserve and parking complex	11.4	14.4	13.4	17.4	24.3	2.26
3. "Sev Lich" State Preserve	0.7	0.9	0.9	0**	0**	0**
4. Dilijan State Preserve	0*	0*	0*	12.4	10.0	0.85
5. Khosrov Preserve	0*	0*	0*	19.8	17.7	24.1
6. Shikahokh Preserve	0*	0*	0*	2.3	4.3	0.34
7. Scientific Centre	0*	0*	0*	8.0	0***	0
8. SPNA Board	0	0	0	38.1	12.8	5.0
Total	**23.3**	**31.3**	**33.9**	**163.0**	**116.1**	**53.35**

financed by the "Armenian Forestry" budget
****** involved in the Preserve and parking complex in 1998***
******* involved in the Preserve and parking complex in 1999***

To date according to the provisions assigned by current legislation all the charges related to nature use (commercial fishing, hay-making, timber procurement, etc.) in the SPNAs, fees for violations of environmental legislation, environmental damage reimbursement sums are totally entering the state budget.

Application of various types of economical mechanisms (instruments) is conditioned by the issues of the SPNA legislation, and regulated by the RoA law "On Specially Protected Natural Areas". Frames and possibilities of application of economic mechanisms are different in terms of the statuses (regimes) of the SPNAs. Frames of their application are, to a greater extent, limited by areas having a status of *state reserve* where the following activities are forbidden:

- water resources exploitation and any activity that intervene water regime,
- construction and operation of commercial, industrial and dwelling objects, construction of roads, pipelines, electric transmission lines and other means of communication (except for construction of objects necessary for the operation of these institution);
- hunting, fishing, intervention of animal habitats;

- introduction of new plant and animal species, as well as any activity to expand individual species;
- collection of set of sample, except for materials envisaged for scientific research of the reserve area;
- use of toxic chemicals for fertilizing and fighting pests;
- research, processing of mineral resources, deterioration of soil cover, exploitation of mineral layers, deposit exits and mine types exits;
- deforestation, procurement of plants, flowers and seeds, animal grazing, hay-making and other interventions of plant blanket;
- traffic of motor and track-type vehicles outside the general-use roads and water routs;
- traffic and parking of mechanized vehicles outside the road network or places duly assigned;
- any other activity, which intervene with the natural systems and objects, or threatens conservation of objects of scientific or cultural value.

It might be definitely stated that no economic mechanism (or instrument) is officially operated in these areas.

Regime specified for national parks is providing relatively larger possibilities for application of economic mechanisms (instruments).

Application of modern economic mechanisms (instruments) in the single "Sevan" National Park operating presently in Armenia is in the very first phase of development, when the actions envisaged by the Lake Sevan Ecological Balance Rehabilitation Project aimed at the Lake Sevan water resources protection and efficient use are in the preliminary state of implementation. Besides, a strategy for recreational coastal zone development is being formulated, and its implementation (organization) mechanisms are being identified.

Below is given a discussion of some of the existing economic mechanisms (instruments).

The determined charge for the use of Lake Sevan water.
As already mentioned above the following tariffs has been assigned according the RoA cabinet Decision No. 864 of 30.12.1998 starting from January 1, 1999 for use of each cubic meter of water from Lake Sevan:

- for irrigation purposes 0.2 Drams
- for other purposes 1.5 Drams

As a matter of comparison, we may refer to the fact, that as a result of the analysis made by the Lake Sevan Ecological Balance Rehabilitation Project the price of water evaluated as a resource (including all the costs related to the ecological balance rehabilitation) amounted to 120-130 Drams. It is obviously clear, that an economic instrument discussed under these conditions fails to sufficiently ensure (correspond) to the two major principles, such as:

- encourage natural resources efficient use;
- create (accumulate) necessary financial means for conservation of natural resources to ensure their natural reproduction.

Recreational activity
Optimal territorial arrangement of public recreation services is identified as the major form of nature use for a national park area. Among the rest of commercial activities only sectors of

economy (agriculture, souvenir manufacturing, etc.) that are an integrated part of recreational infrastructure and consuming its product directly in the recreation are permitted.

Correct territorial arrangement of recreational services is an important part of the general tasks and responsibilities performed by the "Sevan" National Park, because is identifies the efficiency of rest of the environmental and common commercial activity.

Under the limited capacities of the state budget considerable monetary income (flow) anticipated from this activity may have an essential impact on the financial and technical strengthening of the "Sevan" National Park organization.

Application of the SPNAs new economic mechanisms (instruments) needs additional studies and analysis. Their use should be in correspondence with the development strategy for this field and in harmony with on-going institutional and economic reforms.

CHAPTER 3

DESERTIFICATION IN THE REPUBLIC OF ARMENIA

3.1. Desertification Criteria and Factors

Desertification phenomena and measurements of combating it are extremely urgent in Armenia, since being located in the central arid part of the sub-topical climatic zone, the territory of the republic contains all the characteristics of the area's aridity.

From year to year the human impact on the landscapes is being increased, which results in activation of land disruption processes, particularly, water erosion. Almost half of the country's territory is subject to mudflow phenomena, which fosters desertification process by increasing the surface flow. The capital city of the republic is always under the threat of a mudflow disaster. Salinization phenomena, as well as road and irrigation erosion play a significant role in the development of land disruption. Landslide centers are developed in a number of the river basins. Due to human-made impact thousands of hectares of arable land are excluded from the sector of use annually, forest and pasture areas are reduced.

3.1.1. Desertification Criteria

The following may be assumed as desertification criteria on the territory of the Republic of Armenia:

1. Trend for decrease of humidification index,
2. Increase of daily thermal fluctuations in the air and on the earth,
3. The amplitude and value of the absolute temperatures,
4. Increase of evaporation,
5. Decrease of precipitation quantity,
6. Change in the nature of soil-formation process,
7. Biodiversity reduction,
8. River flow reduction,
9. Intensification of badlanding process,
10. Growth of mudflow-generation and erosion,
11. Decrease of sowing areas efficiency and decrease of humus,
12. Intensification of human-made impact.

Estimations and analysis have shown that shift of mean temperature in the republic in 1998 compared to the 1961-1990 stable mean one is about 0.7%. Serious changes in thermal regime are notable particularly in winter months. Besides, atmospheric precipitation within the recent 30 years has been decreased by some 6%. The estimation shows that humidity index (Visotski and Ivanov index) in the heights of up to 1000 m of altitude in the Ararat valley used to be 0.25, only in some places -- 0.2. Presently the area covered by the 0.2 index is expanded and involves Ararat valley entirely.

Draining is predicted in the steppe zone and zone migration upward to the zone of sub-alpine meadows. The 1.0 humidity index in the northern part of the republic would migrate upward to some 150 m, in the southern parts -- 200-250 m.

Evaporation capacity would be intensified in the republic, related to the growth of the ground-based air layer temperature. Besides, due to decrease of precipitation less conceived temperature would be spent on the precipitation process and the soil temperature should increase.

Increase of temperature of the ground-based layer of atmosphere and decrease of precipitation would be resulted in reduction of absolute and relative humidity. During the summer months frequency of the sub-tropical air massifs would be expanded and they would also migrate upward though until present they rarely raised up the level of 1600-2000 m. Relative humidity during summer months would frequently reduce to 20% and below. The number of clear days and duration of the sun shine would be increased.

Increase of temperature on the territory of the republic would also result increasing of temperature amplitude of ground soil and mother rock's top layers. In its turn this would intensify thermal weathering. Up to 1970s the highest temperature in mid-August on the surface of dark brown rock has been registered as 76^0 -- it would approach $80\text{-}82^0$.

3.1.2. Desertification Factors

Natural factors: Such hydrometeorological phenomena as frequently repeated draughts and hot winds are natural factors of desertification on the territory of the RoA.

Lowland and foothill zones of the Ararat concavity are particularly notable by draught frequency. Frequency of below 100 mm precipitation in the Ararat valley lowland part amounts to the 60-70% of years. Draught frequency is essential in the individual districts in the Vayots Dzor and Syunik marzes -- 40-50% of the years. Based on intensity the draughts are divided into three groups: very strong, strong and moderate. Districts located on an altitude of 1000-1400 m in the above mentioned marzes are those of strong draughts. Districts of moderate draught are lowland north-eastern and inner district on an altitude of 1400-1800 m.

Within the recent decades a growth of hot winds is observed, related to the invasion of tropical air massifs. Very intense hot winds are observed in the Ararat valley, Vayk, Syunik (up to 1200-1400 m of altitude). The hot wind frequency amounts to 30-50% of the years, duration -- often 1-2 days. The number of hot winds in the Ararat valley amounts to 120-160 days per year.

Humidity shortage in Armenia in the second half of the year is the first-grade natural factor of desertification.

The RoA is not rich on natural waters. In the lowland zone annual quantity of precipitation is 250 mm, in the average altitude mountains zone -- 400-600 mm, in the mountains -- 800-1000 mm. These reserves are unevenly distributed both in terms of areas and seasons. Kur river basin in the RoA territory is exposed to more precipitation, than the Arax River basin. The rivers are seasonally flooded by increasing their volume by tens of times in springtime and melting waters are flowing outside the country. In the second half of summer the rivers are fed mainly from underground waters, many of them are drying, the discharge is reduced by tens of times. Some 50% of the rivers flow is occurring in springtime.

Area's geomorphologic characteristics -- relief fragmentation density, deepness, mountainous slopes inclination, slopes distant location are other natural factors of desertification.

The 30% of the republican area have up to 0.6-km/km^2 density, which are mainly the Ararat valley and bottom flat parts of the intermontane concavities. Some 56% have density between 0.6 and 1.2 km/km^2, the rest of the 14% of area are extremely fragmented areas.

Part of the republic's area mainly the Ararat and Shirak valleys have no deep fragmentation, existing rivers are transit by deepening by 1-2 meters into the fields. Those rivers are deeply fragmented which are in the plicate-and-fragmented mountains -- with a depth of 50-200 m. These areas amount to 40-45%, the above 200 m deep valleys are amounting to some 30% of the area.

It should be noted here, that the volcanic cover having weak fragmentation, have deep canyons, such as the Akhuryan, Kasakh, Azat, Vorotan, Arpa canyons, when the channel depth from the edge of lava terrace amounts to 600-800 m.

The 10^0 inclinations in the country amount to 60%, between 10-15^0 -- 15%, 15-20^0-- 14%, remaining 11% represent inclinations above 20^0. Large inclinations are met in the plicate-and-fragmented mountains. The edges of canyons also have large inclinations, where lava masses are merely suspended.

Distant locations in the republic's area are mainly southern or northern: the southern one - 32%, the northern one - 27%, the western and eastern ones together - 20%. The remaining 21% are the valleys.

The southern slopes have higher temperature and less humidity. Intensively expressed mechanical weathering is typical to these slopes. Lands of these slopes are more subject to degradation. The slopes of northern and north-eastern dislocation are more wet-containing, therefore, forest areas are mainly located on these slopes.

Landslide phenomena. The landslide phenomena is developed on the territory of the republic, which covers an area of about 500 km^2 (some 2% of the republic's area). They are particularly developed in the zone of medium altitude mountains. There are landslides in the Akhurian valley (north-west from Gyumri), in the basins of Debed, Aghstev, Vedi, Getik, Vorotan rivers. They are destroying the top-soil and vegetative cover and settlements. For example, the village of Marmarashen on the left bank of Akhuryan River has been completely destroyed and the population has moved the village to a tuff terrace. The same picture is in Dilijan. Landslides and collapses are spread over in the some 125 settlements in the republic, in the sites of a number of historical and cultural memorials, such as Makaravank, Goshavank, Jukhtakvank, etc.

Taking into account the role of surface and underground water flows for activation of landslides, construction of water-pipes (water-supply and wastewater treatment), particularly open canals is obviously prohibited. However, such mistakes has been made particularly in Yerevan city water-supply, irrigation and wastewater treatment practices of adjacent villages: due to inevitable filtration losses activation of landslide processes is observed in the "Garni-Hatsavan-Voghchaberd", "Arzni-Getamej-Ptghni" and other sites.

It is also notable, that above 1500 km out of some 8 thousand km of transportation ways in the republic are located in the landslide influence zone.

Mudflows. More than half of the republic's area is mudflow-generating, it is intensively expressed in the medium-altitude mountains zone, where frequency of downpour precipitation amounts to 4-6.

The mudflows are descending from the mountains to the flowing to the concavities and accumulate prolluvial sedimentation.

The city of Yerevan is situated on the cross-road generating mudflows from Jrvezh, Berdajor and Voghjaberd rivers. Jrvezh river in case of 1% probability may bring 150 m^3/sec, Voghjaberd -- 70 m^3/sec. They are disaster-risky threats for Yerevan.

Due to insufficient quantity of engineering and protective facilities and other measures, because of existing obsoleteness and low reliability a great damage is caused to agriculture -- soil wash-out, generation of gorges as a result of cover with mudflow sediments. These phenomena are particularly spread in the provinces of Syunik, Vayots Dzor, Gegharkunik, Tavush, Shirak, Kotayk, and the area of Yerevan agglomeration.

The mudflows damage generally some 200 settlements in the republic. Above 600 sites of mudflow risk have been found on the main transportation ways.

Submergence, floods. Submergence is widely spread on the territory of republic, mainly in the Ararat and Shirak valleys, some parts of Lake Sevan surroundings, as well as in individual settlements and sites in Lori, Syunik, Vayots Dzor marzes.

The largest areas covered with submergence are located in the boundaries of the Ararat valley and compose some 30% of its area, major part of which are agricultural lands. About 80 settlements are located in these areas, crossways for important transport and other communications, with various vital objects.

Submergence is a reason for another phenomena -- soil salinization. Alkali soils are mainly spread in the Ararat valley and cover some 10% of its area.

Essential part of floods is caused by the mudflows and are generated in some sectors of the mudflow basins, particularly in the areas of mitigation of relief inclinations. The floods generated by flooded waters are observed mainly in the valley parts of the river basins, particularly in the Arax, Hrazdan, Aghstev, and other river basins. For example, dwelling districts of "Atarbekyan" and "Jrarat" on the territory of the town of Hrazdan are periodically subject to floods on Hrazdan River and some stretches of its tributary Marmarik by causing great damages to the population's property and health.

Above mentioned processes are spread on an area of some 56,000 ha.

Natural salinization. Soil salinization under arid climatic conditions is a typical form of desertification manifestation. It occurs in lowland areas, where the level of underground waters is close to the earth surface. Dependant upon land grounds mineral and mechanical composition, capillary ascension may approach to 1-5 meters. Due to water capillary ascension water evaporation is taking place on the soil surface by generating salinated areas. If the underground water level amounts to 0-1 m above earth level then it is leading to site waterlogging.

Anthropogenic factors. Generation and activation of external geological processes are multiplied by active human activity.

Urban development activity is an important man-caused factor for land degradation. It is particularly clear expressed within the course of recent decades, which is conditioned by appropriation of new areas for constructing purposes.

Appropriation of new areas has been carried out to develop existing settlements particularly cities and towns, and to create new settlements, productions, gardens and other complexes.

Due to severe scarcity of favourable land plots for construction purposes in the republic, areas and plots of complicated engineering-and-geological conditions have been intensively appropriated, particularly, extremely steep slopes, slopes of fragmented relief, mudflow-risky, flooded areas and those subject to submergence.

As a result of active urban development activity and intensive appropriation of new areas, a large quantity of new disrupted lands. Geological processes of external origin, landslides in particular, have been significantly activated in the older disrupted areas.

Agriculture. Inadequate use of agricultural equipment results in development of different forms of desertification.

1. One of the negative man-caused impacts is violation of plugging rules, when plugging is done along the inclination direction. It is resulted in deterioration of tens of thousands hectares of arable lands, striped mountain slopes due to water erosion.

2. Appropriate application or absence of sowing circulation is also a desertification factor. Sowing circulation is failed to be adequate due to small size of land plots. Average surface area of one privatized agricultural land plot amounts to 1.4 ha including 1.04 ha of arable land, 0.12 ha of perennial plants and 0.24 ha.

Within the period from 1950 to 1999 arable land area in the republic has been decreased by 166,600 ha, hayfields -- by 15,600 ha, pastures -- by 136,500 ha. As opposed to it perennial plant areas have been increased by 28,800 ha (Table 42).

As a whole the cultivated lands area have been reduced by 85,000 ha or 16% from 1986 to 1994, as a result of miserable state of the irrigation system and its high operational costs. Areas under orchards and vineyards have been significantly decreased as opposed to the vegetables and potatoes.

After land privatization agricultural crop productivity has been significantly decreased as a result of a decline of cultivated soil fertility. Cultivated soil (558,000 ha) fertility decline is roughly estimated at 10-12%.

3. The natural waters are not used efficiently in our country. Half of the waters used for irrigation fail to approach the fields being lost -- by generating bogs and alkali soil. Some 40 cu m of water per second used to be formerly reaching the Ararat valley within the irrigation season of 8 months through the canals fed from Arax River and its almost all left-bank tributaries. Enormous filtration losses from reservoirs and canals lack of irrigation equipment and application of old methods, exceeding of watering norms and other reasons were resulting in artificial feeding of groundwater. Large-scale irrigation work was naturally accompanied by drying work as well.
Within recent 50 years more than 1700 km long drainage-and-collection network. However, drying measures significantly lagged behind the irrigation work, which has been resulted in groundwater

rise. In addition, cleaning and repairing work of the drainage-and-collection network in the Ararat valley have been practically suspended within 1991-1997. They were fortunately re-started in 1997. According to data of the RoA Ministry of Agriculture the situation has been rapidly changed: more than 10,000 ha of wetlands generated within recent years were dewatered, the number of some 70 watered settlements have been reduced to 38, some 300 wells were equipped with valves, etc.

Sine 1920s the Ararat valley started to be watered at the account of artesian fountain waters, the number of deep wells (up to 200-250 m) drilled for that purpose, approached in 1980s to some 3,000.

The irrigation is currently carried out only by means of surface irrigation, while in developed water-scarce countries underground (drip) and other advanced methods are applied. If advanced methods are to be applied, then our water resources would be able to expand twice the irrigated areas.

Due to unregulated irrigation the water sometimes becomes an erosion factor. Due to disrepair of canals by outflowing the waters frequently are generating erosion or turn to a swamp by means of stagnation. Within recent period of time swamping is taking place in the surroundings of hatcheries located in the Ararat valley -- particularly due to unsafe use of waters. Expansion of swamps is contributing to spread of mosquitoes called anopheles, which is resulted in annual increase of the number of people catching fever.

4. Overgrazing of animals leads to new erosion centres. Under the hoofs of animals micro-terraces and goat paths free of vegetative cover. The edges of these micro-terraces are frequently destroyed and water jets are generating erosion centres. In the meadow areas of the Aragats, Geghama and other mountain ranges erosion centres generated as a result of animal grazing are notable. Badland areas are expanded due to overloaded grazing. Good practices of animal feeding are not applied in Armenia so far.

Deforestation. Deforestation is one of the serious factors of desertification. Deforestation all over the country, particularly destruction of large forest massifs in Lori, Tavush, Syunik, Gegharkunik, and other marzes contributes activation of erosion and mudflow processes and rapid growth of degraded lands area. As a result active erosion and mudflow processes occurred in the Vanadzor, Goris, Ijevan, a number of villages of the sub-districts of Noyemberyan, Martuni and other settlements, where a great damage has been caused to residential houses, a number of other facilities, as well as land essential areas of lands of agricultural value causing human casualties as well. It is necessary to duly plan sanitary felling of trees. Felling of trees is currently coming outside the planned felling quotas.
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Entrails use. Open mining in the country leads to generation of disrupted lands, which amounts some 8000 ha. Rehabilitation of these lands becomes an important issue, since 1 ha of disrupted area in its turn contaminates on average more than 10 ha area and generates new erosion centers. Particularly Syunik, Armavir, Ararat and Kotayk marzes should be noted.

Transition period and break-up of international economic relations resulted in shut-down of many existing mines or restriction of their activity. This caused generation of a number of abandoned mines. It is necessary to make an inventory of these mines to identify the areas exhausted mines and the areas which are subject to rehabilitation.

Table 42

Changes in Areas of Agricultural Land Types in Armenia during 1950-1999

thousand ha*

Provinces	Arable land			Perennial plantation			Hay-field			Pasture			Total agricultural types		
	1950	**1999**	**+/-**	**1950**	**1999**	**+/-**	**1950**	**1999**	**+/-**	**1950**	**1999**	**+/-**	**1950**	**1999**	**+/-**
Aragatsotn	78.5	56.2	-22.3	2.2	7.7	+5.5	6.6	4.1	-2.5	108.4	68.7	-39.7	195.7	136.7	-59.0
Ararat	40.6	30.0	-10.6	8.6	11.8	+3.2	3.4	2.9	-0.5	65.1	54.4	-10.7	117.7	99.1	-18.6
Armavir	26.1	40.4	+14.3	9.6	13.6	+4.0	0.3	0.2	-0.1	32.0	26.5	-5.5	68.0	80.7	+12.7
Gegharkunik	115.6	95.3	-20.3	0.3	1.8	+1.5	38.2	35.6	-2.6	120.4	107.4	-13.0	274.5	240.1	-34.4
Lori	74.0	48.4	-25.6	2.9	4.5	+1.6	48.7	39.4	-9.3	124.0	99.9	-24.1	249.6	192.2	-57.4
Kotayk	51.8	40.6	-11.2	1.7	7.6	+5.9	8.6	10.9	+2.3	53.4	40.7	-12.7	115.5	99.8	-15.7
Shirak	115.8	84.5	-31.3	0.2	0.5	+0.3	16.3	16.8	+0.5	83.4	63.9	-19.8	215.7	165.7	-50.0
Syunik	81.9	48.3	-33.6	2.3	2.7	+0.4	12.0	9.6	-2.4	124.7	133.7	+9.0	220.9	194.3	-26.6
Vayots Dzor	31.3	20.6	-10.7	1.6	3.3	+1.7	5.8	4.6	-1.2	56.1	47.4	-8.7	94.8	75.9	-18.9
Tavush	40.6	27.8	-12.8	2.7	6.8	+4.1	14.5	15.0	+0.5	58.4	49.0	-9.4	116.2	98.6	-17.6
Yerevan	4.5	2.2	-2.3	2.7	3.3	+0.6	-/-	-/-	-/-	4.6	2.8	-1.8	11.8	8.3	-3.2
Total in the country	660.7	494.3	-166.4	34.8	63.6	+ 28.8	154.4	139.1	-15.3	830.5	694.4	-136.1	1680.4	1391.4	- 289.0

**** Experts data***

Soil contamination. The following forms of activity may serve as soil contamination sources in Armenia: Agriculture, industry, energy, transport, etc.

Agricultural production is one of the major factors of environmental pollution. Use of toxic chemicals (herbicides, fungicides, insecticides, seed disinfectants, etc.) and fertilizers in inadequate sizes cause contamination of arable lands.

Since the Soviet period mainly chemical methods were employed in Armenia to combat agricultural crop pests and diseases. Above 50 pesticides of different groups were used: chlororganic, phosphorus and organic, nitro-phenol preparations, sulfur, copper compounds. Big amounts of toxic chemicals were used in the Ararat valley.

It should be noted that chlororganic compounds are taking a special place among the pesticides. They are preserved in the soil within 15-20 years after application.

The mining-and-smelting and mining-and-extractive industries (The Kajaran copper and molybdenum group of enterprises, Agarak mining and recovery factory, Alaverdi mining and metallurgy group of enterprises, Ararat gold recovery company) are the most important sources of *soil contamination.* All these companies are contaminating soil by heavy metals (Cu, Hg, As, Pb, Mo, Ni, Cd, Cr, etc.) and cyanic compounds.

Total surface area of lands allocated to the mining companies accounts to 9700 ha, including disrupted lands -- 8275 ha and lands under tail storages -- 1400 ha.

More than 130 large and medium capacity mines and same quantity of local value mines were operated in 1997. All the mines, excluding four, were operated in open (ground) method. The volume of accumulated industrial wastes amounts to several hundreds of millions of cubic meters. Some 300,000 m^3 of industrial wastes were generated within only 1966 despite the fact that this sector's capacity reduced by 10 times.

The impact of mining companies to the desertification of surrounding areas is contributed by means of air and water basins pollution as well. There are basins (Debed river downstream basin, Vokhchi river basin), where chemical, mechanical pollution is taking place. Polluted waters are discharged in one way or another to the irrigation system and damaging the plant areas. It is typical that the areas are located on high altitudes (Kajaran mines -- 2000 m ASL, Sotk gold mines -- 2500 m ASL, Meghradzor gold mine -- 2000 m ASL), which was resulted in downstream landscape damages by their flow waters.

The 3-km range area of the Alaverdi copper and molybdenum factory is highly contaminated with Cu, Zn, Pb, Fe, the content of which is several times exceeding allowable thresholds -- 32.3 (Cu) and 16.0 (Pb).

The areas surrounding the Ararat Gold Recovery Company are also contaminated with heavy metals.

The mining companies -- pits, polymetal mines, tail storages in different districts (Kajaran, Ghapan, Meghri, Agarak, Alaverdi) are contaminated with Zn, As, Hg, Cu and other metals.

Stone processing companies are sources for soil contamination.

Chemical industry companies are contaminating soil with a number of chemical pollutants, particularly PCBs. These are mostly those industries, which use chlorine and its compounds in their technological processes. "Nairit", "Polyvinylacetate" scientific and production amalgamations are among them.

The chlorine and phenol derivatives used in *lacquers and paints* production is generating big amounts of dioxins as accompanying substances.

Dioxins and furans are undesirable accompanying outcomes in many production processes. Due to their persistence and lipophily these compounds are accumulated in adipose tissue and hydrogen abundant systems, such as soil and sediments. Dioxins and furans are persistent towards photochemical and microbiological oxidation, which accounts for their high level in natural environments and long-term preservation in ecosystems, particularly, in soil.

Construction materials production - the Ararat, Hrazdan cement-making factories, asbestos slate and alabaster production, asphalt stationary and mobile factories are generating heavy metals, PCBs, dioxins and oil products, which become a cause for soil contamination.

I. The following are most important sources of soil contamination of energy industry:
- Yerevan Thermal Power Plant (TPP);
- TPP transformer stations;
- Hrazdan Hydropower Plant (HPP);
- Transformer stations and other stations;
- Kanaker HPP transformer stations.

The sites of above objects and surrounding land are contaminated with persistent organic polluters (POPs). The source of POPs is the transformer oil containing such substances. Due to lack or inefficient operation of water/oil separating equipment POPs through the release facilities are discharged to the rivers, which are irrigating the fields. Thus, not only area of power plants and thermal plants and their surroundings are contaminated but also arable lands.

In terms of soil contamination operation of automobile transport is hazardous. The reason is the tetra-ethyl-lead added to petrol as anti-detonator. The hazard of its disintegration together with the used gases is emitted to the environment by contaminating not only the road soil but also areas adjacent to it. It should be noted, that vehicles are major source of Polychlorinated Aromatic Hydrocarbons (PAHs) in urban areas. Vehicles are also the source of dioxins and furans generated from the use of leaded gasoline containing dichlorethane and other organic compounds.

Both industrial and domestic wastes are also a factor for land contamination.
Within a period of the most extensive development of industrial potential (1985-1990) in Armenia some 36.7 mln tones of industrial wastes were annually produced in Armenia, including 20,000 t of hazardous containing heavy metals, fluorine, chromium compounds, solvents, etc. There are hazardous substances also in domestic wastes.

There is no waste ground and waste-recycling station is available in Armenia so far. Industrial wastes are disposed in the domestic wastes landfills without any decontamination. The state of the landfills is absolutely inconsistent with the accepted sanitary norms and hazardous substances are penetrating to the soil and contaminating it. PCBs, dioxins and furans are generated from waste burning and contaminating the environment.

Disruption of biological diversity. The current state of wild plants and animals species in Armenia is threatening. The human impact on the environment is continuously growing by reducing the number of species, ecosystems disbalancing and land degradation.. Within the recent millenniums human pressure on land has been basically growing due to expanded use of forest resources and feed holdings. Since 1920s these problems turned to be more obvious due to a progressive population growth and urbanization. This expanded human impact not only on individual species but also on the whole ecosystems. Even a number of species recorded in the Red Book of the Republic of Armenia are endangered (yew-tree**,** maple, Armenian moufflon, panther, Sevan trout, etc.) Due to reduction of natural food resources and elimination of nestling sites birds have also survived a destitution. As a consequence of drying out of Gilli and other wetlands (some 10,000 ha) deep and uncoverable changes took place in terrestrial and wetland flora and fauna. Due to reducing of the Lake Sevan level eutrophication processes originated in it. Due to loss of natural environment and disruption of feed base only 50 species remained today in Sevan out of more than 160 species of migratory birds. The lake's fishes have also strongly degraded and appeared on the edge of elimination, including Sevan trout, koghak, barbel.

The specific composition and quantity of mammals and reptiles have been obviously decreased in the watershed.

A number of species of herbs, eatable and decorative plants are endangered due to unregulated nature-use. This process negatively impacts fauna.

Bad cattle-breeding practices had serious impact on natural biodiversity. They are the following: creation of large-scale cattle-breeding farms, multi-sector incoming and outgoing roads, centralized animal watering sites, which serves a reason for trampling down and complete elimination or degradation of the vegetative cover of arable lands by the machinery and animals. Due to water scarcity epidemic centers are created in the animal watering sites, which are also causing a great damage to wild animals.

Tree specific composition and areas have been changed in addition to forest-covered areas in the republic due to short-sighted human activity and climate dryness. Within the recent 100 years the forests in Armenia have been twice surviving excessive deforestation. The first one took place in 1930-1950s, when the felling was done for industrial purposes. The second one occurred since 1991 due to economic and energy crisis in the republic, which caused elimination of forest-covered areas by disrupting ecological balance in the environment. Due to unsystematic maintenance of the forests, grazing, hay-making and other reasons deep structural changes took place in the forest, such as, loss of ability for natural rehabilitation by the groves, decrease of productivity, activation of erosion phenomenon, disruption of hydrological regime. Due to intensive erosion processes in the deforested mountain slopes the mudflow and landslide possibility have been increased.

Industry and energy also have negative impact to the environment. Several tens of small and medium-size industrial enterprises used to be in Armenia until 1920s having practically no impact on biodiversity. In the future between 1921 and 1990 industry has been strongly developed and negatively impacts biodiversity. The environmental issues were given a secondary significance. It regarded alienation of the land areas, degradation of natural landscapes, soil contamination, and air and water basins pollution. Within only one pre-crisis year (1987) air emission from industrial

enterprises in Armenia amounted to minimum 245,000 t of about 50 types of hazardous substances, including solid waste -- 54,400 t, gaseous and liquid particles -- 190,600 tones.

Currently, when most of the industrial enterprises are lacked, emission of hazardous substances has been rapidly reduced.

The impact of energy has been first recorded since 1950s. Lowering of the Lake Sevan level by 19 meters had a negative impact on the natural balances of whole biogeocenosis. The lake and wetland flora and fauna have suffered. Plant and animal specific composition is also influenced by heat energy.

Vehicle emission has a negative impact on biodiversity. Within the recent years emission of hazardous substances has been decreased. However, a reason for such a decrease is not an outcome of environmental activity, but the consequence of economic crisis (decrease of transport use). In 1995 compared to previous years vehicle emission had a rapid increase -- its share of 53,382 tones accounted to 94%, while in 1987 it accounted to 67% of the total.

Tourism and recreation as an independent sector of economy in Armenia started its rapidly developed since 1980, which became a practical factor of landscape and biological diversity. As a consequence of such impact in case of inefficient arrangement of recreation area the following processes are taking place in the environment:

- trampling and tightening of soil blanket leading to change of the land ground physical and mechanical structure, chemical composition, hydrothermal regime which is resulted in area degradation and desertification.
- change of specific composition of area's biodiversity and biodiversity degradation,
- due to area use, construction and pollution loss of natural habitats of many animals and plants and, consequently, landscape degradation.

Obvious examples of degradation in Armenia are the landscapes of Tsakhkadzor, Marmarik valley, Dilijan, Byurakan forest, where active desertification processes are going on -- reduction of forest upper and lower limits, becoming strictly sparse, massif destruction of plants, active processes of land washing and erosion.

3.2. Peculiarities of Landscape Desertification

The multi-character relief in the Republic of Armenia, as well as geographic location made their own imprint on the nature of the republic's whole area by generating differences in vegetative and soil cover and other elements reflected in different physical-and-geographic districts and landscape ascending zones. Meanwhile, human economic activity is highly affecting the landscapes by communicating them a new property. The landscape property has been also changed in the course of geological development.

The research proves that in the course of geological development landscape evolution in the whole Armenian plateau and its north-eastern part had one common trend -- transformation of slightly expressed humid moderate-type landscapes to changeable humid forest and moderate humid meadow-and-steppe, then to turfy-and-steppe, and pure steppe type landscape. It means that a trend of aridity has been dominating which is still presently continued.

Starting from Holocene the impact of man-made factor on natural development has been continuously increasing by approaching to large sizes within the recent 200 years. It resulted in

significant acceleration of the process of aridity of the landscape shell, which within the recent decades more obviously acquires a desertification character -- forest-covered areas have been decreased, arable land and pasture degradation accepted catastrophic sizes. More than half of the republic's total area 35% of the agricultural holdings are subject to erosion.

The mountainous landscapes are sensitive enough towards climate changes. The archaeological-and-historical data witness, that Armenia's landscapes have undergone essential changes within several millenniums. The forest and alpine landscapes have been essentially reduced versus expansion of the desert and steppe landscapes.

In forest areas (particularly, in the republic's south-east) a slow but persistent expansion of the semi-deserts at the account of the forest's lower section is observed. There is an obvious shift of semi-desert zone towards steppe. The latter is shifted towards the meadow-and-steppe and sub-alpine zone. There a change in ration between steppe and forest which is displayed by invasion of plant cenosis towards the lower forest boundary (western and eastern slopes of the mountains).

Woodlands in Armenia amount to 334,000 ha or 11,2%, which amounts to 0.1 ha per capita. 62% of the forest are located in the north-east and 2% -- in the inner central districts. The analysis of historical data witnesses, that merely 3 millenniums ago the forest-covered areas in the republic exceeded the current sizes of coverage by 3 times.

Due to the influence of natural and human-made factors a heterotropic succession of forest ecosystems and their degradation. However, main reason of forest modification is human activity.

Desertification processes in different areas of the Republic of Armenia have aged-old history.

From this point Ararat concavity is of particular concern, where development of desertification factors are mainly caused by its geological structure and geodynamic characteristics.

Study of formation of hydrogeological and hydrological conditions, active tectonic and young volcanic processes influencing re-allocation of underground and surface flows in a particular district, are very important in terms of understanding of desertification processes and their temporal trends. An indicator of such an impact is the separation of the Arax river-bed, the main water-way in the Ararat valley.

The phenomena of the Arax shift in itself directly made an impact on the target area's land cover qualitative changes and its current state. This phenomena within a long period of time has been resulted in gradual land degradation in the this area and bogging, salination of individual abandoned sites, or served a reason for destructive processes of deflation.

The fact of the Arax river-bed separation has been recorded in the works by Movses Khorenatsi. They witness that 2000 years ago Arax used to flow through the Davtablur foothill (next to the village of Armavir), where the capital city of ancient Armenia -- Armavir used to be located. Then, due to the bogging of Arax river-bed and its separation to the south, the capital city moved to Yervandashat.

The issue of Arax separation has been published in early scientific publications, saying that the Arax's top northern Paleolithic riverbed is Sevjur river. In later research the process of separation is explained by arched ascending of the Aragats and Geghama plateau, and relative descending of the Ararat concave valley. Meanwhile, the outflow cones of the Arax tributaries and accumulation of

alluvial-and-prolluvial masses in the zones of compensation flexures have played an essential role. In the opinion of other authors separation of the riverbed is related with continuos growth of brakhimorf folds resulted from salty tectonic phenomenon.

Based on the analysis of stadia survey: spectral reflective characteristics of grounds and land layer, their level of humidity and other parameters, individual parts of Paleolithic riverbeds have been recovered (see map). The following three major generations are identified: Paleoarax - 1, Paleoarax - 2 and Paleoarax - 3.

The geodynamic conditions and tectonics of the Ararat valley made their imprint on the current state of land cover and served a reason for Arax separation in the central part of the Armavir tectonic depression.

Thus, current desertification processes within the boundaries of Ararat valley are predetermined by existing geodynamic conditions and serve as derivatives of active tectonic movements and local deformation of the region's earth crust. An inter-related row bearing a unified temporal trend is being recorded: active tectonics -- regime of underground and surface waters -- desertification processes.

The separation phenomena of the Arax river serves as a geodynamic processes indication, which is quite sensitively echoing to the dynamic changes of surface relief in the region. At the same time, Arax is the largest water flow in the region. Its spatial changes, which took place within long historic period of time, made a direct impact on the development of desertification processes in the Ararat valley.

In the northern part of the Ararat valley: from the villages of Shenavan and Getashen (west) to the village of Ranchpar (east) numerous riverbeds of Paleo-Arax. There are clear historic data, which allow dating the separation. The first capital of the Armenian Kingdom -- Fortress city of Armavir is located on Davitablur. The "History of Armenia" by Movses Khorenatsi goes to say, that Aramayis builds an apartment for himself and names in his own name as Armavir, and the river -- as Yeraskh (Arax). The second record says that in the Yervand's days the court and the capital are moving from a hill called Armavir, since Yeraskh river removed from it and severe breath of the northern wind during a long winter freezes over its waters and there is no way to obtain water for the king and the capital city. The latter event is dated to 200-220 BC.

Thus, we have a precise date of 200-220, when Arax river is flowing along the Davtablur lowland. The stripes of the older riverbed are well-preserved to present. The speed of Arax separation in those years amounted to 35-40 m/year.

However, Arax continued to be separated also in older times. There is a well-preserved irrigation system of the Urartian period, which is a witness for the Arax's significant separation.

Arax also started to be separated after 200-220s. Another citation from the "History of Armenia" by Movses Khorenatsi dated 220-230 BC says, that Yervand moved to his palace (from Armavir) to the west, on a rocky hill surrounded by Yerashkh. Akhuryan river flows on the opposite side.
The first capital of the Armenian Kingdom had been abandoned in 200-220s due to southern separation of Arax river. The Arax separation generated tectonic activation of active fracture of Sardarapat located south of Sardarapat. The fracture runs along the longitude from Armavir to the current point of mixture of Akhuryan and Arax rivers. The fracture displays a right-side overthrust component -- with a speed of 1cm/year of perpendicular separation. Intensive vertical separations

with Sardarapat fracture are recorded under availability of the Urartian-period canals, which are located 70 m up the Sardarapat fracture -- under the carrying rubble layer -- made by khalcolitic period obsidian-made instruments.

Therefore, activation of Arax in 200-220 BC resulted in separation of Arax, desertification of area located around Armavir, and removal of the first capital city in Armenia.

The capital city has been removed to the west -- Yervandashat. Yervandashat is located on a hill: in the point of junction of Arax and Akhuryan rivers, where many numerous Paleolithic riverbeds of the large river in the region have been preserved.

The Paleolithic riverbeds are clearly identified on the relief and are well pronounced by multi-meter (up to 20 m) alluvial layers, which are mainly the rubble sediments of the larger river. Petrographic composition of the gravel is obviously witnesses that this is the rabble of Arax. Numerous ancient settlements are observed on the banks of this river. Large stony anchors found by us are witnessing, that local population lived next to the big river. In addition, numerous remnants of old irrigation systems. The region located between the point of juncture of Arax and Akhuryan rivers to the north-west is presently one of the most arid district in Armenia. This is absolutely infertile, stony alkaline desert, which is totally free from any vegetation. At the same time there are many traces of ancient settlements located on the banks of large river, and the traces located there witness that people and the rivers used be contemporaries (anchors, canals).

Based on the obtained data the following model of the region development in upper Pleistocene-Holocene may be assumed. In the mentioned period the Ararat valley used to be spread far to the west. Intensive volcanic activity paralleled with the lava and slag eruptions changed the flows of Arax and Akhuryan rivers. However, even then the overall south-western district of Armenia for long time continued to be a fairly favourable place for human activity. These areas contained many lakes in lava pits, and Arax river used to flow in their center. The people used to live on the river banks, and that served the place where the second capital city of Armenian Kingdom moved in 300 BC. That was the place of then cults center -- city of Baghavan. Ruins of large ancient city have been succeeded to identify on a satellite images of today's Turkey territory (right bank of Akhuryan river), which by its size exceeded areas of the largest ancient capital cities of Armenia -- Armavir, Dvin and Ani. This city is presently located in an absolutely decertified area. Possibly, a rapid tectonic activation of the Sardarapat fracture took place in 200-100 BC, which were resulted in a change of the Arax riverbed and general elevation of the area caused by a number of geological disasters. These geological processes lead to a complete desertification of the western part of the Ararat valley.

Movses Khorenatsi writes, that Artashes constructed a city on a hill in the point of juncture of Yeraskh and Metsamor, and called it in his own name -- Artashat. Yeraskh used to abundantly supply him with pine-tree.

Analysis of archaeological and historical data display that the Ararat valley relief from 500 BC to 300-500 AD differs from the current one. Within the limits of Ararat valley Arax river generated numerous bends covered with abundant vegetative cover. Dense wetlands have been formed along the river bends, Paleolithic riverbeds and river basins banks, a dense pine-tree forest used to grow on higher sites. The animal kingdom used to be represented here by a large quantity of dares, wild boars, bears, lions and other animals. Abundant water, an exceptional richness of plant and animal kingdom create favourable conditions for human life. Another large river -- a tributary to Arax -- Metsamor used to flow to the north from Arax. Metsamor means in Armenian a large swampy

river. This river does not exist any more. Modern Sevjur, Kasakh, Hrazdan, Azat and Vedi rivers are joining a united river Metsamor, which is tributary to Arax -- next to the Khorvirap hill. King Artashes established the third capital city of Armenia -- Artashat-- at that particular hill, in the site of juncture of Metsamor and Arax rivers.

In 300-388 BC a regular geological activation of the Sardarapat fracture took place. Metsamor river ceased its existence as a consequence of latter, and river's tributaries -- Sevjur, kasakh, Hrazdan, Azat and Vedi -- flowed then independently into Hrazdan. As a result of said hydrodynamic process surrounding of Artashat turned to be swamps, the air used to be full of adore, and King Khosrov Kotak transferred the capital city to Dvin.

Thus, within a relatively short period of time from 330 to 300 BC, the geological activation made its most serious impact on the Ararat valley's landscape, generated separation of the riverbed of Arax river, caused disappearance of Metsamor river, desertification of significant territories, lead to three transfers of the capital cities, rapid change in economic and political life in the country.

Active geological processes made an impact and would continuously be impacting on the Ararat valley's landscape and desertification and, therefore, require serious investigations and continuos monitoring.

Monitoring based on satellite data may also be quite perspective -- as concerned to the change of Armenia's forest cover, as well as after environmental assessment within the next years.

CHAPTER 4

SOCIO-ECONOMIC CONSEQUENCES OF DESERTIFICATION

4.1. Correlation of Desertification and Economy

Desertification processes contribute prevention and decline of economic sector, and also negatively impact political, social, cultural and environmental sectors by speeding up influence of individual negative factors and aggravating existing social, political, economic and environmental issues.

From the other hand, from the environmental viewpoint, no disbalanced economic development or inefficient management is making a negative impact on the environment; worsen existing environmental situation and ultimately speed-up desertification processes. Therefore, correlation of desertification processes and economic situation is bi-lateral, interrelated and often the influence of the latter is more prevailing.

In order to assess the impact of desertification processes on economy first we need to separate expenditures covered by the state to:

- prevent impact of desertification processes.
- cover mitigation measures for desertification processes impact.
- carry out measures aimed at liquidation of impact of desertification processes.

Ultimately, the total of above costs with some limitations could be assumed as valued economic impact assessment of desertification processes. The costs that are covered by the state in order to prevent, reduce (mitigate) the impact of desertification processes and liquidate their consequences.

Practically it is very difficult to strictly divide costs and measures up to the above criteria, since they are oftentimes duplicated. We would anyway try to assess costs undertaken by comparing to other costs of comparative significance and assessing their being satisfactory or unsatisfactory.

Current and capital costs could be classified as group 1 and 2 environmental costs, including:

1. Land-utilization measures (inventory and cadastre assessment of agricultural and other lands);
2. Flood control measures (riverside and gully protective facilities);
3. Irrigation system operational costs;
4. Hydraulic engineering facilities operational costs;
5. Landslide control measures.
6. Forest-protective and forest rehabilitation activities;
7. Cost of conservation of specially protected areas.

Group 3 costs could include the following:

1. Construction of individual hydraulic engineering facilities;
2. Rehabilitation of disturbed lands;
3. Rural-and-chemical various activities and measures.

Costs undertaken within the recent three years to prevent, reduce (mitigate) and liquidate the consequences of desertification processes in the Republic of Armenia are stated in Table 43.
Compared data stated in Table 43 with the total costs stipulated by the state budget this data amounted to 1.3% in 1998, 1.6% - in 1999, 2.0 – in 2000. Compared to GDP it amounted to 0.30% in 1998, 0.39% - in 1999, 0.45% - in 2000.

Agriculture is a most closely related sector to desertification processes in Armenia. More than quarter of the lands in the Ararat Valley, main agrarian zone in the country, is out of use because of land salinization. These processes are intensified by non-rated irrigation, inadequate state of drainage system and rising of level of underground waters containing dissolved salts. Total surface area of land subject to desalinization amounts to 55000 ha.

Table 43

Types of Measures (name)	Costs covered by the state					
	1998		1999		2000	
	AMD mln	Percentage of total	AMD mln	Percentage of total	AMD mln	Percentage of total
1. Costs incurred to prevent or mitigate the impact of desertification processes, including:	1531	53.4	1444.2	42.1	1497.6	39.3
1.1. Land planning actions	103	3.6	150.0	4.4	0	0
1.2.Anti-flood actions	160	5.6	160.0	4.7	133.0	3.5
1.3. Anti-landslide actions	0	0	190.0	5.5	0	0
1.4. Forest-protection and reforestation actions	100	3.5	64.5	1.9	108.7	2.9
1.5. SPNAs protections costs	142	5	116.1	3.4	53.4	1.4
1.6. Irrigation systems operation costs	317	11	272.2	7.9	388.8	10.4
1.7. Hydraulic structures operation costs	709	24.7	491.4	14.3	813.7	21.5
2. Costs targeted at elimination (partial elimination) of consequences of desertification processes, including:	1337	46.6	1984.6	57.9	2312.7	60.7
2.1. Improvement of reclamation situation of irrigated lands	41	1.4	586.6	17.0	329.3	8.6
2.2. Different agricultural and chemical actions	60	2.1	32.0	1.0	32.0	0.8
2.3. Construction of hydraulic structures	1200	41.8	1350.0	39.4	1915.4	50.4
2.4. Other similar costs	36	1.3	16.0	0.5	36	0.9
Total costs	**2868**	**100**	**3428.8**	**100**	**3810.3**	**100**

Chaotic and short-sighted privatization activities have significantly contributed to reduction of cultivated land areas. It was resulted in shortage of population resources to rent agricultural equipment, to purchase fuel, fertilizers and plant-protection means, to cover irrigation fees.

Studies done at the provinces in Armenia showed that products produced at the farms are mostly consumed in the farms. There are no adequate prerequisites for production growth and development. The production has mainly natural and foodstuff nature rather than goods nature.

The rest of factors that cause low level of marketability of agricultural goods mainly include the following:

- Extremely small sizes of farms,
- No organized markets for seeding materials, fertilizers, toxic chemicals, as well as stable irrigation and breeding services,
- No access to use of crop production and cattle-breeding services,
- No accessible insurance market requiring warranties in the field of farming due to fluctuation of natural and climatic conditions,

- No organized markets for wholesale and retail sale of agricultural products (or low level of accessibility),
- Permanent shortage of credit resources to supplement the lack of circulation resources in the farms,
- No credit towards profitability of corporate investment.

Above-mentioned clearly shows that there are serious problems in the field of agricultural development in the Republic of Armenia. Actions taken by the state so far fail to provide improvement of efficiency of agricultural development, rational use of agricultural lands, expansion of areas of their use. Besides, soil productivity is decreased and weathering processes are intensified due to lack of agricultural equipment, application of bad agricultural practices (e.g. no crop rotation has been practically applied anywhere in RoA within recent 10 years).

Forestry sector. Forests in Armenia by their mountainous nature are notable by their land-protective, water-protective and climate-regulative features. Bearing in mind that forests cover 11,2% of Armenia's territory, then an invaluable role for prevention of desertification processes is becoming obvious. Long-term, intense and non-system forest management taking no account to biological and ecological characteristics of the forests have reduced forest-covered areas in Armenia by 3-4 times. It caused intensification of erosion processes by developing desertification of areas and supporting to aggravation of continentality of the climate.

After declaration of independence in Armenia, when unreasoned and rapid reformation actions in the field of energy sector and long-term blockade of the country caused an energy crisis, which first of all damaged the forests as the cheapest and most affordable energy carrier. Illegal wood-cuttings carried out for fuel and construction wood purposes striped many hectares of mountainous slopes. Calculations show that within recent years some 30000 ha of forests have been cut in different level intensity, including 7000 ha was cut totally. It is natural that deepening of desertification processes in forest areas is a serious threat for further development of forestry sector.

One of unique and distinctive manifestation of interrelation between desertification and economy is the lake Sevan problem, which has both environmental and socio-economic nature for Armenia. It has been recognized as an important regional problem by a number of international organizations. Violation of environmental balance of the lake has a significant impact on the change of regime of surface and underground waters and aridity processes. Lake Sevan is an invaluable perspective source of drinking water in the region.

It is well known that century-old lake's water resources started to be used for irrigation and energy purposes in 1936. As a consequence lake water level has currently dropped by some 19.3 meters (Table 44).

Table 44

Comparative morphometric data on Lake Sevan

Characteristics	1936	2000
Deepest point	98.7	79.7 (-19%)
Average deepness	41.3	26.8 (-35%)
Surface area (sq. m)	1416.2	1238.8 (-12.5%)
Volume (cu m)	58.48	33.20 (-43.2%)
Level (m)	1915.97	1896.65 (-19.32m)

Drop of Lake Sevan water level has been resulted in undesirable changes in the water biochemical circulation, lake ecosystem structural-and-functional correlation, which together with the wastewater discharged contributed to the development of eutrophication processes. As a consequence, biomass of phytoplankton has been increased by about two times; the lake is actively

"blooming" in a regular way thanks to massif reproduction of toxic blue-and-green algae. According to date of the Institute of Hydroecology and Ichthyology of the National Academy of Sciences of the Republic of Armenia accumulations of organic substances in the lake in 1999 amounted to 150000 tons, meanwhile in 1930s it amounted to 25000 tons. Similar pace of lake eutrophication in the near future would invalidate the lake water not only for drinking but also for energy and recreation purposes by exacerbating desertification processes both in lake watershed and in the region.

Activation of desertification processes in the rest of the economic sectors is contributing to irreversible damage caused to topsoil and bad decisions in the field of urban development and consequently constructed facilities, highways, individual settlements, land plots allocated for cottages are making negative environmental impact by mainly activating exogenous and landslide processes.

It is more important for Armenia to arrange rational use of stone mining. Waste generated as a consequence of stone mining is currently amounting to 30 mln cu m. It covers above 900 ha of area.
As a summary it could be stated that impact of desertification processes on the economy is multi-sided and correlated. Activities currently undertaken by the state are still insufficient both in terms of their scope and qualitative composition. On the other hand, existing difficulties in the field of economic development, inadequate economic mechanism fail to support efficient use of land, interior wealth, and other natural resources. As a consequence, activities (costs) undertaken by the state fail to prevent, to mitigate negative impact of desertification processes as opposed to often contribution to their activation. Deepening processes of correlation between desertification and economy are negatively influencing social situation of population, which is expressed by direct and indirect impact.

Direct impact involve material damage caused to population as a consequence of desertification, which generate a need for additional costs aimed at liquidation of their consequences.

The following are forms of impact of desertification on the population social situation:
1.Decrease of monetary income, which is conditioned by:

-

Decrease of soil fertility;

- Decrease of area of used land types;
- Decrease of bioresources used by population;
- Additional costs incurred to liquidate or mitigate the consequences of desertification processes.

2.By deterioration of housing conditions resulted in abandoning of many settlements, activation of population migration processes. It has been expressly reflected within the recent years caused by:

- Earthquake of 1988 and then unprecedented slow pace of rehabilitation process,
- Blockade and military actions in the border-line districts,
- Economic and energy crisis.

Migration processes have two trends: emigration and in-country migration. According to official data some 700000 people emigrated from the Armenia, while some independent experts assess it to 1 mln people. Movement of rural population towards urban and lowland areas, particularly to the Ararat valley, characterizes in-country migration. From this viewpoint the situation is disturbing in boundary and mountainous settlements, where according to analytical data socio-economic situation survived a severe drop of economic potential.

Indirect impact is conditioned by the country's economic base, which predetermines actual situation of population. In this event negative impact of desertification processes is expressed in general terms of damage caused to public and economy in the country, which makes its consequence on the Assessment of desertification processes on the latter could be macroeconomic criteria – expenses incurred by the state to liquidate (reduce, mitigate) the consequences of desertification processes compared to expenses allocated for social sector (Table 45).

Table 45

	1998		1999		2000	
	AMD bln	**Percentage**	**AMD bln**	**Percentage**	**AMD bln**	**Percentage**
Gross Domestic Product in RoA	951.9	100.0	991.5	100.0	1032.6	100.0
Expenses allocated to social sector	57.455	6.0	69.057	7.0	63.84	6.2
Expenses aimed at liquidation of desertification processes and their mitigation	2.868	0.3	3.429	0.34	3.810	0.47

Based on the comparison it could be stated that ratio between expenses incurred for liquidation and mitigation of desertification processes and expenses allocated for social sector is currently amounting to 1:16 – 1:20.

4.2. Economic-and-environmental Predictions for Desertification

Man-made nature of economic development in Armenia in the 20th century generated serious environmental issues, which during recent 10 years due to transition to market economy and existing political situation have been exacerbated. Desertification processes until 1990 have been conditioned by man-made factor and displayed as:

- Pasture degradation and consequent active land erosion,
- Secondary erosion of lands,
- Land degradation by pollutants and domestic and industrial waste of various nature,
- Qualitative depletion of terrestrial waters.

Activation of these processes have been displayed by the following manifestation in 1991-2000:

- Inadmissible reduction of forest areas due to massif deforestation,
- Exacerbation of eutrophication processes in Lake Sevan due to overexploitation of the lake's water resources.

These processes have been resulted in the following:

- Activation of natural factors (humidity scarcity, landslide phenomena, floods, natural salinization) contributing to desertification,
- Quantitative and qualitative decrease of bioresources,
- Reduction of agricultural lands and decrease of gross domestic product,
- Rapid drop in population living standard,
- Activation of emigration and in-country migration.

Continuous nature of the trend of similar processes witnesses that environmental safety issues are still not paid enough consideration in Armenia. There is no environmental safety policy developed

on a state level, which would presume investment of a system of actions and measures to ensure sustainable development of natural systems aimed at security of interests of individuals, public, state, maximum decrease of damage caused to the country's environment.

Assessing the economic-and-environmental situation in Armenia is could definitely stated that:

1. No studies for economic-and-environmental predictions related to economic development are undertaken by the state;
2. Environmental issues are still not considered are priority in the country's short-term, medium-term and long-term programmes;
3. No environmental examination concept, environmental impact assessment and environmental limitation and standards,
4. Inadequate environmental monitoring.

Existing economic-and-environmental situation in the country and no urgent measures aimed at the liquidation of its reasons make grounds to conclude that negative consequences of desertification processes are currently of continuous nature and deepening trend.

P A R T II

CHAPTER 1

STRATEGY TRENDS OF ACTIONS TO COMBAT DESERTIFICATION IN ARMENIA

As a result of the analysis undertaken the problems of desertification in Armenia and reasons and factors causing them have been identified. Comprehensive measurements aimed at improvement of existing socio-economic situation in the country could essentially contribute liquidation or mitigation of the latter by including the following:

- Enhancement of legislation and management system,
- Improvement of economy,
- Enhancement of mechanisms for nature use.

The system of comprehensive measurements completely reflects the nature of international commitments, undertaken by the Republic of Armenia in different sectors, particularly on environmental conventions, such as UN Convention on Biological Diversity, UN Convention on Climate Change, and UN Convention to Combat Desertification. Given this fact the following measures are essential for termination or reduction of desertification processes in Armenia:

- Development and implementation of joint projects within the framework of the Conventions,
- Regional and sub-regional cooperation.

1.1. Enhancement of Legislation and Management System

1.1.1. Enhancement of Legislation

Environmental protection and natural resources use compatibility to legislation is a priority issue in the process to combat desertification. It is necessary to take into account, that legislative basis related to these fields is mainly formulated in the initial phase of market relations (1991-1994). In this viewpoint not only incompliance do exist, but also the laws often do not reflect environmental requirements of RA Civil Code and international conventions, ratified by Armenia. The main reasons for this situation are evolving republic and its legislative body, Soviet regime legacy, which failed to consider environment as a priority task, prolonged duration of laws preparation and adoption.

Need for improvement of legislation is conditioned also by excessive detailed nature of the laws and incomplete adoption of by-laws and regulations resulting from them, mainly in the field of environment, which negatively impacts the quality of applying the laws. On the other hand, a number of fields, directly related to environmental protection, have no legislative support at all.
Given above mentioned, improvement of legislation in the Republic of Armenia should be aimed at:

1. Adoption of new laws, ensuring nature and environmental protection;
2. Adequate changes and amendments in existing laws;
3. Adoption of by-laws.

1. New laws. Efficiency of fighting desertification aimed at maintenance of ecological balance of nature and environment is conditioned by availability of important laws, ensuring regulation of public relations in various economical sectors. In these terms an analysis of the RoA laws proved that there is a number of unresolved issues in the field of environmental protection,

entrepreneurship, agriculture, social security and other sectors, which are not regulated by appropriate laws so far.
Adoption of the following laws of priority significance could essentially support prevention or mitigation of impact of desertification processes in the country:

- On environmental protection,
- On wastes,
- On chemical substances,
- On territorial administration,
- On compensation of damage caused to public by natural and other calamities.

2. Changes and amendments in existing legislation. Changes and amendments in existing RoA legislation are conditioned by compatibility of public relations in the field of environmental protection and use of natural resources. It should be aimed at reflection of environmental provisions regulating all the sectors of economy in the country and comprehensive approach. From this point the following have principle significance:

- Specification of authorities for territorial management and self-governance bodies;
- Definition of rights and obligations of an official in charge, implementing supervision over environmental law enforcement;
- Definition of rights and obligations of an official in charge, implementing conservation of natural resources;
- Economic incentives for natural resources conservation and use;
- Specification of rights and obligations of natural resources users;
- Specification of implementing mechanisms for state management and monitoring of natural resources;
- Definition of criteria and legal regime for environmental calamities and areas subject to desertification, as well as mechanisms for introduction of compensation system and privileges for local population.

The above mentioned changes and amendments should be done in the RoA laws "On Nature Protection Legislation Principles", "On Specially Protected Natural Areas", "On Self-Governance", "On Atmosphere Air Protection", "Forest Code" and "Water Code".

The appropriate articles in the RoA "Administrative Transgressions Code" need to be revised as well. With this respect it should be underlined that the more socially threatening is the transgression aimed against public relationship, the more expressive should be the measure of coercion.

Changes and amendments in the existing RoA legislation should be aimed at elimination of discrepancies and internal contradictions. For example, according to Article 15 of "Nature Protection Legislation Principles" it is prohibited to pass for operation those objects, which do not match all the environmental requirements. Board chairmen and members responsible for passing objects are subject to administrative and criminal responsibility.

In this respect it should be mentioned that Articles 61, 73 and 81 of the Code stipulate administrative responsibility for putting into operation enterprises, municipal and other objects without facilities and installations to prevent negative impact (Article 61); for putting into operation new and reconstructed enterprises, workshops, units, transportation ways, municipal and other objects without stations to prevent negative impact on the forests (Article 73); putting into

operation new and reconstructed enterprises, facilities and other objects which fail to meet air protection requirements (Article 81).

3. By-laws. It is obvious that availability of by-laws and regulations calls for adopted codes and laws acting force and are important mechanisms to support their activities. A particular importance in the process to combat desertification in Armenia obtains adoption of the by-laws which refer to:

- Conducting of natural resources cadastres;
- Arrangement and implementation of natural resources monitoring;
- State environmental supervision;
- Sanitary and protective zones protection;
- Compliance the RoA legislation and international agreements;
- Environmental impact assessment.

Besides, there are absolutely no by-laws for state reserves protective zones. Charters of the reserves need to be reviewed to comply with RoA legislation. Regimes for state reserves are not defined, as well as criteria for identification and inventory of nature monuments. A need to adopt by-laws proceeding from the RoA Forest Code do exist.

Adoption of these by-laws and regulations is an urgent task today. Their development requires serious scientific justification, which should proceed from international criteria by taking into account local peculiarities.

1.1.2. Improvement of Management System

Success of fighting desertification first of all depends on implementation of unified strategy in the field of environment. From this point major task of the state is to strengthen the mechanism for environmental management, to improve environmental planning and integrate environmental and other sectors' policy while economic reformation. Sustainable socio-economic development of population should be based upon:

- Capacity to take into account environmental priorities while preparing and making economic and other decisions;
- Conducting a unified state environmental policy;
- Study and analysis of reasons for environmental degradation interrelated by social, economic and environmental factors;
- Improvement of environmental activities within the state socio-economic policy framework and environmental management system;
- Implementation of permanent, comprehensive and universal programmes for public environmental education and training;
- Effective participation of non-governmental organisations and local population in conducting comprehensive activities for unified environmental policy;
- Provision of open, full, reliable and timely environmental information.

Therefore, improvement of state management system for implementation of unified state policy for environmental protection and use of natural resources should be aimed at:

- coordination of institutions involved in environmental issues,
- expansion of territorial management and local self-governance bodies authorities,
- settlement system management.

Coordination of Environmental Institutions

Comprehensive structure of the public environmental administration involves almost all the bodies of public administration (ministries, agencies, territorial administration), where an urgent need to improve cooperation to implement a comprehensive environmental policy do exist.
Implementation of integrated public policy in the field of survey, conservation, rehabilitation and use of natural resources by an integral public administration body for natural resources is an obligatory necessity to handle desertification issues in the country. According to the requirements of existing legislation this body is the Ministry of Nature Protection of the Republic of Armenia. In order to coordinate activities of institutions involved in environmental issues and implement public environmental policy, the priority issue is development of the following strategic areas.

1. Improvement of environmental monitoring system. Different organisations are currently involved in implementation of environmental monitoring in Armenia, which act to different extent, in an incomplete format and without any regulation. It is resulted in lack of coordination data collection and processing. Air, land, water resources, flora and fauna monitoring fail to be adequately performed. In order to handle these issues the following is required:

- develop an environmental monitoring concept in Armenia,
- improve organisational chart of the Centre for Environmental Monitoring under the RoA Ministry of Nature Protection

Performance of these responsibilities would enable set-up of valid environmental monitoring and establish a system for desertification monitoring to cover the following:

- set-up of a pilot network for the most essential sites, aimed to permanent or temporary control of ecosystems state,
- creating aero satellite and mapping data bank for natural resources,
- scaling of landscape ecological tension criteria and assessment,
- operative thematic mapping (current state, change and prediction),
- landscape optimisation and operation modelling,

2. Improvement of state environmental examination system. Environmental impact assessment is aimed at ensuring environmental vital characteristics and public environmental safety. It covers environmental protection and planning of economic activity. The operation of the state environmental examination system under the RoA Ministry of Nature Protection should be streamlined at:

- development of an environmental examination concept,
- set-up activities to implement environmental examination
- review and improvement of institution's legal status
- drafting required by-laws and normative acts,
- public involvement in implementation of environmental examination and provision of information

In addition, mechanisms should be set to enable:

- involving the environmental impact assessment into the natural resources use licensing and land use planning;
- use the environmental impact assessment while preparation of programmes, projects and policy concepts;
- contribution to alternative analysis of environmental impact assessment.

3. Improvement of state environmental monitoring. The Republican State Environmental Inspectorate (RSEI) under the RoA Ministry of Nature Protection is in charge of state control over compliance with requirements of the environmental legislation. Emerging market and public

relations, political and socio-economic situation established in the country since 1990 caused serious problems in the process of performance of RSEI responsibilities.
Current setting of majority of environmental laws in force and a number of environment-related international obligations undertaken by Armenia challenges rapid improvement of RSEI system. The following priority issues are strategically important in these terms:

- formulation of RSEI concept,
- set-up of RSEI activities,
- review of RSEI's organisational chart,
- development of methodological regulations for performance of inspectorate responsibilities in different sectors of economy,
- introduction of modern laboratory equipment and methods,
- technical re-equipment,
- introduction of mechanisms to stimulate RSEI staff,
- publication of statistical data on RSEI activities.

To improve coordination of institutions involved in environment-related issues in order to ensure objective performance of responsibilities and efficiency of reforms in Monitoring Center under the RoA Ministry of Nature Protection, State Environmental Expertise and RSEI the following measures are required :

- develop and introduce mechanisms, which would ensure interrelated and harmonious operation of these services;
- develop and introduce mechanisms, which would ensure interrelated and harmonious operation of the RoA Ministry of Nature Protection with republican and provincial governance;
- develop and introduce mechanisms, which would enable environmental integration of non-governmental, scientific and educational institutions activities
- discuss the issues of decentralisation of natural resources state governance, nature protection and nature use.

Principal and fair implementation of environmental monitoring and expertise is required in the fields of entrails and forest use in transition period.

Enhancement of Responsibilities of Territorial and Local Self-governance Authorities

Natural-and-geographical, demographic characteristics, discrepancy in the levels of socio-economic development cause the significance of territorial policy, where the key issues are as follows:

- harmonious socio-economic development of administrative and territorial units;
- further decentralisation of public administration and economic regulation;
- improvement of local self-governance role and efficiency;
- balance between state administration and local self-governance;

The Government would pursue an active economic policy with respect to the provinces with different level of socio-economic development. It should be realistic, provide possibility to promote settlement development. State policy would be aimed at supporting to businesses, application of incentive system and provision of necessary conditions for their independent development, including restructuring economical infrastructures in marzes, ensuring terms for investments, development projects, aimed to new workplaces creating, review of financial support systems.
Based on above-mentioned issues improvement of management system should be carried out in the following directions.

1. Specification of Responsibilities of Territorial and Local Self-governance Authorities. It particularly foresees to provide maximum supervisory, regulatory responsibilities to marz governors by expanding and clarification of local boards responsibilities and activities. The major task should be implementation of normative legal acts of the RoA laws, RoA President, Cabinet, Prime Minister and ministries and agencies. In order to perform this task the marz institution should be also empowered with the responsibility to implement local monitoring on the territory of marz, retaining the national level to the ministries and agencies. Regulation of implementation mechanisms of delegated responsibilities by the state and specification of their funding is given a special importance.

Those well-known principles for local self-governance should be mainly applied, such as transfer of public authorities to local self-governance bodies, if they could be more efficiently exercised in the communities, compliance of authorities exercised and their funding, a right to perform any kind of activity, which is not against the law.

Community ownership should be assumed as the basis of local self-governance that should form measures for local revenues to meet socio-economic requirements of the population. This would encourage development of local self-governance system as one of the major elements of civil society.

Enhancement of the rights of local self-governance authorities in the field of socio-economic development, use of raw materials, natural, labour resources and environmental protection would support restructuring of inter-provincial and inner-provincial relations management, including improvement of inter-relations between local self-governance and territorial administration authorities.

2. Further decentralisation of public services, widening of community ownership margins, which foresees:

- Improvement of community infrastructure management administrative-and-legal forms, elaboration of management model and their activity, establishment of inter-community associations,
- Allocation of capital investments, subsidies, subventions, cash grants and other assistance by means of inter-community associations.

It particularly relates to water-supply, irrigation, housing fund, waste disposal, green zone protection, community transport, maintenance and use of power and gas supply network.

In this context an option for community consolidation is being foreseen to be considered by retaining the authority of providing such services to larger cities and reducing costs in smaller communities, or liquidating existing community enterprises.

Similar issues should be resolved also with respect to social infrastructure transferred particularly in the field of education, health, and culture.

The role of communities should be raised within the social service system. This would serve a basis for application of other projects of social welfare by the communities, particularly introduction of housing welfare system. Decentralisation processes would necessarily be inter-related with ongoing economic reforms in a given field, which would be resulted in community group ability to provide similar sustainable services of adequate quality.

3. Formulation of target projects, aimed at support to marzes, communities, separate areas development and improvement of their enhancement. Development of efficient schemes for productive force allocation in said areas. To that aim it is necessary:

- Initiate circulation of draft concept for settlements aimed at even development of RoA marzes;
- Develop a data system for marzes, communities (areas) socio-economic characteristics and assessment methods.

A system for community socio-economic resources characteristics would serve a basis for preparing a community passport. These passports should enable to separate and classify the communities, as well as specify government approaches to financial resources allocation and territorial policy implementation.

A particular attention should be paid to elaboration and implementation of target projects for development of abandoned, boundary, underdeveloped, mountainous settlements, zones, and separate areas. Development of such projects is conditioned by high level of poverty in these settlements and sparse population - a factor for desertification threat.

In these terms it is necessary to keep-on elaborating projects on rural settlements development, boundary settlements enhancement. RA Government has approved concept paper and timetable for solving the problems of high mountainous and boundary settlements. Communities and settlements involved into the projects on above mentioned, as well as projects on disaster zone recovering must be provided with a number of privileges.
On the viewpoint of economical policy the state support to the business activation, enhancing of economical potential of this settlements is required. Similar actions would involve establishing a state-owned network of infrastructures to carry out economic activities in these settlements.

Settling System Management

Development and expansion of a perspective settling outline by the RoA Cabinet is significant for the resolution of the issues related to Republic of Armenia area rational settling, environmental improvement, creation of favourable conditions for public life, work and recreation.

Implementing of outline provisions taking into account demographic capacity and environmental balance of area, should ensure a broad action programme – from rational settling around the RoA territory to identification of functional role of individual settlements and prediction of their development trends. The outline should consider feasible options of project proposals in the field of industry, agriculture, energy, environment, education and science, communication, social welfare and other sectors.

Settling outline assessment should be resulted in:

- Capacities of efficient use of natural resources, which define trends for perspective development integrated with the issues of environmental protection;
- Level of consuming capability of different urban development and economic zones for improvement of preferable economic forms, transport and engineering infrastructure of settlement network, and further regime for use of these zones ;
- Estimation of demographic capacity determining the maximum amount of population, which could meet its daily requirements basing on own resources, without violating the environmental balance.
- Establishing of multi-functional urban or rural centers in under-developed zones;
- Rehabilitation of formerly abandoned or liquidated settlements.

Implementation of these measures would enable to finally form developed provincial and inter-marz (economic) settlement systems with improved engineering infrastructures and decrease the threat of desertification on the territory of country.

1.2. Economic Development

Economic development of Armenia the coming years will keep-on the man-made nature. Thus, handling of environmental concerns in Armenia would be more complicated and cost-consuming. Even under current situation additional environmental actions and costs are required to be made by public, state, territorial administration and local self-governance authorities.

The economic situation in the country could be stabilised and improved by means of change of socio-economic development by setting new value and moral basis, reviewing the structure of measures, priorities, objectives and requirements of human activity,

It is necessary that productive and economic activities be built based on the system of environmental and legal relationship system, which would regulate meeting environmental and sanitary-and-hygienic requirements and ensure implementation of measures for public health and environmental actions. The idea that environmental protection would only be efficient in case, once it becomes major part of economic mechanism and profitable for a business unit, should be the basis for economic and environmental changes.

1.2.1. Agriculture

In order to find a way out of the situation established in agriculture and further to prevent desertification processes or mitigate the impact, it is necessary to implement scientifically justified following integrated actions:

a) In the field of cattle-breeding
- establish cattle-breeding maintenance system;

b) Pasture and hay-field improvement:
- introduction of anti-erosion reclamation measurements, rotative grazing, pasture regulation, stone collection, elimination of harmful plants, fertilising, road development, watering;

c) Arable land development:
- introduction of anti-erosion land treatment and phyto-reclamation measure;
- use of organic and mineral fertilisers to maintain land humus stock and fertility in the rates stated below:

On forest chestnut stepped soil

For <u>irrigable</u> tier crops
Manure 30-60 t/ha+ $N_{90-120}P_{60}K_{60}$ or $N_{120-150}P_{90}K_{90}$,
For wheat: $N_{120-150}P_{60-90}K_{45-60}$,
For perennial and annual grass: $N_{30-45}P_{30}K_{30}$.
For <u>non-irrigable</u> wheat: $N_{60-90}P_{30-60}K_{30-45}$,
For perennial and annual grass: $N_{30-45}P_{30}K_{30}$.

On black soil

For <u>irrigable</u> tier crops
Manure 45-60 t/ha+ $N_{90-120}P_{90-120}K_{60-90}$ or $N_{150-180}P_{90-120}K_{60-90}$,
For wheat: $N_{120-150}P_{60-90}K_{60}$.
For <u>non-irrigable</u> wheat: $N_{90-120}P_{60}K_{60}$,

For perennial and annual grass: $N_{30-45}P_{30}K_{30}$.

On brown soil

For irrigable tier crops:
Manure 30-60 t/ha+ $N_{90-120}P_{60}K_{60}$ or $N_{120-150}P_{90}K_{90}$,
For wheat: $N_{120-150}P_{60-90}K_{60}$,
For perennial and annual grass: $N_{30-45}P_{30}K_{30}$.
For perennial and annual grass: $N_{60-90}P_{30-60}K_{30-45}$.

On semi-desert gray soil

For tier crops:
Manure 60-90 ï/Ñ³+ $N_{60-90}P_{90}K_{60}$ Ï³Ù $N_{120-180}P_{90-120}K_{60-90}$,
For wheat $N_{90-150}P_{60-90}K_{45-60}$,
For perennial grass: $N_{45-60}P_{30-45}K_{30}$.

In parallel to all this it is necessary to carry out the following:

- Selection of optimal options for crop rotation,
- Use of technical measures provided for soil tillage???, mountain farming,
- Use of reasonable quantities the most safe types of chemical means for plant protection aimed to ensure environmentally safe production,
- Cleaning from stones of arable lands and crumbling of cemented layer in the desert-and-steppe zone lands (particularly in case of establishing perennial plantations),
- Adjustment of irrigation system, water supply of crops,
- Rehabilitation of irrigation and drainage collection system,
- Set-up of wash-out regime with high irrigation standards in new improved and secondary salinated lands,
- Use of the safest means for plant protection in defined rates and optimal terms.

1.2.2. Urban Development

Combat desertification in the field of urban development activities from the point of action ranking could be reviewed from the point of three aspects:

1. Application of environmental limitations,
2. Rational land use,
3. Prevention of exogenous geological processes.

1. Combination of urban development activity and environmental limitations requires actions for the following step-by-step phases:

- Designing
- Project discussion and approval
- Project implementation

Nature protective limitations are represented in relevant construction norms, state standards, instructions and guidelines.

2. Natural resources conservation expects sustainable land use. In this purpose the land for settlement development have to be unuseful for agriculture(exceptions are made according to --). Though a great deal of high quality lands have been escaped from the agricultural circle.

Allocation of agricultural lands for urban development purposes is often related to the appropriation of areas with fragmented relief and complicated geological conditions. Appropriation of such areas requires a number of additional actions, including:

- development of new urban development concept,

- special construction and architectural approaches of buildings and facilities,
- engineering background of areas, as well as provision of regular operation of other measures serving to safety of areas and engineering protection facilities,
- implementation of a comprehensive measures of engineering protection of areas from exogenous geological processes of areas.

3. One of the most important perspectives of urban development activities is *engineering protection of areas from exogenous geological processes,* which are part of the important desertification factors (landslides, mudflows, etc.).
In this field actions targeted to combat desertification could be conditionally divided into following phases:

Priority engineering-and-protective actions. In order to fulfil priority phased engineering-and-protective actions on the most endangered areas it is required:

- Design and exploration work:
- Project implementation:
- Commission of engineering-and-protective facilities:

Long-term actions to prevent exogenous geological phenomena. This is composed of a number tasks, including sustainable monitoring of the process, coordination of all the activities, perspective (strategical) projects development and implementation.

In order to prevent exogenous geological phenomena and timely execution of priority engineering-and-protective actions (anti-landslide, anti-rockslide, anti-mudflow, anti-erosion) it is necessary:

- Mapping of external geological phenomena on the territory of Armenia in the scale of 1:200000 or 1:100000 dependent upon the level of the threat,
- Decoding of districts and areas with external hazardous geological processes, large-scale mapping, scientific justification and assessment of the level of risk, catalogue and data bank creating,
- Development of spatio-temporal prediction theory and methods of engineering-and-geological conditions, their typification and zoning. Identification of interrelation of exogenous and endogenous factors. Comprehensive classification and assessment. Development of new methods of the phenomena investigation and decoding. Preliminary investigation of the mostly hazardous areas
- Development of actions to raise slope and landscapes sustainability, input of new materials, methods and technologies,
- Prediction of endogenous geological processes development, mathematical modelling of actions developed.
- Development of theoretical basis and comprehensive methods to arrange and put into operation geodynamic, hydrodynamic geomonitoring.

1.2.3. Industry

Activities of industrial sector makes a multi-lateral impact on natural landscapes. In Armenia this is contributed by landscapes, tailings generated from mining, inadequate state of sewage treatment plants, etc. which are resulted in plant, animal and land degradation, agricultural land area reduction, pollution of water resources, deterioration of sanitary-and-hygienic conditions, and finally, desertification.

Hence, improvement works should be first of all targeted at providing vitality of environmental situation, including:

- Develop a scientific technical program for environmental safety in Armenia,
- Develop and introduce wasteless industry technologies,
- Develop and introduce waste processing technologies,
- Improve the management system for waste removal and disposal.

In order to prevent further degradation of ecosystems in Armenia it is necessary to:

1. Conduct waste inventory. It is known that last time such inventory in the country has been conducted in 1987, which estimated to 24.4 mln tons of total waste quantity in the country.
2. Conduct reclamation of man-made landscapes, which would essentially contribute to stabilisation of environmental conditions. Major trends of reclamation of disrupted lands should be the following: agricultural, recreation, forestry, water and fishery, construction.
3. Improve the process of conducting environmental standards by applying such a system, which would enable gradual implementation of limitations within coming 20-30 years using intermediate standards.
4. Use those market mechanisms, which enable improvement of pollution fees system.
5. Review priorities of state expenses in terms of targeting industrial rehabilitation at minimisation of environmental impact. For this purpose it is necessary to apply economic incentive measures. Provide regular and sufficient funding of public services in charge of sewage treatment, waste removal and conducting their cadaster. Invest necessary resources in increase of efficiency of energy-carriers use, conservation of natural resources, introduction of low-wasted and low-cost technologies, procurement and installation of modern equipment to minimise emission.

1.2.4. Energy

Improvement of energy system in Armenia related to combat to desertification has not only local but also regional significance.

Before collapse of the USSR Armenian energy system used to be a component of the Transcaucasian united system. Armenia's energy sector used the fuel (gas, mazut, nuclear fuel) imported from the other Soviet republics being at the same time an electric power exporter. Thermal power plants (TPP) built in 1960-1970s and the Metsamor Nuclear Power Plant (NPP) had regional significance (it particularly regards to the NPP).

Due to well-known reasons energy systems of the Transcaucasian countries have been split since 1989. However, restart of Unit 2 of the NPP in 1996, institutional reforms in the field of energy sector, construction of the Iran-Armenia high-voltage electric communication line enabled exportation of power to neighbouring countries, particularly to Georgia and Islamic Republic of Iran. This enables Georgia to partially cover electric power deficit, and Armenia to use existing production facilities.

Electric energy is exchanged with Iran currently. During summer months electric power is being transmitted to Iran, in winter – from Iran to Armenia. Exportation of electric power enables levelling of load schedule, which favours the NPP and TPPs operation.

Besides, Armenia could export electric power to Turkey and Nakhijevan, which is, however, constrained by political circumstances.

Armenia has the following electric communication lines:

Ararat – Nakhijevan, 220 kW, 100 km;
Agarak (Meghri) – Akhar (Iran), 220 kW, 110 km;
Alaverdi – Marneuli, Georgia, 220 kW, 65 km;
Gyumri – Ghars, Turkey, 220 kW, 65 km;
Hrazdan HPP – Akstafa, Azerbaijan, 330 kW, 108 km.

Proceeding from above said energy sector development in Armenia should be based on the following provisions:
1. Conducting policy of differentiated energy sources creation;
2. Investigation and use of local resources of fuel, particularly focused on development of hydropower generation;
3. Regional cooperation.

Reconstruction actions include two phases:
1. Urgent – for keeping equipment operational within 3-5 years, as well as "freezing" (conservation) of some of the plants;
2. Long-term – modernisation of plants equipment.

Besides, development projects should include investments for conservation and construction of producing, transmitting, and transporting plants, (including in the field of alternative energy sources).

Investments are required in the following directions:
1. Construction of steam-and-gas plant at the Yerevan TPPs;
2. Completion of construction of Unit 5 at the Hrazdan TPP;
3. Improving safety of Unit 2 of the Armenian NPP;
4. Rehabilitation and re-equipping of hydropowerplants (HPP);
5. Construction of new HPPs;
6. Construction of alternative power plants;
7. Implementation of energy-saving actions;
8. Reconstruction of power networks, including:
   - Reconstruction and re-equipment of the 220 kW substations of "Kamo" and "Vanadzor-2",
   - Reconstruction of electric communication networks,
   - Construction of 110 kW line of Shinuhayr-Stepanakert,
   - Modernisation of existing dispatching management system;
   - Modernisation of electric energy inventory system.

Stabilisation of electric energy tariffs is an important socio-economic issue, implementation of which will be focused at two major actions:
- Minimisation of electric energy losses at all the units of the technological chain: production, transmission, sharing;
- Electric energy consumption regime optimisation, including application of adequate exchange regimes with neighbour countries..

1.2.5. Transport

Armenia's geographical location and relief peculiarities are the prevailing prerequisite for enhancement of transport sector, targeted at improvement of communication ways and services.

This should be accompanied by application of necessary environmental norms, which would essentially contribute to mitigation of impact of desertification factors.

Automobile transport. Automobile roads are an important integrated part of the transportation system in the country. Armenia's automobile roads under the weak development of railway network have a crucial role for the country's socio-economic development. The role of the highways is irreplaceable also in the field of international transportation.

Automobile road network of general use formed in Armenia covers 7637 km of which 96.7% have solid cover. There is 258 km of roads per 1000 sq. m of Armenia's area.

Within the recent decade almost not any permanent coordinated activities required to keep the automobile roads in a working order are carried out in the country on the matter of lack of finances. All the normative terms for the road network maintenance have passed long ago. Current maintenance have been done on the highways in an inadequate scope, which has been resulted in massive collapse of the roads. Collapse of the roads has been contributed by an unprecedented increase of flow of vehicles with heavy weight characteristics. All of these cause the following priority issues in he field of automobile transport:

- Policy-making for road network development and improvement and ensure its implementation,
- Undertake construction, reconstruction and maintenance of automobile roads of general use, ensure technical level and enhancing exploring quality,
- Conduct integrated technical policy for automobile road construction and maintenance,
- Develop and introduce norms and standards related to the sector,
- Create data bank of automobile roads of general use.

Development and promotion of the automobile road network in Armenia are closely related to environmental issues. Thereupon, while implementing important actions it is necessary to take into account:

- Saline materials used for road winter maintenance are penetrating into the soil and cause soil and flora degradation,
- Implementation of road-building works should be in compliance with the landscape and crust characteristics of the site , in order to prevent contribution to further development of landslide processes,
- Road projects contain environmental measures, provided by the legislation.

Railway transport. The length of the main railway transport in the country amounts to 789.4 km. 38 per cent of the line amounts to inclined passages. There are many artificial facilities, including 32.6-km length of tunnels and large bridges. There are ruined sections on the way (Sanahin-Kober, Ijevan-Dilijan).

The length of lines under operation amounts to 695.4 km or 88.1 per cent of the total. The most intensive freight transportation direction is Yerevan-Ayrum of 298-km length.

Further development and current improvement of railway in Armenia have their relevant environmental impact. This is mainly the construction factor, which results removal of soil and plant layers, transfer of huge land massifs, creating landfills. Given this to mitigate negative impacts of construction it is necessary to:

- strongly consider earth crust relief and plant characteristics of each section of railway while designing,
- organised and targeted transfer of land massifs.

1.3. Improvement of Economic Mechanisms for Natural Resources Management

In order to improve existing environmental situation, mitigate economic loads on the environment and solve other environmental issues in Armenia relevant priority environmental measures should be implemented in necessary scope, as well as a targeted environmental policy should be conducted in purpose of provision of the following:

- Improvement of efficiency of natural resources use ,
- Reproduction of natural resources and limitation use for non-renewable resources,
- Gradual decrease of environmental impact up to environmentally sound limits,
- Essential arising of state revenues from use of natural resources.

To attain these objectives it is necessary to:

1. Reform the system for natural resources inventory and economic assessment. Improve limitation and licensing systems for natural resources use.
2. Improve mechanisms for natural resources reproduction and environmental protection financing, ensure formation and further development of labor and services market in these fields.
3. Ensure prediction, exploration and assessment of strategically significant and extremely deficit natural resources, gradual rise of their scope and further development of the forms.
4. Ensure promotion of new methods and technologies for investigation reproduction, use and conservation of natural resources, as well as rise of specific gravity of secondary resources use, increasing the level of waste use.
5. Enhance activity targeted at biodiversity and landscape conservation, ensure development of specially protected areas network.

Sustainable economic development of Armenia is possible to ensure only by increasing regulatory role of government, re-understanding and improving it. It presumes implementation of the following actions by the government:

- Inventory and economic assessment of natural resources,
- Development and implementing of national and local projects for natural resources use, reproduction and conservation ,
- Establishing environmental standards, norms, regulations, including natural resources management and use,
- Helding natural resources use, basing on licensing, establishing of nature protective and environmental rates for natural resources use,
- Identification of benefits dimensions, obtained from natural resources use or exploration,
- Ensure compulsory use of environmental fees and user's charges for reproduction of natural resources and environmental protection; ensure adequate conditions for financing natural resources conservation, use and reproduction management system,
- Licensing of activities and services in the field of natural resources conservation and environmental protection,
- Ensure development of specially protected areas network,

Improvement of economic mechanisms for natural resources economical assessment methods and their paid use principles and the rates determination contributes sustainable use of natural resources, their reproduction and environmental protection.

1.3.1. Use of Water Resources

Conservation of water resources and improvement of economic mechanisms of their efficient use has a critical significance in the process to combat desertification on the territory of the country. From this point, Armenia's water balance, including public water supply issue, is extremely tense. It is caused by gradual applying of new adopted comprehensive concept for water resources use, as well as low level of rates for environmental fees and nature user's charges.

Priority actions contributing to reduction of tension of water balance should be aimed at prevention of large-bulk losses of water resources, including:

- Rehabilitation of reservoirs, exploration of collection-and-drainage systems, turning gravity wells to gated regime,
- Ensure maintenance of irrigation systems, hydrotechnical facilities, pumping stations, deep wells,
- Completion of the Vorotan hydrotechnical facility construction and its exploration, which would provide annual diversion of 165 mln cu m of water to Lake Sevan,
- Construction and exploration of new reservoirs, mainly small and of local significance.

Another priority problem in the field of conservation of water resources in Armenia is timely identification, termination and further prevention of pollution sources. It is known that major eutroficators and polluters of hydroecosystems in Armenia are agricultural and industrial activities. Measures to eliminate or mitigate their negative impact should include:

- Introduction of contemporary sewage treatment technologies,
- Implementation of actions planned by the Lake Sevan Ecological Rehabilitation Project,
- Meeting sanitary norms of water springs,
- Limitation of mineral fertilizers use,
- Water resources regular monitoring,
- Expansion of sanitary zones network and provision of adequate regular services in that field.

Efficiency of water user's charges is currently low enough, which is caused by failure to payments made by water users (collection rate fails to exceed 30 percent).

In order to raise the efficiency of reforms in the field of water supply, as well the level of collection rate of water user's charges and fees retained for discharge of harmful substances it is necessary to:

- Prevent huge losses occurring in the water use process,
- Improve technical and administrative aspects for measuring actual bulk of water use,
- Simplify the mechanism for water use by providing its transparency.

1.3.2. Use of Entrails

The sectors of entrails use in the Republic of Armenia are geological survey, mining operations and non-mining operations.

As a result of long-term geological survey around the territory of Armenia some 480 deposits have been explored and prospected, including 417 - of solid mineral resources, 42 - of freshwater, 21 – of mineral waters.

In addition to reserves registered by the state balance prospective resources are registered within the limits of identified manifestations. This is a basis to assume that source of mining and raw material in the country could be expanded and qualitatively improved.
About 95% of the deposits of solid mineral resources are operated in an open way, which results disturbance of the land areas, including roads, areas designed for siting landfills, ore dressing waste disposal sites, etc. Besides, there are a number of faults in the field of entrails use, such as:

- Illegally (lacking double contracts) operating deposits,
- Complicated mechanism for entrails allocation for mining operations
- Not specified concept of mining operations licensing,
- Incompliance of financing and implementing activities on rehabilitation and recultivation of damaged lands

Consequently, areas disturbed by mining operations in the country amount to some 7000 ha. 20% of the areas allocated to mining enterprises is the share of landfills disposal, some 13% - for processing waste disposal areas.

In order to overcome existing shortcomings of entrails use, the following actions should be implemented:

- Application of more efficient, environmentally safe methods of mining operations
- Inventory and comprehensive use of the state and dislocation of reserves of mineral resources, their losses and deterioration, as well as crude ore and empty areas,
- Extraction of useful components associated to crude ore,
- Improvement of mechanism of entrails use,
- Developing mechanisms for rehabilitation (recultivation) of damaged lands
- Gradual increase of environmental fees specified by the RoA legislation for of mineral resources use (extraction, discharge) up to approaching their estimated or real economic value,
- Formulation and introduction of accounts for rehabilitation (recultivation) of damaged lands
- Introduction of new economic mechanisms for entrails use.

1.3.3. Land Use

Under the conditions of Armenia's complicated and fragmented relief economic activity is concentrated on areas of 60 percent, which has been resulted in generation of different problems in the field of land protection and efficient use. Their resolution requires:

- Ensure planning of targeted land use according to schemes for use and zoning,
- Form the land market,
- Improve state monitoring over land protection and use by applying economic instruments stipulated by law,
- Establish an off-budget fund for rehabilitation of disturbed lands,
- Prevent hazardous impact of different polluters on land,
- Enable consolidation of agricultural lands aimed to ensure comprehensive agricultural circle,
- Ensure principles of pastures comprehensive use.

Nature protective solution in the field of land use was committed to state expenditures aimed at improving the soil resources.

Currently the soil tax entry into the state budget is reduced due to the changes in allotments into the state budget and community budget. Given this the soil tax is considered mostly as a source to

fulfill community budget, than a source of income generation for target projects on soil resources improvement.

The same time insolvency of agrarians, rural households leads to increasing the levels of tax debts on soil taxes. This situation do not incense soil conservation and effective use.

Here the economic incentives failed to be applied:

- Payment release and privileged crediting for the lands in the phase of improvement(melioration)
- Encouraging the rural households and farmers in the case of traditional agriculture and clean production.

The main direction in the field of land use and protection is prevention and reduction of pollution. Economic solutions targeted at control and reduction of land pollution presume:

- Application of economic instruments to contribute and encourage introduction of "cleaner" production;
- Creation of flexible taxation and preferential conditions for secondary raw material,
- as well as development of measures aimed at emission and waste generation.

1.3.4. Biological Resources Use

Environmental economics is a new field in Armenia. Therefore, many issues are not illuminated so far. Within recent years lack of financial resources, required information and statistical activities due to economic situation in Armenia and immature methodology in this sector prevent realistic assessment of biological resources on economical aspect. Given that fact we would try to make a general economic assessment of bioresources available in the country related to direct benefits from their use (Table 1).

Table 1

Type of bioresource	Economic assessment (AMD mln)	Principle Based for Assessment
Forests	42000	Total timber reserves (42000 mln cu m) multiplied by average value of stub charge (AMD 1000)
Natural holdings (hay-fields, pastures)	750-1000	Total area of hay-fields and pastures multiplied by rate estimated per 1 ha
Medicinal plants	25	Stock subject to possible annual collection multiplied rate estimated per 1 kg
Eatable plants	90	Stock subject to possible annual collection multiplied rate estimated per 1 kg
Fruits, berries	90	Stock subject to possible annual collection multiplied rate estimated per 1 kg
Lake Sevan fish stock	36	Stock subject to possible annual fishing multiplied rate estimated per 1 kg
Fish stock of other water basins	25	Stock subject to possible annual fishing multiplied rate estimated per 1 kg

Studies necessary for economic assessment of bioresources in Armenia include inventory, cadastre conducting and monitoring, the principles of which are described the RoA laws "On Flora", and "On Fauna".

Improvement of economical mechanisms for biological resources conservation and sustainable use has an essential significance in the process to combat desertification. From this point identification of the reserves of bioresources is a priority task, which is crucial for sustainable use of

bioresources. Monitoring of species and ecosystems would enable impact assessment of boresources use and would guarantee potential risk identification at the initial phase of impact.

Provision of public awareness is necessary for bioresources protection. It would enable the public to assume main trends of bioresources sustainable use by supporting their conservation.

1.3.5. Recreational Industry

Recreation industry depends upon the level of environmental management industry, agriculture, transport, communications, trade and culture development, as well as creates prerequisites for their further development and specialization, regulates their inter-sectoral relations, and often make radical changes therein.

The following are characteristics of modern recreation industry:

- Environmental orientation of the field and close connection with the conservation of environment,
- High profitability of the sector,
- Investment notable by rapid and short-term circulation of capital.

Possibilities for recreation development in Armenia as a new and economically and environmentally profitable sector of nature use are conditioned by the following factors:

- Availability of recreation resources,
- Territorial scarcity of traditional economic sectors,
- Rapid return of capital investments.

Recreation industry development would contribute both to the growth of economic profitability and creating new workplaces . It would contribute to:

- Promotion of public domestic, educational and aesthetic levels, development of new cultural centers, many forms of national arts,
- Rapid development of transport and other sectors of infrastructure,
- Use of areas excluded from the field of production, particularly settling of abandoned mountainous villages as tourist services centers,
- Set-up of extensive network for non-productive sectors, trade and other services,
- Activation of national ancient crafts and hand-work,
- Agricultural improvement and creation of extensive networks for greenhouse units.

Thus development of recreation and related sectors has a great significance to improve public material and moral living standard, revival of economy, increase national revenues, leveling different districts development by finally contributing to a significant decrease of man-made impact to desertification. Therefore, the following is required to develop recreation:

- Cadaster studies of recreational resources in Armenia by taking into account vulnerability of plant and animal communities;
- Identify recreation development criteria for different landscapes;
- Assess impact of recreational activity on specially protected and damaged areas and identify recreational development criteria for them;
- Develop short-term and long-term projects for recreational development.

Planning based on regional and temporal scientific criteria of different functions of recreational industry, identification of permissible load over natural systems sustainability and capacity norms are important factors for desertification processes prevention and impact mitigation.

1.3.6. Reserves

The analysis of specially protected areas activities in Armenia demonstrates that it fails to comply with modern demands of nature protection. Conservation regime is constantly violated in all the areas: deforestation, grazing, hay-making, land-reclamation, unauthorized construction, unorganized tourism, illegal hunting, etc. Besides, there is a number of administrative and structural shortcomings in the network of specially protected areas; jurisdiction to different agencies, lack of adequate specialists, inadequate material and technical base.

A particular concern is related to the state of preserves. They are actually out of protection: due to lack of adequate control, appropriate staff and developed conservation regime.

As to the nature monuments in Armenia, their list is not yet approved. There is no certification and, consequently, protection.

Existing setting in the Armenia's protected areas is conditioned by the following:

- Lack of conceptual principles for development of reserves,
- Lack of cadastre activities,
- Non-perception of socio-economic significance,
- Inadequate environmental awareness campaign.

Radical improvement in the reserve system in Armenia has a critical significance in the process to combat desertification as an integrity of necessary actions targeted at rehabilitation of disturbed ecosystems, conservation of measuring-and-sampling ecosystems and genetic fund, maintaining nature chronology. Therefore, it should pursue the following objectives and tasks:

- Rehabilitation and reproduction of natural resources,
- Ensure favorable environmental balance,
- Environmental protection,
- Ensure possibilities for recreational development,
- Purposeful scientific research work,
- Improvement of environmental education principles,
- Regular provision of information.

Given the above said the activities targeted at reserve system improvement in Armenia should include the following approaches.

1. Policy-making. It is necessary due to change of social relations; development of market economy, existing setting of specially protected areas in the country and international obligations, undertaken by Armenia. Actions targeted at policy-making for reserve system should include the following:

- Formulation of a concept,
- Improvement of legislation (changes and amendments in existing legislation, adoption of adequate by-laws and regulations).

2. Management Mechanisms Strengthening. Requires

- Enhancement of material and technical basis,
- Provision of adequate trained personnel,

- Clarifications in the territorial-functioning plan and protective zones,
- Involving economical intencives and encouraging
- Ensure public participation in reserve system and information dissemination.

3. Administration of scientific research work. Specially protected areas are environmental, scientific-and-research institutions, where the compulsory requirement is scientific study, including conducting of nature chronology. Currently, Armenia's reserves, national park and preserves lack adequate scientific groups, laboratories, and equipment required. The following is required as a priority action:

- Establishment of scientific departments
- Monitoring, conducting of cadastres and data bases creating
- Set-up hydrometeorological stations at reserves and national parks,
- Ensure cooperation with national and international scientific research institutions.

4. Performance of socio-economic tasks. The role of specially protected areas in the country's socio-economic development is currently low. Implementation of multilateral tasks in this field would contribute to:

- Efficiency of natural ecosystems protection,
- Efficiency of biological resources use (in national parks) and reproduction,
- Replenishment of state budget,
- New workplaces creating,

Therefore, the following socio-economic tasks should be performed in the specially protected areas of the country:

- Determination of rights for reserves, national parks, preserves staff, and compulsory state insurance,
- Open out-budgetary accounts,
- Determination of rights, obligations and privileges of population located in protective zones,
- Set-up of regulations for contractual-based use of recreational resources and natural resources in national parks,
- Arrangement of cognitive tourism,
- Administration of museum science,
- Provision of practical training courses,
- Development of cooperation with cultural, educational and tourism institutions and organizations,
- Publishing activities.

1.4. Conventions Related Joint Actions

The UN Convention to Combat Desertification makes frequent references to sustainable development, biological diversity, water resources, climate change, energy resources, food safety and socio-economic factors. It serves a ground to conclude that actions to combat desertification should include wide-range measures targeted at efficient use of natural resources. It would contribute to reduction of the scope of soil erosion and rehabilitation of degraded lands and mitigation of draught consequences. A particular role in attaining these objectives belongs to preparation of joint action programs in the framework of international conventions and their implementation. The efficiency depends upon inevitability of compliance with the international obligations undertaken by the state.

The Republic of Armenia is currently a part of a number of conventions, including those, which are directly related to prevention of desertification phenomena or mitigation of impact consequences, such as Convention on Climate Change, Convention on Biological Diversity, Convention on Wetlands, Convention on Environmental Impact Assessment in a Transboundary Context, Convention on Transboundary Transfer of hazardous Waste and Their Disposal Control, and other conventions.

Joint projects implemented in the framework of Conventions would also enable to avoid such duplication as follows:

- Improvement of legislation,
- Capacity assessment
- Monitoring,
- Environmental impact assessment,
- Public environmental awareness raising,
- Training,
- Development of early notification system.

Environment-related joint projects should be targeted at implementation of comprehensive environmental actions, which should take into account the following.

1. Mutual relation between desertification and climate change. In this context a number of measures should be carried out, which would enable preventing or minimizing growth of greenhouse gases total content, particularly carbon gas in the atmosphere. To attain this objective required measures should be targeted at:

- Reduction of mineral fuel use,
- Conservation of carbon's natural absorbers and accumulators (vegetation in overall).

Thereupon, forest areas protection and expansion has a particular importance for Armenia, which are in a line with another obligation undertaken under the Convention on Climate Change: ecosystems vulnerability reduction and increase of compatibility. Simultaneously, the following measures, related to ecosystems compatibility, should be carried out:

- Set-up of protective forest zones,
- Establishment of rapid growing tree species,
- Development and water-saving irrigation practices,
- Establishment of snow-retaining facilities,
- Rehabilitation of hydrotechnical facilities and construction of new ones.

2. Interrelation between desertification and biodiversity. Actions planned in this field should be first of all targeted at *in-situ* conservation of biodiversity, which presumes:

- Improvement of reserve network,
- Improvement of economic mechanisms for biological resources use,
- Establishment of plantations and nurseries for commercially valuable species,
- Recreational development,
- Application of alternative sources of energy in purpose to prevent deforestation.

3. Interrelation between desertification and water areas. The water areas in Armenia have a strategic significance in combating desertification. They serve as a decisive factor for the whole Trans-Caucasian region and adjacent districts. In additions, Lakes Arpi and Sevan and the watersheds have been enlisted in the Ramsar Convention on Wetlands. Therefore, actions targeted

at prevention and mitigation of desertification factors in this sector cover integrity of those projects, which are related to:

- Protection and sustainable use of water resources,
- Rehabilitation of Lake Gilli wetland ecosystems,
- Rehabilitation of Lake Sevan ecological balance.

4. Relation between desesrtification and industry.

Industrial development in Armenia is principally conditioned by compliance with the international obligations undertaken by the Conventions, such as Convention on Environmental Impact Assessment in a Transboundary Context, Convention on Transfer and Disposal of Hazardous Waste, Convention on Transboundaty Industrial Accidents. Given that the framework of actions to combat desertification should involve joint actions which are related to:

- Development of national environmental safety concept,
- Development of environmental impact assessment methods,
- Reprocessing and safe disposal of industrial and domestic waste,
- Introduction of low-wasted and wasteless industrial technologies,
- Regular operation of wastewater treatment facilities.

5. Relation between desertification and external geological processes. International obligations undertaken by Armenia in this field cover Convention on World Cultural and Natural Heritage. Active external geological processes in Armenia are causing serious threat to historical-and-cultural monuments. Almost all the unique wildlife and abiotic natural monuments are in miserable situation. Therefore, actions in this field should cover the projects, which are related to:

- Prevention of landslides, mudflows and soil erosion,
- Inventory of natural monuments.

While analyzing environment-related international obligations undertaken by Armenia the interrelation and complimentary nature becomes obvious, which enables coordinated implementation of bilateral and multilateral actions. Such approach would contribute to efficiency of combating desertification and saving resources involved therein, as well as ensure favorable conditions for expansion of international development.

1.5. International Cooperation

Political, economic and environmental problems of Armenia have an equal significance in development and deepening of desertification processes. From this point actions targeted at combating desertification could not be fully implemented without multilateral international cooperation. On the other hand, pursuant to Principle 6 of the Rio Declaration an issue of particular concern are less developed and environmentally vulnerable countries. Articles 11 and 12 of the UN Convention to Combat Desertification confirm importance of international cooperation as a factor to ensure favorable international situation for implementation of the Convention provisions.

Given the above said international cooperation targeted at resolution of desertification related issues in Armenia should be implemented on the following levels:

1. Secretariats of international environmental conventions,
2. International organizations,
3. Developed countries,
4. Regional, sub-regional and inter-regional levels,
5. Transboundary issues.

The Republic of Armenia has an extensive experience of international cooperation in the field of environmental protection, resulted from harmonious and efficient activity with Conventions Secretariats, UN structures (UNEP, UNDP, GEF, FAO, UNSO) and the World Bank. In the framework of such cooperation a number of strategical projects have been elaborated.

Development of regional and sub-regional cooperation is the major prerequisite for efficient improvement of measurements in the field of environmental protection, particularly the process to combat desertification, and enhancement of environmental safety principles. Its importance is also expressed in Article 11 of the UN Convention to Combat Desertification, which states that such cooperation could involve joint projects for sustainable management of transboundary natural resources, improvement of science and engineering, and adequate institutions. From this point, the first steps have already been taken to promote inter-state contacts, adequate and coordinated actions, a number of international agreements have been signed.

Prospective trends of regional and sub-regional cooperation should involve the following framework:

1. Institutional: It is necessary to establish a regional center to combat desertification with the following tasks and responsibilities:

- Identification of regional priorities in the field of combating desertification;
- Preparation and implementation of joint projects for regional and sub-regional actions;
- Coordination of scientific-research activities;
- Coordination of information collection, analysis and exchange
- Training and re-training;

All the member countries to the Convention in the region should be equally involved in the management of the regional center for combating desertification. The representation should involve governments, self-governance authorities, scientific circles and community.

2. Informational: Availability of comprehensive and coordinated information system has a significant importance for assumption of desertification processes and elaboration of adequate measures. Therefore, it is necessary to build an integrated network of national information centers. It should be built based on comprehensive data availability on desertification prerequisites, land degradation and socio-economic criteria of population.

Building an integrated regional and sub-regional information network would also cause building an integrated monitoring system and integrated prior notification system.

3. Transboundary natural resources management. Cooperation in this field should involve the following:

- Protection and sustainable use of water resources,
- Landscapes and biodiversity conservation
- Creating joint specially protected areas
- Integrated forest management actions.

Efficiency of actions undertaken to combat desertification could significantly contribute to establishment of inter-regional cooperation, which presumes:

- Exchange of information and experience,
- Exchange and adaptation of adequate technologies,
- Provision of scientific resources,

- Joint scientific research,
- Training.

CHAPTER 2

THE ROLE OF EDUCATION AND SCIENCE IN COMBATING DESERTIFICATION

Desertification is a complicated process of ecosystems degradation, accompanied by reduction of efficiency and deterioration of socio-economic conditions of the population. From this point a situation established around the ecosystems of Armenia dictates that ecological mentality is in need of critical change. Despite the great progress of Armenia in environmental legislation, actually it could act only under the presence of a global environmental education and training network. Multilateral study of desertification factors, covering dimensions of biological, geographical, agricultural, economic-and-scientific sciences (geobotanical, agrarian, landscape, climatological, agrochemical, cattle-breeding, silviculture, social and other studies) serve a critical prerequisite for forming it.

2.1. Environmental Education Issues

Environmental education issues could be solved with efficiency of required actions, significantly caused by an adequate level of public education.

Improvement of the system of environmental education in Armenia should be based upon the principle of sustainable education by involving all the age groups and layers of population. From this point coverage of environment-related knowledge in the country is covered by the syllabi of high school and higher education institutions. However, a profound knowledge is available only for students, majoring in appropriate fields. Thus, environmental education shouldn't be limited only to academic and educational syllabi and their improvement. Major prerequisites for sustainable environmental education are the following:

- Improvement of environmental education management system,
- Ensure public awareness on national environmental legislation,
- Ensure wide information on environmental issues and their consequences,
- Ensure transparency of environment-related authorities activities,
- Ensure coverage of world global environmental issues and efforts of international community aimed at their resolution,
- Ensure rising the role of nature protection as a national security task
- Improvement of specialists training and re-training,
- Ensure the prerequisites for co-operation of environment-related public authorities and non-governmental organisations,
- Ensure popular scientific publications on perception, valuation and significance of natural components of republic,
- Ensure data collection, analysis and advocacy on traditional knowledge on use of natural resources in Armenia,
- Ensure periodical arrangement of courses, workshops on natural resources conservation and use by involving national public authorities in economy, territorial administration and local self-governance authorities, as well as state and private sectors.

Implementation of the above mentioned strategic directions of sustainable education in the country would support formation of public environmental awareness, which is major and sustainable guarantee of the process to combat desertification.

2.2. Scientific Research

The reasons of desertification and results of scientific research addressed to improve the efficiency of combating it are the critical prerequisites that serve a basis for state policy-making aimed at prevention or mitigation of desertification factors impact and actions undertaken. The comprehensive scientific research requires significant capital investments, application of advanced methods and technical supplies, serious approach towards environmental issues, improvement of environmental state, and scientific prediction of possible negative phenomena. Major directions of scientific research in Armenia are currently formed. A valuable experience has been accumulated in Armenia. From this point, studies accumulated for identification of desertification phenomena and environmental monitoring has obtained a traditional nature. They have been and keep to be carried out by the National Academy of Sciences of Armenia, higher educational institutions and institutions within the system of some ministries (Ministry of Nature Protection, Ministry of Agriculture). In overall 34 scientific topics related to issues to combat desertification are being currently prepared. Major significant topics are the following:

- Desertification Issues in Armenia (Yerevan State University),
- Landscape Predictions in the Marzs of Shirak and Lori (YSU),
- Environmental Setting of Lands and Waters Polluted by Man-caused Substances (YSU),
- Engineering-and-geological Description and Development of Anti-landslide Measures (Geological Institute),
- Agroindustrial Grouping of Top-soil in Armenia (Institute of Agronomy and Agrochemistry),
- Scientific Principles for Integrated Use of Water Resources (Water Resources Institute),
- Rapid Rehabilitation Technology of Sparse Growth of Junipers in Mudflow Hazardous Slopes in Forest-scarce Districts in Armenia (Agricultural Academy),
- Flora and Vegetation in Armenia (Institute of Botany).

New methodological approaches, introduction of new managerial units in the field of science and industry in order to deepen these and other studies, increase applied significance of generated outputs.

From the point of the process to combat desertification in the country the following scientific studies, related to natural resources conservation and efficient use are considered as priorities:

- Identification of quantitative and qualitative characteristics of different landscape dynamics and impact of human economical activity on it,
- Development of strategy for regulation of man-caused pressure over the environment,
- Improvement of environmental monitoring new methods of man-caused biogeocenosis situation,
- Improvement of agricultural system,
- Prevention of secondary salination of irrigated soils,
- developing and introduction of agroforest melioration measurements
- Improvement of pastures,
- Biodiversity conservation and sustainable use.

It should be stated that there is no adequate concern towards desertification expressed by economics, sociology, technical, chemical, geological sciences, which should take care of environmental modelling, systematised analysis, prediction of desertification processes, as well as development of concrete forms and methods to combat desertification. From this point, socio-economic studies, aimed at presenting the ways for industrial forces development, conservation and improvement of agricultural traditions, are of a particular significance. Integrity of these issues could be covered in the following three groups:

1. Social: related to protection of public health and genetic value of future generations, as well as improvement of living standard;
2. Environmental: conditioned by sustainability of natural systems, violation of their life support functions and decline of natural resources efficiency,
3. Economic: originates from growth rates under current economic system and dictates a necessity to turn to an alternative technology.

The role of the state is of essential importance for timely implementation, increase of efficiency and application of scientific-research studies with the following priority issues:

- Establishment and co-ordination of co-operation at international level by paying a particular attention to seeking financial, human, organisational and technical resources and co-ordination,
- Strengthening of national centres for biological, agrarian, agricultural, hydrological, hydrometeorological and other research,
- Encouraging and financing to obtain and adapt contemporary technologies.

CHAPTER 3

PUBLIC PARTICIPATION IN COMBATING DESERTIFICATION

UN Convention to Combat Desertification pays an essential significance to the role of public participation with respect to obligations of the states undertaken under the Convention and preparation of action plans and implementation (Articles 3, 5, 9, 10). Public participation in environment-related decision-making and implementation is paid a particular significance by the Arhus Convention adopted on January 25, 1998. Priority of a special focus to this matter made by the international community is justified by a circumstance, that enhancement of public environmental right guarantees multilateral and active role of all the members of public and organisations for natural resources conservation and sustainable use policy-making and its implementation. Attain this objective is the major prerequisite to provide human society development.

3.1. Provision of Public Awareness

Efficiency of actions to combat desertification is conditioned first of all by major forms of desertification processes in the country, contributing natural, economic and social reasons, as well as public awareness on environmental legislation.

However, it should be stated that demonstrated awareness is basically the result of public interest and is based on one's own initiative and is spontaneous. Therefore, required actions aimed at environmental improvement; as well as regular provision of information on legislation in force is currently extremely urgent in the country. It would ensure public perception of the environmental processes consequences, which would enable deliberate involvement of the public in the resolution of environmental challenges. In this purpose the following problems are considered as the most important for the state:

- set-up a system, enabling the public to request and receive respective environmental information from the state authorities;
- set-up a system to collect environmental information by the state authorities and provide to the public without its request.

Environmental information should cover a wide scope of issues, which enable public representatives, if needed, to make appropriate decisions. Such a range of issues includes information of the content:

- on responsibilities of relevant state authorities and their performance,
- on planned or on-going activities which could have an environmental impact,
- on emergencies,
- on state of the environment,
- on legislation, international contracts and projects,
- on emission, flows, transportation and disposal of hazardous and chemical substances,

- limitations of environmental information, as well as procedure for receiving information.

The following means are providing environmental information to public without a prior request:

- mass media,
- arrangement of workshops, seminars, training courses and meetings at marzs, communities, enterprises, educational institutions, etc.,
- celebrations, grand ceremonies and mass events on the International Environment Day (June 5th) and Day to Combat Desertification (June 17th),
- publication of popular scientific materials,
- communications
- bulletins and newspapers published by public authorities and non-government organizations,

3.2. Provision of Public Participation in Decision-making and Implementation of Actions

Public participation in planned actions envisages close cooperation with state authorities. However, the initiative should basically belong to state authorities, which are in charge of:

- Provision of public participation on an early phase of planned actions,
- Identify public stakeholders and jointly determine the level of their participation in relevant actions,
- Provide all the relevant information to public stakeholders.

Among planned activities it is very important to identify the forms of public participation, which include:

- Due arrangement of public hearings,
- Participation in the environmental impact examination process,
- Participation as an expert in designing projects and programs,
- Participation as a member in different commissions acting in public authorities,
- Participation in project implementation.

3.3. Public Stakeholders

The following entities are acting as public stakeholders:

- Local self-governance authorities,
- Community representatives,
- Non-governmental organizations,
- Scientific research centers,
- Faculty and teachers at educational institutions,
- Students and youth organizations,
- Nature users, entrepreneurs and their associations,
- Rural households,
- Individuals.

PART III

Priority Projects of Local Importance

1. Recovery of Lands Subject to Desertification in the Garni Community in the Province of Kotayk of the Republic of Armenia

Introduction

Before 1990 irrigated areas used to be increasing from year to year in the country. However, in 1991 due to lack of financial resources no money was allocated for construction, maintenance and operation of irrigation systems in this field, which was resulted in exclusion from use of thousands of lands of agricultural and other value. Its own negative impact made the factor, that major portion of the irrigation systems are those supplied by pumps, which fail to be operated due to high power tariff. The latter amounts to some 50-60% of the irrigation tariff.

Compared to 3 bln m^3 of water intake for irrigation purposes in 1990 it amounted to 2 bln m^3 in 1999. All these were resulted in reduction of irrigated areas in 1999 to some 180,000 ha versus 317,000 ha in 1990. Actually 137,000 ha of lands have been degraded and are subject to degradation.

Similar situation is mainly typical to all the districts in the country, including Garni community in the Province of Kotayk, Republic of Armenia.

General Information

The village of Garni is located at a distance of 20 km east of Yerevan. The village is located on the right bank Azat River (Arax River basin) on an altitude of 1400 m above sea level in a foothill zone. It occupies an area of some 6000 ha.

The climate is soft. Average annual precipitation amounts to 488 mm, which is 104 mm less than the average one in the republic. The highest air temperature approaches to $+40^0$, the lowest one -- -30^0, average wind velocity -- 1.3 m/sec.

The number of population amounts to 8000 people. Before 1990 some 80% of the community labour used to be employed by the industrial enterprises of light and radio engineering industries located next to the village. Due to shut-down of the businesses present employment of the community is mainly conditioned by agriculture and cattle-breeding. Gross product of the latter recessed within the recent ten years by appropriately 30% and 25%, which is caused by degradation of agricultural and arable lands.

During land privatization a family of 4-6 persons has been allocated with 4800 m^2 of land plot, processing of which presently fails to meet the socio-economic needs of the family. The situation is more deteriorated, when due to shortage of irrigation water the farmer loses in summertime some 25-30% of the orchard or melons and gourds yield productivity.

In general, out of the 5866.5 ha of the land in the community 1070 ha are under irrigation, while the 4796.5 ha due to no water either absolutely fails to be irrigated or is irrigated when the plant water demand is high and there is enough water in the system (April, May).

The community is currently makes water intake from Azat River with the maximum flow of 800 l/sec. The water receiver is located on the territory of Khosrov preserve. The water-supply system is by gravitation, the diameter of the water pipeline is 800 mm, the length -- 13 km.

Within the plants germination period, when the water demand approaches the maximum (summertime), due to no water 370 ha of the privatized lands fail to be absolutely irrigated or at the most (dependent upon the climatic conditions) are irrigated extremely inadequate.

Due to the above mentioned within the recent 10 years 30 ha of vineyards and 60 ha orchards were dried or under desertification. Every year 50 ha of lands for cultivation of melons and gourds crops are disabled. 40 ha of lucerne are on the edge of destruction.

Project Justification and Objectives

Priority of preparation of a project for improvement of irrigation situation is conditioned by the following:

- As a consequence of use of the water resources available in the community outside its area, social inequity generated in the community, liquidation of the sense of psychological depression.

  Abundant high-quality water resources reserves in the village area are totally (1200 l/sec) allocated to drinking water-supply of the capital city of Yerevan. Presently, the villiage faces a deficite in provision of water demand.
- Growth of population employment in farming and cattle-breeding of a large rural settlement in the country like Garni, and consequently, by the degree of development of the agricultural and cattle-breeding products market.

  Close location of the community to the capital city of Yerevan (20 km) and more efficient use of the land areas would enable to create potential possibility for introducing high-quality agricultural and cattle-breeding products to Yerevan.
- Maximum conservation of the Khosrov preserve's natural ecosystem due to reduction of water withdrawals from Azat River for irrigation purposes. Irigation water intake in the community is carried out from Azat River, which passes through the territory of the Khosrov preserve, a significant site in terms of conservation of the republic's biodiversity genetic fund.

The objective of the project is to provide regular irrigation for 30 ha of vineyards, 60 ha of orchards, 50 ha of melons and gourds crops under desertification and 40 ha of land areas under lucerne on the edge of destruction, as well as 30 ha of vineyards and 160 ha of orchards.

Irrigation water scarcity of the community may be justified by doing an estimation of the community irrigation water demand:

W = S x N, where:

W - community's normative water demand (thousand m^3)

S - surface area subject to irrigation (600 ha)

N - total norm during the irrigation season per 1 ha, for village of Garni, it amounts to 6 thousand m^3

(Reference: "Watering Norms for Agricultural Crops" approved by the RoA Ministry of Agriculture).

W = 6000 x 6 = 36000 thousand m^3

Actual derived calculation of annual water quantity is the following:

$W = Q \times T \times 10^{-6}$, where

W - actually received water quantity (thousand m^3),

Q - actually received water flow (800 l/sec),

T -number of seconds within 7 irrigation months:

$T = 7x\ 30 \times 24 \times 3600 = 18144000$

10^{-6} - water volume measuring unit change index, (1 liter = $1m^3 \times 10^{-6}$)

$W = 800 \times 18144000 \times 10^{-6} = 14515.2$ thousand m^3

By summarizing, it might be said, that irrigation water deficit in the village of Garni amounts to 60% of the water demand, which is resulted in degradation of above mentioned land areas.

The Garni community administration several times raised the question at the RoA Kotayk province administration, RoA Ministry of Agriculture. Increase of water intake from Azat River was observed as an option for the resolution of the question. However, this would be resulted in further violation of the conservation regime in the Khosrov preserve. Proceeding from the requirements of the RoA Law "On Specially Protected Natural Areas" the RoA Ministry of Nature Protection prevented implementation of the "Project for Improvement of Irrigation in the Village of Garni" prepared by the RoA Ministry of Agriculture.

As an alternative option for problem solution it is proposed to rehabilitate the former water-pipe of the village which operated before 1970 fed from an untitled tributary to Azat River and drinking water springs located in the village. The water from latter is provided to the city of Yerevan for drinking domestic purposes, but there are significant filtration free losses, which are collected in an inoperative water-pipe.

It is proposed to feed the water-pipe from:

1. Untitled tributary to Azat River -- 110 l/sec
2. From filtration waters collected in the water-pipe -- 120 l/sec
3. From captured non-operated spring waters downstream village of Goght not useful for drinking purposes -- 20 l/sec.

Necessary Prerequisites and Conditions for Project Implementation

Major prerequisite for project implementation is availability of adequate water resources at the above mentioned points of water intake.

It should be first noted that the tributary to be used for primary water intake for canal d=400mm, L=2500m (where d is the diameter, L is the length) is formed and join Azat River outside the Khosrov Preserve (Annex 1). Up to hydro-geological fund data upstream groundwater springs of some 162 l/sec are feeding the tributary. Out of this outflow 50 l/sec is left as an environmental flow, the rest of some 110 l/sec is considered as free outflow, which may be used for irrigation purposes.

Closed canal at its 2500^{th} meter should join the open canal of 5000 m subject to rehabilitation, which passes through the land areas in the village of Goght and downstream the capture points of drinking water for the city of Yerevan. There is a number of springs on this section, which have been captured, but due to failure to comply with the drinking water state standard requirements, they failed to be joint to the municipal water-pipe and are currently discharged to the untitled tributary with an outflow of 15-20 l/sec. These waters are also subject to be joined to the water-pipe.

The survey showed that during the watering season of the land plots located upstream the village of Goght, both filtration and free flows of the springs (120 l/sec) are significantly increased, which is collected in the canal and therefrom filtered to the river.

Since 1991 a group of village-dwellers by own strength cleaned the section from older water-pipe water springs up to the operated main canal section, which provided supplemental flow of another 100 l/sec for irrigation purposes.

While carrying-out these works due to lack of financial resources the canal failed to be fully cleaned from drift and all associated filtration flows failed to be eliminated.

In order to implement the project it is necessary to bring to an operable state the former water-pipe of 7500 m length, out of which a section of 5000 m should be cleaned from the canal silt drift, recovered from damages and surface-cemented. In order to carry-out these works US$ 17,200 is required including US$ 9,300 for construction materials and US$ 7,900 for the execution of works. It should be noted that the community population is willing to contribute in labour for this section of the canal.

Given the existing unrecoverable setting of the canal's 2500-meter section it is planned to construct here a closed canal with iron water-pipes of d=400mm. According to the existing market prices the cost of water-pipe is US$ 22,000, including US$ 17,000 of water-pipe and US$ 5,000 -- installation works.

Taking into account 8% or US$ 3,100 of miscellaneous expenses total cost of canal rehabilitation would amount to US$ 42.4 (see Table 1).

Table 1

Financial Estimation of Rehabilitation Former Inoperative Canal

#	Name of work	Unit of measurement	Scope of work	Unit value US$	Total cost US$
1.	Canal cleaning[1]	cu m	892	3	2676
2.	Canal walls concreting[2]	cu. m	525	10	5250
3.	Cement	t	150	50	7500
4.	Sand	cu. m	525	3.5	1837.5
5.	Iron pipe d=400mm L=2500m (1m = 68.19 kg)	t	170	100	17000
6.	Pipe installation	m	2500	2	5000
7.	Total				39263.5
8.	Miscellaneous	%	8		3141.1
9.	TOTAL				42404.6

[1)] Canal cutting is table-like, the foundation -- 0.7 cm, length of side -- 1.4 m, height of filled drift -- 0.35 m, upper side of filled drift -- 1.0 m, length of section subject to cleaning -- 3000 m.

[2)] Volume subject to canal rehabilitation -- V = S x h

S = (1.4 + 1.4 + 0.7) x 3000 = 10500 m^2, h is the concrete thickness -- 0.05 m.

V = 10500 x 0.05 = 525 m^3.

Duration of the canal rehabilitation would be 4 months. Given the objective of canal operation during the irrigation season it is purposeful to execute these works in March-June (see Table 2).

Table 2

Work Schedule for Rehabilitation Works of Former Inoperative Canal in the Garni Community

#	Name of work	Duration of execution			
		Month 1	Month 2	Month 3	Month 4
1.	Canal cleaning				
2.	Procurement of construction materials				
3.	Canal walls concreting[2]				
4.	Procurement of pipe				
5.	Installation of pipe				

According to the Garni village administration data farmer's average income per 1 ha amounts to US$ 210. Consequently, rehabilitation of mentioned 370 ha of lands and in case of their use under agricultural processing the community population would have US$ 77,700 (370x210) of income, including US$ 10,000 of land tax would be collected to the state budget, which currently fails to be paid due to non-operation of these lands.

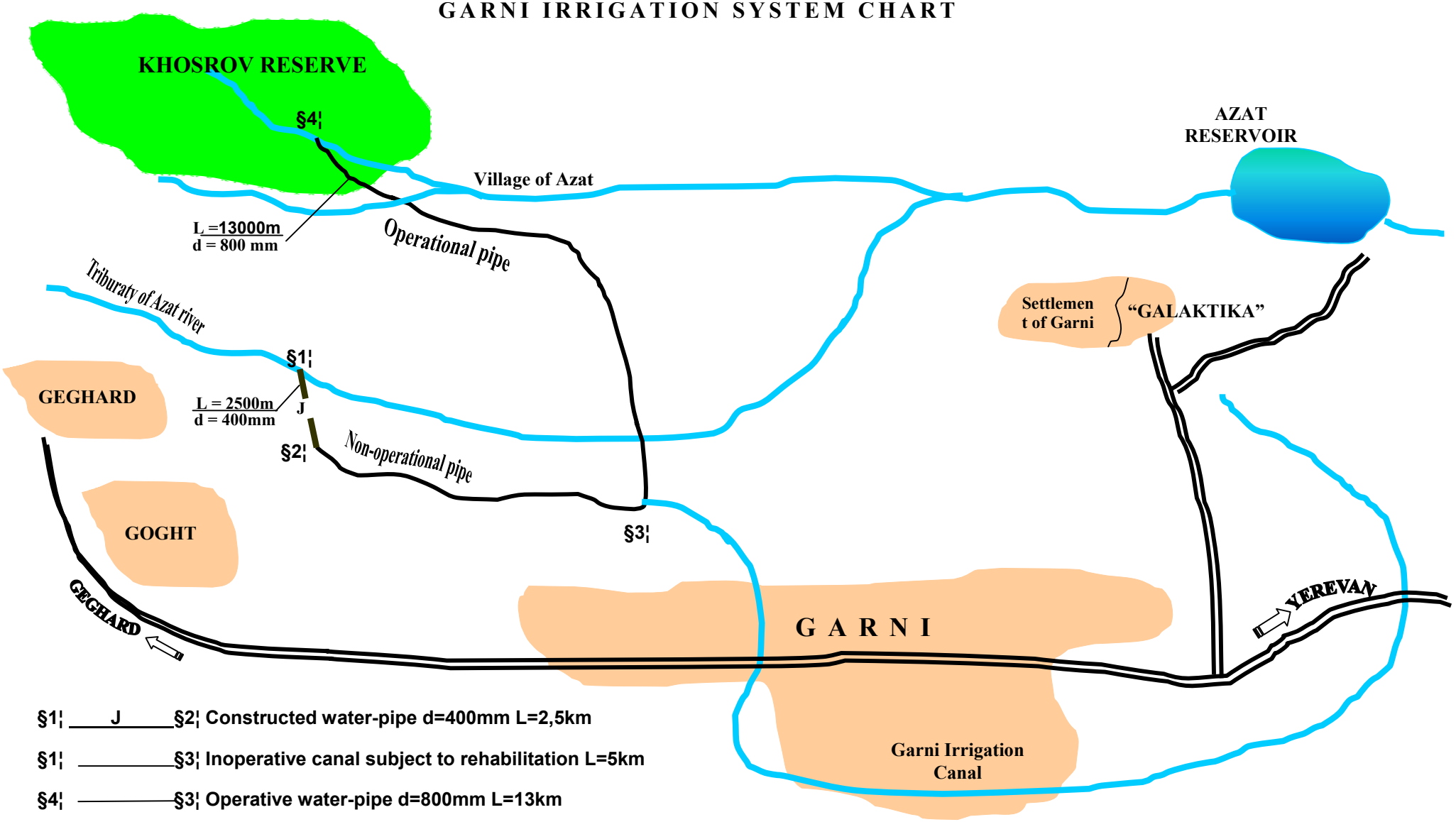
Expected Outcomes and Contribution to the Solution of National Action Programme to Combat Desertification

By recovering former water-pipe a possibility would be created for the village's main canal to provide 250 l/sec of water and regularly irrigate said 370 ha of land areas and prevent from desertification.
Up to preliminary estimation and predictions by the Grani community administration rehabilitation of said water-pipe would be resulted in:

1. Growth of livestock in the community
2. Growth of yield productivity
3. Growth of farming incomes
4. Growth of employment
5. Reduction of people leaving for traveling works
6. Poverty reduction
7. Reduction of water intake from Azat River in springtime by flow of 250 /sec.

Implementation of the project would enable in springtime by means of currently operated water-pipe to substitute water intake of 600-700 l/sec by 350-400 l/sec. Actually water quantity of 250 l/sec would be left in the river to, which would possibly recover the Khosrov preserve's water balance.

GARNI IRRIGATION SYSTEM CHART



§1¦ ____J____ §2¦ Constructed water-pipe d=400mm L=2,5km

§1¦ _____ §3¦ Inoperative canal subject to rehabilitation L=5km

§4¦ _____ §3¦ Operative water-pipe d=800mm L=13km

2. Goris River Non-structural Mudflow Mitigation in the Province of Syunik of the Republic of Armenia

Background

Natural and climatic conditions in the Goris river basin, relief's large inclinations, obsolete top-soil and vegetative cover, high intensity and frequency of downpours are contributing to the rapid development of erosion and mudflow phenomena and create unfavourable conditions for sustainable economic development in the province.

Negative impact of human activity is contributing to the erosion and mudflow phenomena:
- overuse of the area due to construction in the field of agriculture, urban development and means of communication
- destruction of vegetative cover and spontaneous deforestation,
- abuse of operation of the irrigation system
- lack of vegetative cover conservation measures
- application of bad agricultural practices
- intense use of arable lands.

Due to the existing situation soil fertility is rapidly decreased, conditions are created for desertification of areas and deterioration of socio-economic conditions.

Objectives

The programme is aimed at identification of the site's most vulnerable centres and prepare erosion and mudflow mitigation measures based on an analysis of natural and climatic conditions for generation of erosion and mudflow phenomena in the Goris (Vararak) river basin.

The programme would prevent desertification phenomena threatening to the area, conditions would be created to increase soil fertility, new inoperative lands would be introduced to agricultural circulation, and the threat of frequent mudflows to the population of the town of Goris would be liquidated.

Physical and Geographic Conditions of the River Basin

Goris River which upstream is also known as Vararak, is located in the south-eastern part of the Republic of Armenia and is one of the most significant left-bank tributaries to Vorotan River. The river is originating from the upper slopes of Big Ishkhanasar on the altitude of 2800 m, length -- 29 km, the river basin surface area is 146 sq km.

The Goris River left-bank part is mainly composed of the Goris plateau volcanic and sediment rocks, and upper flows and right-bank part -- andesite and basalt lavas of the Ishkhanasar and Yerablurs. Thus, major mountain-formation units in Goris River basin are the Big Ishkhanasar's large, highland, shield-shaped mountain massif southern slope, Goris lito-sculpture and Yerablurs lava plateaux. Goris River generated a deep canyon in the contact zone of the latter, which is slightly expanded within the limits of the town of Goris and transferred to the trough-shaped valle.

Upper slopes of Big Ishkhanasar mountainous massif are of relatively weak inclination (5-15%) and slightly fragmented. As opposed to it, the lower slopes of the mountain massif next to the

villages of Brun and Verishen are rapidly steep descending towards the Goris River valley by generating articulation cones in its bottom composed of rubble, cobblestone and detritus.

Numerous abundant springs are going out from under the alluvial articulation cones. The majority of the slopes are free from top-soil and vegetative cover, which contributes to the strengthening of weathering phenomena, and the slopes inclination -- to the inflow of solid materials.

On the right bank of Goris River, from the mountain massif foots to the Vorotan canyon's right-bank part, the Yerablur plateau is raised up, where on its surface a number of small and big volcanoes composed of red and black sledges are raised up. The Yerablur plateau is composed of repeatedly over-layered lava and andesite and basalt, which evened the older fragmented surface. Thanks to porosity of the rocks of volcanic origin, surface flow generation and slopes fragmentation are excluded here.

The left bank of Goris River is occupied by the Goris lito-sculpture plateau by its steep, strictly fragmented temporarily operative downpour-generating ravines descending to the river. Numerous and diverse miracle forms of relief are spread here. Cone-formed erosion remnants from several meters to 20-25 m height and 3-15 m of base diameter are mostly developed. There are also mushroom-like rocks, which are columns up to 10 m height -- widened in the upper part. These forms are represented both isolated and in groups. There are also tower-like remnants and large-toothed inter-ravine peaks and walls. They are mainly generated due to intensive deep erosion and are connected with the Goris stretch vertical crevices, as well as with the slightly cemented agglomerate materials of large fragments.

The climate in the river basin is moderately mountainous, with severe durable winter in the northern highland parts.

Air average annual temperature averaged for the whole river basin is 4^0C. In January the average air temperature is fluctuating between -2^0C (in the lowland zone) and -10^0C (on the summit part of Ishkhanasar), and the in July -- appropriately 22^0C and 10^0C. The highest air temperature is 28^0C, and the lowest one -- -30^0C.

The north-western winds are dominating in the river basin with an average annual velocity of 2-3 m/sec, and the highest one -- 29 m/sec.

Relative air humidity is 70%. Annual atmospheric humidification index is 1.25, in July -- 0.75, and in germination period -- 1.0.

Annual evaporation is 375 mm, evaporation-capacity is 600 mm.

The precipitation in the target river basin is 780 mm, including 450 mm as snow. 25 days within a year have above 10 mm of precipitation, the value of the maximum precipitation may account up to 80 mm (1% probability).

A stable snow-blanket is generated since December 20th, snow melting starts since March 20th.

Permanent flow of Goris River is generated from the springs outflowing from the contact of the Ishkhanasar volcanic rocks and Goris plateau fragmented volcanic-and-sedimentation rocks. The river is fed by underground waters (70%), melting waters (18%) and stormwaters (12%).

According to the Goris water-measuring observation point data average annual discharge amounts to 0.36 m^3/sec, annual flow is 11.4 mln m^3, flow module is 5.6 l/sec/km^2.

The 40% of the river's annual flow pass during the spring flood season.

The spring flood in an average year starts on April 10^{th}, continues 57 days and ends on June 6^{th}. Then a long-term water-scarce period starts being frequently interrupted by rainy floods.

The largest discharge observed in the river during spring floods in 1972 used to be 19.4 m^3/sec. This value is not acceptable for mudflows since the hours they occur do not coincide with the observation terms and, therefore, fail to be recorded.

Average annual turgidity of the Goris River waters is 150 l/m^3. Average annual temperature of the river waters is 6^0C.

The river basin's top-soil and vegetative cover is subject to vertical zoning. There are mountainous and forest brown no alkaline, typical carbonate and steppe lands dominating on the altitude of 1000-1600 m. The forests, which quite recently had a significant spread, are currently represented in a limited spread in the form of individual parks and stripes.

Typical and carbonate mountainous black soils with cereal and grass-and-cereal plants are spread on the altitude of 1600-2000 m.

The sub-alpine mountainous-and-meadow lands with the meadow steppe plant blanket are on the altitude of 2000-2500 m.

Mountainous-and-meadow turf-and-peat lands covered with sub-alpine and alpine meadows are typical to the areas on the altitude of 2500-3000 m.

Significant inclination of the southern slopes of Goris River basin, relief fragmentation and wrong land-use are contributing to deterioration of top-soil and vegetative cover.

The 53% of the basin's area compose stony, striped, inoperative lands. The 77% of the mountainous pastures, as well as 47% of arable land are medium and strong eroded.

Described geo-formation, climatic and top-soil and vegetative cover characteristics create prerequisites for formation of mudflows in case of rainfalls.

Assessment of Mudflow Phenomena

Goris River's design cutting has 26 tributaries with permanent and temporary flow, which are to different extent causing mudflows. Not all of the tributaries have their own titles and they are numbered for further description of the stuff . The morphometric indicators of the mentioned tributaries are given in Table 3.

The mudflow and further desertification phenomena are particularly developed in the Goris River left-hand tributaries basin, which are located on the Goris plateau's south-eastern slopes.

Thanks to high infiltration characteristics of recent volcanic cover that diminish the probability of surface flow formation, the mudflows are too weak in the right-hand basin of the Goris River's

tributaries basins, which are located in the right part of the Yerablurs plateau and on the slopes of the Big Ishkhanasar volcanic massif.

Table 3

Data on Mudflows Occurred in the Goris River Basins

#	River, tributary	Date	Mudflow parameters		Caused material damage						Cost of cuased damage (US$ thousands)	Human victims
					Destroyed			Killed livestock (heads)	Water covered			
			Maximum discharge m^3/sec	The largest D of the stones removed, mm	Jetties (m)	Bridge (units)	Canal head		Gardens, vegetable gardens, (ha)	Agricultural land fields,		
1	Goris river	15.06.1936	40	1.8	-	5	-	20	-	-	25	-
2	-,,-	4.06.1957	81.5	1.0	-	2	-	-	-	-	12.0	-
3	-,,-	18.06.1967	45.1	1.5	700	5	2	6	-	40	220	-
4	Ghatrin gorge	29.08.1988	7.8	-	-	-	-	-	-	-	-	-
5	Sandi gorge	-,,-	9.8	-	-	-	-	-	-	-	-	-
6	Goris river	25.05.1997	150	2.0	-	-	-	-	260	40	837	-
7	Shor water and Ghatrin gorges	22.06.1997	35	1.3	-	-	-	-	-	-	554	4

Weak resistance towards weathering of the rocks composing the Goris plateau's river basins together with the combined weak water transparency and high frequency of downpours are contributing to development of erosion phenomena and generation of strong, destructive mudflows.

Out of these mudflows the strongest ones took place on May 25 and June 22, 1997, which caused damage of a huge size. The ground-floor apartments and basements homestead gardens of the Goris dwelling houses were filled with sediments, street asphalt cover was destroyed, the sewerage was damaged. The 60% of the population were deprived of their drinking water, and communication means were damaged.

The RoA Government has allocated some money to eliminate the consequences of the mudflows, but due to the insufficiency of the resources an essential part of these works remained to be incomplete.

In case of downpours (40-50 mm per hour), the frequency of which within the recent years due to climate aridity started to be increased, real possible threat of the mudflows would be continued with the same capacity.

In order to prevent the mudflows and minimize the risk of desertification it is necessary to carry out both channel and slope erosion mitigation measures.

In order to quantitatively assess erosion and mudflow phenomena and select the types and sizes of mudflow mitigation facilities based on methodical instructions drafted by the Armenian Institute of Water Problems and Hydraulic Engineering liquid and solid flow maximum discharges and volumes were estimated. The estimation results are given in Table 4.

Table 4

Goris River Basin Mudflows parameters total

Tributary number	Title	Tributary length(km)	tributaries basins	Terracing	Average height of basin (m)	Mudflow parameters of 1 % security					Relative Mudflow threat
						Maximum flow discharge m^3/sec.)	Maximum discharge of flood 1000m^3	Maximum mudflow discharge m^3/sec.)	Mudflow discharge 1000 m^3)	Mudflow discharge in solid sediments 1000 m^3)	
1	-	0.3	0.06	333	1400	0.99	0.10	1.7	0.14	0.03	1.14
2	-	0.5	0.09	200	1400	1.30	0.29	2.01	0.38	0.06	1.8
3	-	0.5	0.16	300	1425	2.53	0.51	4.20	0.71	0.13	2.3
4	-	1.5	0.75	200	1500	9.49	2.4	14.7	3.19	0.53	1.8
5	-	1.2	0.31	242	1495	4.5	2.0	7.0	2.67	0.45	4.0
1	2	3	4	5	6	7	8	9	10	11	12
6	-	1.1	0.28	225	1475	5.40	1.6	8.37	2.1	0.34	3.4
7	Ghatrine gorge	1.5	0.5	160	1490	6.3	3.6	9.45	4.68	0.72	4.1
8	Shor jur	3.4	3.5	124	1590	28.6	39.2	42.0	50.57	7.45	6.1
9	-	0.2	0.04	200	1425	0.6	0.06	0.9	0.08	0.014	1.14
10	Chopchi gorge	0.8	0.45	93	1435	5.0	2.16	6.97	2.70	0.37	2.1
11	Sandi gorge	4.4	7.2	159	1780	48.4	86.4	73.1	112.3	17.3	6.8
12	-	0.5	0.12	280	1580	1.9	0.29	2.98	0.39	0.07	1.6
13	-	0.9	0.16	189	1635	2.2	0.9	3.38	1.19	0.19	3.4
14	Dzorak Verishen	1.2	0.51	216	1715	6.7	3.26	10.78	4.4	0.75	4.0
15	-,,-	0.6	0.16	188	1725	2.2	0.51	3.37	0.67	0.11	1.8
16	-,,-	6.6	8.62	80	1805	55.0	168.0	77.0	210.0	29.4	9.0
17	-	5.4	9.88	191	2385	58.5	126.5	83.6	159.4	22.8	6.3
18	Goris river	11	27.8	96	2390	90.9	440.4	120.9	532.9	66.1	5.8
19	Goris river	11	37.7	96	2390	107.8	543.4	143.0	657.0	81.4	5.3
20	-	0.6	0.25	403	1825	3.4	0.8	5.88	1.14	0.22	2.4
21	-	0.6	0.31	371	1805	4.1	0.99	6.37	1.32	0.22	2.0
22	-	0.4	0.03	500	1820	0.5	0.05	0.75	0.07	0.012	1.0
23	-	0.6	0.08	452	1760	1.2	0.26	1.85	0.34	0.06	2.0
24	-	0.6	0.19	484	1750	2.8	0.61	4.62	0.82	0.14	2.1
25	-	0.6	0.19	523	1685	2.6	0.46	4.73	0.63	0.11	1.6
26	-	0.5	0.17	600	1670	2.6	0.41	4.23	0.57	0.11	1.7
27	Goris river	16	70.1	107	2294	162.8	1121.6	244.0	1458.0	224.3	8.7

The volume (module) of 1%-probability mudflow sediment outgoing from the basin's 1 sq km to make risk assessment for erosion and mud flow phenomena. Comparative indicators for mudflows formed in the Goris River tributaries basin (Table 5) has been estimated by assuming the minimum value of sediment module as one unit of the mudflow risk.

Counter Mudflow Hydrotechnical Measures

In order to decrease desertification risk in the town of Goris and its environment hydrotechnical mudflow mitigation measures are very important.

Their objective is to prevent disaster-risky phenomenon and create conditions for surrounding steep slopes to preserve from erosion by means of elaborated counter mud flow measures.

Preliminary survey of the site and miximum cost analysis showed that design area contains 26 mud flow channels including 17 most dangerous.

It planned to carry out the following comprehensive measures for the most dangerous mudflows:

1. Construction of mudflow regulation facilities (MRF).
2. Construction of mudflow energy mitigation facilities (MEMF).
3. Construction of mudflow collection facilities (MCF).
4. Construction of bank-preserving facilities (BPF).

Table 5

The Volumes and Costs of Erosion Mitigation Measures

Tributary	Titles	Agrotechnical				Forest-and-reclamation		Terracing	
		Arable land		Pastures					
		ha	thousand US$	ha	thousand US$	ha	thousand US$	ha	thousand US$
1	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	5	12.5	-	-
4	-	-	-	-	-	5	12.5	6	18.0
5	-	-	-	-	-	8	20.0	-	-
6	-	-	-	-	-	7	17.5	-	-
7	Ghatrin gorge	14	0.56	-	-	10	25.0	14	42.0
8	Shor jur	19	0.76	-	-	14	35.0	18	54.0
9	-	-	-	-	-	-	-	-	-
10	Chapchi gorge	7	0.28	-	-	5	12.5	7	21.0
11	Sandi gorge	23	0.92	102	16.83	18	45.0	23	69.0
12	-	5	0.20	-	-	4	10.0	-	-
13	-	-	-	-	-	8	20.0	-	-
14	A ravine in Verishen	13	0.52	-	-	10	25.0	-	-
15	-,,-	6	0.24	-	-	5	12.5	6	18.0
16	-,,-	139	5.56	280	46.20	23	57.5	50	150.0
17	-	21	0.84	304	50.16	16	40.0	40	120.0
18	Goris river	-	-	584	96.36	29	72.5	83	249.0
19	Goris river	-	-	-	-	-	-	-	-
20	-	8	0.32	-	-	8	20.0	8	24.0
21	-	7	0.28	-	-	7	17.5	7	21.0
22	-	3	0.12	-	-	3	7.5	3	9.0
23	-	7	0.28	-	-	7	17.5	7	21.0
24	-	7	0.28	-	-	7	17.5	7	21.0
25	-	5	0.20	-	-	5	12.5	5	15.0
26	-	6	0.24	-	-	6	15.0	6	18.0
27	Goris river	30	1.20	130	21.45	30	75.0	30	90.0
Total		**320**	**12.80**	**1400**	**231.0**	**240**	**600**	**320**	**960**

Mudflow Regulation Facilities. The Shori gorge (No. 8), a left-hand bank tributary to Goris River and Sandin gorge(No.11) are the most mudflow risky, which during the 1997 mudflow caused destruction of the Goris town left-hand bank facilities and means of communication by filling the town area with some 45,000 m^3 of mudflow sediments.

After the 1997 mudflows a mudflow canal has been designed with its head regulation unit of US$ 159,000 total cost. Presently, only a mudflow canal has been constructed by appropriating US$ 104,000. Due to lack of financial resources the construction has been suspended and increased the causes for a mudflow risk.

The programme plans according to the prepared design to construct head unit and to accomplish incomplete parts of the mudflow canal of US$ 50,000 cost.

Given relief conditions of the Sandin ravine it is planned to construct a mudflow storage up to maximum height of 22 meters, 300 m^3 of capacity on a distance of 1050 meters from the river mouth. In case of a mudflow storage of such capacity and 1% of probability of mudflow sediments, its operation term would amount to 30-35 years which corresponds to a 5^{th}-grade hydrotecnical facility normative term. Taking into account that there are numerous rocky ores in the mudflow regulating stretch it is planned to be constructed as rockfill dam.

Maximum mudflow flow after cleaning from large solid sediments is transferred to the lower bief by means of side sluice and collection canal. Preliminary cost estimate of financial resources required for implementation of the Sandin gorge mudflow regulating hydraulic unit amounts to US$ 228,000.

A mudflow regulator created by means of the rockfill dam would enable to accumulate bottom sediments within the years of operation, to mitigate the channel inclination and by preventing mudflow phenomena to ensure safety of the Goris town public and socio-economic facilities.

Mudflow Energy Mitigation Facilities (Barrages). In order to prevent development of mudflow phenomenon and create conditions for further use of eroded areas it is planned to install 20 facilities to absorb solid sediments and mitigate mudflow energy in the most active zone of mudflow-generating ravines.

Given the inclination of the ravines 6-8 meter height barrages are planned to be installed on a distance of 50÷100 meters from each other. Similar arrangement of the barrages would create a possibility to mitigate the ravine's inclination by 4÷15 times and by decreasing potential energy of mudflow to diminish its environmental impact.

Taking into account availability of numerous rocky ores in the area the barrages are planned to be of permeable-rockfill structure in a rocky row.

In order to ensure stability of the barrages inclination of the slopes are installed on the rocky ores after removal of channel alluvial sediments.

In order to remove small outlets of the ravines the barrage body is designed to contain 5÷6 expansion drains of the size of 0.3x0.3 m, in a checkered arrangement.

Identification of the number of barrages for each and every mudflow-generating ravine is dependent upon its erosion degree and inclination Table 6.

Mudflow-collection Facilities. In order to regulate cumulative outlet of some 13 m^3/sec of mudflow generated in ravines number 12, 13, 14, and 15 and small ravines on the right side of the Goris-Verishen highway and its inflow to the town and desertification phenomena it is designed to construct a 2.2 km long mudflow-collection canal along the highway.

The canal is designed to be tabletop cutting in some stretches -- with the right-bank retaining wall. The canal's construction cutting $w_l = 6.0$ m^2.

Table 6

Tributary number based on the map	Barrage height (meter)	Quantity of barrages (unit)	Barrage capacity		Cost of barrage, thousand US$	
			1 unit m^3	Total m^3	1 unit	total
3	6	1	130	130	1.84	1.84
4	6	1	125	125	1.74	1.74
5	6	2	140	280	1.98	3.96
6	6	1	145	145	2.05	2.05
7	6	2	130	260	1.84	3.68
8	8	2	145	290	2.05	4.10
10	6	1	125	125	1.74	1.74
11	8	3	220	660	2.85	8.55
16	8	3	220	660	2.85	8.55
17	8	2	230	460	3.25	6.50
18	8	2	230	460	3.25	6.50
Total		**20**		**3595**		**49.21**

Main construction works of the canal are: land-and-rocky work - 19,200 m^3; concrete work - 3,800 m^3; ferro-concrete work - 15,000 m^3; construction cost of the mudflow-collection canal is US$ 504,000.

Jetties. During the 1997 mudflow phenomenon absence of jetties along Goris River -- in the head stretch and the Kamo-Myasnikyan streets part on a length of some 700 meters -- served a reason for desertification-level damages in the town of Goris.
In order to protect the town from the threat of desertification, public and socio-economic objects it is designed to complete the above parts with jetties corresponding to the existing sizes.

To this aim it is necessary to carry out the following works:

- land-and-rocky works - 2400m^3;
- buto-concrete works - 4650 m^3;

Construction cost of jetties would amount to US$ 726,400.

Conclusions

The cost of counter-erosion and counter-mudflow measures planned by the programme per hectare would amount on average to US$ 1,500, and the total cost would amount to US$ 3,361,000 (Table 7).

Table 7

#	Name of measure	Cost in US$
1.	Agrotechnical	243,800
2.	Forest-and-reclamation	600,000
3.	Crop-and-technical	960,000
4.	Flood-regulating in Sandin ravine	228,000
5.	Construction of barrages	49,200
6.	Mudflow-collection canal	504,000
7.	Jetties	726,400
8.	Incomplete construction in Shori gorge	50,000
Total		**3,361,400**

Programme measures implementation would create conditions to decrease erosion of surrounding slopes, minimize destructive impact of the mudflows on an area of some 2300 ha, prevent desertification phenomenon and ensure public security and sustainable development of socio-economic system.

Work scheduled within the programme, including execution of designing and survey work, would require two years (Table 8).

Table 8

Schedule of Programmed Measures

#	Name of measure and facility	Name of expenses, thousand US$			Implementation terms	
		Design-and-survey	Implementation	Total	Year 1	Year 2
1.	Agrotechnical	2.8	241.0	243.8	120.0	123.8
2.	Forest-and-reclamation	6.0	594.0	600.0	300.0	300.0
3.	Crop-and-technical	19.2	940.0	960.0	500.0	460.0
4.	A mudflow-regulating facility in Sandin gorge	10.0	218.0	228.0	100.0	128.0
5.	Construction of barrages	1.2	48.0	49.2	20.0	29.2
6.	Construction of mudflow-collection canal	11.0	493.0	504.0	250.0	254.0
7.	Jetties	15.4	711.0	726.4	370.0	356.4
8.	Completion of the Shor gorge mudflow canal	-	50.0	50.0	50.0	-
TOTAL		**65.6**	**3295.8**	**3361.4**	**1710.0**	**1651.4**

3. Project for Engineering and Geological Survey of the Site of Makaravank Memorial Complex in the Tavush Province of the Republic of Armenia

Brief Information on the Makavank Monastery Memorial Complex

The Makavank Monastery Memorial is located at a distance of 15 km from the Town of Ijevan in the Province of Tavush, Republic of Armenia and 3 km south-west to the nearby village of Achajur, on the slope of Mount Paytatap.

Makaravank, a spiritual and cultural centre of the historical Mahkanaberd, is one of the significant medieval architectural complexes, which is notable by sculptural and ornamental scrutiny and perfection. This church complex is also a beautiful sample of harmony of architectural facilities and the environment. A complex of three churches, a yard, a chapel and other facilities built in 10-13th centuries with its unique ornaments, richness and diversity is ranked among Aghtamar, Bgheno Noravank, Gandzasar. The churches are built out of dark rosy andesite red tuff, whereas the adjacent facilities -- out of greenish stones. There used to be a school next to the church surrounded by an extensive settlement, which later were destroyed due to probable landslide or other natural phenomenon.

The old church was built in 10-11th centuries, the Saint Blessed Virgin -- in 1198 by the Makaravank's leader Hovhannes. Major church built in 1205 is rich in Armenian medieval art masterpieces of pentangle asterisks, polygons and ornaments framed with wattled curving.

This wonderful complex of great spiritual, cultural and architectural significance for Armenia within almost an entire millennium survived natural calamities (earthquakes, atmospheric and other impacts). It has approached us although somehow obsolete, but in overall stable state. (In the beginning of 1980s the Monastery facilities were partly restored suspended due to lack of funding).

The Monastery is facing a threat of total destruction due to rapid activation of landslide processes in the territory of the Monastery. In order to save the Memorial Complex it is necessary to promptly prepare and implement anti-landslide measures.

Brief Description of Area's Natural and Climatic Conditions

The matter of issue is located on the east slop of Gugarats range, on the right bank of Agstev river left tributary - Magaraget. General steepeness of the relief is from the west to the east. The absolute point of the surface is fluctuating between 1020 m (in the uvular section of the landslide) and 1155 m (in the Memorial Complex's plateau).

Climatic conditions, particularly quantity and dissemination of atmospheric precipitation play a decisive role for one of the most important factors that originate landslide -- formation of hydrogeological conditions. Thus, the highest monthly average quantity of precipitation in the district is observed in May-June by approaching 98 mm, meanwhile the lowest one -- in December-February amounting to 21 mm. Precipitation is mostly rain frequently of rainfall nature. Average air temperature is 10.8^{o}C. The highest average monthly temperature is (+) 21.7 ^{o}C (July-August), the lowest one -- (-) 0.3 ^{o}C (January-February). Forest masses are playing a significant role in the district's temperature regime by mitigating rapid fluctuations of temperature and increasing humidity, which creates additional feeding for underground waters.

The geological structure of the district and target area is represented by sedimentation and volcanic-and-sedimentation ores -- limestone, sandstone, tuff-and-sandstone, tuff conglomerates and tuffs, which are fundamental base ores. The latter is mostly covered with the Quaternary age alluvial-and-prolluvial, colluvial (landslide) sediments.

Underground waters are represented by several horizons. Deep waters are located in the fundamental base ores, including mineral waters, which are related to tectonic fracture zones. First horizon waters (groundwater) are located in the sediments of Quaternary age. Within the target area's territory they are located at different depths (above 11 m). These waters have surface outlet as springs.

Brief Description of Landslide Phenomenon

Rapid occurrence of landslide phenomenon in the area adjacent to Makaravank witnessed by the local residents took place in 1960-1970s. The upper limit of the landslide (the edge of cut) is located at a distance of 20 km to the east from the Monastery facilities. Design sizes of the landslide body are the following: the length is about 500 m and width is 300-350 m. Mentioned with sizes are in the medium parts of the landslide, meanwhile it is suddenly reduced in the uvular section. The sizes given above are the outcome of the preliminary visual observation to be verified in the course of detailed survey. The slide surface depth in the medium sections may presumably amount to 30-40 m. Cut wall height (below the edge of cut) amounts to 3-4 meter, in some places -- 5 m. The slide body surface is strongly wrinkled, cut by numerous cracks of different length and cut-out, which are witnessing of a fact that the landslide process is in the process.

Underground waters are one of the active factors that contribute to the deterioration of slope stability, which is supplemented by the surface water inflow to the deeps of the landslide body. Availability of numerous opened cracks, holes are mostly contributing to the infiltration of the waters. Irregular flow of waters from a number of springs to the east (up the slope) from the Monastery is the essential part of general surface flow, which penetrates into the landslide body.

It is assumed that the Monastery complex is built on the peak section of a large ancient stabilized landslide, origination of which had a seismo-gravitation nature. Target landslide would be observed as secondary with respect to the assumed one. The factors of origin of the latter may also lead to consideration of seismic impacts, which are almost permanently acting with various strength.

The Makaravank's area failed to be studied subject to development of anti-landslide measures. Since mid-1980s up to the recent years some observations have been done by different specialists, commissions, preliminary engineering and exploration survey in the area's small section -- mostly around the Monastery's facilities, by means of small depth holes.

Package of Engineering Survey

Correct choice of stabilization for landslide processes requires serious justifications. These justifications are impossible without detailed complex engineering survey, the objective of which is to get not merely qualitative description of landslide generation factors, but also, which is very important, and their quantitative indices. Frequently, due to lack or inadequate survey of the latter, efficiency of designed and implemented measures is extremely low, and sometimes similar measures lead to a negative result, i.e. they contribute to the development of the landslide.

Such a large and complicated landslide, as the Makaravank's landslide requires a more many-sided and detailed survey to identify the following:

- geometric parameters of the landslide body (surface area, depth, nature of slide surface, etc.).
- geological structure,
- hydrogeological conditions,
- regime of underground waters, filtration characteristics of water-bearing rocks,
- dynamics of tense state of the landslide body,
- regime of surface flow, change of environmental conditions after shift of the slope,
- typical landslide characteristics (nature of relief surface, sizes of cracks, state, density, etc.),
- slope stability
- age and activity of the landslide,
- prediction of future development.

Topographic and Geodesic Works

In order to perform the tasks listed above the following survey is envisaged to be conducted.

- as a basis for any type of research, registering their data, as well as selection and design of follow-up actions it is envisaged to make topographic survey of 1:1000 scale on an area about 35 hectares by covering the landslide body and adjacent area, particularly around the Monastery and to the south from it - US$3000;
- set-up of a geodesic network for long-run observations, for various type (long-run, advance, short-run, etc.) prediction purposes - US$2000;
- observations - US$1600 (cost of one-year observations cycle).

Package of Engineering and Geological Survey

- Collection, study, analysis, processing of research data of former years, including identification of aerophotography made in various years, formulation of appropriate outlines and maps, development of programs for topographic and survey routs - US$1600;
- engineering and geological topography on an area of about 100 ha - US$300;
- package of engineering and geological survey of 1:2000 scale on an area about 30 ha - US$1800.

Mining and drilling works, including:
a) holes drilling - 12 units of 360 running meters of total depth, out of which 6 holes of average 40 m depth and 6 ones -- average 20 m depth. Drilling is envisaged by means of mechanical column method without wash-up in short routs, ground and underground waters sampling - US$9000;
b) prospecting pits boring - 6 units of 5 m of average depth, ground sampling - US$ 800.

The holes (except for those envisaged for observations) and prospecting pits once drilled out, they should be filled in and tamped layer after layer.

- experimental filtration research in holes and prospecting pits including:

a) extrusion from holes - 2 extrusion - US$ 1000;
b) prospecting pits wash-up - 2 wash-ups - US$ 200

- underground waters regime observation, including:

a) equipping of 6 observation holes by filters and other necessary instruments - US$ 800;
b) observations - US$300 (1 year observation cost).

- engineering and geophysical research, including:

a) electric and prospecting works - research of holes, earth surface (geological cutting, hydrogeological conditions, ground features study, measuring of tense state, etc.) - US$ 1700
b) seismic and prospecting and acoustic survey from the earth surface, in holes, and between them - US$1200;

- field ground survey in holes (presiometric) and prospecting pits - US$ 700.
- laboratory research, including:

a) ground physical-and-mechanical and features (some 40 samples) - US$ 800;
b) underground water samples (some 10 samples) - US$ 200.

- office processing of field research data, including data of:

a) mining and drilling works - US$ 1000;
b) package of engineering and geological survey - US$300;
c) hydrogeological, experimental-and-filtration and regime observations - US$ 300;
d) engineering-and-geophysical works - US$400;
e) ground and underground water laboratory and field research - US$350;
f) calculation of slope stability - US$300;
g) reporting, formulation - US$550;
Total cost of works envisaged under Item 5.2. would amount to some US$22,600.

Besides the works mentioned above a number of small-sized works is envisaged to be executed (e.g. hydrological, etc.) and auxiliary works (geodesic layout and tie-in of drilling ant other observation points, etc.). These and some other works would require some US$1000. The cost of whole package of above mentioned works would amount to US$ 28,600.

Work Schedule

General work schedule is conditioned by their type and size amounting to some 15 months. The crucial role here belongs to regime observations duration, which amounts to one year per one cycle (minimum requirement for prediction of landslide process). Work schedule is outlines in Table 9.

Table 9

Work schedule of the pachake of engineering investigation works

	Name of works	Months														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1.	Topographic survey, set-up of geodesic network															
2.	Geodesic observations															
3.	Data collection, processing															
4.	Engineering-and-geological survey															
5.	Mining-and-drilling works															
6.	Experimental-and-filtration works															
7.	Underground waters regime observation															
8.	Engineering-and-physical works															
9.	Ground investigations															
10.	Office work															

4. Mitigation and Neutralization of Harmful Impact of the Shamlugh tail Storages in the Syunik and Lori Provinces of the Republic of Armenia

Background

Twelve tail storages have been constructed in the Republic of Armenia at different years that accumulate some 300 M cu m of wastes from mining industry. Waste composition is conditioned by mineral combination of paragenetic minerals.

Existing economic situation in Armenia within the recent years prevents set-up of full control over the tail storages. Being complex hydrotechnical facilities tail storages are representing a permanent hazard and appear to be a reason for a calamity.

Due to the impact the natural-and-climatic conditions content of tail storages (mainly metals) is weathered, transferred and spread to the adjacent areas by causing irreversible impact on human health, environment, including fauna and flora and resulting in activation of desertification processes.

From this viewpoint conserved tail storages of Geghanush in the province of Syunik, and the tail storage of Akhtala in the province of Lori are mostly hazardous. These tail storages are located on densely populated and developed farming areas and cause huge damage to the environment and human vital activity by simultaneously contributing to desertification of lands exclusion of them from the lands of farming and other value.

The necessity to protect the tail storages proceeds from not only the fact, that it is necessary to minimize and neutralize their harmful impact on the environment and human health, but also from rational use of natural resources, since the latter contain big quantities of useful and rare metals that represent a material value and their use might contribute to the country's development. However, these tail storages are not re-processed due to a lack and high cost of adequate technologies. The tail storages (Appendix 1) as objects of hazardous hydrotechnical calamity by their impact on the environment and human health are classified based on the factors mentioned Table 10 and effects:

Table 10

Classification of Tail Storages Based on Harmful Factors and Effects

#	Harmful factors and effects	Grading unit (point)
1.	Volume	1-3
2.	Number of population in the affected zone	1-5
3.	Lands located in the affected zone (quality, class)	1-5
4.	Operated	1-2
5.	Conserved	1-4
6.	Facility construction form - ferro-concrete	1
7.	Land dam	2
8.	Content of hazardous substances, elements (%1m^3)	1-5
9.	Content of useful metals (%1m^3)	1-5
10.	Level of dispersion	1-2
11.	Possibility to conduct measures to prevent hazardous impact	1-5

According to the mentioned indicators classification of tail storages as the highest risk centres are referred to in Appendix 2.

The storages of Geghanush in the province of Syunik and the storage of Akhtala in the province of Tavush are selected as storages representing high risk and requiring primary preventive works to be prepared and implemented.

Selection of these tail storages is conditioned by the following criteria:

1. The tail storages of Geghanush and Akhtala are located in densely populated areas. Towns of Kapan, Shamlugh, Akhtala, a number of other villages and settlements are located within its affected zone.
2. Desertification processes have been activated within the affected zone of the tail storages of Geghanush and Akhtala, which has been resulted in total extinction of plants and continuation of land alienation phenomenon.
3. Geological conditions of establishing and formation of the Kapan copper and Shamlugh copper multi-metallic deposit, as well as content of harmful components in the Geghanush and Akhtala tail storages caused by technological failure of ore material re-processing, which exceeds by 8-10 times the indicators of the rest of the tail storages.
4. High percentage of useful metal content conditioned by the prerequisites mentioned in item 3, which should protected for the economic development in the country.
5. The geographic location and natural-and-climatic conditions of the Geghanush and Akhtala tail storages could contribute to the wash-up and dispersion of the tail storages, while in the case of a collapse the animal kingdom of Vokhchi and Debed rivers would be extinct.
6. Further operation of the Geghanush tail storage is prohibited given the fact, that drainage-system facilities located in the tail storage to secure removal of stormwater are under high pressure and additional accumulations on the currently conserved galleries would result in an accident by causing great damage to the environment, to the residential houses in the town of Kapan and commercial facilities.
7. Operation of the Akhtala tail storage is possible only in the case if the drainage-system canal is reconstructed.

Measures Aimed at Mitigation and Neutralization of Harmful Impact of the Tail Storages

In order to minimize hazardous impact of the tail storages generated due to the mining industry production activity it is necessary to conduct recovery and reclamation of the storage surfaces.

A tail storage or slurry field of each and every non-ferrous metallurgy concentrating mill are former landscapes, which appeared to be under a layer of toxic substratum of chemical substances. Meanwhile, production wastes are fully eliminating natural fertile lands and fruitful biocenosis and new neo-landscapes of technological origin that lost their original economic and social values are spontaneously generated that leads to desertification.

All the prerequisites generate a necessity to conduct land reclamation, which includes a number of engineering, reclamation and biological measures to set-up fruitful land-and-plant landscapes.

In order to mitigate and neutralize harmful impact of the conserved tail storage of Geghanush in the province of Lori and tail storage of Akhtala in the province of Tavush it is necessary:

1. To arrange and carry-out a periodical wetting system for tail storage surfaces layers and sow perennial plants. For that purpose it is necessary to select a method for artificial raining of the whole tail storage area. Water used for artificial raining could be procured both by gravity and pumping methods.
2. To cover (encircle) the whole surface of the tail storage by a liquid of polyacrylamide. The advantage of this method is, that polyacrylamide is gradually being hydrolysed by generating

polycrylacidic ammoniac brine, which changes the structure of land surface layer by strengthening it and simultaneously remaining transparent for air and water and creating favourable enough conditions for regular growth of plants.
3. As a temporary measure to strengthen the tail storages surface land layer by means of special machine equipment to prevent shift of surface land layer under wind impact.
4. To reconstruct and repair drainage-system facilities surrounding the tail storages in order to prevent transportation of wastes from the Geghanush and Akhtala tail storages to other areas through river waters and generation of new desertification centres.
5. To cover the tail storage surface by a 10-15cm-thick land layer and sow perennial grass plants.

Financial-and-economic calculations and cost estimation for the implementation of mitigation and neutralization measures of harmful impact of the tail storage of Geghanush in the Syunik marz and tail storage of Akhtala in Lori marz should be refined by a competent designing organization taking into account peculiarities of local natural-and-climatic conditions, location of tail storages, availability and quantity of surface waters, feasibility studies of invested measures, etc.

The measure of covering the tail storage by a 10-15cm-thick land layer is not observed by the financial-and-economic calculation, since it requires large-scale land works which would deteriorate the landscape natural balance.

In order to prevent harmful impact of the tail storages on the environment it is considered reasonable to input combined measures with the following essence. The tail storages surface is preliminary processed by polyacrylamide. Then a wetting system for the surface land layer is constructed and afterwards perennial plants are sown.

Financial and Economic Estimation

1. The surface area of the Geghanush tail storage amounts to 300x150=45000 sq m. A 40% water liquid of polyacrylamide per square of the tail storage would be required.

In order to process the whole surface of the tail storage 45000x0.4=18000 kg or 18 tonnes of polyacrylamide would be required (Table 11).

Table 11

#	Name of action	Required volume	Unit cost (US$)	Total cost (US$)	Term of execution
1.	Moistening with polyacrylamide	18 t	650	11700	1 month
2.	Miscellaneous			2340	
3.	Transportation cost 10%			1170	
4.	Construction of wastewater treatment facilities			600,000	5 months
Total				**615,210**	

1.a. Financial estimation for construction of wetting system of upper soil layer.
The gravitation wetting system for Geghanush tail storage's upper soil layer covers 45 ha of area; quantity of used steel pipes is 1600 line meters, the weight of 50-mm pipes would amount to 1600x5 kg=8000 kg; 1 tonne of 50-mm pipes costs US$150 (Table 12).

2. Financial and economic estimation of covering of the Akhtala tail storage's surface with polyacrylamide liquid. The Akhtala tail storage surface area amounts to 250 mx80 m=20000 sq m.
In order to cover the whole surface of the tail storage 20000 x 0.4=8000 tonne of polyacrylamide would be required (Table 13).

Table 12

#	Name of action	Required volume	Unit value (US$)	Total cost (US$)	Term of execution
1.	Procurement of 50-mm steel pipes	8.0 t	150	1200	1 month
2.	Transportation of pipes			300	1 week
3.	Mounting of pipes			800	1.5 months
4.	Use water charge per year	6 months	250	1500	
5.	Procurement of pumps	3 units	500	1500	0.5 month
6.	Used electric energy	4500 kW/year	0.05	225	
7.	Total			5525	
8.	Miscellaneous 20%			1105	
9.	Transportation cost 10%			553	
10.	Construction of wastewater treatment facilities			600,000	5 months
Total				**607,183**	

Table 13

#	Name of action	Required volume	Unit value ($US)	Total cost	Term of execution
1.	Covering with polyacrylamide	8 t	650	5200	20 days
2.	Miscellaneous 20%			1040	
3.	Transportation cost 10%			520	
4.	Construction of wastewater treatment facilities			200,000	2 months
Total				**206.760**	

2.a Financial estimation (in US$) for construction of wetting system for the Akhtala tail storage's upper soil layer.

The wetting system for the Akhtala tail storage's upper soil layer covers an area of 20 ha, the quantity of 55-mm diameter steel pipes to be used is 800 line meters, cost of 1 tonne of 50-mm steel pipes is US$150 (Table 14).

Table 14

#	Name of action	Required volume	Unit value (US$)	Total cost (US$)	Term of execution
1.	Procurement of 50-mm steel pipes	4.0 t	150	600	1 month
2.	Transportation of pipes			250	1 week
3.	Mounting of pipes			400	1.5 month
4.	Use water charge per year	6 months	250	1500	
5.	Procurement of pumps	3 units	500	1500	0.5 month
6.	Used electric energy	4500 kW/year	0.05	225	
7.	**Total**			**4475**	
8.	Miscellaneous 20%			895	
9.	Transportation cost 10%			418	
10.	Construction of wastewater treatment facilities			200,000	2 months
Total				**205,788**	

The financial and economic estimation is done is based on the market price in the Republic of Armenia as of January 01, 2000.

Appendix 1

Classification of Tail Storages Located on the RoA Territory

#	Tail storage title and location	Year of putting into operation	Year of conservation	Volume M m^3	Particles average diameter	Waste content
1.	Right-bank tributary to Vokhchi River, Village of Darazam	1953	1961	3	0.067	
2.	Right-bank tributary to Vokhchi River, Village of Pkhrut	1958	1969	3.3	-"-	
3.	On Vokhchi River	1962	1977	30	-"-	Mo
4.	On Artsvanik River	1978	Working	210	-"-	Cu
5.	On Geghanush River	1961	1989	4.6	0.084	SiO_2
6.	On Davazam River	1957	1977	30	0.087	Al_2O_3
7.	In gorge No. 1 of Agarak	1978	Working	9	-"-	MgO CaO
8.	In gorge No. 2 of Agarak	1979	Working	17	-"-	TiO_2 FeO
9.	In gorge No. 3 of Agarak					Na_2+K_2O P_2O_5
10	On Nahatak River nearby Settlement of Akhtala	1971	1988	3.2	0.082	S, Zn, Pb
11	Nearby Village of Arazap (Province of Ararat)	1982	Working	20	0.085	rare metals
12	On the right-bank tributary to Nazik River nearby Settlement of Dastakert	1960	1968	3.1	-"-	

Appendix 2

Assessment of Hazardous Impact of the Tail Storages

Right-bank tributary to Vokhchi River, Village of Darazam	**Right-bank tributary to Vokhchi River, Village of Pkhrut**	**On Vokhchi River**	**On Artsvanik River**	**On Geghanush River**	**On Davazam River**	**In gorge No. 1 of Agarak**	**In gorge No. 2 of Agarak**	**On Nahatak River nearby Settlement of Akhtala**	**Nearby Village of Arazap (Province of Ararat)**	**On the right-bank tributary to Nazik River nearby Settlement of Dastakert**	**On the right-bank tributary to Nazik River nearby urban village of Dasakert**
Volume	1	1	2	3	1	2	1	2	1	2	1
Population in the impact zone	2	2	2	2	5	1	1	2	5	5	1
Lands in the impact zone	2	2	2	4	5	2	2	2	4	5	2
Working, Non-working	3	3	3	1	3	1	1	1	3	1	3
Form of facility	1	2	2	1	4	2	1	1	4	1	2
Availability of hazardous substances	2	2	3	3	5	2	2	2	5	5	1
Availability of useful metals	2	2	3	3	5	2	3	3	4	1	4
Dispersion rate	2	2	2	2	1	1	1	1	1	2	1
Possibility to conduct measures to prevent harmful impact	2	2	3	1	5	2	1	1	4	3	3
Total	17	18	20	20	34	15	13	15	31	25	18
Degree of hazard	2	2	2	2	1	3	3	3	1	1	2

PART IV

MAPPING OF AREAS SUBJECT TO DESERTIFICATION IN ARMENIA

1. METHODS OF CUMPUTER-BASED MAPPING OF AREAS SUBJECT TO DESERTIFICATION

Computer-based mapping of areas subject to desertification in Armenia have been carried out in three phases:

1. Set-up of graphic copies based on hard maps,
2. Set-up of subject maps in the environment of Arc View 3a GIS software and collection of background data,
3. Set-up of maps of areas subject to desertification by comparing subject maps.

Graphic copies have been generated by scanning sections (34 x 42 cm) of hard copies of subject maps (scale: 1:200 000) and making appropriate raster files with the TIF or BMP extension. These files have been installed in the Corel Draw 8 software. The edges of the sections of hard copies of the maps have been attached by generating graphic objects, which fully reproduce the colour and form of the hard and raster-based existing areas.

Afterwards the final graphic copy of scale of 1:200 000 has been reflected in automated design software of Microstation'95 with CGM extension, where the electronic graphic copy designing scale has been changed in its environment to further generate a map of 1:1 scale applicable to the Arc View 3a GIS software (it is necessary for precise calculations and further monitoring). The DGN extension files containing electronic copy of subject maps generated in Microstation'95 software have been derived to Arc View 3a GIS software and obtained a SHP extension and a file used in the Arc View 3a GIS software.

Afterwards, explanation margins have been added to every graphic object (point, polygon, line) of the explanation table in the given topic, which contained characterizing digital data related to appropriate subject map resulted in DBF extension file related to above-mentioned SHP extension file.

Data set in the subject maps and explanation tables therein set in the Arc View 3a GIS software enable precise analysis of desertification processes.

2. LAND COVER

The Republic of Armenia is a land-scarce country, however, notable by its land cover, which include the following land zones (Map 1).

The Ararat concavity is notable by its unique economic, social and environmental characteristics of land cover, where desertification phenomena are more actively occurring, mainly by means of natural and secondary salination phenomena (Map 2).

Soil salinity is a typical form of desertification under arid climatic conditions. It occurs in lowland areas of the valleys, where groundwater level is close to the earth level. Given the mineral and mechanical composition of the land grounds capillary elevation could approach 1-5 meters. Due to water capillary elevation water evaporation is occurring on the earth surface by generating

salinated areas. When the groundwater level approaches to the deepness of 0-1 m from earth surface, then it is resulted in wetlands and swamps.

Vertical zoning is strongly expressed in the Ararat valley. Water solutions reaction is weak acidic in high mountains, pH is 6-6.5 which have been resulted in downstream migration of calcium, sulfur, natrium and other easily soluble matters. The reaction in the medium-altitude mountainous zone becomes basic, pH = 8-9, which is resulted in accumulation of carbonates, sulfates and chlorides. Carbonate weathering crust has been particularly developed in the volcanic cover, which are acting the role of buffer, including only in shady environment. The carbonate crust in watershed parts and positive forms of relief is growing by means of accumulation of dust and calcium containing in water solutions and hydrocarbonate ion slipping down from the atmosphere.

Availability of carbonate crust becomes very important to neutralize acidic rain reaction by means of precipitation. This process is contributed by the carbonate dust emission from the Ararat cement factory. Sulfate and weathering crust is being created in the Ararat valley and foothills, which contributes to the desertification process. The sulfate crust has been formed mainly in the southern part of the valley, east from Yerevan (gypsum is mixed with clay), and chloride crust in several parts of the valley itself -- in the form of alkali soil. Man has a crucial role in the process of salinization. Contribution to salinization by man is made through irrigation. The submountain zone (900-1600 m altitude) in the Ararat concavity is more subject to salinity. The major part of the slopes here is exposed to the south and has 3-30º inclination. Slightly differentiated gray semi-desert, light and dark brown, in some places black soil, chestnut forest and other soil types are more spread. Humus content in the soil layer between 0-20 cm is 2-4%. Soil erosion rate in 1980s in the major part of used land approached to 60-70%. Economic evaluation of lands on a 100-point scale amounts to only 15-25 points. Specific gravity of improved cultural and technical lands amounts here to hardly 5-10% compared to general agricultural areas.

Development of desertification factors in the Ararat valley is mainly conditioned by its geological structure and geodynamic characteristics.

From a geological point the Ararat valley is quite a complicated unit. Its development characteristics are relative (sometimes also absolute) decrease and sediment-accumulation processes. There are sand-and-clay and gypseous saliferous stratums with a total capacity of 2.5 and above kilometers.

Study of impact of active tectonic and young volcanic processes on formation of hydrogeological and hydrological conditions, re-allocation of underground and surface waters in this region is very important for understanding of desertification processes and their temporal trend. An indicator for such an impact is move of the Araks river basin.
This in its turn influences the qualitative changes and modern condition of the land cover. Such a long-continued process led to gradual land degradation and served a cause for swamping, salinization or deflation destructive processes in individual abandoned areas.

Thus, current desertification processes in Ararat valley are predetermined by geodynamic conditions available here. They are derivative from active tectonic movements and local deformation of the earth crust in the region. An interrelation line of united, temporal trend is recorded: active tectonic – underground and surface waters regime – desertification processes.

The Ararat valley is considered as the most developed farming area in the country, where meadow gray irrigated lands are spread (on an altitude of 800-850 m above sea level) – the best soil in the

country in terms of fertility under the conditions of irrigation. Under favourable climate conditions the following crops grow and bear fruits here, such as, apricot-tree, vine, peach-tree of perennial plantations, as well as numerous vegetables, and melons and gourds, and wheat.
An agrarian survey of large scale of 1:5000 of irrigated lands in the Ararat valley has been carried out in 1982-1986. It was targeted at clarification of existing setting of these lands and to develop respective complex actions, including improvement of land-reclamation of cultivated farmlands and prevention of secondary salinization of these lands.

The study has identified those intensively used lands in the Ararat valley, including cultivated farmlands amount to 81.0 thousand ha, out of which 50.0 ha are practically desalted (those lands are considered to be practically desalted, where there absolutely no water-soluble salts are available in the water sections of the land which are hazardous to the plants, or the percentage is low enough – 0.05%).

The 27.5 thousand ha practically accounts for the communities in the Province of Armavir, whereas 22.5 thousand ha – to the communities in the Province of Ararat (Table 1).

The 31.0 thousand ha out of these intensively cultivated lands are salinated to different extent, including 16.7 thousand ha account for the limits of lands scheme in the communities in the Province of Armavir, and 14.3 thousand ha – for the limits of lands scheme in the communities in the Province of Ararat.

Weakly salinated lands are the lands, where harmful water-soluble salts amount to 0.2% in land water sections. Medium salinated lands are those, where water-soluble salts are fluctuating between 0.2 and 0.3%.

Strongly salinated lands are those, where water-soluble salts are fluctuating between 0.3 and 0.4%. Natrium sulfates and natrium chlorine salts (Na_2CO_3, $NaHCO_3$) are also considered harmful, has strong basic reaction under which no crop is able to grown without a chemical reclamation.

Natrium sulfate and natrium chlorine salts are also considered as harmful. In case of presence of their 0.5% salts agricultural crops and perennial plants are not able to regularly grow.

Absorbed natrium is also of high percentage in salinated alkali soil except for the above-mentioned soluble salts, which is strongly cementing the soil and deteriorates its physical characteristics. 5.0 mg of absorbed natrium in 100g of soil is fading crop roots, meanwhile this quantity of naturium in salinated alkali soil amounts to 12,0-17,0 mg/100g in soil.

A reason for secondary salination served the soil in those areas, where groundwater are close to the earth surface fluctuating between 1.5-2.5 meters depth. These are the soils in almost all the communities in former Masis District, and those land plots in the Ararat and Armavir Provinces communities, which cut the left-bank valley, where during early spring floods riverside groundwater level is flooded.

Reasons of secondary salination serve also unclean state of moisture eliminators and collectors.

Due to recent-year energy crisis meliorative state of irrigated lands survived further deterioration. Agrotechnical measures are not applied, the vine and apricot orchards have been destroyed and eliminated. Most of the best soils in the Ararat valley were put under wheat crops, which is more deteriorating soil physical characteristics by decreasing fertility.

Table 1

Soil Survey Data of the Irrigated Lands in the Ararat and Armavir Provinces of the Republic of Armenia based on Salination and Alkaline Degree (Lands under Armavir, Hrazdan and Artashat Internal Canals)

Provinces	Total area	Arable land and perennial plantations (ha)						Different degree salinated and alkali rocky soils of
		Intensively used and soil under household	Secondary salinated soils					
			Including practically salt-free	Total	Including			
					Weak	Medium	Strong	
Armavir Province								
Armavir	37660	23701.1	15536.3	8164.8	5852.4	993.2	1319.2	6324.5
Echmiadzin	32198.4	20542.4	12017.5	8524.9	5685.3	1217.9	1621.7	5797.3
Total in Province	**69858.4**	**44243.5**	**27553.8**	**16689.7**	**11537.7**	**2211.1**	**2940.9**	**12121.8**
Ararat Province								
Artashat	22075.2	14790.8	10875.4	3915.4	3034.4	530.9	350.1	4056.7
Ararat	26121.1	12755.6	8330.7	4424.9	3613.5	554.5	256.9	6411.5
Masis	16645.4	9227.6	3242.8	5984.8	3390.9	1074.2	1519.7	2750.2
Total in Province	**64841.7**	**36774.0**	**22448.9**	**14325.1**	**10038.8**	**2159.6**	**2126.7**	**13218.4**
Total	**134700.1**	**81017.5**	**50002.7**	**31014.8**	**21576.5**	**4370.7**	**5067.6**	**25340.2**

Mountainous inclination is of the significant factors conditioning the state of Armenia's soil cover. A 10^0-inclination amounts to 60% in the country, $10\text{-}15^0$ – 15%, $15\text{-}20^0$ - 14%, the rest 11% are represented by above 20^0 inclination. Big inclination are met in the plicate-and-fragmented mountains. Basalt plateaus in the volcanic covers have soft inclination. Inclination is typical only to volcanic summits composed of acidic lava. The edges of canyons, where frequently lava is merely suspended, are of big inclination.

The arable lands are dispersed on the $3\text{-}16^0$ inclination lands, sometimes on $18\text{-}20^0$ (Tavoush Province), and pastures and hay-fields – $7\text{-}35^0$. It should be noted, that arable lands average precipitation on areas occupied by arable lands, pastures and hay-fields fluctuates between 400-700 mm, most of which occurs in early spring and autumn, when the soil surface is mainly striped. It makes obvious active soil phenomena development.

According to 1980-1985 agrarian survey data land fund in the country amounts to 2 mln 560.0 thousand ha, including different-level weathered soils amount to 1 mln 112.7 thousand or 44.0% (Map 3) of the total area. Weathering phenomena are more intensive in developed Provinces of Aragatsotn, Syunik, Kotayk, Lori, Vayots Dzor (Table 2). Less weathering is notable in the forest zone and Province of Shirak.

Table 2

Land Characteristics in the Republic of Armenia Based on Weathering

Name of provinces	Total area ha %	Non-weathered	Weathered lands			
			Soft	Medium	Strong	Total
Aragatsotn	255297.0	108839.0	58900.0	69427.0	18131.0	146458.0
	9.9	42.7	23.0	27.2	7.1	57.3
Ararat	187326.0	85515.0	43241.0	45242.0	13328.0	101811.0
	7.3	45.6	23.1	24.1	7.1	54.3
Armavir	93717.0	64748.0	18855.0	4557.0	5557.0	28969.0
	3.7	69.0	20.1	4.9	6.0	31.0
Gegharkunik	380466.0	265095.0	81836.0	32535.0	1000.0	115371.0
	14.9	69.6	21.5	8.6	0.3	30.4
Loti	349333.0	224848.0	74834.0	31706.0	17945.0	124485.0
	13.7	64.4	21.4	9.1	5.1	35.6
Kotayk	174910.0	83735.0	39607.0	33212.0	18356.0	911175.0
	6.8	47.9	22.6	19.0	10.5	52.1
Shirak	248723.0	173454.0	57490.0	13547.0	4232.0	75269.0
	9.7	69.7	23.1	5.4	1.8	30.3
Syunik	402999.0	183144.0	90773.0	71300.0	57782.0	219855.0
	15.8	45.4	22.5	17.7	14.4	54.6
Vayots Dzor	200130.0	77661.0	48876.0	38579.0	35014.0	122469.0
	7.8	38.8	24.4	19.3	17.5	61.2
Tavoush	255022.0	162424.0	48180.0	40725.0	3693.0	92598.0
	9.9	63.7	18.9	16.0	1.4	36.3
Yerevan	12411.0	4026.0	7045.0	941.0	399.0	8385.0
	0.5	32.4	56.8	7.6	3.2	67.6
Total	**2560334.0**	**1433489.0**	**569637.0**	**381771.0**	**175437.0**	**1126845.0**
	100.0	**56.0**	**22.2**	**14.9**	**6.9**	**44.0**

Study data show that strong weathering is notable mainly in south-located strongly steep and dry slopes.

Due to the energy crisis in recent years land types in country have been consigned to oblivion: no measure has been applied in the pastures, hay-fields, particularly to improve arable lands and other

land types. Meadow pastures loaded due to grazing have been weathered and lost their best features, turned to be among the obsolete worthless.

The Republic of Armenia being a mountainous country is the most land-poor in the region, where 0.12 ha of arable land and perennial plantations fall per capita. Significant part of arable land being dispersed on 3-16 degrees and sometimes above inclinations due to spring and autumn intensive precipitation and inadequate agrotechnical activities are subject to different extent weathering (Map 4).

Cultivated lands in the country amount to 464.3 thousand ha or 20.3% of total area. Medium and strong weathered soil are mainly extended in the Province of Aragatsotn amounting to 4429 ha or 8.0% of the arable land in the province. Medium and strong weathered lands in the Province of Syunik amount to 1573 ha or 3.6% of lands in the province. Medium and strong weathered soil in the submountain zone in the Province of Armavir amounts 1188 ha, in Vayots Dzor amount to 1064 ha or 5.1% of the province area. An analysis of the areas of weathered soil in the country identifies that 78.9 thousand ha of lands in the country are soft weathered, which amounts to 17%. Softer weathered arable lands are extended in the Province of Shirak – 12183 ha, in the Province of Syunik – 12136 ha, in the Province of Gegharkunik – 18481 ha.

Land disturbance due to construction and open mining of mineral and other resources is a factor that contributes to desertification in Armenia (Map 5).

Disturbed lands are allocated in the 11 provinces' 281 communities in the country (Table 3). According to the 1978-1998 inventory data 640 sites have been identified on the territory of Armenia – total area of 7530.0 ha, out of which 3780.0 ha before disturbance used to be agricultural lands. Out of total area of disturbed lands 4493.0 ha are under maintenance. Mineral and non-mineral mining on the rest 3037.0 ha is complete. These lands are subject to reclamation to further use in agriculture, forestry, water industry, fishery, and construction.

Soil contamination is one of the major factors contributing to desertification in Armenia. Almost all sectors of economic activity serve a source for this.

Significant source of soil contamination is mining metallurgy and mining industries (Kajaran Copper-Molybdenum Group of Enterprises, Ararat Gold Recovery Company). All these companies are polluting the land by heavy metals (Cu, Hg, As, Pb, Mo, Ni, Cd, Cr, etc.) and cyanic compounds (Map 6).

The area of the Alaverdi Copper-Molybdenum Group of Enterprises 3 km in diameter is strongly contaminated by heavy metals, content of which is 20-40 times exceeding maximum allowable concentrations Copper (32.3 times) and lead (16.0 times) concentrations are the most high.

Areas adjacent to the Ararat Gold Recovery Company are also contaminated by heavy metals.

Table 3

Generalized Data on Province-based Disturbed Lands in the Republic of Armenia

#	Province and community name	Number of contours of disturbed lands	Total surface are (ha)	Including	
				Exploitable	Exploitation completed
1	**2**	**3**	**4**	**5**	**6**
	1. ARAGATHOTN				
1.	Agarak	4	23.0	5.0	18.0
2.	Alagyaz	2	2.0	-	2.0
3.	Ashnak	1	3.0	-	3.0
4.	Aparan	2	4.0	-	4.0
5.	Avan	1	3.0	-	3.0
6.	Aragats	8	65.0	60.0	5.0
7.	Aragatsotn	1	4.0	-	4.0
8.	Arayi	2	5.0	2.0	3.0
9.	Areg	3	8.0	8.0	-
10.	Apnagyugh	3	1.0	-	1.0
11.	Byurakan	2	7.0	5.0	2.0
12.	Geghadir	2	13.0	13.0	-
13.	Geghadzor	1	2.0	2.0	-
14.	Yernjatap	1	1.0	-	1.0
15.	Talin	1	3.0	-	3.0
16.	Irind	3	24.0	6.0	18.0
17.	Tsilkar	3	4.0	-	4.0
18.	Katnaghpyur	2	8.0	4.0	4.0
19.	Kakavadzor	1	3.0	3.0	-
20.	Kosh	4	43.0	37.0	6.0
21.	Hartavan	2	2.0	-	2.0
22.	Mastara	7	7.0	3.0	4.0
23.	Melik-gyugh	4	7.0	7.0	-
24.	Mulki	1	8.0	8.0	-
25.	Mughni	1	4.0	-	4.0
26.	Nerkin Bazmaberd	2	11.0	-	11.0
27.	Norashen	1	6.0	6.0	-
28.	Shenavan	1	3.0	3.0	-
29.	Shgharshik	1	5.0	5.0	-
30.	Vosketas	1	2.0	-	2.0
31.	Jamshlu	1	1.0	-	1.0
32.	Sasunik	5	14.0	10.0	4.0
33.	Verin Bazmaberd	2	6.0	6.0	-
34.	Ujan	1	4.0	4.0	-
35.	Parpi	2	4.0	3.0	1.0
36.	Kuchak	3	8.0	-	8.0

1	2	3	4	5	6
37.	Ohanavan	1	4.0	4.0	-
38.	Oshakan	3	5.0	4.0	1.0
PROVINCE TOTAL		**86**	**327.0**	**208.0**	**119.0**
2. ARARAT					
1	Aygezard	1	5.0	5.0	-
2	Ayntap	1	6.0	-	6.0
3	Ararat	2	138.0	122.0	16.0
4	Goravan	12	25.0	-	25.0
5	Yeraskh	2	8.0	-	8.0
6	Lusarat	1	6.0	-	6.0
7	Hovtashat	2	8.0	-	8.0
8	Paruyr Sevak	1	15.0	15.0	-
9	Vedi	2	14.0	12.0	2.0
10	Reserve lands	1	40.0	40.0	-
PROVINCE TOTAL		**25**	**265.0**	**194.0**	**71.0**
3. ARMAVIR					
1	Aghavnatun	3	77.0	42.0	35.0
2	Aygeshat	2	32.0	-	32.0
3	Apaga	4	107.0	25.0	82.0
4	Aragats	1	5.0	5.0	-
5	Araks (Echmiadzin District)	4	169.0	-	169.0
6	Araks (Armavir District)	2	5.0	1.0	4.0
7	Argavan	3	148.0	-	148.0
8	Arshaluys	4	10.0	-	10.0
9	Artashat	1	23.0	-	23.0
10	Arevadsht	9	51.0	7.0	44.0
11	Arevik	4	93.0	-	93.0
12	Bagaran	2	5.0	5.0	-
13	Baghramyan (Echmiadzin Dis.)	1	11.0	11.0	-
14	Baghramyan (Baghramyan Dis.)	3	14.0	-	14.0
15	Berkashat	1	1.0	1.0	-
16	Dalarik	6	21.0	-	21.0
17	Dasht	2	2.0	-	2.0
18	Yeghegnut	6	130.0	20.0	110.0
19	Yeraskhahun	3	80.0	-	80.0
20	Yervandashat	1	1.0	1.0	-
21	Lenughi	1	7.0	-	7.0
22	Lernagog	5	169.0	169.0	-
23	Keghbavan	11	29.0	12.0	17.0
24	Hushakert	1	15.0	7.0	8.0
25	Mayisyan	1	4.0	-	4.0
26	Metsamor	2	29.0	7.0	22.0
27	Merdzavan	3	45.0	45.0	-
28	Musaler	1	6.0	6.0	-
29	Nalbandyan	1	65.0	65.0	-
30	Nor Artasges	1	1.0	1.0	-
31	Nor Kesaria	1	1.0	1.0	-
32	Shenik	5	12.0	5.0	7.0

1	2	3	4	5	6
33	Voskehat	1	1.0	-	1.0
34	Janfida	4	241.0	-	241.0
35	Jrarat	4	90.0	8.0	82.0
36	Tandzut	1	103.0	-	103.0
37	Parakar	1	3.0	-	3.0
38	Karakert	6	16.0	-	16.0
PROVINCE TOTAL		**112**	**1822.0**	**444.0**	**1378.0**
4. GEGHARKUNIK					
1	Aygut	1	5.0	5.0	-
2	Areguni	1	2.0	-	2.0
3	Artsvakar	2	3.0	1.0	2.0
4	Artanish	1	5.0	5.0	-
5	Geghamavan	4	20.0	-	20.0
6	Geghakar	1	8.0	8.0	-
7	Geghahovit	3	7.0	7.0	-
8	Ddmashen	3	14.0	14.0	-
9	Kolakar	2	8.0	8.0	-
10	Lchashen	6	38.0	28.0	10.0
11	Lusakunk	1	5.0	5.0	-
12	Tsakkar	1	7.0	7.0	-
13	Tsakhkunk	1	4.0	-	4.0
14	Tsovazard	3	6.0	5.0	1.0
15	Tsovak	2	24.0	24.0	-
16	Kakhakn	1	30.0	-	30.0
17	Karmir gyugh	1	20.0	20.0	-
18	Kutavan	1	16.0	16.0	-
19	Hayravank	3	4.0	-	4.0
20	Dzoragyugh	2	7.0	7.0	-
21	Chambarak	4	13.0	3.0	10.0
22	Makenis	1	5.0	5.0	-
23	Norakert	1	2.0	-	2.0
24	Noradus	6	52.0	49.0	3.0
25	Vanevan	1	320.0	320.0	-
26	Vardenik	1	5.0	-	5.0
27	Vardenis	3	17.0	8.0	9.0
28	Varser	2	8.0	-	8.0
29	Pambak	1	3.0	-	3.0
PROVINCE TOTAL		**60**	**658.0**	**545.0**	**113.0**
5. LORI					
1	Arevatsag	3	6.0	5.0	1.0
2	Armanis	1	3.0	-	3.0
3	Arjut	1	14.0	14.0	-
4	Akori	2	5.0	5.0	-
5	Bazum	1	13.0	-	13.0
6	Gyughagarak	1	7.0	-	7.0
7	Dashtadem	2	2.0	-	2.0
8	Yeghegnut	1	8.0	8.0	-
9	Teghut	1	3.0	-	3.0

1	2	3	4	5	6
10	Lernapat	3	55.0	54.0	1.0
11	Lori-berd	1	1.0	-	1.0
12	Tsater	1	1.0	1.0	-
13	Koghes	1	3.0	3.0	-
14	Hagvi	1	3.0	-	3.0
15	Haghpat	2	7.0	2.0	5.0
16	Hartagyugh	1	2.0	-	2.0
17	Chochkan	2	34.0	18.0	16.0
18	Mets Ayrum	1	14.0	-	14.0
19	Maksim Gorki	1	2.0	-	2.0
20	Novoseltsevo	1	1.0	-	1.0
21	Norashen	1	4.0	-	4.0
22	Nor Khachakap	3	21.0	19.0	2.0
23	Shahumyan	3	22.0	17.0	5.0
24	Shenavan	2	4.0	1.0	3.0
25	Shirakamut	2	2.0	1.0	1.0
26	Sanahin	1	6.0	6.0	-
27	Saratovna	3	8.0	-	8.0
28	Stepanavan	1	44.0	-	44.0
29	Vahagni	2	2.0	1.0	1.0
30	Tashir	3	11.0	5.0	6.0
31	Pambak	1	13.0	13.0	-
32	Karaberd	3	4.0	4.0	-
33	Karinj	2	4.0	4.0	-
34	Fioletovo	1	1.0	1.0	-
PROVINCE TOTAL		**56**	**330.0**	**182.0**	**148.0**
6. KOTAYK					
1	Abovyan	1	10.0	10.0	-
2	Alapars	5	18.0	3.0	15.0
3	Aghavnadzor	3	7.0	7.0	-
4	Arinj	1	3.0	3.0	-
5	Aragyugh	2	4.0	4.0	-
6	Aramus	3	12.0	11.0	1.0
7	Arzakan	3	14.0	8.0	6.0
8	Arzni	3	68.0	68.0	-
9	Artamet	2	7.0	-	7.0
10	Balahovit	2	11.0	11.0	-
11	Buzhakan	2	19.0	8.0	11.0
12	Geghashen	2	26.0	26.0	-
13	Yeghvard	4	19.0	10.0	9.0
14	Zoravan	2	2.0	2.0	-
15	Karenis	4	55.0	8.0	47.0
16	Kamaris	3	10.0	7.0	3.0
17	Hankavan	3	17.0	-	17.0
18	Hrazdan	3	36.0	36.0	-
19	Mayakovski	1	2.0	-	2.0
20	Meghradzor	2	39.0	39.0	-

1	2	3	4	5	6
21	Nor Geghi	4	61.0	60.0	1.0
22	Jraber	3	68.0	23.0	45.0
23	Jrarat	4	3.0	-	3.0
24	Jrvezh	2	35.0	35.0	-
25	Kasakh	1	4.0	-	4.0
26	Karashamb	2	5.0	2.0	3.0
27	Reser lands	4	15.0	14.0	1.0
	PROVINCE TOTAL	**71**	**570.0**	**395.0**	**175.0**
	7. SHIRAK				
1	Azatan	4	11.0	-	11.0
2	Aygabats	2	2.0	-	2.0
3	Arapi	4	24.0	-	24.0
4	Aregnadem	1	3.0	-	3.0
5	Artik	3	366.0	198.0	168.0
6	Bagravan	11	167.0	80.0	87.0
7	Bayandur	2	12.0	-	12.0
8	Bandivan	1	1.0	-	1.0
9	Getk	1	2.0	-	2.0
10	Goghovit	1	3.0	3.0	-
11	Gusanagyugh	2	22.0	-	22.0
12	Tavshut	1	5.0	-	5.0
13	Lanjik	1	1.0	-	1.0
14	Kamkhut	2	6.0	6.0	-
15	Kaps	3	5.0	-	5.0
16	Karnut	4	22.0	5.0	17.0
17	Hayakert	3	9.0	4.0	5.0
18	Haykadzor	1	6.0	6.0	-
19	Haykavan	1	5.0	-	5.0
20	Hayrenyats	3	9.0	9.0	-
21	Harich	3	169.0	169.0	-
22	Hovit	1	20.0	20.0	-
23	Hovtun	2	2.0	-	2.0
24	Dzithankov	3	10.0	-	10.0
25	Dzorakap	3	20.0	11.0	9.0
26	Mayisyan	8	158.0	7.0	151.0
27	Maralik	2	5.0	-	5.0
28	Marmashen	7	32.0	-	32.0
29	Musayelyan	2	26.0	-	26.0
30	Shirakavan	5	11.0	3.0	8.0
31	Voghji	2	10.0	-	10.0
32	Pemzashen	9	164.0	23.0	141.0
33	Jajur	4	17.0	1.0	16.0
34	Jradzor	1	8.0	-	8.0
35	Sarnaghbyur	2	42.0	-	42.0
36	Vahramaberd	3	25.0	-	25.0
37	Tufashen	4	124.0	35.0	89.0
38	Panik	2	6.0	-	6.0
39	Karaberd	1	2.0	-	2.0

1	2	3	4	5	6
40	Keti	2	7.0	7.0	-
	PROVINCE TOTAL	**117**	**1539.0**	**587.0**	**952.0**
	8. SYUNIK				
1	Aldara	1	2.0	2.0	-
2	Angeghakot	3	7.0	5.0	2.0
3	Artsvanik	3	298.0	298.0	-
4	Geghanush	2	23.0	23.0	-
5	Geghi	1	1.0	1.0	-
6	Gorhayk	1	3.0	3.0	-
7	Goris	4	12.0	9.0	3.0
8	Davit-Bek	1	3.0	3.0	-
9	Tasik	1	1.0	1.0	-
10	Lernadzor	3	81.0	81.0	-
11	Khndzoresk	1	2.0	2.0	-
12	Khot	1	2.0	-	2.0
13	Kapan	2	100.0	100.0	-
14	Karchevan	2	255.0	255.0	-
15	Kuris	1	86.0	86.0	-
16	Harchis	1	1.0	1.0	-
17	Meghri	3	8.0	6.0	2.0
18	Noravan	1	6.0	6.0	-
19	Shaki	9	34.0	28.0	6.0
20	Shinahayr	2	8.0	7.0	1.0
21	Sarakunk	1	8.0	8.0	-
22	Avarants	1	4.0	-	4.0
23	Syunik	4	89.0	89.0	-
24	Vaghatin	1	3.0	3.0	-

1	2	3	4	5	6
25	Tshtun	1	1.0	1.0	-
26	Tegh	1	1.0	1.0	-
27	Karahunj	1	3.0	3.0	-
28	Reserve lands	2	492.0	492.0	-
	PROVINCE TOTAL	**55**	**1504.0**	**1484.0**	**20.0**
	9. VAYOTS DZOR				
1	Azatek	1	4.0	4.0	-
2	Arin	3	22.0	-	22.0
3	Bardzruni	1	3.0	3.0	-
4	Gndevag	1	2.0	-	2.0
5	Yeghegnadzor	3	7.0	7.0	-
6	Yeghegis	2	4.0	3.0	1.0
7	Karmrashen	3	2.0	2.0	-
8	Kechut	2	9.0	9.0	-
9	Her-Her	1	8.0	8.0	-
10	Martiros	2	15.0	10.0	5.0
11	Vardahovit	1	1.0	1.0	-
12	Jermuk	1	3.0	3.0	-
	PROVINCE TOTAL	**21**	**80.0**	**50.0**	**30.0**

1	2	3	4	5	6
10. TAVUSH					
1	Achajur	1	3.0	3.0	-
2	Berd	1	2.0	2.0	-
3	Gandzakar	4	8.0	6.0	2.0
4	Gosh	2	11.0	-	11.0
5	Ditavan	2	3.0	3.0	-
6	Ijevan	2	8.0	8.0	-
7	Teghut	1	3.0	3.0	-
8	Tovug	1	3.0	3.0	-
9	Lusadzor	1	3.0	3.0	-
10	Haghartsin	1	2.0	2.0	-
11	Haghtanak	1	2.0	2.0	-
12	Movsesgegh	1	3.0	3.0	-
13	N. Karmir Aghbyur	1	2.0	2.0	-
14	Noyemberyan	3	7.0	2.0	5.0
15	Norashen	1	2.0	2.0	-
16	Chortan	1	3.0	3.0	-
17	Paravakar	1	7.0	7.0	-
18	Sarigyugh	2	142.0	142.0	-
19	Sevkar	2	95.0	95.0	-
20	V. Karmir Aghbyur	1	7.0	7.0	-
21	V. Kyurplu	1	19.0	19.0	-
PROVINCE TOTAL		**31**	**335.0**	**317.0**	**18.0**
11. YEREVAN					
1	Erebuni	1	25.0	25.0	-
2	Malatia-Sebastia	3	11.0	-	11.0
3	Mastots	1	62.0	62.0	-
4	Shengavit	1	2.0	-	2.0
PROVINCE TOTAL		**6**	**100.0**	**87.0**	**13.0**
COUNTRY TOTAL		**64.0**	**7530.0**	**4493.0**	**3037.0**

3. SEISMIC SITUATION IN ARMENIA

Earthquakes are among those factors, which contribute to the development of desertification processes. From this point Armenia is one of the world's seismically active districts included in the Mediterranean seismic zone (Map 7). According to the existing abundant historical data on earthquakes (there are data for some two thousand years) the most power approached to 10 points (Yerznka district) on a 12-point scale. The earthquakes are originally connected with active deep fractures and zones of their cutting. Therefore, a number of districts are identified in Armenia, where both earthquake recurrence frequency and intensity is big. Armenia's big, active fractures are the Garni, Pambak-Sevan, Zheltorechensk-Saridamish and Akhuryan fractures.

Garni fracture in addition to seismic activity is notable also by high tectonic activity. Four strong earthquakes are territorially connected with the fracture: in Vayotsdzor in 906, in Garni in 1679 and 1827, in Spitak in 1988. The overall length of the Garni fracture amounts to 290 km and consists of four sections.

Pambak-Sevan active fracture of total length of 370 km. It consists of sections: 260 km-long Pambak-Sevan section (western) and 110 km-long Khonarhasar section (eastern). Centers of strong earthquakes of 5-6 millenniums BC and well-known earthquakes in Garni in 895, 915, 1139, 1308, 1407, 1931 and 1968 are territorially connected with the fracture.
Akhuryan active fracture length is 150 km, including 60 km-long section between the town of Digor and Akhuryan water storage reservoir, which displays the most seismic activity. During recent 950 years 26 earthquakes occurred here, including 6 resulted in disastrous consequences.

Zheltorechensk-Sarighamish active fracture displays high tectonic activity and is characterized by significant seismic activity. Total length of fracture is 350 km. Strong earthquakes are territorially connected with its south-eastern wing – in the section between from town of Sarighamish to the villages of Norman and Bardiz.
Armenian plateau's earthquake centres have small deepness up to 30-35 km, i.e. earthquakes centres are in the earth crust giving origin to the earthquake name like crusted. Relatively intensive earthquake centres are located on a depth of up to 10-15 km.

Sometimes a strong earthquake is proceeded by weak shakes (aftershocks). Activity of foreshocks and aftershocks of earthquakes on the territory of Armenia takes a relatively short period of time. There are districts in Armenia (Zangezur, Gyumri), where strong earthquakes failed to be proceeded by weak earthquakes. It is not always that the number of weak earthquakes in the districts of strong earthquakes is high and vice versa there are districts of accumulation of weak earthquakes, where earthquakes are rare (Lake Sevan basin, Vardenis mountain chain).

The whole area in Armenia is divided into seven-point and eight-point point seismic zones, which involve Shirak valley, Ararat concavity, Vayots Dzor and Southern Zangezur. The eight-point zone includes 70% of Armenia's territory, and the eight-point zone – 30%. Intensity of the most powerful earthquakes could be 9-10 points on a 12-point scale, which are connected with the cross-points of deep breaks (Gyumri, Zangezur, Vayots Dzor).

4. NATURAL FODDER HOLDINGS

Qualitative characteristics of Armenia's natural fodder holdings are important criteria for desertification processes. Armenia's natural fodder holdings occupy 1062.7 thousand ha of area and are allocated along the vertical zoning (Map 8).

1. Semi-desert zone fodder holdings occupy 52.5 thousand ha or 5% of the total area. They are spread in the Provinces of Aragatsotn, Ararat, Armavir, Kotayk, Vayots Dzor, and Yerevan on an altitude of 600-1000 m by approaching 1300 m in some places.
Vegetation in this zone is notable by xeric characteristics. Crop capacity and crop values of the fodder holdings are mainly low by amounting to 3-7 centner of dry eatable bulk. Hay-fields are mainly located within the irrigation network. Fodder holdings are mainly used as spring and autumn or winter pastures.
Fodder holdings are mainly stony, weathered, and trampled, which amount to 90% of the total area, bush cover amounts to 10%. Vegetation is degraded poor eatable, non-eatable and pestilent plants are prevailing.

2. Steppe zone fodder holdings occupy 86.5 thousand ha or 8% of the total area. They are spread in the Provinces of Aragatsotn, Ararat, Armavir, Kotayk, Shirak, Syunik, Vayots Dzor on an altitude of 1000-1800 m. It includes mainly dry continental and moderately hot agroclimatic zones. The vegetation cover here is relatively dense. Both crop capacity and sustenance of

vegetable cover are the highest ones in spring and early summer. Meanwhile, in dry phase, when the weeds are developed sustenance values are decreasing. Average crop capacity amounts to 4-8 dry eatable mass.
Significant part of the pastures and hay-fields with high sustenance value in shade backward and relatively humid mountainous slopes is located in this zone. The vegetation cover in sun backward slopes is sparse enough and mainly weathered to different extent.
Fodder holdings in the zone are used as spring and autumn pastures. Fodder holdings here are also mainly stony, weathered and trampled, which amounts to 90% of total area, poor eatable, non-eatable and pestilent plants are prevailing.

3. Meadow-steppe zone fodder holdings occupy 317.6 thousand ha or 30% of total area located on an altitude of 1800-2200 m (2400). They are spread in the Provinces of Aragatsotn, Ararat, Gegharkunik, Lori, Kotayk, Shirak, Syunik, Vayots Dzor, Tavoush.
The zone covers moderately cold, insufficiently humid and humid agroclimatic zones. It is characterized by dense vegetation and abundant specific composition. Forage values of fodder holdings are normally high. Medium crop capacity amounts to 12-20 centner of dry eatable bulk. Fodder holdings in this zone, which are located in southern position slopes, are used as spring-autumn pastures, and those in the northern slopes – summer pastures. Fodder holdings crop capacity and trampled areas amount to some 70%, harmful and poor eatable plants are also prevailing within the vegetation cover.

4. Fores-meadow zone fodder holdings occupy 146.6 thousand ha or some 15% of total area. They cover 146.6 thousand ha or 15% of total area. They are spread in the Provinces of Aragatsotn, Ararat, Gegharkunik, Lori, Kotayk, Syunik, Vayots Dzor, Tavoush. They are spread on an altitude of 600-2100 m by approaching up to 2400 m in some places. It includes moderately hot, moderately humid and humid agroclimatic zones.
The fodder holdings here have secondary origin. They have been generated on the places of destroyed forests – in clearings. Both steppe and meadow vegetable types are found, which are mainly used as hay-fields. Fodder holdings crop capacity and forage values are high. Medium crop capacity amounts to 10-18 centner of dry eatable bulk. They are used as spring-autumn pastures.
The stoniness, trampled nature and weathering in this zone amounts to some 50%. Poor eatable and harmful plants are prevailing in the grass cover.

5. Sub-alpine zone fodder holdings occupy 323.0 thousand ha on al altitude of 2200-2800 m above sea level. They are spread in all the provinces except for the Provinces of Armavir and Yerevan. It includes moderately cold and cold agroclimatic zones.
The fodder holdings here have large specific gravity within the cattle-breeding forage balance. These are the most valuable fodder holdings. Medium crop capacity amounts to 10-14 centner of eatable bulk. They are used as summer pastures. The stoniness, trampled nature and weathering in this zone amounts to some 40%. Harmful and poor eatable plants are prevailing in the grass cover.

6. Alpine zone fodder holdings are spread on an altitude of 2700-3500 m above sea level and occupy 13.2 thousand ha or 12% of total area. There are found almost in all the provinces.
In includes cold agroclimatic zone. The basis of vegetation cover is perennial grass plants, which are notable by their high sustenance value.
Proceeding from natural conditions vegetation is notable by rapid reproduction rate, high activity of vegetative reproduction.

Armenia's alpine vegetation despite its poor specific composition is notable by multicoloured character. Medium crop capacity amounts to 6-8 centner of dry eatable bulk. They are used as summer pastures. The stoniness, trampled nature and weathering in this zone amounts to some 60%.
Summarizing it should be mentioned that according to 1972-1984 study outcomes qualitative characteristics of natural fodder holdings in Armenia is the following: clean fodder holdings amount to 225.3 thousand ha or 21% of total area, stony ones – 759.8 thousand ha or 71%, lumpy ones – 161.2 thousand ha or 15%, bushy ones – 173.5 thousand ha or 16%, with prevailed harmful and poor eatable plants – 861.6 thousand ha or 81%, trampled 369.5 ha or 35%, weathered – 388.4 thousand ha or 36%, swamped – 6.3 thousand ha, 0.6%.

5. FORESTS

State fund of forests in Armenia as of January 1, 1993 forest management registration outcomes amount to 459.9 thousand ha, out of which 334.1 thousand ha forest areas, including 50.2 thousand ha artificial forests.

Forests in Armenia as classified based on significance:

a) protective – 257.3 thousand ha,
b) social – 106.1 thousand ha,
c) special significance – 96.5 thousand ha.

As opposed to the CIS countries average forest areas of 28% only 11.2% of Armenia is forest.

Average efficiency rate of forests is 38 mln cu m, wood resource of 1 ha is 350 thousand cu m. 0.11 ha of forest falls to each resident in the country, which in bulk expression amounts to only biomass of 12 cu m of wood.

274 tree and bush species are found on the territory of Armenia, including major forest-making species of beech, oak, hornbeam and pine. These four species occupy 89.1% of all the forest areas and 97.2 of total forest resources in Armenia.
Forests are unevenly allocated around the country area. Forest areas in the northern districts amount to 29%, in the southern ones – 13%, and in central Armenia – 2%.
Uneven allocation of forests is caused by natural and climatic conditions and man-made negative impact. These factors during centuries lead to forest area destruction and reduction. Due to inadequate and intensive use in many forest sections undesirable changes occurred. Valuable beech, oak, pine, ash tree grooves have been substituted by low-efficient dazhuts, hornbeam groves, tsakut, etc.
Analysis of historical data proves that only 3 millenniums ago forest areas in the country used to be by 3 times exceeding the current coverage size. In environmental and landscape terms south backward forest areas on the mountain slopes and particularly arid and bushy populations, where penetration of dry steppe and semi-desert plant species occurs, are in the most unsustainable state. As opposed to lower ecotone sections of forest zone, where forest ecosystems degradation is mainly notable, the forest upper boundary is in more favourable state in hydrothermal terms.

The 70% of Armenia's natural forests is decayed and aged. The 36% of total wood in bulk expression is concentrated in mature and over mature forests. There is a need here to combine forest use with increase of economic efficiency of forests and implementation of environmental processes.

Forest husbandry is the basis for conducting and developing forestry in the country. Forest husbandry related activities in Armenia have been performed within a period from 1930 through 1993 by the Transcaucasian forest management enterprise located in Tbilisi. In 1993 the activities were terminated due to lack of financing.

In order to identify the consequences of unregulated wood-cutting, and to regulate reforestation and forest use the Ministry of Nature Protection initiated forest husbandry works in the Noyemberyan District in 1999 on behalf of the "Forestry Research Centre" State Joint-Stock Company under the Ministry.
The forest husbandry works were carried out according to the former Soviet Union instruction to conduct forest husbandry in the first-group forests pursuant to the RoA Forest Code (1994) provisions.

Topographic maps of 1:25000, aerial photographs, former forest husbandry maps and land-planning data served basis for map development.

The survey identified that during 1993-1999 the quantity of unregistered illegal wood-cutting amounted to 311019 cu m (actual stock of wood in the Noyemberyan forest enterprise area as of 01.01.2000 amounted to 3493406 cu m (Map 9). However, it should be noted that the Noyemberyan forest areas are located incomparably far from the part of densely populated central Armenia. Hence it might be assumed what is the situation in the rest forest areas close to the central part.

6. LANDSLIDE DANGEROUS AREAS

Territory of the Republic of Armenia is characterized by excessively intensive and widely developed landslide processes. It is caused by big inclination of the slopes, complex geomorphological, geological peculiarities, which are deteriorated by intense and frequently careless activity. As estimated by the Emergency Management Administration average annual damage caused by the landslides to the socio-economic institutions amounts to some US$30 mln.

There are more than 2000 landslides on the territory of the Republic of Armenia, many of which are located within the boundaries of settlements: towns of Dilijan, Ijevan, Kapan, Vanadzor, etc., as well as numerous villages (Map 10). High landslide danger is threatening the transportation and energy highways, pastures and cultivated lands in the country.

The map of Armenia's landslide dangerous areas is compiled on the basis of satellite black-and-white and coloured multi-spectral pictures of high photometer "Landsat-TM (USA), "Spot" (France), "Euros", "Soyus", (Russia) systems, as well as small-scale aero survey data of the territory of Armenia.

Analysis of information on landslide processes obtained from satellite pictures served a basis for identification of regional zones of development of these processes on the whole territory of Armenia. The boundaries of these zones include those regions, where slope gravitation process origination and development conditions are possible or already exist: critical relief inclinations, lithological and textured peculiarities of slop ores, degree of weathering (erosion), degree of slope deformation, etc. These zones include numerous small, territorially split gravitation formations, which are not possible to express in this measuring.
Up to large-scale satellite pictures and aerial pictures data landslide processes maximum development areas are identified within the limits of these zones. They represent local districts,

where large landslide bodies are grouped and an active transit of large slope material is referred. Landslides that display both modern activity and those landslides that "completed" (so-called stabilized landslides) their transit process are covered by these districts. However, "stabilization" criteria is quite conditional here, since under high geodynamic activity of the country's territory, intensive pressure made on the geological environment and other factors changed temporally, could be reactivated by multiplying degree of risk of the district. Therefore, degree of absolute environmental impact of dangerous landslide processes is assumed under risk assessment here.

Proceeding from this, local districts identified on the map act as special units – landslide risk absolute characteristics of area's each district.

Landslide body groups integrated on the map are strongly different by their transit mechanisms. According to remote survey data the mechanism of the most spread transit of the country's area is the slide of partly crushed landslides over the surface of lower located ores – so-called sliding landslides (Dilijan, Ijevan, Artavan, Chiva, etc.).

Block sliding (landslide blocks) is frequent enough, which are represented mainly by large blocks of parent material separated from the major mass but maintaining their integrity and internal structure (subwatershed parts of the Ijevan plateau, canyon of River Vorotan, etc.).
Landslip formations (landslips) of decayed material of minimum sliding, and flow landslides of quite unique shape are also found, which are characterized by boggy and plastic flow, completely decayed internal structure and maximum amplitude of landslide mass transit (Martiros, Arevis, Hovk, etc.).
All the types of mentioned landslide transit on the territory of the country are quite frequently modified during the transit in the following pattern: landslip-slide-flow (e.g. Jermuk landslide group).

The slope material gravitation soil creep areas resulted from sol layer deceration and solifluction (mountain districts) are identified in a separate group on the map.
These processes could lead to destruction of hardly-recoverable soil, and therefore, like typical landslide processes, they are also dangerous and decaying for pastures and arable lands.

The majority of modern and historically active landslide processes are definitely connected with the zones of active fractures, which contribute slow (creep) and seismic (impulsive) slides.

Specific zoning is typical to seismic landslides caused by the differences in seismic regimes of fracture zones, maximum slope deformation and violation of their stability. Under high seismically of Armenia's territory such landslides are particularly dangerous. Therefore, those large groups of landslides are identified on the map, for which regular a reological display jointly with their seismic material is approved (Vokhchaberd, Khosrov, Saravan, and other groups).

The Voghchaberd landslide group in the Province of Kotayk is genetically connected with seismic activity of Garni fracture and is currently displaying very high activity by permanently damaging the Yerevan-Garni highway, and the villages of Voghchaberd, Hatsavan, Geghadir. In case of impulse slide it would create dangerous situation in this districts.

The landslide group located upstream Vedi River in the Province of Ararat is also genetically connected with the Garni fracture's activity. This group's modern activity is not studied. In case of impulse activation it could dam upstream of Vedi River and threaten the town of Vedi and a number of villages in the Ararat Valley.

The Saravan landslide group is located in the boundary part of Provinces of Syunik and Vayots Dzor. It is represented by a number of large-scale and numerous medium and small landslides. The group is genetically connected with Pambak-Sevan fracture's seismic activity. It represents a high risk for a number of villages along the Yerevan-Meghri highway and the Sisian pass.

7. MUDFLOW RISKINESS IN RIVER BASINS

Mudflows are the most expressive display of water erosion and are one of the strong incentives for desertification in Armenia.
Soil erosion starts during downpour precipitation and ends by formation of mudflows, which by their pumps pollute the rivers, block the riverbeds and cover coastal lands of river valleys. Damage caused by erosion-mudflow phenomena to the socio-economic system amounts to annually US$3-3.2 mln.

Watershed basins of mudflow risky rivers mostly have surface of 100 sq km and rarely exceed 200 sq km. Duration of downpours originating mudflows does not exceed one hour, and the flow duration is 4-6 hours. The mudflow attains its maximum power within 10-30 minutes, and then the flow is slowly declining.

The average number of mudflows on the territory of Armenia is ten per year. The in-year quantitative allocation of mudflows shows that the maximum number of mudflows occurs in June 30%, then in July – 25%, August – 17%.

Irrational use of lands, animal over-grazing and deforestation accelerated the process of erosion-mudflow phenomena particularly within the recent twenty years.

Mudflow frequency based on natural and climatic conditions in the river basins assumes different values: between 1 and 3 years in the Akhuryan, Pambak, Arpa, Debed River basins, and between 3 and 5 years in the Hrazdan, Vekhchi, Vorotan, Dzoraget, Aghstev River basins. Mudflow frequency is decreased in the Azat and Vedi River basins – between 10 and 15 years.

Based on frequency of one mudflow in target basin it is easy to calculate also the average annual module for sludge pump, the value of which fluctuates within big enough values (100-7100 m^3/km^2) and complicates their generalization.
In order to map the power of erosion-mudflow phenomena it is convenient to express average annual values of sludge pump module in relative values.

By assuming the smallest value of average annual module of sludge pumps as bafflement criteria for erosion-mudflow phenomena, a 5-time larger value was assumed as 3rd-degree (weak) mudflow-risky basin, 10-time larger one – as 2rd-degree (medium) mudflow-risky basin, and above 10-time one – as 1st-degree (strong) mudflow-risky basin (Map 11).

Relative values of sludge pump modules are calculated for about 400 river basins and mapped based on mudflow riskiness degree. By analysing the map data it is possible to note a relation between geological structure and mudflow riskiness. The most mudflow risky basins (1st and 2nd degrees) are spread on the slopes of plicate and fragmented mountains, and the 3rd-degree
In order to clarify chronological process of mudflows quantity integral curves of mudflow activity modules indexes with the Armenia's territory annual river flow module index's integral curves. The comparison showed that the mudflows mostly (55% of the cases) occur in low-water years. The Akhuryan, Vedi, Arpa, Vokhchi, Pambak, and Debed River basins are among them. Small

water transparency and high rate of soil erosion contribute to generation of medium and strong saturated mudflows (P= 320-1000kg/m^3) even in case of precipitation of 15-20 mm layer rains.
In high-water years less saturated (P= 80-320kg/m^3) mudflows are generated in the Hrazdan, Azat, Vorotan, Aghstev River basins with high water transparency. Using this regularity it is possible to make specific predictions on the quantity of anticipated mudflows based on succession of high-water and low-water years. This regularity could be spread over a longer period of time. Climate scientists predict climate aridity and water scarcity for the nearest 50 years. In this case the quantity of mudflows with weak saturation (P= 80-320kg/m^3) would decrease, and mudflows with high saturation (P= 320-1000kg/m^3) would increase. Therefore, in the future 50 years intensification of erosion-mudflow phenomena is expected.

8. LAKE SEVAN PROBLEM

The Lake Sevan problem is a unique and distinctive display of correlation of desertification and economy, which has not only environmental but also socio-economic nature. It has been recognized as important regional problem by a number of international organizations. Imbalance of the lake's ecology has a significant impact on the change of surface and underground waters regime and aridity processes in the region. Lake Sevan also has an invaluable role as a perspective source of drinking water in the region.

It is known that the process of use of age-old resources of the lake started to be used for irrigation and power generation purposes since 1936. It was resulted in drop of the water level by some 19.3 meters (Map 12).

Decrease of the Lake Sevan water level resulted in undesirable changes in biochemical circulation of substances in the water, lake's structural-functional correlations, and species of aquatic organisms, which together with the wastewater discharged from the lake's watershed, contributed to the eutrophication processes development. Consequently, phytoplankton biomass currently increased by two times, the lake is regularly and actively "blooming" due to mass reproduction of by toxic blue-and-green algae. According to the 1999 data of the Institute of Hydro-ecology and Ichthyology under the RoA National Academy of Sciences accumulations of organic substances in the lake amounted to some 150 thousand tons. Meanwhile, in 1930 it amounted to 25 thousand tons. Maintaining similar trends of the lake's eutrophication would make the lake's water useless not only for drinking but also for irrigation, energy and recreation by intensifying desertification processes both in the lake's watershed and in the region.

9. DESERTIFICATION ON THE TERRITORY OF RA

Analysis of desertification processes in Armenia, mapping of those territories and --- enabled creating maps for territories subject to desertification> (Map 13). According to computer data about 24 353 km2 or the 81,9%(without lake Sevan and basin surface) is subject for desertification. The severe affected territories cover 26,8% of total territory of Armenia, strongly affected – 26,4% middle – 19,8% and the poorly affected ones – 8,8%.

More insufficient is situation in Syunik marz, where eroded, as well as mudflow territories, contaminated and damaged lands cover large areas.

Only 13,5% (4006 km2) is not impacted by desertification processes.
In conclusion, an essential basis, enabling activities to implement monitoring of desertification processes, is currently created.

10. COMPUTER BASED MAPS

List of maps

1. The Land Cover of Armenia
2. The land Cover in Ararat Valley
3. The Erosion of Land Cover in Armenia
4. The Arable Lands in Armenia
5. The Disrupted Lands in Armenia
6. The Areas Polluted by Heavy Metals in Armenia
7. The Seismic Zones in Armenia
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9. The State Forest Areas in Noyemberyan in the Republic of Armenia
10. The Landslide Zones in Armenia
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12. The Dynamics of Lake Sevan Water Level Lowering. 1939-1999
13. The Territories Subject to Desertification in Armenia
14. The Provinces of the Republic of Armenia.

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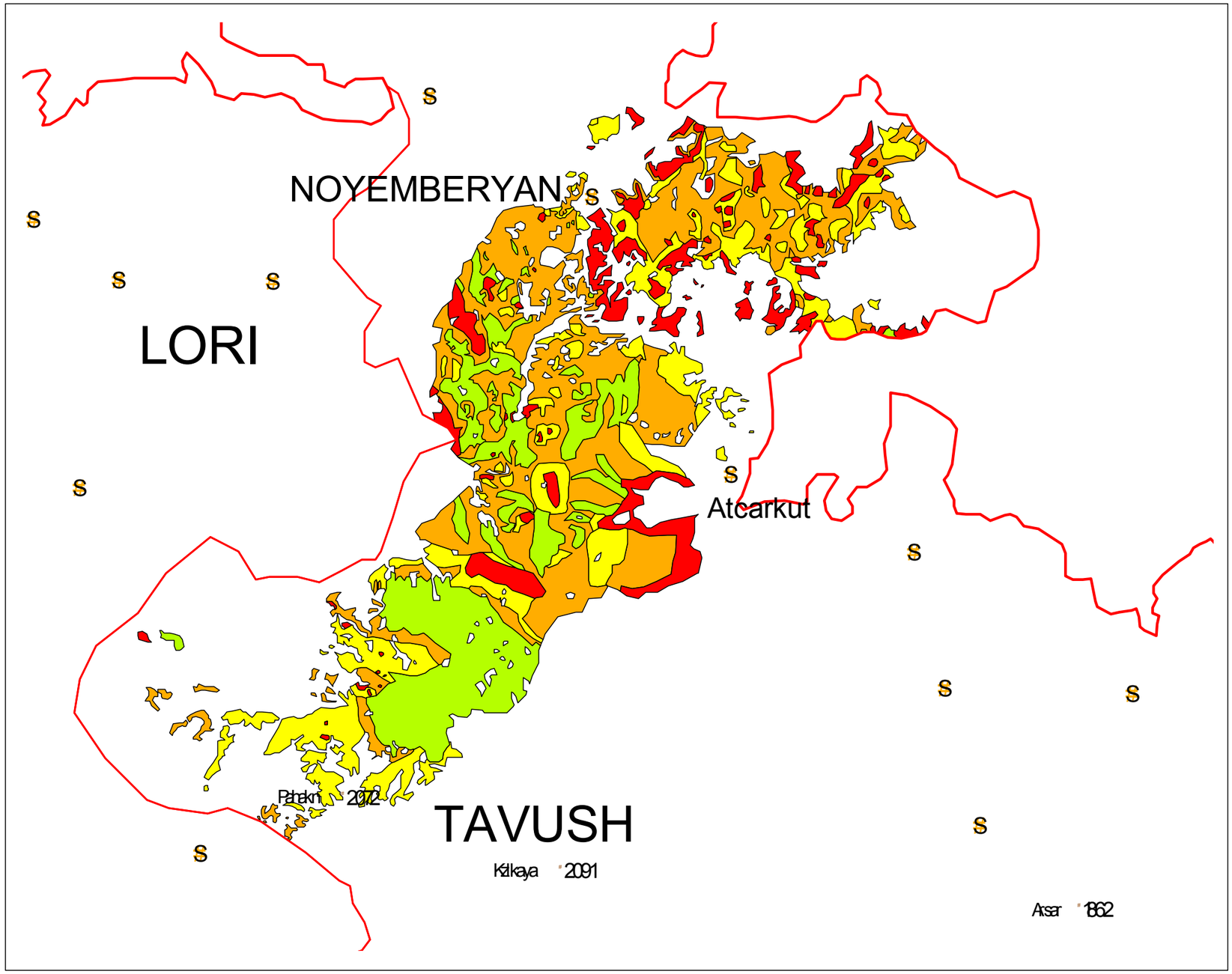
Distribution map of cut areas in the Noyemberyan forestry

Map 9



Legend

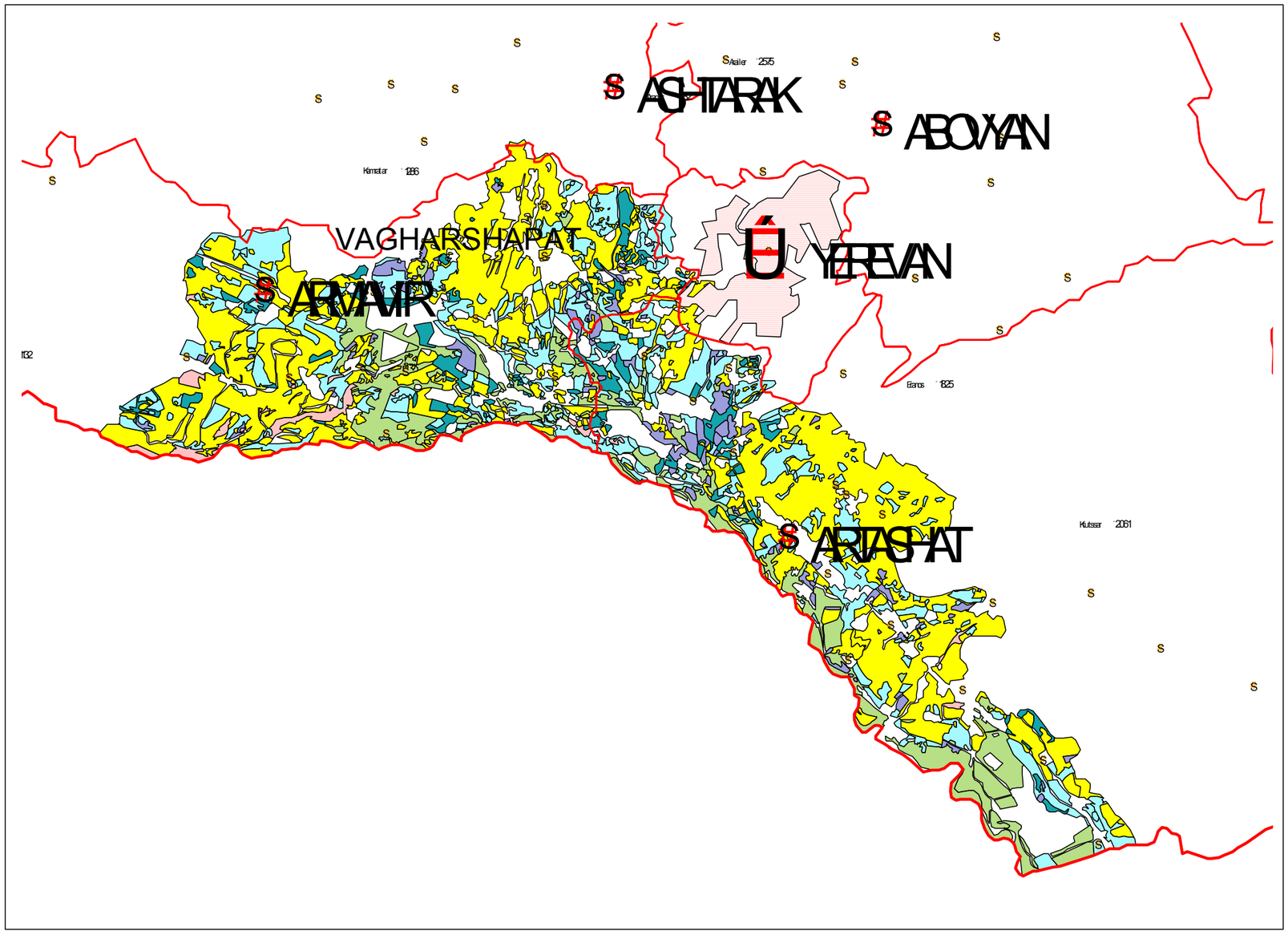
- Lowering of fullness 01-02 (sparse growth of trees)
- Lowering of fullness 03-04 (sparse growth of trees)
- Lowering of fullness 05-06 (sparse growth of trees)
- Non cut areas
- Settlement

7 0 7 14 Kilometers

W

Map of land cover in the Republic of Armenia Ararat valley

Map 2



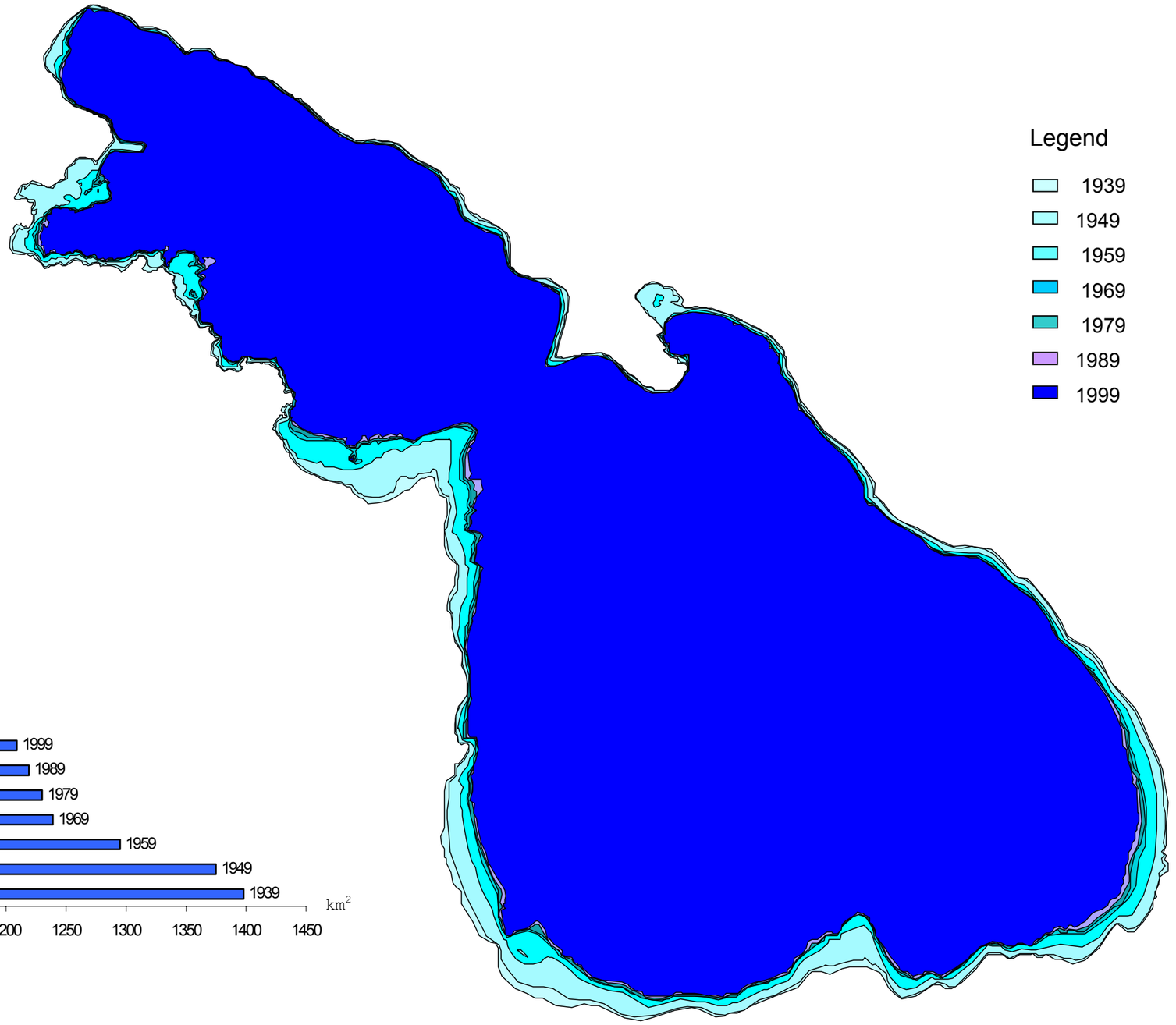
Legend

- Non saline lands
- Poor saline lands
- Medium saline lands
- Strongly saline lands
- Saline alkali lands
- Sandy-soil
- Settlement

10 0 10 20 Kilometers

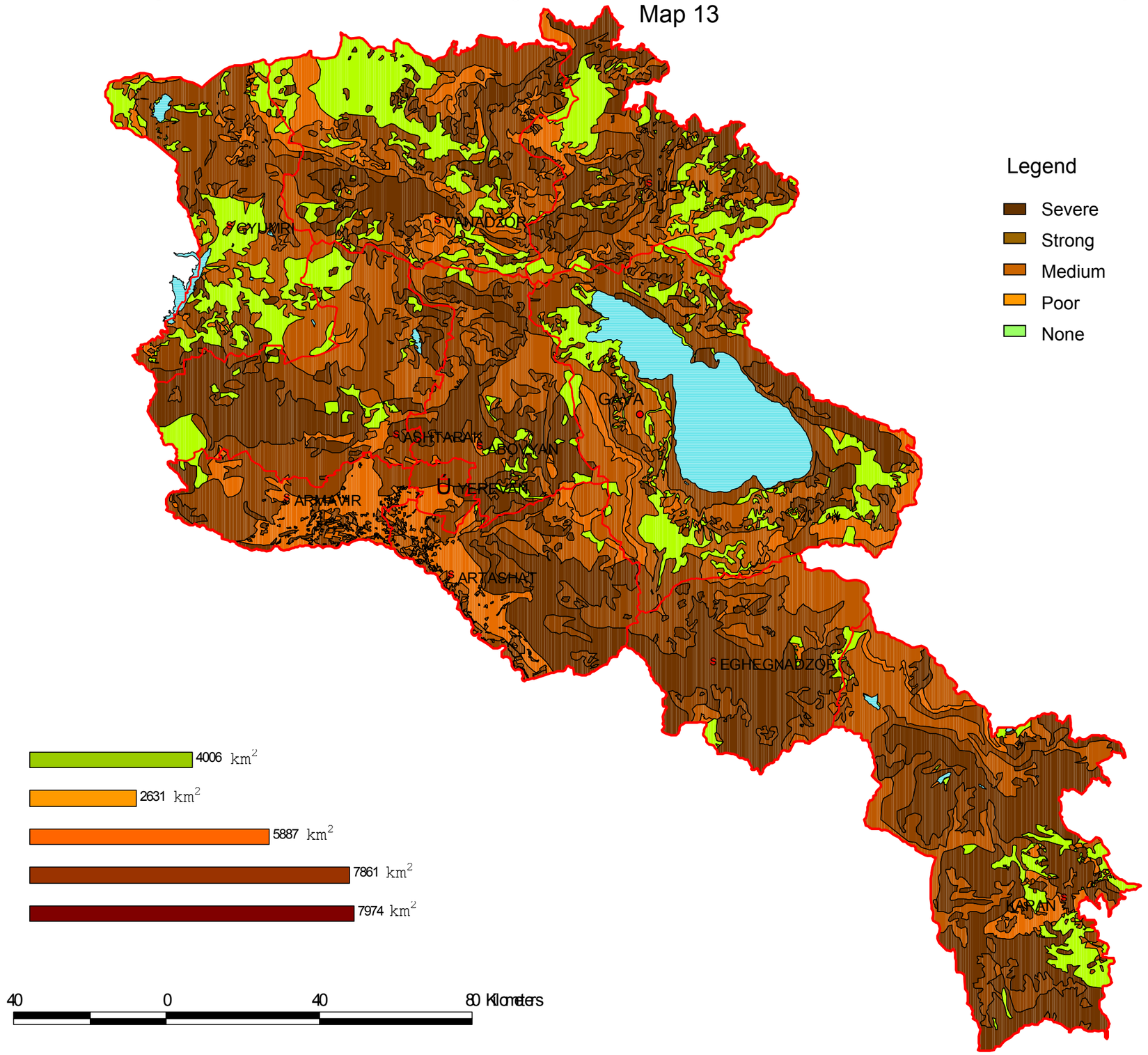
W

Map of the dynamics of the lake Sevan water level lowering. 1939-1999



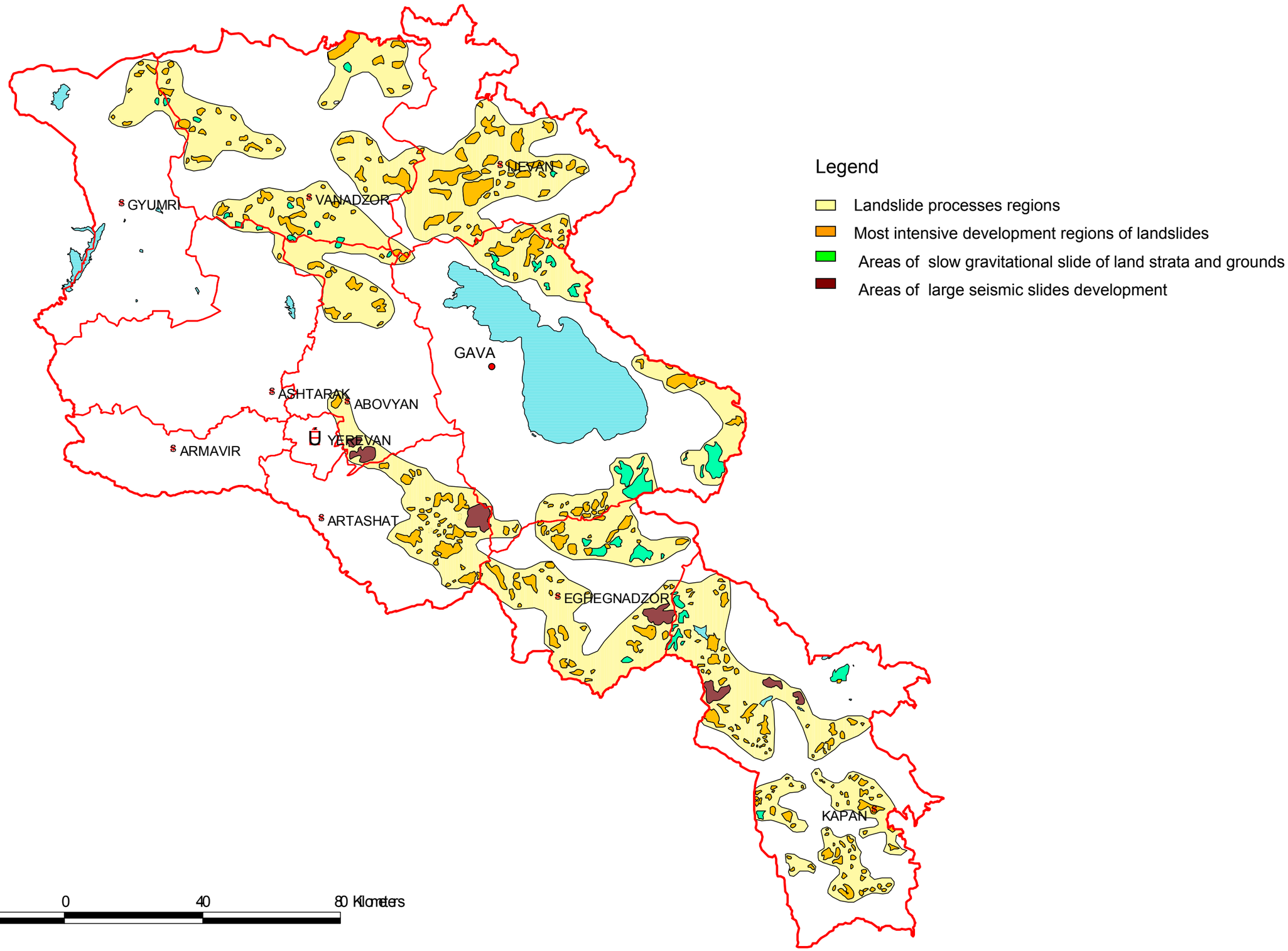
Map of territories subject to desertification in the Republic of Armenia

Map 13



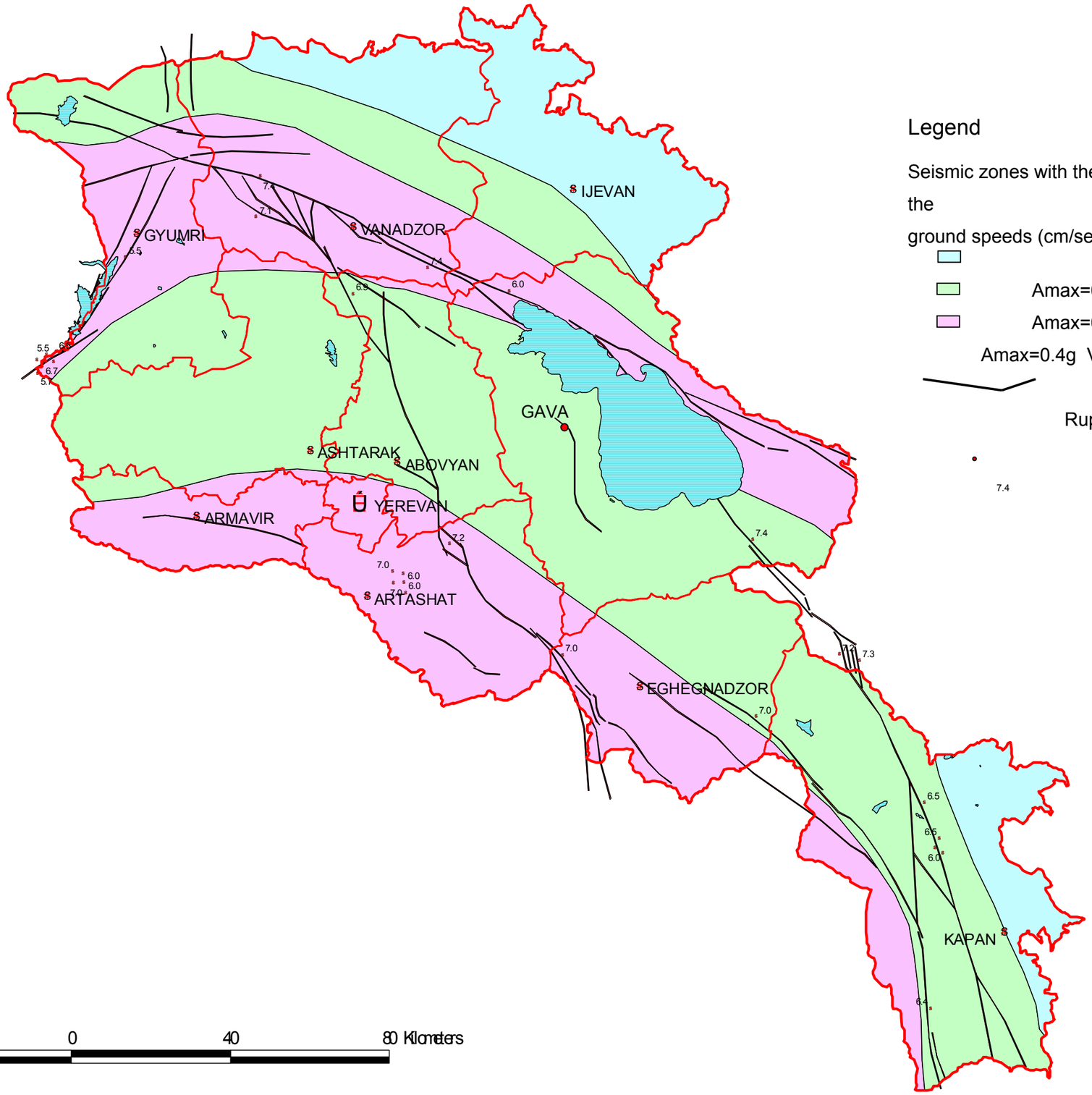
Map of landslides of the Republic of Armenia territory

Map 10



Map of seismic zones of the Republic of Armenia territory

Map 7



Legend

Seismic zones with the expected max. accelerations (g), and the

ground speeds (cm/sec) and the balls of MSK-64 scale

Amax=0.2g V=16 cm/sec, up to VIII-IX

Amax=0.3g V=24 cm/sec, VIII-IX

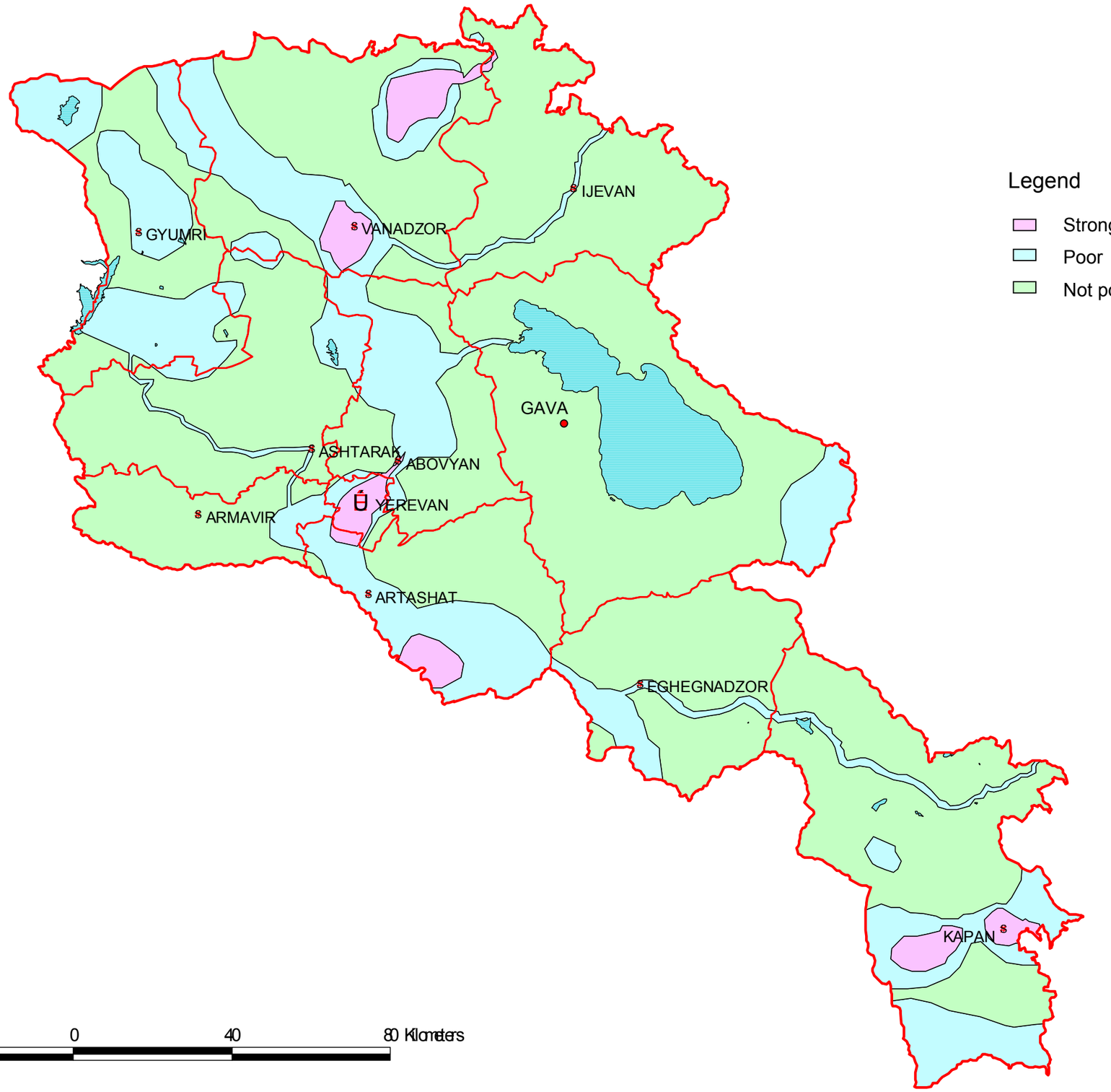
Amax=0.4g V=32 cm/sec, IX and over

Rupture

7.4 Epicenters of historical earthquakes

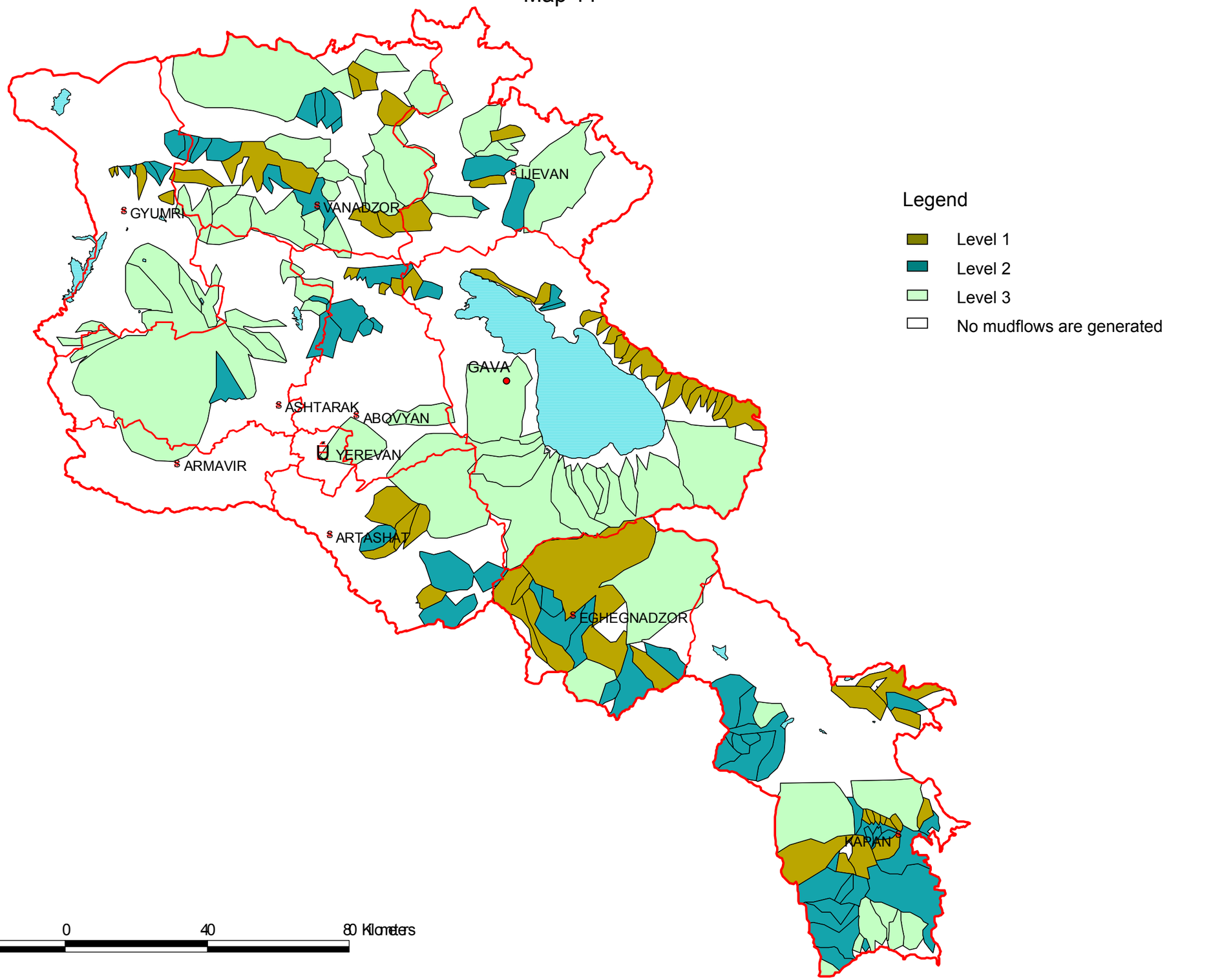
Map of areas polluted by heavy metals in the Republic of Armenia

Map 6



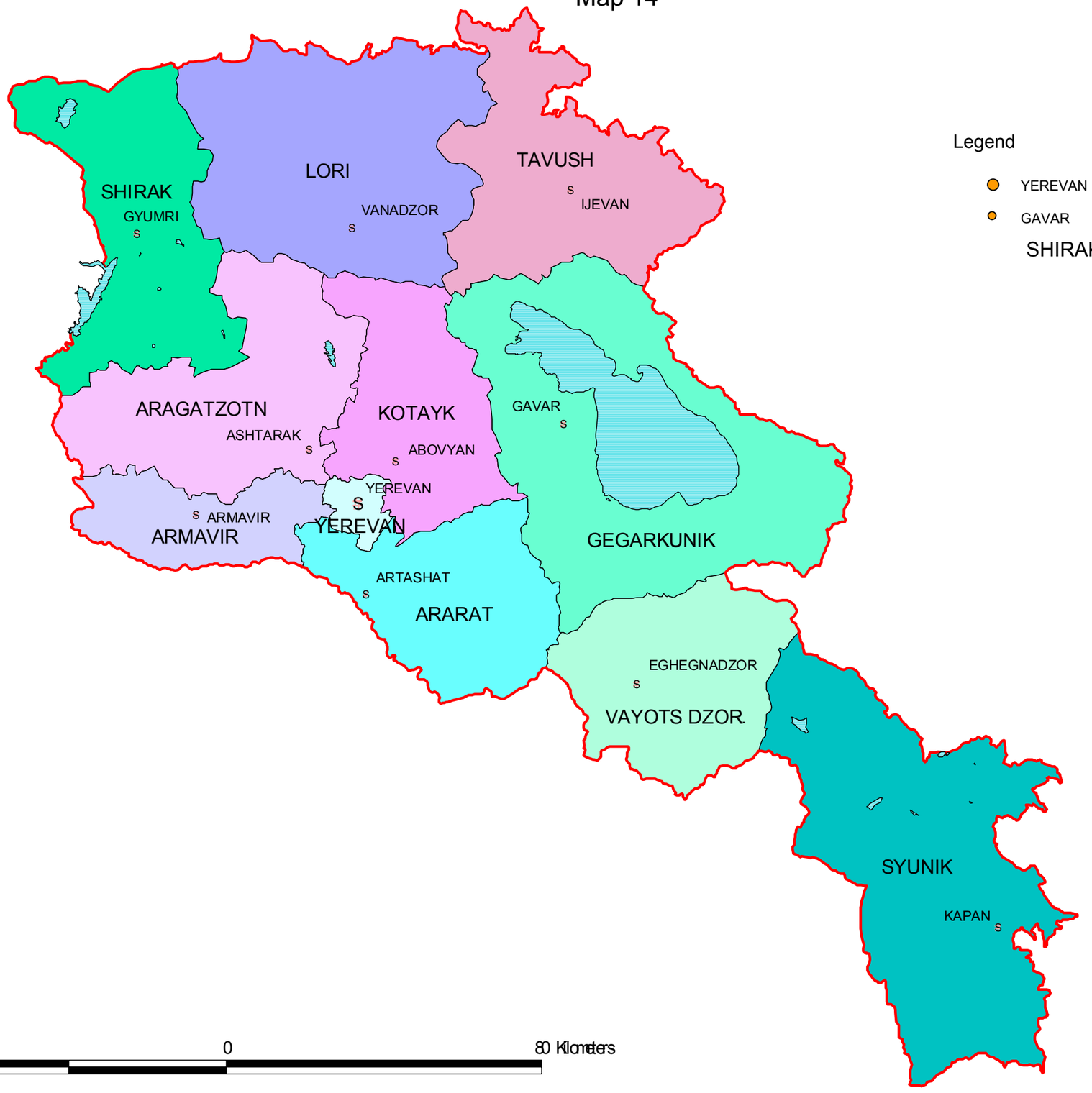
Map of mudflow zones in the Republic of Armenia

Map 11



Map of provinces of the Republic of Armenia

Map 14

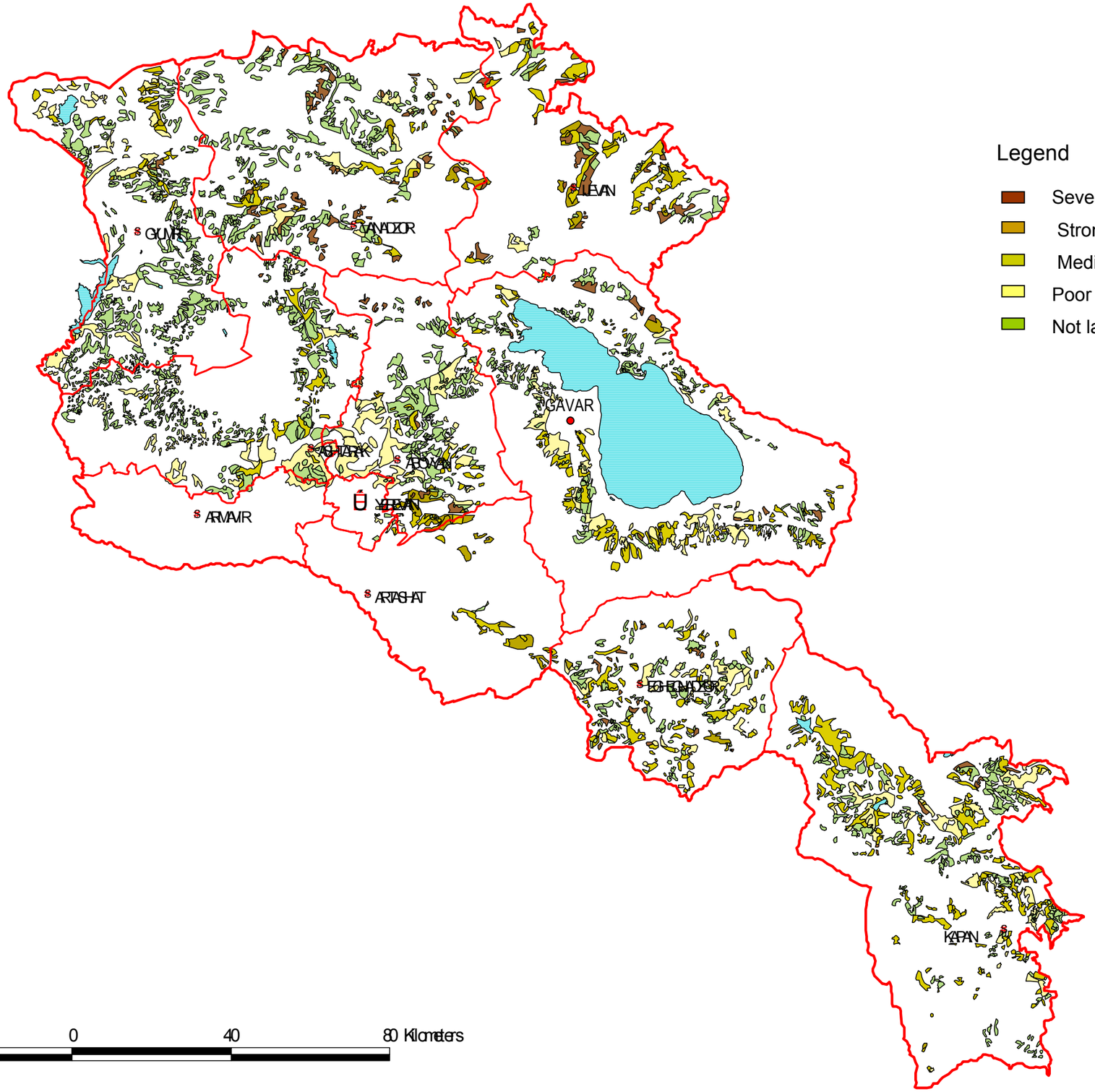


Legend

- YEREVAN capital
- GAVAR province center
- SHIRAK province

Map of arable lands in the Republic of Armenia

Map 4

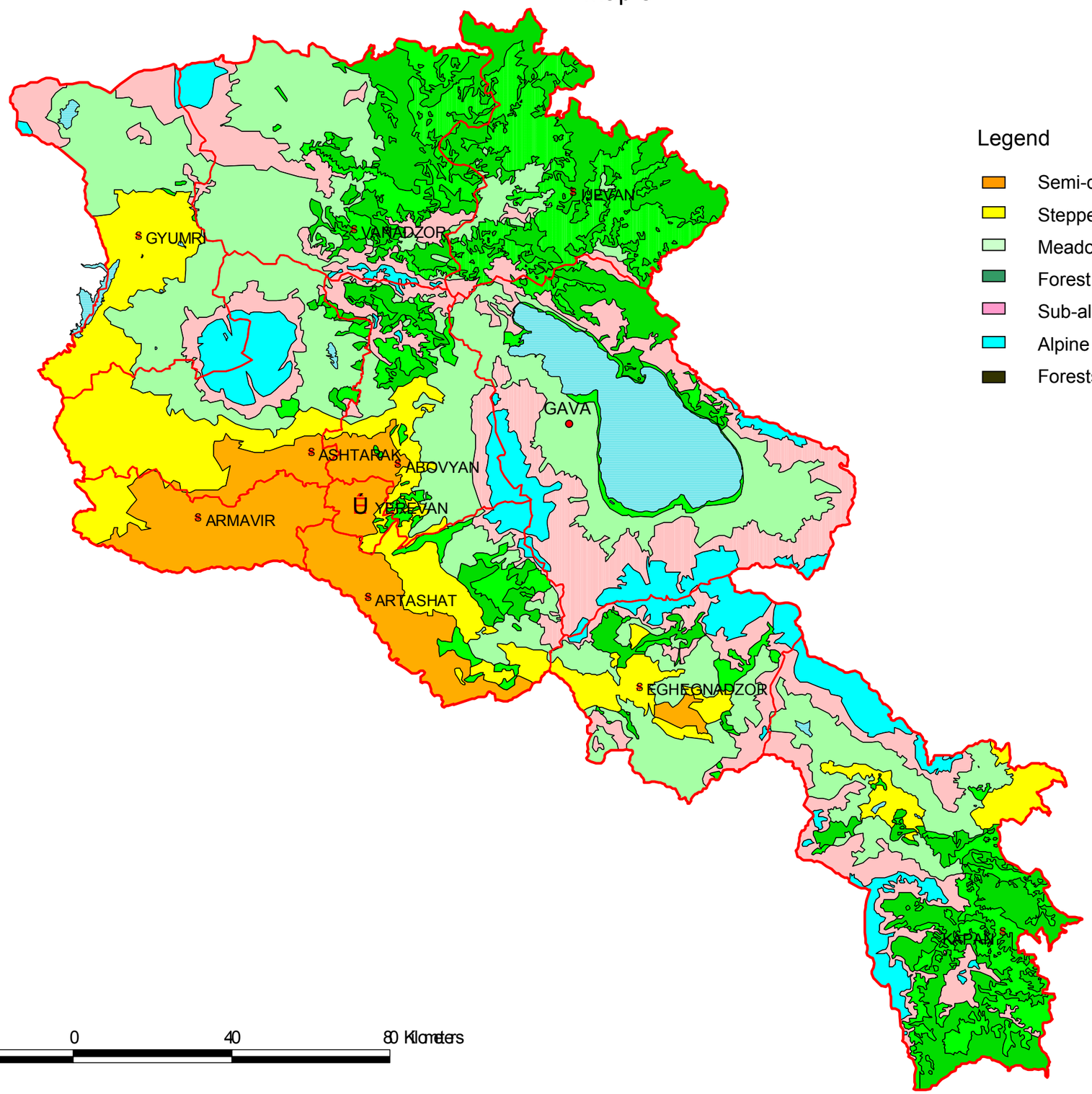


Legend

- Severely landed
- Strongly landed
- Medium landed
- Poor landed
- Not landed

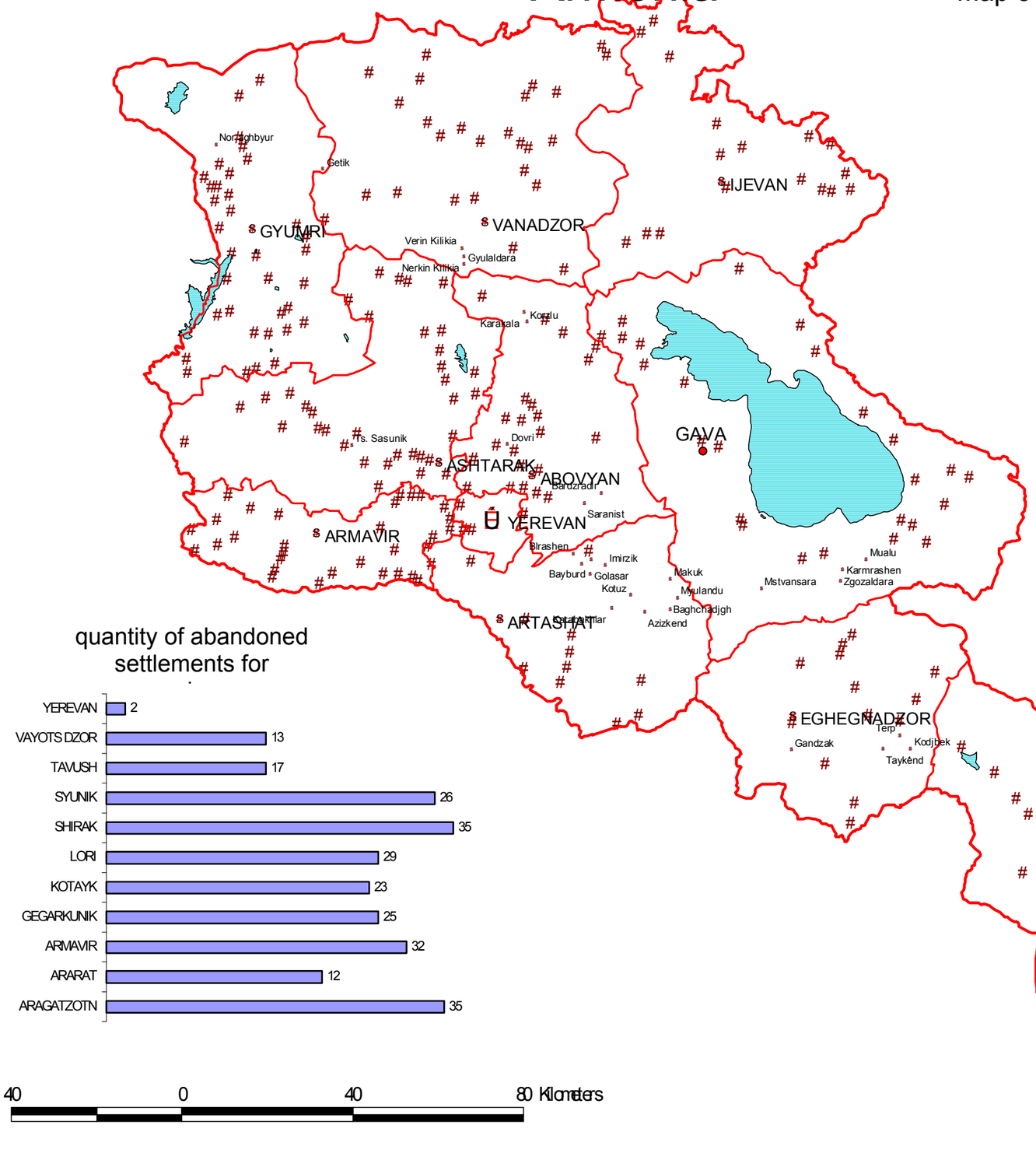
Map of natural fodder holdings of the Republic of Armenia territory

Map 8



Map of disrupted lands and abandoned settlements of the Republic of Armenia

Map 5



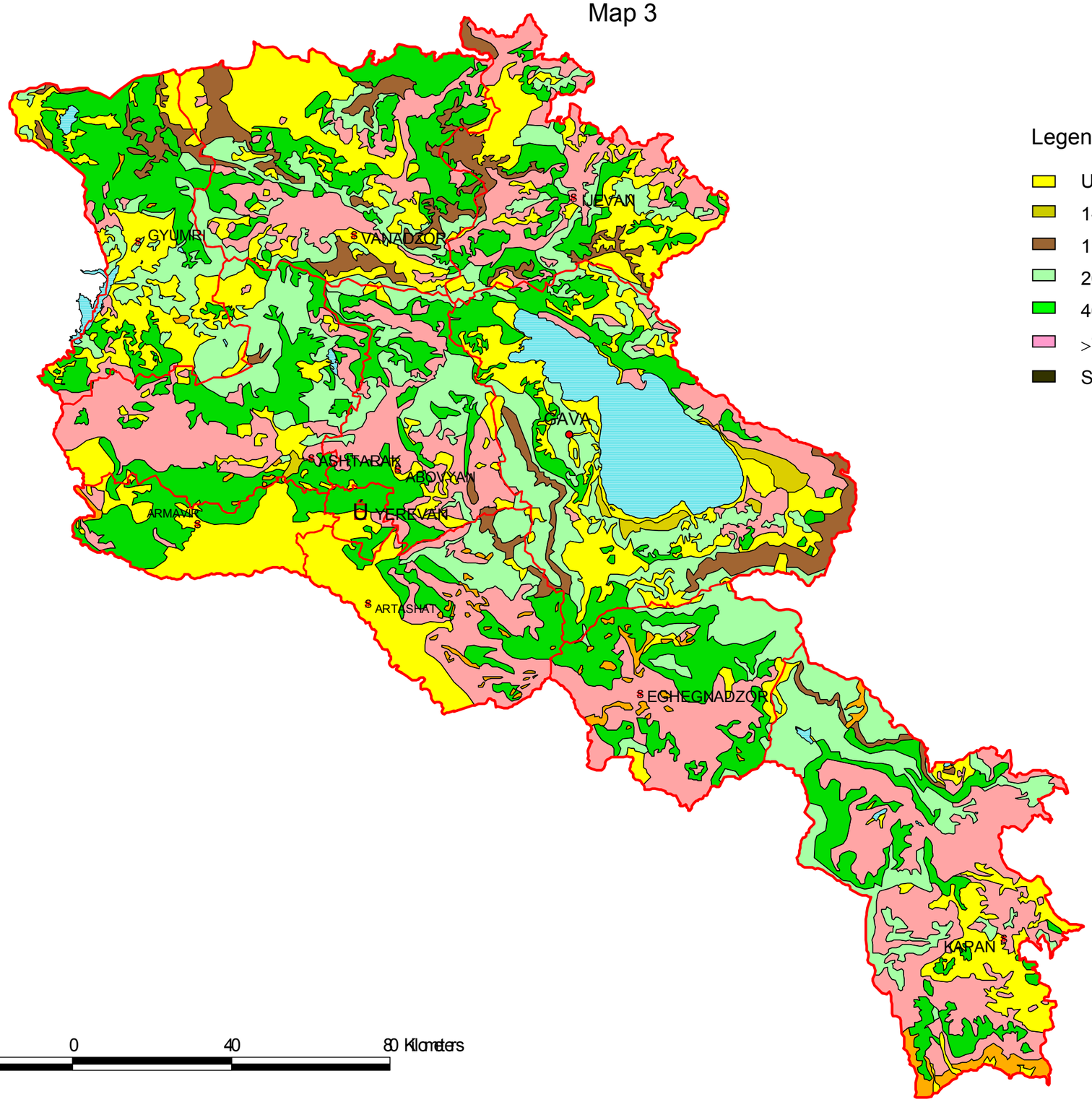
Legend

- Disrupted lands
- Abandoned settlements

40 0 40 80 Kilometers

Map of general landed areas in the Republic of Armenia

Map 3

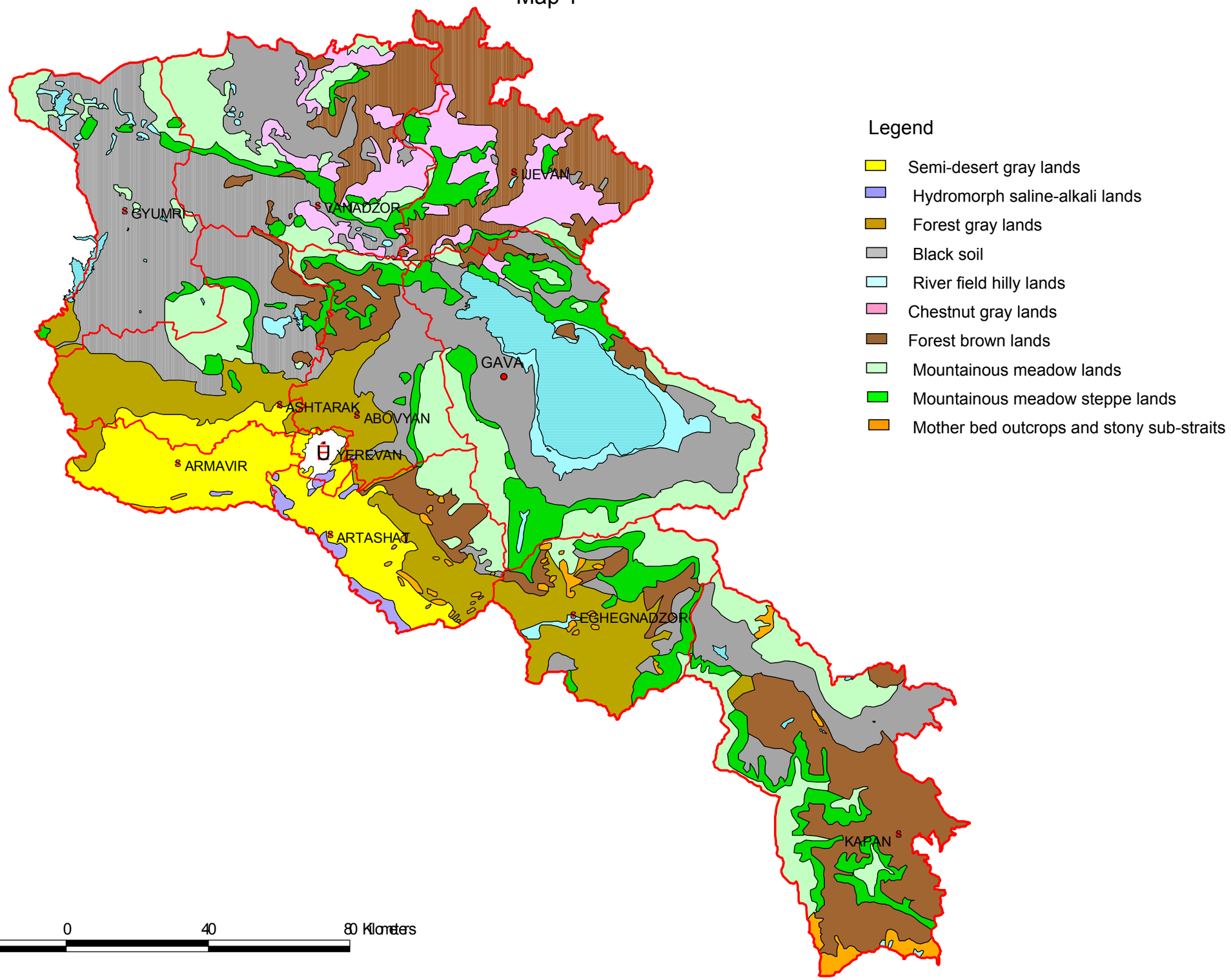


Legend

- Up to 1% (landed areas)
- 1-10% (landed areas)
- 11-25% (landed areas)
- 26-45% (landed areas)
- 46-70% (landed areas)
- >70% (landed areas)
- Story sub-straits and mother bed outcrops

Map of land cover of the Republic of Armenia territory

Map 1



Legend

- Semi-desert gray lands
- Hydromorph saline-alkali lands
- Forest gray lands
- Black soil
- River field hilly lands
- Chestnut gray lands
- Forest brown lands
- Mountainous meadow lands
- Mountainous meadow steppe lands
- Mother bed outcrops and stony sub-straits